

Four-Square Arrays

**ACB-4-A Series: COM-ACB-160-A, COM-ACB-80-A,
COM-ACB-40-A, COM-ACB-30-A, COM-ACB-20-A**

COM-ACB-A-INS-Revision 6



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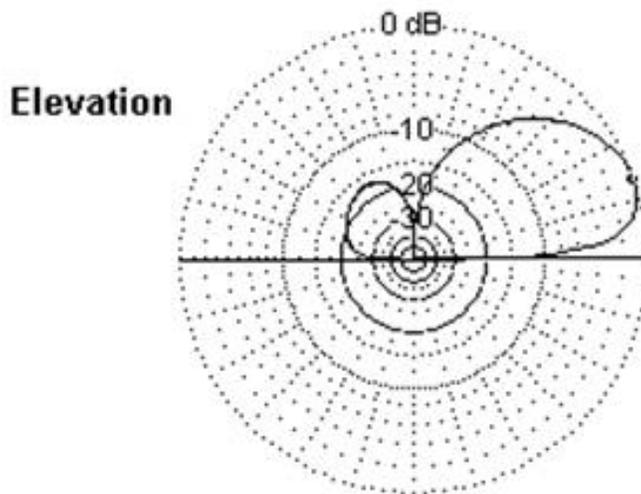
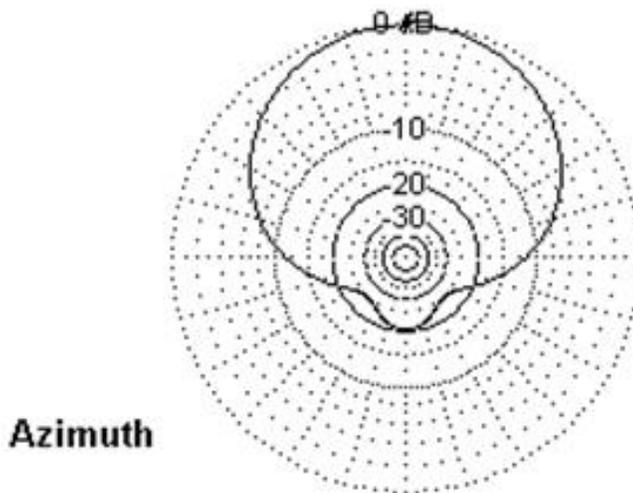
Congratulations! You are now the proud owner of a COMTEK ACB-4 Hybrid Four-Square Phasing System for use in a mono-band phased array. These systems offer reliable, enhanced operations for many years and have been proven to be a powerful weapon in the arsenal of the contester and DXer. Connected with quarter-wave phasing feedlines to four ground-mounted verticals, these hybrid systems allow the user to steer the pattern of the array to one of four directions. COMTEK ACB-4 Hybrid phasing systems are affordable and are simple to install and use. They are designed and built with specific, high quality components for a single band, available for the 160, 80, 40, 30 and 20 meter bands.

4-Square Array Radiation Patterns

These phased arrays consist of four elements fed with a particular phase and power ratio to obtain a directional pattern.

Each element of the array can be fed with different amounts of power and phase relationships to obtain this directional pattern, providing good gain and front-to-back and front-to-side ratios.

COMTEK phased array relay units used with 4 vertical elements. Our 4-square vertical array offers very good directivity.



**4-Element
4-Square Array**

4-Square Array

More gain and better front-to-back and front-to-side ratios are possible using a 4-element array. Four separate verticals are arranged in a square -- a 4-Square Array -- one vertical at each corner of a square. The square is one quarter wavelength on a side. Its pattern is directional across each diagonal of that square. In other words, it beams across opposite corners of the square. The COMTEK ACB-4 provides the correct power and phase division between these 4 vertical elements and a switch matrix which allows rotation of the relative powers and phases allowing 4 separate directions at the flick of a switch from your operating position.

The exterior Relay Unit of the ACB-4 contains all the switching and phase and power controls using hybrid toroids. No coax cables are hanging at the switchbox. You switch 90 degrees at each of the 4 switch settings-providing a full 360 degrees of coverage.

ACB-4 HYBRID PHASING COUPLER SPECIFICATIONS

The ACB-4 is band specific. You cannot use an 80M ACB-4 for any band other than 80M. In order to meet your needs, we offer the ACB-4 for other amateur bands.

CONTROL CONSOLE

- Operation on 12 to 13.6 Vdc, well filtered, 2 amp minimum
- Heavy duty diodes with RF bypass caps
- Current limiting resistor protection for each LED
- Chassis and cover custom manufactured to our specifications.
- Label made for recording your favored directions
- Compact size: 2-3/8" H x 6-1/4" W x 5-1/2" D



90 DEGREE HYBRID-RELAY UNIT

- High amperage gold plated contact relays with dust covers
- PTFE silver stranded wire over fiberglass tape wound toroids
- Balanced temperature, frequency and voltage stable capacitors
- Laboratory analyzed for improved performance
- Double-sided printed circuit board
- Two kW conservative rating for Amateur Radio Service
- MOV's for lightning surge protection with RF bypass capacitors
- Size: 4" H x 6" W x 8-1/2" D
- Brushed aluminum finish Z-Chassis and Cover with riveted seams



Manual Updates and Information

Every effort is made to supply the latest manual revision with each product. Occasionally a manual will be updated between the time your COMTEK product is shipped and when you receive it. Please check the DX Engineering web site (www.dxengineering.com) for the latest revision manual.

INSTRUCTIONS

The ACB-4 consists of a control console and the hybrid relay unit. They are connected via a three conductor control cable. Our tests have used 1,500 feet of 24 AWG wire. For those with long runs, 18 AWG control cable should be adequate.

The heart of a four-square system is the COMTEK ACB-4. As with any antenna system, the vertical radiators themselves are vitally important. The following types of vertical antennas have been successfully used worldwide:

- 1) Conventional ground mounted 1/4-wave verticals - available from DX Engineering
- 2) 1/4-wave elevated ground plane verticals

The ACB-4 Relay Unit contains two hybrids and the necessary switching matrix to provide correct phasing to each of the four elements 0 & -90 and -180 & -90 degrees.

