

WELLBROOK K9AY PHASED ARRAY 500kHz to 2MHz

The **Wellbrook K9AY Phased Array** is a sophisticated Broadband Antenna System, designed for enhanced MW and 160m Ham band reception. This Antenna System is the only Broadband Phased K9AY to offer a uni-directional pattern similar to the Beverage, over 360 degrees with electronic Null optimisation. The design is the result of combining the Wellbrook Broadband Phase Loop array technology with a special K9AY antenna. This special K9AY uses a very low distortion phased match amplifier embedded into each Head Unit. The array is designed to provide a high front to back ratio and high rejection of rear high angle signals with a narrow front lobe. More importantly, there is the added ability for the user to optimise the F/B up to 50dB on steady signals; a must for MW Dxr.

The Phased Array has much higher directivity and F/B than a single K9AY, 2 element vertical and loop arrays. Also the array is far more tolerant of phase and amplitude variations compared to the 3 and 4 element Flag and vertical arrays.

The maximum RDF is about 11dB, this is on a par with a 660foot terminated Beverage and a 4 Square vertical array.

Phased Array Design: The Phased Array consists of a **Control Unit** and two **Special K9AY antennas**. Each K9AY requires just one support pole. The K9AY Phased Array can be expanded to use four K9AY antennas to provide 360 degree coverage.

The output of the two K9AY antennas are combined using a phase tracking technique known as “**Variable Cross-Fire**” i.e. the antennas are combined in anti-phase using a variable time delay equal to approx. 70% of the spacing of the antennas. This phase tracking technique provides a uni-directional reception pattern over a very wide bandwidth. This has a considerable advantage over the majority other phasing (noise cancelling phasing) systems which require constant adjustment even with small frequency changes.

Special K9AY antennas: Each K9AY Head Unit has a low noise **20dB** gain, high IOP2/3 close phase matched amplifier. This ensures that the array pattern tracks the design bandwidth. The use of the high gain amplifier together with a low capacitance antenna matching transformer provides very high antenna/feeder isolation, this ensures that any feeder pickup won't degrade the F/B. The Head Amplifiers are powered from the Control unit via the antenna feeders.

The Control Unit has an amplitude **Balance** control plus a **Unique Continuously Variable Delay-line** for the **Phase** control, this lets the user optimise the Front to Back ratio and for Null steering. The Control unit has two channels; Phase channel and an Amplitude channel. The Phase channel has the variable delay line and a very high dynamic range amplifier. The Amplitude channel provides the variable gain and also has a very high dynamic range amplifier. Both channels are buffered and are fed to the receiver output via a power combiner. A significant feature of the Phased Array, is complete antenna and receiver isolation. This prevents current from one antenna feeding back to the other antenna or changes in the receiver input impedance degrading the array performance. Most other phased arrays don't provide any significant antenna/receiver isolation!

K9AY PHASED ARRAY KEY FEATURES

- Uni-directional pattern similar to the Beverage
- High Front to Back ratio
- Up to 50dB null steering
- Head Amp. OIP3 +43dBm; OIP2 +80/90dBm
- Much lower IMD compared to active 4 square
- 360° with 4 Loops
- Simple to erect
- Min. real-estate; 20 to 40m ant. spacing
- Low noise high gain Head amplifiers
- Control Unit OIP3 +43dBm; OIP2 +75dBm
- Very high antenna isolation
- 12Volt DC power, ideal for Dxpeditions
- Antenna Factor; approx. 0dB at 1MHz, 40m antenna spacing

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The **K9AY Phased Array** is available in two versions:

1. **2 K9AY**; supplied complete with the Control Unit, 2 K9AY Head Amplifiers. Additional K9AY Head amplifiers can be purchased to upgrade to a the 4 direction array.
2. **4 K9AY**; supplied complete with the Control Unit, 4 K9AY Head Amplifiers.

The user must provide: The Antenna support poles, ground rod and the antenna wire, the RG58c feeder cable and a 12v 500mA regulated power supply

The Phased Array is very simple to use, with just 3 controls; Direction, Phase and Balance. The Antenna input and Receiver are 5 BNC, a Binding Post for the K9AY beam reversal wire and a standard 2.1mm dc connector for the 12 Volt power supply.

The Control Unit is housed in a grey powder coated die-cast enclosure, 6.75" x 4.75" x 2.1" (117x112x56mm)

Phased Array Operation: Connect the Receiver the loop antenna feeders to the respective Control Unit connectors. Also connect the 12volt power supply to the Control Unit. The Phase and Balance control should be set to the middle position.

