Receive Eight Circle Controller and Switch Package

DXE-RCA8B-SYS-2P

DXE-RCA8B-SYS-2P-INS Revision 3
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Introduction

Congratulations on your purchase of the DX Engineering Receive Eight Circle Array System designed by W8JI, which offers the best directional receiving performance in proportion to the space required. Advanced design, with a stable, clean, narrow and low-angle pattern in eight selectable directions, makes the DX Engineering Eight Circle Array the ultimate receiving antenna.

DXE-RCA8B-SYS-2P - Receive Eight Circle Array

The Eight Circle Array System is an eight element, eight direction-switchable array based on a four element end-fire/broadside combination of short receiving vertical elements. This antenna array is capable of delivering pattern directional performance superior to standard or short Beverage or reversible Beverage systems, and typical three element or four square arrays of short vertical elements. The DX Engineering Receive Eight Circle Array System offers selectable directional performance comparable to eight very long phased Beverages, and does it in far less space.

Advantages of the DXE-RCA8B-SYS-2P Receive Eight Circle Antenna System over other arrays:

- W8JI design with stable, clean, narrow and low-angle pattern
- Directional performance varies with circle radius
  Can be built with passive verticals to cover any single band
- Excellent directivity in a smaller space than phased Beverages for better signal-to-noise ratio
- Reduced susceptibility to high angle signals compared to phased Beverage antennas, as well as superior performance over EWE, Flag, Pennant, K9AY antennas.
- Switching console selects one of eight 45° spaced directions
- Directivity over a very wide frequency range
- Less physical space and less maintenance required than phased Beverage antenna arrays
- Enhanced relay contact reliability
- DC powered control console allows system operation without AC power mains

Are you ready to build your Eight Circle Array?

We presume that you purchased this DXE-RCA8B-SYS-2P Controller and Switch Console Package because you intend to construct or supply the other required components for complete system.
Before you proceed to the installation, there are some fundamental concepts that you should know.

1. This DXE-RCA8B-SYS-2P Controller and Switch Console Package are intended to be installed as a mono-band array with your passive verticals. Do you require multi-band coverage? You will want to review the DX Engineering manuals for the DXE-RCA8B-SYS-3P and DXE-RCA8B-SYS-4P Receive Eight Circle Array Systems, and review the explanation of the optimal monoband and multiband frequency coverage of the Eight Circle
Array in the Array Performance section.

2. Have you sized your array to achieve the desired performance within your space? If not, see the sections entitled Site Selection and Sizing The Array.

3. Do you know how to build your own passive vertical elements for the DXE-RCA8B-SYS-2P described in this manual? See the section Receive Eight Circle Passive Vertical Elements.

4. Are you ready to build your system? Proceed to the following pages!

The DXE-RCA8B-SYS-2P Receive Eight Circle Array Package includes:
- **DXE-RCA8B-1** Receive Eight Circle Array Controller
- **DXE-CC-8A** Special eight position Receive Eight Circle Control Console modified to provide +12 Vdc for powering the active antennas.
- **DXE-SSVC-2P** Stainless Steel V-Clamp for mounting the RCA8B-1 Receive Eight Circle Array Controller to a mounting post between 1" and 2" OD

Additional Parts Required, Not Supplied with the DXE-RCA8B-SYS-2P

- **DXE-CPT-659** Coaxial Cable Prep Tool for RG6, F6 75Ω Coaxial Cable, w/extra blade
- **DXE-SNS-CT1** Snap-N-Seal® Crimp Tool for 75Ω coaxial cable
- **DXE-SNS6-25** Package of 25 Snap-N-Seal® Connectors for 75Ω F6 coaxial cable
- **Five-Conductor Power and Control Cable - DXE-CW9S** CAT5e may be used
- **DXE-F6-1000** 75Ω Coaxial Cable or equivalent
- Eight identical Vertical Antenna Elements

Eight Circle Layout

The array optimized for single band performance has antenna elements are arranged in a circle with a radius of about 175 feet for 160 meters, or 84 feet for 80 meters, or 44 feet for 40 meters. See the Theory Of Operation sections and for exact dimensions and guidance in choosing the best orientation.

The default direction of the array with no voltage (BCD 000) places elements 1 and 6 in front and elements 2 and 5 at the rear, with pairs of lines through two opposite vertical element pairs (tangents) that point toward the receiving directions. Elements 1, 2 and 5, 6 are selected as the default for a forward direction of North-East for North America, with elements installed as shown. A mirror image of this element positioning would be a typical default North-West for European installations.
System Overview

The heart of the DXE-RCA8B-SYS-2P system is comprised of the modified DXE-CC-8A Eight Position Control Console and the RCA8B-1 Receive Eight Circle Array Controller. These units interconnect and work together using factory default settings to control the Receive Eight Circle Array. The modified CC-8A control console uses BCD switching voltages for the RCA8B-1 to change the receiving direction of the array.

When the modified CC-8A Eight Circle Control Console and the RCA8B-1 Receive Eight Circle Array Controller are connected as shown in the installation section below and the layout is as described for North America in Figure 1, the switch positions on the modified CC-8A will switch the array in the eight directions as shown in Figure 2.
Installation

The RCA8B-1 Receive Eight Circle Array Controller can be mounted to a customer supplied galvanized steel pipe driven into the ground at the center of the array. A galvanized pipe ranging from 1 inch OD to 2 inches OD may be used. The length of the controller unit's mounting pipe is dependant on your location. The standard 1-1/2” galvanized water pipe (with its 1.9” OD) is just fine for this application and can usually be found at your local home building supply store.

The RCA8B-1 relay unit has been pre-drilled to accommodate up to a 2 inch OD pipe using an appropriate clamp. The included DXE-SSVC-2P Stainless Steel V-Bolt Saddle Clamp is for 1” to 2” OD pipe. An optional DXE-CAVS-1P V-Bolt Saddle clamp can be used for pipe from 3/4” to 1-3/4” inches OD. The controller can also be mounted on a sturdy wooden post if provision for grounding the RCA8B-1 unit has been made. Note: UMI-81343 Never-Seez or DXE-NSBT8 Anti-Seize should be used on all clamps, bolts and stainless steel threaded hardware to prevent galling and to ensure proper tightening.

The Receive Eight Circle Array Controller unit should be mounted as shown in Figure 3 with cover upward and the control and coaxial cable connections downward to prevent water from entering the box. The stainless steel base of the Receive Eight Circle Array Controller unit has weep holes to allow condensation that may build up inside the unit to leave. Additional weatherproofing protection can be provided when using the DXE-22058 Permatex Dielectric grease on all coaxial connections. Dielectric grease is ideal for keeping moisture from entering your coaxial connectors. It also acts as a lubricant allowing easy connector removal by stopping corrosion of electrical connectors.

Figure 3 - RCA8B-1 unit mounted to 2" pipe using the included DXE-SSVC-2P V-Clamp
Control and Power Connections

1. Locate the removable green connector on the rear of the modified CC-8A labeled “G A B C D”. The green connector is a two part connector as shown and the top part can be removed by pulling it straight off. This will allow easier wire replacement or servicing as needed. When pushing the removable connector back in place, ensure you press straight inward to fully seat the connection.

