BevFlex-4 Low Noise Receiving Antenna Installation Manual

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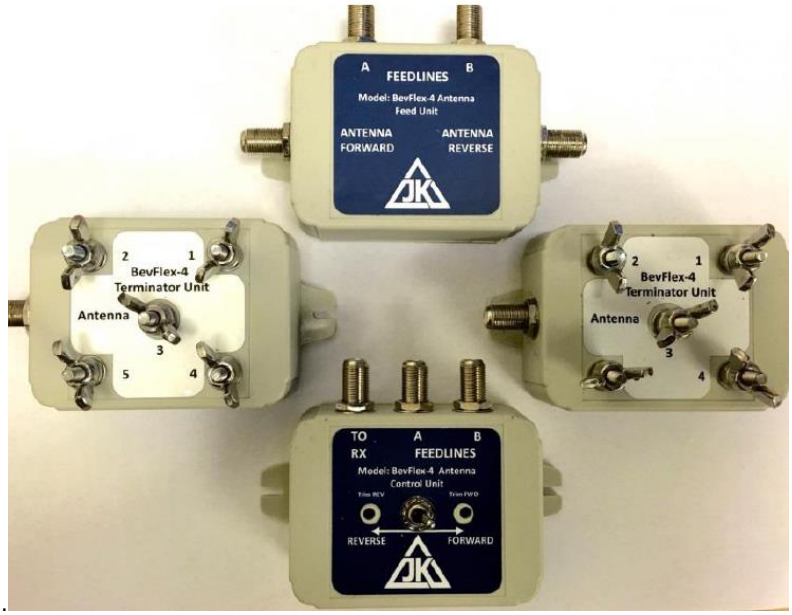
Call us at: +1 845 228 8700
JK Antennas LLC
72 Grays Bridge Road, Unit D
Brookfield, CT 06804 USA
Email: bevflex4_sales@jkantennas.com
https://jkantennas.com/rx-antenna.html

BevFlex-4 System Description and Performance Guidelines

The JK BevFlex-4 is an upgraded version of the BevPro-1 Beverage antenna system now in use worldwide for weak signal, low noise reception. This product retains ALL of the features of the original BevPro-1 while adding the flexibility to accommodate a total of four different antenna systems where the installation of a classic, above ground, Beverage is impractical due to space constraints. A key feature of the BevFlex-4 system is the ability to install ANY of these four antennas using the SAME components included with the BevFlex-4 kit. Descriptions of each antenna possibility follow.

Figure-1 Components in BevFlex-4 Kit



Included Items in BevFlex-4 Kit

QTY	Description
2	Antenna End Terminator Units
1	Antenna Feed Unit
1	Antenna Control Unit

1. Classic Beverage system

The Beverage receiving antenna was invented by Harold H. Beverage in 1921 and is a proven performer for receiving weak DX signals in the presence of atmospheric and man-made noise. The Beverage antenna is not suitable for transmitting, since its overall relative gain is typically 10dB or more lower than a dipole antenna. You may ask why a receiving antenna with such low overall gain is useful as a receiving antenna. The answer lies in the fact that the noise levels on the long wave, medium wave, and lower HF bands are far above the sensitivity of modern receivers. While the overall gain of the Beverage receiving antenna is much lower than most transmit/receive antennas, the signal to noise ratio of signals received in the favored direction of the Beverage antenna will be typically significantly higher than on the main, transmit/receive antenna. The physics behind the antenna design itself are well documented and well understood. You will find many reference articles on-line that fully describe a wide range of creative implementations of Beverage antenna designs ranging from simple to complex.

The performance of the BevFlex-4 Beverage antenna system will be as good as or better than conventional Beverage system installations of the same height and length. The BevFlex-4 design uses RG-6 coaxial cable that is inherently easier to install and more stable than reversible systems employing “open wire”, “window/ladder line“, or “twisted pair wire”. The BevFlex-4 provides increased performance and ease of adjustment in real world installations. The BevFlex-4 also provides the means to independently adjust the terminating resistances at each end of the antenna from the operating position to optimize the performance of the antenna.

The basic Beverage antenna consists of a wire antenna element, a terminating resistance at the far end, and a feed system to bring the signal back to the receiver. Reversible Beverage systems provide the additional feature of switching the termination and feed ends of the antenna system to provide bi-directional performance.

The BevFlex-4 uses a common mode, receiving antenna, wire element, consisting of the outer shield of the RG-6 coaxial cable that extends to each end point of the antenna. The outer shield of the coaxial cable is continuously connected regardless of where the unique feed system is placed along the entire length of the antenna. The terminating resistances to correctly match the impedance (Zo) of the antenna at each end point are replaced with precision reflection components to couple the signals from each end as differential signals inside the coax between the center conductor and shield of the coaxial cable. The center conductor of the coaxial cable can be separated at any point along the entire antenna element length where these differential signals from each end are then brought to the receiver location via the feed point coupling unit to two individual, coaxial feed cables. *Regardless of where the feed point is installed along the antenna, the entire length of the antenna is always utilized.* The coaxial cable used as the antenna wire simultaneously operates as a common mode antenna and as a differential mode transmission line to bring the signal back from the one end of the antenna while also providing the correct terminating resistance to the other end of the antenna. At the receive location, a switching and impedance matching system is employed to reflect the correct terminating resistance value back to each end of the antenna via the inner conductor of the coaxial cable. By making the terminating resistance adjustable at the operator position, it is possible to optimize antenna performance in either direction right at the receiver location.

While all this sounds simple, it has taken years of prototyping and testing with precision test equipment to get the various components designed and developed to the point where a product can be manufactured in quantity to get predictable results.

The exact performance of any given beverage antenna system is dependent on many variables, such as ground conductivity and mounting height above ground, but the most common variable under the control of the operator is the overall antenna length. The following chart in Figure-2 can be used as a general guideline to aid in typical installation decisions. The bulk of field experience with the BevFlex-4 design has been with systems ranging from 270 ft. to 800 Ft. in length, but testing with antennas as short as 150 Ft. in length has yielded encouraging results, especially for the 40 meter to 15 meter bands. Figure-3 shows a typical antenna pattern for a 500 ft antenna at 4 MHz. and Figure-4 shows a typical antenna pattern for a 500 ft antenna at 1.9 MHz.

Figure-2 BevFlex-4 Performance Guidelines for Above Ground Beverage Antenna

Antenna Length	Overall Performance Vs. Band						Relative Directivity					
	160m	80m	40m	30m	20m	15m	160m	80m	40m	30m	20m	15m
100 Ft.	P	F	G	G	E	E	Nil	P	G	E	E	E
150 Ft.	F	F	G	E	E	E	Nil	F	G	E	E	G
250 Ft.	G	G	E	E	E	E	F	G	E	E	E	G
350 Ft.	E	E	E	E	G	G	G	E	E	E	G	F
450 Ft.	E	E	E	E	F	F	G	E	E	E	F	P
550 Ft.	E	E	E	E	P	P	E	E	E	E	P	P
750 Ft.	E	E	E	G	P	P	E	E	G	G	P	P
950 Ft.	E	E	G	G	P	P	E	G	G	P	P	P

E=Excellent, G=Good, F=Fair, P=Poor, NIL=Insignificant

Figure-3 Typical Antenna Pattern for a 500 Ft BevFlex-4 Antenna @ 8FT above ground (4 MHz)

3 dB Beam-width: 59.6°
Front to Back Ratio: 20.6 dB
Elevation Angle 29.0 deg.
Outer Ring -4.4 dB ref.
NEC-4 EZNEC Pro/4

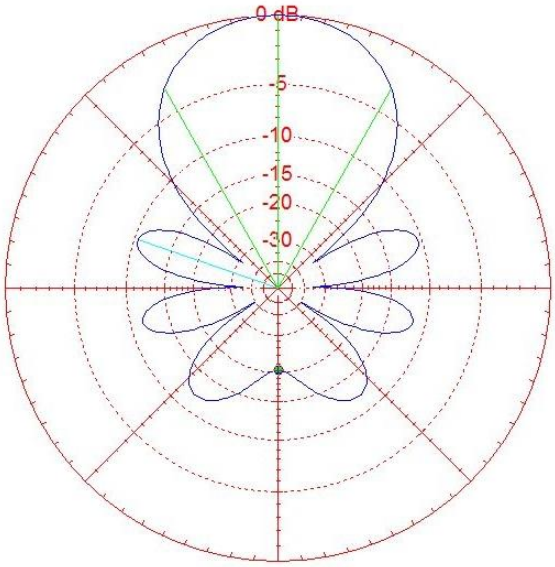
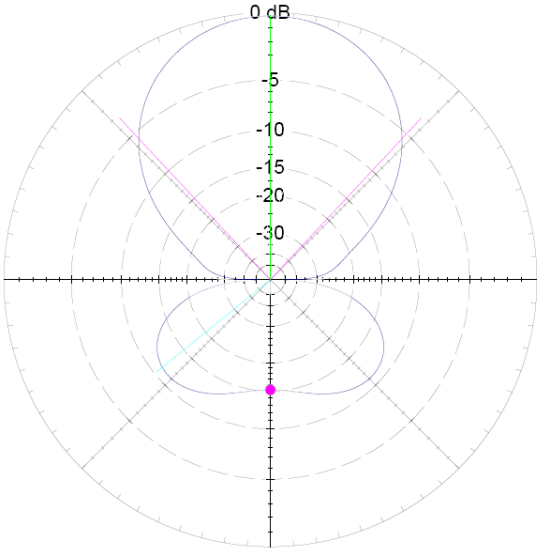


Figure-4 Typical Antenna Pattern for a 500 Ft BevFlex-4 Antenna @ 8FT above ground (1.9 MHz)

3 dB Beam-width: 86.2°
Front to Back Ratio: 15.0 dB
Elevation Angle 30.0 deg.
Outer Ring -11.3 dB ref.
NEC-4 EZNEC Pro/4



The JK Antennas BevFlex-4 Beverage antenna kit will enable you to construct a Beverage receiving antenna that has a uni-directional receiving pattern that can be reversed. In either of its two directional patterns, it is capable of providing outstanding results for the reception of weak signals that are otherwise unreadable using your normal transmit antenna. The key receiving benefit of the BevFlex-4 is not to increase the received signal level, but to improve the received signal to noise ratio in the favored direction, especially on signals arriving from distant stations at a low elevation angle. All received signal levels will be lower on the BevFlex-4 than receiving on your transmit antenna, but you will now be able to hear signals that were buried in the noise on your transmit antenna. "If you can't hear them, you can't work them" even if they can hear you!

