

McHF Spectral Purity Tests

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These spectral purity tests were made after all alignment and adjustment procedures had been performed, at the five watt level on a stock Version 6 McHF transceiver, using a 40 dB Tap and a Rigol DSA815 Spectrum Analyzer.

The requirement in the US is that all spurious output be at least 43 dB below the fundamental.

Test results showing harmonic levels as compared to the fundamental:

	2nd	3rd	4th
1.8 MHz	-20 dBC	-19 dBC	-47 dBC
3.5 MHz	-41.5 dBC	-69 dBC	
5.251 MHz	-32.3 dBC	-73 dBC	
7 MHz	-52 dBC	-71 dBC	
10.1 MHz	-31 dBC	-79 dBC	
14 MHz	-62 dBC	-74 dBC	
18.1 MHz	-23 dBC	-59 DBC	
21 MHz	-32 dBC	-72 dBC	
24.9 MHz	-56 dBC	-70 dBC	
28 MHz	-57 dBC	-74 dBC	

McHF Version 6 transmitter spectral purity test conclusions:

Although it is "recommended" that an outboard Low Pass Filter be used with this rig if one wants to transmit in the 160 Meter band, it really should be absolutely required.

Of the nine HF bands for which output filters are supplied, only in four of those did it meet the current US requirement.

The requirement was met only on the 40 Meter, 20 Meter, 12 Meter and 10 Meter bands in this rig, which was built stock except for using four turns in the T7 secondary instead of three.

It gets close on the 80 meter band, with the second harmonic at -41.5 dBC, but needs help on the 60 Meter, 30 Meter, 17 Meter and 15 Meter bands.

In order to correct this situation, adjustment to the output filters was needed.

Having faced 2nd Harmonic problems in the past, I knew that often the second harmonic could be significantly reduced by paralleling one of the inductors in the output filter with a cap of a value that closely resonates it to the second harmonic.

Using this method proved to be completely successful with the 80 Meter, 60/40 Meter and the 30/20 Meter Filters.

There was almost complete success using this method with the 17/15/12/10 Meter filter. However, even with a carefully selected parallel cap value, the 10 Meter output was considerably reduced, down to 2.5 Watts. Here are the values used and their locations.

220 pF paralleled L21 in the 80 Meter filter.

150 pF paralleled L22 in the 60/40 Meter filter.

100 pF paralleled L23 in the 30/20 Meter filter.

56 pF paralleled L24 in the 17/15/12/10 Meter filter.

Test results below show harmonic levels as compared to the fundamental, with the above described parallel caps in place:

	2nd	3rd	4th
3.5 MHz	-55 dBC	-69 dBC	
5.251 MHz	-55 dBC	-70 dBC	
7 MHz	-71 dBC	-73 dBC	
10.1 MHz	-60 dBC	-73 dBC	
14 MHz	-62 dBC	-74 dBC	
18.1 MHz	-51 dBC	-64 DBC	
21 MHz	-55 dBC	-63 dBC	
24.9 MHz	-58 dBC	-67.7 dBC	
28 MHz	-54 dBC	-61 dBC	

With the added caps, which provide an easily accomplished, very simple solution, the rig now more than met US specs, except of course for 160 Meters, where an outboard filter is an absolute must.

If one doesn't care about the low power output on 10 Meters, with the sunspot cycle at its current low, these measures take care of the 2nd harmonic problem without having to re-design the current output filters.

MM0GYX designed an elliptical filter to replace the existing 17/15/12/10 Meter design, and the next step was to replace the original filter with his design and perform spectral purity tests with it in place. Please see his article in the files section for details.

After making the changes to the 17/15/12/10 Meter filter outlined in MM0GYZ's article, here are the results:

	2nd	3rd	4th
18.1 MHz	-53 dBC	-50 dBC	
21 MHz	-45 dBC	-64 dBC	
24.9 MHz	-49.7 dBC	-68.7 dBC	
28 MHz	-55 dBC	-48 dBC	
28.5 MHz	-52 dBC	-47 dBC	
29.0 MHz	-50 dBC	-44.59 dBC	
29.7 MHz	-46.45 dBC	-42.87 dBC	

Although the third harmonic is just barely below the - 43 dBC requirement at 29.7 MHz, this figure may change as the filter is improved so as to level the power output across the 10 Meter band.

That figure will also be affected by the drive level to the PA. Being careful not to overdrive it should help.

With the MM0GYX filter in place in my McHF, a version 6 with the 2/4 winding of T7, here are the power readings across the 10 Meter band on both 5W and Full power settings:

	5 Watts	Full Power
28.0	5 Watts	7.4 Watts
28.5	4.5 Watts	5.6 Watts
29.0	2.65 Watts	3.25 Watts
29.7	.9 Watts	1.0 Watt

Although further work is needed so as to increase the passband of this filter, it does a good job of containing the harmonics of the four bands it is being asked to handle, and I would like to thank MM0GYX for his work.

In summary:

Although initial testing of the rig's transmitter output was disappointing, the fix is easy on three of the four output filters.

Simply installing the parallel caps detailed below should bring the McHF's transmitter well into specs on 80 through 20 Meters.

220 pF paralleled L21 in the 80 Meter filter.

150 pF paralleled L22 in the 60/40 Meter filter.

100 pF paralleled L23 in the 30/20 Meter filter.

If you don't want to go to the trouble of replacing the parts in the 17/15/12/10 Meter filter, and don't mind the 2.5 Watt output on 10 Meters while the sunspots are so low, you can install a 56 pF in parallel with L24 and the harmonics on all four of those bands will be well within specs.

73,

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