2. Insert the five wire cable on the green connector as shown in Figure 4.

3. The same five wires are connected to the RCA8B-1 removable green connector (G A B C D) as shown in Figure 5. (“D” is required only for voltage on the element feedlines and should not be connected for passive vertical arrays.)

4. The modified CC-8A Control Console requires a nominal +12 Vdc fused input (+12 to +14 Vdc, 2 Amps and well filtered) through the 2.1 mm connector on the rear of the unit.

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

“D” is required only for voltage on the element feedlines and should not be connected for passive vertical arrays.

![Diagram showing control and power connections](image-url)
The **RCA8B-1** uses a removable five terminal plug as shown in Figure 5. The **RCA8B-1** connections are labeled “G A B C D”. The terminals use the same connection letters and are connected G to G, A to A, B to B, C to C and D to D.

On the **RCA8B-1** the green connector is a two part connector as shown in Figure 5 and the top part can be removed by pulling it straight off. This will allow easier wire replacement or servicing as needed. When pushing the removable connector back in place, ensure you press straight inward to fully seat the connection.

![Figure 5 - RCA8B-1 Green Connector](image)

**NOTE:** Since no voltage is required on the feedlines of mono-band passive vertical elements, do not connect a voltage source to the “D” terminal on the **RCA8B-1** connector.

<table>
<thead>
<tr>
<th>Switch Position</th>
<th>G</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
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<td>1</td>
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</tr>
<tr>
<td>7</td>
<td>GND</td>
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<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 1 - Modified DXE-CC-8A Output Truth Table**

Control lines (usually BCD) can normally use good quality CAT5e cable (4 twisted pairs of 24 AWG wire) for runs up to 1000 feet. Typical DX Engineering BCD control lines requirements are +12 VDC at 25 milliamps.

Depending on the number of control lines needed (usually 3 or 4) you can double up the twisted pairs of CAT5e cable, or use control wire that is at least 22 AWG, allowing runs up to 1500 feet. If you use a cable with more conductors, it is a good idea to tie the unused conductors to ground.
For longer runs of control cable, use a line loss calculator to ensure you supply the proper control levels needed.

**Approximate BCD Control Line Lengths.**

<table>
<thead>
<tr>
<th>Minimum Copper Wire Gage (AWG)</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>1,000 feet</td>
</tr>
<tr>
<td>22</td>
<td>1,500 feet</td>
</tr>
<tr>
<td>20</td>
<td>2,000 feet</td>
</tr>
</tbody>
</table>

**Receive Eight Circle Passive Vertical Elements**

The **DXE-RCA8B-SYS-2P** Eight Circle Array is intended to be used with eight customer supplied passive vertical elements designed for single band operation. Elements should be installed with ground radials with their feedpoints as close to the ground as possible but above any standing water.

Your passive vertical elements must be identical and need to be constructed so that they are resonant on your array band of choice. Their feedpoints must be matched to 75Ω coaxial cable in order to match the DX Engineering RCA8B-1 system impedance of 75Ω. Short elements are required to prevent mutual coupling and top loading with symmetrical capacity hat wires is recommended to add electrical length.

**It is important that the ground radial system is identical on each vertical element in the array.**

Extensive details on the construction of the required passive elements are contained in “ON4UN’s Low Band Dxing” by John Devoldere, available from DX Engineering.

**Array Spacing**

Performance of the **Receive Eight Circle Array** can noticeably decrease if structures radiating even small amounts of noise or signals are within 1-wavelength of the array. There is no detrimental effect when a higher frequency array of small receiving elements is placed inside the circle of a lower frequency array of short elements.

**Note:** The **DXE-RCA8B** Eight Circle Receiving Array System should be separated from transmitting or other antennas and structures (particularly metal) by at least 1/2-wavelength. Less separation may cause significant pattern distortion and the introduction of re-radiated noise into the system. This becomes apparent as reduced front-to-rear directivity in one or more directions or a higher noise level.

With so many variables involved, there is no optimum or minimum spacing for effects on pattern. The best practice is to install the array as far as possible from tall conductors or noise sources, or
place potential problems in less frequently used directions. For best pattern, space the system as far as possible from conductors that might be noise sources or re-radiate unwanted signals. One wavelength or more is generally ideal, although adequate performance generally occurs with much smaller spacing, with one-half wavelength minimum recommended.

**Typical DXE-RCA8B-SYS-2P Receive Eight Circle Configuration**

![Diagram of DXE-RCA8B-SYS-2P Receive Eight Circle Configuration]

Coaxial Cables are shown in various colors for clarity. Shown with optional DXE-RPA-1 HF Preamplifier, optional DXE-RFCC-1 Receive Feedline Current Choke and optional DXE-CW9S Control Cable. Power connection to the modified DXE-CC-8A Control Console is not shown.

**Figure 6**
Station Feedline, Active Antenna Feedline and Delay Line

The weakest link in an antenna system is often the coaxial cable connections. All connections must be high quality and weather tight to prevent contamination and corrosion, which can cause the feedline impedance to change. This can affect the signal-to-noise ratio and the directivity of the array. If the coaxial cable is compromised the shield will then pick up unwanted signals. This is why the shield connections are most critical. In addition, the DXE-RCA8B uses the shield as a ground return path for the active element power.

All feedlines must be 75Ω and can be any length as long as they are all equal and they should come from the same roll of cable so they have the same velocity factor (VF).

If the resistance of the shield increases due to contamination, the active elements may not function properly. Any splices in the feedline should be high quality and entirely weather tight. Do not use splices in the delay line cable. The DXE-RCA8B system has been designed to use only 75Ω coax.

High quality, flooded 75Ω CATV F6 type coax is recommended. The DXE-F6-1000 flooded cable automatically seals small accidental cuts or lacerations in the jacket. Flooded cable also prevents shield contamination and can be direct-buried.

Feedline connections must have good integrity and be weather resistant. Highly recommended for any DX Engineering array, and specifically designed for the DXE-F6-1000 flooded cable is the Snap-N-Seal® F connectors, model DXE-SNS6-25 which contains 25 connectors; enough for the entire array plus spares. Snap-N-Seal® connectors cannot be installed with normal crimping tools or pliers. The DXE-SNS-CT1 Compression Tool for Snap-N-Seal® 75Ω Coax Connectors is an essential tool for proper connector installation.

Lightly coat threads of F connectors with pure clear non-hardening silicon dielectric compound, such as DXE-22058 Permatex Dielectric Grease, to improve reliability of electrical connectors. This will lubricate threads, seal connector threads from water ingress, and reduce chances of unwanted bonding or welding of connector threads. If dielectric grease is not used, the potential for damage to the various connectors may result and is not covered under warranty.