As a reminder, this is a <u>RECEIVE ONLY ANTENNA AND MUST NEVER BE CONNECTED DIRECTLY TO THE OUTPUT OF A TRANSCEIVER .</u> The application of more than a few milliwatts of power into the system will result in damage and such damage is NOT covered by the warranty.

Figure-5

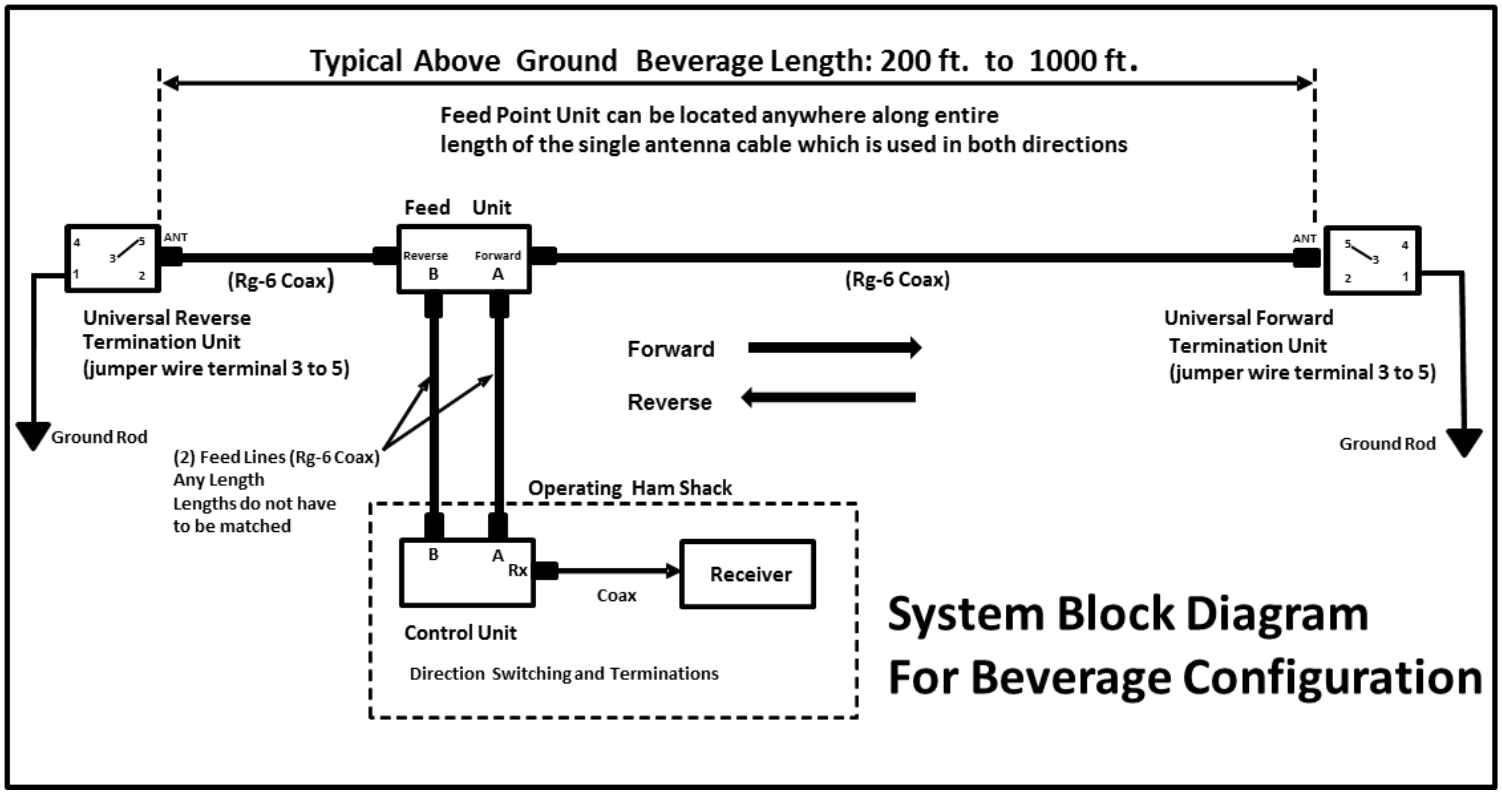


Figure-5 shows the wiring diagram for the entire system.

Prior to installation, determine the directions you want the antenna to cover. For example, in the Northeast USA, pointing the antenna element axis at 45 degrees in the forward direction and 225 degrees in the reverse direction, allows optimum reception from Europe or the South Pacific areas. The uni-directional receiving pattern of the antenna will typically be about 60 degrees wide at the -3dB response points. Antenna directivity patterns will typically allow reception well off the primary axis of the antenna which, unlike a dipole antenna, is off either end of the BevFlex-4 antenna element.

Please review the enclosed BevFlex-4 SYSTEM DESCRIPTION AND PERFORMANCE GUIDELINES to aid in determining optimum length for your antenna!

GENERAL INSTALLATION INSTRUCTIONS

In addition to the BevFlex-4 kit, you will need to have the following items as part of your Beverage antenna installation:

RG-6, 75 Ohm, CATV, coaxial cable: Sufficient RG-6 coaxial cable for use as the actual antenna element, plus (2) separate, feed lines from the feed point anywhere along the antenna element to your receiver location. Any good quality RG-6 coaxial cable with or without a messenger support wire can be used. (1000 Ft spools of RG-6 cable can be obtained at local builder's supply stores or over the Internet.)

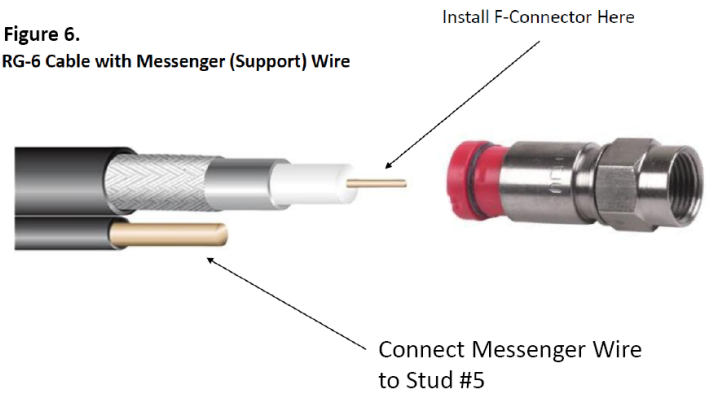
Ground rods: You will need one 4 Ft copper clad, steel, ground rod (1/2" or ¾" copper water pipe can be used in soft ground), a wire clamp, and a short piece of #12 or #14 hook up wire for each end of the BevFlex-4.

Cable supports: You will need support devices to hang the RG-6 coaxial cable from trees or other supports. Simple plastic cable ties or electric fence wire insulators work well for this application.

Weather proof Coaxial Connectors: You will need at least (8) outdoor type "F" connectors and the proper tools to attach them to the coaxial cable. Weatherproof, compression type, "F" connectors with "O-ring" seals are recommended.

The application of a small amount of silicon grease to the threads on each of the "F" connectors during assembly is also recommended to keep the connections weatherproof and free of corrosion. Wrapping the connections with silicone rubber type fusion tape is recommended for a good weather tight seal that is easily removable for future repairs.

Figure 6.
RG-6 Cable with Messenger (Support) Wire



INSTALLATION:

1. Determine the location for your BevFlex-4 antenna and install a 4 Ft ground rod at one end. (Scrap copper water pipe can also be used in soft ground). Try to locate the BevFlex-4 antenna element as far as possible from your transmitting antenna and/or its counterpoise radials. Undesirable coupling between the BevFlex-4 and other antennas can degrade the directivity and noise performance of the BevFlex-4. Close coupling of the BevFlex-4 to a transmitting antenna can also result in damage to the BevFlex-4 components and the receiver. It is recommended that the BevFlex-4 be spaced a minimum of 50 ft. from a transmitting antenna operating at power levels up to1500 Watts. There is one exception to the spacing rule. Two BevFlex-4 antennas can be placed perpendicular to each other to provide reception in four different directions. In this case the two perpendicular antennas can cross over each other as long as at least 12" of spacing between the two coaxial antenna elements is maintained. Multiple BevFlex-4's can be used as a phased array, but this application is beyond the scope of these instructions. Using the measurement tool within Google Earth to place the antenna location and directional heading on your property can be a very helpful planning step.

