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.

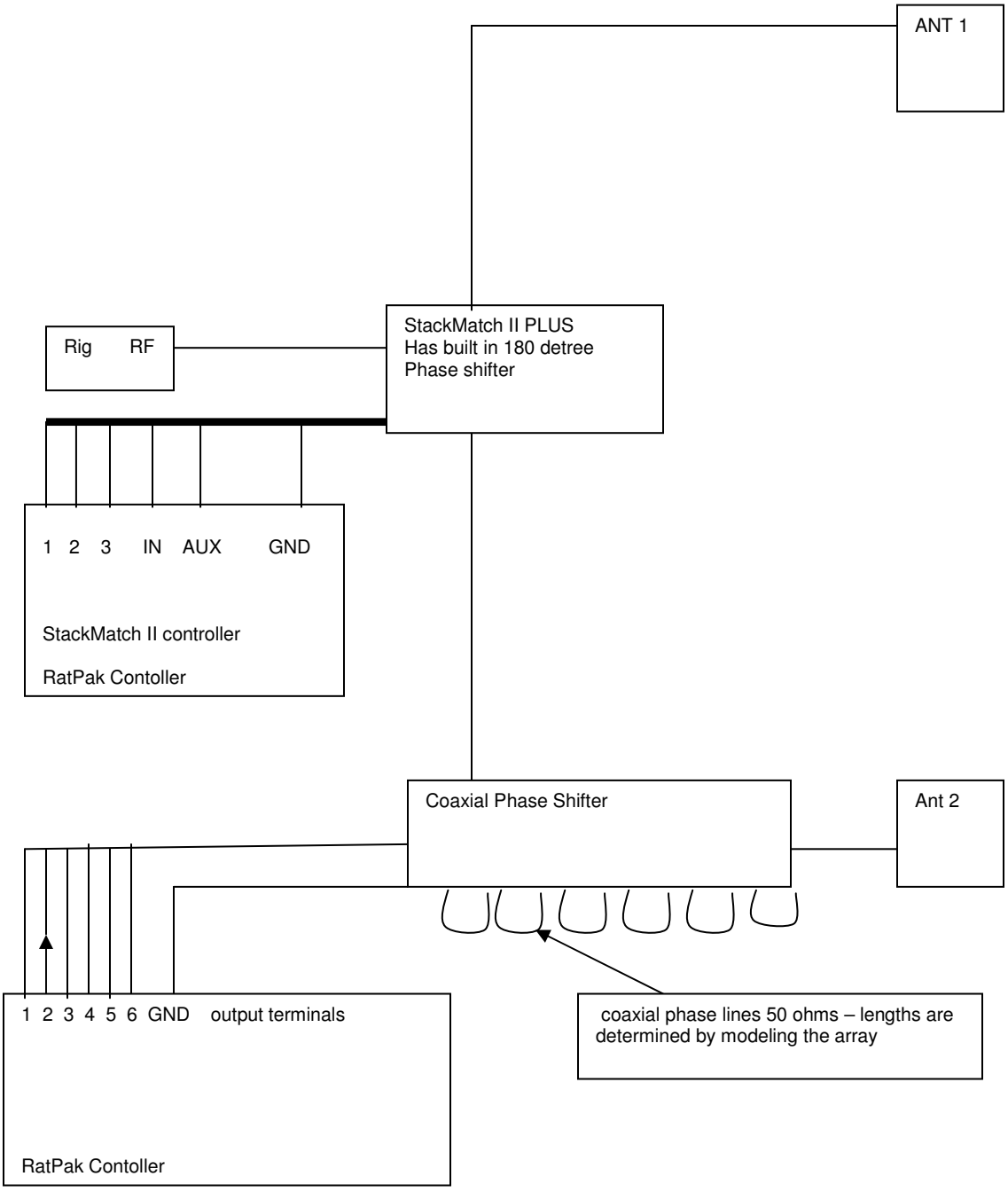
The system will produce a broadside pattern and an end fire pattern figure 8 as well as other lobes and nulls in the various directions as you change the combinations. One should model this antenna using EZNEC or some other antenna modeling program to determine the patterns which are available to the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


