

Array Solutions W8AV Triangular Array User's Guide



Array Solutions – W8AV 160m Triangle Array Steering System shown
Note: Not shown is the phasing line

Congratulations.

You have selected one of the finest phased array steering systems made. We have under-rated the power this system can handle to assure the user high reliability under heavy use such as in a 48 hour radio contest. Please contact us if you have any questions about the product and please send a picture and description of your station showing the Triangle Array control system installed and in use.

The W8AV system has two components: a relay box that will be mounted midway between the three verticals and a control box that is connected with a 4-wire control cable inside the operating room.

Wiring the system:

Take the cover off the switch box and unwrap the circuit board. Wire the control cable before mounting the board to the box.

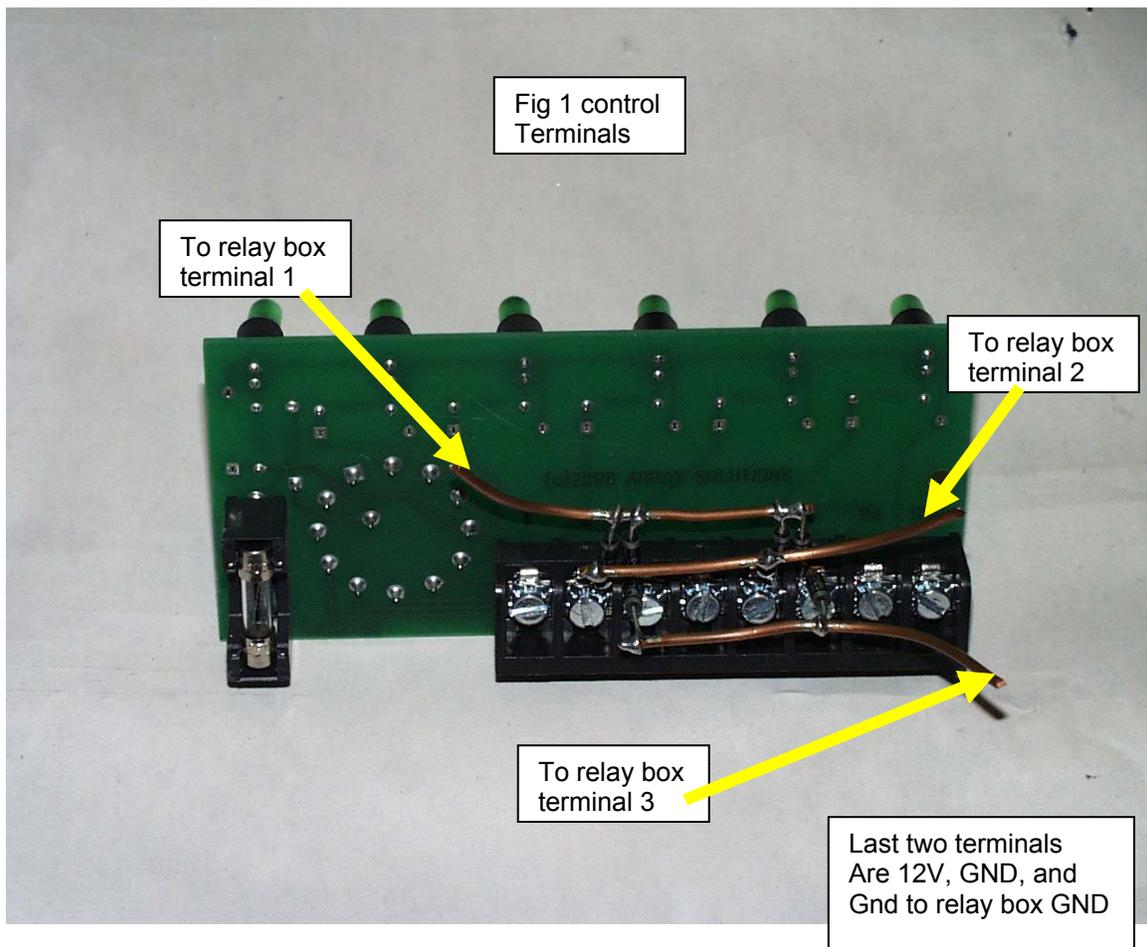
You will need a cable with 4 wires. Small gauge wires are fine and will fit inside the boxes better than large rotor cable. For runs of less than 500 feet #18 or larger gauge stranded wires will be adequate. The relays draw only 100 ma at 12V DC.