RF power division is also accomplished with the ACB-4 so all ports get an equal power split. Due to mutual coupling within the array, each element will present different impedance; i.e. different from the impedance of a single element.

If all elements are not the same, your system may not be symmetrical and an imbalance may result. Be careful to make each vertical radiator as identical as possible.

The physical layout of the array is also important. Elements should be symmetrical in placement, within one foot of each measured location.

Use of a good radial system is paramount with any high performance earth mounted vertical antenna system. With a vertical antenna system, the radials are the second half of the antenna. They also act like a screen, shielding radiation from the lossy earth below the radials. Radials greatly influence radiation efficiency of a ground-mounted vertical antenna system.

Use of the DX Engineering **DXE-RADP-3** Stainless Steel Radial Plate is an ideal solution to having a symmetric and well designed radial system. Mount a **DXE-RADP-3** to the 2" OD (maximum OD is 2") mounting pipe at each of the vertical antennas using a **DXE-SSVC-2P** Stainless Steel V-Clamp.

For best performance, refer to **Table 1** for the radial system required for the band of operation. In most cases peak performance actually comes with as few as 20 or 30 radials. At that point the array stops rapidly increasing in field strength as radials are added. 32 radials is generally a very comfortable number when cost vs. efficiency is considered. Payback is generally only a fraction of a dB when more than 40 radials are compared to 20-30 radials. In any event, it is never necessary to use more than 50 or 60 radials. Dozens of studies have proven there is very little change in efficiency beyond 50 radials, regardless of soil type. DX Engineering **DXE-RADW** Radial Wire, a stranded copper 14 gauge relaxed PVC insulated copper wire is suggested for the best results.

Band of Operation	Minimum Number of Radial Wires	Maximum Length of each Radial Wire	Minimum Length of each Radial Wire
160 Meters	32	130 Feet	65 Feet
80 Meters	32	65 Feet	32.5 Feet
75 Meters	32	65 Feet	32.5 Feet
40 Meters	32	33 Feet	16.25 Feet

Table 1 - Radial Wire Lengths

Not all of the radial wires will be 1/4-wavelength long. Since the four vertical antennas are spaced 1/4-wavelength apart, the radial fields would cross each other. At the point where the radial fields do cross, they can be cut and bonded together with intersecting radials from the adjacent radial fields, as shown in **Fig 1**.

The wire radials should be placed as symmetrically as possible straight from the feed point around each of the vertical antennas and spaced evenly, regardless of how many radials are used. Do not run radials parallel or in bundles and avoid bending radials to extend the length. This nullifies or reduces radial effectiveness.

If you have limited space, put in as many straight radials as you can. Radials must be connected to the antenna feedline shield. The DX Engineering **DXE-RADP-3** Stainless Steel Radial Plate is an ideal optional item for making radial connections. The corrosion resistant stainless steel plate provides an excellent reliable system for attaching radial wires to your vertical antenna system feed point.

Radial wires can be laid in shortly mowed grass using DX Engineering **DXE-STPL-100K/BD** Steel or Biodegradable Radial Wire Anchor Staples to hold them down. Use enough staples to ensure the wires will not be snagged by mowers, people, or animals. Grass will quickly overgrow the radial wires and it will be virtually impossible to see them. An article describing this process is available on the DX Engineering website in the **Tech Support** section. Radials can also be buried just under the surface by using a power edger or single blade plow to make a slit in the soil.

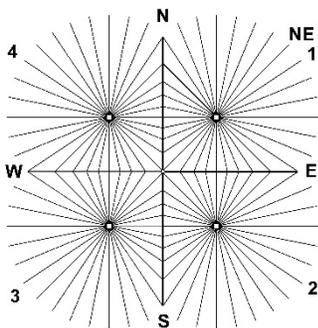
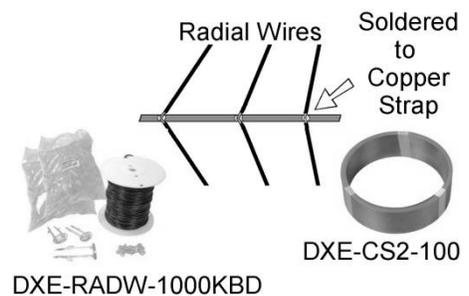


Figure 1 - Typical Radial Field

When the radial field is set up for the four vertical antennas, copper strap or heavy solid buss wire should be used to provide cross bonding of the radials that meet each other.



The four-square array is directional across its diagonals. When laying out your array, make certain you know the difference between true north and magnetic north (using a compass) for your QTH and place the elements accordingly to true north. Remember that you will be beaming across the diagonals. Using the formula **246/f (MHz) should determine spacing along the sides of the square** for best pattern results. This means the diagonal distance will be 1.41 X 246/f (MHz).

Other spacing close to this value may work, but the characteristics of the main lobe will change gain, directivity and front-to-back. Time spent in laying out a symmetrical installation will pay solid dividends. The system is forgiving, but the best front-to-back is obtained when symmetry is maintained and with each element resonant on the same frequency and with each antenna base at the same elevation. Use $234/f$ (MHz) for the vertical and radial length.

The ACB-4 uses a Quadrature hybrid in toroid form to obtain 90 degree phase shifts. This device is a four-port hybrid and one port must be terminated with a 50-ohm dummy load. **This termination is vital!** When the array is working well, with all elements resonant, there is typically less than 5% power dissipated by this load. However, when an element is open, shorted, or not resonant at the same frequency as other elements, this load will dissipate power. A test for your system is to measure the power between the ACB-4 and the dummy load. The lower the power reading, the better your system is performing. Coax between the load port and the dummy load may be any convenient length of 50-ohm cable. A length of 50-ohm cable to the operating position connected to a wattmeter and the dummy load will allow simultaneous operation and monitoring the power level to the load.

Front-to-back is affected by the balance between elements. If you want good front-to-back, pay attention to the details of making each element the same and ensure the array is symmetrical. Using the Four-Square vertical array, you will notice the best front-to-back on low angle signals. Signals arriving at high angles see all elements in the array at the same time (no phase delay is possible) and therefore may display small front-to-back ratios. Don't worry if this happens; just wait for low angle signals to test your system.

