

# Array Solutions' AS-2L Two element Hybrid Array Manual and User's Guide



## **Congratulations.**

You have selected one of the finest phased array steering systems made. We have underrated the power capability of this system 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.

The Array Solutions AS-2L Array system has two components: a relay box that will be mounted midway between the two verticals and a control box that is connected with a four wire control cable inside the operating room. With this system you will be able to beam in two end-fire pattern directions and one broadside bidirectional pattern.

## **Wiring the system:**

A four terminal connector is used at the PCB of the controller switch. Table 1 shows the connections to the corresponding 4 wire terminals in the relay box and the control switch connector. You may use our DC power supplies which are regulated linear supplies, or use one of your choice. A 2.1 mm DC coaxial connector pigtail is included for connecting to your DC supply. We recommend a 1000 mA or more supply.

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 120 mA at 12 V DC. Try to use a supply that has a 13.8 V DC output or more for very long runs.



Wire the control switch connector to the relay box per the following Table 1.

Control Switch Connector	Relay Box Terminal strip
1	1
2	2
3	3
G	GND - Ground

Table 1

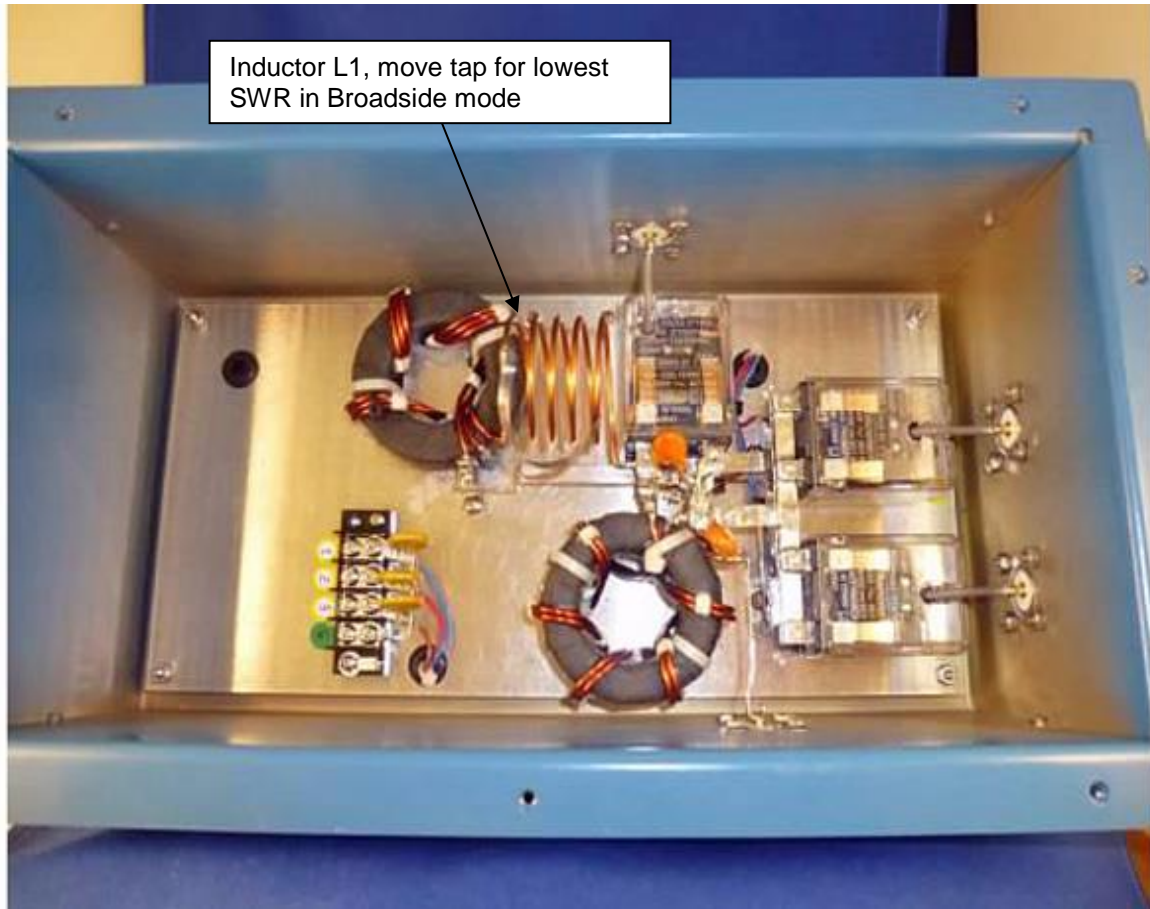
**Suggestion:** Use a connector on a short piece of cable so you may disconnect the control unit from the control cable when not in use, or when a thunderstorm arrives. We also recommend the use of a surge protector at the station end for the control cable and RF cables, such as our AS-8-SP control line protector and our AS-302 or AS-303U coaxial cable protectors. A little money spent now can save valuable radios later. We also have MOV protection inside the relay box.

