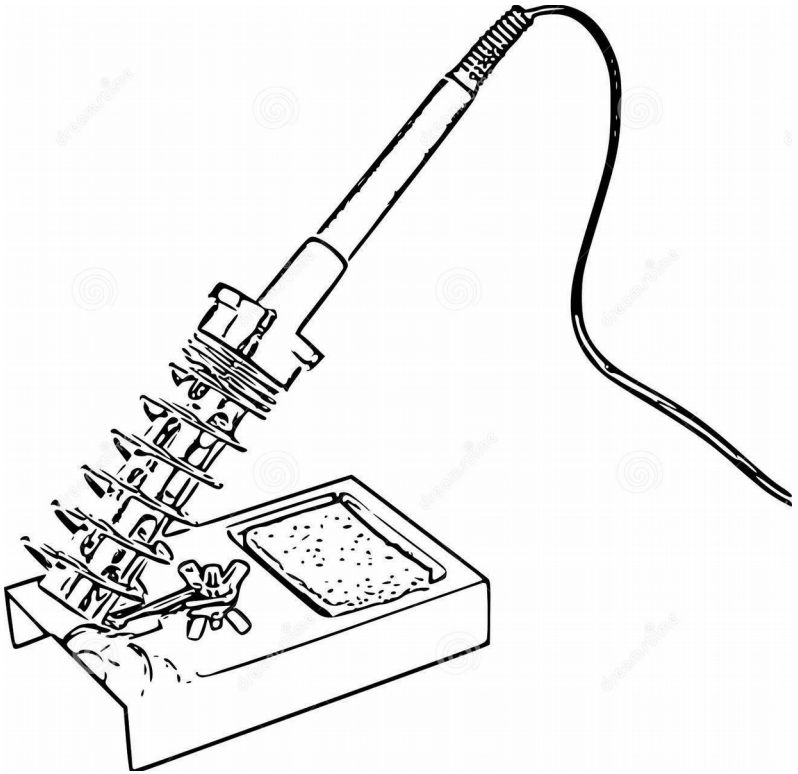
Kit Building Committee Report



Rich “FluxMan” Mitchell, N3III

Steve “FlipBits” Beckman, N3SB

September 10, 2018

UBITX Harmonics and Spurs

Reports seen on the BITX20 Group indicate that the uBITX is not meeting FCC Requirements for attenuation of spurious and harmonics (43 dB down from carrier.)

47 CFR Part 97 Section 97.307 (d) states:
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.

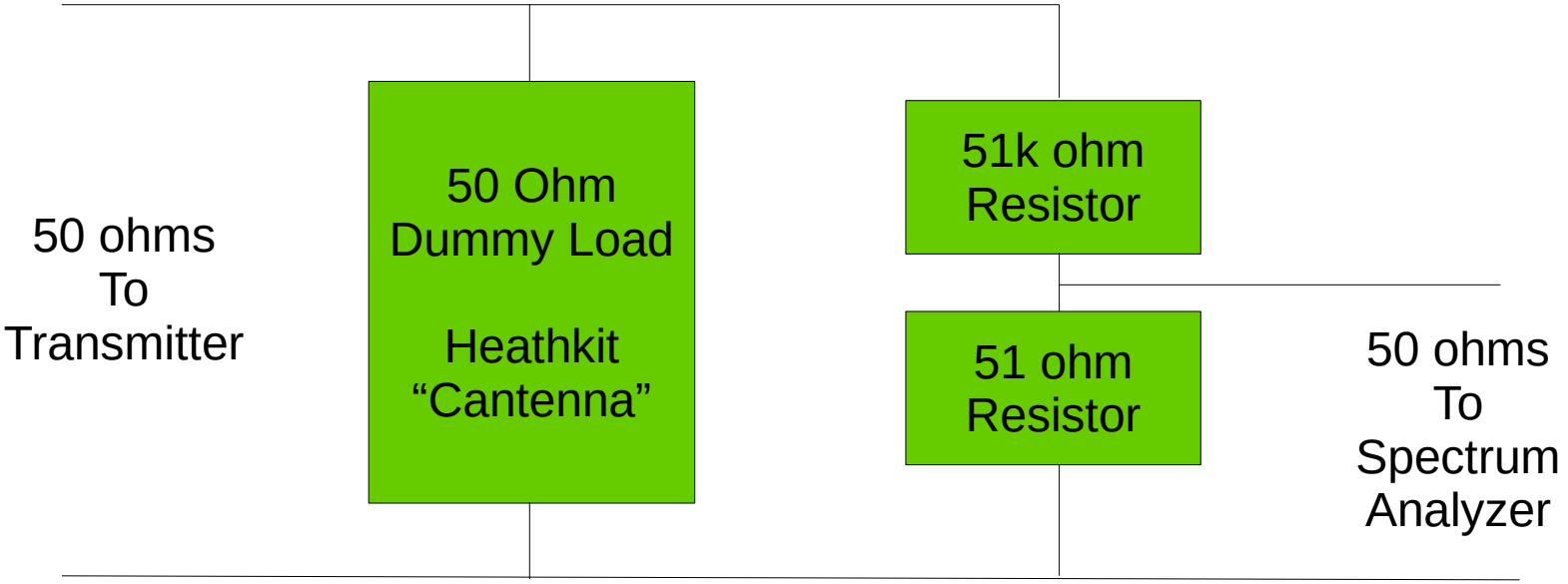
The Plan

- Measure Harmonics and Spurs on a uBITX
- Measure both SSB and CW:
  - SSB is generated at 12 MHz, mixed to 48 MHz, then mixed to final operating frequency
  - CW is generated directly at the operating frequency
- Report results to the group
- Share any known approaches for fixing issues
- Decide if we should still go forward with a group purchase of uBITX

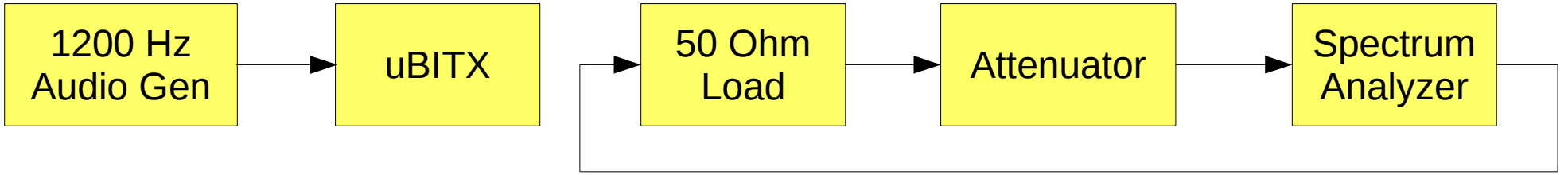
Measurement System

- Problem – how to take measurements on a transmitter that produces 10 Watts (+40 dBm) using a spectrum analyzer that can tolerate no more than a +20 dBm signal
- Answer – use a dummy load and attenuator
- Since the attenuation needed is at least 20 dB, a 51k ohm and 51 ohm resistor in series across the dummy load will provide a good match to both the transmitter and the spectrum analyzer

Attenuation Network

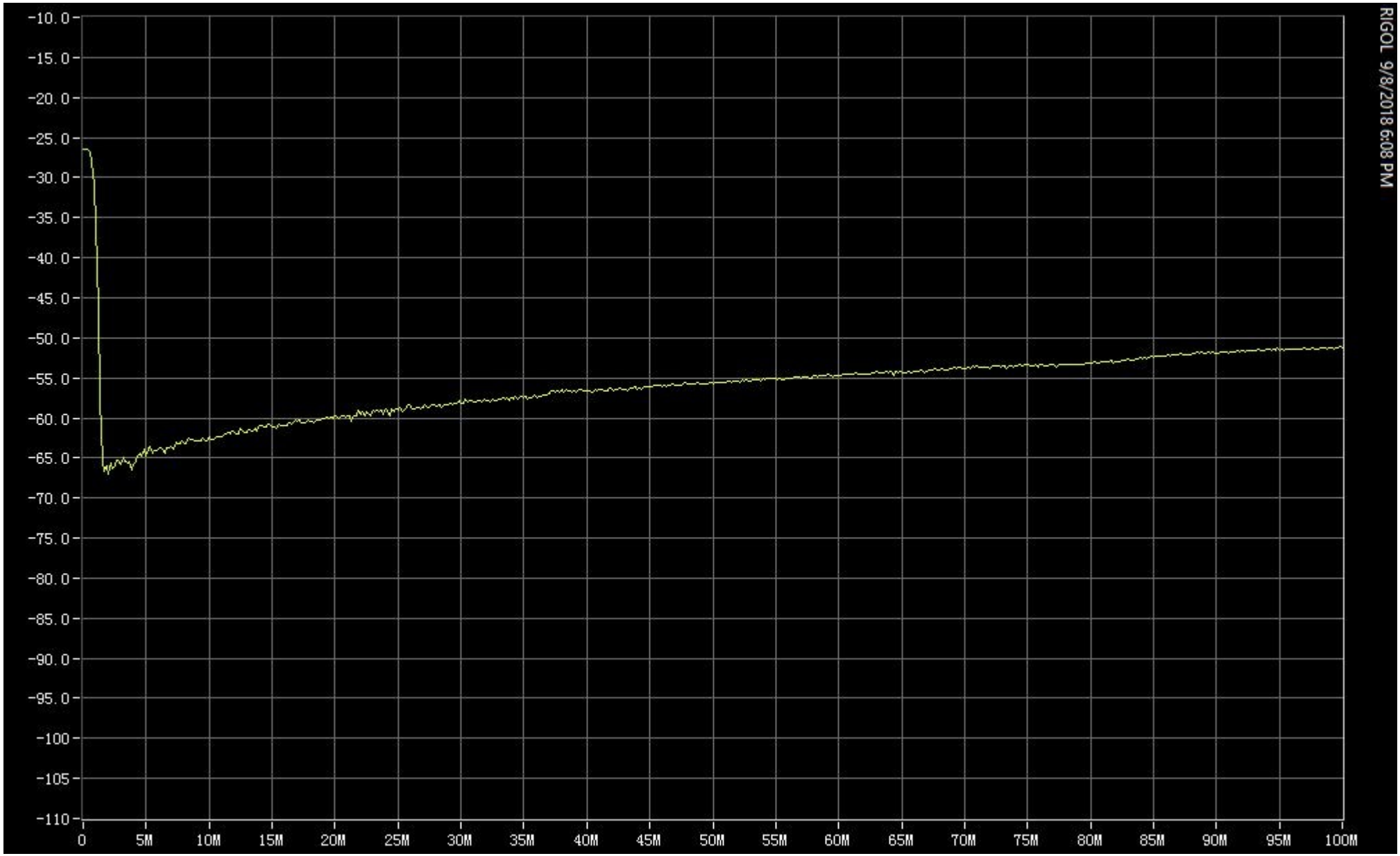


Measurement System Calibration

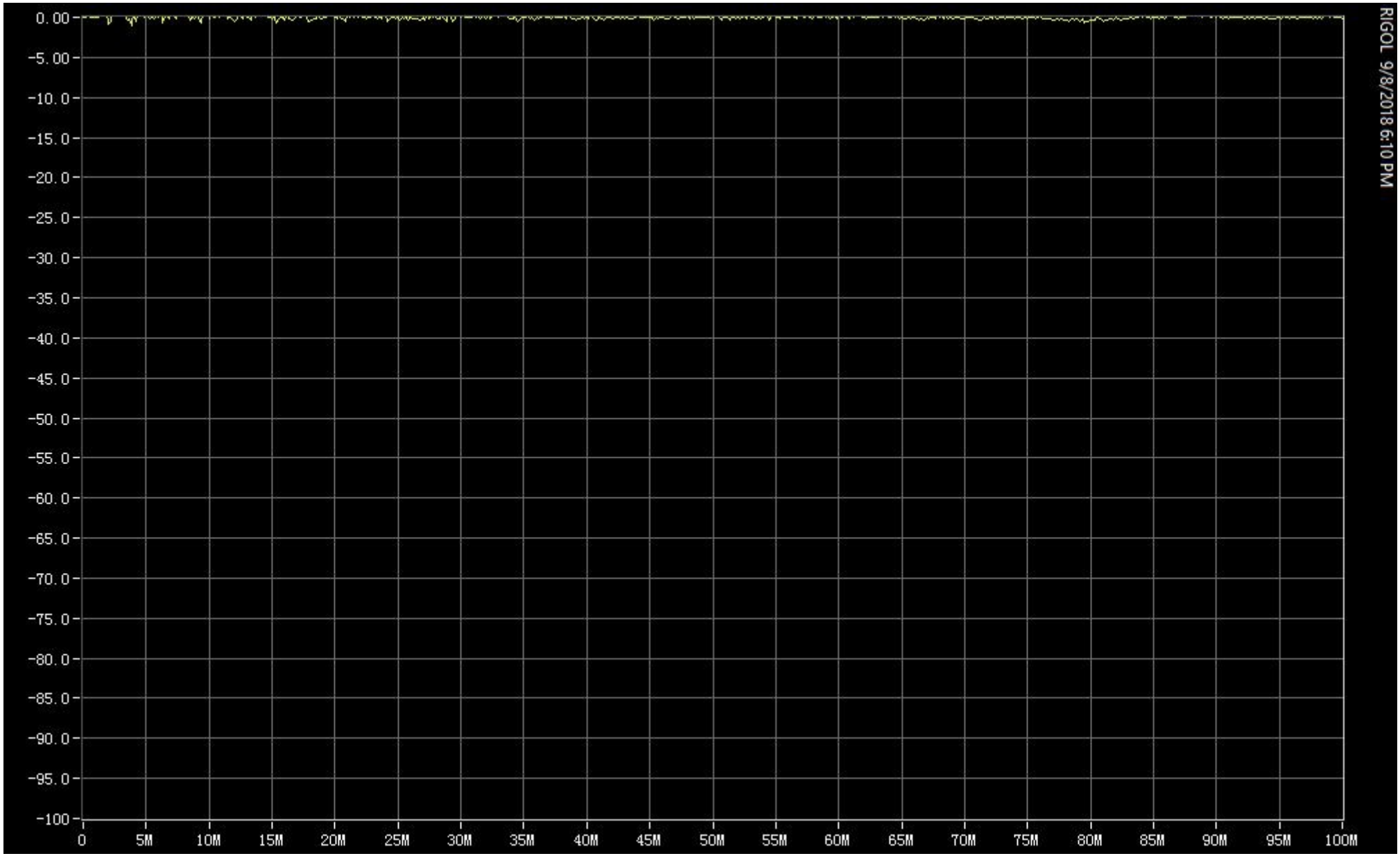


- Problem – how to account for attenuator changes vs frequency (due to resistor construction)
- Answer – use the tracking generator output from the spectrum analyzer, and its built-in normalization functions, to correct for the measurement errors caused by varying attenuation vs frequency