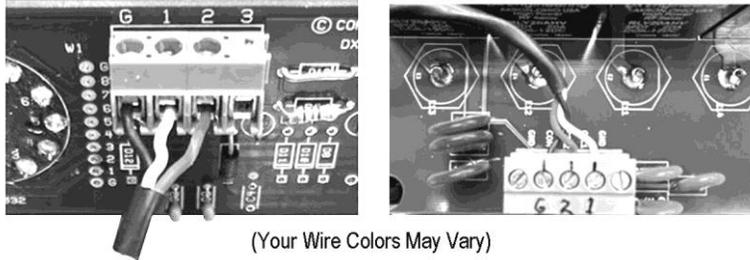
Tuning the vertical elements (use this procedure with any type element)

(See additional Tuning Notes from K3LR on Page 14)

- 1) Install one vertical element and install the ground radial system. ($234/f$ (MHz))
- 2) Connect a short 50-ohm cable and antenna analyzer to the first vertical element feed point.
- 3) Tune the quarter-wave element to resonance (defined as the least amount of power in the load) approximately 4% lower than the desired array center frequency. Due to mutual coupling, the array will shift up approximately 100 kHz when all verticals are connected and fed from the ACB-4 Hybrid Relay Unit. Our experience has shown reduced mutual coupling with less than 1/4-wave sized elements, 1/4-wave wire elements.
Examples: For an 80 meter system tune each element at 3.550 kHz for a center frequency of 3.650 kHz mid-range coverage. For a 40 meter system tune each element at 7.000 kHz for a center frequency of 7.100 kHz.
- 4) Disconnect 50-ohm feed line. One at a time, make sure the remaining elements identical to the first element.
- 5) Drive a 1-1/4" to 1-1/2" outside diameter pipe into the ground at the array center. Install the hybrid relay unit with supplied U-Bolt.
- 6) Connect all the vertical elements with 1/4-wavelength 75-ohm RG-11U foam coax to their respective ports on the ACB-4 relay unit.

Use cable tags to identify coaxial cable from each vertical element and place several inches below connectors at the ACB-4 relay unit. This will aid in properly installing the cables if disconnected for any reason.

- 7) Connect a 50-ohm dummy load to load port via 50-ohm coax.
- 8) Connect the 50-ohm feed line from ACB-4 relay unit to the transmitter.
- 9) Connect a 3 conductor cable to terminals inside the control console and the ACB-4 relay unit.



Use the included Ty-Wrap on the cable as shown to avoid accidentally pulling the cable out of the control box.



A 2.1 mm power cord is supplied with unit. The wire with the white stripes is the +12 Vdc line.



Outer Connection is GROUND  **Center Pin is +12 VDC.**

Power used must be +12 Vdc, well filtered at 2 amps (fused) minimum.

All Models Ship with the DC powered ACB-4 Control Console

1	Northwest
2	Northeast
3	Southeast
4	Southwest

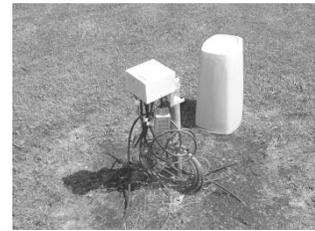


The output of the Control Console is as follows:

POSITION		TERM. 1	TERM. 2
1	Northwest	12-14 Vdc	12-14 Vdc
2 (Default)	Northeast	None	None
3	Southeast	12-14 Vdc	None
4	Southwest	None	12-14 Vdc

Voltage level depends on DC voltage used to power the Control Console.

For those customers in high snowfall totals or pesky wildlife, an 8 gallon plastic trash can, may be obtained and placed over the ACB-4 relay unit to prevent snow from building up to the connector ports.



We recommend you install the coax cables so position 2 on the inside control is your most favored direction. Position 2 is the default position and does not supply any voltage to the relays. This means when the control box is off, you are beaming in the direction of position 2.

NOTES

- 1) As an example, most types of RG-11 foam coaxial cable have a velocity factor of 78%.

The formula for a specific frequency is: $246/f \text{ (MHz)} \times .84 = \text{length in feet}$. This works out to 50 feet 6 inches at 3.800 **after measuring for an electrical 1/4 wave. Foam RG-11 coax** must be used to reach the antennas. DX Engineering **DXE-11U** Coaxial Cable is ideal.

CATV hardline velocity factors are typically .81% or higher. Polyethylene coax with a velocity factor of .66 will not reach the antennas.

Your VSWR should be less than 2:1 from 3.5-3.8 MHz with full size aluminum vertical elements, with 5% or less of transmitted power "dumped" into the 50-ohm load.

- 2) See the *ARRL Antenna Handbook* chapter on "Antenna Orientation" for details on how to determine true north for your QTH. Using only a compass with no correction can cause the array to be off by as much as 30 degrees.
- 3) **Do not HOT SWITCH, i.e. transmit while switching. THIS CAN DAMAGE THE RELAY. HOT SWITCHING is NOT covered under warranty.**

**WARNING ! DO NOT INSTALL ANTENNAS NEAR POWER LINES!
METAL OBJECTS TOUCHING HIGH VOLTAGE LINES CAN CAUSE SERIOUS OR
FATAL INJURIES!**

**QUARTER-WAVE (1/4w) FEEDLINE SET-UP FOR FAVORED DIRECTION USING
DEFAULT POSITION**

RELAY UNIT PORTS:	#1	2	3	4
Directions:	NW	NE	SE	SW
(This is normally used by North American stations.)				

The following setup directions are for other parts of the world. Remember Position 2 is the favorite direction:

RELAY UNIT PORTS:	#1	2	3	4
	SW	NW	NE	SE
	NE	SE	SW	NW
	SE	SW	NW	NE

Position 2 is the default position, i.e., the array favors this direction when no power is applied to the relays.

Position 1 applies voltage to all relays, which are closed.

Position 2 no voltage and all relays open

Position 3 applies voltage and closes relays RLA1A, RLA1B, RLA2A, RLA2B .

Position 4 applies voltage and closes relays RLA3A and RLA3B.