You will also need a small two-wire 12V DC line for power. A 13.8VDC 1/2 amp power supply should be ample. But please use a reliable power source, since wall wart transformers have a habit of falling out of plugs and going bad in the middle of a contest.

The silk-screen on the PCB indicates where to wire the +12 V DC (+13.8V DC is fine) supply and its RETURN or GND wire to the Power Supply.

You will see some diodes that are attached to the terminal strip. **See fig 1.** These are where you solder the control cable wires. Wire the 3 wires from the diodes marked 1,2 and 3 to your cable that goes to the control box and relays K1, K2, and K3. The return 4th wire connection is direct to the power supply GND connection.

Please use a connector on a short piece of cable so you may disconnect the control unit from the control cable when not in use, or when a thunderstorm arrives. We also recommend the use of a surge protector at the relay box, such as the model 348 we sell. A little money spent now can save valuable radios later.



There are 8 diodes in the actual box. See the Schematic to see how they are actually connected to steer 12V to the relays of the phasing controller.

As seen in Fig. 1 the Terminal strip has a diode steering matrix with the 3 copper floating leads. These floating leads are where the control cable is soldered. Use the tie wrap supplied as a strain relief when the control cable is fed through the grommet hole. Snug the tie wrap next to the hole in the back of the box to prevent the wire from being pulled and stressing the PCB.

Do the same with the 12V-power cord you will supply in the other grommet hole. It is a good idea to put a connector and plug of your choice so you can disconnect the controller if desired.

Relay Box

Route the control cable through the rubber grommet hole in the relay box tray. Use the supplied Ty-wrap™ as a strain relief. Just connect an appropriate connector to this pigtail. Then continue the control cable to the radio shack and the controller.

You can see the Relays marked K1, K2, and K3 in the Relay box. The relay box also is marked at the terminal strip to indicate the ground, K1, K2, and K3 terminals. The relays are bypassed with MOVs, capacitors, and diodes. For RF and lightning suppression relays. See **Fig. 3** which is a picture of the inside of the phasing box.

The area marked capacitor bank is for placement of HV RF capacitors. Although usually not needed a L network can be formed here to reduce SWR at the desired frequency by soldering in one or two HV capacitors (supplied). Call us if you have any SWR problems and we can help with this. We have adjusted the system for a SWR of less than 1.1:1 at the desired frequency using dummy loads at the factory. Real antennas may require a small adjustment of the capacitance value.

