W9AD 2 Vertical multi band phase system

The system consists of three main components.
1. StackMatch II PLUS to power split and supply 180 degree phase shift. 180 degree phase shifter to feed antenna 1
2. Coaxial Phase Shifter
3. RATPak controller and StackMatch II controller

The diagram below depicts the setup of this system. The Antennas are usually set up to be 1/4 WL apart at the lowest frequency to be used and are fed with an equal but odd multiple of a ¼ WL long 50 ohm coax.

The system will produce a broadside pattern and an end fire pattern figure 8 as well as other lobes and nulls in the various directions as you change the combinations. One should model this antenna using EZNEC or some other antenna modeling program to determine the patterns which are available to the user on all bands of use.

A model of the system will allow you to simulate the different coaxial cable delay lines to find out which lengths yield the best pattern for your operation goals.

The multiband verticals can also be selected as a single antenna for omni-directional pattern.

Wiring the system is straightforward. The Stackmatch II PLUS manual will show you how to wire the control wire connections. And operate two antennas either singly, Both IN Phase (BIP), and Both Out of Phase (BOP)

Wire the Ratpack control wires 1 to 1 on the marked terminals from the ratpak controller to the large coaxial phase shifter box. In other words terminals 1,2,3, etc to 1,2,3 etc of both boxes. Also wire up the GND terminals. You will need to also wire in a 13.8V DC source to the controller switch in the shack.
Rig       RF

StackMatch II PLUS
Has built in 180 degree
Phase shifter

1 2 3 IN AUX GND
StackMatch II controller
RatPak Controller

Coaxial Phase Shifter

1 2 3 4 5 6 GND output terminals
RatPak Controller

coaxial phase lines 50 ohms – lengths are determined by modeling the array
StackMatch II PLUS for power splitting and 180 degree phase shifter

Coaxial Phase Shifter inside Terminal strip to be connected to the RatPak controller terminals numbers as below
1-1
2-2
3-3
4-4
5-5
6-6
Ground ret to Ground return

Phase Shifter – Connect the coaxial cables to upper and lower SO239s as shown 1 out to 1 in etc
Input connector and antenna connectors are on the sides and are marked as such.
Patterns Possible on 80/40 example

Two verticals spaced 66 feet apart and fed with 2 ¼ WL 75 or 50 ohm lines.

Having modeled the system we recommend that you build 6 (15 degree on 80, which would be 30 degrees on 40) long cables for 80 and 40m use.

Let's say you interested in 75m only. Using RG213 (VF=.666) they would be 6.9 feet long. A total of 6 of them are needed. And when used all together will result in a delay of 41.4 feet which is 90 degrees on 75 meters.

Modeling the array on 80/75 meters shows that the only real useful combinations are:

Both IN Phase (BIP) – StackMatch II selects both antennas, no delay, no 180 degree phase shift
Both OUT of Phase - StackMatch II selects both antennas, + 180 degree phase shifter is on
Endfire towards element 2 – Stackmatch II selects both antennas, + all 6 delay lines chosen
Endfire towards element 1 - Stackmatch II selects both antennas, + all 6 delay lines chosen, + 180 degree shifter on

Modeling the array on 40 meters shows that the only real useful combinations are:

Both In Phase (BIP) - StackMatch II selects both antennas, no delay, no 180 degree phase shift
Both OUT of Phase - StackMatch II selects both antennas, + 180 degree phase shifter is on
Antenna 2 delayed 90 degrees – StackMatch II selects both antennas and chose 3 delay lines in delay line selector
Antenna 1 delayed 90 degrees from antenna 2 – select 180 degree phase shifter from above combination. This will reverse the pattern from the above one.
80/75 meter plots
Fed 90 degrees out of phase the array can be endfire in one direction or the other if the phase shifter is flipped on.

Fed both in phase we get a slight oval pattern broadside to the array on 75/80 meters.
A 180 degree phase shift caused by powering the two elements both in phase and flipping the 180 degree shifter on.
40 Meter Patterns - Both In Phase

Antenna 2  antenna delayed -90 degrees  Notice the deep nulls created could be useful
Antenna 2 delayed 180 degrees

Azimuth Point  
Elevation Angle 25.0 deg.  
Outer Ring 4.18 dB

Cursor Az 0.0 deg.  
Gain 4.18 dB

Slope Max Gain 4.18 dB @ Az Angle = 0.0 deg.  
Front/Side 59.89 dB

Beamwidth 111.6 deg., 3-dB @ 104.3, 55.3 deg.  
Sideband Gain 4.18 dB @ Az Angle = 180.0 deg.  
Front/Side Ratio 0.0 dB

7.15 MHz