Measurement System Prior To Calibration



Measurement System After Calibration



Measured Power Output

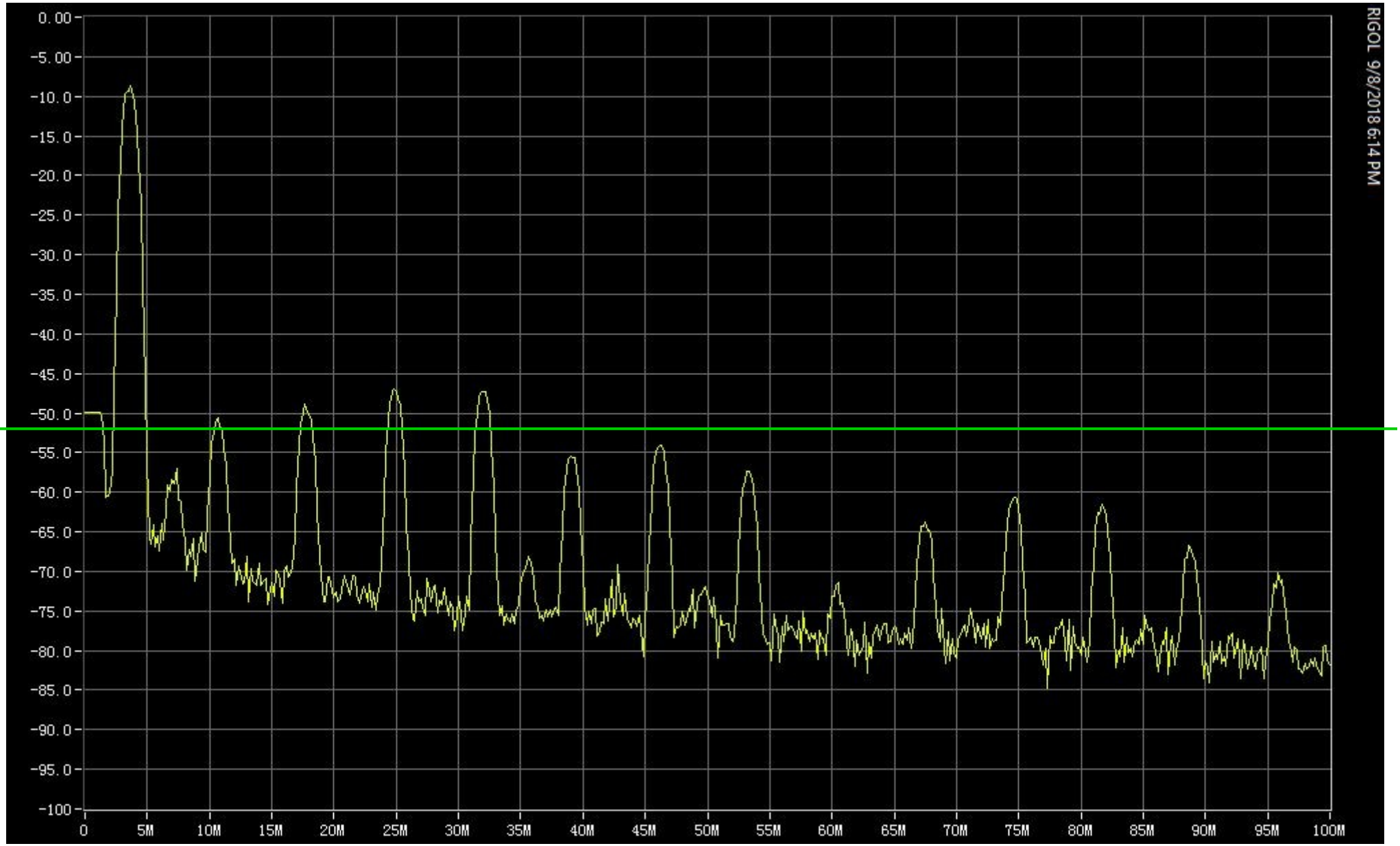
Frequency	CW Power Watts	SSB Power Watts
3.550	12	12
7.050	8	8
10.125	8	8
14.050	13	10
18.100	8	8
21.050	8	6
24.900	7	5
28.050	5	5

- uBITX Unit Under Test (UUT) Power Output measured at 13.8V, in CW Mode.
- SSB Power dependent on audio level at microphone input. Audio generator adjusted to obtain the power levels shown.