ANT 1
StackMatch II PLUS
Has built in 180 detree
Phase shifter
Rig RF
1 2 3 IN AUX GND
StackMatch II controller
RatPak Contoller
Coaxial Phase Shifter
Ant 2
1 2 3 4 5 6 GND output terminals
RatPak Contoller
coaxial phase lines 50 ohms – lengths are determined by modeling the array

StackMatch II PLUS for power splitting and 180 degree phase shifter

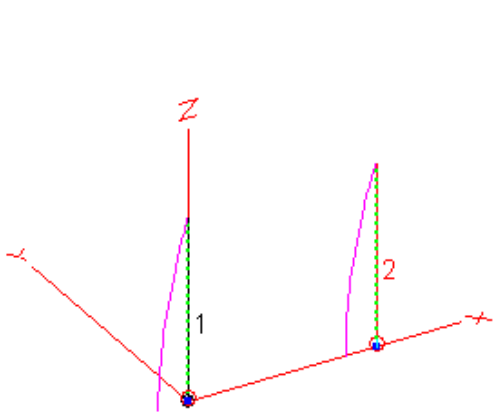
Coaxial Phase Shifter inside
Terminal strip to be connected to the RatPak controller terminals numbers as below
1-1
2-2
3-3
4-4
5-5
6-6
Ground ret to Ground return

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.
Lets say your 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:

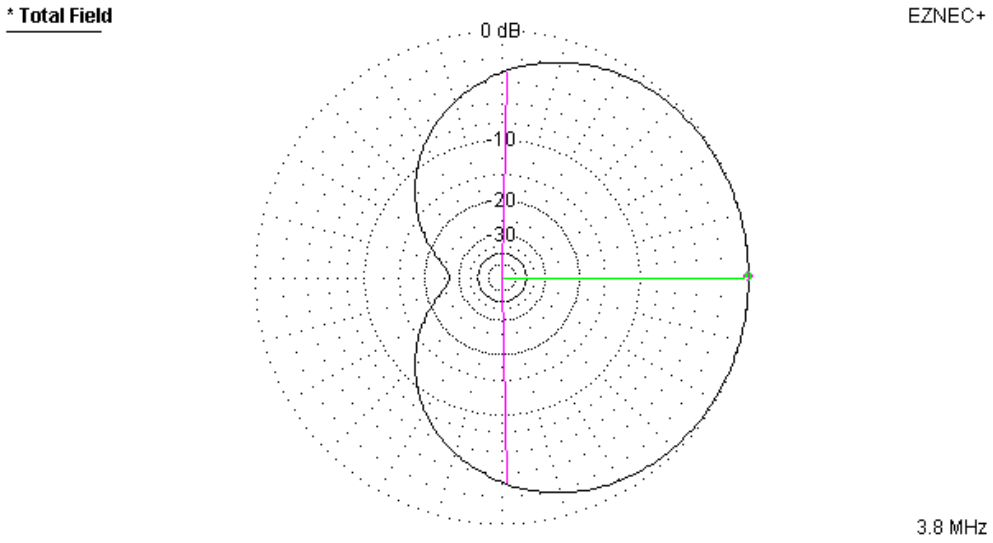
Both IN Phase (BIP) – StackMatch II selects both antennas, no delay, no 180degree phase shift
Both OUT of Phase (- StackMatch II selects both antennas, + 180 degree phase shifter is on
Endfire towards element 2 – Stackmatch II selects both antennas, + all 6 delay lines chosen
Endfire towards element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