Note: DO NOT use pliers or other tools to excessively tighten the type F connectors; they do not require high torque to make a good connection. F connectors are very reliable strong connectors for their size, but carelessness can damage them. Excessive tightening torque can loosen the chassis mounting-nut, allowing the connector body to rotate and fracture the mounting tabs on either installation or removal of the connector. F-connector require modest torque, typically 6-12 inch-pounds. 20-30 inch-pounds are FAR too high. That value, although commonly used, is just wrong. Damage to the various connectors may result and is not covered under warranty. Use a tool such as the DXE-CIT-1 F Connector Tightening Tool. Additional weatherproofing protection can be provided when using the DXE-22058 Permatex Dielectric Grease on all coaxial connections. Dielectric grease is ideal for keeping moisture from entering your coaxial connectors. It also acts as a lubricant allowing easy connector removal by stopping corrosion of electrical connectors.
Vertical Element Feedlines

Use 75Ω coaxial cable from each antenna element to the RCA8B-1. The eight feedlines from the RCA8B-1 to the elements can be any length needed to accommodate the size of the array, but must all be the same physical length, velocity factor and type. Note the orientation and numbering of the elements by using Figure 7. Be sure the appropriate antenna element is connected to the proper ANT connector on the RCA8B-1. Additional weatherproofing protection can be provided when using the DXE-22058 Permatex Dielectric grease on all coaxial connections. Dielectric grease is ideal for keeping moisture from entering your coaxial connectors. It also acts as a lubricant allowing easy connector removal by stopping corrosion of electrical connectors.

![Figure 7 - Vertical Elements Coaxial Connections to the RCA8B-1](image)

Delay Line

The **DX Engineering DXE-RCA8B-1** uses a time delay system, not a traditional phasing system. The delay line length is dictated by array dimensions rather than operating frequency, allowing for the use of a single delay line for optimum directivity over a very wide frequency range. This results in phase being correct for a rearward null at any frequency.

The DXE-RCA8B-1 unit has two delay line female F connectors marked DELAY. This connection pair will require one specific length of a coaxial cable assembly with male F connectors acting as a jumper between the two female F connectors. Delay line electrical length is critical. Careful measurements and the use of 75Ω coaxial cable with a known Velocity Factor (VF) is very important.

We strongly recommended the use of DX Engineering **DXE-F6-1000** High Quality, Low Loss, 75Ω F6 type **Direct Bury Coax** "Flooded" Coax. The DX Engineering **DXE-F6-1000** 75Ω coaxial cable has a nominal VF of 0.85. Keep in mind that solid Teflon® or polyethylene (PE) dielectric coaxial cable has a VF of approximately 0.66. Foamed coaxial cable cables typically range anywhere between 0.75 and 0.90 VF, depending on the ratio of air-to-dielectric material in the cable core. If you do not know the VF of the coaxial cable you are using, you must directly measure the electrical length of the coaxial cable you have with an analyzer or obtain cable with a known VF.
For a single-band Eight Circle Array, the required **electrical** length of the delay line is based on the distance between each of the two adjacent elements on the circle. As shown in **Table 2**, the calculation of the electrical length of the delay line is 95% of the physical distance between adjacent elements or adjacent element distance times 0.95 for a single band or multiple band array. The electrical length is then multiplied by the VF of the coaxial cable being used to determining the correct physical length of the delay line. The result is the correct physical length for the Delay Line in the right column of **Table 2**.

*Note: These calculations are in decimal feet, not feet and inches.*

**Table 2** shows delay line length calculations based on the dimensions for the three most common bands for a Receive Eight Circle Array.

<table>
<thead>
<tr>
<th>Band Coverage Desired</th>
<th>Optimal Eight Circle Array .327-wavelength Radius in Feet</th>
<th>Adjacent Element (Endfire Cell) Quarter-Wavelength Physical Spacing in Feet</th>
<th>Factored 0.95 Electrical Length in Feet</th>
<th>Delay Line Physical Length in Feet (0.85 VF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>160 meters only (1.830 MHz)</td>
<td>175.64</td>
<td>134.43</td>
<td>127.71</td>
<td>108.55</td>
</tr>
<tr>
<td>80 meters only (3.800 MHz)</td>
<td>84.58</td>
<td>64.74</td>
<td>61.50</td>
<td>52.28</td>
</tr>
<tr>
<td>40 meters only (7.200 MHz)</td>
<td>44.66</td>
<td>34.17</td>
<td>32.46</td>
<td>27.59</td>
</tr>
</tbody>
</table>

**Table 2 - Specific Delay Line Length Calculations for single band arrays.**

**For Example:** An Eight Circle Array intended to be optimized for 160 meter only operation has an optimized .327-wavelength radius dimension of 175.64 feet, and Endfire Cell adjacent element spacing of 134.43 feet. The 0.95 factored electrical length is 127.71 feet. Multiply 127.71 by 0.85 (the VF of DX Engineering 75Ω coaxial cable) to determine the physical length of the delay line.

The correct physical length for this delay line is 108.55 feet, or 108 feet 6-5/8 inches.

The delay line cable can be neatly coiled in a 1-1/2 ft diameter coil. Support the weight of the coiled cable by taping or securing it to the support pole or mast rather than allowing it to hang from the connectors.

It is important to use 75Ω feedline to the operating position from the **DXE-RCA8B-1** unit. Do not use amplifiers, combiners, filters or splitters that are not optimized for 75Ω systems.

**Lightning Protection**

While amateur radio installations rarely suffer damage from lightning, the best protection is to disconnect electrical devices during storms. The key to lightning survival is to properly ground
feedlines and equipment and to maintain the integrity of shield connections. A proper installation improves lightning protection and enhances weak signal receiving performance.

Consult lightning protection and station grounding information in the ARRL handbooks, or by referring to the NEC (National Electric Code). The DX Engineering website has technical and product information listed under “Lightning Protection and Grounding”. Use lightning surge protectors for the coax feedline and control lines such as the DXE-RLP-75FF Lightning Protector, Receive 75Ω, DC Pass, with F Connectors, for the array feedline at the station end ground.

**Optimizing the Array**

To determine if the antenna system output level is the limiting factor, tune the receiver to the lowest band at the quietest operating time. This is usually when propagation is poor but some signals are heard. Disconnect the antenna and set the receiver to the narrowest selectivity you expect to use. Receiver noise power is directly proportional to receiver bandwidth (going from 2.5 kHz selectivity to 250 Hz selectivity reduces noise by 10 dB). Connecting the antenna should result in a noticeable increase in noise. If so, the array signal level is sufficient and further optimization or amplification may not be needed.

If the array is used on 160m, and the array still lacks sensitivity on 160 meters, then a preamplifier with high dynamic range should be used to compensate for the low signal level. Using a preamplifier when sufficient signal is already present may result in amplification of the noise along with the signal. **It is always best to use the least gain possible.** Depending on conditions, a preamplifier can cause receiver overload; this may require an attenuator or bypassing the preamplifier. The DXE-RPA-1 HF Preamplifier has better dynamic range than most receivers and can be used to compensate for the decrease in array signal output.

**Theory of Operation of the Eight Circle Array**

The following Sections contain specific information about the fundamentals of the Eight Circle Array. It contains all of the information needed to make decisions about the band coverage desired, and how band coverage is affected by the selection of the optimal pattern in relation to the circle radius. Also included is information discussing the differences between the use of passive or active vertical elements.

**System Design Features and Benefits**

The **DX Engineering Receive Eight Circle Array** is the highly sophisticated receive eight circle system that uses time delay phasing - rather than the conventional narrow-band, frequency dependent phasing - to provide eight 45 degree spaced directional patterns. The time delay phasing is directivity-optimized to produce wider and deeper rear nulls and a narrower main lobe. The result is that noise and undesirable signals are greatly reduced by superior front-to-rear (F/R). The array forms a clean stable pattern with high directivity over wide bandwidth.
W8JI initially developed and used this array in the 1980’s. This array started appearing in the 1990’s at larger more advanced low-band DX stations. The phasing system in this array, as well as the active element design, offer much better dynamic range and directivity bandwidth than other later copies.