Test Results

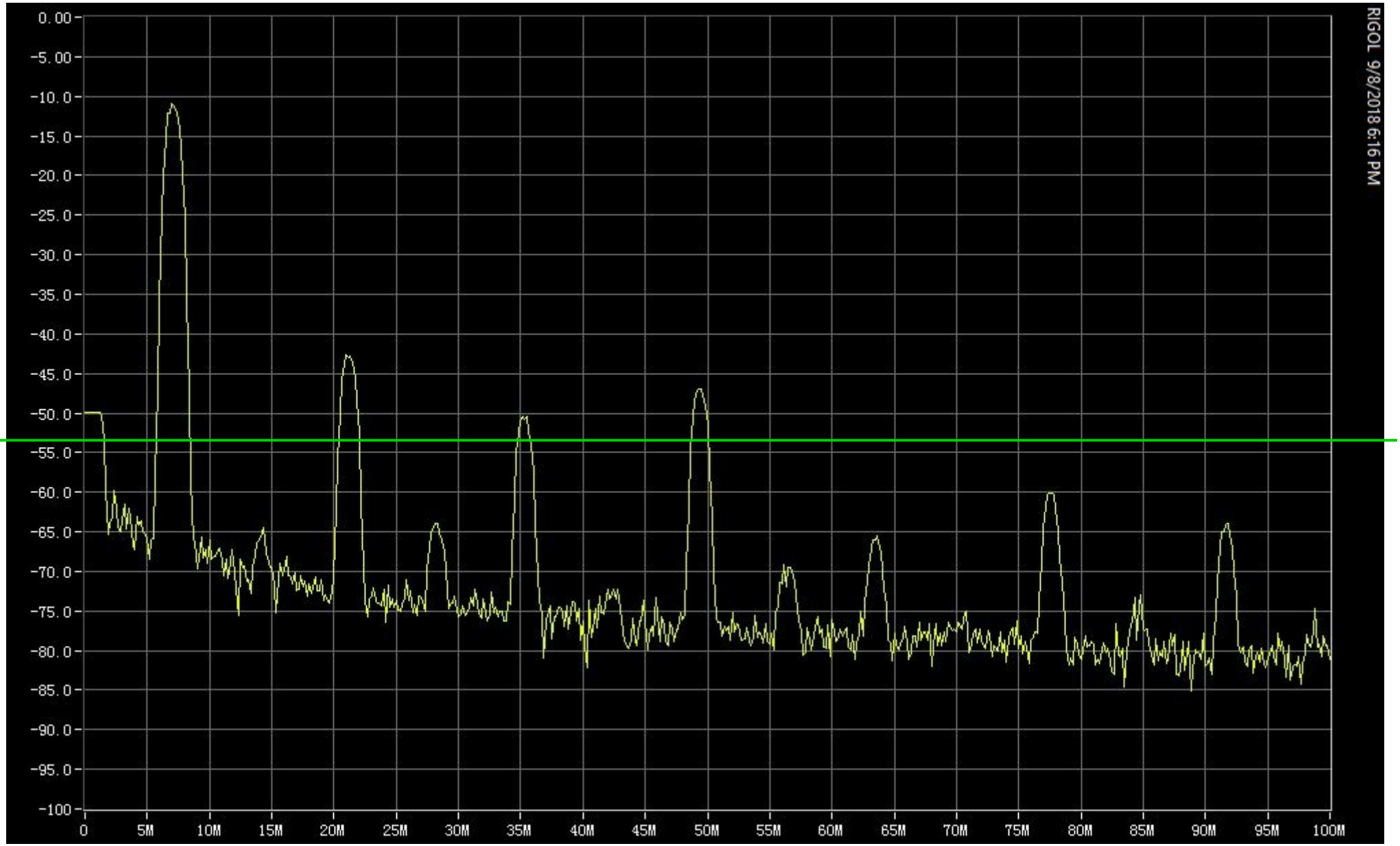
Out of Spec

80M CW



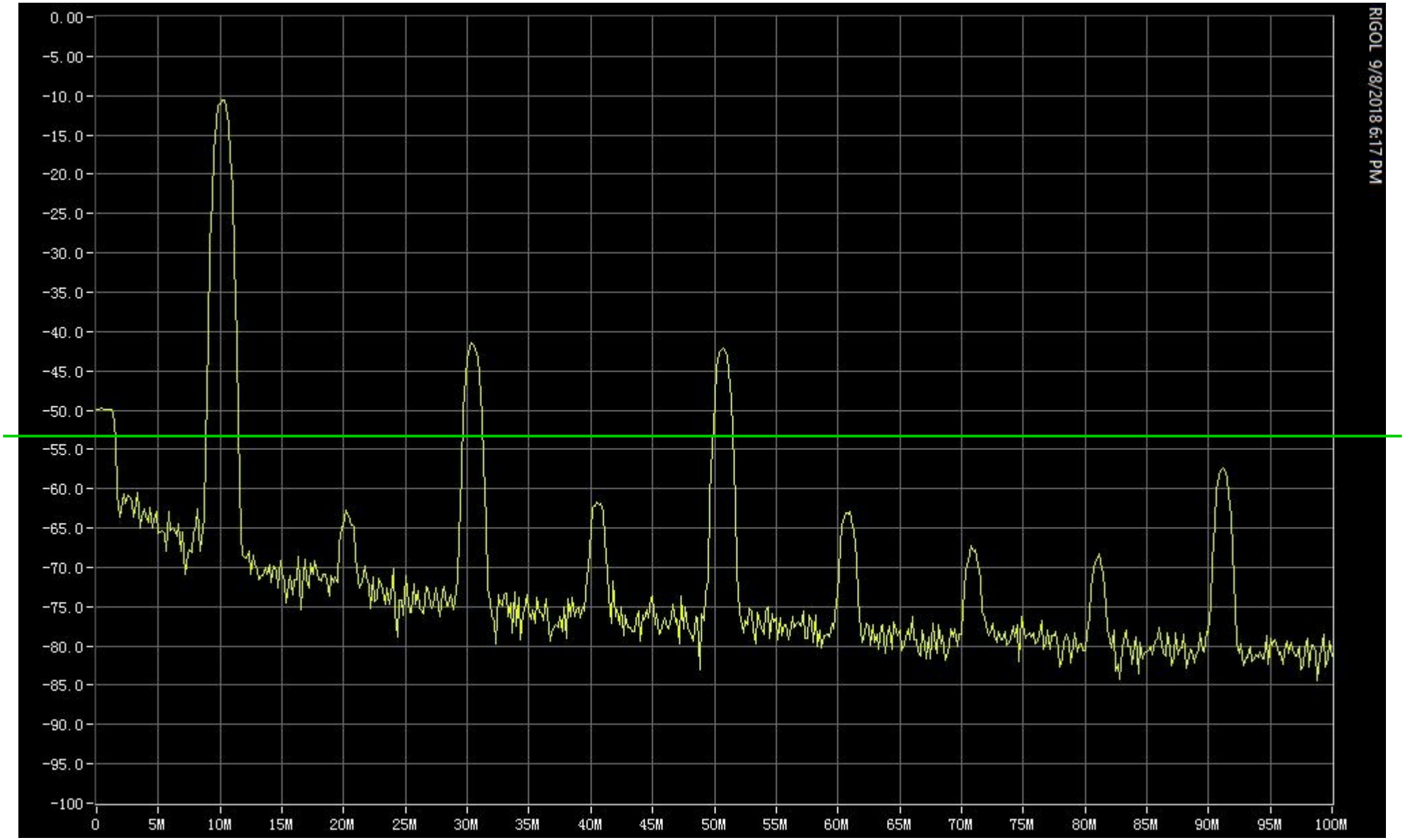
Out of Spec

40M CW



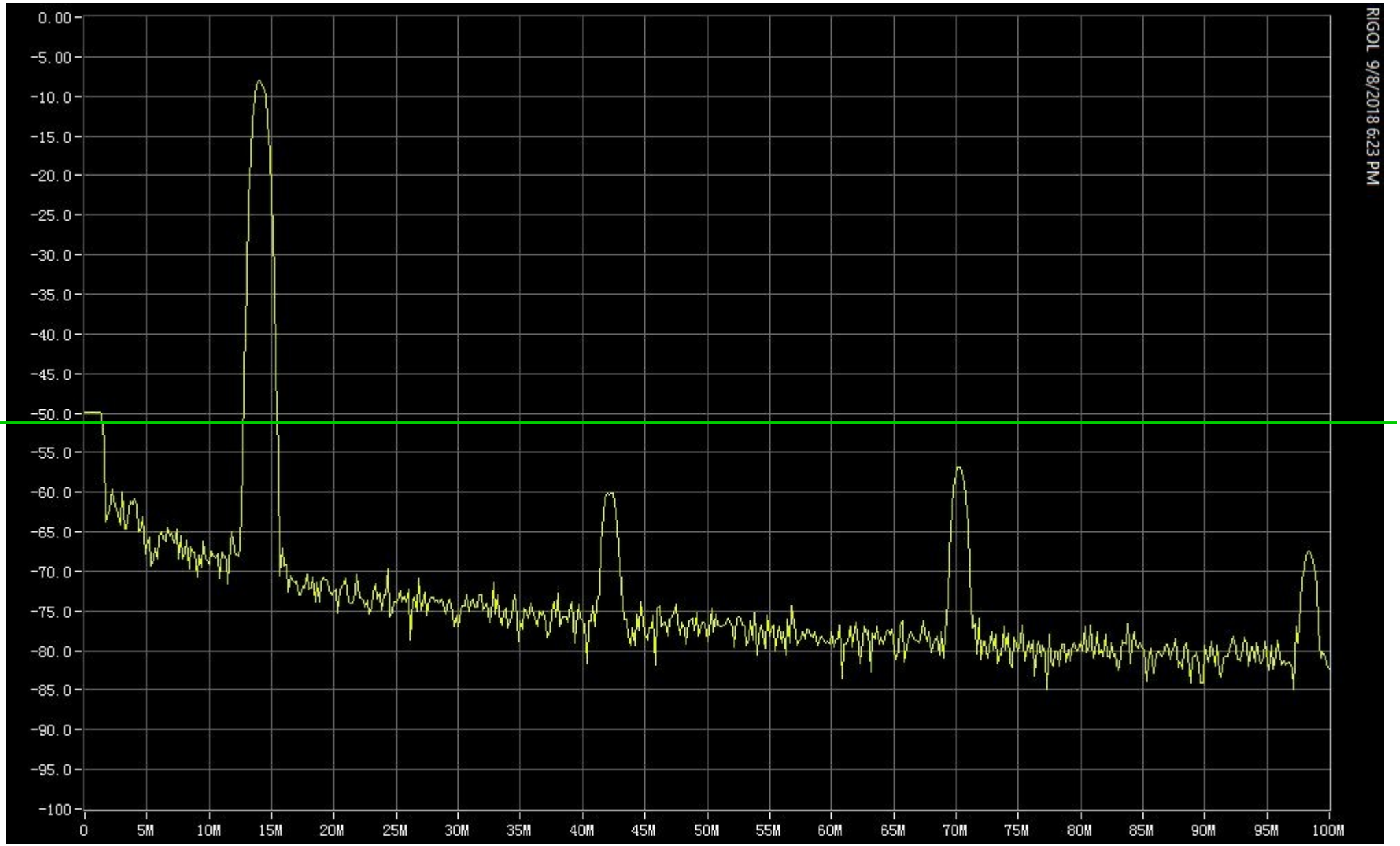
Out of Spec

30M CW



OK

20M CW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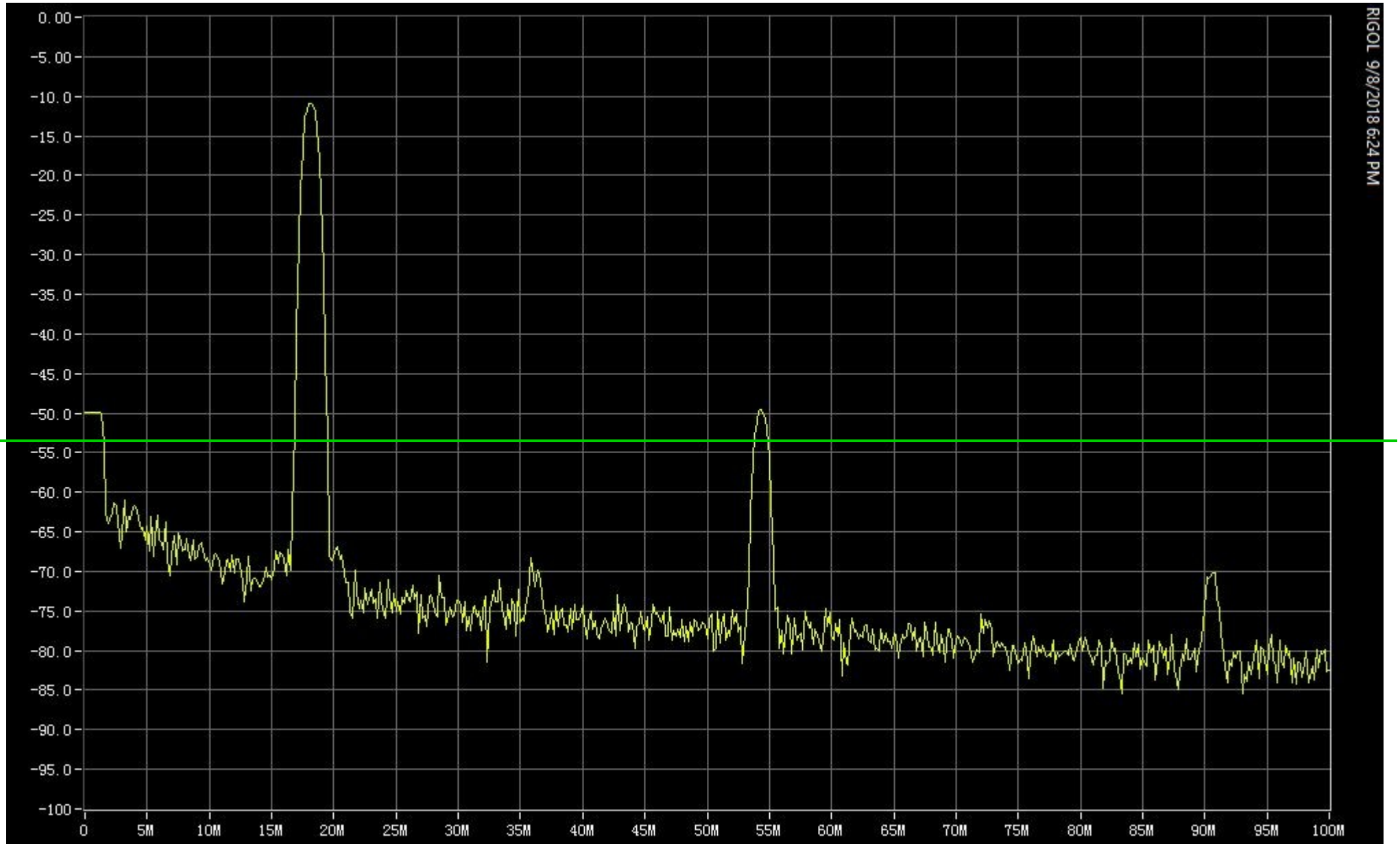
RIGOL 9/8/2018 6:23 PM