Tune the receiver to a station (mid band) with a steady signal that is approx. in line with loops selected by the Direction switch. Then change the direction switch for the same loop pair. The signal should be lower by several dB with Direction switch set to the 180 degrees from the station. Then adjust the Balance and the Phase controls to increase the null. Over the MW band the Front to Back ratio should be approx. 30dB, tweaking the controls should allow for station nulling of up to 50 dB. However, some experimentation with all the controls may be required to obtain the best null especially when the signals are fading.

Maximum F/B will normally be +/- 60 degrees off the back of the antenna.

Antenna Positioning: The basic 2 K9AY system requires the antennas to be spaced between 20 to 40m. The K9AYs are positioned in line relative to each other i.e. one K9AY is positioned North and the other K9AY is placed 20 to 40m to the South. Where the 4 K9AY system is deployed, the other 2 K9AYs are position as above but in East and West direction. The K9AY antennas should be positioned as far as possible from buildings, and sources of interference. In most cases satisfactory results will be obtained by mounting the antennas at least 30m away from buildings. See *Fig. 1*.

Figure 2 shows a typical K9AY antenna. The antenna loop is approx. 8m high with a 9m base. The K9AY head Amplifier is connected at the centre of the base wire. A user-provided 8m high pole supports the antenna loop wire. Two 1.5m user-provided poles, support the ends of the base wire. The centre of the base wire should be approx. 1 metre off the ground. Alternatively, the K9AY antenna can be a triangle 7m high with a 12m base 1m above the ground. The Head Amplifier Earth terminal is connected to a user provided 4 foot ground rod.

Note 1: The K9AY mast must be non metallic, two K9AY heads must not share the same mast

Note 2: Nearby overhead cables etc, wire fences and metal structures can upset the antenna pattern

Note 3: 20m antenna spacing will provide approx. -6dB lower gain.

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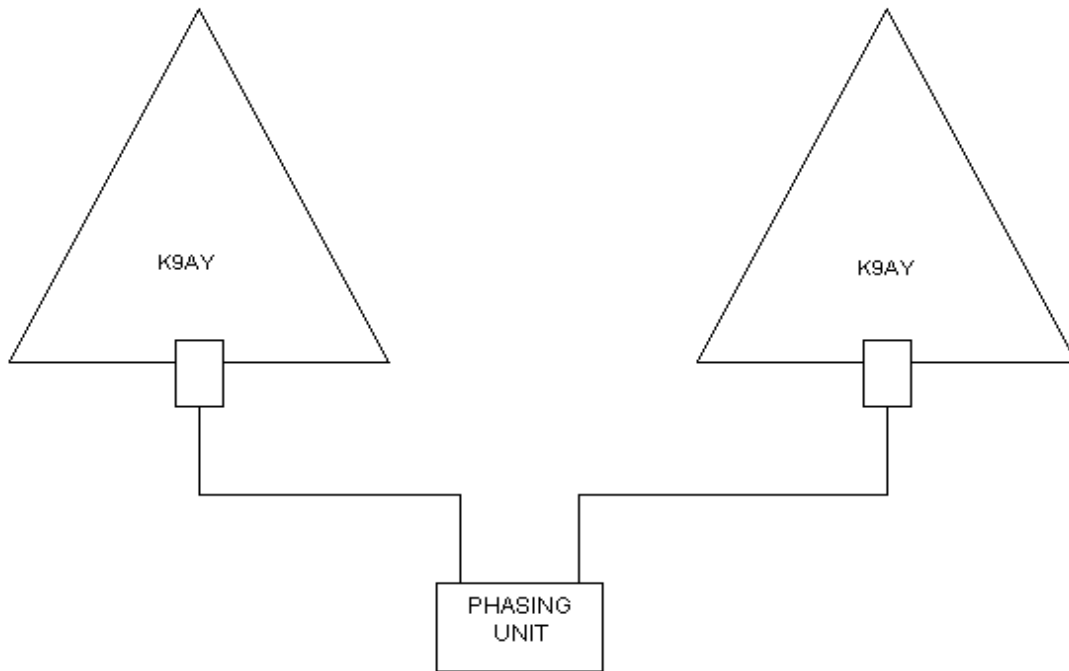