Unlike unidirectional transmitting arrays using large elements, very small elements do not create significant mutual coupling related current-distribution and phase errors. Better control of phase and currents provides a much cleaner pattern than found on available vertical antenna transmit arrays.

Additionally, this array combines independent unidirectional cells across the full width of the array to add additional broadside directivity. Broadside phasing is also frequency independent.

Time-delay phasing produces a \textit{frequency independent} rearward null.

Phasing remains perfect over very wide frequency ranges. This results in excellent front-to-back performance on multiple bands, despite using a single delay line with fixed element spacing. The deep rearward null reduces rearward noise and undesirable signals over very wide frequency ranges. The rearward null is frequency independent up to element-to-element spacings of just over $1/4$-wavelength.

The DX Engineering \textbf{RCA8B-1} Receive Eight Circle Array Controller uses sealed relays sized for receiving applications. (High current contacts, suitable for transmitting, commonly have unreliable contact connections at low currents. This is because of the large surface areas and hard contact materials necessary to support high contact switching currents.) The \textbf{RCA8B-1} Receive Eight Circle Array Controller uses sealed relays optimally sized for receiving applications. Contacts are bifurcated and gold-flashed, substantially improving low signal level switching reliability. The improved low-level signal optimized bifurcated contacts virtually eliminate non-linearity, rectification, and other maladies caused by poor relay connections.

\section*{Frequency Coverage - vs. - Element Type}

The Eight Circle Array uses eight elements to form a clean, narrow beamwidth, low-angle pattern in eight equally spaced user selectable directions. The elements form the most space-efficient type of directional array, a broadside-endfire combination. With broadband active elements, this array has an exceptionally good pattern over at least a 3:1 frequency range. With monoband passive resistor loaded elements, this array has unbeatable performance across a single band.

The Eight Circle Array upper frequency limit for a clean unidirectional pattern is slightly above where the array is 0.35-wavelength radius. The frequency of optimum performance is where the array is approximately 0.327-wavelength radius. Construction care, element construction, desired beamwidth, and local noise floor determines the minimum array size in wavelengths. Minimum useful frequency typically occurs with an array less than 0.1-wavelength radius; although that limit can be pushed lower with care in some situations. Careful construction will allow useful directivity over the entire HF range with an exceptionally good pattern over a 3:1 frequency range.
A Special Application

The DX Engineering DXE-RCA8B Eight Circle Array phasing and switching system may also be used as a unidirectional or bidirectional end-fire/broadside array with the installation of only four vertical elements, using 1/10 to 1/4-wavelength endfire spacing in combination with 1/4 to 3/4-wavelength broadside spacing.

This limited implementation is for the user who specifically wants a very directional receive antenna system that is pointed only in one direction, without power required, similar to a single direction, phased Beverage array. It would also be switchable to a second opposite direction with DC power, similar to a very long Reversible Beverage.

However, this end-fire/broadside array alternative to building a phased Beverage array requires a lot less space and a lot less maintenance! Contact DX Engineering for more details on the use of the DXE-RCA8B for a four element system.

Receive Antennas – Gain and Efficiency

One popular misconception is that antenna gain pays equal dividends in receiving and transmitting. While transmit to receive antenna gain reciprocity applies to changes in absolute signal levels, it does not apply to signal-to-noise. Once external noise levels are slightly above receiver noise floor, signal-to-noise ratio is almost entirely a function of antenna pattern. System loss or system gain is no longer a factor, and excessive gain can actually hurt reception of weak signals.

Efficiency is not a major consideration in dedicated receiving systems. This allows application of techniques that increase directivity in receive-only systems, techniques generally unworkable or unacceptable in transmitting antennas. In a Multi-Multi contest station environment, passive receive elements offer significantly greater dynamic range.

Site Selection

Site selection is important. Three major things upset the pattern and performance of an array. Phase errors, element impedance errors, and improper spacing. This array’s phasing system uses a combination of end-fire and broadside phasing. This array forms a clean stable pattern with high directivity over wide bandwidth. Because of the stable, clean, narrow pattern in eight selectable directions, this antenna is the ultimate in receiving.

Directing the antenna pattern away from noise sources or toward the desired signal path is the primary benefit. Antenna gain is a secondary advantage. As frequency increases, the fixed array size becomes electrically larger in terms of wavelength. The increased electrical spacing produces higher sensitivity (average gain) even though front-to-rear ratio only changes slightly. On the low bands,
once the receiving system, including the antenna system and the receiver, are hearing the lowest possible level of local and propagated ambient noise, antenna directivity (F/R) is the only thing that affects the signal-to-noise ratio.

The default direction of the array with no voltage (BCD 000) places elements 1 and 6 in front and elements 2 and 5 at the rear. Pairs of lines through two opposite vertical element pairs (tangents) point toward the receiving directions. Elements 1, 2 and 5, 6 are selected as the default, for a forward direction of North-East, with elements installed as shown for North America. A mirror image of this element positioning would be a typical default direction of North-West for European installations.

This array can use active or passive elements. Passive elements provide the greatest dynamic range and immunity to overload. Active elements provide the widest system bandwidth, but at the expense of dynamic range.

Receiving antennas work best when they have a clean pattern with narrowest possible lobe, and minimal spurious lobes. This is because noise generally comes from many directions, while a signal comes from one useful direction at a time. If a signal comes from multiple angles or directions we still do not want those directions, because the phase relationship and levels of the multiple path single source signal will vary a great deal. This will cause undesirable fading and distortion. We cannot successfully directly mix multiple antennas for diversity reception for the same reasons we do not want an antenna to respond to the same signal source over multiple paths, since we cannot combine randomly varying phase and level signals without increasing fading or reducing signal-to-noise (S/N) ratio.

**Note:** The **DXE-RCA8B** Eight Circle Receiving Array System should be separated from transmitting or other antennas and structures (particularly metal) by at least 1/2-wavelength. Less separation may cause significant pattern distortion and the introduction of re-radiated noise into the system. This becomes apparent as reduced front-to-rear directivity in one or more directions or a higher noise level.

With so many variables involved, there is no optimum or minimum spacing for effects on pattern. The best practice is to install the array as far as possible from tall conductors or noise sources, or place potential problems in less frequently used directions. For best pattern, space the system as far as possible from conductors that might be noise sources or re-radiate unwanted signals. One wavelength or more is generally ideal, although adequate performance generally occurs with much smaller spacing.

There is no detrimental effect when a higher frequency array of small receiving elements is placed inside the circle of a lower frequency array of short elements.
Effects On Pattern

As far as pattern goes every directional array, no matter how constructed or designed, will always interact with surrounding conductors. Adequate spacing is almost entirely dependent on electrical characteristics of the surrounding conductors for a given style of receiving array.

For example, a given style array of similar dimensions from one company will be similarly affected by surrounding conductors regardless of element design, for a given style of element. The effect on pattern depends almost entirely on how much surrounding objects absorb and re-radiate signals, if the undesired structure is in a null or peak of the receiving array, and how close the systems are in terms of wavelength.

