Al Dewey, KØAD, with Paul Bittner, WØAIH

The Rhombics at WØAIH

For those of us with typical city lots, the full-wave rhombic probably is not the first antenna that pops into your mind when you're thinking about putting up a high-performance contesting antenna. Most of us don't have the room, but with 120 acres space is certainly not a problem for Paul Bittner, WØAIH. Relatively speaking, a full-size rhombic hardly takes up any room at "the farm," as Paul and upper Midwest contesters affectionately call Paul's contest station. So, why not put up *four* of them! This is just what Paul did, but I'm getting ahead of myself.

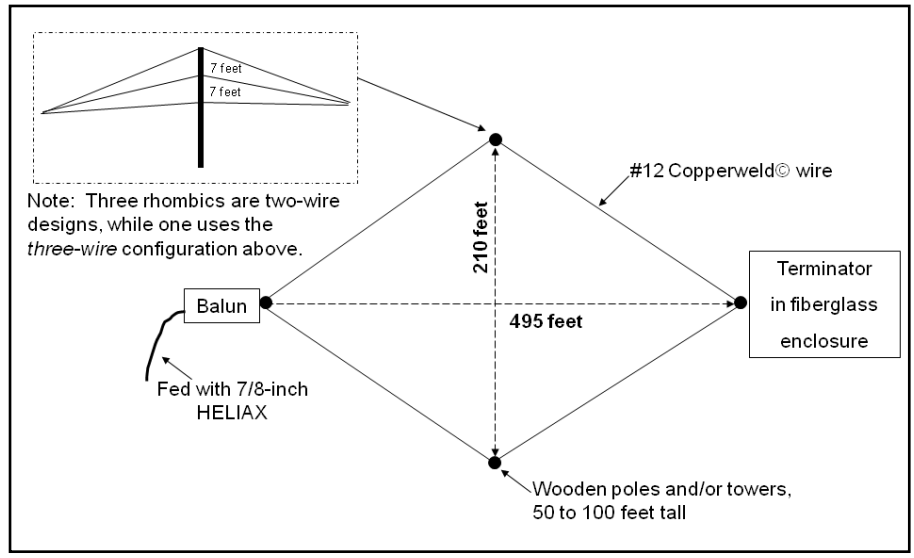

Figure 1 — The basic WØAIH rhombic design

Farm History

WØAIH began building his contest station at the farm in 1977. To describe this amazing place is well beyond the scope of this article. See **www.qth.com/w0aih** for more details. Suffice it to say that a visit to the farm and operating a contest with the impressive collection of towers, Yagis, stacks, verticals, bobtail curtains, Beverages and more is an unforgettable experience. For years Paul dreamed about putting up a rhombic at the farm. That dream became reality shortly after he tried one out while operating the IARU HF World Championship Contest from K4VX in the 1990s. Paul put up his first rhombic, pointed toward Europe, using the basic design shown in Figure 1. The circumference of each rhombic is approximately 2150 feet. Each is fed with 7/8-inch HELIAX® through a 10 kW balun (see Figure 2) he got at Dayton Hamvention®. Additional scrounging produced the 600 Ω terminating resistors (see Figure 3) that Paul uses at the end of the rhombic opposite the feed point. Supports were two 90 foot towers and two 90 foot wooden poles at the four corners.

Paul used a multiwire rhombic design, constructing each antenna with two runs of #12 Copperweld® wire spaced approximately seven feet apart. Based on the success of the European rhombic, it wasn't long before Paul had four rhombics in the air, covering Europe, Japan, Africa and Caribbean. Figure 4 depicts the current configuration and approximate positions of the four rhombics at the farm. The rhombic pointed toward the Caribbean is at 45 feet, while the others are at approximately 100 feet.