Plug both the control line and power supply connectors into the back of the control box.

**Hot Switch Protection** – to activate the hot switching safety feature, just plug an RCA PTT line from your transceiver into the RCA jack in the back of the controller. When PTT is asserted (GND) no relays will switch if a control pushbutton is accidentally pushed.

**NETWORK** – These connectors are for the ShackLan network, you can daisy-chain connect several controllers of the Hamation line, this will allow control over the network for instance for a remote station. See <http://hamation.com/> for more information.

## Switching and Phasing 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. The relay box terminal strip is marked to indicate the connection to terminals. See the above **Table 1** for the proper connections. The relays are bypassed with MOVs, capacitors, and diodes for RF and lightning suppression. See **Fig. 2** which is a picture of the relay phasing controller.

## Description

**INPUT** - This connector is for the 50 ohm feedline

**Antenna Ports 1-2** - These are the output connectors to the 2 antennas. Each one should have a  $\frac{1}{4}$  wavelength 50 ohm feedline connected to it. We use  $\frac{1}{4}$  wavelengths to take advantage of the current forcing properties of this length of line. This will also give the Hybrid coupler impedance close to 50 ohms for most antenna arrays. The antenna ports are marked as directions that the antennas would normally be attached to the controller. **Note: If your antennas are not full sized and its feed point impedance is low (20 – 25 ohm) you may need to use  $\frac{1}{4}$  WL 35 Ohm lines (these can be made using two 70 ohm coaxial cables, like RG-11 or RG-6 in parallel or 35 ohm coaxial cable like RG-141-35) to step-up the drive impedance closer to 50 ohms at the controller antenna ports.**

**Dummy Load** – A 50 ohm dummy load with a rating of a minimum of 100 W continuous duty should be plugged into the RF connector that is indicated on the relay controller box.

**Water proofing** the connections is always a good idea even though the lip of the cover will protect the connectors from direct rainfall.

## Setting up the system

The **AS-2L** is easy to install and special instruments should not be necessary to set it up and get it operational in the normal quadrature feed situation.

Place the controller relay box in the center of the array. Use the U-bolt mounting bracket provided to mount the box onto a ground rod, pipe, or tower leg. Feed each vertical with its  $\frac{1}{4}$  wavelength of feedline. The galvanized U bolt can accept a water pipe driven into the ground as the mounting post. It has a 1.5 inch (38 mm) inside diameter mount it on the edge of the cover as shown and tighten the U-bolt against the pipe with the connectors facing down. For added lightning protection you can drive in a ground rod and ground the relay box to the ground rod as well.