IF any two antenna connections are not in the proper ports, the array will not function correctly and a higher SWR will result.

COMTEK SYSTEMS ACB-4 4-SQUARE SETUP DIMENSIONS

160 = 1.835

Spacing = 134 feet

Diagonal = 189 feet

Foam Coax = 104 feet 6 1/2 inches (RG-11 @ 78% to 81% VF minimum is required.)

ACB-4 to any vertical = 94 feet 6 inches (78% minimum figures shown)

80 = 3.500 (Favors CW Operation)

Spacing = 70 feet 3 inches

Diagonal = 99 feet

Foam Coax = 54 feet 9-1/2 inches

ACB-4 to any vertical = 49 feet 6 inches

30 = 10.125

Spacing = 24 feet 3 inches

Diagonal = 34 feet 3 inches

Foam Coax = 18 feet 11-1/4 inches

ACB-4 to any vertical = 17 feet 1-3/4 inch

80 = 3.650 (Favors CW & Phone Operation)

Spacing = 67 feet 4 inches

Diagonal = 95 feet

Foam Coax = 52 feet 6-1/2 inches

ACB-4 to any vertical = 47 feet 6 inches

20 = 14.200

Spacing = 17 feet 3 inches

Diagonal = 24 feet 4-1/2 inches

Foam Coax = 13 feet 6 inches

ACB-4 to any vertical = 12 feet 2-1/4 inches

80 = 3.775 (Favors DX Phone Window)

Spacing = 65 feet 1-3/4 inches

Diagonal = 91 feet 10 inches

Foam Coax = 50 feet 9-1/2 inches

ACB-4 to any vertical = 45 feet 11 inches

40 = 7.100

Spacing = 34 feet 7 inches

Diagonal = 48 feet 10 inches

Foam Coax = 27 feet

ACB-4 to any vertical = 24 feet 5 inches

Band of Operation	Minimum Number of Radial Wires	Maximum Length of each Radial Wire	Minimum Length of each Radial Wire
160 Meters	32	130 Feet	65 Feet
80 Meters	32	65 Feet	32.5 Feet
75 Meters	32	65 Feet	32.5 Feet
40/30/20 Meters	32	33 Feet	16.25 Feet

Radial Wire Lengths

Not all of the radial wires will be 1/4-wavelength long. Since the four vertical antennas are spaced 1/4-wavelength apart, the radial fields would cross each other. At the point where the radial fields

do cross, they can be cut and bonded together with intersecting radials from the adjacent radial fields, as shown in **Fig 1**.

The wire radials should be placed as symmetrically as possible straight from the feed point around each of the vertical antennas and spaced evenly, regardless of how many radials are used. Do not run radials parallel or in bundles and avoid bending radials to extend the length. This nullifies or reduces radial effectiveness.

Comtek 4-Square typical performance:

Directivity is diagonal-through each of the two sets of verticals.

Gain:	4 dB over single vertical
Beam width:	+/- 46 degrees
Front-to-Back	> 20 dB over 120 degrees
Front-to-Side	> 15 dB
Rotation time:	< 1 second
Directions:	4 - Across diagonals
Required Footprint:	Including radials
160M (1.835)	400 X 400 feet
75/80M (3.650)	200 X 200 feet
40M (7.100)	105 X 105 feet
20M (14.200)	51 X 51 feet

Array Layout Examples:

X-1 X-2

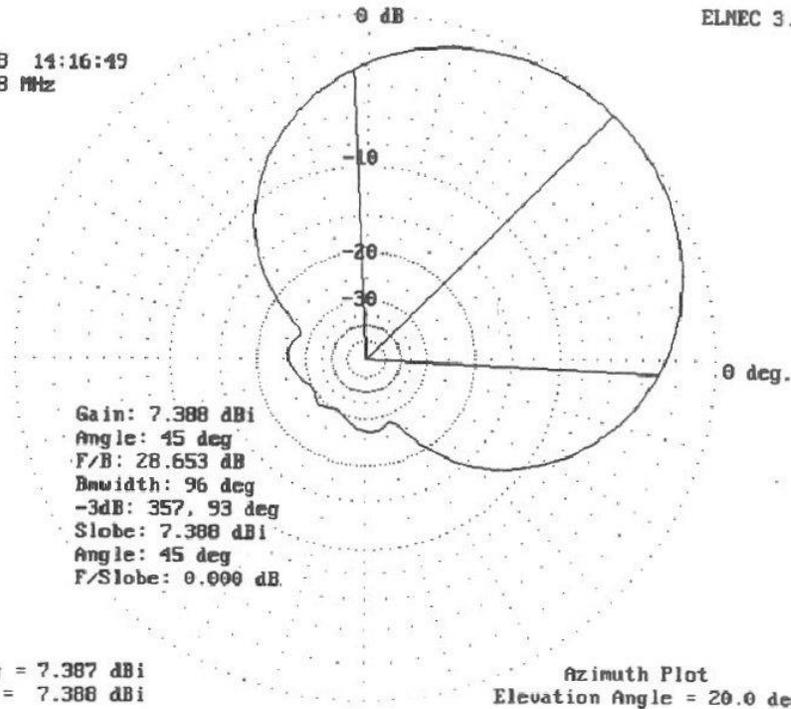
X-4 X-3

Band	Freq. MHz	X-1 to X-2. X-2 to X-3. X-3 to X-4. X-4 to X-1	Diagonal X2 to X4	Diagonal X1 to X3
160	1.835	134'	189'	189'
80	3.500	70' 3"	99'	99'
80	3.650	67' 4"	95'	95'
80	3.775	65' 2"	92'	92'
40	7.100	34' 7"	48' 10"	48' 10"
30	10.125	24' 3"	34' 3"	34' 3"
20	14.200	17' 3"	24' 5"	24' 5"