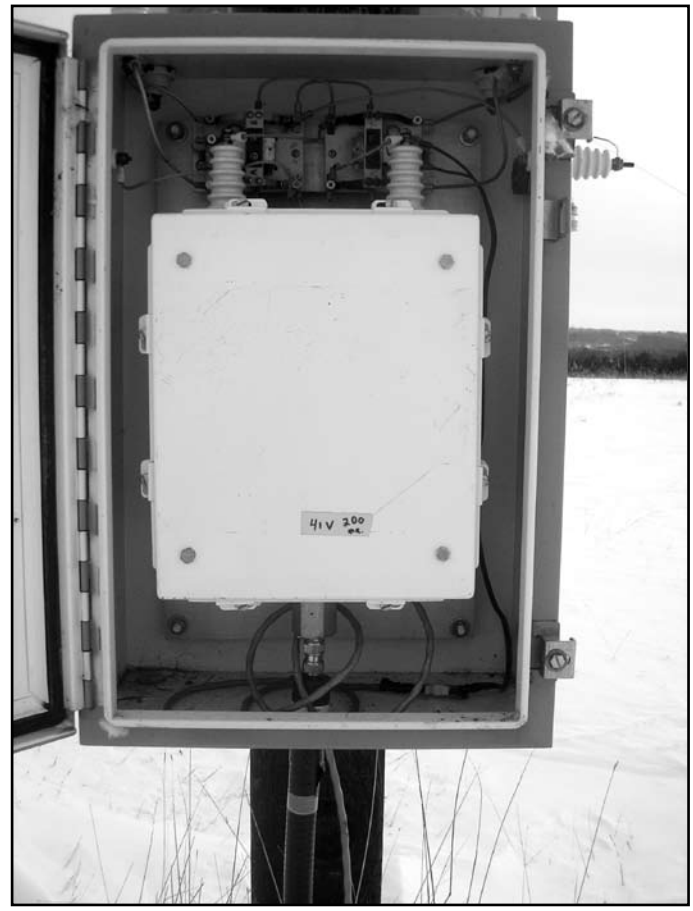

Figure 2 — 10 kW balun used to feed rhombic

Reversing Direction

Each rhombic is capable of switching

direction. This is done by connecting open-wire (balanced) feed lines to the opposite ends of each rhombic; these are brought into a central switching box. Two remotely switchable DPDT relays allow the terminator and balun to swap positions. Figure 5 diagrams the switching arrangement, while Figure 6 shows the balun and terminator, as mounted on the ground between the two ends of the rhombic. Initially Paul tried to reverse the direction of the Japan rhombic to hit the Caribbean, but he found that the antenna was simply too high for it to be effective in the opposite bearing. While three of the rhombics are two-wire designs, the Caribbean rhombic employs *three* parallel runs of #12 Copperweld® wire. (Chapter 13 of *The ARRL Antenna Book* — 21st ed includes a discussion of rhombic design and construction considerations.)

Switching

Having operated at the farm, I can tell you that the rhombics are in high demand on 15, 20 and 40 meters at both the running and spotting positions. To make it possible to share the rhombics, Paul installed