With so many variables involved, there is no optimum or minimum spacing for effects on pattern. The best practice is to install the array as far as possible from tall conductors or noise sources, or place potential problems in less frequently used directions. For best pattern, space the system as far as possible from conductors that might be noise sources or re-radiate unwanted signals. One wavelength or more is generally ideal, although adequate performance generally occurs with much smaller spacing.

Site Selection in Relation to Noise Sources

Because the array is directional, use this example as a guide: If you have a noise source and if your primary listening area is northeast, locate the array northeast of the dominant noise source. This ensures the array is looking away from the source of noise when beaming in the primary listening direction. The second-best location for the array is when the noise source is as far as possible from either side of the array. If you look at patterns, the ideal location for the array is one that places undesired noise in a deep null area.

If this receiving array is in an area free of noise sources (power lines, electric fences, etc.), locate the array so transmitting antennas and buildings are located in a null direction or commonly unused direction.

Noise that limits the ability to hear a weak signal on the lower bands is generally a mixture of local ground wave and ionosphere propagated noise sources. Some installations suffer from a dominant noise source located close to the antennas. Noise level differences between urban and rural locations can be more than 30 dB during the daytime on 160 meters. Nighttime can bring a dramatic increase in the overall noise level as noise propagates via the ionosphere from multiple distant sources. Since the noise is external to the antenna, directivity can reduce noise intensity.

Consider these things about noise sources:

- If noise is not evenly distributed, performance will depend on the gain difference between the desired signal direction (azimuth and elevation) and gain in the direction of noise.
- If very strong noise comes from the direction of a receiving antenna null, improvement in S/N ratio can be as much as 30 dB or more.
- If noise predominantly arrives from the direction and angle of desired signals (assuming polarization of signals and noise are the same) there will be no improvement in the signal-to-noise ratio.
If the noise originates in the near-field of the antenna, everything becomes unpredictable. This is a good case for placing receiving antennas as far from noise sources (such as power lines) as possible.

**Proximity to Transmitting Antennas**

The ability of passive vertical element matching system components to survive high RF fields depends on component ratings.

The DX Engineering Active Matching Units with customer supplied vertical elements, or the DXE-ARAV3-8P Receive Antenna Active Vertical with Relay active elements and your transmitting antenna need only minimal physical separation to maintain safe power levels when the DXE-TVSU-1A Time Variable Sequencer Unit is used. With 1500 watts output and a unity gain (0 dB) antenna, the closest active element can be 1/10-wavelength from the transmitting antenna at the lowest transmitting frequency. Doubling the protection distance quadruples safe power levels. See Table 3.

<table>
<thead>
<tr>
<th>Band</th>
<th>Unity (0 dB) Gain</th>
<th>3 dB Gain (2x)</th>
<th>6 dB Gain (4x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>160m (1.8 MHz)</td>
<td>55 ft</td>
<td>110 ft</td>
<td>220 ft</td>
</tr>
<tr>
<td>80m (3.5 MHz)</td>
<td>28 ft</td>
<td>56 ft</td>
<td>112 ft</td>
</tr>
<tr>
<td>40m (7.0 MHz)</td>
<td>15 ft</td>
<td>30 ft</td>
<td>60 ft</td>
</tr>
</tbody>
</table>

**Table 3 - Array Safety Distance Minimums at 1500 watts**

Table 3 indicates minimum safe distances for the sequenced active array from transmitting antennas with 0 dB, 3 dB and 6 dB gain (ERP) using a 1500 watt transmitter. Your actual system may vary according to location and proximity to various objects. Your actual system may vary. Safe distance will vary depending on operating frequency, antenna polarization and orientation, and transmitting antenna pattern.
Examples of Array Performance

The **DXE-RCA8B** eight circle array system occupies less space than phased Beverage arrays and is much easier to install, is less conspicuous and operates over a wider frequency range with similar or better performance.

The Eight Circle Array achieves an optimal pattern when the array has a radius of .327-wavelength. This is represented by this azimuth pattern labeled as “.325-wavelength radius”, which shows the best combination of a narrow front lobe and acceptable side lobes. This pattern is true for any frequency from 500 kHz to 30 MHz. This pattern achieves the best Receiving Directivity Factor (RDF), which is a figure that compares the forward-lobe gain to the average gain of the antenna array in all directions, including azimuth and elevation. More information about the rating of receive antenna systems and Receive Directivity Factor are described in “ON4UN’s Low Band Dxing” by John Devoldere, available from DX Engineering (DX Engineering part number: **ARR-8560**).

As shown by the patterns of **Figure 9**, an optimized 160 meter Eight Circle Array is not useable on 80 meters. That is why the best performing Receive Eight Circle is built as a mono-band array.

The ultimate low band receiving antenna would be two Eight Circle Arrays, one optimized for 80 meters built inside of the other optimized for 160 meters. Each is optimally sized for a .327-wavelength radius, according to the dimensions in **Table 4**.

The DX Engineering Eight Circle Array offers better directivity than the Receive Four Square. However, it requires more real estate to accomplish better directivity, which in turn requires eight selectable directions to cover all directions properly.

*Only a monoband array may be installed with passive verticals or active vertical elements, but a multi-band Eight Circle Array must be installed with Active Vertical elements.*

**Multi-Band Arrays with Active Elements**

Only the DX Engineering Active Receive Verticals or Active Matching Units with constant 75Ω impedance and unsurpassed dynamic range across the frequency range will allow this Eight Circle Array coverage. See the manual for the **DXE-RCA8B-SYS-3P** Eight Circle Array Electronics Package, or the **DXE-RCA8B-SYS-4P** Complete Eight Circle Array System Package.

Considering the available patterns from the Eight Circle Array, the best possible choice for a two-band array covering 80 and 160 meters is one that is optimized for 80 meters. The resulting patterns are represented closely to the patterns in **Figure 9** by the “.325-wavelength radius” for 80 meters and by the “.15-wavelength radius” for 160 meters, with a narrower pattern and performance exceeding short Beverage arrays.
The absolute maximum useful directional frequency coverage of the Eight Circle Array is about a 4:1 ratio. A compromise Eight Circle Array System should be sized with its highest frequency corresponding to an array radius of .375-wavelength, being limited by allowable side lobe levels, as shown in Figure 9.

For example, an array built to cover 160, 80 and 40 meters has the highest frequency of 7.3 MHz will have a .375-wavelength radius of about 50.5 feet, which offers excellent rear rejection on 40 meters, a respectable cardioid pattern on 80 meters, and still offer useable directivity on 160 meters.

The patterns on these bands are represented in Figure 8 by “.375-wavelength radius” for 40 meters, just about the same as the “.2-wavelength radius” pattern on 80 meters and the “.1-wavelength radius” pattern for 160 meters.

An array sized for the highest frequency of 2.0 MHz with a .375-wavelength radius of 184.43 feet, would provide the best pattern (.327-wavelength radius) at 1.744 MHz, but still offer good directional performance down to 500 kHz. An array sized for the highest frequency of 21.5 MHz with a .375-wavelength radius of 17.16 feet, would provide usable directivity down to 5.3 MHz.