88m-70

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Freq = 3.8 MHz

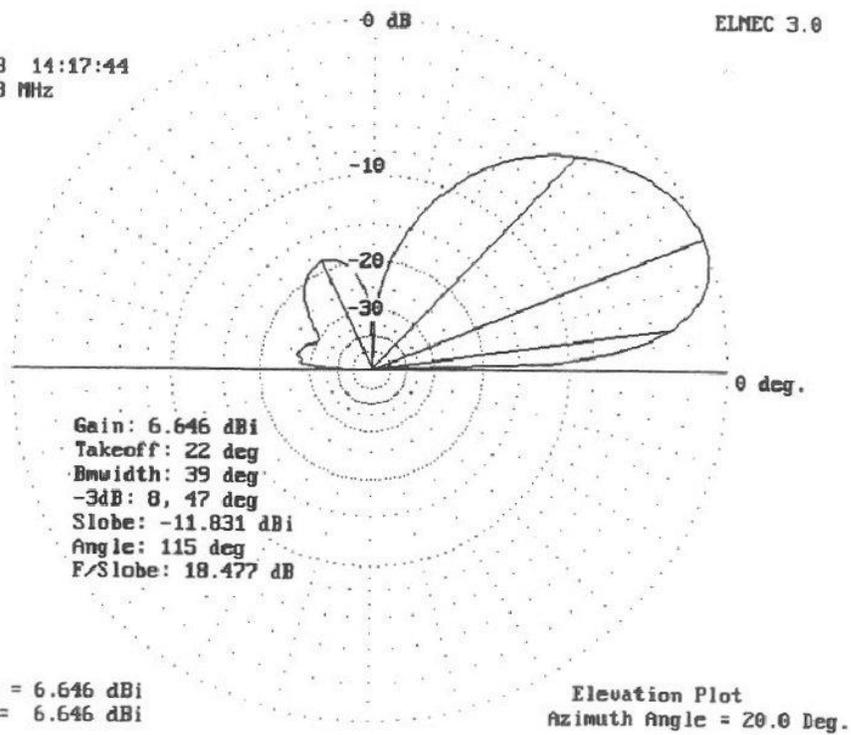
ELNEC 3.0



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Freq = 3.8 MHz

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TROUBLESHOOTING AND MISCELLANEOUS

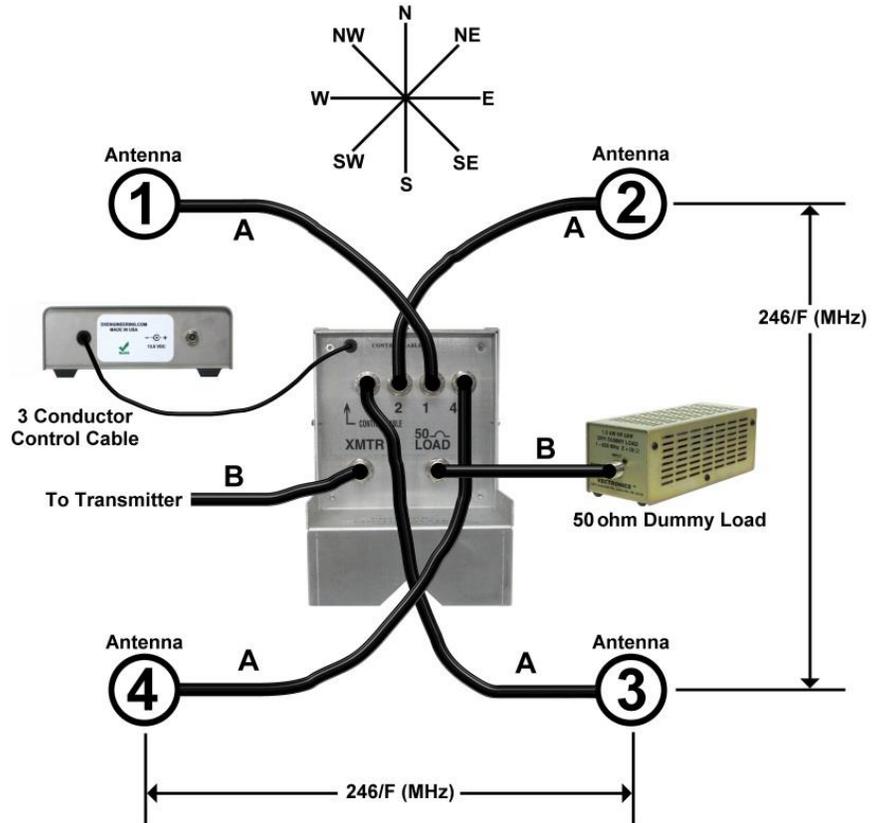
The **Cable ID Tags** should be numbered 1, 2, 3, and 4, and placed on the 1/4-wave coax lines from each antenna at the hybrid coupler relay unit port end. This will prevent an out of sequence connection, which will result in poor performance. A waterproof marker used to number the tags is recommended.

TYPICAL NORTH AMERICAN EXAMPLE

Position 1 = Northwest
Position 2 = Northeast
Position 3 = Southeast
Position 4 = Southwest

These are the favorite directions for North America users. Remember, Position 2 is the default position when power is off, the array will beam towards Europe (Northeast).

Insure DC power is OFF prior to connecting the 3 conductor control cable to the hybrid terminal strip.



Initial test should be with transmitter in low power position.

A = 1/4 Wavelength of 75 ohm Foam coaxial cable at .78 Velocity Factor or greater
B = Any length of 50 ohm Coaxial Cable

Never switch relays while transmitting. "HOT SWITCHING" at HIGH power levels will damage the relays and possibly the transmitting equipment.

Hot switching at 50 to 75 watt power levels is acceptable and will aid in the cleaning of the relay contacts by rotating the control switch from Position 1 to Position 2 then back to 1. Repeat this sequence several times when 'cleaning' relay contacts.

Comtek stocks two sizes of RF beads which slip over RG-11 foam or RG-59 foam coax. These beads choke RF from flowing on the shield, resulting in cleaner patterns.

SIMPLIFIED POWER MONITORING PROCEDURE

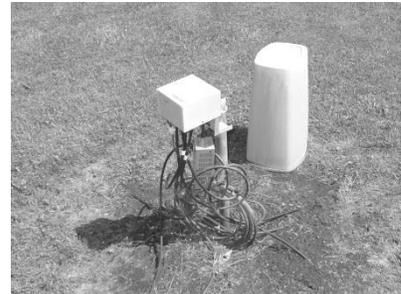
After the array is tuned, you may run a length of RG-58 or RG-8X from the Dummy Load Port to a wattmeter in the shack. Connect a short jumper from the wattmeter antenna out to the dummy load. This allows complete monitoring of the dissipated power at all times while on the air.