Figure 1. Typical installation

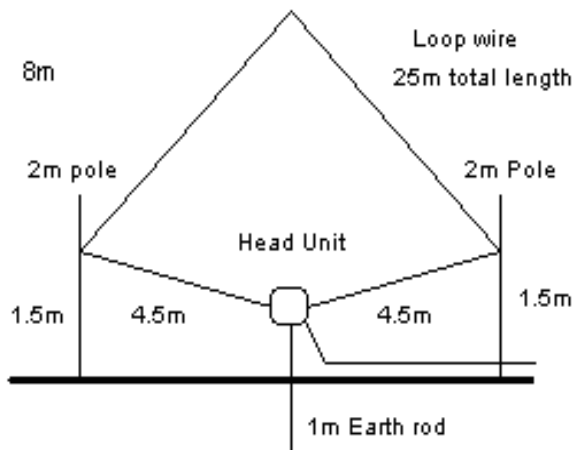


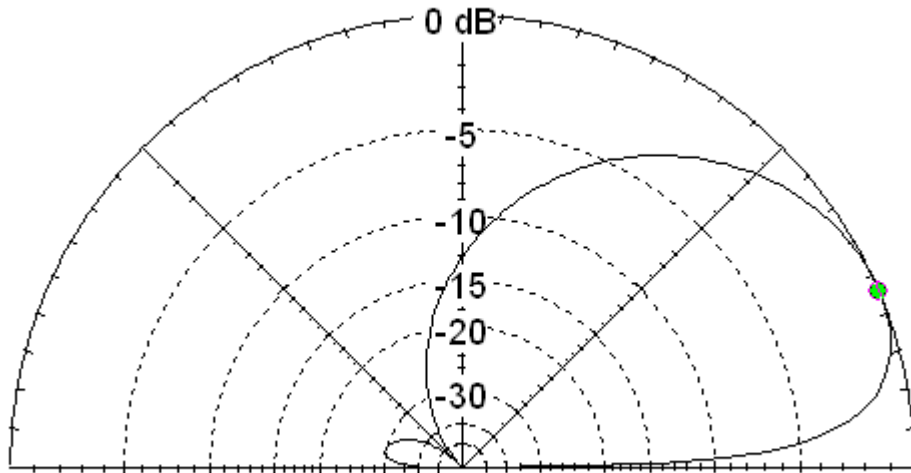
Figure 2. K9AY Antenna

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The plots below show the improved directivity afforded by the K9AY array compared to an active vertical array and a single K9AY.