2. Connect one end of the RG-6 coax cable used as the antenna to one of the **Termination Units** in the kit.

3. Connect a short piece of hook up wire (non-critical, #12 or #14 recommended) between the ground rod clamp and terminal stud # 1 of the end box. It is recommended that the **Termination Unit** be located near ground level and close to the ground rod. If you use coaxial cable with a "supporting messenger wire" (not required, but mechanically stronger), see Figure 6 and connect this wire to stud # 5 on the end box. Connect a jumper wire between studs # 3 and # 5 to select the proper termination transformer tap for the classic Beverage configuration. See Figure-5 and Table 1 for details.

4. Run the RG-6 coaxial cable between the two end points maintaining relatively constant height above ground and keeping track of your direction of travel. A height of 7 to 10 feet above ground is ideal and keeps the wire high enough to allow mowing under the antenna and to reduce the possibility of damage from passing people or animals. (antenna heights as low as 18 inches above ground level can be used, but make the antenna more vulnerable to damage) Variations in the height above ground due to uneven terrain or uneven support heights will have little effect on the antenna performance. The RG-6 coaxial cable can follow the general contour of the land if you are going up and down hills and can be supported to tree limbs with cable ties or tree trunks with "nail on" electric fence insulators. Whichever type of supports you use, allow the coaxial cable antenna element to slide freely though the supports to allow for expansion and contraction as well as movement of the supporting trees, etc. The RG-6 coaxial cable comprising the antenna element does not have to go in an exact straight line on the desired heading It is OK for the antenna to zig-zag a few feet in either direction as long as the average heading of the antenna element is maintained. A moderate amount of symmetrical zig-zag of the antenna element coaxial cable actually introduces some "electrical loading" and reduces the velocity factor of the antenna, making it perform as if it were physically longer than it actually is. **BE SURE TO ALLOW A FEW EXTRA FEET OF RG-6 COAXIAL CABLE AT THE POINT WHERE YOU INTEND TO FEED THE SIGNALS BACK TO YOUR SHACK.** At that point, it is advisable to provide stress reduction loops where the **Feed Unit** will be connected.

5. At the far end of the antenna, install the other **Termination Unit** from the kit the same way as in instructions #2 and #3 above.

6. The feed point for the BevFlex-4 can be located at any point along the entire length of the coaxial cable antenna element. If you are feeding it from either end, simply connect the feed box from the kit directly to the end box with a short RG-6 coaxial jumper or an "F" male to male barrel adapter. Locate the feed point at the position most convenient to your receiver location. The entire length of the coax run used as the antenna is always used regardless of where feed unit is placed.

7. Install two RG-6 coaxial cables from the feed point box supplied with the kit to your receiver location. You can use two independent runs of RG-6 coaxial cable or the "Siamese twin" type dual RG-6 coaxial cable. The length and matching of the length on these feedlines is not critical.

8. NOW IS A GOOD TIME TO INSPECT AND WEATHERPROOF ALL OUTDOOR CONNECTIONS! Silicon rubber type fusion tape is recommended for a good weather tight seal that is easily removable for future repairs. The application of silicon grease to the threads on the "F" connectors also helps to keep the connections weatherproof and free of corrosion.

9. Connect the two RG-6 coaxial cables to the feed point box making note of which cables connect to the "A" and "B" labels on the box. Mark the cable ends on both cables and connect them to the corresponding "A" and "B" labels on the indoor **Control Unit**. (Note: these connections are reversed in the EWE and FLAG configurations)

10. Connect a user provided, 50 Ohm coaxial cable (impedance not critical) from the "RX" terminal on the Control Unit to the RECEIVE input on your radio. (User provided RCA phono or BNC adapters may be required to mate with the control unit and the appropriate input on your transceiver)

DO NOT CONNECT THE BevFlex-4 TO ANY TERMINAL CAPABLE OF TRANSMITTING, AS YOU MAY DAMAGE THE BevFlex-4 ANTENNA COMPONENTS! If your receiver or transceiver does not have a separate "receiver antenna" input terminal, you will need to provide an external transmit/receive relay that is controlled by the PTT function on your transceiver such as:

MFJ-1707 AUTOMATIC RF SENSE ANTENNA SWITCH
http://www.mfjenterprises.com/Product.php?productid=MFJ-1707

DX Engineering RTR-2 Receive Antenna Interface
https://www.dxengineering.com/search/product-line/dx-engineering-rtr-2-modular-receive-transmit-interfaces?autoview=SKU&keyword=receive%20antenna%20interface&sortby=BestKeywordMatch&sortorder=Ascending

ADJUSTMENT AND OPERATION

Termination Resistance Adjustment.

The **Control Unit** provides the ability to select the receiving direction of the antenna and to independently adjust the terminating resistance for each end of the antenna. The resistance value will be in the range 30 to 130 ohms and can be adjusted via trim pots located in the **Control Unit** with a small screw driver. These trimpots can be accessed through small holes on the top of the **Control Unit** marked "TRIM REV" and TRIM FWD" (See Figure-7). As shipped from the factory, each termination is set to 75 ohms. As a general rule, this setting will prove acceptable and provide good results without further adjustment. Depending on the overall antenna parameters, operating frequency, and sky wave reception angle, the resistance can be adjusted to optimize the antenna front to back ratio. Once these trim pots are initially adjusted properly you should not need to adjust them again.

Figure-7

A VSWR analyzer can be useful to determine that the antenna is correctly installed and adjusted. By connecting the analyzer to the "RX" port on the **Control Unit** and sweeping the frequency from 1.8 to 10 MHz, you should see a relatively flat and non-fluctuating (but not necessarily extremely low) SWR that is less than 2:1 (referenced to 50 Ohms). In some cases, adjusting the resistance for minimum "SWR VARIATION" while frequency sweeping, results in a better F/B ratio. If in doubt, leave the factory resistance settings and enjoy the antenna!

If you have adjusted the termination resistances and want to restore them to the original setting, you can use an Ohm meter to measure and adjust the terminating resistances back to 75 Ohms at the "A" and "B" input "F" connectors on the **Control Unit**. You will need to operate the direction switch to route the terminating resistance to the connector you are measuring. The resistance measured will be in the 30 to 130 Ohm range if the direction switch is in the proper position.

Listening to various signals, you should observe lower atmospheric and man-made noise levels than on your transmit antenna as well as a significant (sometimes more than 20 dB) front to back ratio when switching directions.

Spend time listening to signals on several different bands and compare the signal to noise ratio to your other antennas. There are a number of HF broadcast signals that can be helpful in determining the performance of your BevFlex-4 receiving antenna system.

For example, in the eastern USA:

- Gander and New York aviation weather broadcasts on 3,485kHz and 10,051kHz (USB mode)
- CHU Canada time and frequency references on 3,330 kHz and 7,850 kHz
- WWV time and frequency reference on 2,500, 5,000, and 10,000kHz
- Radio Australia on 9,580 kHz is also a good source.

These are all reliable and predictable HF sources that can aid in understanding the performance of your antenna.

Also trying listening to AM broadcast stations in known directions relative to your BevFlex-4's favored directions. Listen to both daytime ground wave and night time skywave.

You will notice that all received signal levels will be more than 10dB lower than on your transmit antenna, but the signal to noise ratio on the BevFlex-4 will typically be much better than on your transmit antenna for signals coming from the favored direction of the BevFlex-4 antenna. The lower overall received signal strength is not usually a problem since the sensitivity and excellent noise figure of modern receivers/transceivers is great enough to make up for this difference. The signal and noise levels on the lower HF bands below 10MHz are far above the receiver signal thresholds even when using the BevFlex-4 antenna system.

We hope you will find the BevFlex-4 receiving antenna system a highly useful and satisfying tool for digging signals out of the noise to hear what you could not hear on your other antennas.

Now that you CAN hear them, you CAN work them! Here's to good DX and shortwave listening!