TOWER LEG INSTALLATIONS

Remove the sheet metal screw above the U-Bolt prior to installing the hybrid on a tower leg, as in a dipole array. This permits the cover to be removed later without removing the U-Bolt.

DEEP SNOW PROTECTION

For customers residing in areas with high snowfall amounts, one suggestion is to purchase an 8 gallon trash container and turn it upside down over the Hybrid installed on a 2 or 3 foot pipe. This will prevent snow from accumulating around the UHF connector ports. An 8 gallon size may be purchased in home supply stores. A brick or heavy block of wood can be placed on top to prevent being blown over by strong winds.



TYPES OF VERTICAL MATERIAL

The following have been successfully used in Four-Square arrays in conjunction with the COMTEK SYSTEMS ACB-4 SERIES:

1. Aluminum irrigation tubing 3" to 5" OD. Typical height for 3" OD coupled is 64 feet for resonance at 3.650. Heights will vary slightly, being determined by the diameter used.
2. Rohn 20/25G tower on insulated bases for 80 meters. Rohn 25G and 45G are used on 160 meters.
3. Wires supported from nylon/Dacron ropes, which are in turn tower supported. Trees offer supports for wire arrays as well, however, tree supported arrays require heavy maintenance. Wire arrays typically do not exhibit bandwidth as aluminum elements.
4. Hy-Gain Hy-Towers extended to 75 feet with all other stubs removed, for 3.650.
5. Short Top-Loaded verticals for 80 meters from 38 feet to 50 feet in height. These work well, but do not cover the entire band as full quarter wave sized aluminum elements.
6. Commercial verticals may also be used in a four-square array. DX Engineering (www.dxengineering.com) has a full line of vertical antennas that are perfect for phased array systems.

DX Engineering sells quality aluminum tubing in 3' and 6' lengths. The 6' pieces are UPS shippable. Phone: 330-572-3200 or visit the DX Engineering web page at www.dxengineering.com

ADDITIONAL REFERENCES

Antennas and Techniques for LOW-BAND DX'ing by ON4UN, was published by ARRL, *The Amateur Radio VERTICAL ANTENNA HANDBOOK* by Capt. Paul H. Lee, N6PL. This excellent book covers Conical Monopoles, an excellent vertical superior to shunt-feeding towers. *All About VERTICAL ANTENNAS* by William I. Orr, W6SAI & Stuart D. Cowan, W2LX.

INSTALLATION NOTES and FREQUENTLY ASKED QUESTIONS. (FAQ)

How close can I install my 4-Square to other verticals or my tower?

Unless the 4-Square will be installed on a multi-acre location, insure the array will not be beaming into towers or other objects such as buildings closer than one-half wavelength. Some installations perform well at lesser distances, but one-half wave distance is the recommended minimum.

Will a 4-Square cover the entire band?

Yes and No. Using **full sized aluminum verticals**, the 20, 40 and 80-meter bands can be fully covered with appropriate spacing. 160 meters can easily cover 1.800 to 1.900 using Rohn 20G/25G tower sections as the radiators. Using wire elements will not permit full coverage.

Can I install a 40 meter 4-Square inside my 80 meter 4-Square?

This is not recommended. The 40 m performance will be greatly reduced due to mutual coupling. (No 20 m inside a 40 m; No 80 m inside a 160 m etc. also applies.)

If one phasing line is too short to reach a vertical, can I add a few feet? Can I make one 3/4 wave long while the other 3 are at 1/4 wavelength?

Simply stated, No. If un-equal lines are used, the phase relationship is incorrect and performance will be poor. Make ALL either 1/4 or 3/4 electrical wavelengths in length.

How deep do I bury the radials?

If foot traffic is minimum, simply cut grass shorter than normal and pin radials down with wire lawn staples every 3' to 5' as terrain requires. Grass thatch will cover them in a few months. (Don't forget to raise cutting level of mower!) If burial is required, slight trenching 1"-2" is sufficient.

Should I use three or four conductor control cable?

Four conductor control cable is recommended for future upgrades. This is when you would replace the COMTEK system components (relay unit and control console) with a complete DX Engineering Transmit Four-Square system which will improve performance and give you the added benefit of Omni.

Additional Tuning information from K3LR:

All of the elements must be on the exact same frequency. This has to be done by floating three elements while working on one. Floating means disconnecting the coax (RG-11) at the vertical feed points.

Put a wattmeter on the output of the dummy load port (4 square box) and look at the power going into the dump load. Vary the frequency until you see the minimum dump power. Then determine the "shift" you need to lengthen or shorten the elements to bring the "dump load" power to minimum in the middle of your desired "band of operation". With 100 watts into the box, you should have less than a watt in the dump load at the lowest point.

On the 40 meter four square at K3LR, the elements are tuned so the minimum dump power is at 7.100 for best DX performance of 7.000 to 7.200 MHz. Operation above 7.200 is also just fine.

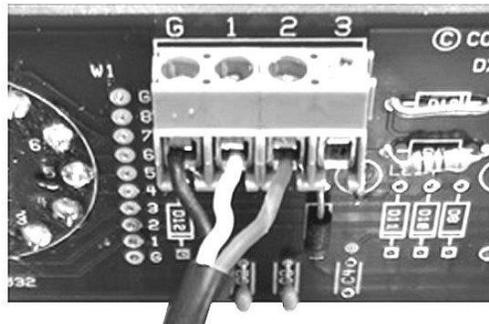
The elements are individually tuned (all on the same frequency) at 6.880 MHz to give minimum dump power at 7.100 MHz. Your elements might be lower or higher than mine, it depends on the diameter of your elements.

The feedlines can run on top of the radials - no problem.

