

## New Life for the Johnson Matchbox

John Meade W2XS

The Johnson Matchbox is still preferred by many operators who use balanced line to feed their antennas. However, like everything else in life, there are pros and cons to this venerable workhorse.



### Pros

- Very good balance
- Low insertion loss
- Conservative power rating of 250W
  - 100pF 3KV capacitors
  - No. 12 wire used in the coil
- Solid construction with heavy-duty components
- Easy to change bands
- 15dB harmonic attenuation
- Coverage of WARC bands (except 5.2MHz)

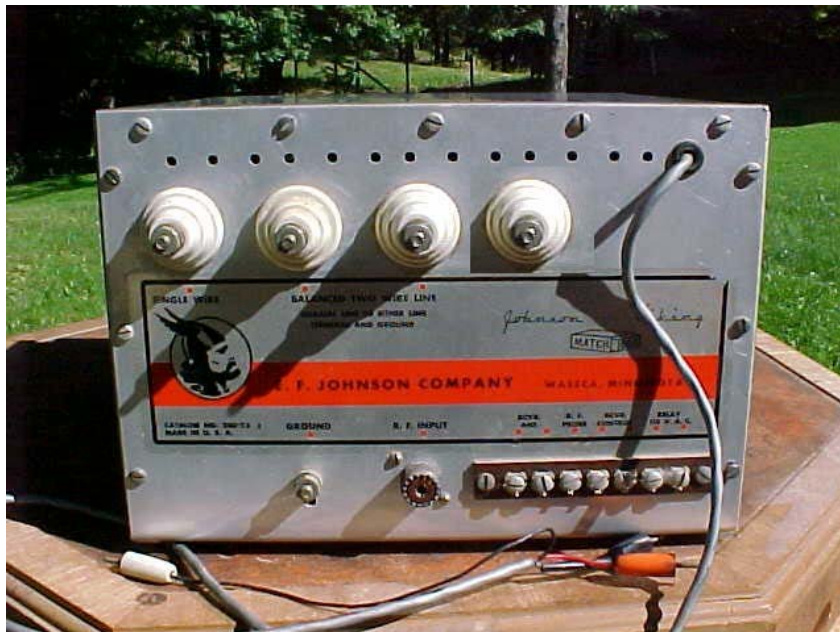
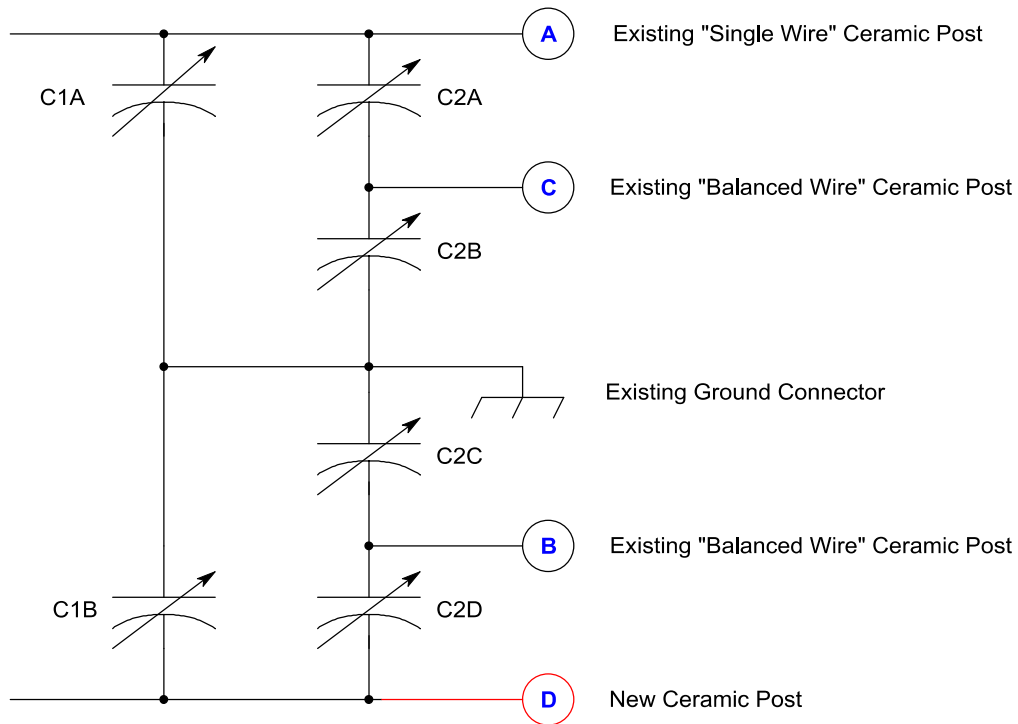
### Cons