73,

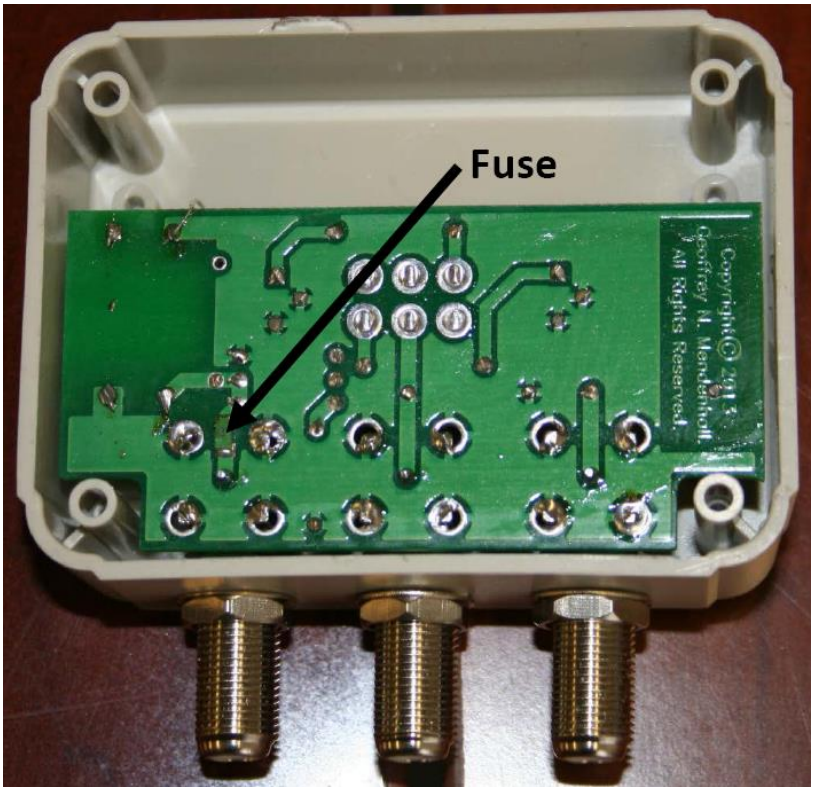
The BevFlex-4 Team

Notes of caution:

As stated at the beginning of this document, the BevFlex-4 is a RECEIVE ONLY antenna system and must be protected from accidental application of RF power to the Rx output "F" connector or any of the other system RF connectors. The BevFlex-4 antenna should be located as far as possible from transmitting antennas (50ft minimum separation from a 1500W transmitting antenna) to provide best receive performance and to protect the receiver from damage. The BevFlex-4 antenna switching and termination unit has RF limiting diodes to protect the receiver from nearby transmitted signals up to a fairly high level of 100 milliWatts (0.1 Watt) or +20dBm, but the system can still be damaged from close coupling to a transmitting antenna. The limiting diodes begin to operate at 1.1Volts RMS or +12dBm and reach a fully limited output of 3.0Volts peak to peak at +20dBm. If you are located close to a broadcast transmitter that drives the protection diodes into conduction, you may experience intermodulation distortion to the desired signals you are trying to receive. Try re-orienting the BevFlex-4 to reduce the nearby, strong, interfering signal or contact JK Antennas for other suggestions.

The antenna switching and termination unit is also protected against accidental application of RF power from the transmitter by a small surface mount fuse which can be seen if you open the bottom of the unit (See Figure-8). Should you accidently blow this fuse, the unit will be non-operational. If this occurs, you can replace this fuse with an identical fuse (USFF 1206 or Schurter, p/n 3413.0002.11, Mouser Electronics p/n 693-3413.002.11) or insert a small jumper wire or 10 ohm resistor across the pads. If you bridge the blown fuse with a resistor or jumper, the future protection of the BevFlex-4 system will be compromised.

Figure-8



If your transceiver does not have a separate receive antenna connector, be very careful about using an external switching arrangement to create a receive antenna function external to the transceiver. Many of these external T/R relays do not have enough isolation and fast enough switching time to protect the BevFlex-4. If your transceiver has an adjustment to delay RF output for a time interval after the PTT keying is activated, this delay should be set to at least 25 milliseconds to avoid hot RF switching and possible damage to receiver or the BevFlex-4 receive antenna system. It is known that the SPE Expert linear amplifier internal antenna switch will not adequately protect the BevFlex-4.

2. Beverage on Ground ("BOG") or Beverage In Sod ("BIS")

The BOG antenna, sometimes referred to as a "snake" antenna is nothing more than a BevFlex-4 installed on or just under the ground surface. While it might seem counterintuitive to have your receive antenna at or slightly (less than 1 inch) below ground level, it does work and has some interesting feature differences when compared to an above ground Beverage installation. The BevFlex-4 installed as a BOG retains the same advantages with respect to the use of RG-6 coax for the antenna element and feed lines as well as the ability to feed it from any point along its length. In addition, since the velocity factor of the antenna wire at ground level is much lower (~50%) than a wire above ground, the overall electrical length of the antenna is nearly twice as long as the physical length of the antenna. This extended electrical length characteristic along with the ability to hide the antenna in sod, can put the advantages of this low noise receiving antenna within reach of those with limited space and/or HOA restrictions on antennas. The BOG installation performance will be approximately as shown in the chart and polar plot below. One major difference, however, will be that the overall signal level will be lower than a traditional above ground Beverage antenna. While signal levels from a BOG will normally be sufficient for lower frequencies below 7 MHz, the use of the BevFlex-4 in a BOG configuration above 7 MHz may require the use of a low noise preamplifier at the output of the switch box.

BevFlex-4 Performance Guidelines for Beverage Antenna On Ground (BOG)

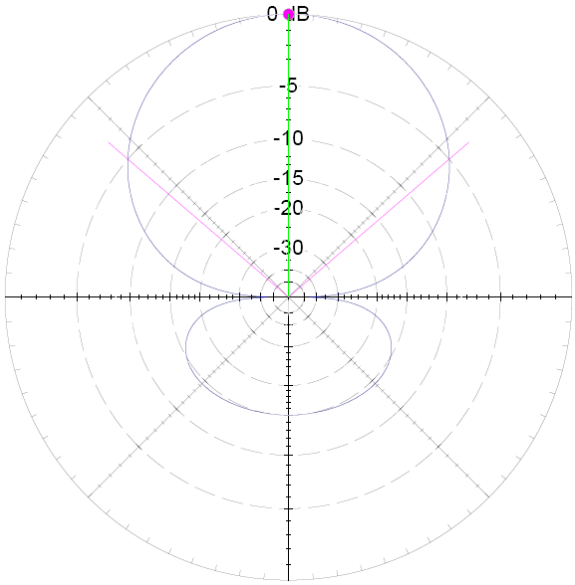
Antenna Length	Overall Performance Vs. Band			Relative Directivity		
	160m	80m	40m	160m	80m	40m
100 Ft.	F	G	G	F	F	G
150 Ft.	F	G	G	G	G	G
200 Ft.	G	E	E	G	E	E
250 Ft.	E	E	E	G	E	G
300 Ft.	E	E	E	G	E	G

E=Excellent,
G=Good, F=Fair,
P=Poor,
NIL=Insignificant

Operation at 40m and above may require a pre-amplifier

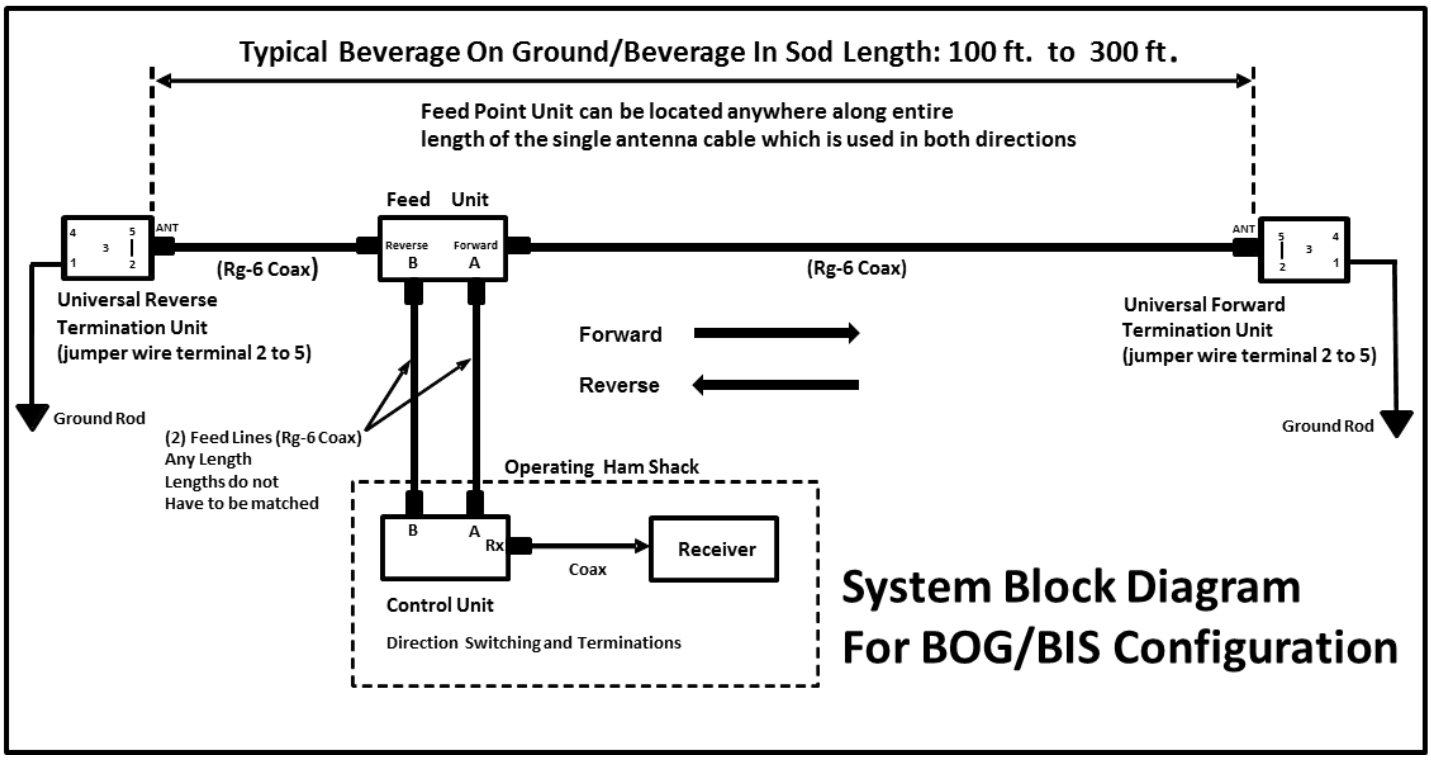
Figure 9. Typical Antenna Pattern for a 175 Ft BevFlex-4 Beverage on Ground Antenna (BOG @ 1.9 MHz)

3 dB Beam-width: 98.6°
Front to Back Ratio: 15.1 dB
Elevation Angle 35.0 deg.
Outer Ring -21.6 dB ref.
NEC-4 EZNEC Pro/4



BOG INSTALLATION:

Installation of this antenna configuration is similar to the classic, above ground Beverage described above except the studs on the termination units are wired differently. See Table-1 and Figure-10 below for details.