The MFJ-259B (269B) cannot be used for this tuning. It gets bad readings because of nearby AM broadcast stations. The verticals by themselves will be resonant below 7.0 MHz. Please use a RigExpert meter to do this. All verticals must be measured with the others open circuit (no feedlines) and each vertical MUST be on the same frequency

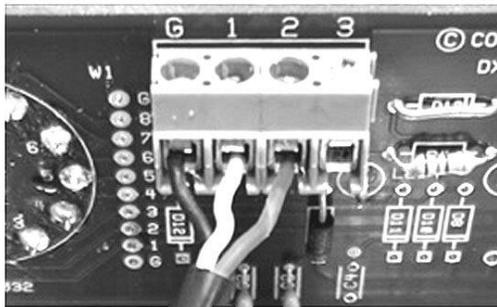
ACB-4 TROUBLESHOOTING

One of the most common reported problems after a new installation is lack of front-to-back or working a station opposite the normal direction. This is caused by incorrect sequence of wiring from the inside control console or the quarter-wave coax lines, to the relay unit. The control console wiring sequence from left to right is G-1-2 (3 is not used):

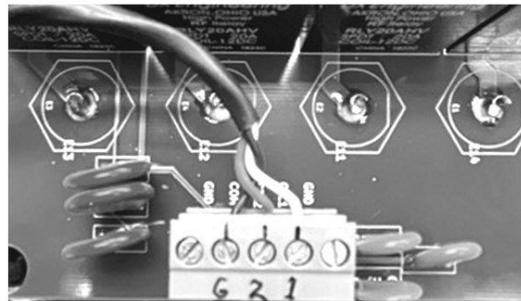


(Your Wire Colors May Vary)

On the relay unit, the connection pattern is COM, CTL2, CTL1.



The

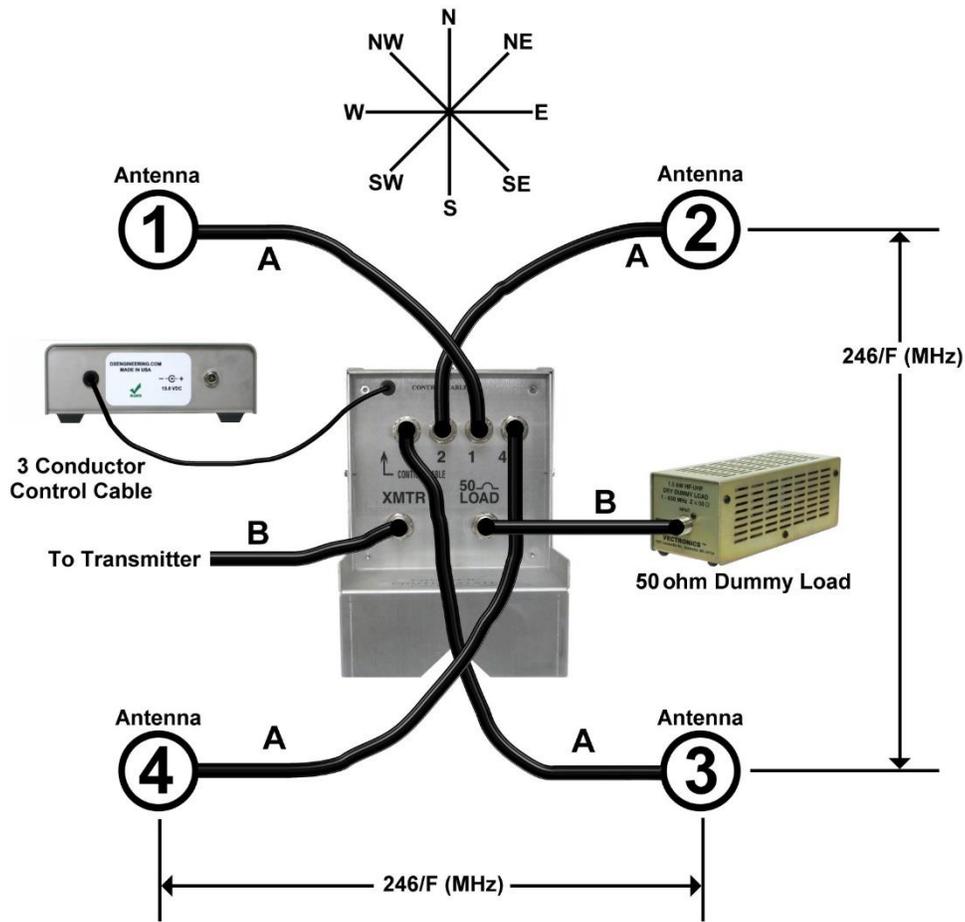


(Your Wire Colors May Vary)

following truth table indicates relay closure in selected positions, and voltages applicable to the terminals in the ACB-4 control console. See page 8 for directional connections for the quarter-wave coax.

POSITION	TERM. 1	TERM. 2	K1	K2	K3
1	12-14 Vdc	12-14 Vdc	Close	Close	Close
2 (Default)	None	None	Open	Open	Open
3	12-14 Vdc	None	Close	Close	Open
4	None	12-14 Vdc	Open	Open	Close