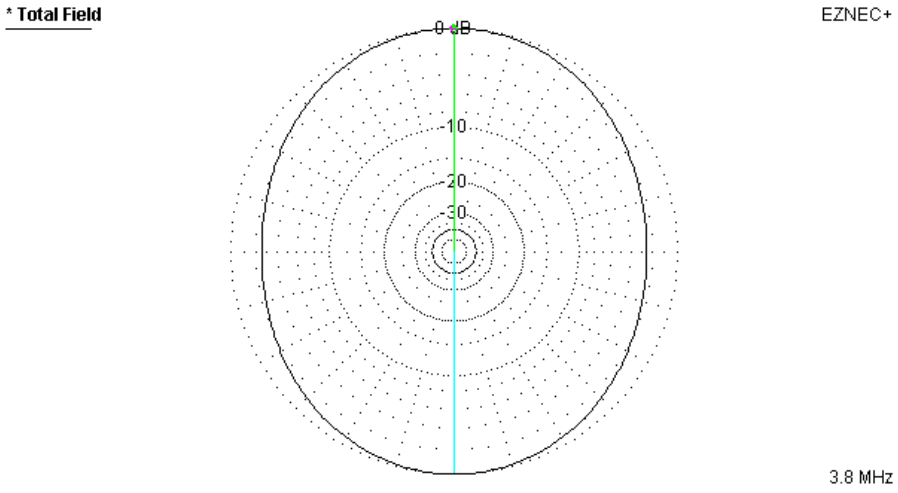
Fed 90 degrees out of phase the array can be endfire in one direction or the other if the phase shifter is flipped on



Azimuth Plot		Cursor Az	0.0 deg.
Elevation Angle	25.0 deg.	Gain	5.47 dBi
Outer Ring	5.47 dBi		0.0 dBmax

Slice Max Gain	5.47 dBi @ Az Angle = 0.0 deg.
Front/Back	26.38 dB
Beamwidth	177.4 deg.; -3dB @ 271.3, 88.7 deg.
Sidelobe Gain	< -100 dBi
Front/Sidelobe	> 100 dB

Fed both in phase we get a slight oval pattern broadside to the array on 75/80 meters



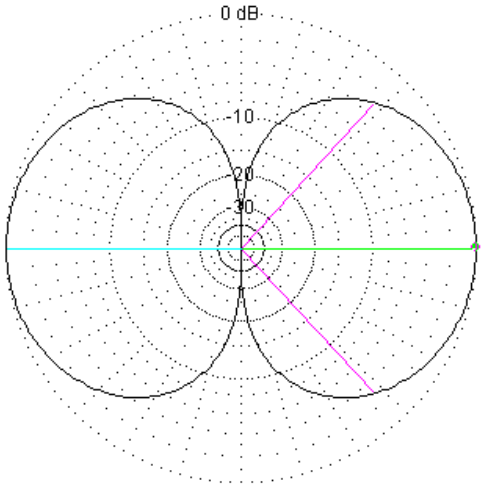
Azimuth Plot		Cursor Az	90.0 deg.
Elevation Angle	25.0 deg.	Gain	3.53 dBi
Outer Ring	3.53 dBi		0.0 dBmax

Slice Max Gain	3.53 dBi @ Az Angle = 90.0 deg.
Front/Side	2.52 dB
Beamwidth	?
Sidelobe Gain	3.53 dBi @ Az Angle = 270.0 deg.
Front/Sidelobe	0.0 dB

A 180 degree phase shift caused by powering the two elements both in phase and flipping the 180 degree shifter on

*** Total Field**

EZNEC+



3.8 MHz

Azimuth Plot	
Elevation Angle	25.0 deg.
Outer Ring	5.23 dBi

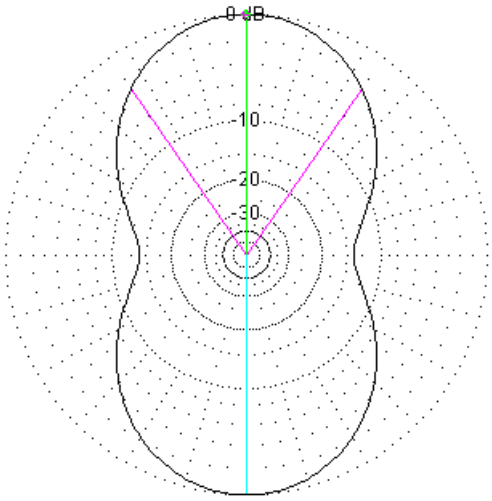
Cursor Az	0.0 deg.
Gain	5.23 dBi
	0.0 dBmax

