Kit Building Committee Report

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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

- 50 ohms Dummy Load
- 50 Ohm Dummy Load
- Heathkit "Cantenna"
- 51 ohm Resistor
- 51k ohm Resistor
- 50 ohms To Transmitter
- 50 ohms To Spectrum Analyzer
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

<table>
<thead>
<tr>
<th>Frequency</th>
<th>CW Power Watts</th>
<th>SSB Power Watts</th>
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<td>7.050</td>
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</table>

• 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
80M CW

Out of Spec
Out of Spec

40M CW
Out of Spec

30M CW

Graph showing signal levels over time with peaks exceeding the Out of Spec threshold.
20M CW
Out of Spec

17M CW
10M CW
OK

80M SSB
Out of Spec

30M SSB
17M SSB

Out of Spec
Out of Spec

12M SSB
10M SSB
Test Results

Focusing on SSB
Sweep 0 – 50 MHz
Easier to read frequency of spurs
80M SSB Detail

[Graph showing signal strength with peaks and troughs across different frequencies]
Out of Spec

30M SSB Detail
Out of Spec

20M SSB Detail
Out of Spec

17M SSB Detail
Out of Spec

15M SSB Detail
12M SSB Detail

Out of Spec
10M SSB Detail

Graph showing signal strength over a frequency spectrum.
## Test Result Summary

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<tr>
<th>Band</th>
<th>SSB</th>
<th>CW</th>
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<td>Out of Spec Harmonics</td>
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<td>20</td>
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<td>17</td>
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<td>15</td>
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<tr>
<td>10</td>
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Potential Solutions
Harmonics
UBITX Block Diagram
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

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Discussion:
Do we proceed with the group order?

Questions?