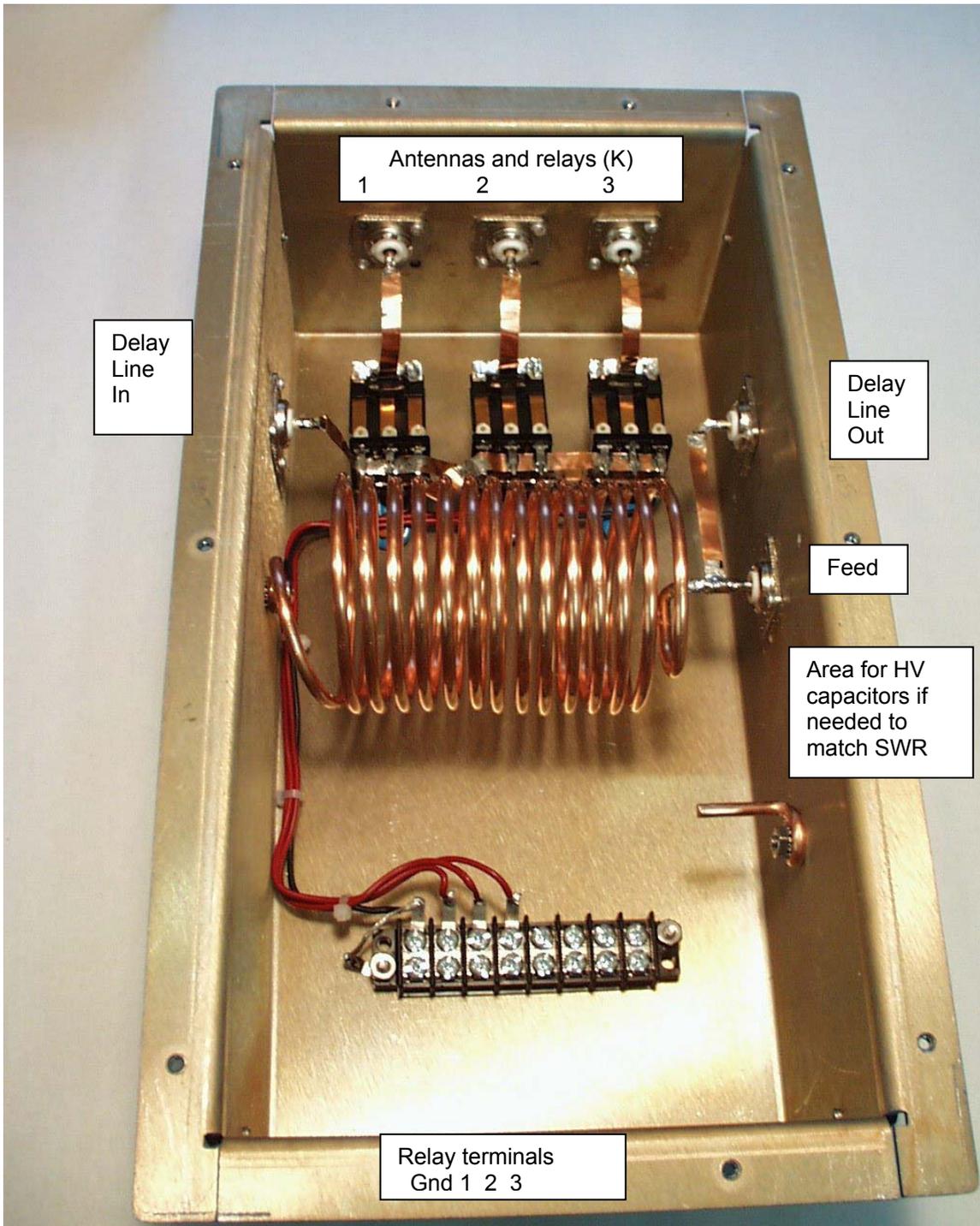


Figure 3

Observing Fig. 3, note that there are RF connectors on the left and right sides of Relays K1 and K3 respectively. These two connectors are where the Phase Line is connected. The phase line creates the phase difference of 90 degrees Please weather proof all RF connectors.

Connect the Feed Line cable to the Feed Line input connector.

Connect the three vertical antennas to their appropriate RF connectors. The best idea is to allow the default or power "off" to be in the "main" default pattern position. Lets say you are in North America. Then the best default position is Europe. So Place the NE Vertical in the K1 relay connector. Then K2 would be the SE direction vertical, and lastly K3 would be the W direction vertical. The control switch has 6 positions. Every third position is a repeated position. The number 1 and number 4 positions are the default direction on the control switch. Mark your controller to the positions you have chosen for your array.

VSWR and matching the system.

Lastly and most importantly matching the system to a 50 feed impedance is required. The system is tested with the use of three 50-ohm dummy loads. The 160m system sees an SWR of about 1.1: 1 under these conditions. You will probably find that on your array you may have a little more SWR, but this really is of no concern. The SWR will remain fairly constant over the useful range of your array. You can add some capacitors provide between the input side of the coil and the ground to form an L network matching network as discussed above to further reduce the SWR seen on your system.

