FTDX5000 Progress Report

Test Setup

- This is a report on my occupied bandwidth measurements of a neighbor's FTDX5000, both before and after implementation of Yaesu's September 2014 firmware update. I've chosen the slide show format to display it because it's the best way I can think of to compare the data.
- The test setup is described in some detail. I've chosen the P3/SVGA as a measurement platform because it offers far better frequency resolution than either my HP 8590D or my Rigol analyzer, and because its dynamic range is sufficient to clearly show differences between rigs that matter on the air.

Test Setup

- **My testing is not about “specsmanship.” I do not currently have the capability to measure phase noise at the levels that matter at a multi-transmitter site.**
- **This set of measurements is intended to answer the question, “will I be a good neighbor using one transceiver as opposed to another.” Many feature descriptions and specifications are needed to characterize a good radio. I’m focusing here on only one that, while very important, has been ignored for too long.**

Test Setup To Measure K3

- Two K3s with P3/SVGAs in SO2R setup
- #1 K3 transmits to 500W dummy load
- High isolation tapoff in line fed K3 #2
  - 20 dB attenuator added at tapoff for power amps
- LP100A wattmeter in line, set for peak reading
  - Listed power is from LP100A
- Power for K3s provided by 2-6V 220Ah golfcart batteries with solar and line powered charging
  - DC voltage under load 12.6 – 13 VDC

Test Setup To Measure K3

- Pink noise from 11 kHz .wav file drives K3 Line Input via Tascam US100 USB interface
- Value of compression noted is that indicated by peak value of K3 LED bar graph for Compression
- K3 TXEQ set for full cut (-16dB) of 50 Hz, 100 Hz, 200 Hz octave bands, 3dB cut of 400 Hz band, 3dB boost of 3.2 kHz 2/3 octave band
- CW test signal a string of dits from internal keyer
- Keying speed in the range of 30 wpm

Test Setup For Other Rigs and Amplifiers

- KPA500 and Ten Tec Titan are part of my SO2R setup, so were switched on when desired.
- Other rigs are tested by substituting them for #1 K3 in the test setup

P3 Setup

- Two different SVGA monitors were used, screen captures are different for the two
  - Started with 1024x768 normally used in SO2R setup
  - Switched to higher resolution monitor for later measurements, and all subsequent measurements use the higher resolution monitor
- On SSB, receiving K3 tuned to same frequency as TX K3, so that cursor indicates carrier frequency
- On CW, receiving K3 purposely tuned a bit off frequency so that RX frequency cursor does not obscure peak of wavefrom
- Blue traces are accumulated peaks

Post Measurement Analysis

- **Using the cursor to read frequency, recorded bandwidth at selected values of dBC for CW and dB re: peak for SSB, RTTY, and PSK31. With the higher resolution monitor, the readout is in 1 Hz increments for the span widths used**
- **This procedure was adopted and refined after many of the earlier measurements of the K3, so not all data includes these annotations.**

Measurement Conditions Chosen

- **Distortion in linear amplifiers can vary both with drive level and DC supply voltage.**
- **I tested at rated power, and at reduced power levels typically used to drive a linear amplifier. The KPA500 requires about 30W for rated output; my Ten Tec Titans 40-60W.**
- **The K3 was tested at these levels.**
- **The FTDX5000 was tested at 50W, 100W, and 200W.**

Rigs Chosen For Measurements

- I've tested the rigs I own and those widely used by contesters that I've been able to borrow
- I would like to measure current ICOM and Kenwood models.
- I am especially interested in W9AC's testing of the new Flex 6000-series rigs with the latest firmware. ARRL Lab tests done with earlier firmware showed extremely poor occupied bandwidth performance, and a recent software update is reported to have significantly improved it.

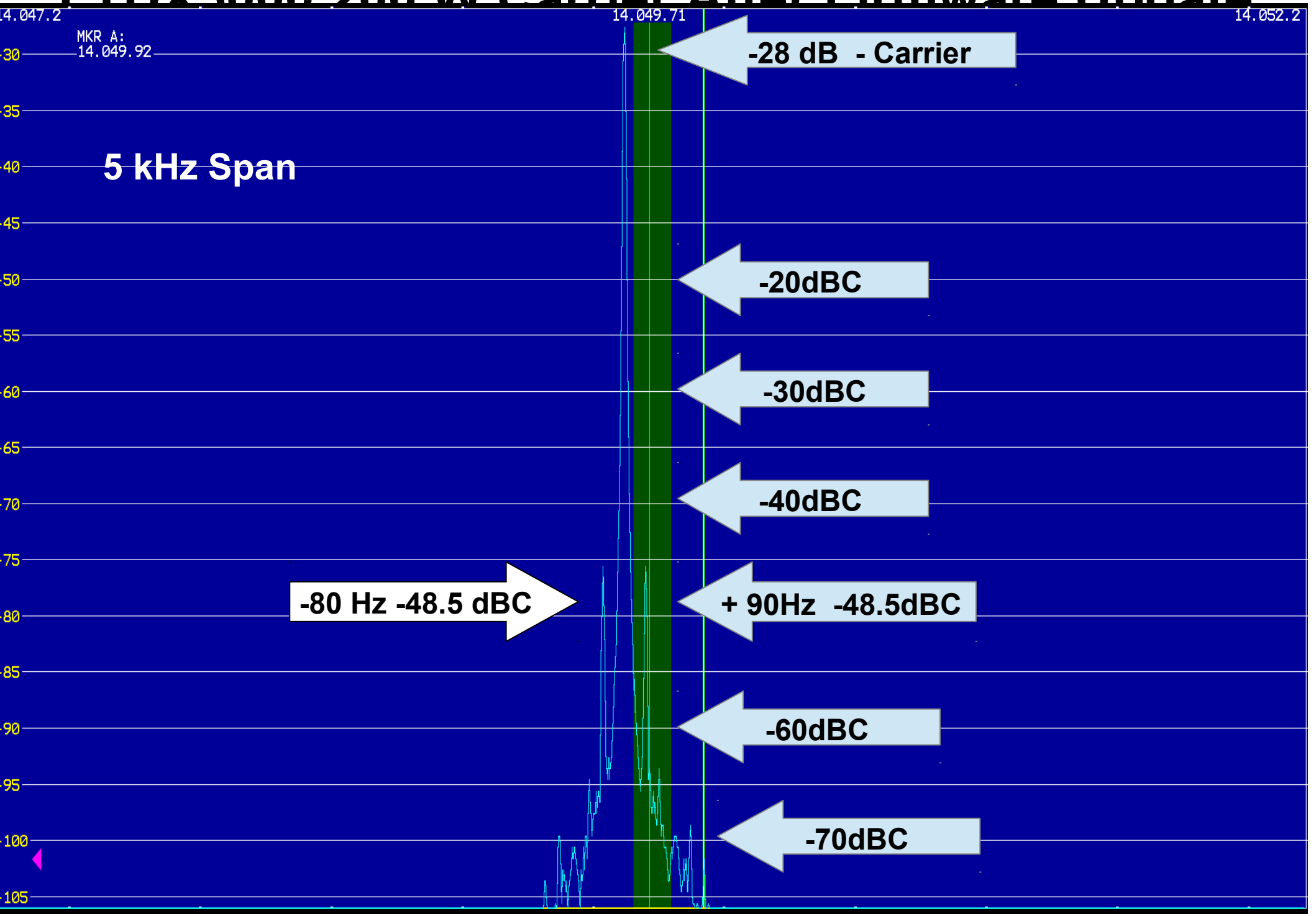
FTDX5000 Test Setup

- Pink Noise Fed to Mic Input from Numark USB audio adapter
- Processing Turned Off
- Class A Mode Off except as noted
- CW sent as a string of dits using internal keyer
- No VOX or QSK, TX initiated by front panel
- This rig was loaned by N6TA, who bought it new, and assisted with testing
- Unit was tested before and after installation of the Sept 2014 firmware update