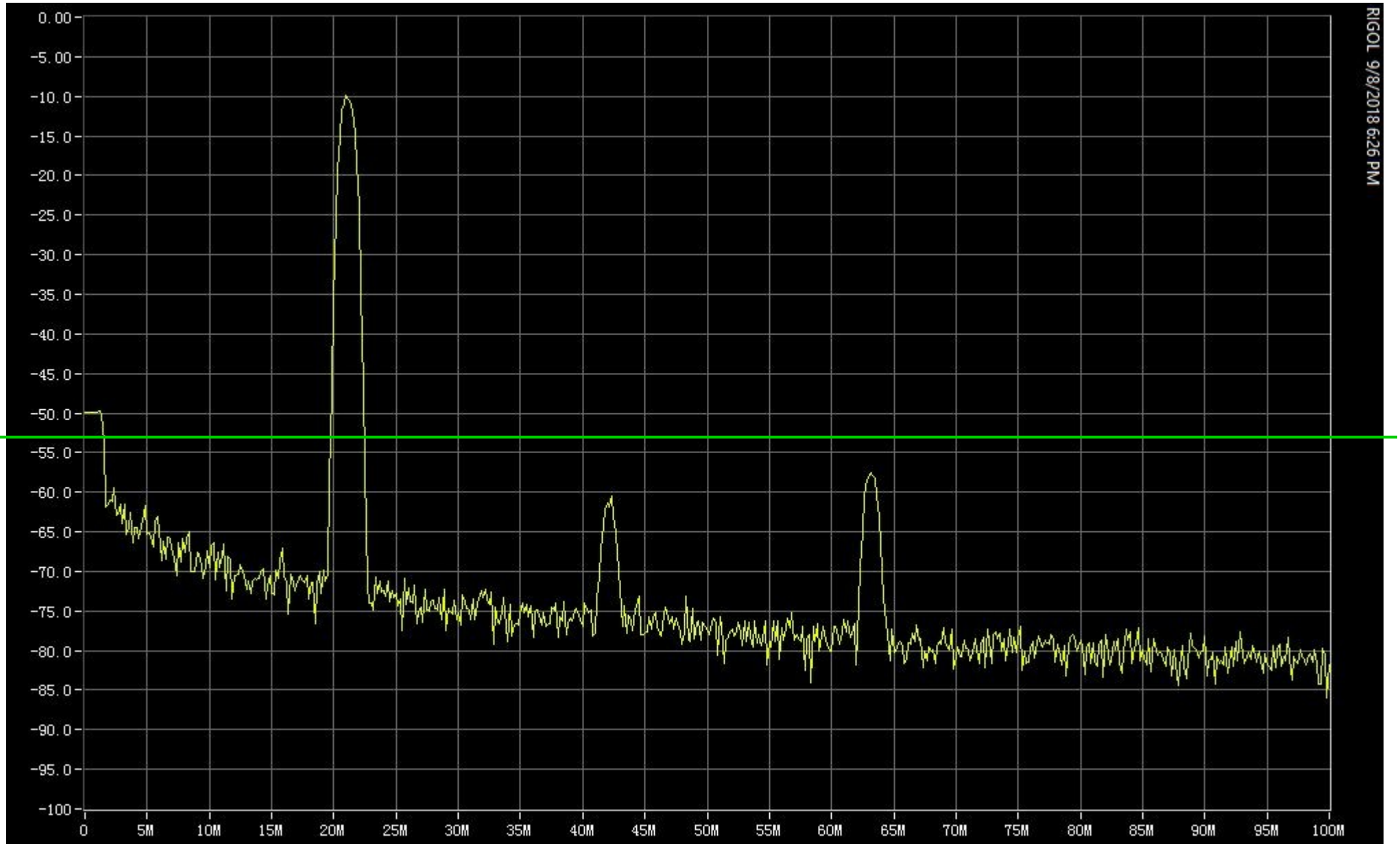
Out of Spec

17M CW



OK

15M CW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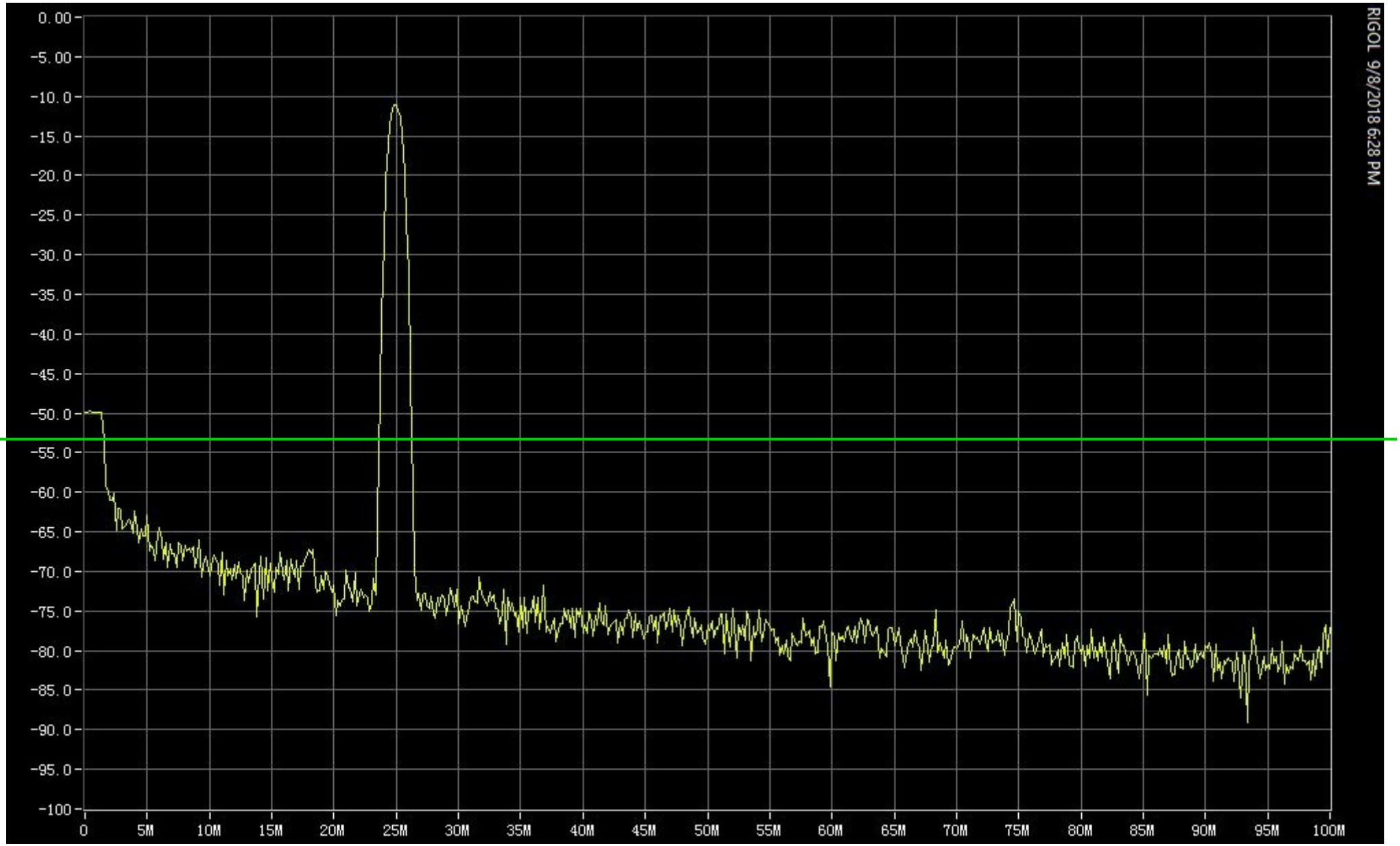
RIGOL 9/8/2018 6:26 PM

OK

12M CW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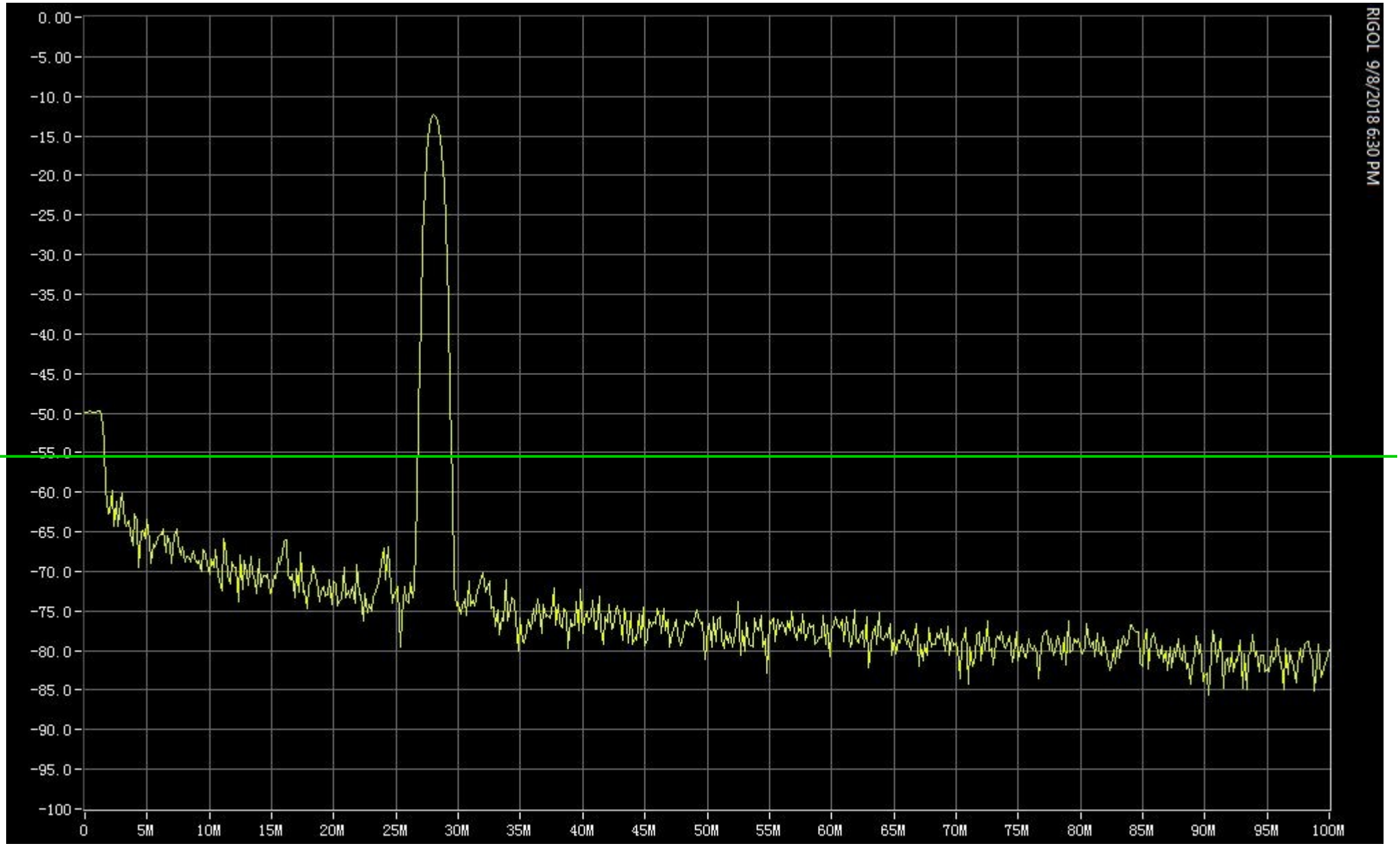
RIGOL 9/8/2018 6:28 PM