Usually the use of $\frac{1}{4}$ wave verticals requires no additional matching, but variances in radial grounding systems, ground conductivity, and even use of other types of arrays like dipoles pulled out from a tower will cause the SWR to be higher then desired. Try to adjust your verticals so they are 50 ohms at their feedpoint. Of course this is not possible on direct fed $\frac{1}{4}$ WL verticals over a good ground radial system. You may see 36 ohms of feed impedance or less with the mutual coupling of the array. You can experiment with the use of $\frac{1}{4}$ WL 75 ohm feeds to bring up the impedance of all three of the verticals too. We can help you with problems if you have any.

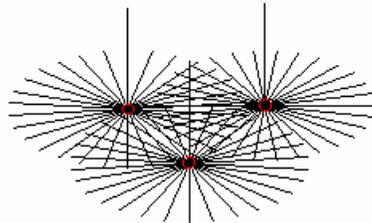
But if you cannot get a good feed impedance into the controller you can compensated for and matched back to a 1:1 SWR using an L network. To do this we usually have to only place a capacitor in the Relay Box at the input connector to ground. In some cases a full L Network will be required. We can supply these at a reasonable cost to our customers. They are supplied as a small die cast AL box to be attached to the input RF connector. They are custom designed for a true 1:1 SWR at the desired operating frequency. To do this we need to know exactly what the impedance you are measuring at the input of the controller. We also can help you design an L-network of your own.

Please contact us for help in tuning your array or if you have any other questions.

Theory of operation:

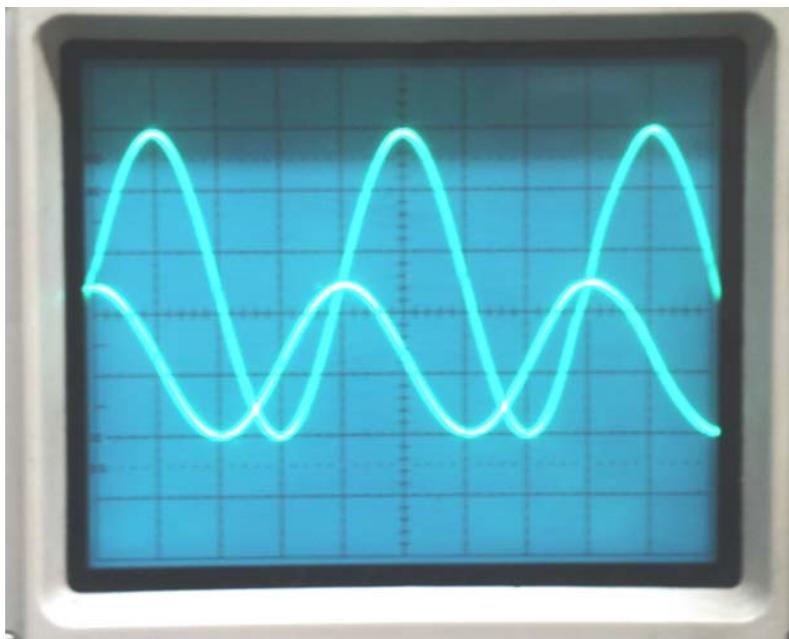
The system consists of three verticals separated by .29 WL.

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The triangle arrays are three verticals that are located in equilateral triangle typically .29 wavelengths apart from each other. We can compensate with phase if you have three verticals with other dimensions as well.