3. EWE Antenna

The inverted EWE antenna was first described by Floyd Koontz, WA2WVL, and documented in the February, 1995 edition of QST. It is by far, the smallest of the four receiving antenna variations possible with the BevFlex-4 system. The EWE consists of a single wire element in an upside down "U" configuration as shown below. The EWE is not a traveling wave antenna like the Beverage and BOG, but is really a phased array of two, short, vertical, antennas that are top coupled by the horizontal wire. Using this design, a good performing, low frequency, receiving, reversible, antenna is possible to deploy in a very small space. Each end of the EWE is fed back to the operating position with RG-6 coax and the termination resistance can be adjusted for best F/B ratio. Like the Beverage and the BOG, a 4 Ft. ground rod needs to be installed at each end of the EWE.

If the ground conductivity is poor, an additional wire connected between the ground rods and buried just beneath the ground may help the performance of the EWE antenna. The box normally used as a "feed point unit" for Beverage and BOG installations is now used as an isolation transformer to maintain balance and eliminate ground loops. Note that the coaxial feed-line connections to the switching control unit are reversed from the Beverage connections when the BevFlex-4 is configured as a EWE or FLAG antenna system.

EWE INSTALLATION: See Figure-11 below and Table 1 for details.

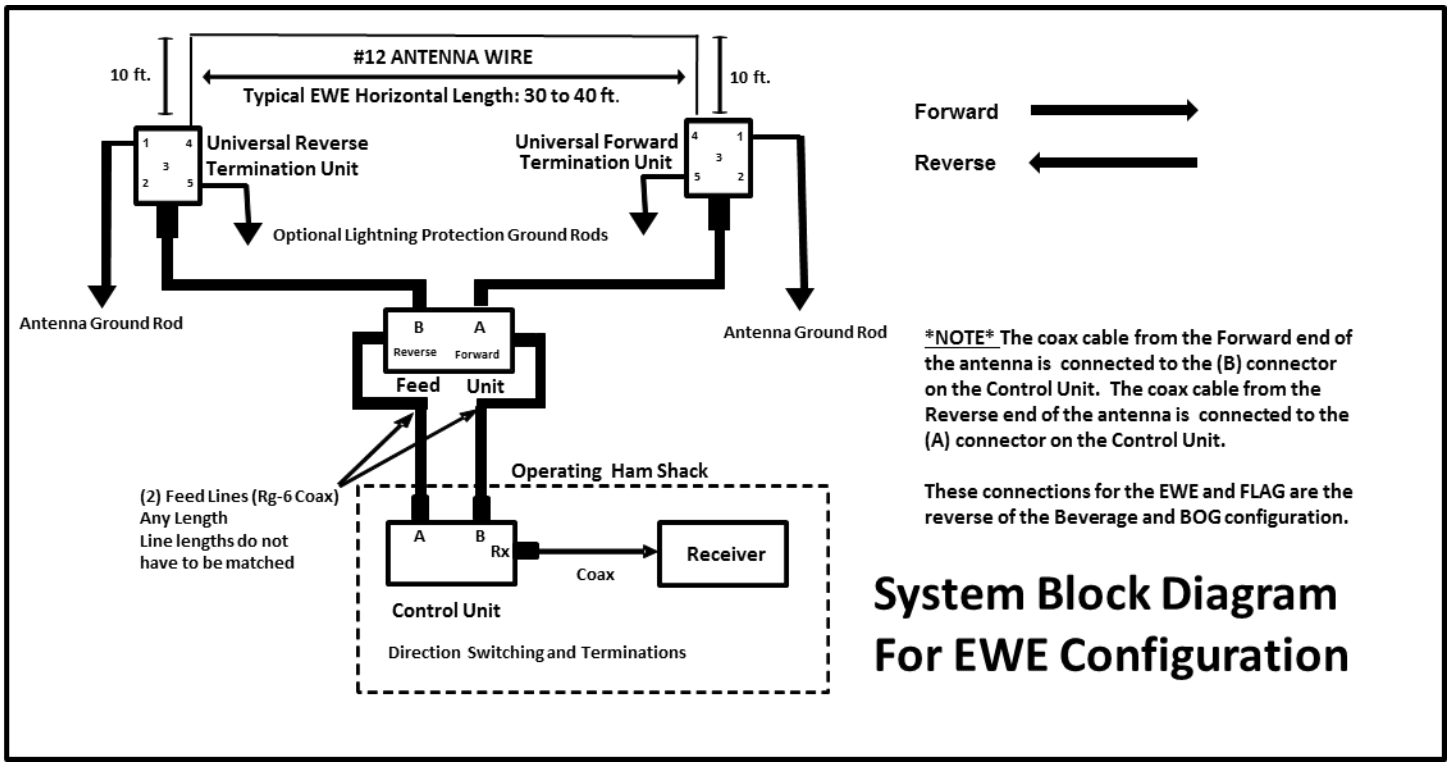
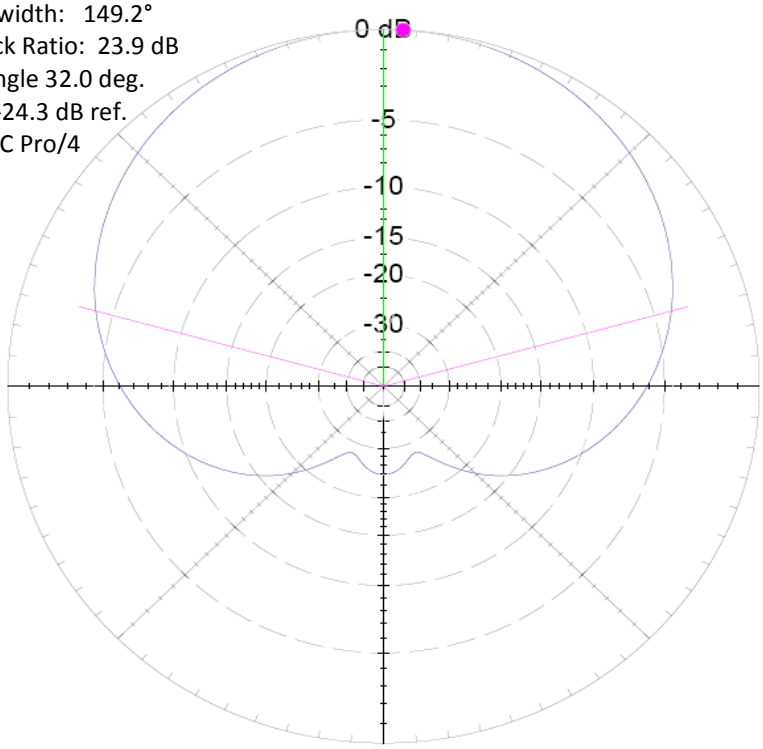


Figure-12 Typical Antenna Pattern for a 40ft x 10ft EWE (1.9 MHz)