OK

10M CW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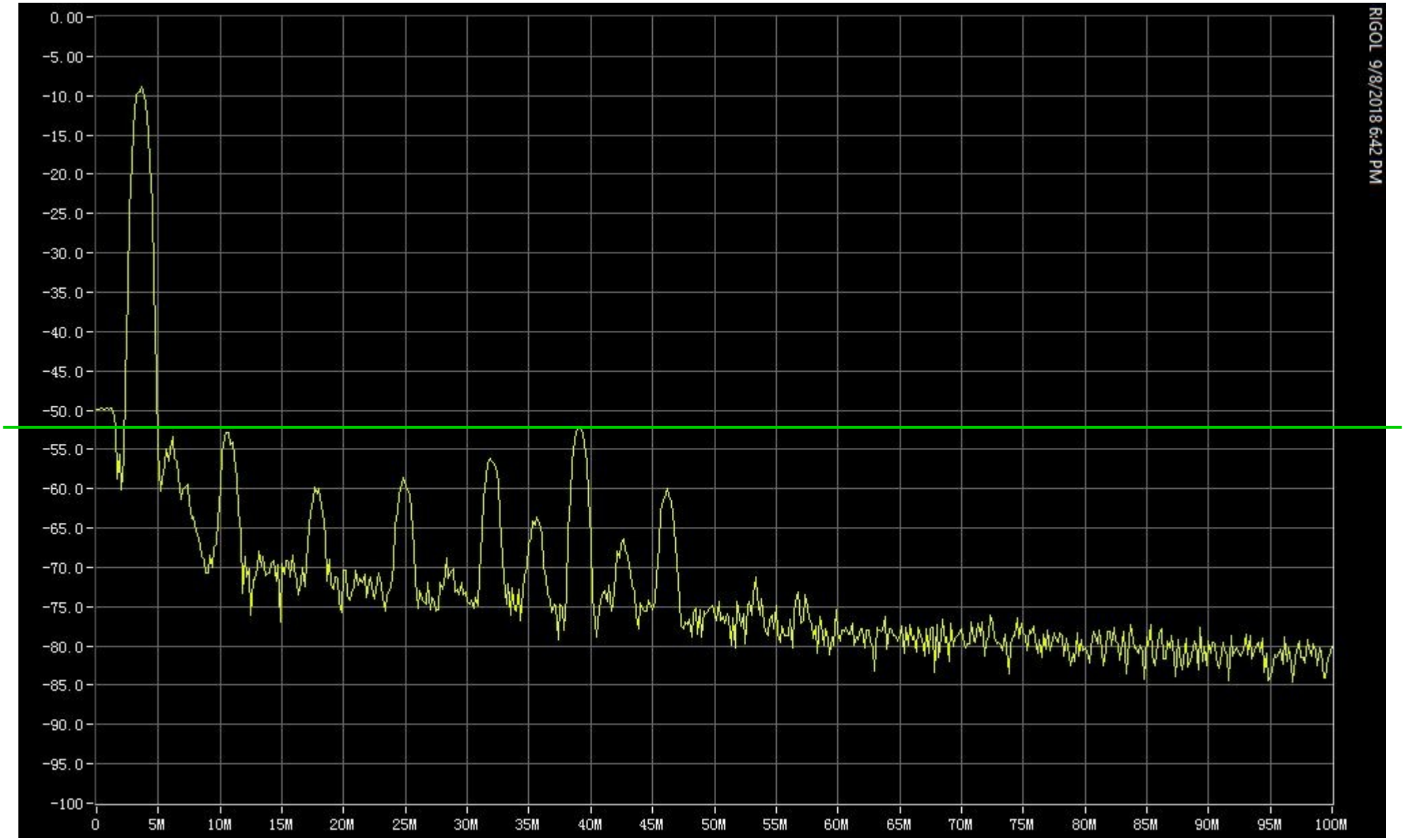
RIGOL 9/8/2018 6:30 PM

OK

80M SSB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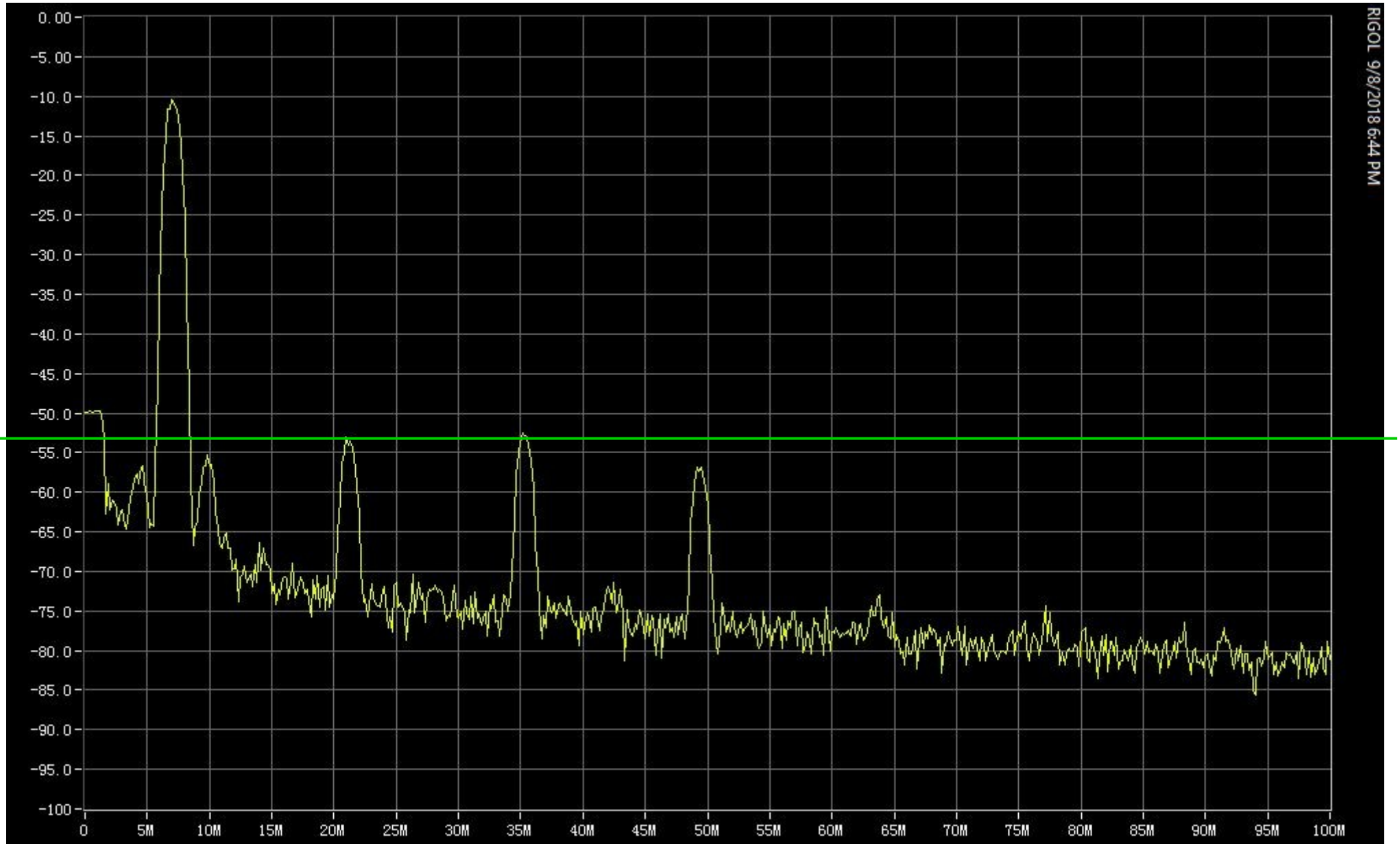
RIGOL 9/8/2018 6:42 PM

OK

40M SSB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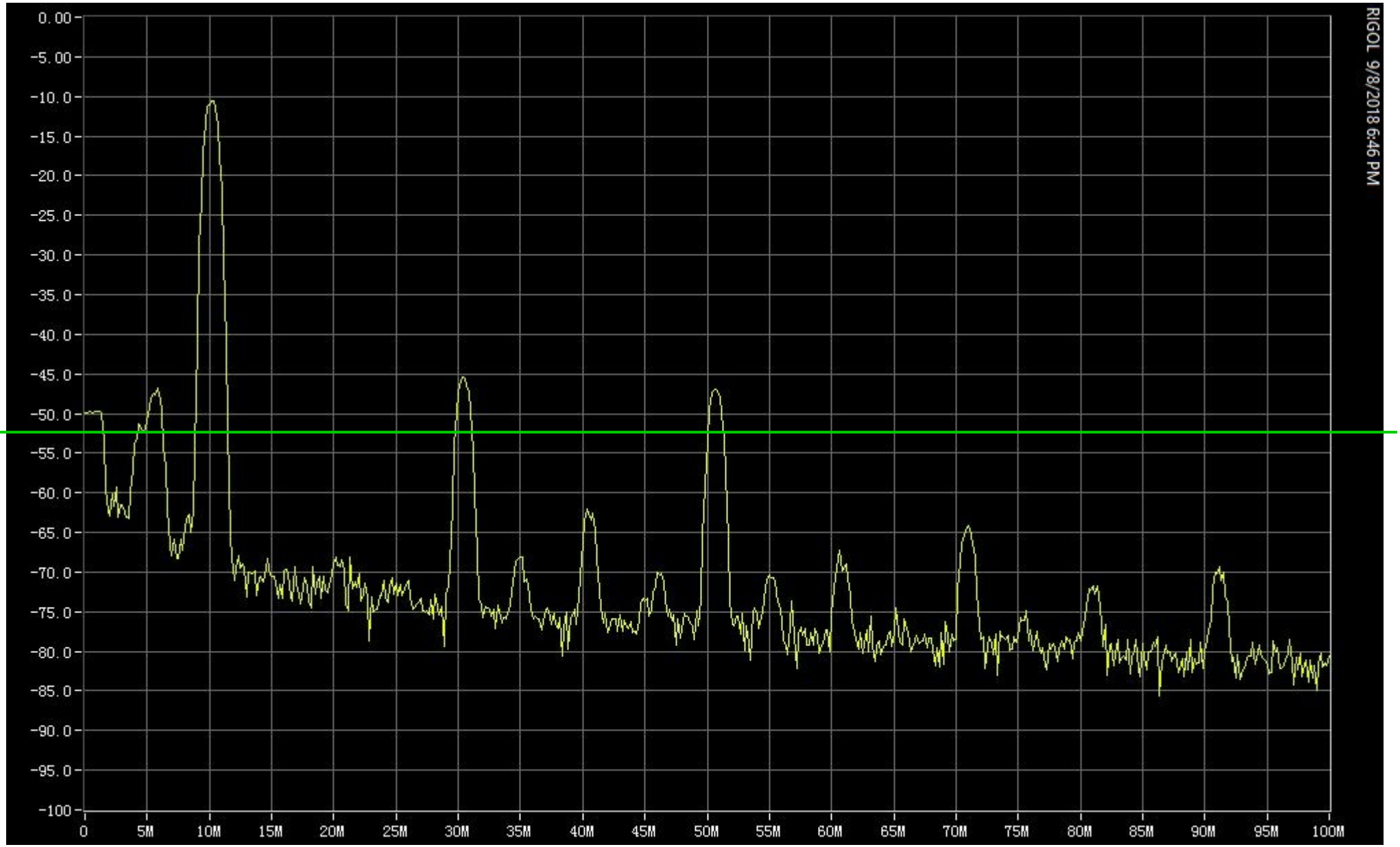
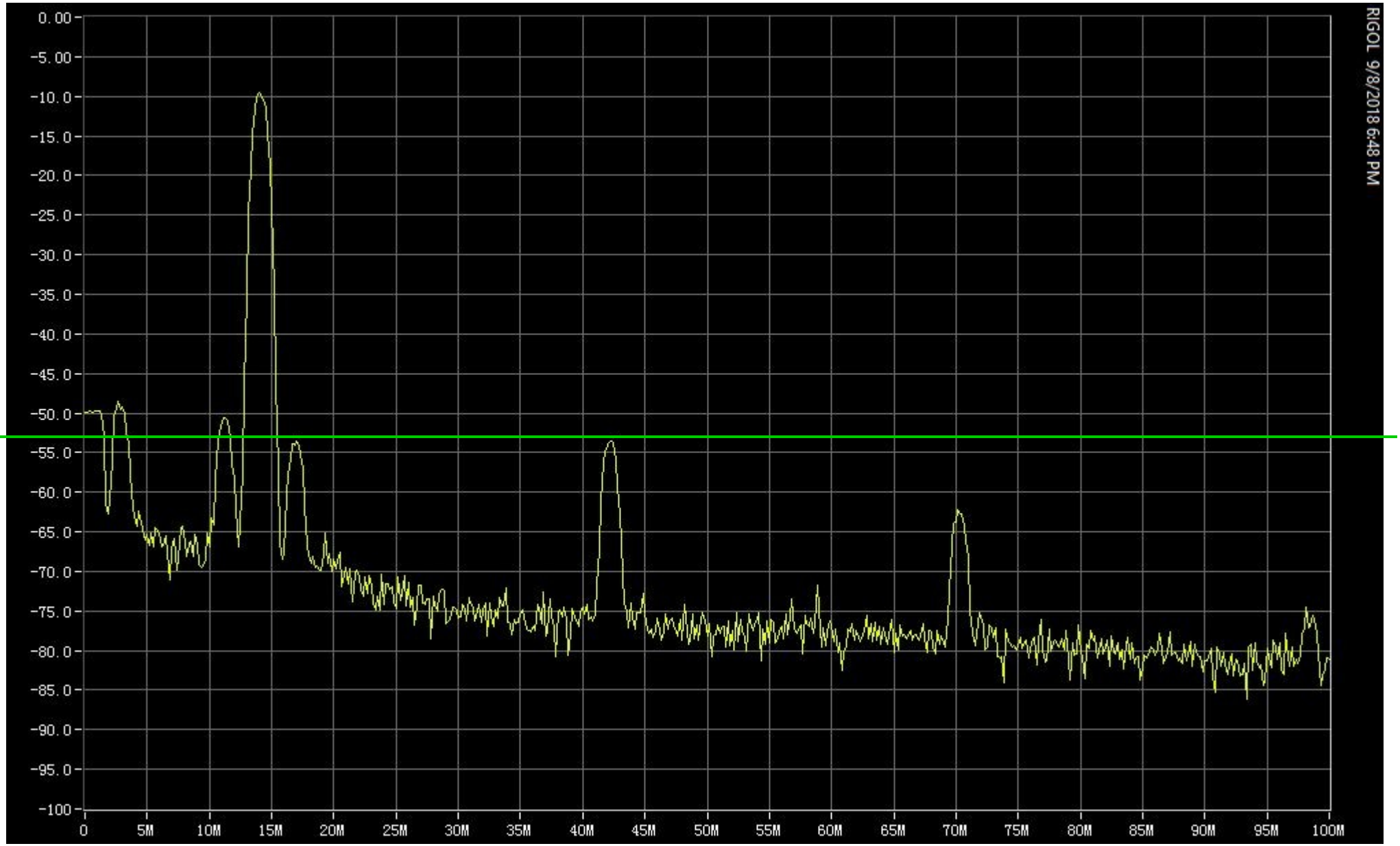
Out of Spec