Figure 3 — 600 Ω noninductive terminator used at the far end of each rhombic

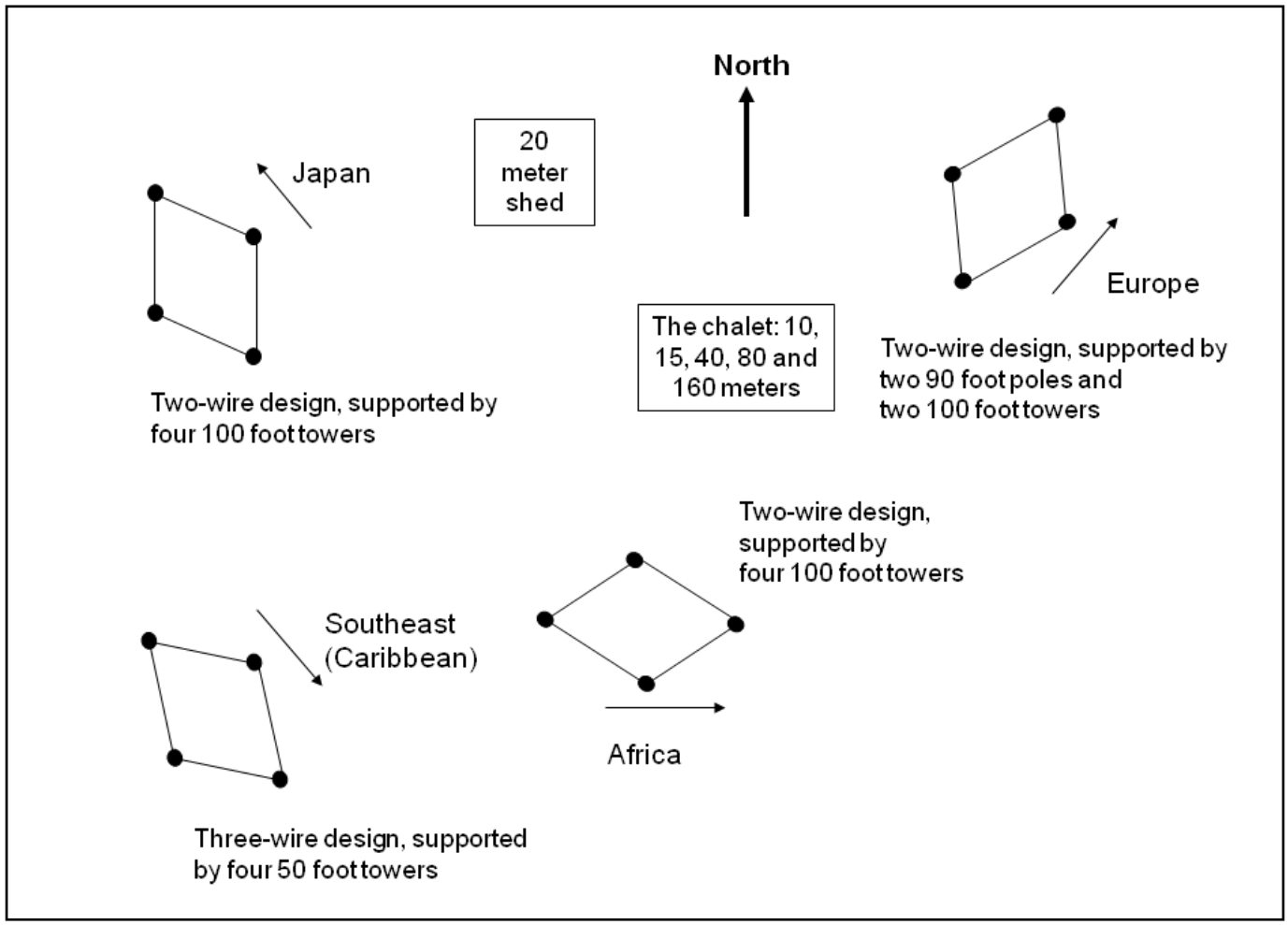

Figure 4 — Position of the four rhombics at "the farm"