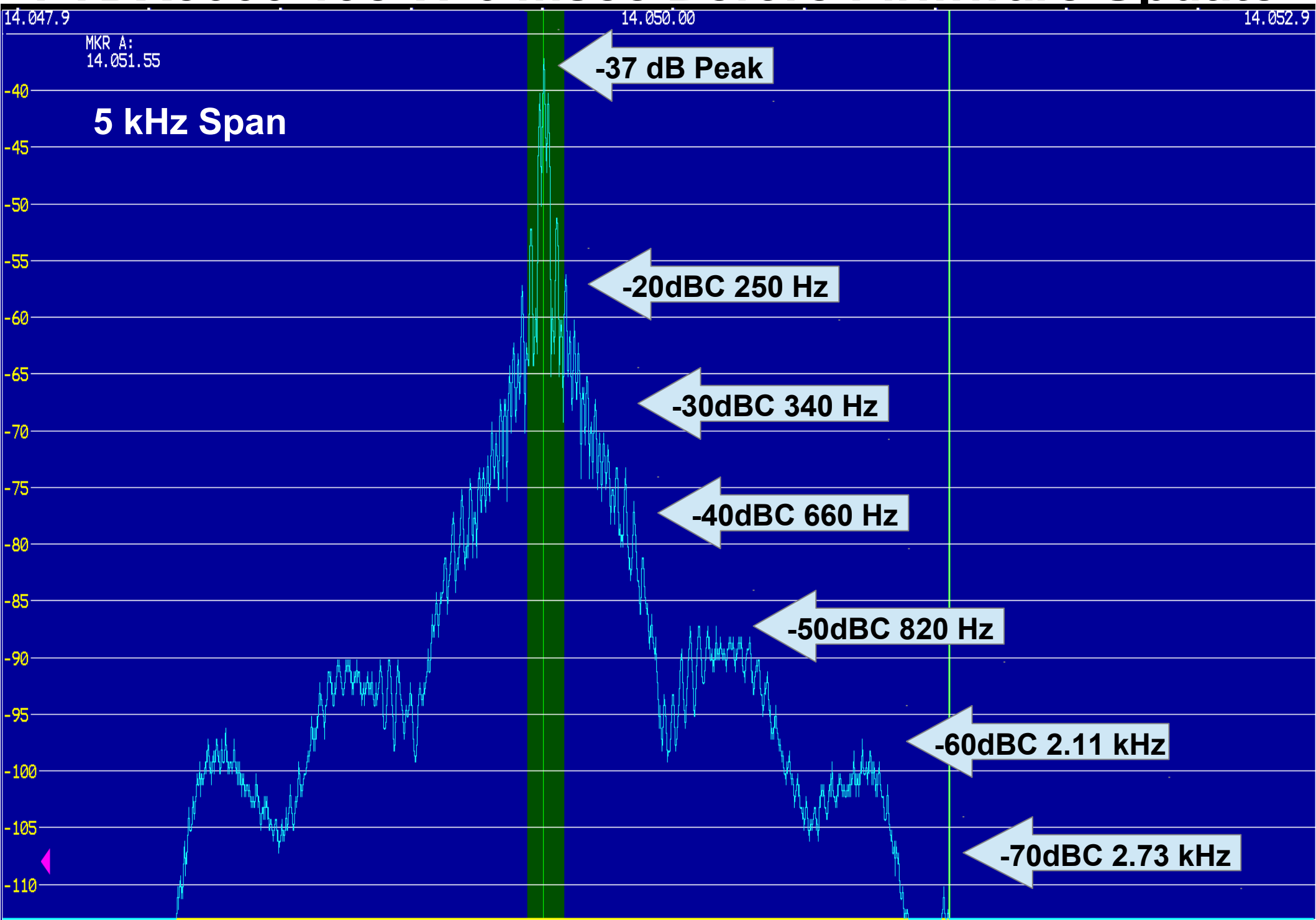
How Good Is the Measurement System?

- See the following data for the FTDX5000 with continuous carrier at 200W
  - Strongest responses are -48.5 dBC at -80 Hz, +90 Hz
  - Next strongest are -64dBC at -130 Hz, +140 Hz
  - Next strongest are -70dBC at -295 Hz, + 310 Hz
- These responses may be in the DUT or the measurement system
- It is clear that the measurement system is good enough – even if all of the spurious responses are in the measurement system (i.e., the transmitter is a pure sine wave with no noise), the strongest are at least 20 dB below the signals being measured

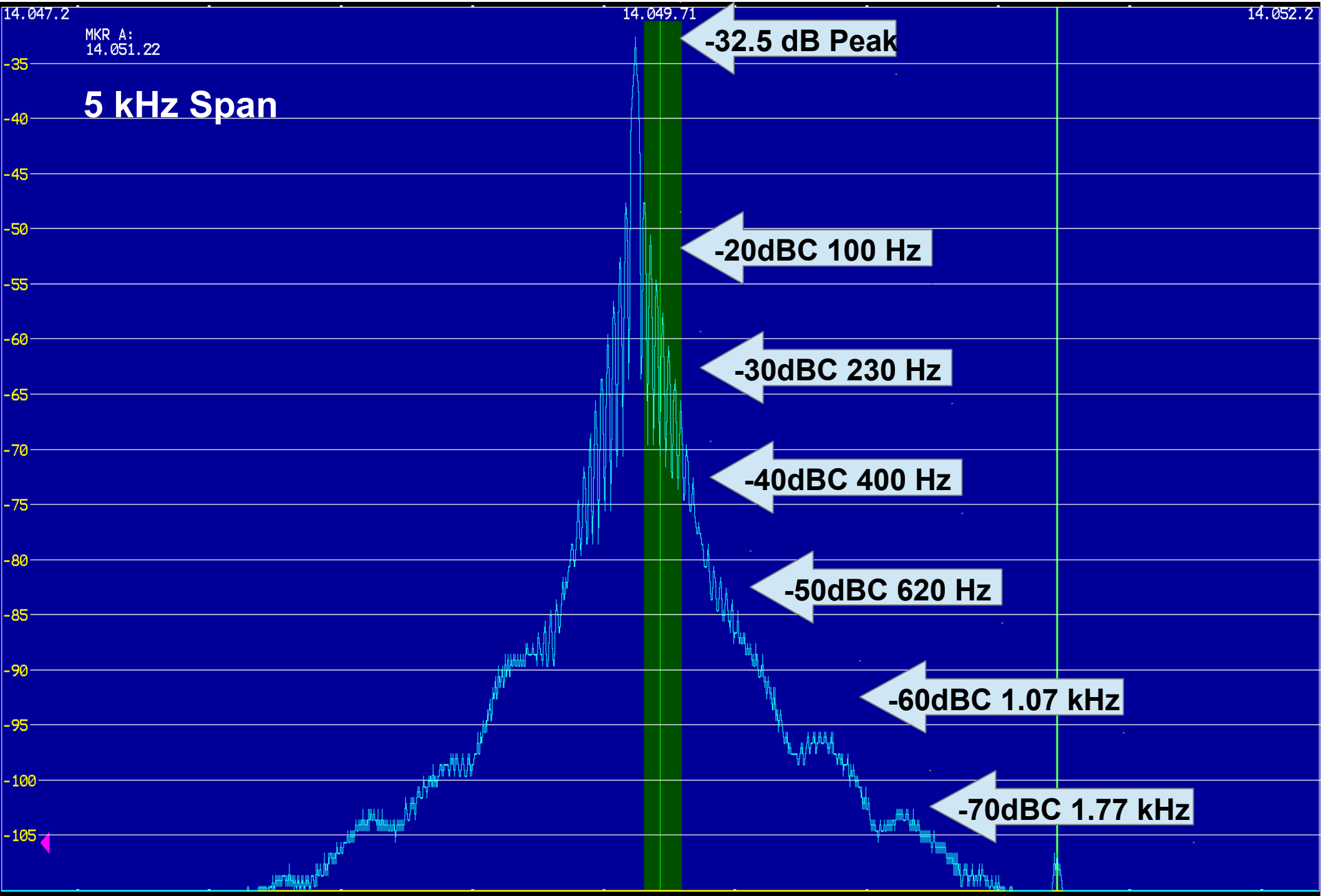
FTDX5000 200 W Carrier After Firmware Update