30M SSB



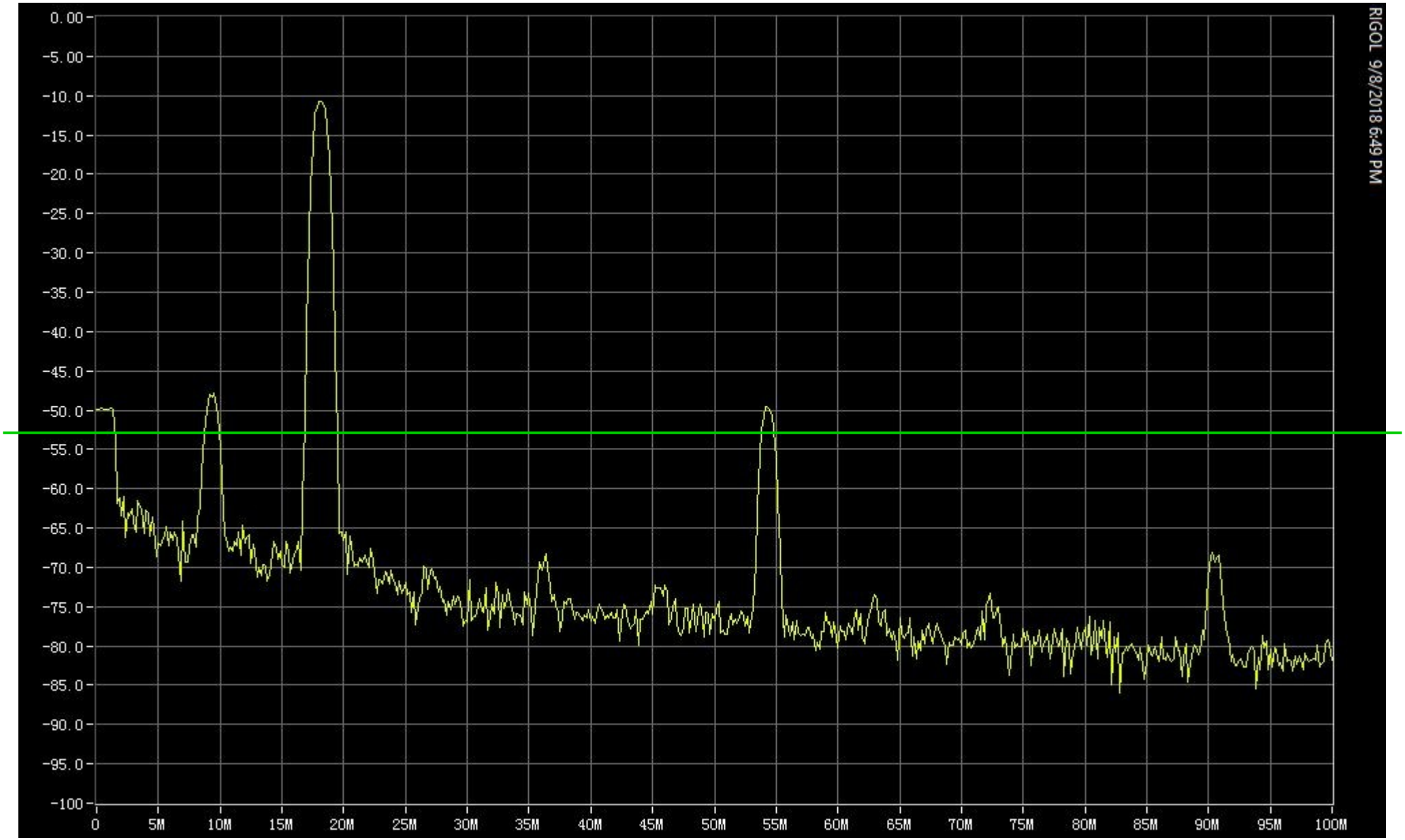
Out of Spec

20M SSB



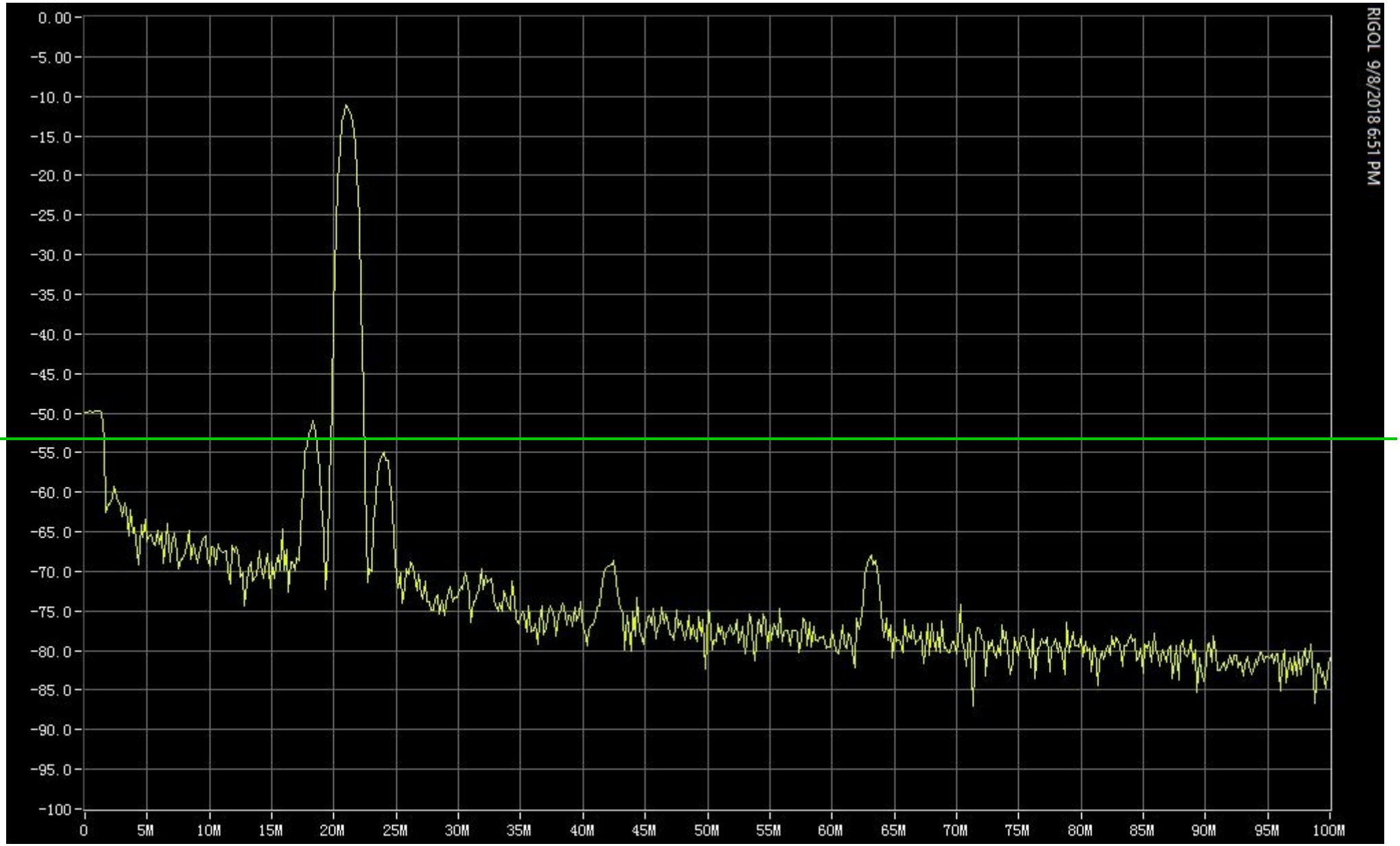
Out of Spec

17M SSB



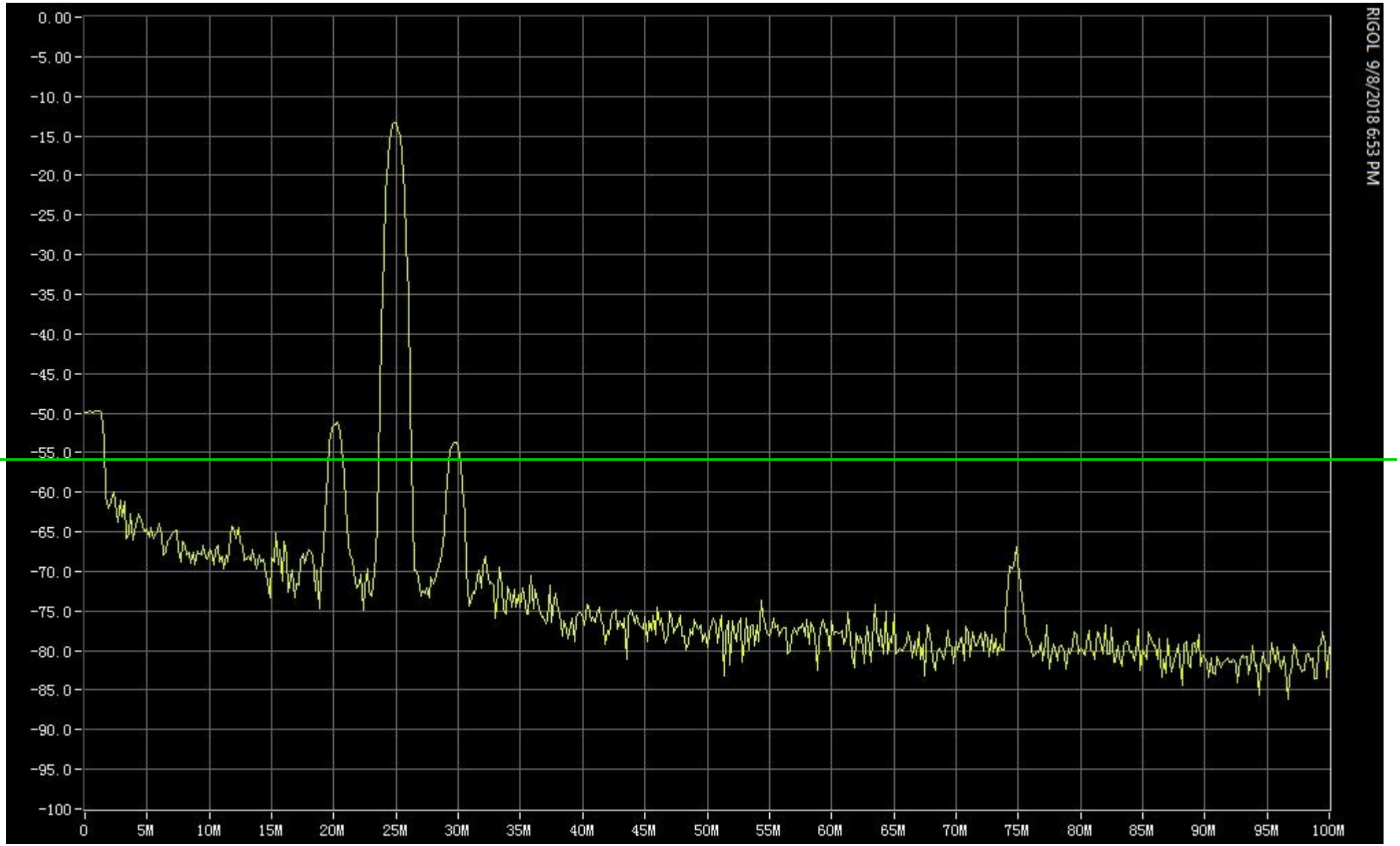
Out of Spec

15M SSB



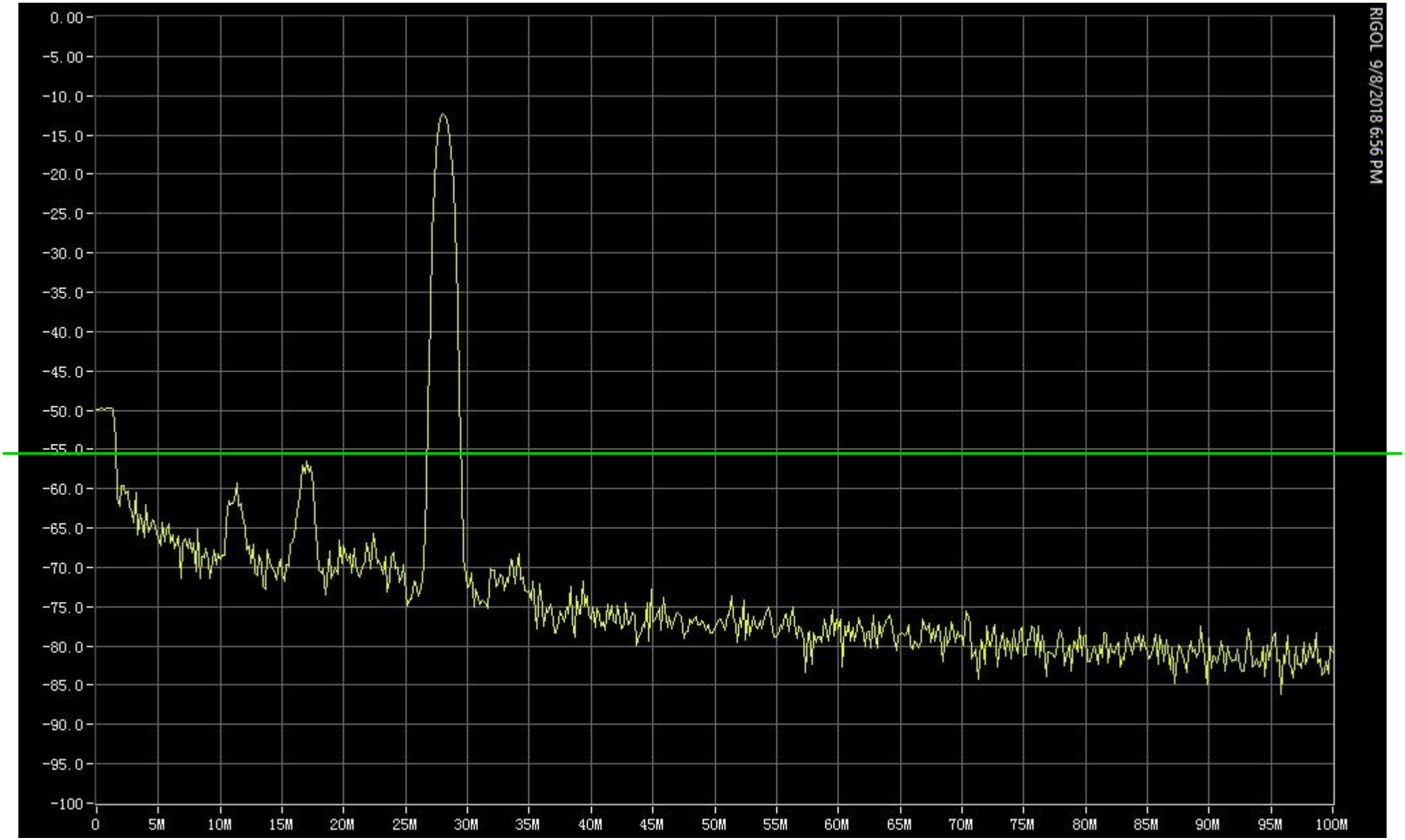
Out of Spec

12M SSB



OK

10M SSB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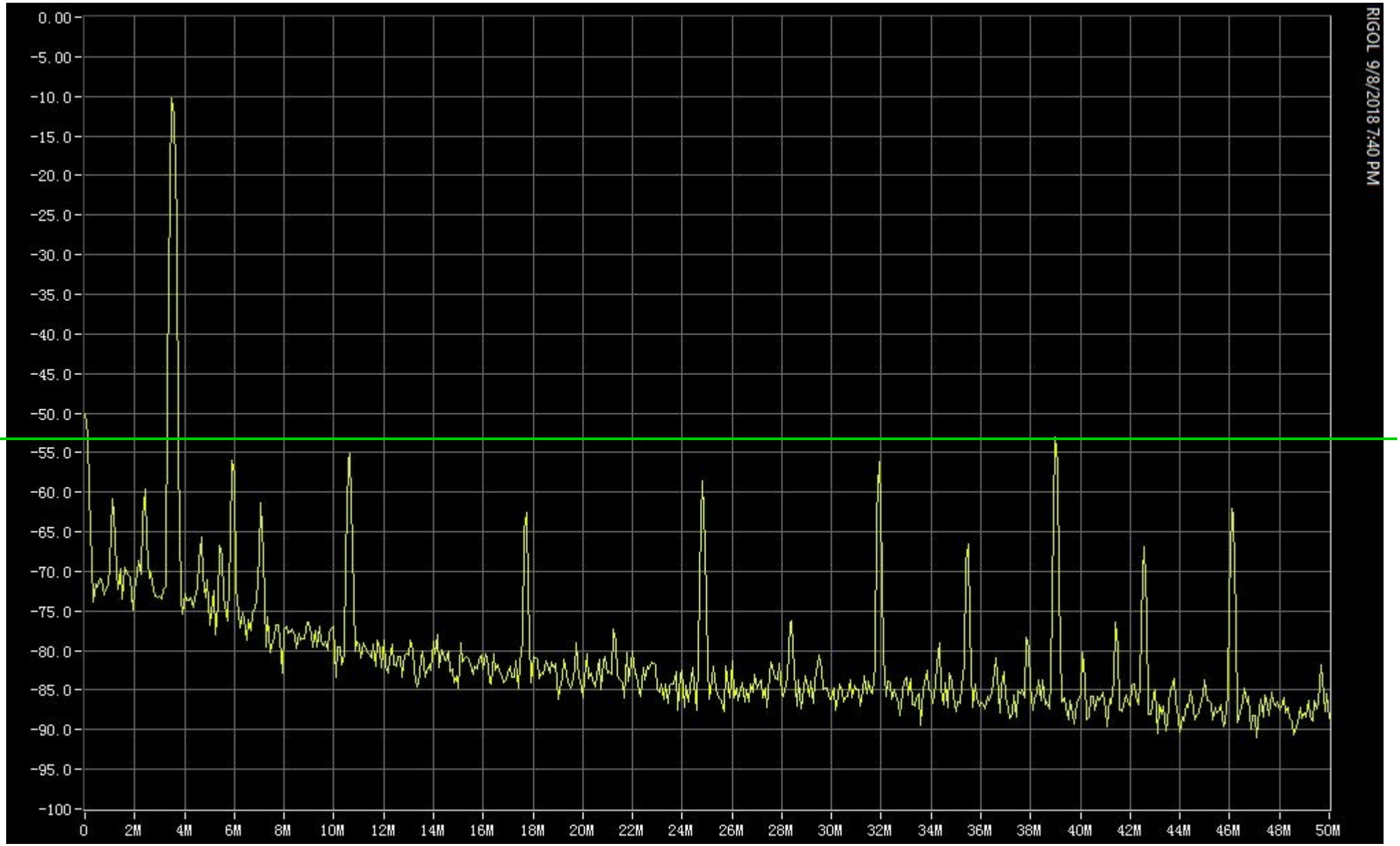
RIGOL 9/8/2018 6:56 PM