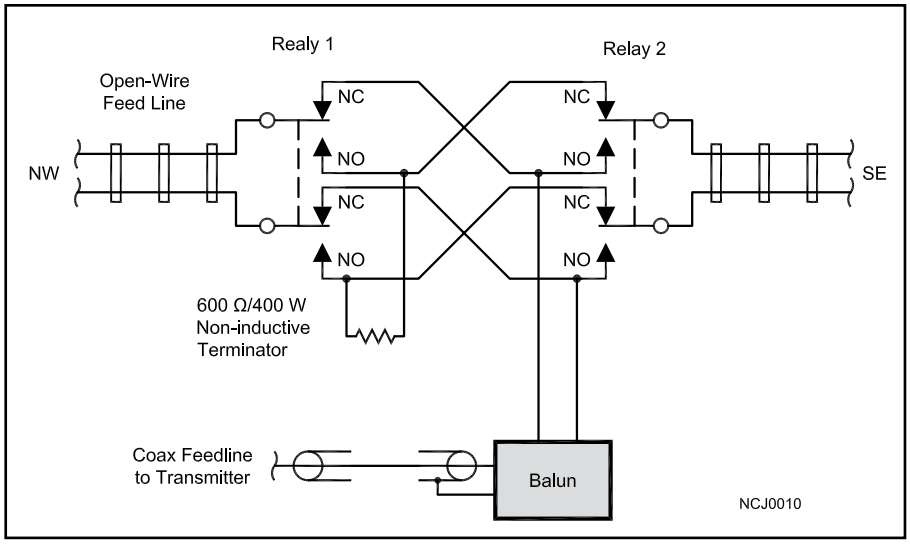

Figure 5 — Switching arrangement to change direction at WØAIH: Open-wire feed line is connected at each end of a rhombic and brought to a central point on the ground. DPDT relays effectively swap the feed point and the position of the 600 Ω termination resistor.

a five-position switch for each rhombic (see Figure 7). This switch is located in "the chalet," which houses all operating positions except 20 meters. If someone at one of the operating positions wants to use one of the rhombics, they put out a request on the *CT* "gab" network. For example, the 20 meter run operator might put out a message asking, "Can I have the Japan rhombic?" If nobody is using it, someone in the chalet switches the Japan rhombic to the 20 meter position. The Japan rhombic then becomes one of the available antennas at the 20 meter station — along with Yagis, stacks and so forth. It's a pretty simple system, and it works well.

How Do They Play?

A detailed modeling analysis of these rhombics is beyond the scope of this article, but Paul did have Lew, K4VX, model these antennas using Paul's dimensions at a height of 60 feet. He found that with a length of 495 feet, a width of 206.7 feet

Figure 6 — Balun (left) and terminating resistor, mounted below the center of a rhombic for direction switching

Figure 7 — Switches in "the chalet" direct rhombics to each operating position.

and a half-apex angle of 22.7°, the gain at 14.2 MHz is 18.9 dB. At 21.2 MHz, the gain is 20.8 dB. In an actual application, it is suggested that the theoretical gain would be reduced by approximately 2 dB to account for losses in the termination resistors. Lew also found that the presence of towers inside a rhombic does not have a significant effect on the antennas' performance. Of course, it's one thing to model an antenna and another to use these rhombics at the farm in real-world contesting situations. The anecdotal evidence is quite positive.

Scott, NE9U, recalls being in the 20 meter shack at 4 AM and finding the band dead. He was twirling the stack (4/4/4/4 Hy-Gain 204Bs at 50 to 199 feet) and didn't hear a thing. Just for the heck of it, Scott switched to the European rhombic and, lo and behold, he heard an HZ (Saudi Arabia)! It was the *only* signal on the band. He moved the stack back to 43° and switched to it. The Saudi station was gone! He switched back to the European rhombic, and there it was at S-9. Scott worked him on the first call.

Bill, ACØW, has found that when the band is just starting to open on the East Coast and there's still some time before it opens in the Midwest, the rhombics allow him to get on the band earlier. By getting on the band as the same time as the East Coast stations, he is able to establish and hold a run frequency. If he waits until the stack is able to hear and work stations, the band is so crowded with East Coast stations it's very difficult to find an opening and establish a run frequency.

Paul, WØAIH, has found that the African rhombic plays very well into Oceania (VK/ZL) when he reverses its direction. He dreams of a 160 meter rhombic aimed at Europe, but he also realizes that even his 120 acres do not provide enough room to fit the necessary 2000 feet legs. On 160 meters Paul does sometimes *listen* on the rhombics which are very quiet (his transmitting antenna is a vertical array). He simply switches to the rhombic that "hears" the best; typically it's the one pointed in the direction of the station he's working, Paul says.