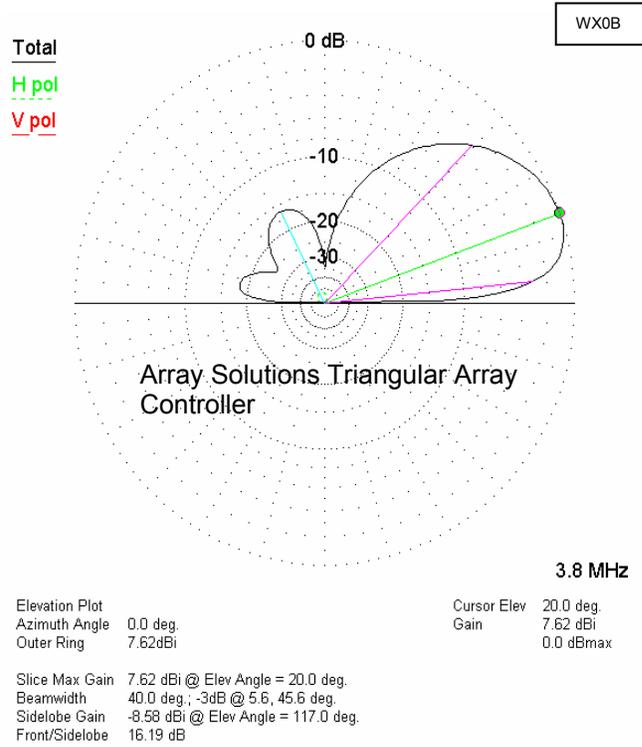
The W8AV controller will power all three of these verticals in such a way as to accomplish a 90 degree difference in phase from the one of these verticals (lagging) and the other two verticals (0 degree reference). It also power splits the current so the lagging vertical will receive twice the current as the other two. To do this we use an inductive power-splitter and a phasing line. The controller is "tuned" up at Array Solutions factory using dummy loads. The results are shown on the oscilloscope pattern in the next picture.



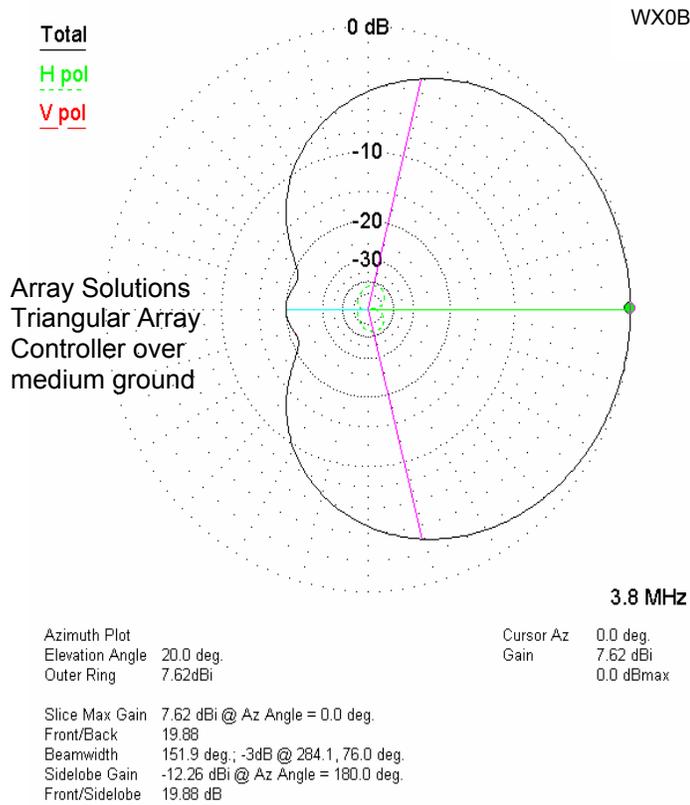
These two curves show the lagging antenna with 2 times the voltage of the leading antenna ports. It also displays the lagging angle between the two waves as being set to -90 degrees. One complete sine wave is 360 degrees. So there are 4

vertical reticule lines per 360 degrees on this display. Each horizontal reticule represents 90 degrees of delay.

The triangular array when fed with this phase and magnitude relationship will develop a cardioid pattern with great front to back characteristics and good gain to the front point of the array.



The Azimuth Pattern at 20 degrees elevation is as follows:



As you can see the Triangle Array is a great way to achieve almost the same gain as a four square array. It can actually exceed the performance of the typical hybrid coupler array since it does not have the many compromises being made by using the hybrid coupler on a complex array since it is using a broadcast type phasing system. It may take a little time to set it up correctly but the performance will be worth it.

Thank you for your purchase of this fine system.

Jay Terleski, WX0B