NOTE: An array which is intended to be used over a frequency range greater than 3:1 requires a different Delay Line than one intended for a single or two-band system. See the manual for the DXE-RCA8B-SYS-3P Eight Circle Array Electronics Package, or the DXE-RCA8B-SYS-4P Complete Eight Circle Array System Package for details.
The azimuth patterns in Figure 9 were generated using EZNEC+ and show the effects on the patterns when varying the radius of the array. These patterns are not to be viewed as pointing in a default or particular direction.

Figure 9
Topographical Considerations

Flat land is best. Erecting the receiving array on sloped land or steep hills may degrade performance. To avoid pattern degradation, antenna elements must have reasonably similar elevations. It's recommended the ground height difference between any element in the array be less than 10% of the array diameter. For example, a 100 foot diameter array should be within ten feet of level. Every effort should be taken to make the elements symmetrical. Elements should all be identical in construction and grounding, and should be mounted above any potential standing water line but as close to the ground as possible. In general, the system will not be affected by trees or foliage as long as the foliage does not contact the element. Ideally, in important receiving directions, there should be a clear electrical path for at least 1-wavelength. The site should allow a ground system to be evenly distributed around each antenna, if one is required, as for passive elements.

Sizing the Array

If there are no space constraints, follow the dimensional recommendations in Table 4 for excellent performance.

**Only a monoband array may be installed with passive verticals or Active Vertical elements, but a multi-band Eight Circle Array must be installed with Active Vertical elements.**

An Eight Circle Array that is optimized for a certain band will not yield useful results on the next higher frequency band. If you are using the Active Receive Verticals so that you can obtain directional receiving performance on two or more bands, the array must be sized for the highest frequency band. The Active Receive Vertical elements provide the required $75\Omega$ impedance across multiple bands in order to maintain pattern stability.

A monoband 160 meter optimized Eight Circle Array is sized by multiplying the free space wavelength at 1.832 MHz of 537 feet/wavelength times the optimum pattern circle radius of 0.327 wavelengths, which yields an optimal circle radius of 175.6 feet. This places the vertical elements about one-quarter wavelength apart, 134.25 feet.

However, as shown by the patterns of Figure 9, an optimized 160 meter Eight Circle Array is not useable on 80 meters.

If the Eight Circle Array is intended to be used monoband on 80 meter, or if it will be used on 80 and 160 meters, then the best choice for sizing the array is shown at the bottom of Table 4. This is where the free space wavelength at 3.803 MHz of 258.65 feet/wavelength is multiplied by the optimum pattern circle radius of 0.327 wavelengths, which yields an optimal circle radius of 84.58 feet. This places the vertical elements about one-quarter wavelength apart, 64.74 feet.
Antennas are spaced 45 degrees apart. Layout above is typical for North America with the default position (1) having the array point toward the North East.

<table>
<thead>
<tr>
<th>Freq MHz</th>
<th>Distance Between Antennas = 246/F [feet]</th>
<th>One Half Distance Between Antennas [feet]</th>
<th>Radius of Circle[feet] = 1/2 distance between antennas divided by sin 22.5 degrees (0.383)</th>
<th>Diameters of Circles [feet]</th>
<th>Diameter, Endfire Spacing &amp; Broadside Spacing form a triangle</th>
<th>Broadside Spacing as a % of WL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.800</td>
<td>136.67</td>
<td>68.33</td>
<td>178.6</td>
<td>357.1</td>
<td>329.9</td>
<td>0.604</td>
</tr>
<tr>
<td>1.825</td>
<td>134.79</td>
<td>67.40</td>
<td>176.1</td>
<td>352.2</td>
<td>325.4</td>
<td>0.604</td>
</tr>
<tr>
<td>1.830</td>
<td>134.43</td>
<td>67.21</td>
<td>175.64</td>
<td>351.3</td>
<td>324.5</td>
<td>0.604</td>
</tr>
<tr>
<td>1.860</td>
<td>132.26</td>
<td>66.13</td>
<td>172.8</td>
<td>345.6</td>
<td>319.3</td>
<td>0.604</td>
</tr>
<tr>
<td>3.500</td>
<td>70.29</td>
<td>35.14</td>
<td>91.8</td>
<td>183.7</td>
<td>169.7</td>
<td>0.604</td>
</tr>
<tr>
<td>3.650</td>
<td>67.40</td>
<td>33.70</td>
<td>88.1</td>
<td>176.1</td>
<td>162.7</td>
<td>0.604</td>
</tr>
<tr>
<td>3.800</td>
<td>64.74</td>
<td>32.37</td>
<td>84.58</td>
<td>169.2</td>
<td>156.3</td>
<td>0.604</td>
</tr>
<tr>
<td>7.200</td>
<td>34.17</td>
<td>17.09</td>
<td>44.66</td>
<td>89.32</td>
<td>82.5</td>
<td>0.604</td>
</tr>
</tbody>
</table>

Table 4 - Array Dimensional Layout (Highlighted figures are optimal for 1.83, 3.8 and 7.3 MHz)
Receive Eight Circle Troubleshooting

There are several possible causes for a malfunction of a DX Engineering Receive Eight Circle System. Testing the system is not difficult and can be completed in an hour or so. Separate circuits for directional switching, Active Vertical Antenna power, and antenna phasing can each be affected by a variety of cabling, connection and or component problems. If you are troubleshooting a new system or using a replacement **DXE-RCA8B-1** Receive Eight Circle Array Controller unit, check that the wiring from the Control Console to the Array Controller is correct and no damage has been done to the lines.

Here are the most common causes of Receive Eight Circle malfunction, especially in a system that was previously functioning properly:

- **A** Broken/Shorted Conductors
  - Animals, Chewed, Punctured, Stretched, or Broken
  - Green Connector may have broken wire or is tightened against insulation - not bare wire

- **B** Center Conductors Slipped
  - Check all F connector center conductor wires. They may have pulled inward.

- **C** Shorted/Open conductors due to water
  - Check feedlines and control cable.

- **D** Zapped by lightning pulse or RF overload
  - Make sure units are at least 1/2-wavelength, on the lowest frequency, away from any transmit antenna.
  - May want to use an optional DXE-TVSU-1 Time Variable Sequencer for AVA-2 units.

- **E** Damaged due to lightning
  - Rare, but it can happen.

- **F** Damaged by animals or insects
  - Animals have been known to relieve themselves on the units and the urine will corrode and damage electronics
  - Insects getting inside units and shorting out electronics
A) Broken and/or shorted conductors due to animal, weather or other damage, including chewed, punctured, stretched and broken control and power lines and/or feedlines for the system and each antenna. Also, screws in the green removable connectors can inadvertently be tightened onto the insulation of control or power conductors.

B) Regressed center conductors in the feedlines causing disengagement from the female center capture pin of the F connector. This can happen in delay lines as well as in antenna or main feedline connections. Many times a compression F connector that seems to have a long enough center conductor when it was first made, has regressed to the point that it is not long enough to make proper contact. A properly installed F connector should have the center conductor protruding 1/4 inch beyond the shell when viewed from the side. Check all F connectors!

C) Shorted or opened conductors caused by water migration into a control line or a feedline.