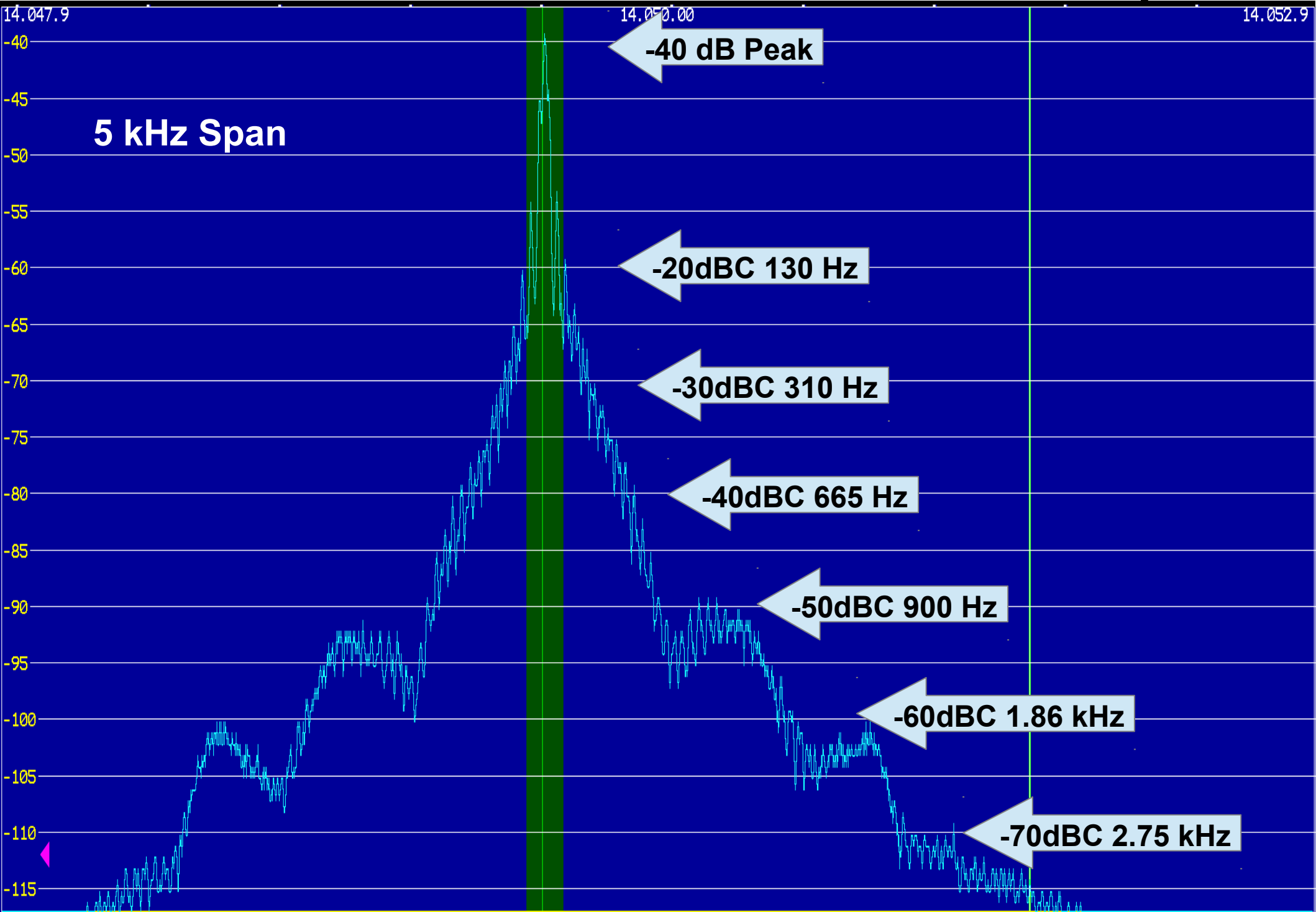
FTDX5000 198 W 6 msec Before Firmware Update



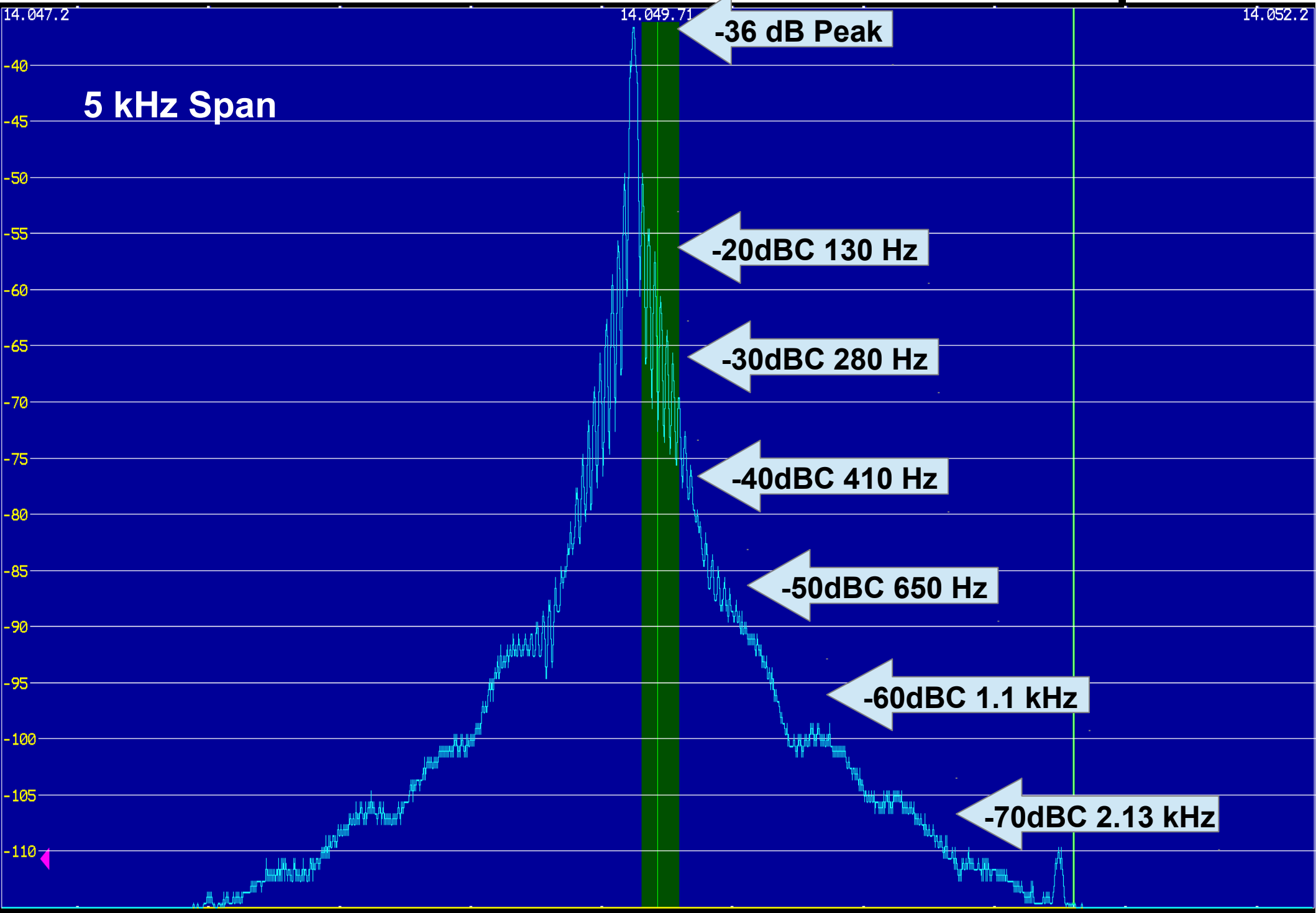
FTDX5000 198 W 6 msec After Firmware Update