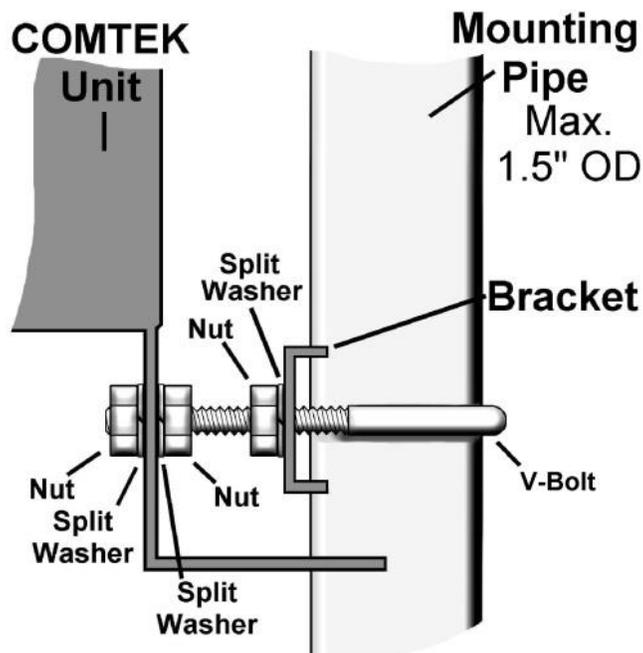
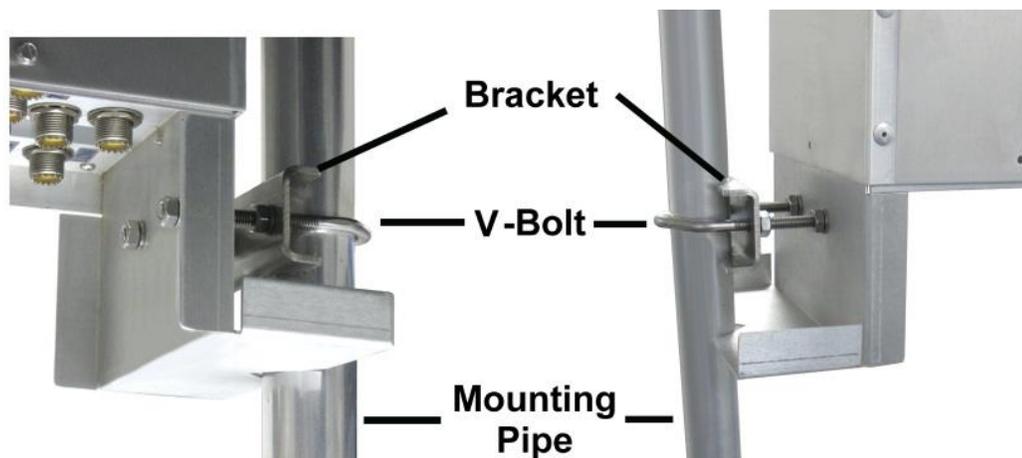
Voltage level depends on DC voltage used to power the Control Console.



A = 1/4 Wavelength of 75 ohm Foam coaxial cable at .78 Velocity Factor or greater
 B = Any length of 50 ohm Coaxial Cable

Control Console Position	Beam Direction	Relative Phasing			
		#1	#2	#3	#4
1	NW	-180	-90	0	-90
2	NE	-90	-180	-90	0
3	SE	0	-90	-180	-90
4	SW	-90	0	-90	-180

MOUNTING INSTALLATION CLAMP



Thank you again for purchasing a Comtek Hybrid Phasing System for your 4-square. Comtek has manufactured hybrids since 1989, and have models in use world wide by major Contest and DX stations.

Enjoy your 4-Square array's performance while contesting and DXing.

Comtek Systems: www.comteksystems.com

ACCESSORIES

COM-CW3	3 conductor control cable
COM-CW4	4 Conductor wire
COM-VFA-4	Vertical Feed Point Assembly
DXE-RADP-3	Stainless Steel Radial Plate

ACB Series Part Numbers:

COM-ACB-160-A	160 Meter Relay Unit and Control Console
COM-ACB-80-A	80 Meter Relay Unit and Control Console
COM-ACB-40-A	40 Meter Relay Unit and Control Console
COM-ACB-30-A	30 Meter Relay Unit and Control Console
COM-ACB-20-A	20 Meter Relay Unit and Control Console

COM-ACB4A Control Console

COM-ACB-160	160 Meter Relay Unit
COM-ACB-80	80 Meter Relay Unit
COM-ACB-40	40 Meter Relay Unit
COM-ACB-30	30 Meter Relay Unit
COM-ACB-20	20 Meter Relay Unit

COMTEK SYSTEMS 4-SQUARE DUMPED POWER CHART

Dumped Power
In Watts

200				
150				
100				
50				
0				

1.8	1.9	2.0	
3.5	3.6	3.7	3.8
7.0	7.1	7.2	7.3
14.0	14.1	14.2	14.3

Record dumped power levels at these frequencies, depending on which ACB-4 model hybrid phasing system installed. Maintain with your instructions as a reference in the event SWR or dumped power levels change.

Technical Support

If you have questions about this product, or if you experience difficulties during the installation, contact Comtek Systems (DX Engineering) at (330) 572-3200. You can also e-mail us at:

Info@comteksystems.com or DXEngineering@DXEngineering.com

For best service, please take a few minutes to review this manual before you call.

Warranty

All products manufactured by DX Engineering are warranted to be free from defects in material and workmanship for a period of one (1) year from date of shipment. DX Engineering's sole obligation under these warranties shall be to issue credit, repair or replace any item or part thereof which is proved to be other than as warranted; no allowance shall be made for any labor charges of Buyer for replacement of parts, adjustment or repairs, or any other work, unless such charges are authorized in advance by DX Engineering. If DX Engineering's products are claimed to be defective in material or workmanship, DX Engineering shall, upon prompt notice thereof, issue shipping instructions for return to DX Engineering (transportation-charges prepaid by Buyer). Every such claim for breach of these warranties shall be deemed to be waived by Buyer unless made in writing. The above warranties shall not extend to any products or parts thereof which have been subjected to any misuse or neglect, damaged by accident, rendered defective by reason of improper installation, damaged from severe weather including floods, or abnormal environmental conditions such as prolonged exposure to corrosives or power surges, or by the performance of repairs or alterations outside of our plant, and shall not apply to any goods or parts thereof furnished by Buyer or acquired from others at Buyer's specifications. In addition, DX Engineering's warranties do not extend to other equipment and parts manufactured by others except to the extent of the original manufacturer's warranty to DX Engineering. The obligations under the foregoing warranties are limited to the precise terms thereof. These warranties provide exclusive remedies, expressly in lieu of all other remedies including claims for special or consequential damages. SELLER NEITHER MAKES NOR ASSUMES ANY OTHER WARRANTY WHATSOEVER, WHETHER EXPRESS, STATUTORY, OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS, AND NO PERSON IS AUTHORIZED TO ASSUME FOR DX ENGINEERING ANY OBLIGATION OR LIABILITY NOT STRICTLY IN ACCORDANCE WITH THE FOREGOING.

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COM-ACB-A-INS