Over 80% of all Receive Eight Circle malfunctions have been caused by the above system problems. A thorough inspection and subsequent testing of each control cable, RF cable, and their respective connections, will uncover the cause of most Receive Eight Circle troubles. Here are a few other causes for Receive Eight Circle malfunction:

1) One or more burned out Active Vertical Antenna units model AVA-2 or AVA-1, due to lightning pulse or high power RF overload. One-half wavelength on the lowest frequency is the minimum distance between the Active antennas and any transmit antennas. If that distance is less and high power is used, then the Time Variable Sequence Unit, model DXE-TVSU-1A (or B) must be used to interrupt power to the AVA-2 units.

2) Damaged Receive Eight Circle unit due to lightning. This has been reported only a couple of times and is not very likely.

3) Active units that were damaged by animals. Once we received actives damaged by an animal that relieved themselves on the antenna whips and AVA units, as if they were “trees”.

The above items are the most common failure points in the system needed to be checked.

If necessary, the following further troubleshooting procedure may assist in finding the malfunction.
Receive Eight Circle Control Troubleshooting Procedure

1) Test the modified **DXE-CC-8A** Control Console unit, which should be connected only to the control lines of the Receive Eight Circle System. When the modified DXE-CC-8A is connected to the control cable, do all of the selected switch position LEDs light normally?

2) When rotating the modified DXE-CC-8A Control Console switch from position 1, 2, 3 and 4, if all LEDs light normally, measure BCD output voltages. Nominally, +12. Connections A, B, C and D, reference to the ground pin G as shown below. The selected position will supply the BCD logic voltage as shown in the chart below.

<table>
<thead>
<tr>
<th>Switch Position</th>
<th>G</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>GND</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>GND</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 1 - Modified CC-8A Output Truth Table
“1” Equals +12 Vdc (Default)

3) If the voltages are not normal, less than +10 to 18 Vdc, with the control line connected, then disconnect the control line and retest the modified DXE-CC-8A Control Console. If voltages that were not correct, are now okay, that indicates a short in the control line or a problem in or beyond the Receive Eight Circle System relay unit.
4) If the modified DXE-CC-8A has only a couple LEDs lit with the control cable disconnected, then it may have sustained lightning pulse damage and will need to be repaired or replaced. A new modified DXE-CC-8A is available from DX Engineering.

**Continue troubleshooting the array control** with a good modified DXE-CC-8A or by using a 1A fused power source.

5) Determine if the control line is intact by resistance or voltage testing each conductor for shorts with the far end of the control cable disconnected from the Receive Eight Circle System unit.

6) With a good modified DXE-CC-8A or other power source connected, measure A, B, C and D control conductor voltages at the Receive Eight Circle System relay unit with the control cable connected, and again at the end of the control cable that is disconnected from the Receive Eight Circle System relay unit. If measured voltages are not between +10 to 18 Vdc on the selected line, a resistive, short or open circuit problem exists in the control line or in the Receive Eight Circle System relay unit or antenna feedlines. Normal voltages on the connected control line will cause relays to switch inside the Receive Eight Circle System unit. If switching voltages are correct, lack of system directivity or gaps in reception may be due to antenna, feedline or delay line issues.

7) Test the Active Antennas by feeding a voltage on the tested control line A and/or B conductor(s) to select one direction of Receive Eight Circle System unit operation. Simultaneously feed normal operating voltage on the tested conductor that powers the Active Verticals for reception. If a low value fuse blows, then a short circuit may be isolated by disconnecting antennas and reconnecting them one at a time.

If no fuses have blown and connected voltages stay near the nominal +12 Vdc levels, then:

8) Test for active operating voltage at the end of each antenna feedline. If all are good, proceed. If not, repair feedlines and/or connectors. If voltage is present on the power line to the Receive Eight Circle System relay unit, but is not measured at the end of good feedlines, inspect inside Receive Eight Circle System relay unit to determine if there is an obvious reason that Active Vertical Antenna power is not making it out the antenna ports. A bad connection outside of the RFS relay unit is usually the problem, and rarely has a component failure inside the Receive Eight Circle System relay unit been discovered.

**Proper Receive Eight Circle System phasing requires that each Active Vertical Antenna, and its respective equal length feedline, actually provides the same signal level to the Receive Eight Circle System unit.** Use a steady, non-fading ground wave signal from a low or medium power daytime AM Broadcast station that is over 10 miles away, on a frequency high in the band, or another constant signal source near 160 or 80 meters, well away from the array, to test that each Active Vertical receives the same signal level. Do not use sky wave or night signals for these signal level tests.
9) Test reception of each Active Vertical Antenna by connecting each antenna feedline, one at a time, to an activated port on the Receive Eight Circle System. This assumes that a good port has been identified and is functioning properly. Normal reception must be confirmed from each antenna. If any antenna is not providing the proper RF signal level, move the AVA unit to a known good feedline position to rule out the possibility that a bad feedline is attenuating the RF. If one or more Active Receive Verticals produce a low or no signal, then the AVA unit at the base of that antenna may not be receiving power. Retest for DC power at the antenna end of that feedline. If +10 to 18 Vdc is found, then the Active unit may need to be serviced or replaced. New DXE-AVA-2 units are available separately by calling DX Engineering.

10) If all Active Verticals tested provide the same signal level, then change switching voltages to activate the other ports, one at a time, and test each Receive Eight Circle System unit port, using one of the good antennas, testing for the same level of reception. If one or more ports is dead or has diminished reception, there may be a problem in a delay line or in the Receive Eight Circle System unit.

11) Using tested or replaced delay lines and connectors, if one or more ports is dead or has diminished reception, the Receive Eight Circle System unit may require service or replacement.

At this point, the problem in your system should have been identified.

If you need additional assistance from DX Engineering, feel free to call or write. Detailed discussions of system function, connections, and troubleshooting is best handled by telephone, Monday through Friday, 8:30 am to 4:30 pm Eastern Time, at 330-572-3200.

Optional Items

**DXE-RPA-1 - Receiver Preamplifier, 0.3-35 MHz**

This is the best HF low noise amplifier available. The RPA-1 is optimized for 0.3-35 MHz operating range. The push-pull amplifier design and robust components enable it to withstand high signal levels and operate when you need it most. The dynamic range of the RPA-1 is better than most receivers. The RPA-1 is suitable for indoor or outdoor installation, with the option of being powered through the coaxial feed. The metal housing provides shielding and improved lifespan. The unit uses RCA type phono jack and CATV F connector for the input and output connections, and has a relay that automatically bypasses the amplifier when dc power is removed.

**Benefits:**

- Push-pull operation eliminates harmonic distortion
- High quiescent current increases ability to handle strong signals without distortion or overload
- Meticulous craftsmanship and durable components provide superior dynamic range
- RCA type phono jack and type F connector ease installation
- Simplified switching - automatic bypass eliminates gain when dc power is off
- 10-18 Vdc power using power connector or through the coax
- 10-18 Vdc through coax enables remote operation at antenna
DXE-RLP-75FF - Lightning Protector, Receive 75Ω, DC Pass, F Conn
Unique In-Line® design is impedance matched to 75Ω and is virtually transparent to all analog or digital bi-directional signals from DC to 1.0 GHz. Tii's patented proprietary coaxial gas tube surge protector is equipped with an integral fail short mechanism for a power-cross condition which shunts both the coaxial cable's center conductor and sheath for a common path to ground. The DC breakdown voltage of the protector provides superior protection against transient surges, yet is compatible with network powered applications. The protection element is designed to reset after each over voltage event. Metallic housing of the Tii In-Line® Coaxial Lightning Surge Protector provides necessary EMI shielding. When properly connected the protector is environmentally sealed (15 psi) to prevent ingress of moisture and humidity encountered in broadband pedestals, vaults, NIDs and stand alone applications. Full 360° “F” port connectors provide superior RF performance and tighter connections.