Test Results

Focusing on SSB
Sweep 0 – 50 MHz
Easier to read frequency of spurs

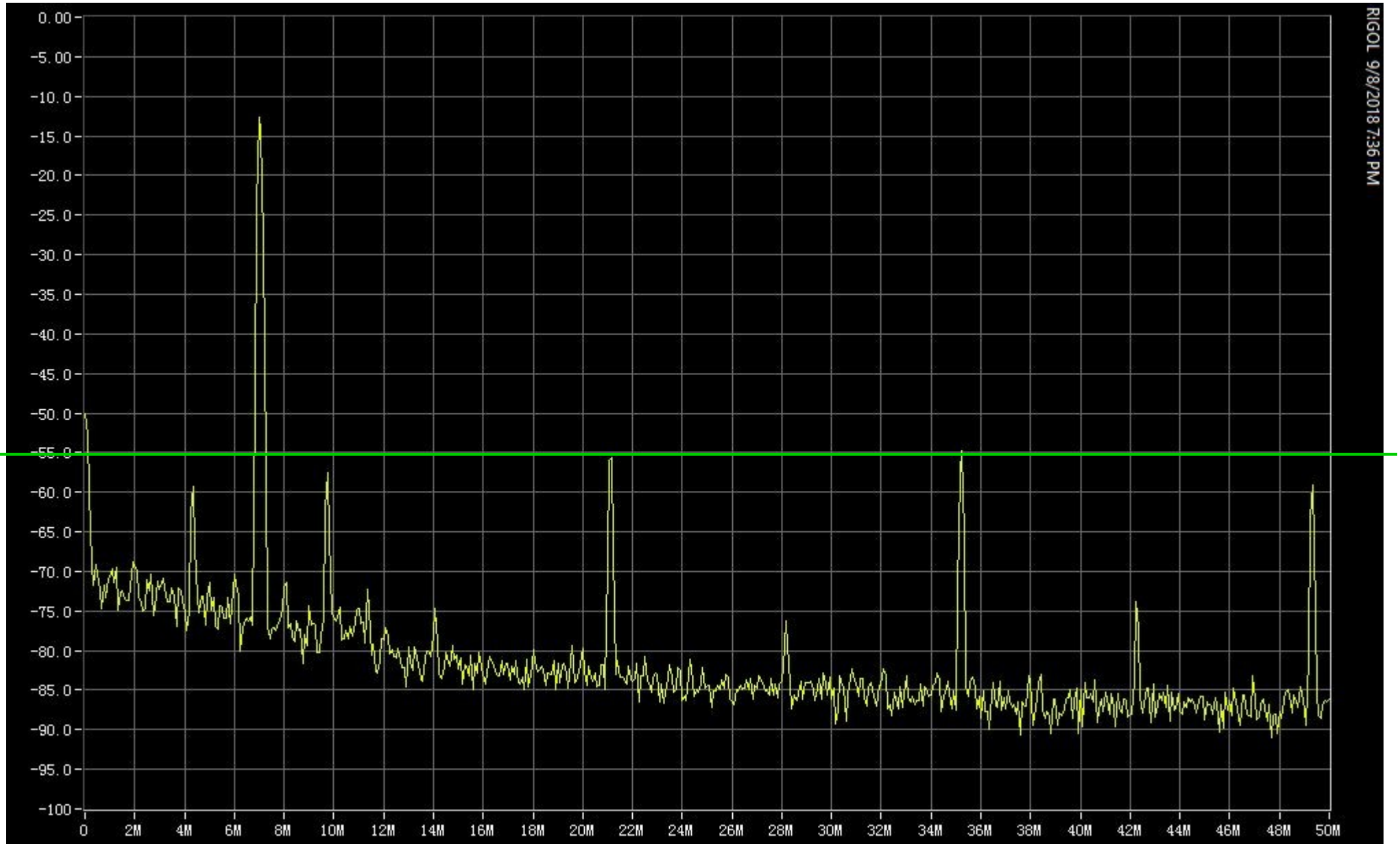
OK

80M SSB Detail



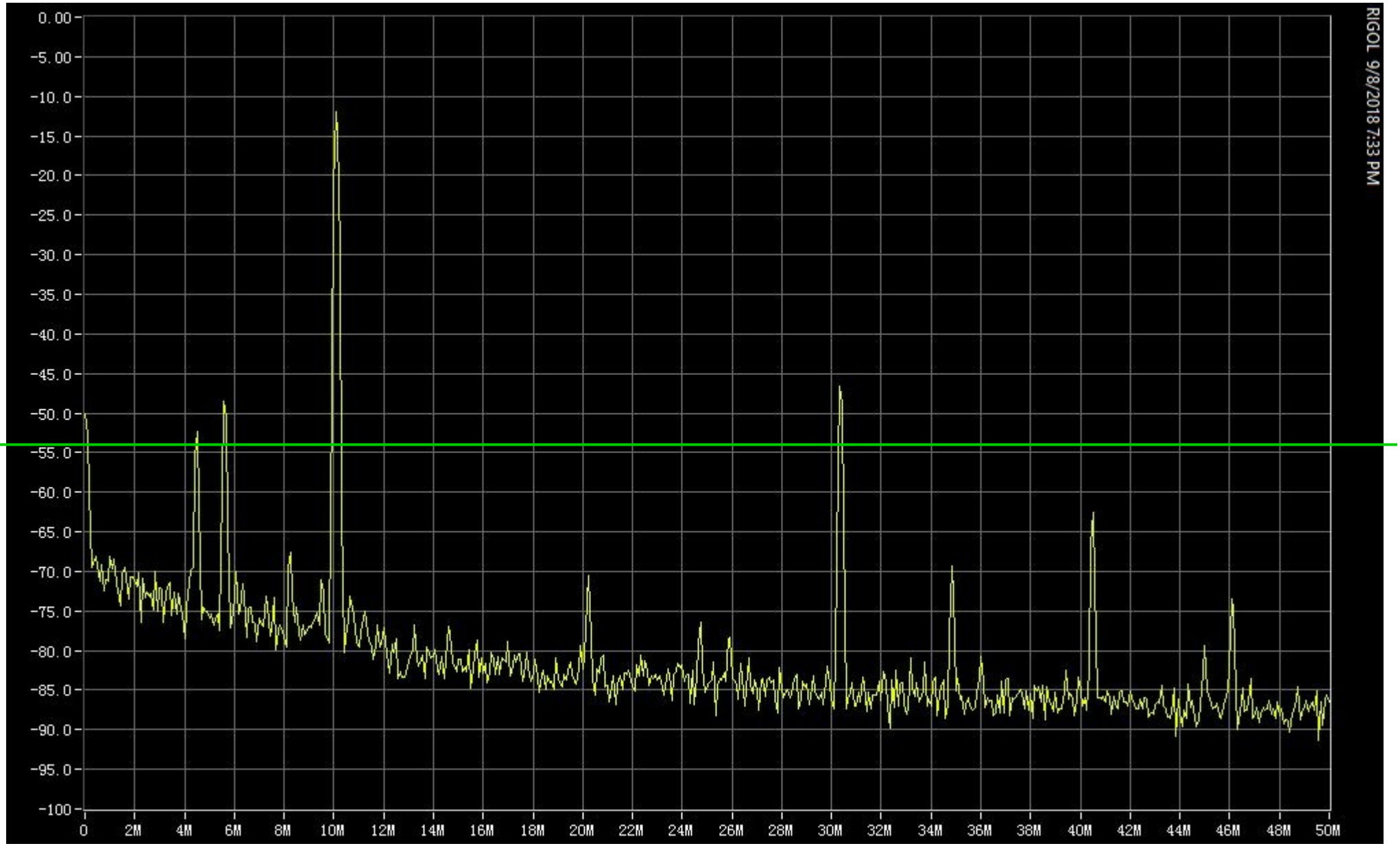
OK

40M SSB Detail



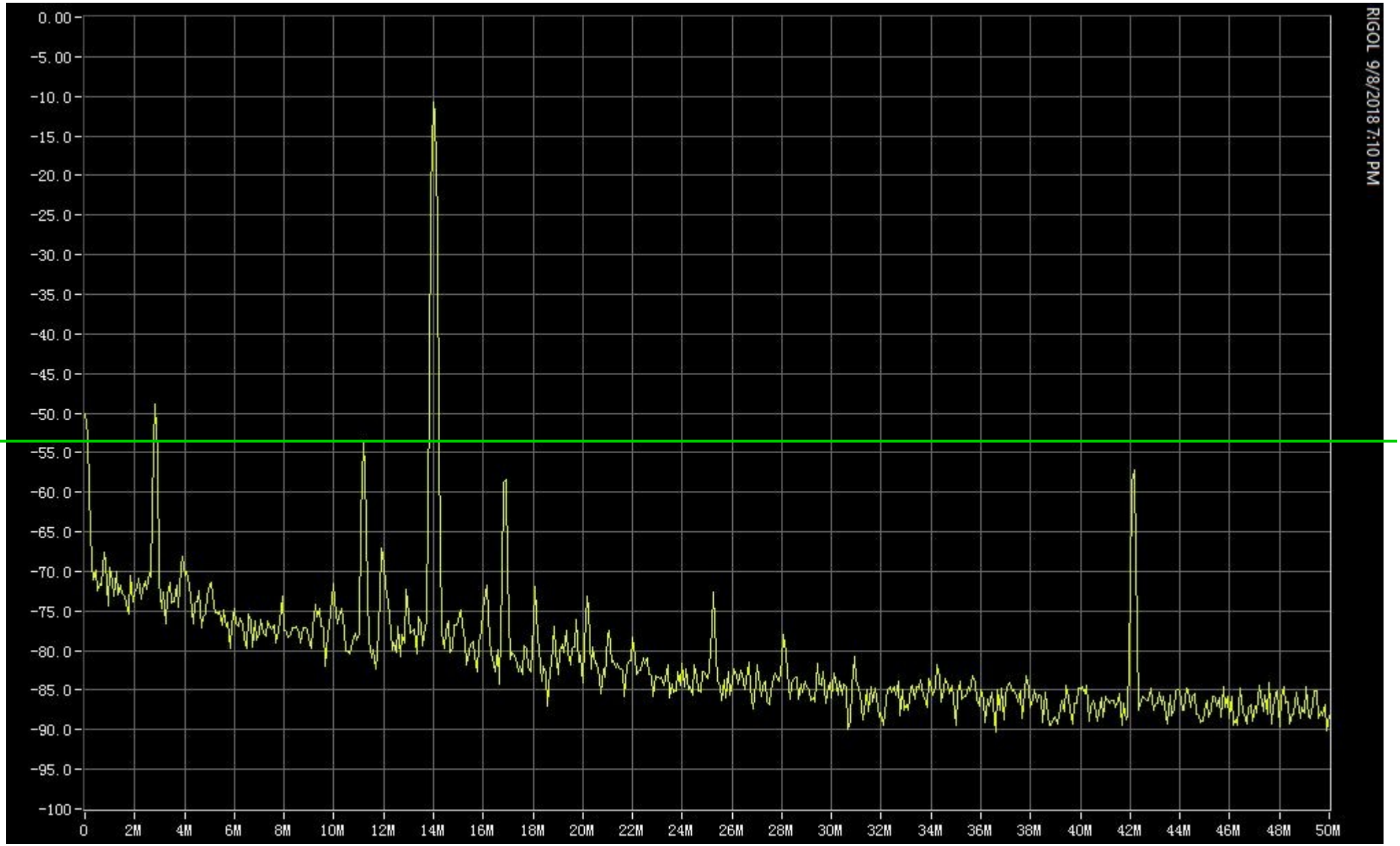
Out of Spec

30M SSB Detail



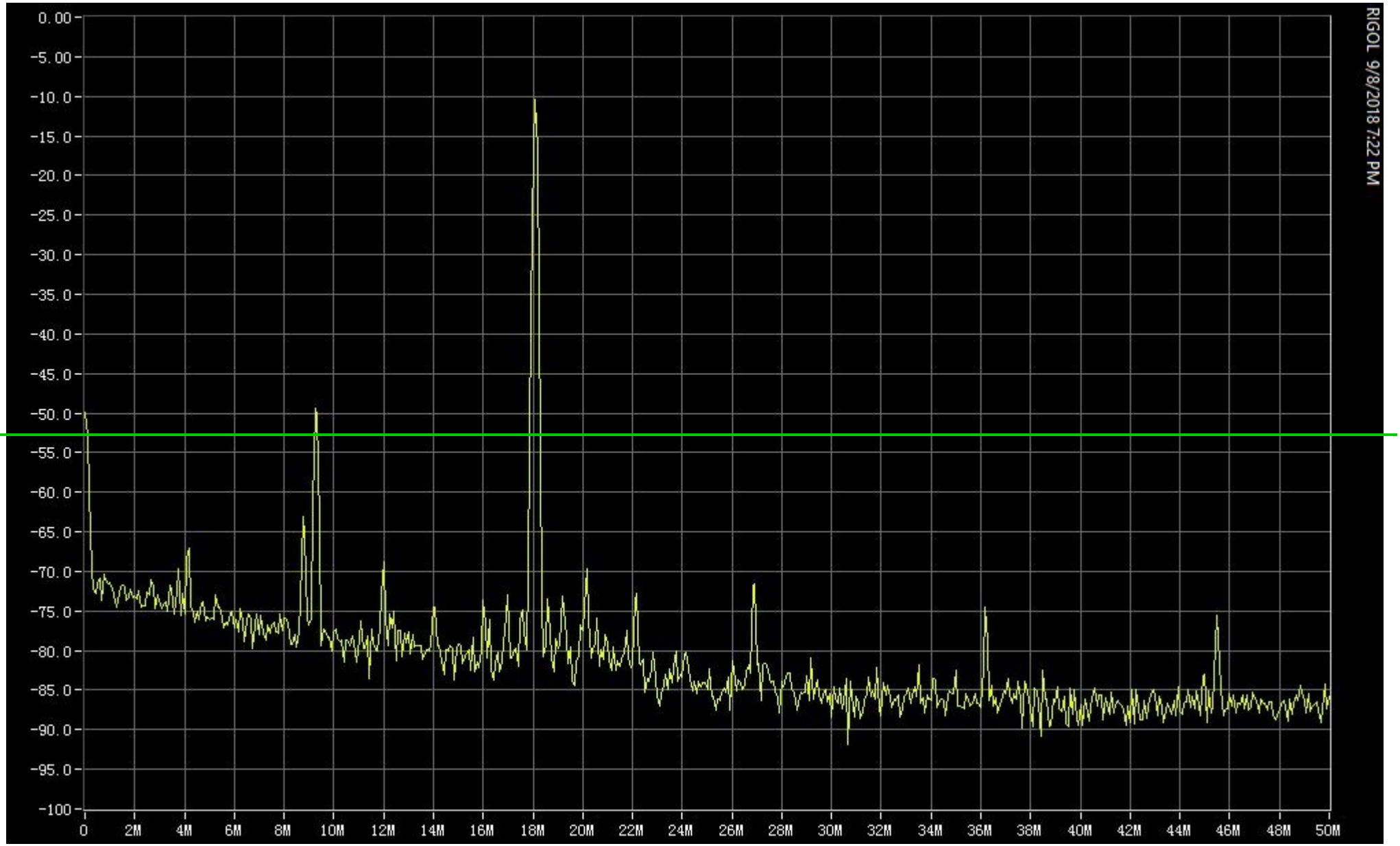
Out of Spec

20M SSB Detail



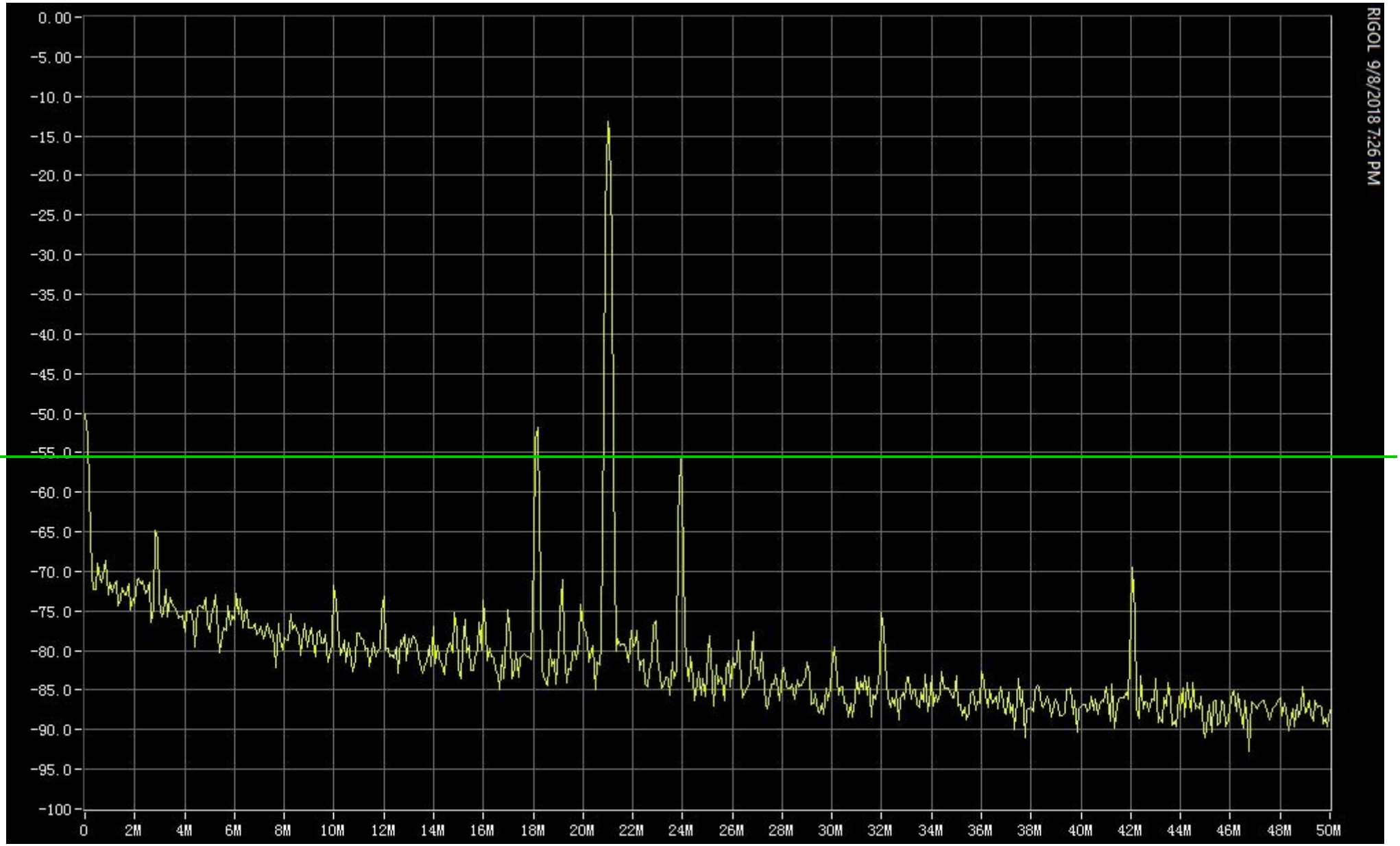
Out of Spec

17M SSB Detail



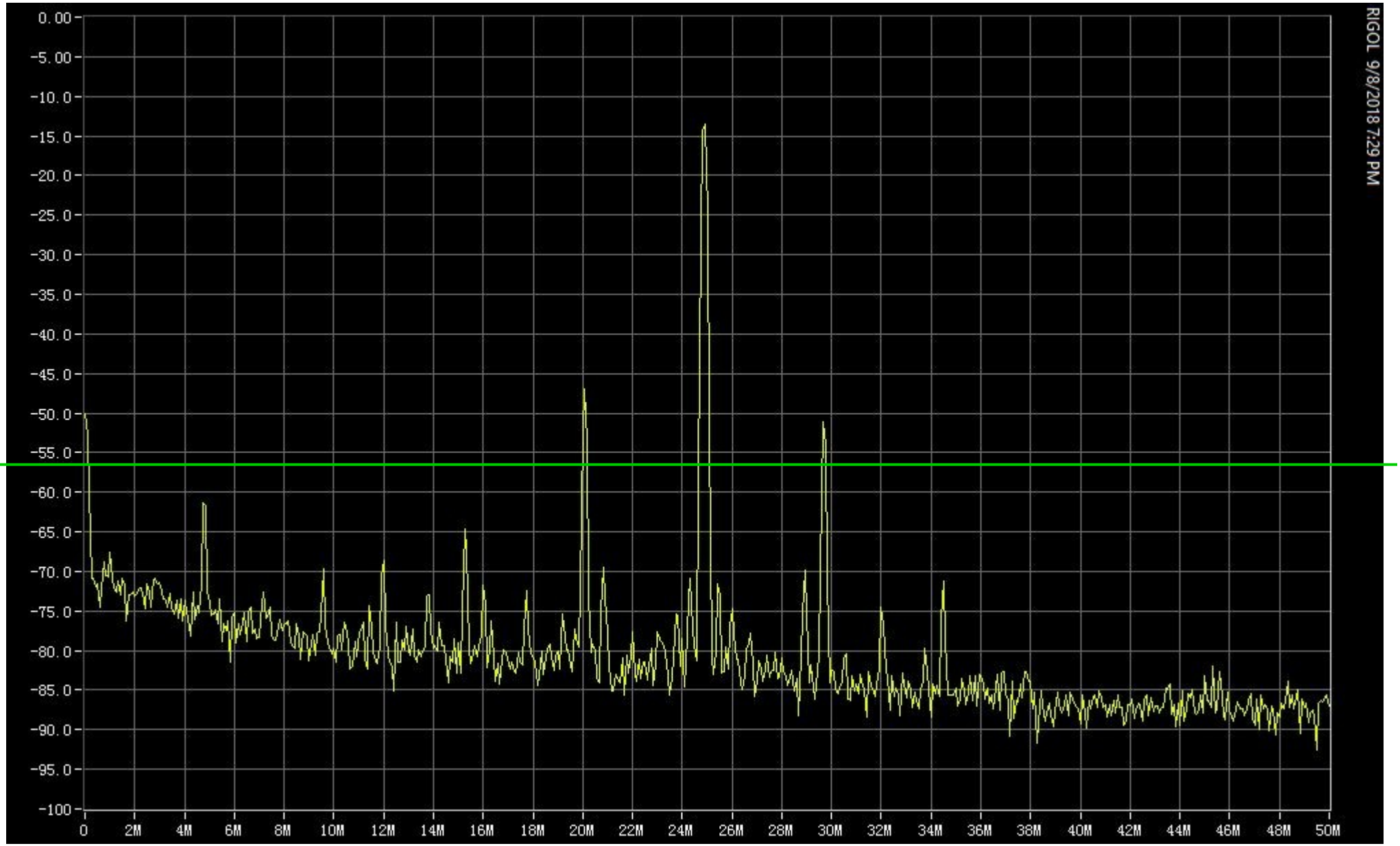
Out of Spec

15M SSB Detail



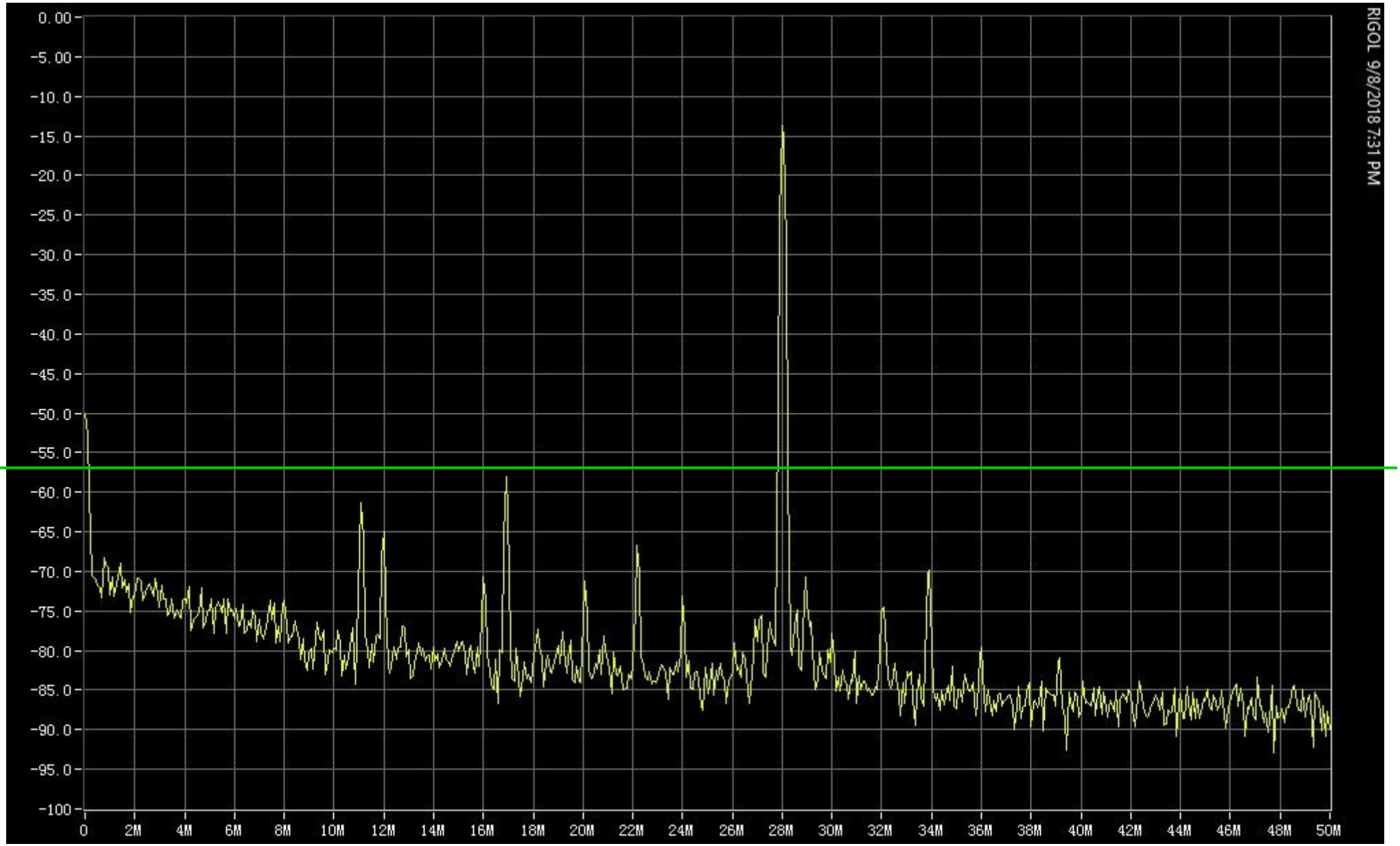
Out of Spec

12M SSB Detail



OK

10M SSB Detail

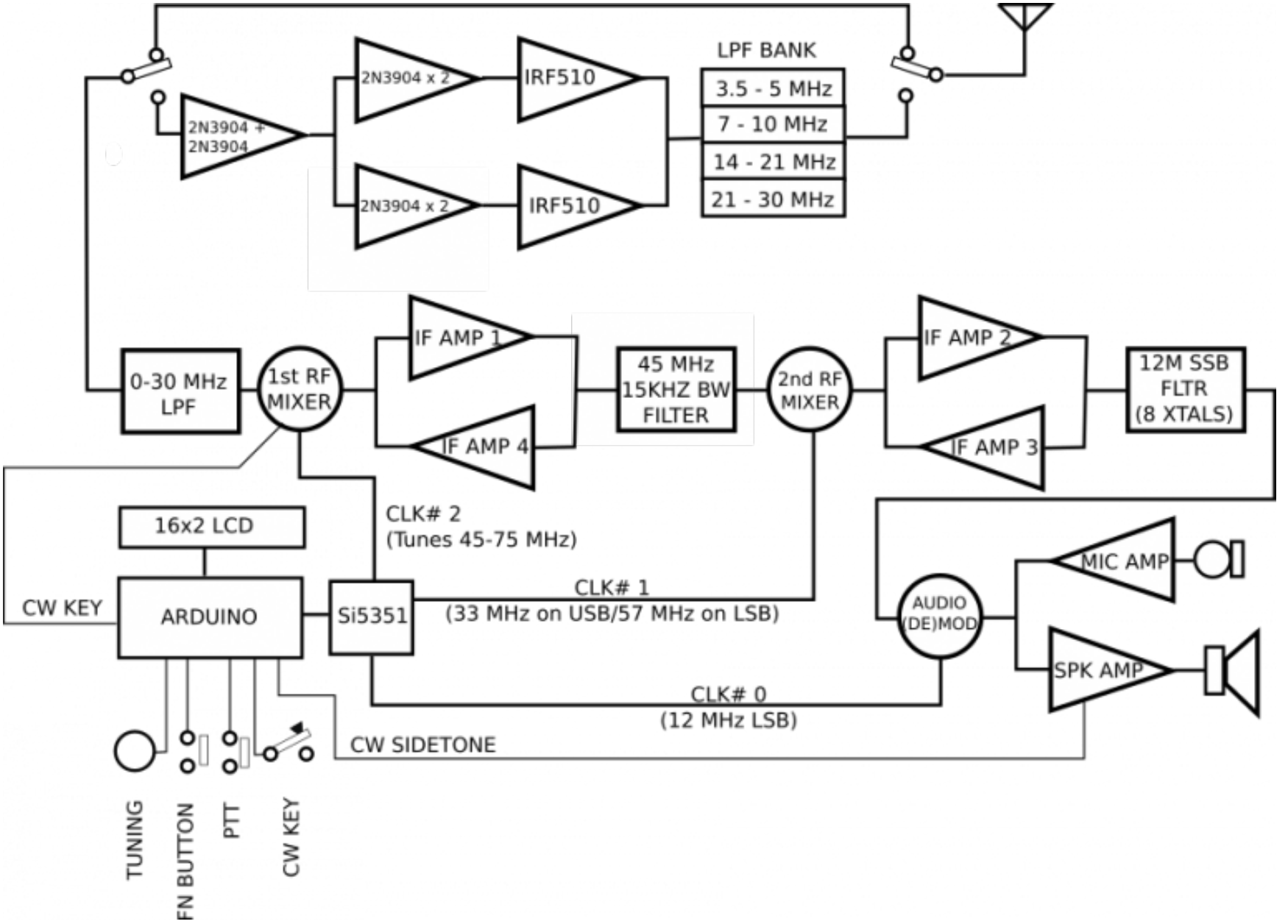


Test Result Summary

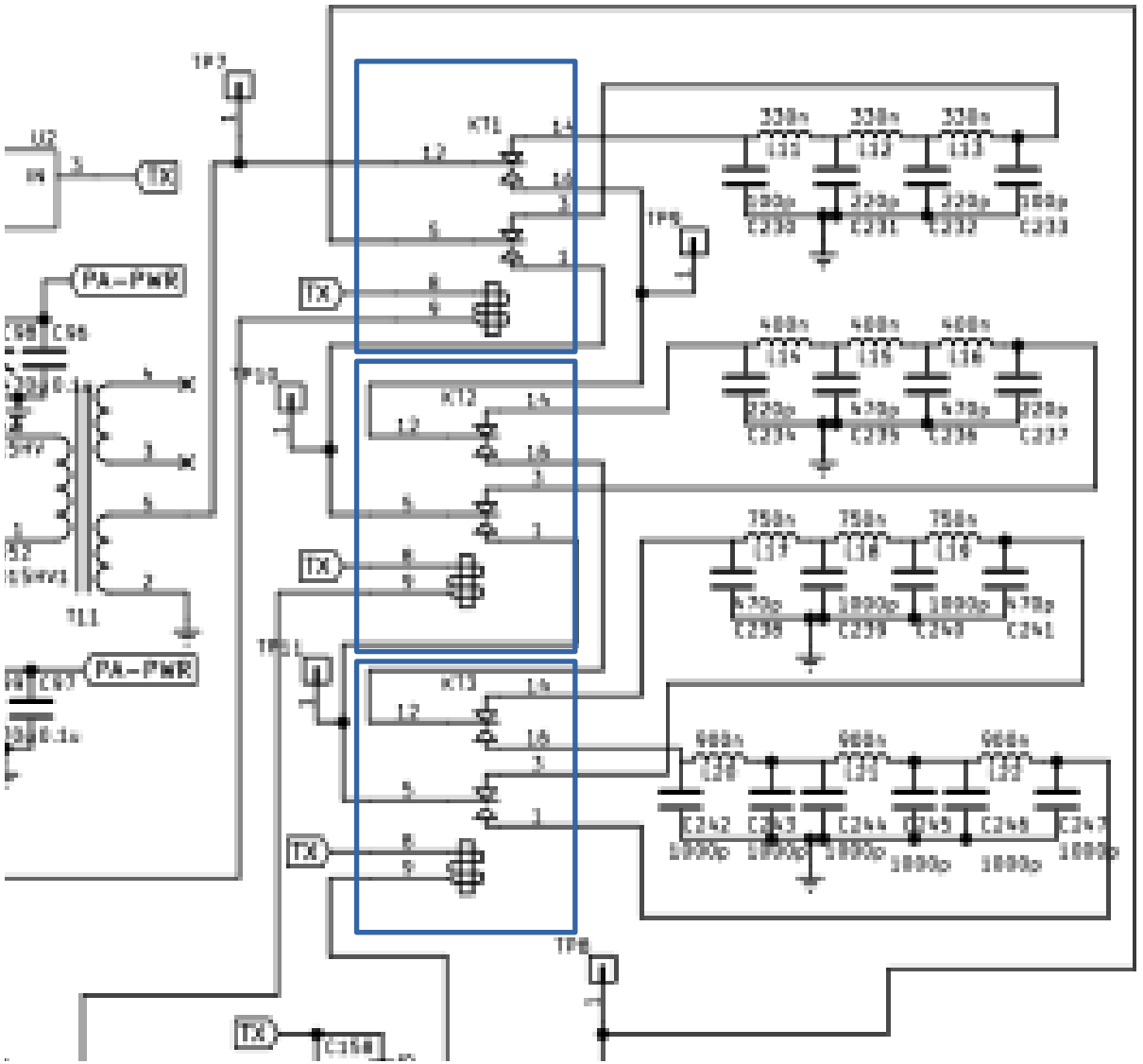
Band	SSB	CW
80	Good	Out of Spec Harmonics
40	Good	Out of Spec Harmonics
30	Out of Spec Harmonics & Spurs	Out of Spec Harmonics
20	Out of Spec Spurs	Good
17	Out of Spec Spurs	Out of Spec Harmonics
15	Out of Spec Spurs	Good
12	Out of Spec Spurs	Good
10	Good	Good

Potential Solutions
Harmonics

UBITX Block Diagram



UBITX Low Pass Filters



Currently, the low Pass Filter inputs and outputs for each frequency range are routed through the same, small relay. Capacitive coupling between the relay structures is limiting the effectiveness of the filters.