Total Field

EZNEC+

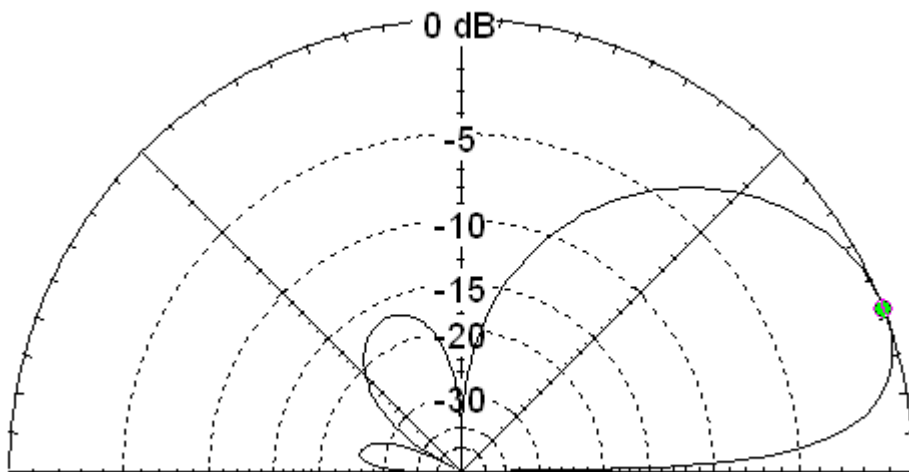


1.06 MHz

K9AY Array Elevation

Total Field

EZNEC+

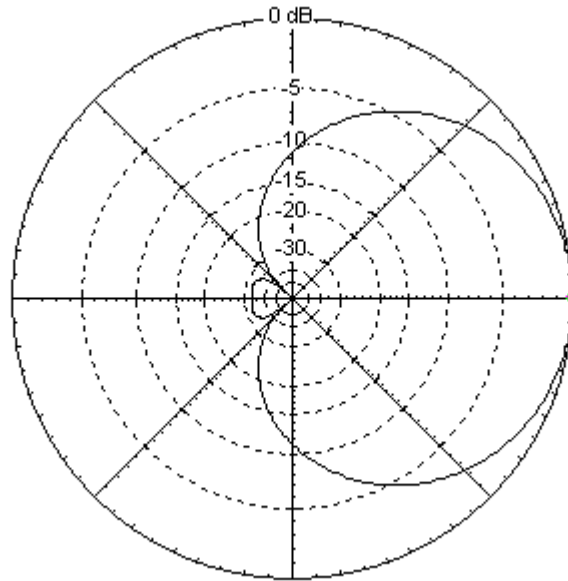


1.06 MHz

2 Active Vertical
has too high rear response

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Total Field

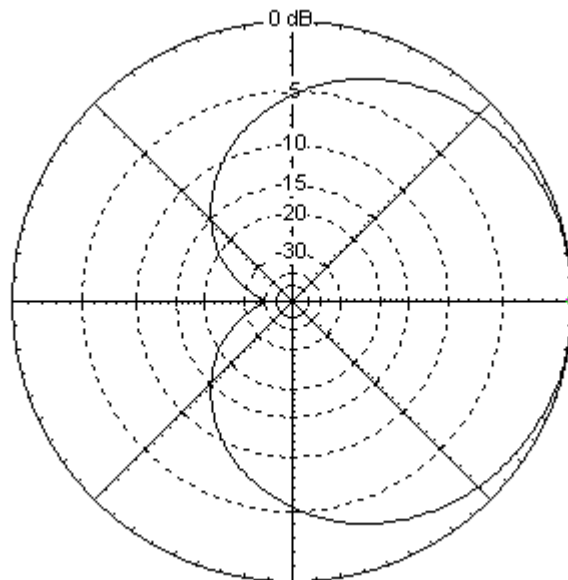


EZNEC+

1.06 MHz

K9AY Array Azimuth

Total Field



EZNEC+

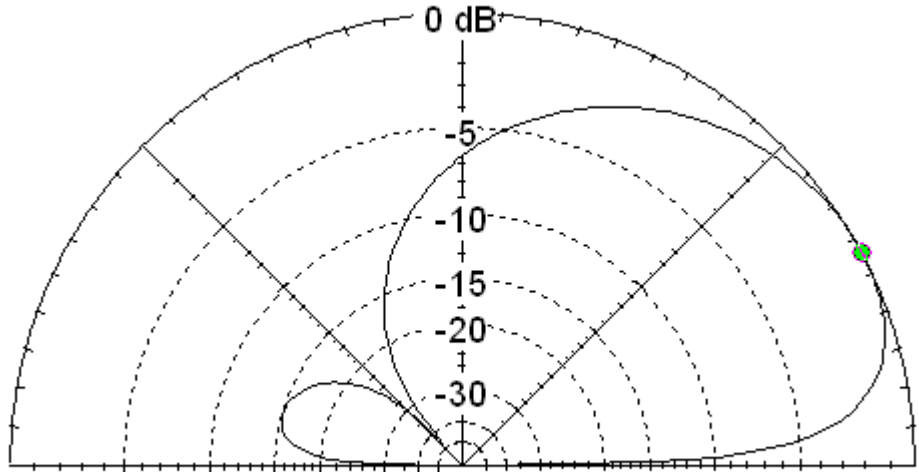
1.06 MHz

2 Active Vertical Array Azimuth
has much lower rear signal rejection

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Total Field

EZNEC+

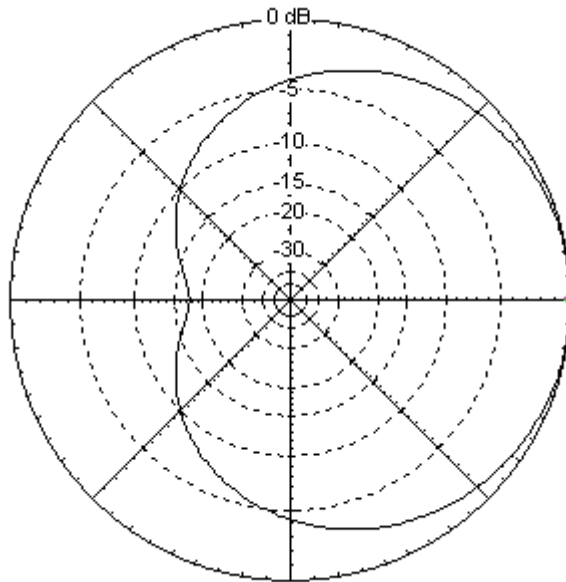


1.06 MHz

Single K9AY Elevation

Total Field

EZNEC+



1.06 MHz

Single K9AY Azimuth