VHF/UHF   Dual Band J-Pole

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The DBJ-2: A Portable VHF-UHF Roll-Up J-pole Antenna for ARES

WB6QMN reviews the theory of the dual band 2 meter / 70 cm J-pole antenna and then makes detailed measurements of a practical, easy to replicate, “roll-up” portable antenna.

Edison Fong, WB6QMN

It has now been more than three years since my article on the dual band 4-pole (DBJ-1) antenna appeared in the February 2010 issue of QST. I have had over 100 inquiries regarding that antenna. Users have reported good results, and a few individuals even built the antenna and confirmed the expected measurements. The real major concern is using the antenna for their mobile, shelter, or emergency operation purposes. When asked why they choose the DBJ-1, the most common answer is an UHF J-pole antenna is a real “lightweight” and you will not have a performance drop-off. The DBJ-1 (Dual Band 4-pole) is an excellent choice.

In my earlier column I used 150 watt antennas and what you get is a WB6QMN 4-pole antenna with 2V (Vertical performance on both VHF and UHF). It is in a small size within a diameter of three antennas for mobile, shelter, or emergency operations, buildings, etc. It would certainly meet the needs of most people.

Since this antenna was designed for CW, it is often referred to as a “CW” antenna. Because I have personally constructed over 400 of these antennas for various groups and individuals and have had excellent results. One user asked for a portable version of the antenna for backpacking or emergency use. I would like to address that request. I will describe here the principles of the DBJ-1 can be expanded into a portable roll-up antenna. Since it is a small version of this antenna, I call it the DBJ-2.

Principles of the DBJ-1

The dual band 4-pole antenna is based on the J-pole, shown in figure 1. Unlike the popular ground plane antenna, it doesn’t need ground

More appear on page 50.

The DBJ-1: A VHF-UHF Dual-Band J-Pole

Searching for an inexpensive, high-performance dual-band base antenna for VHF and UHF? Build a simple antenna that uses a single feed line for less than $10.

By Edison Fong, WB6QMN

The 2-meter antenna is small compared to those for the VHF frequency bands, and the availability of expansion on both bands greatly extends the range of lightweight and portable handheld and none handheld stations. One of the most popular VHF and UHF base stations antennas is the J-Pole.

The J-Pole has no feed wire and it is easy to construct using inexpensive materials. For its simplicity and small size, it offers excellent performance. Its radiation pattern is close to that of an "ideal" dipole because it is and field that results in virtually no distortion to the radiation pattern by the feed line.

The Conventional J-Pole

I was introduced to the Résoudra version of the J-Pole by a magazine friend, Dennis Menchel, AR6C, and I was intrigued by its simplicity and high performance. Résoudra's J-Pole design is one of the 最初 designs and is also used on VHF with UHF Rogers becoming more popular as an automotive antenna. I accepted the challenge to compare both hand-held one antenna with no gaps to similar antennas with gaps and evaluation patterns. A common question asked was "Why do I see that 154 MHz?" 154 kHz is a notch at 1.2 MHz above 154 kHz. The Notch Band has a reduced velocity factor (about 0.8 compared to air) and switches from a rectangular to a sine wave matching transformer.

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Why a J-pole?

- J-pole configuration - no radials
- Ground plane requires radials – high wind load
- Very close to an ideal dipole pattern
• First introduced to the ribbon J by AE6C in 1990
• Antenna excellent - considering simplicity
• Stick it in a PVC 3/4” - very durable
• Will last for years since PVC is UV protected.
• To date – we have delivered over 10,000
• Price to performance - excellent
• It will also resonate at odd harmonics
• Ah ha!!! It will also work at UHF
• Very poor performance because of phase cancellation
• Typically 6-8 dB of loss at 3\textsuperscript{rd} harmonic
• Goal is to design a dual band J-pole but without the loss
• New design must be simple, reproducible, no radials due to wind load.
• No inductors, no capacitors, because they are not easily reproduced.
• I tried all types of configurations, but this one seems to work the best.
• Basically matching is the same at VHF and UHF.
• A 1/4 wave decoupling stub (RG174) is used at UHF
Smith Chart

Represents 1/2 wavelength once around
0 ohms on left side
infinity at right side
normalized to 1 at center
Cut out a 1/4” notch

Splice and short together

RG174a coax

300 ohm twinlead

37 1/4”

15 1/4”

1 1/4”

**Figure 1** The original 2 meter ribbon J-Pole.
Figure 2 Horizontal pattern of fundamental and 3\textsuperscript{rd} harmonic. At the third harmonic most of the energy is launched at 45\textdegree.
Figure 3  The 2 meter J-pole modified for both VHF and UHF operation.
Figure 4  The dual band J-pole modified for portable operation. Note that dimensions are slightly longer due to the velocity factor of air.
Notice that the dimensions on the DBJ-2 (roll up) are longer than the DBJ-1 (base station). This is because we have compensated for the velocity factor of the pvc pipe.

The pvc pipe used is very important. We found that Lowe’s item #23990 was the best performance for RF.
**Figure 5a** 2 meter J-pole at UHF.

**Figure 5b** DBJ-1 at UHF.
<table>
<thead>
<tr>
<th>VHF ¼ wave mobile</th>
<th>VHF rubber duck</th>
<th>Standard VHF J-Pole</th>
<th>Dual Band J-Pole</th>
</tr>
</thead>
<tbody>
<tr>
<td>-24.7db</td>
<td>-30.5 dB</td>
<td>-23.34 dB</td>
<td>-23.47 dB</td>
</tr>
</tbody>
</table>

**Table I** Measured relative performance of the dual band antenna at 146MHz.

<table>
<thead>
<tr>
<th>UHF ¼ wave mobile</th>
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<tbody>
<tr>
<td>-38.8 dB</td>
<td>-41.3 dB</td>
<td>-45 dB</td>
<td>-38.9 dB</td>
</tr>
</tbody>
</table>

**Table II** Measured relative performance of the dual band antenna at 445 MHz.
Here I am in my lab using the HP8753D 6 GHz network analyzer.
Stub shows a clear resonant at 445MHz.
Hands touching at shorted end. Graphs changes, but not 445MHz resonant point. This says I can place anything at shorted end without affecting the 445MHz resonant high impedance.
146 MHz marker of the UHF shorted stub.
445 MHz marker of open wire.

146 MHz marker
DBJ-1 mounted on the side of the roof.
DBJ-2 kit – roll up dual band with BNC, SMA, and reverse SMA. Also 6ft extension cable.
The two element UHF phase conlinear with the voltage and phase given on the right. Dimensions are given for insertion into ¾ inch 200 PSI pvc pipe. US patent 8,947,313.
DBJ-1 dual band base antenna - available in HAM (144-148 MHz and 440-450 MHz) or Commercial (152-157 MHz and 460-470 MHz) $25

DBJ-2 dual band roll up antenna - available in HAM (144-148 MHz and 440-450 MHz) or Commercial (152-157 MHz and 460-470 MHz) $25

220 MHz base antenna - uses J-configuration fits inside a pvc pipe. $20