Set up your vertical antennas spaced  $\frac{1}{4}$  WL apart from each other; we will define the array as follows: The antenna ports are marked ANT 1 and ANT 2

**NE**  
o ANT1

o ANT2  
**SW**

**The above diagram indicates verticals (o), Antenna number (1-2), and Directions normally used. The default direction is towards antenna 1, you are free to set up the array in any direction you like.**

The controller has pushbuttons that correspond to these antennas, ANT 1 to the right side.

**Antenna Feed lines** - Build your 2 antenna feed lines and make them  $\frac{1}{4}$  wave-length long. If you have raised radials you may need to use  $\frac{3}{4}$  wave-length lines to span the additional length added by the routing of the feedlines between the relay box and the antennas.

Attach the antenna feed lines to the correct ports as marked on the relay box per the above diagram. Also attach your dummy load (100 W or more) to the Dummy Load port of the relay box.

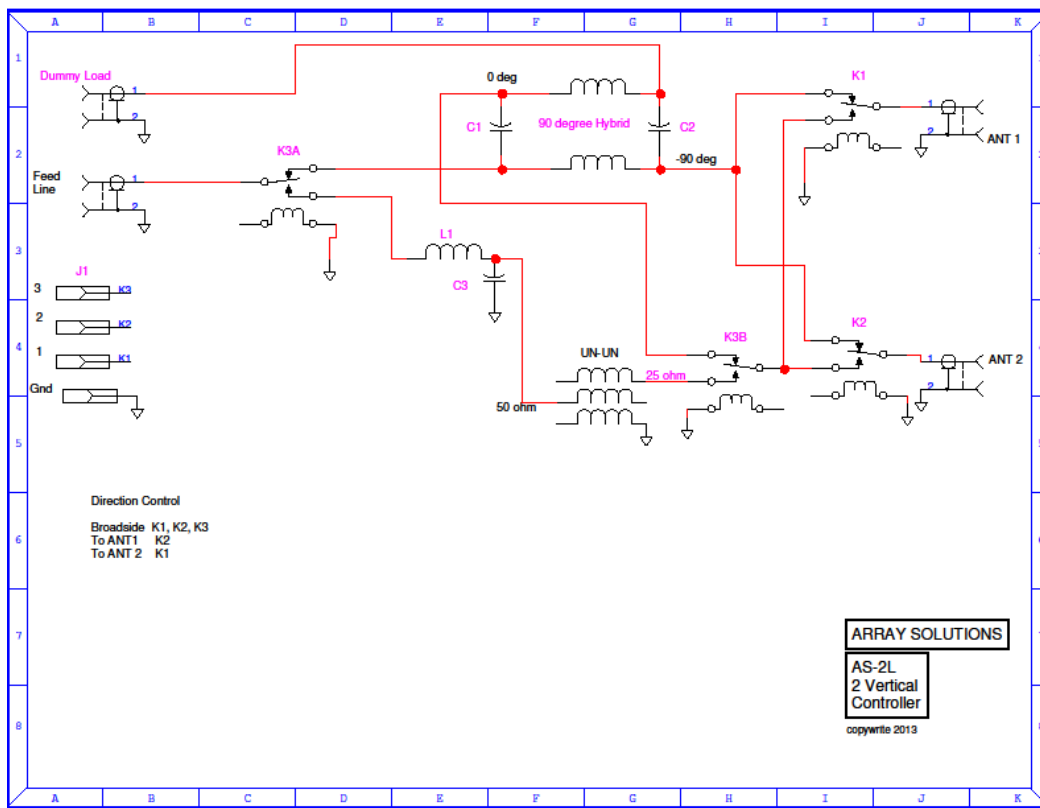
**PTT** – There is a PTT input in the back of the controller to inhibit hot switching the relays.

**Switching the directions** of the array's pattern is done with the push buttons on the controller control switch. The outer buttons have arrows on the controller to indicate the directions and the center button indicates the broadside selection with the vertical double arrow.