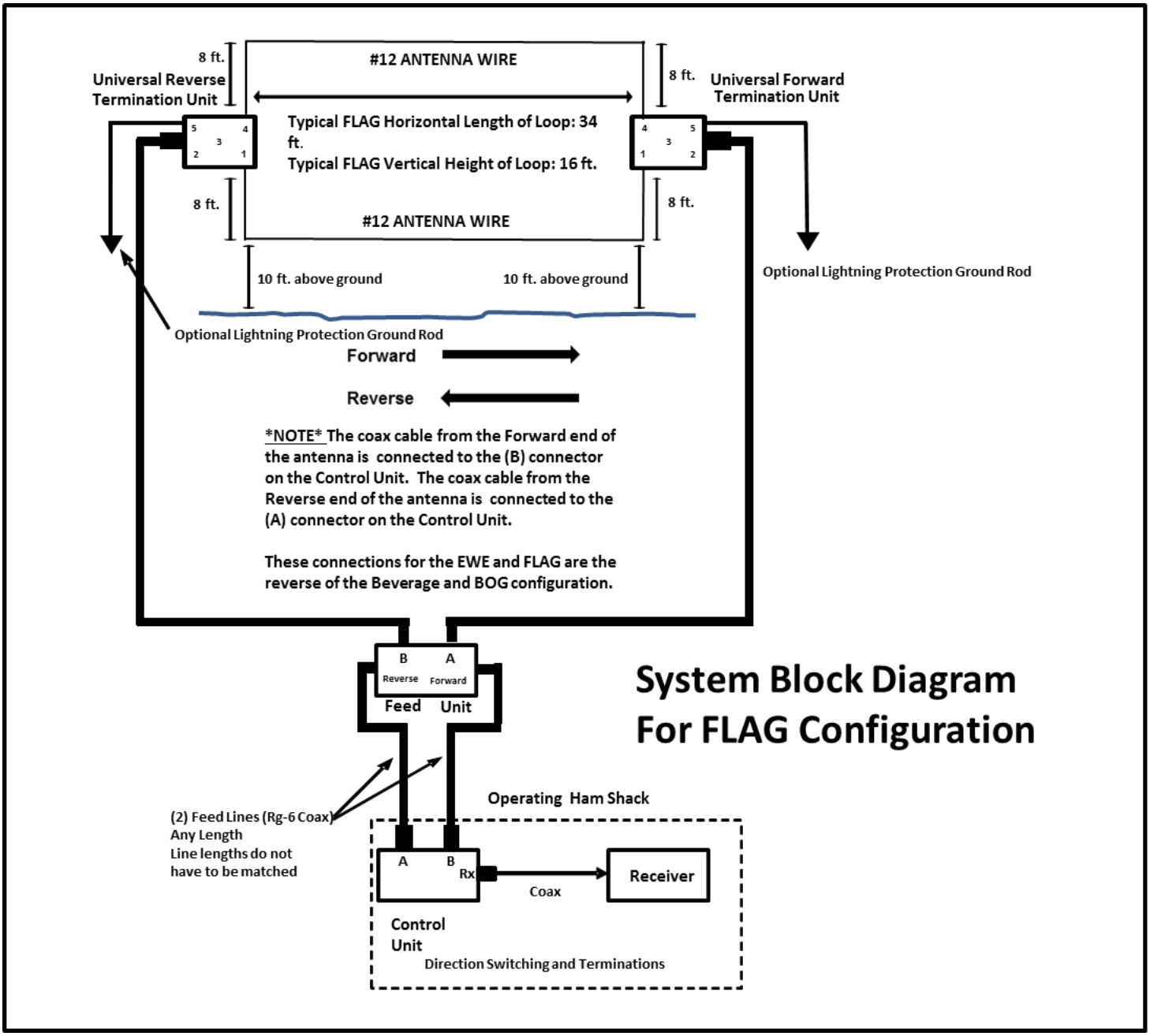
3 dB Beam-width: 149.2°
Front to Back Ratio: 23.9 dB
Elevation Angle 32.0 deg.
Outer Ring -24.3 dB ref.
NEC-4 EZNEC Pro/4



4. FLAG Antenna

The FLAG antenna is a rectangular, single wire, element with dimensions of approximately 34 Ft wide x 16 Ft high and is typically installed 10 to 25 Ft above ground. The FLAG, like the EWE, is not a traveling wave antenna like the Beverage and BOG, but is really a phased array of two, short, vertical, antennas that are top coupled by the horizontal wires. It may be also thought of as a pair of back-to-back EWE antennas mounted above ground. Details of FLAG operation theory and performance are widely available on-line. The illustration below shows a typical FLAG antenna installation.

FLAG INSTALLATION: See Figure-13 below and Table 1 for details.



Like the EWE, the FLAG has a feed point on one vertical element (forward direction) and a termination point on the other vertical element (reverse direction). By selecting the appropriate taps on the BevFlex-4 universal termination units, the FLAG now is totally reversible with individual RG-6 coax feed lines connected via the termination unit to each of the two vertical elements as shown. The box normally used as a "feed point unit" in Beverage and BOG installations is now used as an isolation transformer to maintain balance and eliminate ground loops in the system. Note that the coaxial feed-line connections to the switching control unit are reversed from the Beverage connections when the BevFlex-4 is configured as a EWE or FLAG antenna system. As in the Beverage and BOG implementations, adjustment of the termination resistance is accomplished at the operating position for best F/B ratio. The major advantage of the Flag antenna is retention of reasonable low frequency, low noise performance with a much smaller real estate requirement than either the Beverage or BOG. Figure-14 shows a typical FLAG antenna pattern.

Figure 14. Typical Antenna Pattern for a 34ft x 16ft FLAG @ 10ft (1.9 MHz)

3 dB Beam-width: 150.8°
Front to Back Ratio: 33.2 dB
Elevation Angle 31.0 deg.
Outer Ring -29.7 dB ref.
NEC-4 EZNEC Pro/4

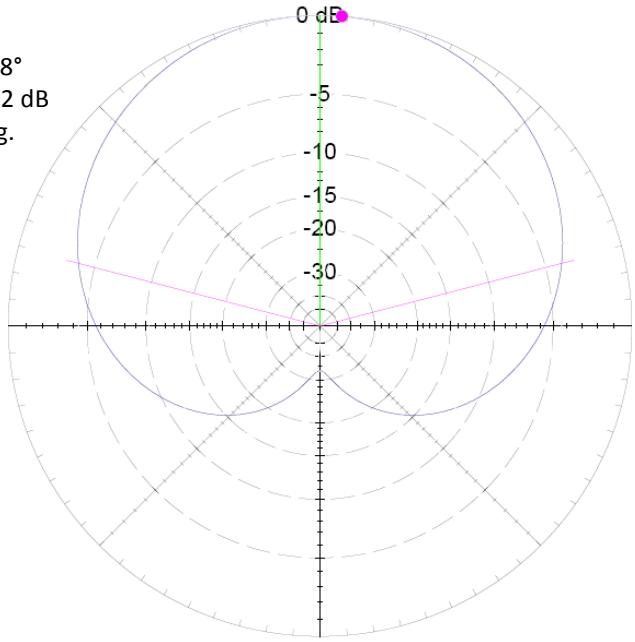


Table 1. End Terminator Unit Stud Connections for each Antenna Type

Antenna type	Stud # 1	Stud # 2	Stud # 3	Stud # 4	Stud # 5
Classic Beverage	Connect to Ground Rod	Not Connected	Connect to Stud # 5	Not Connected	Connect to Stud # 3
Beverage on Ground or in Sod	Connect to Ground Rod	Connect to Stud # 5	Not Connected	Not Connected	Connect to Stud # 2
EWE	Connect to Ground Rod	Not Connected	Not Connected	Connect to EWE Antenna Wire	Connect to Optional Separate Lightning Protection Ground
Flag	Connect to open end of bottom loop	Not Connected	Not Connected	Connect to open end of top loop	Connect to Optional Separate Lightning Protection Ground

Troubleshooting the BevFlex-4 System

To fully test all the components of the BevFlex-4 system, you will need an RF antenna analyzer in addition to an Ohmmeter. The RF analyzer is required because most of the connectors on the BevFlex-4 system components are terminated in transformers which will measure as very low resistance readings on an Ohmmeter. There are a few simple DC measurements that can be made using an Ohmmeter with the ability to measure low values of resistance to verify that the transformer windings are intact and the coaxial cables are correctly connected.

End termination unit DC resistance measurements:

- The resistance measured with an Ohmmeter from the center pin of the "F" connector to the outer shield on the end termination unit should measure less than 1 Ohm showing that the transformer winding is intact.
- The resistance measured with an Ohmmeter from terminal #1 to terminals #2, #3, and # 4 should be less than 1 Ohm.
- The resistance measured with an Ohmmeter from terminal #1 to terminals #5 should be on open circuit.
- The resistance measured with an Ohmmeter from terminal #5 to the shield of the "F" connector should be less than 1 Ohm.

Feed-point unit DC resistance measurements:

- The resistance measured with an Ohmmeter from the center pins of all four of the "F" connectors to their respective outer shields should measure less than 1 Ohm showing that all the transformer windings are intact.
- The resistance measured with an Ohmmeter from the antenna forward "F" connector to the antenna reverse "F" connector should measure less than 1 Ohm.
- The resistance measured with an Ohmmeter from either the antenna forward "F" connector or the antenna reverse "F" connector should measure as an open circuit to shield of either the A or B feedline "F" connectors.

Control unit DC resistance measurements:

Here are some simple tests with an Ohmmeter to check the functionality of the control box.

- If a transmitter or transceiver accidentally feeds RF power into the Rx port of the control box, a micro-fuse will open to protect the BevFlex-4 receiving antenna components. You can easily check the condition of this fuse by measuring the resistance from the center pin of the Rx connector to shield ground. The resistance should measure approximately 10 Ohms. If this port measures open, the fuse has blown. The fuse can be replaced by removing the back cover of the control box and soldering another fuse across the blown surface mount fuse. (The Manufacturer is: Schurter, p/n 3413.0002.11, Mouser Electronics p/n 693-3413.002.11) Alternatively, a 10 Ohm resistor can be soldered across the blown fuse, but future protection from accidental transmissions into the system will be compromised.
- With the direction switch in the "Forward" position, the resistance reading from the center pin of the A port to shield should be approximately 75 Ohms. This value is adjustable by the "Forward Trim" potentiometer and is limited to a range of 33 to 133 Ohms.
- With the direction switch in the "Forward" position, the resistance reading from the center pin of the B port to shield should be approximately 1 Ohm. This is the resistance of the transformer winding.

