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.
Update

• Modifications have been implemented on the uBITX to reduce harmonics and spurs:
  – A Daughter Board (designed by Gordon Gibby) has been added to the Low Pass Filter circuit, that switches filter inputs and outputs through separate relays, reducing harmonic leakage.
  – A 45 MHz filter and small impedance transformer (mod designed by Warren WA8TOD) have been added to the input of the last mixer to reduce overload from the high power amplifier, reducing spurs.
<table>
<thead>
<tr>
<th>Band</th>
<th>SSB</th>
<th>CW</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>Good</td>
<td>Out of Spec Harmonics</td>
</tr>
<tr>
<td>40</td>
<td>Good</td>
<td>Out of Spec Harmonics</td>
</tr>
<tr>
<td>30</td>
<td>Out of Spec Harmonics &amp; Spurs</td>
<td>Out of Spec Harmonics</td>
</tr>
<tr>
<td>20</td>
<td>Out of Spec Spurs</td>
<td>Good</td>
</tr>
<tr>
<td>17</td>
<td>Out of Spec Spurs</td>
<td>Out of Spec Harmonics</td>
</tr>
<tr>
<td>15</td>
<td>Out of Spec Spurs</td>
<td>Good</td>
</tr>
<tr>
<td>12</td>
<td>Out of Spec Spurs</td>
<td>Good</td>
</tr>
<tr>
<td>10</td>
<td>Good</td>
<td>Good</td>
</tr>
</tbody>
</table>
## Test Result Summary - Modified

<table>
<thead>
<tr>
<th>Band</th>
<th>SSB</th>
<th>CW</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>40</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>30</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>20</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>17</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>15</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>12</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>10</td>
<td>Good</td>
<td>Good</td>
</tr>
</tbody>
</table>
uBITX Low Pass Filters

The stock 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.

Note: The board tested was wired in using unshielded wire. Further improvements are expected when shielded coax is used to connect this daughter board to the uBITX.
uBITX Transmit Mixer

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

Adding a 45 MHz filter has been shown to reduce the spurs.

Note: An alternative solution, replacing L5 and L7 – currently toroids – with chip inductors, has recently been proposed. Parts have been ordered, but this solution has not yet been tested.
Recap
uBITX measurements prior to modifications
Out of Spec

20M SSB Stock
Out of Spec

17M SSB Stock

[Graph showing data points and a green line indicating out of spec values]
Out of Spec

12M SSB Stock
10M SSB Stock
Out of Spec

80M CW Stock
Out of Spec

40M CW Stock
30M CW Stock

Out of Spec
17M CW Stock

Out of Spec
12M CW Stock
uBITX measurements after modifications
40M SSB Modified
20M SSB Modified
17M SSB Modified

OK
15M SSB Modified
12M SSB Modified

[Graph showing signal levels with a green 'OK' box on the top left]
OK

10M SSB Modified
80M CW Modified
30M CW Modified

OK
20M CW Modified
12M CW Modified
10M CW Modified