- Somewhat limited matching range compared to the “Ultimate” transmatch
  - 25 to 1200  $\Omega$  (balanced)
  - 25 to 3000  $\Omega$  (unbalanced)
- No 160 meter position
- No bypass position (useful for SWL'ing)

A simple addition to the Johnson adds some versatility to the unit and allows for experimentation. The addition is a single ceramic standoff that can be used to add additional external capacitors in a variety of configurations.

## The Modification

The modification is the addition of a ceramic post in line with the three existing ceramic posts already there. Look for the dual-differential capacitor C2 that is connected to the existing post marked "single wire." The new post is connected to that same capacitor but at the opposite end. (C2D). Look at the diagram below:



On the schematic diagram, the connections through the ceramic posts are labeled A, C, B, and D. The reason for this has to do with the way the Matchbox is wired. The first ceramic post on the right rear panel of the unit is A, then B, then C, and then D. In order to add external capacitors, however, the correct posts need to be used in pairs. That is why the first and third are pairs, and the second and fourth.

To get my Matchbox to work on 5.2MHz (using my Autek RF Analyzer, of course!), I added a 100pF 1000V capacitor across terminals A and C, and another identical capacitor across terminals B and D. I could then find a smooth match condition for the new band. I did not do any efficiency or power loss measurements, however. The antenna at this time was a CF Zepp (132') fed with ladder line.

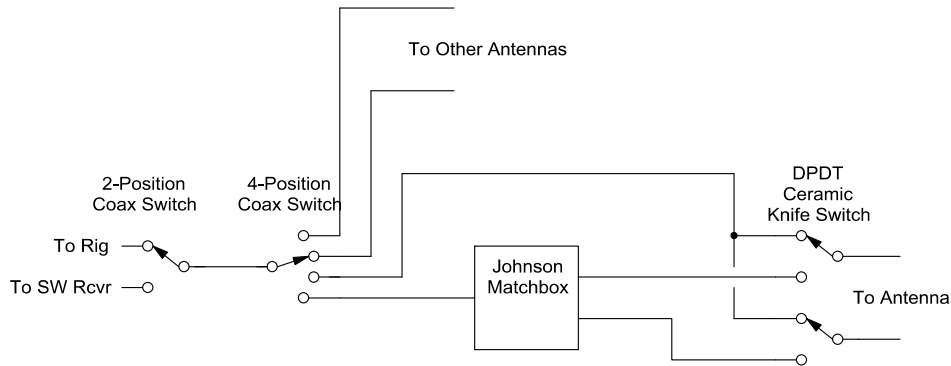
Here is a chart listing my settings for each band. I keep this chart handy to make tune up very simple. I pre-set the dials as per the chart, and then fine-tune as necessary.

F	BAND	TUNING	MATCH	External Capacitor (pF)*	
				A to C	B to D
3,530	80	42	43		
3,630	80	52	44		
3,677	80	53	46		
5,200	40			100	100
7,030	40	30	82		
10,103	40	91	84		
14,030	20	80	48		
18,070	15	10	58		
21,030	15	65	4		
24,900	10	52	32		
28,030	10	45	26		

\* A single capacitor from A to D may also work. 160m may also be covered with a suitable value (in the 80m band position).