- With the direction switch in the “Reverse” position, the resistance reading from the center pin of the B port to shield should be approximately 75 Ohms. This value is adjustable by the “Reverse Trim” potentiometer and is limited to a range of 33 to 133 Ohms.

- With the direction switch in the “Reverse” position, the resistance reading from the center pin of the A port to shield should be approximately 1 Ohm. This is the resistance of the transformer winding.

Frequently Asked Questions about the BevFlex-4

1. What is unique about the BevFlex-4 product?

The JK BevFlex-4 is actually a kit that allows you to construct the best possible, reversible, low frequency, receiving antenna system for your particular situation. By simply changing jumpers on the termination boxes you can create a classic, above ground, Beverage; Beverage on ground (BOG); Flag; or inverted EWE antenna. No other product on the market offers the ability to create all four configurations and CHANGE them if and when your installation situation changes. Although the classic Beverage antenna configuration should yield the best results, the BevFlex-4 kit allows you to experiment and find what works best for you within the limitations of your location.

2. With four possible configurations, which one is the best?

That all depends on the real estate you have available and which directions are most important to you for low noise, low frequency, receiving. All (4) configurations have been and still are successfully used by world class DX’ers. As a general rule, the performance rating order would be:

Beverage - The longer the better (200 to 1000ft), Installed above ground

BOG - Same concept as Beverage, but placed on the ground—can be much shorter, but has reduced gain, particularly at higher frequencies.

FLAG - A balanced antenna with two parallel above ground conductors—requires considerable planning with regard to the supporting structure.

Inverted EWE – Unbalanced, short, above ground, antenna with simple support requirements.

(Both the FLAG and inverted EWE require MUCH less physical space than either the Beverage or the BOG.)

3. What is the main difference between a Beverage and a BOG configuration?

The Beverage antenna is installed ABOVE ground—typically 7-10 ft. above the surface while the BOG is installed at or just below (less than 1”) the surface of the ground or it can be installed in sod as a BIS (Beverage In Sod). A BOG can generally be made much shorter than the above ground, Beverage, due to its lower velocity of propagation factor. The BOG can provide similar results to an above ground Beverage twice the physical length of the BOG, but with a reduction in overall gain.

4. What is the main difference between a FLAG and an inverted EWE antenna configuration?

The FLAG antenna is a balanced antenna configuration while the inverted EWE is unbalanced. In simple terms, the inverted EWE looks much like half of a FLAG antenna. The FLAG requires a slightly more complex installation due to having two parallel wire elements above ground while the inverted EWE only requires one. Several users of the inverted EWE claim enhanced results in poor conductivity soil, by placing a small ground radial field at each end of the antenna or by connecting the two ground rods with a wire that is buried in the ground between them. This is not required for the FLAG configuration.

5. What is special or new about this Beverage antenna kit vs. others that are available?

The BevFlex-4 has the unique ability to be fed from any point along its entire length and the ability to adjust the end terminations from inside the shack at the operator's position. Plus, it utilizes inexpensive RG-6 coax cable vs. more expensive ladder line that is required for other reversible direction systems.

6. What bands does this antenna cover?

The BevFlex-4 antenna is capable of receiving all HF bands as well as the AM and LW broadcast bands. The most dramatic reception improvements are usually in the 1.8, 3.5, 7.0, and 10 MHz. amateur bands. It is still usable on 20m through 10m bands and down to 100kHz.

7. How does the overall system cost of this antenna compare with other Beverage antennas available?

Overall cost of the BevFlex-4 system is lower than any other commercial available system on the market due to the use of low cost CATV type RG-6 coaxial cable for all portions of the antenna and feed system. The system is entirely passive which reduces cost (no pre-amp required) and increases reliability.

8. Which is better, a shielded loop or a Beverage antenna? Both are advertised as low noise receiving antennas.

Both antennas have advantages and disadvantages. Although there will be few cases where the loop may nearly equal the performance of the BevFlex-4, the main advantage of the loop it that it requires no significant space. The loop can be rotated to null out specific, local, noise sources. If you are receiving signals from the directions favored by the Beverage polar pattern, the BevFlex-4 will always outperform the loop. A combination of the loop and the BevFlex-4 as a phased array using a two input antenna noise cancelling device is a very powerful noise suppression tool.

9. What is the optimum height above ground where I should position the Beverage antenna cable?

7 to 10 feet above ground is ideal in that it maintains the correct impedance as well as allowing for mowing under the antenna and minimum interaction with wandering people and animals.

10. Can I install the Beverage antenna on the slopes of hills on my property without the need for the terrain to be flat in elevation for best results?

Absolutely! Simply follow the contour of the land whether it is flat or hilly. Crossing a creek or depression in the ground will have little impact on the antenna's performance. The ground under the BevFlex-4 does not need to be flat. You can even install it on a moderate hill side.

11. How much can I deviate from a straight line in azimuth and still get good results as I layout the cable?

Although the ideal situation is to have a long antenna run in a perfectly straight line, deviations of 20 to 30 degrees from the desired direction are acceptable. Try to keep the average direction correct as you install the antenna, but do not worry too much about necessary variations to accommodate your situation. Symmetrical, horizontal, zig-zags in the direction of the BevFlex-4 antenna wire where space is limited, can actually be helpful by providing some loading of the antenna which effectively increases the antenna's electrical length versus its physical length.

12. Can I attach the RG-6 antenna cable to metal fence posts with wire ties or do I need to use some kind of insulator to standoff the cable from the metal post?

Insulated supporting posts or trees have the least impact on the BevFlex-4 performance. Metal posts can be used if the antenna element is supported with an insulator at least 18" away from the metal post. The antenna performance will be significantly degraded if there are any nearby wires running parallel to the antenna element.

13. What is the best kind of RG-6 cable to use? Quad-shield, standard single-shield RG-6 or 75 Ohm coax with a carrier support wire?

Quad shield is ideal, but not necessary. The better the shielding, the less likely you will pick up unwanted interference. We recommend using good quality cable with a UV resistant jacket and weatherproof connectors. Any type of 75 Ohm characteristic impedance coaxial cable can be used, including coaxial cables that incorporate a supporting, steel, messenger/carrier wire. If long spans are required between supporting posts or trees, the use of coax with a supporting messenger/carrier wire is desirable. Much of the surplus coaxial cable from CATV companies has an integrated carrier wire and can often be obtained for free. The messenger/carrier wire should be connected to terminal #5 on each of the end termination units.

14. What effect does my local ground conductivity have on antenna performance and should I make any adjustments to height above ground to compensate for this?

When mounted at least 7ft above ground level, electromagnetic modeling of the BevFlex-4 antenna shows little effect on the antenna's performance over a range of soil conductivities between 0.1 mS/m and 50 mS/m which are typically found in most locations.

15. How will weather conditions affect the performance of my antenna?

No more so than with any other wire antenna installation. The reversible Beverage allows you to switch directions to reduce interference from atmospheric storms coming from predominantly one direction. In such cases, it is better than other antennas for receiving under high noise conditions.

16. Why are there ground connections on each of the end terminating units?

The ground rods provide a connection between the custom reflection transformers at each end of the antenna and the ground under the antenna which completes the circuit between the two ends of the antenna.

17. Will I need to use an external preamp with this antenna?

Generally, no external pre-amplifier is required or desired as signal levels from the BevFlex-4 are well above the noise floor of your receiver on frequencies below 10 MHz. Received signals from the BevFlex-4 will almost always be LOWER in "S" meter readings than on your transmit antenna, but the overall signal to noise ratio will be higher. An antenna pre-amplifier may be helpful for a BevFlex-4 configured as a Beverage-On-Ground (BOG) or EWE at frequencies above 7.0 MHz.

18. How often will I need to adjust the terminating resistors?

The terminating resistors do not need to be adjusted frequently, if at all. They are set at the factory for 75 Ohms. In some situations, it will be possible to increase F/B ratio by adjusting the termination resistance, but this is not normally necessary.

19. What kind of connector is required to interface with my radio?

The output from the switching and termination unit is via a standard "F" connector matched to the 50 Ohm input impedance found on most receivers. You will need to provide a 50 Ohm cable and the adapters required to connect to your particular radio. ("F" to BNC, PL-259, RCA phono, etc.)

20. Do I need to use 50 ohm cable between the switching unit and my radio?

With the short lengths of cable involved in most installations, either 50 Ohm or 75 Ohm coaxial cable can be used.

21. What is the minimum distance that I need to maintain between my transmit antenna and the closest point of the Beverage?

The further, the better, as noise can be re-radiated from the transmit antenna into the BevFlex-4. Typically, 50 ft. spacing is sufficient. It is important to locate the BevFlex-4 away from vertical transmit antenna systems including the ground or elevated radial wires. If possible, route the BevFlex-4 antenna wire perpendicular to any other nearby antenna wires to minimize the coupling between the antennas. If it is not possible to provide this spacing, a relay can be used to open the connection (float) the transmit antenna while receiving. If high power is applied to a nearby transmit antenna, it is possible that the receiver protection, voltage limiting devices, in the switching and termination unit could be damaged.