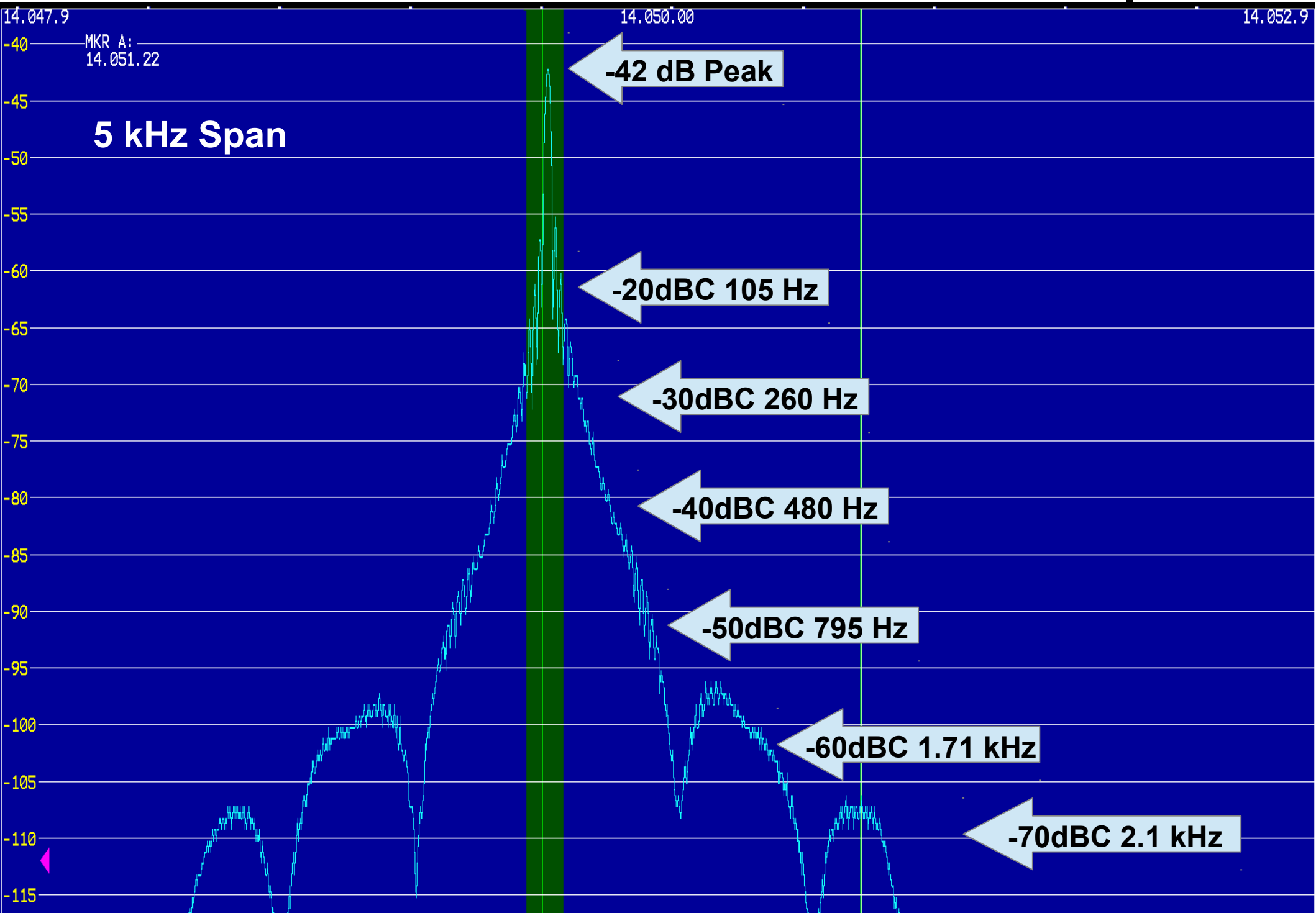
FTDX5000 100 W 6 msec Before Firmware Update



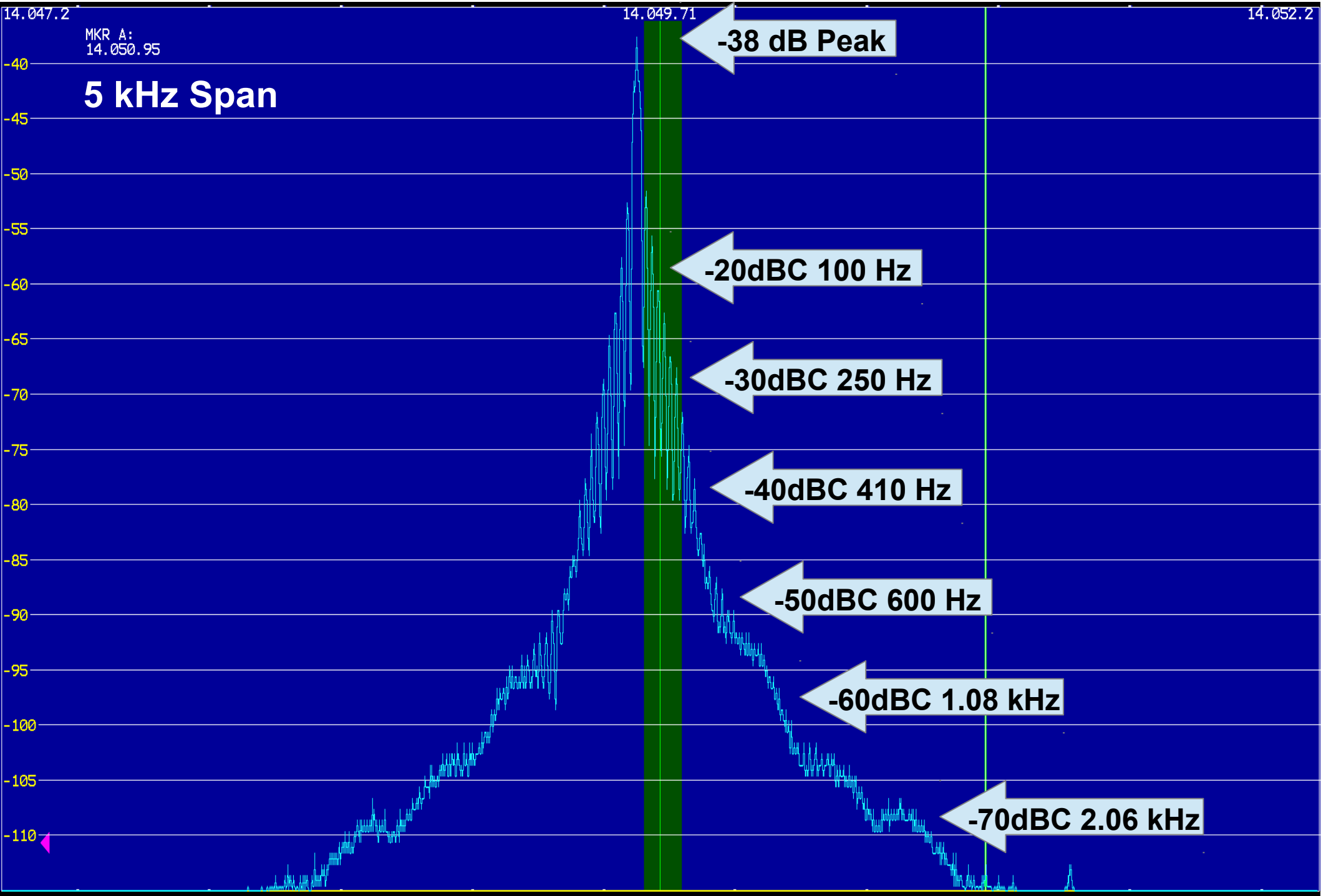
FTDX5000 100 W 6 msec After Firmware Update



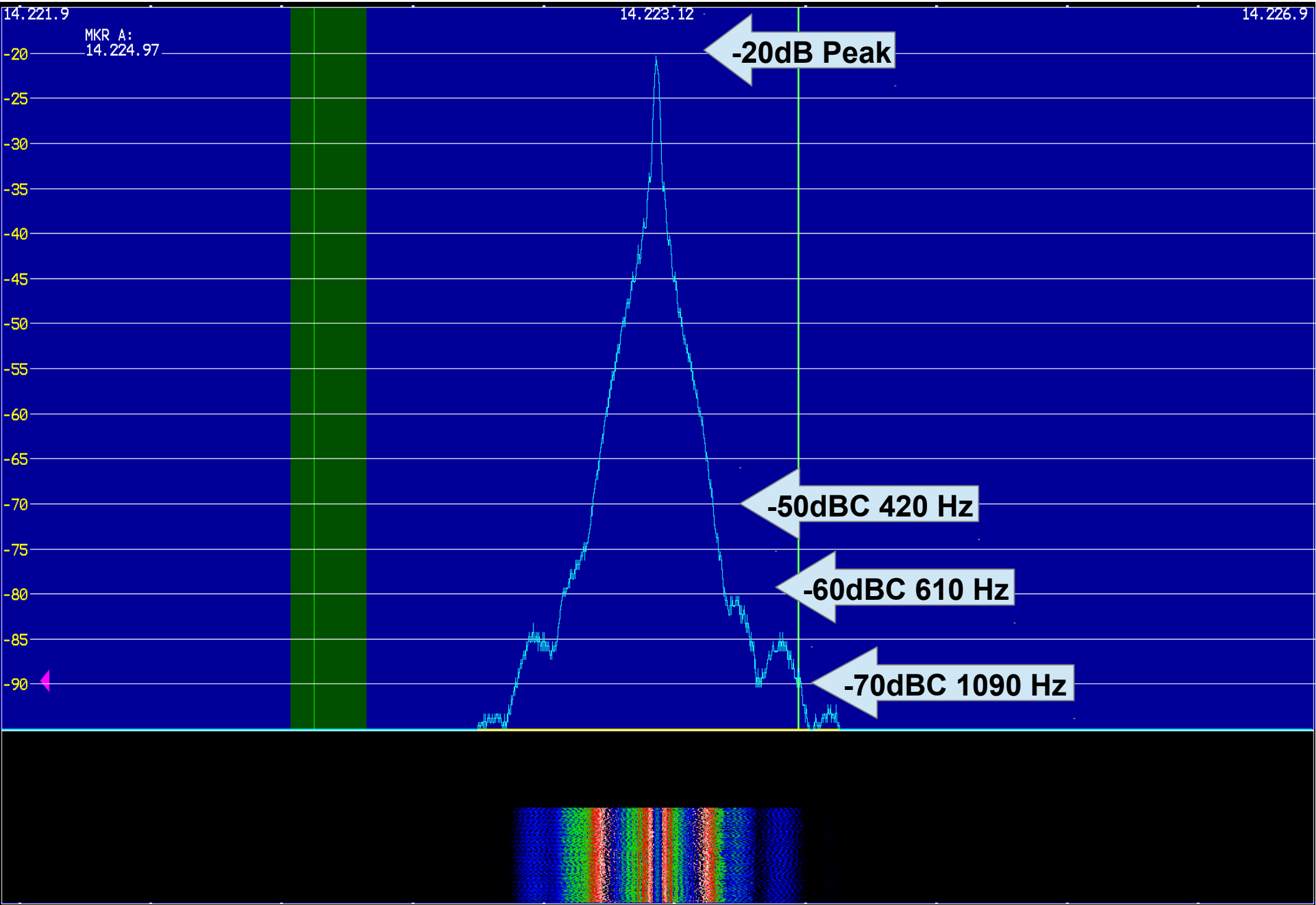
FTDX5000 50 W 6 msec Before Firmware Update