Slice Max Gain	5.23 dBi @ Az Angle = 0.0 deg.
Front/Side	99.99 dB
Beamwidth	95.2 deg.; -3dB @ 312.4, 47.6 deg.
Sidelobe Gain	5.23 dBi @ Az Angle = 180.0 deg.
Front/Sidelobe	0.0 dB

40 Meter Patterns - Both In Phase

*** Total Field**

EZNEC+



7.15 MHz

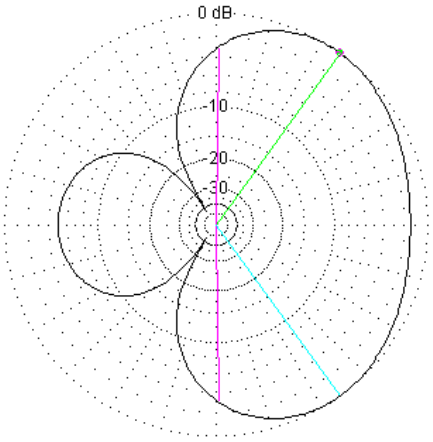
Azimuth Plot		Cursor Az	90.0 deg.
Elevation Angle	25.0 deg.	Gain	5.46 dBi
Outer Ring	5.46 dBi		0.0 dBmax

Slice Max Gain	5.46 dBi @ Az Angle = 90.0 deg.
Front/Side	13.84 dB
Beamwidth	70.0 deg.; -3dB @ 55.0, 125.0 deg.
Sidelobe Gain	5.46 dBi @ Az Angle = 270.0 deg.
Front/Sidelobe	0.0 dB

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

*** Total Field**

EZNEC+



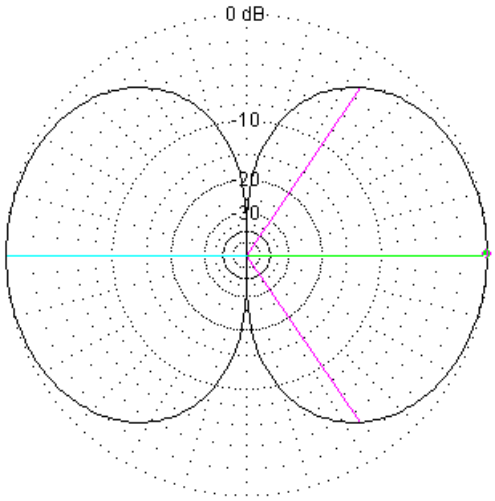
7.15 MHz

Azimuth Plot		Cursor Az	54.0 deg.
Elevation Angle	25.0 deg.	Gain	4.86 dBi
Outer Ring	4.86 dBi		0.0 dBmax

Slice Max Gain	4.86 dBi @ Az Angle = 54.0 deg.
Front/Back	28.8 dB
Beamwidth	178.4 deg.; -3dB @ 270.8, 89.2 deg.
Sidelobe Gain	4.86 dBi @ Az Angle = 306.0 deg.
Front/Sidelobe	0.0 dB

Antenna 2 delayed 180 degrees

*** Total Field** EZNEC+



7.15 MHz

Azimuth Plot		Cursor Az	0.0 deg.
Elevation Angle	25.0 deg.	Gain	4.18 dBi
Outer Ring	4.18 dBi		0.0 dBmax

Slice Max Gain	4.18 dBi @ Az Angle = 0.0 deg.
Front/Side	99.99 dB
Beamwidth	111.8 deg.; -3dB @ 304.1, 55.9 deg.
Sidelobe Gain	4.18 dBi @ Az Angle = 180.0 deg.
Front/Sidelobe	0.0 dB