### VSWR and Matching

A Hybrid coupler is used to develop the 90 degree phase shift to the antennas to provide a directional pattern. The Hybrid coupler is very forgiving and the SWR you see driving your array providing you have tuned all your antennas correctly and identically should be nearly 1:1 or less then 1.3:1 over the band for normal  $\frac{1}{4}$  wavelength verticals

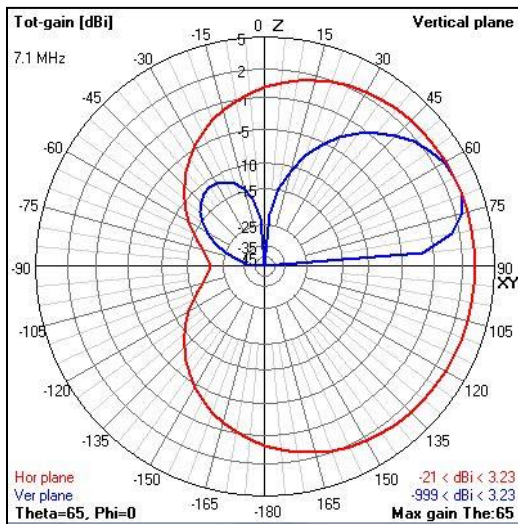
In the broadside mode an UNUN is used to match the combined impedance of the two antennas (usually around 20-25 ohms) back to 50 ohms. You will see in the following schematic an L1 and C3 network that is physically connected to the UNUN, also see the Relay Phasing Box picture above for the location of L1. You will note an copper strap jumper for L1, start with it fully shorting the inductor and test the SWR of your array. Using a small amount of power, or an antenna analyzer you can move the tap along the inductor to achieve the best SWR in broadside. For very short arrays **you may need to add some capacitance as shown in the schematic as C3 from the inductor to ground.** With careful adjustment you should be able to have a 1:1 SWR at your desired operation area of the band. There is a copper buss for adding capacitors on one side of the inductor or other. Extra capacitors are included in the kit.



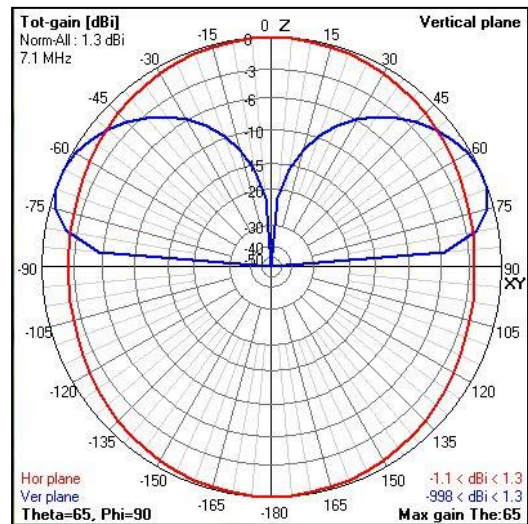
## Specifications

Construction	Corrosion resistant Aluminum metal box, painted and silkscreened
Power	5 kW CW / 10 kW PEP
VSWR	Less then 1.3:1 over the band of operation
Gain	3 dB over single vertical for the endfire cardioid patterns. 1.3 dB for the broadside bidirectional pattern.
Directions	3 directions with two cardioid endfire patterns and one broadside bidirectional pattern
Electronic phasing	Optimized Hybrid Coupler and LC network for OMNI mode
Phasing Options	0 degrees, and -90 degrees
Capacitors in networks	Temperature stable high current RF capacitors – NPO
Weight and size	Relay box: 12 lb, 11" x 6.5" x 3.625" (5.44 kg, 280 mm x 165 mm x 92 mm) Controller: 0.5 lb, 2" x 4" x 5" (0.23 kg, 51 mm x 102 mm x 127 mm)

Typical Endfire and Broadside Patterns, the elements are along the plots' horizontal axis



Endfire Patterns, E and H Planes



Broadside Patterns, E and H Planes



Thank you for purchasing this high quality antenna phasing system.