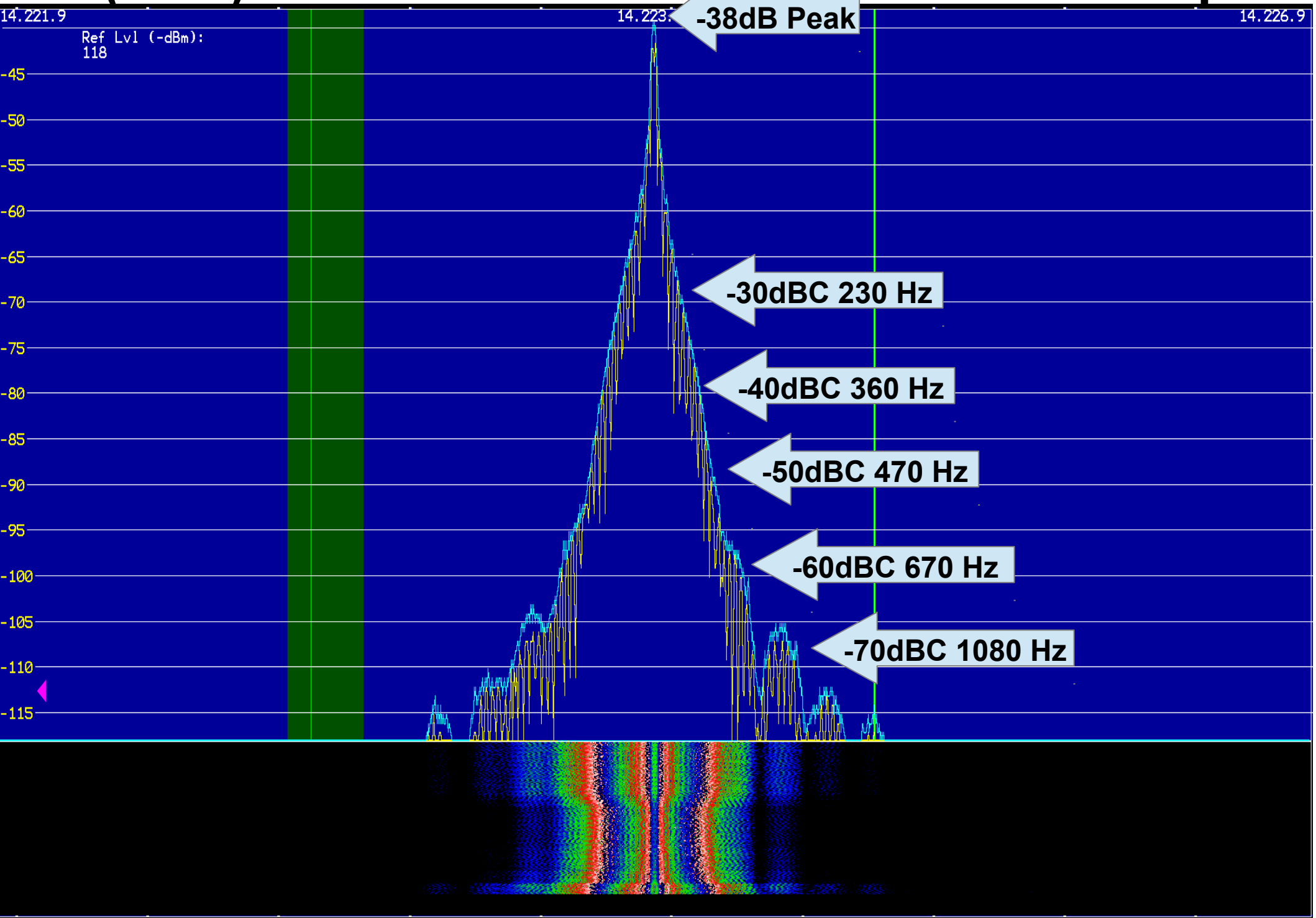
FTDX5000 50 W 6 msec After Firmware Update



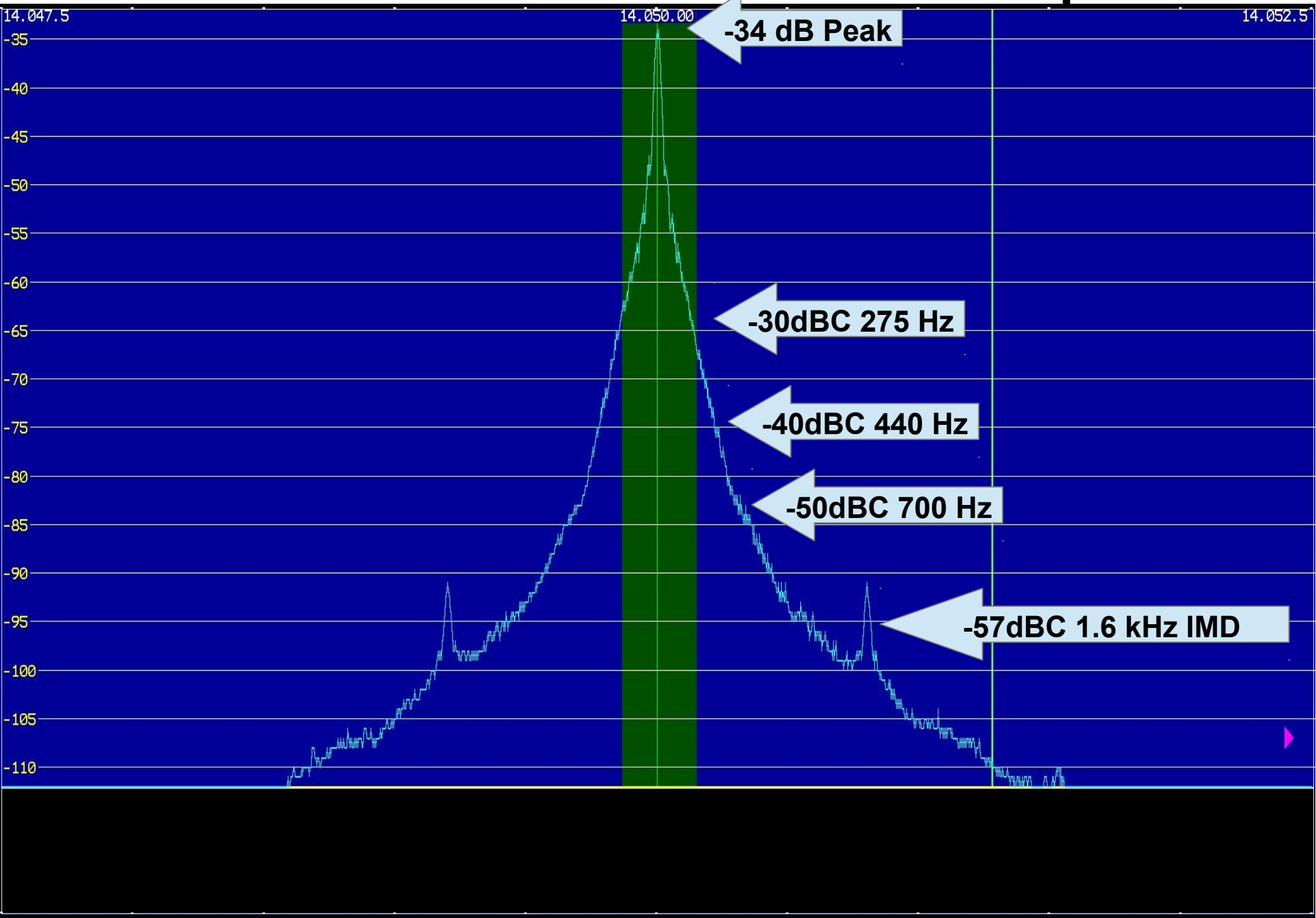
K3-KPA500 550W CW 5kHz Span



K3 (40W)-Ten Tec Titan 425 1500W CW 5 kHz Span



K3 to ACOM 1010 675W CW 5 kHz Span



FTDX5000 Observations - CW

- **CW Bandwidth is significantly reduced by the Sept 2014 update**
  - **The greatest improvement is at 200W, and for the lower amplitude sidebands**
  - **The update bring the FTDX5000 bandwidth closer to the the IC7800 and 7600**
  - **The improvement might best be described as a reduction in the higher order harmonics that excite IMD to produce the more widely spaced sidebands**
  - **CW bandwidth is now nearly the same at 50W, 100W, and 200W**
- **Thanks to N6TA for the loan of his FTDX5000, and for assisting with the measurements**