My personal favorite is the JA rhombic on 20 meters. I typically use the stack, mentioned above, for most of the morning and into mid-afternoon. The first time I hear or work a station in Japan, however, I immediately request the JA rhombic and start calling "CQ." Almost every time this leads to a long and productive JA run.

Paul's Story

After looking at rhombic antennas in an edition of *The ARRL Handbook* from the early 1950s, I dreamed of one day having one. Hearing of W6AM and his rhombics led to *more* dreaming.

I moved from Virginia, Minnesota, to Grand Island, Nebraska, in 1974, and it was a delight to meet the FCC crew in Nebraska and admire their nine receiving rhombics and three or four transmitting rhombics. One day John, WØAP ("Mr FCC"), told me he was going to cut down a 70 foot pole that was not being used. *What? Cut it down? For his wood burner?* In my eyes this was almost a sin.

My suggestion was that I give him firewood, and I get the pole. Even with the help of a congregation member who owned a crane service, getting the pole out and moving it into town was no small trick. About two years later, the FCC replaced its receiving rhombics with six new ones. If I wanted the decommissioned antennas, I could obtain them. So, after church meetings I would race out to the site five miles away, climb the poles, get down the wire and roll it up with the FCC's rolling machine.

The FCC truck with its generator was mine to use. I designed a special tool for my drill to unscrew all the pole steps once the poles were on the ground. It was a very speedy operation. I filled a 55 gallon drum with all the steps and stashed the many insulators in apple boxes in anticipation of a day that might come. From good ground conductivity in Nebraska to very low ground conductivity in Wisconsin, I arrived with wire, insulators and assorted goodies, should "rhombic day" ever arrive.

E.F. Johnson was getting out of the antenna business and had a whole box of non-inductive 500 to 700 Ω resistors it was *giving away*. I took five or six of them and stashed them away for another day. I should have taken the whole box, as I understand that they were later thrown away. Dayton Hamvention® produced 10 kW baluns (50 Ω to 600 Ω). I bought several, just in case I would need them some day.

Then I operated the IARU HF World Championship Contest at K4VX. Lew had glowing things to say about his rhombic. I tried it, and I liked it. He sent me the computer-generated dimensions for a four-wavelength 20 meter rhombic. I began to measure out where it would go and decided to point it at Europe. End supports were 90 foot wooden poles that required a crane and a large drilling machine to install. Supporting the sides was much easier; I used 90 foot towers. I mistakenly tried to lift both legs of the two-wire array at the same time, but the Copperweld® became a tangle. It took five minute to try to raise them but five hours to untangle it all. I learned to raise the top leg on each side first and then the lower leg.

The antenna not only worked great on 20 but on 40 and 15 — as well as on 30, 17 and 12 meters! With more than 2000 feet of wire in the air, "RF gotta go somewhere," as ARRL antenna expert Dean Straw, N6BV, likes to say.

The next rhombic was pointed toward Japan. It worked well. During a visit from Bill Bridges, W6FA — a friend for more than 50 years, it was suggested that I connect open-wire feed lines to each end of the antenna, bringing these to a central point in the middle and switching in a termination resistor or a balun to switch directions. It switched okay, but the angle seemed far too low for places like KP2. The third rhombic I put up was aimed at Africa. Again, it was a two-wire array.

Pondering why reversing the JA rhombic didn't work better to the southeast, I put up a fourth rhombic — a three-wire array this time. It's only 45 feet high and works much better into the Caribbean. It's interesting to switch back and forth between the high southeast rhombic and the low southeast rhombic. There is a difference.

During a contest, the operators at the 40, 20 and 15 meter positions put in their requests for a certain rhombic. Any of the four rhombics can easily be switched to any of the operating positions. When working 30, 17 and 12 meters, I just see which of the four is best for receiving and load the transmitter into that one.

Clearly, this is not a city lot antenna, but with 120 acres to work with, it is a young Nebraska boy's dream come true. — *Paul Bittner, WØAIH*

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