DXE-UT-KITF - F-Connector Coaxial Cable Prep Tool Kit
This cost-saving kit provides a handsome, convenient carrying case complete with the DX Engineering F-6 coaxial cable prep tools and accessories. It features a rugged, lockable enclosure fitted with a precut foam insert with a home for each tool. The DXE-UT-KITF kit provides the case complete with the following:
- DXE-CPT-659 - Stripping Tool for RG-59/F-6 size cable w/extra blades
- DXE-SNS6-25 - Snap-N-Seal Watertight F Connectors - qty. 25 pcs
- DXE-SNS-CT1 - SNS Connector Compression Tool
- CNL-911 - Coaxial Cable Shears
- DXE-CIT-1 - F Connector Tightening Tool

UMI-81343, DXE-NSBT8 - Anti-Seize & Never-Seez®
An Anti-seize compound MUST be used on any Stainless Steel nuts, bolts, clamps or other hardware to prevent galling and thread seizure. Any of these products can be used for this purpose.

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>*UMI-81343</td>
<td>Anti-Seize, 1 oz. Squeeze Tube</td>
</tr>
<tr>
<td>*UMI-81464</td>
<td>Anti-Seize, 8.5 oz. Aerosol Can</td>
</tr>
<tr>
<td>*DXE-NSBT8</td>
<td>Never-Seez®, 8 oz. Brush Top</td>
</tr>
<tr>
<td>*DXE-NMBT8</td>
<td>Never-Seez®, 8 oz. Brush Top, Marine Grade</td>
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</tbody>
</table>

* These products are limited to domestic UPS Ground shipping only

DXE-F6-1000 - 75Ω F-6 Style Direct Bury Coax, 1000 ft. Spool Hi Quality "Flooded" Coax
Sold by the spool, or as Custom Cable Assemblies

- Center Conductor: 18 AWG Copper-Clad Steel, Nominal Diameter: 0.040 in.
- Dielectric: Gas Expanded Polyethylene, Nominal Diameter Over Dielectric: 0.180 in.
- Shield: 1st Shield: Aluminum-Polypropylene-Aluminum, Laminated Tape with overlap Bonded to the Dielectric, Nominal Diameter Over Tape: 0.187 in.
  2nd Shield: 34 AWG Aluminum Braid Wire, 60% Coverage
- Jacket: PE (Flooded for Underground), Nominal Diameter Over Jacket: 0.272 in., Nominal Jacket Thickness: 0.030 in.
- Electrical Properties: Impedance: 75.0 +/- 3.0 Ω, Velocity of Propagation: 85.0% Nominal

We recommend the use of Snap-N-Seal connectors to ensure a high quality and weather resistant feedline connection. The proper tool must be used to install these connectors.

DXE-22058 - Permatex Dielectric grease, 3 oz.
Dielectric grease is ideal for keeping moisture from entering your coaxial connectors. It also acts as a lubricant allowing easy connector removal by stopping corrosion of electrical connectors. Multi-use 3 oz package. Safe for all RF connections.
Time Variable Sequencer Unit - DXE-TVSU-1A

The DX Engineering TVSU-1A Time Variable Sequencer Unit is a microprocessor-based transmit / receive control-signal delay unit. It provides 0-30 ms of delay, programmable in 2 ms increments, to as many as five outputs tied to the CW keying or push-to-talk (PTT) lines. By controlling the receive-to-transmit (and back) timing of linear amplifiers, preamplifiers, and other sensitive equipment, damage caused by improper switching can be eliminated. This sequencer improves CW performance by eliminating annoying leading edge chopping or truncating of Morse characters. This is especially important in contests or pileups where sending accuracy is critical. Now RoHS compliant, the TVSU-1A can also control external devices such as preamps, active antennas, or external relays that need to have power removed during transmit. Separate power-in and power-out jacks on the front panel are used to control external power in this type of application. Two 2.1 mm power plugs and two 3.5 mm stereo plugs are provided.

Benefits

- Control timing of PTT turn-on, hang delay of PTT, amplifier hang delay, external antenna relay hang delay and turn-on delay of auxiliary output
- Dip switch settable delays of 0-30 milliseconds in 2 millisecond steps
- Side tone generator that follows input of keyer or hand key not transmitter
- Side tone pitch can be programmed from 300 to 1000 Hz in 50 Hz steps, front panel headphone jack with adjustable volume
- Supports CW full break in
- Can control external power to our Active Receive Antennas and permit operation in closer proximity to transmit antennas

DXE-CW9-1K - Shielded Control Wire, Economically Priced, 9 Conductor, 1000 ft Reel

Economically priced DXE-CW9-1K is a 1000 foot box of high quality shielded outdoor FTP (Foil Twisted Pair) Cat 5e cable. It features 4 Twisted pairs of 24 AWG solid wires with Al foil shielding plus a solid tinned copper drain wire - providing a total of 9 conductors for DC switching applications. It has a polyethylene jacket and is rated for direct burial. A nice feature is the "rip cord", which allows for easy stripping of the heavy jacket without worry about nicking or accidentally cutting the conductors. Excellent for use in all outdoor applications of switching, networking, data transfer and phone lines. As a data transfer line, it supports 10/100/1000 Mbps. The Shielded Control Wire may also be purchased 'by the foot' - call DX Engineering for details.

DXE-CW9S - Shielded Control Wire, 9 conductor stranded, per foot

DXE-CW9S is a high quality shielded outdoor cable. It features 9 #24 AWG stranded conductors with aluminum foil shielding plus a #24 stranded tinned copper drain wire. This gives you 8 switch positions plus common ground - plus the separate shield. It has a gray PVC jacket. This cable is ideal for DX Engineering Remote Antenna Switches and Four Square arrays, and should be considered for any low-current custom remote switching application you have - such as receiving antenna arrays. Order by the foot in the length you require. Price shown is per foot. A nice feature is the "rip cord", which allows for easy stripping of the heavy jacket without worry about nicking or accidentally cutting the conductors.

KLE-11055 - Klein-Kurve Wire Stripper / Cutter 11055, 18-22 AWG

Klein Tools Klein-Kurve wire strippers are ideal for stripping solid (10-18 AWG) and stranded (12-20 AWG) wire cleanly and easily. The 7 1/8 in. strippers also have precise shear-type blades to cut copper wire nicely, easy-to-read markings on both sides, and extra-soft grips and curved handles for comfort.

DXE-CIT-1 - F Connector Tightening Tool

The CIT-1 installs and removes F connectors in high density and hard to reach locations, and is the only tool that works with bent coax. Only finger force is required. Provides enough leverage to achieve a 30 in/lb tightening force by hand. Helps insure proper connections thereby reducing the potential of loose connector related service calls.
**Technical Support**

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

[DXEngineering@DXEngineering.com](mailto: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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