FTDX5000 Observations - CW

- The updated rig is not “nearly as good” as a K3 at the power levels needed to drive a power amp
- Data for the K3 driving a KPA500 and Ten Tec Titan to rated power show a much reduced sidebands at -50 dBC and below. These are pretty clean amplifiers, and their spectrum plots are nearly identical to the K3 barefoot at the required drive levels.
- The ACOM 1010 is not as clean as the other two amps.

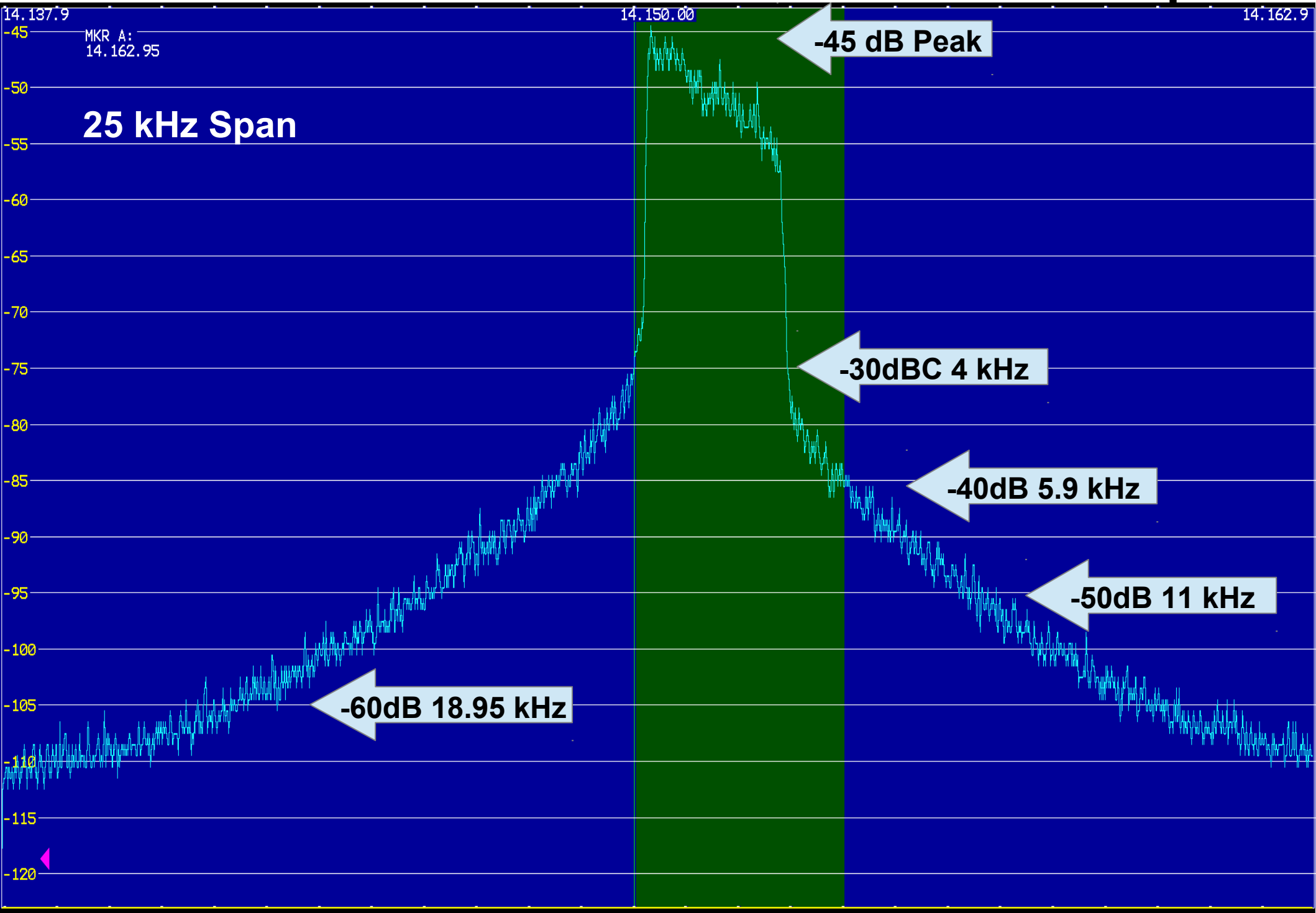
FTDX5000 Observations - SSB

- **Because the firmware update was described as addressing CW bandwidth issues, only CW performance was measured after the update.**
- **Occupied bandwidth for 50W operating Class A with no signal processing is quite comparable to that of the K3 with 10 dB of compression. Occupied bandwidth in AB is significantly wider in the range of -50dB relative to peak**
- **These data make it clear that the FTDX5000 should always operate Class A when driving a power amp**