Adding a daughter board with three more relays to allow for switching of filter inputs and outputs using separate relays has been shown to fix the harmonic problem by eliminating this leakage path.

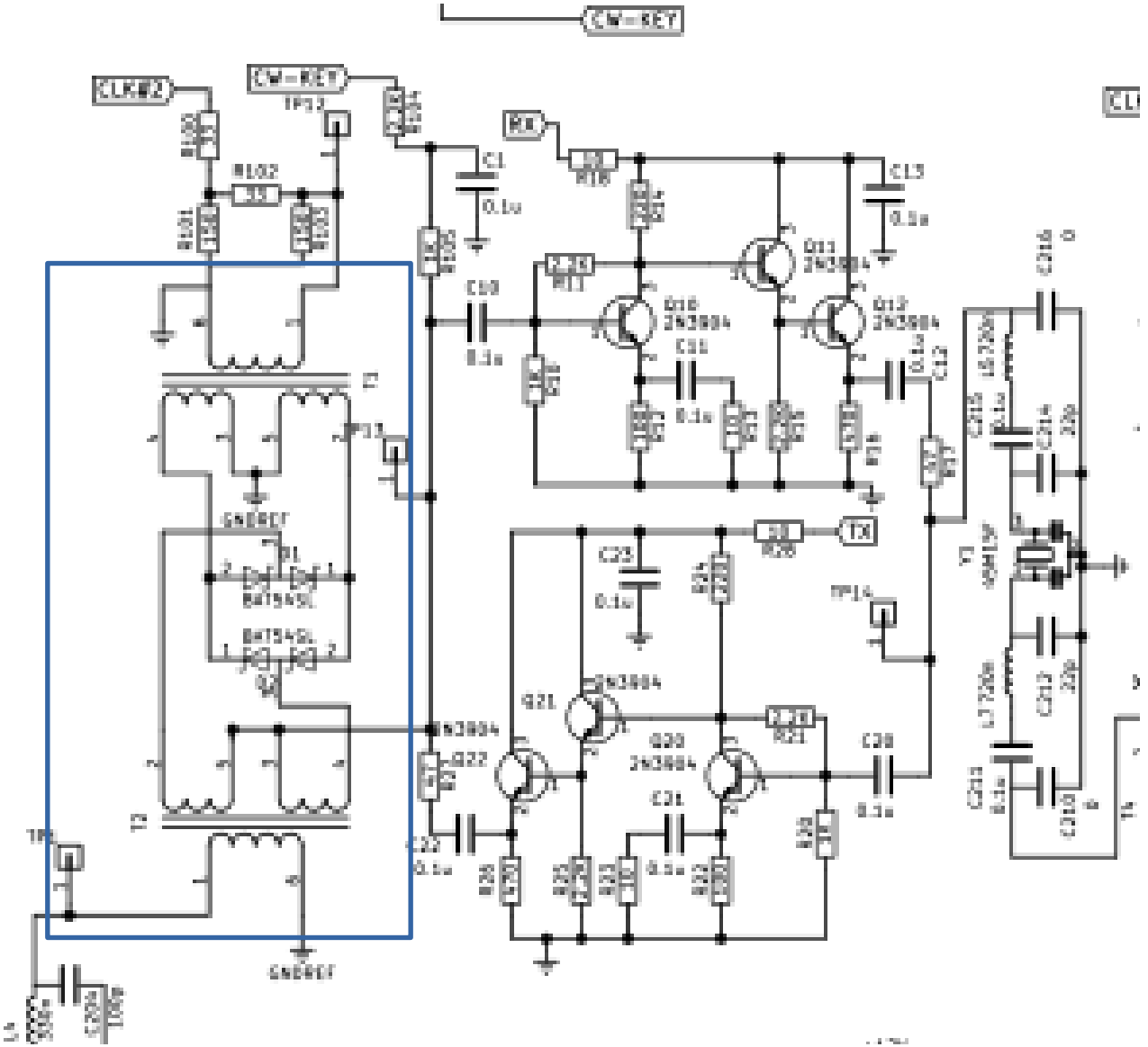
Cost $15.00 - $20.00.

Other approach is to reduce drive in CW mode.

Cost – Free.

Potential Solutions
Spurs

UBITX Transmit Mixer



45 MHz Transmit Mixer is picking up RF energy from the transmitter final amplifier, and is being overloaded, resulting in spurs.

Solution #1 – Add a 45 MHz filter. Good results have been reported by replacing C22 with this filter.

Cost $6.00 - $8.00

Other solutions worth looking at:

Add shielding around the mixer; improve TX Power filtering into the mixer.

Cost – $2.00

uBITX Ordering Summary
From August

Call Sign	BitX40	uBITX	Either	Case	Color
N8PK		2		2	
KE3FL		1			
AA3DA		1			
WB8YYY		1			
W3DVG		1			
W8IS		1			
K3TNV		1		1	
KB3SRU			1		
N3JET			1		
K3ZE		1			
WV3S		1		1	
KI4USA		1		1	Grey
KV3LPJ		1		1	
N3III		1		1	
N4EOC		1			
KC3FDL		1		1	Grey

Discussion:
Do we proceed with the group order?

Questions?