### **Bypass**

Here is a simple circuit that I use to bypass the tuner when I want to use the antenna as a long wire for short wave or AM BCB reception. Keep the leads as short as possible. My Hallicrafters S38 receiver still works great and it is fun to listen to when no one answers my CQ on 40m CW.



List of other Johnson Matchbox Mods and Information:

1. “Matchbox Plus Two”– Ham Radio Magazine – July 1979 – Page 45. Coax to Coax matching and Antenna Switching by K4IHV
2. Correction for the above article – Ham Radio Magazine – Sept 1979 - Page 92
3. Extending the Johnson Matchbox Range – QST – Dec 1963 – Page 67. Adding coils to the output terminals by LGM. (Lew G. McCoy?)
4. W4RNL’s Antenna Website. <http://www.cebik.com/radio.html>. Look at the Link-Coupled Tuner links.
5. Johnson Matchbox Manual. One is available at: [http://bama.sbc.edu/e\\_f.htm](http://bama.sbc.edu/e_f.htm)
6. “Adding 160m to the JMB” – Bill WC3K – Electric Radio Magazine – Number 142 – March, 2001. He added 20uH to each end of the coil, or, 200pF across what would be terminals A and D in my diagram.

## **Some Current Measurements**

I compared the Johnson Matchbox and three other methods of feeding my balanced antenna: the K3 with built in tuner and a BL2 balun (4 to 1 ratio), the K3 with built in tuner and a BL2 balun (1 to 1 ratio), and the K3 with built in tuner and no balun (direct connection to the ladder line). I used an MFJ Balanced-Current Meter. Here's what I found:

1. All methods provided a 1to1 match.
2. For the most part, the Matchbox produces the highest current in the ladder line.
3. The balance between line 1 and line 2 is best with the Matchbox.
4. The balance is good with the balun but the balun heats up indicating loss.
5. Without a balun, the balance can be horrible on some bands.
6. The bands sounded quieter with the Matchbox.

I used an MFJ-835 Balanced Antenna current meter to measure the currents in each side of the ladder line connected to my Cobra Ultralite antenna. It has two 0 to 100 scales on it. One is for Side1 and the other for Side2 of the ladder line. In each case there was a 1 to 1 SWR on the K3 SWR meter. The K3 was set to 100W output in all cases. The antenna current meter was in the same spot for all tests which is right after a DPDT knife switch that can switch between the Matchbox and the direct (or balun) connections.

I wrote down the scale reading for each of the 4 matching circuits. Then I added Side1 plus Side2 (to show the total current) and subtracted Side2 from Side1 (to show the balance).

Here's a summary of the sums of the scale readings (side1 plus side 2). For each row, the higher the number, the more current is flowing in total. Don't compare one row to another, though.

Band	JMB Sum	Direct Sum	4to1 Sum	1to1 Sum
160	N/A	84	71	75
80	73	62	67	65
40	124	87	108	84
30	93	75	101	88
20	73	149	61	42
17	140	117	135	117
15	75	80	80	80
12	50	49	57	55
10	70	65	73	67
6	N/A	44	44	45

Here's a summary of the differences of the scale readings. The smaller the better. The higher numbers indicate poor balance from one side to the other. The direct case is pretty poor except for 160m and 6m.

Band	JMB Difference	Direct Difference	4to1 Difference	1to1 Difference
160		6	7	5
80	3	20	3	1
40	6	23	12	18
30	-3	65	3	8
20	3	11	3	2
17	2	33	17	7
15	1	16	4	4
12	0	11	1	1
10	0	25	3	3
6		0	2	3

So I am sticking with the Matchbox except for 160 and 6 meters even though all other cases resulted in a perfect match and 1 to 1 SWR. The results are on my website if you want to look at them. Look my call up on QRZ.COM and there is a link to the website there.