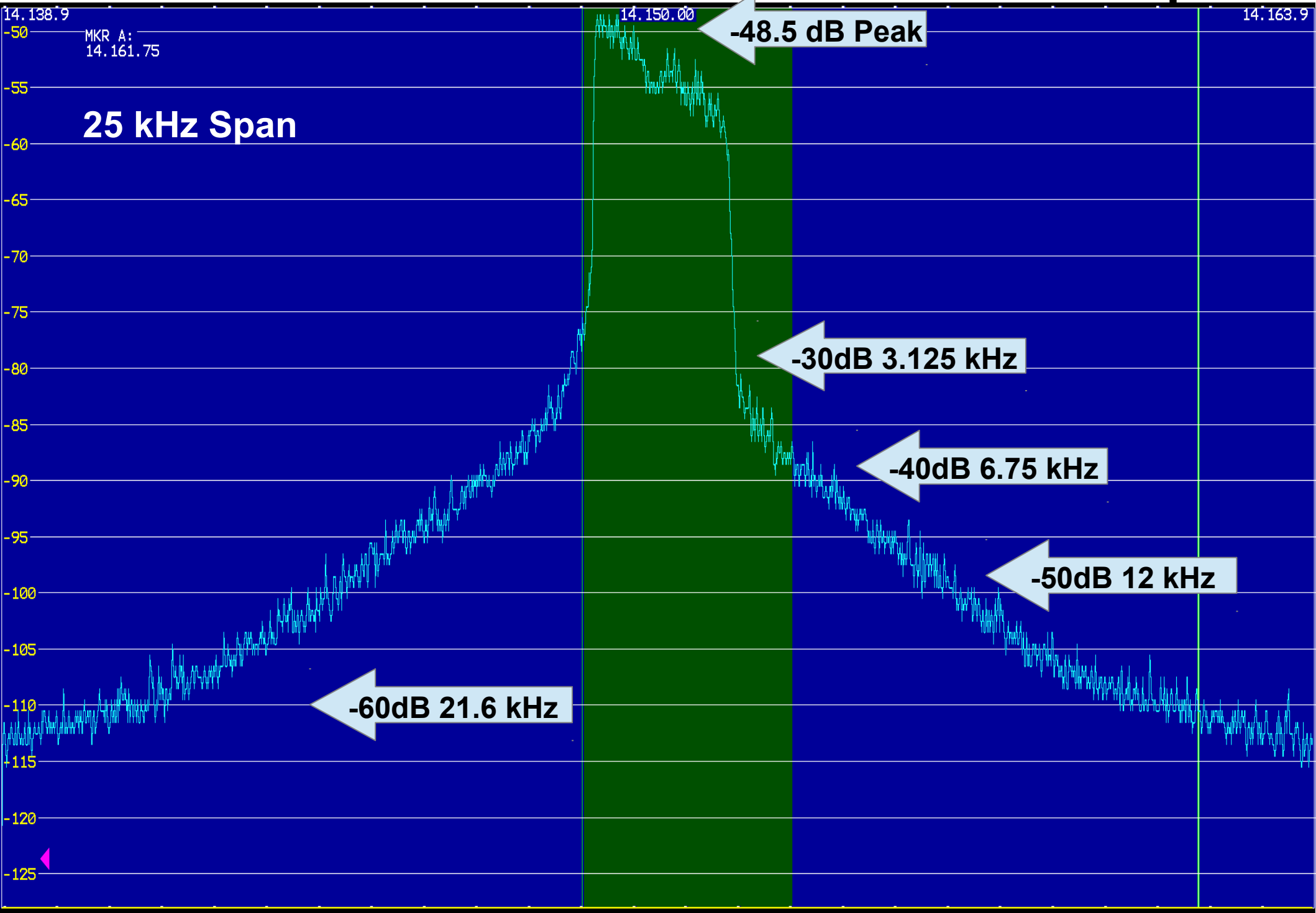
FTDX5000 Observations - SSB

- **The pronounced slope of the passband for the FTDX5000 is the result of little or no equalization in the audio chain. The response of the K3 is far less pronounced because the K3's internal equalizer was set to attenuate audio below about 400 Hz, which is how I use it with my microphone, a Yamaha CM500. Many popular ham mics, like the Heil mics, have some of this equalization built in.**

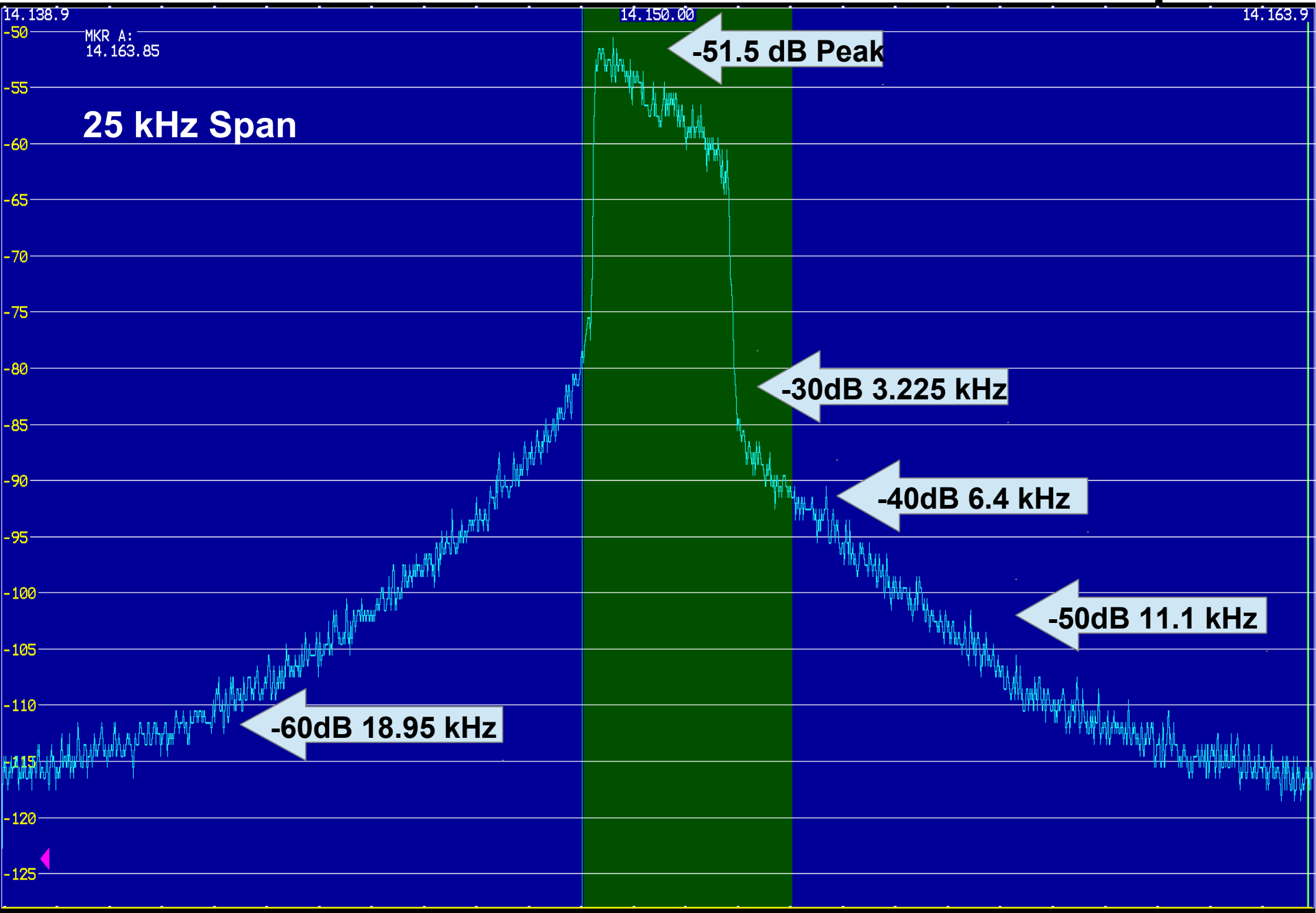
FTDX5000 194 W Pink Noise Before Firmware Update



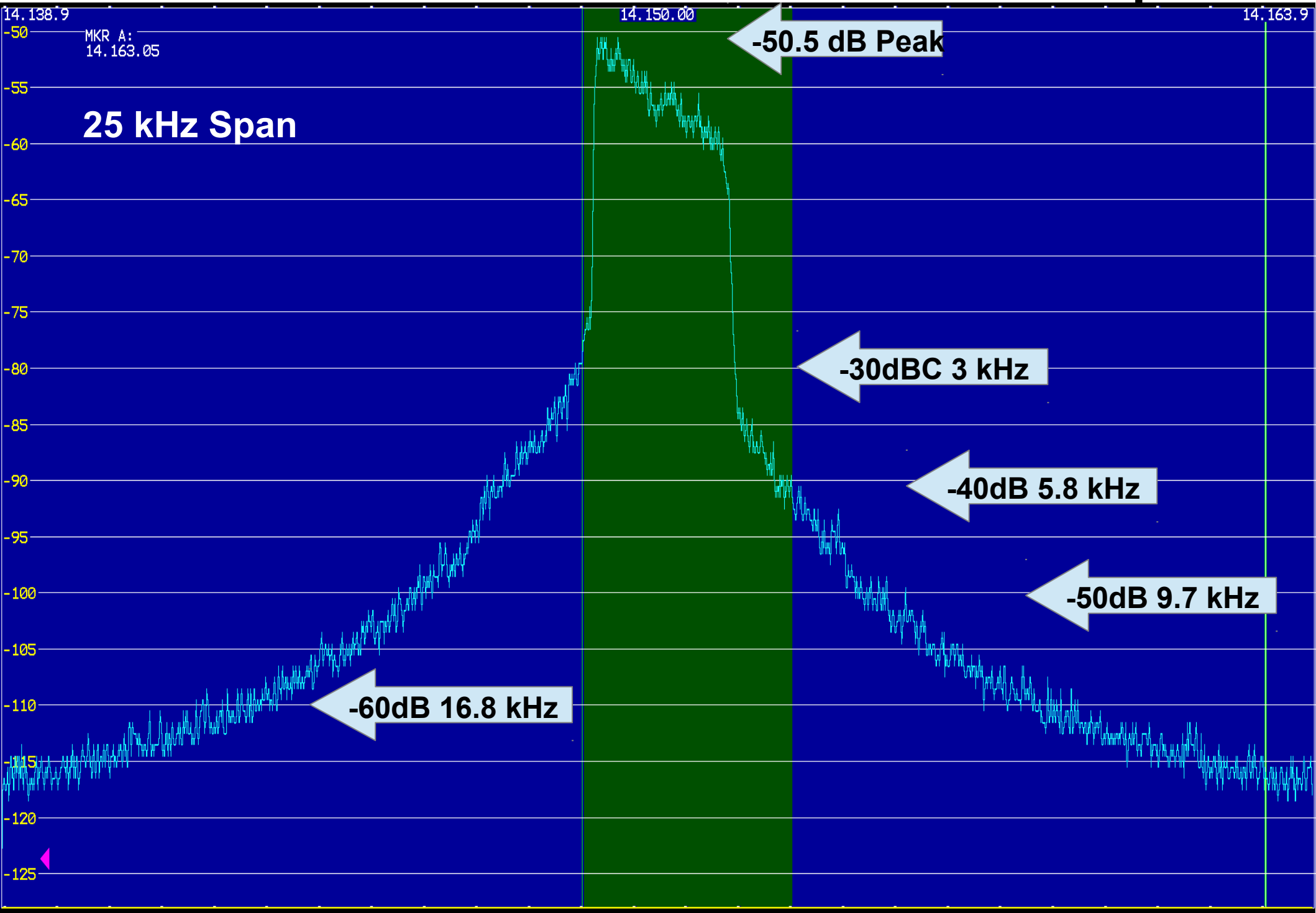
FTDX5000 100 W Pink Noise Before Firmware Update