22. When I adjust the terminating resistors I see no difference in performance. Is something wrong or defective?

This is normal. Many factors affect the optimum terminating resistance including the angle of incidence of the received signal. On stable signals with no fading, it may be possible to see increased F/B ratios by carefully adjusting the termination resistor, but in most cases you will see little if any variation in performance over the limited range of the variable resistance. If in doubt, set it to 75 Ohms and enjoy the performance.

23. Are the outdoor units weather proof?

YES, but it is the installer's responsibility to use properly installed, weatherproof, connectors and seal the connections with appropriate over tape.

24. Do you have any weather proofing and installation tips?

- Use plastic electrical tape to tape over the seams where the box and lid come together on the various units
- Be sure to allow a generous amount of coax center conductor protruding from the F connectors when you install them. This will allow for contraction of the center conductor during cold weather
- Coat the center conductor with WD-40 or contact cleaner to maintain a good connection and prevent corrosion
- Use Vaseline or silicon grease on the threads of the F connectors when you put them together
- Place a bead of RTV silicon rubber around where each F connector penetrates the various unit boxes. You can also use "liquid tape" for this purpose.
- Use copper clad steel ground rods You can also use scrap, copper, water pipe if the ground is soft.
- Use bronze or stainless steel clamps to make connections to the ground rods
- If you hang an above ground Beverage hung from trees, etc., use plastic electric fence insulators with loose ty-raps to hang the RG-6 coax, but also let it slide as the supports move in the wind

25. What kind of lightning protection is provided?

Each end termination unit is protected by gas discharge tubes to reduce the possibility of damage from nearby static discharges.

26. What is minimum length needed for the Beverage antenna?

Please review the chart in the application information for each antenna configuration. In general, the longer the better, with a practical minimum length being approximately 150 ft. While lengths greater than 1000 ft. can improve the gain of the antenna, the F/B ratio may suffer when the antenna is longer than (2) wavelengths at the desired reception frequency. There are many on-line references that discuss this trade-off in length.

27. I only have 270 ft. to work with. Should I configure the BevFlex-4 as an above ground Beverage antenna or as a Beverage-On-Ground (BOG)?

We have experience with a 270 ft. above ground, Beverage, antenna and were pleasantly surprised by how well it worked even on 160m. We also have experience with a175 ft. BOG on rocky soil and were impressed by how well it worked on 160m and 80m. This short BOG was able to achieve a 20dB front to back ratio on an AM broadcast station 40 mi away on 1600 kHz. If you want high front to back ratio on 160m with a short antenna, we would recommend the BOG configuration. We were frequently able to receive DX stations on either of these antennas that could not be copied on the transmitting antenna. Even with the BOG configuration, you will generally not need a pre-amplifier on 160m and 80m since the atmospheric noise level is still higher than the noise figure of a modern receiver.

28. I have less than 50 ft. to work with. Can I still build an effective, receiving antenna with the BevFlex-4?

Yes, we have experience with EWE and FLAG antenna configurations as short as 25 ft. Although the gain is lower than a Beverage or BOG antenna, the EWE or FLAG antennas can still provide a low noise receiving capability with good front to back directivity. We have experience working stations than could not be heard on a dipole transmitting antenna using a 25 ft. EWE antenna for receiving.

29. Can I have two BevFlex-4 antennas installed at right angles to each other in order to get optimum reception from (4) different directions?

Yes, you can install multiple BevFlex-4 antennas that cross each other as long as the antenna wires cross at close to a 90 degree angle to each other and are separated by at least 12 inches. This will minimize the coupling and interaction between the two antennas.

30. Can I feed more than one receiver from my BevFlex-4 antenna system?

Yes, you can use any standard 50 or 75 Ohm, isolated port, signal splitter that works down to your frequency band of interest to feed multiple receivers. The splitter would normally be placed after the direction switching unit. You can also split the forward and reverse feedlines from the antenna coupling unit into multiple feeds ahead of the directional switching unit, but you will lose the ability to individually optimize the terminating resistance for each end of the antenna.

31. How long can the feedline cables be from my shack to the feed unit?

Insertion loss measurements of coaxial cable with either solid copper or copper plated steel center conductors confirm that the losses of RG-6 coaxial cable are very low at HF frequencies. Feed cables up to 1000 feet should not be an issue. Dual RG-6 “Siamese” pair type cable is very convenient for the feedlines from the antenna feed-point to the operating position. The feedline cables do not have to be equal in length.

32. Do the A/B feedline cable lengths need to be matched in length?

No, the cables do not have to be length or phase matched for any of the four configurations to work properly.

33. Why is coaxial cable better than “open wire”, “window/ladder line“, or “twisted pair wire” for the antenna?

The use of well shielded, RG-6, coaxial cable provides better isolation between the common mode received signal on the outer surface of the shield and the differential mode signal inside the coaxial transmission line. The characteristic impedance (Zo) of the coaxial transmission line is not affected by the external mounting environment as much as the (Zo) of unshielded, parallel conductor, transmission lines. Light weight, RG-6, coaxial cable is generally less expensive, easier to hang, and maintain than window/ladder line.

34. Why are the coaxial feedline connections reversed for the EWE and FLAG antenna system configurations?

The EWE and FLAG antenna configurations operate with the received signal transformer at the end of the antenna wire toward the direction of reception. The Beverage and BOG antenna configurations operate with the received signal transformer at the end of the antenna wire away from the direction of reception. The EWE and FLAG configurations operate as a pair of top coupled, phased, vertical antennas while the Beverage and BOG configurations operate as resistively terminated traveling wave antennas.

35. How do I measure the impedance or resistance of the various components of the system when troubleshooting?

The end termination units and the feed-point unit all utilize RF isolation transformers between the various segments of coaxial transmission lines. Resistive measurements with an Ohm meter are of little value other than determining if there is a broken connection. The DC resistance measured across either of the feedlines to the shack will be a low value equal to the DC resistance of the coaxial cable in series with the DC resistance of the transformer in the feed-point unit. The DC resistance measured across either end of the coax used as the antenna, will be a low value equal to the DC resistance of the coaxial cable in series with the DC resistance of the transformer in the end termination unit. You can use an Ohm meter to set the terminating resistor values in the control box. This is done by measuring the resistance across the A or B inputs to the control box. The A input should measure 75 Ohms with the switch in the Forward position. The B input should measure 75 Ohms with the switch in the Reverse position. The only way to accurately measure the rest of the components of the system is to use a RF antenna analyzer to determine the actual RF impedances of the parts of the system you are troubleshooting.

36. What can an RF antenna analyzer tell me about the operation of my BevFlex-4?

If all the connections are intact and the correct impedance taps are selected on the end termination units, you should see a VSWR of typically less than 2:1 (referenced to 50 Ohms) across a frequency band from 1.8MHz to 10.0MHz when you look into the "TO RX" connector of the control box with an antenna analyzer. As the frequency is swept across this range of frequencies, there should not be a large variation in the VSWR reading. The correct terminating resistor in the control box can be adjusted to minimize the VSWR variations as the frequency is changed. At this point the Beverage antenna performance should be maximized.

37. I want to avoid running multiple pairs of coaxial cables to my operating position. Can I control multiple BevFlex-4 antennas from a single control box?

Yes, if you want to switch between two or more BevFlex-4 antennas (in any configuration) pointed in different directions without running multiple pairs of coaxial cables back to the operating position, you can use a remote DPDT coaxial relay to switch between the antennas. If you don't have a DPDT coaxial relay, you can easily mount a small Double-Pole-Double-Throw (DPDT) relay in a shielded box with (6) chassis mount "F" connectors. An inexpensive multiple DPDT relay board that works well for this purpose is: **https://www.amazon.com/JBtek-Channel-Module-Arduino-Raspberry/dp/B00KTEN3TM/ref=sr_1_5?ie=UTF8&qid=1487614909&sr=8-5&keywords=relay+board.** This is a very low cost arrangement and works fine as long as you keep the wires carrying RF from the relay to the "F" connectors reasonably short.

You can also purchase remote coaxial relays from: **http://www.greenheronengineering.com/proddetail.php?prod=GHE_RX8-2,** This product is fully configurable in software and uses wireless connectivity for control.

Some other products that use a simple wired interface are:

http://www.mfjenterprises.com/Product.php?productid=MFJ-4712,
http://www.ameritron.com/Product.php?productid=RCS-8V,

You can use pairs of the MFJ and Ameritron remote coaxial relays to switch the multiple pairs of coaxial cables from the multiple antennas to the single control box at the operating position.

The only compromise in doing remote switching of the coaxial cable pairs, it that the termination resistances for all of the antennas will be the same. This limitation does not have a significant impact on the performance of the antennas. It is suggested that the terminating resistors in the control box be left at the factory setting of 75 Ohms. There is no requirement that all of the BevFlex-4 antenna configurations be Beverage or any other type of bi-directional antenna. Beverage antennas can be switched with BOG, EWE, or FLAG antennas as long as the correct antenna impedance taps are selected on the end termination units for each of the antennas.