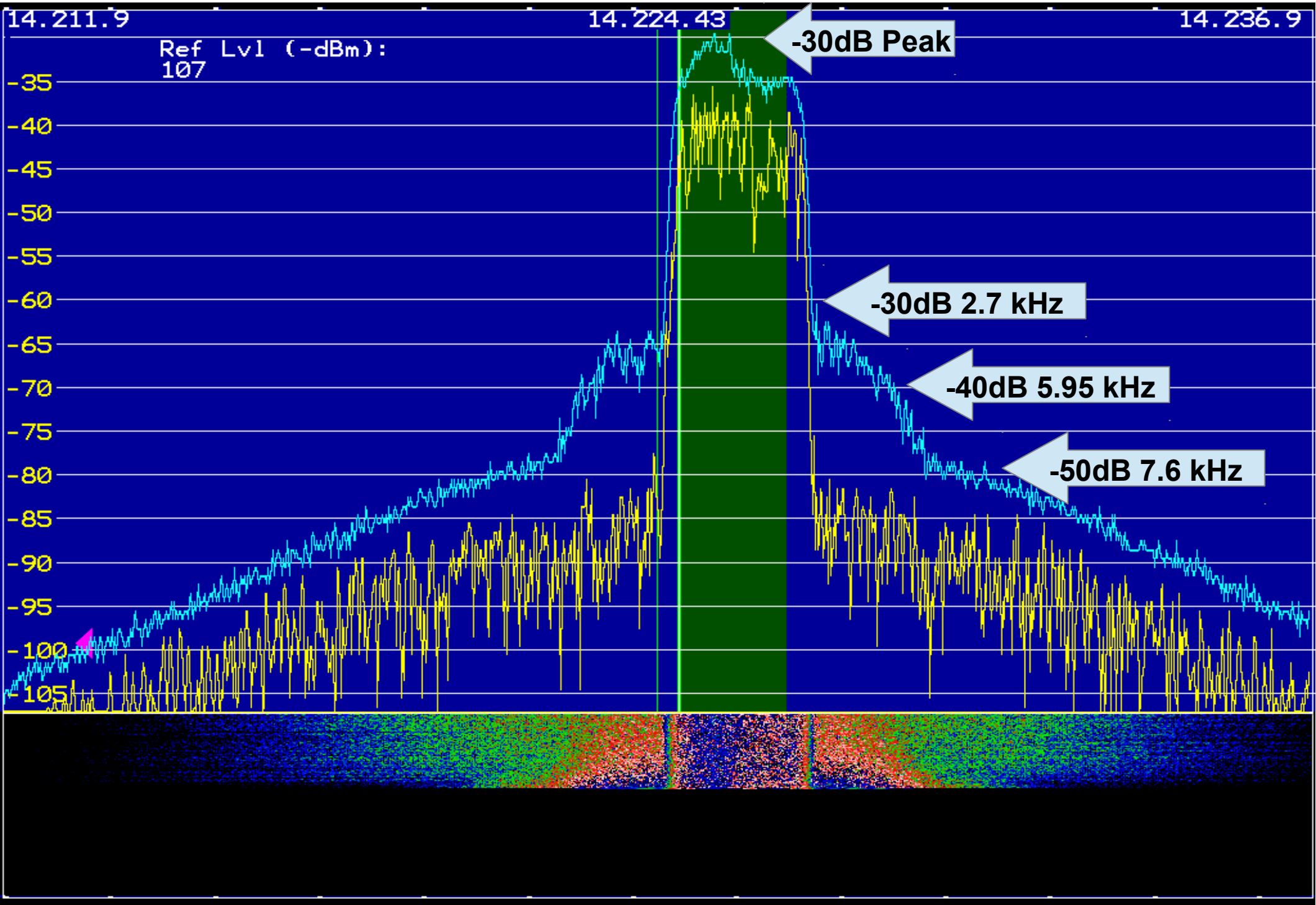
FTDX5000 50 W Pink Noise Before Firmware Update



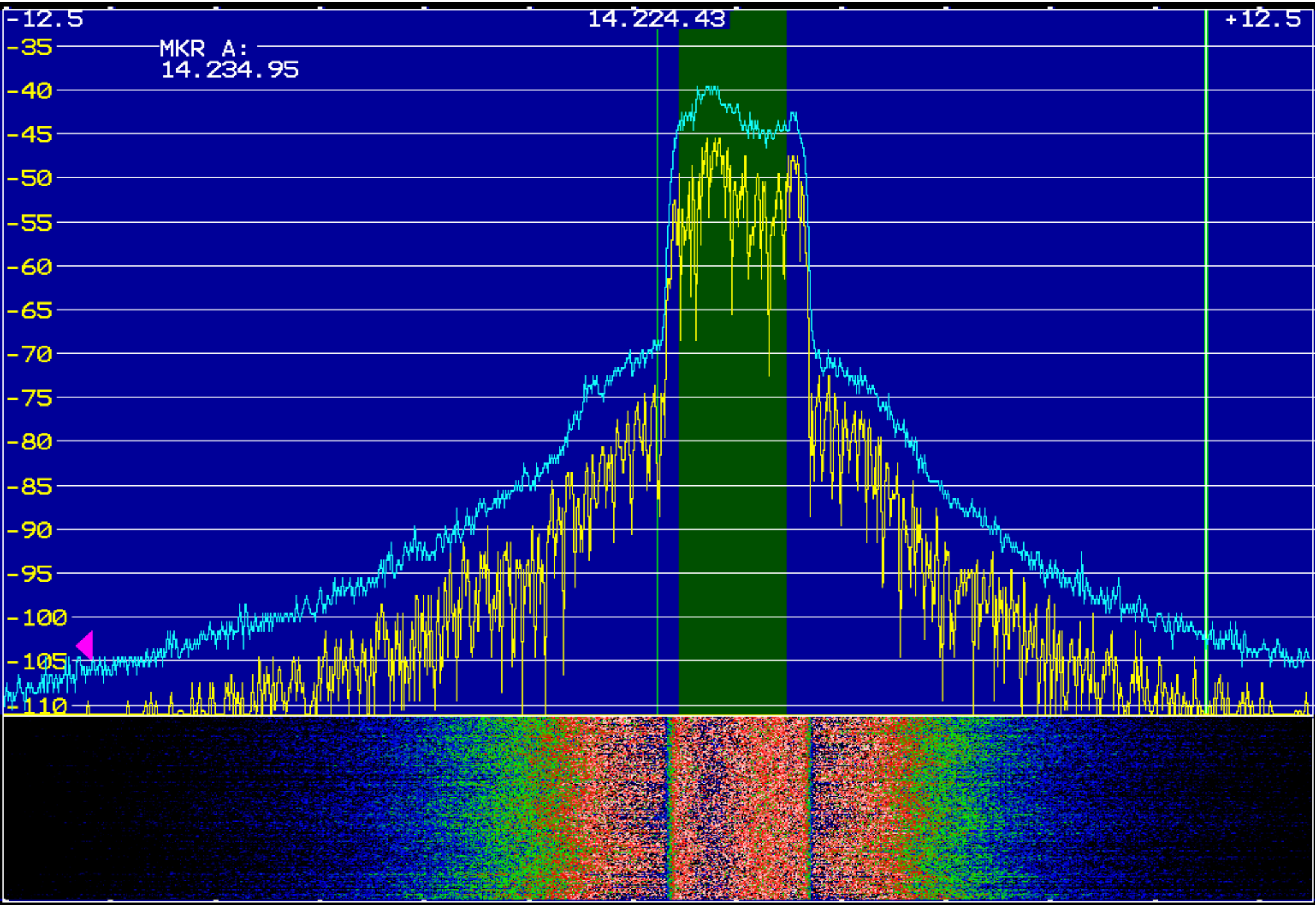
FTDX5000 50 W Class A Pink Noise Before Update



K3-KPA500 550W Pink Noise 10dB Compression



K3 100W Pink Noise No Compression



K3 30W Pink Noise 10dB Compression