

# **SteppIR<sup>TM</sup>** **Antenna Systems**

Yagi • Dipole • Vertical (Patented)

## ***2 Element Yagi Instruction Manual***



### **SteppIR Antennas**

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## Abbreviations

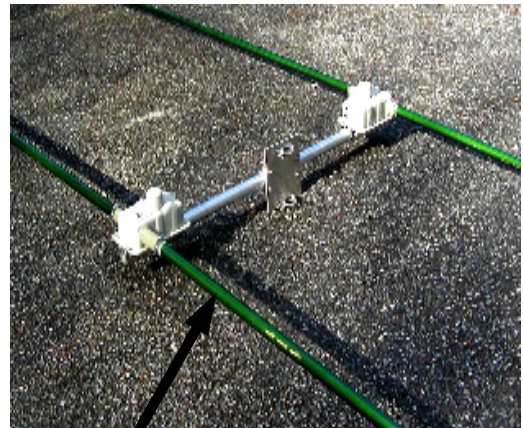
EHT	Element Housing Tube
EHU	Element Housing Unit
EST	Element Support Tube (pole)
FCC	Flexible Connection Coupler (rubber)

**EHT**



**EHU**

**FCC**



**EST**

SteppIR Antenna Information Web Sites(as of 4/09/07)

<http://steppir.com/>

<http://groups.yahoo.com/group/steppir/>

## SteppIR - Why Compromise?

The SteppIR antenna was originally conceived to solve the problem of covering the six ham bands (20m, 17m, 15m, 12m, 10m and 6m) on one tower without the performance sacrifices caused by interaction between all of the required antennas.

Yagis are available that cover 20 meters through 10 meters by using interlaced elements or traps, but do so at the expense of significant performance reduction in gain and front to back ratios. With the addition of the WARC bands on 17m and 12m, the use of interlaced elements and traps has clearly been an exercise in diminishing returns.

Obviously, an antenna that is precisely adjustable in length while in the air would solve the frequency problem, and in addition would have vastly improved performance over existing fixed length yagis. The ability to tune the antenna to a specific frequency, without regard for bandwidth, results in excellent gain and front to back at every frequency.

The SteppIR design was made possible by the convergence of determination and high tech materials. The availability of new lightweight glass fiber composites, Teflon blended thermoplastics, high conductivity copper-beryllium and extremely reliable stepper motors has allowed the SteppIR to be a commercially feasible product.

The current and future SteppIR products should produce the most potent single tower antenna systems ever seen in Amateur Radio! We thank you for using our SteppIR antenna for your ham radio endeavors.

Warm Regards,

***Mike Mertel***

***Michael (Mike) Mertel - K7IR  
President***

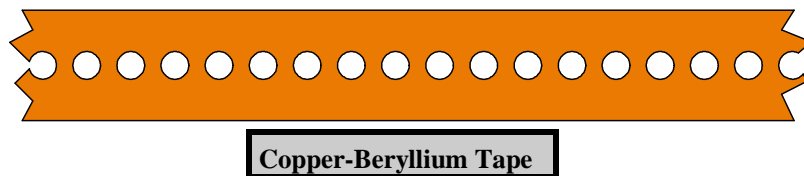


## SteppIR Design

Currently, most multi-band antennas use traps, log cells or interlaced elements as a means to cover several frequency bands. All of these methods have one thing in common—they significantly compromise performance. The SteppIR™ antenna system is our answer to the problem. Resonant antennas must be made a specific length to operate optimally on a given frequency.

So, instead of trying to “trick” the antenna into thinking it is a different length, or simply adding more elements that may destructively interact, why not just change the antenna length? Optimal performance is then possible on all frequencies with a lightweight, compact antenna. Also, since the SteppIR can control the element lengths, a long boom is not needed to achieve near optimum gain and front to back ratios on 20 - 10 meters.

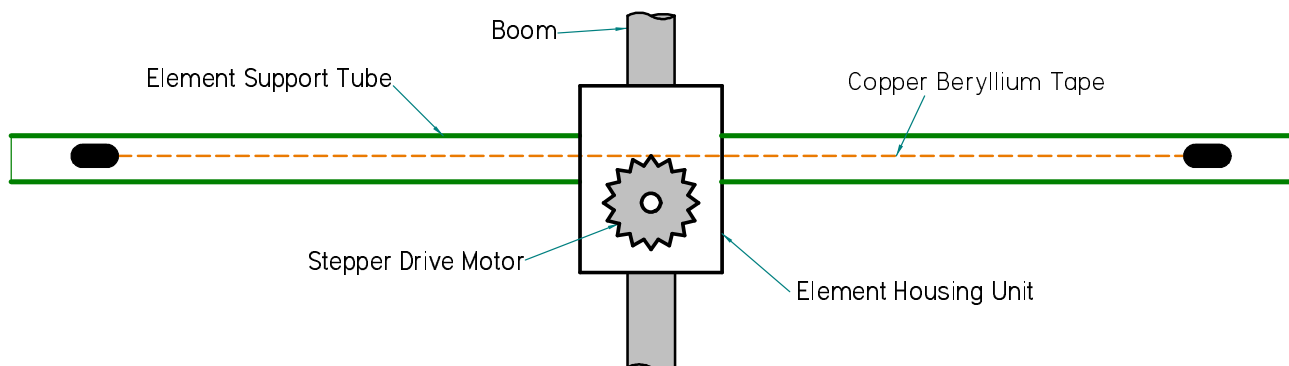
Each antenna element consists of two spools of flat copper-beryllium tape conductor (.54” Wide x .008” Thick) mounted in the element housing unit. The copper-beryllium tape is perforated to allow a stepper motor to drive them simultaneously with sprockets. Stepper motors are well known for their ability to index very accurately, thus giving very precise control of each element length. In addition, the motors are brushless and provide extremely long service life.



The copper-beryllium tape is driven out into a hollow fiberglass elements support tube (see below), forming an element of any desired length up to the limit of each specific antenna model (a vertical uses only one side). The fiberglass elements support tubes (poles) are telescoping, lightweight and very durable. When fully collapsed, each one measures approximately 48” in length. Depending on the model, their may be additional extensions added to increase the overall element length.

The ability to completely retract the copper-beryllium antenna elements, coupled with the collapsible fiberglass poles makes the entire system easy to disassemble and transport.

The antenna is connected to a microprocessor-based controller (via 22 gauge conductor cable) that offers numerous functions including dedicated buttons for each ham band, continuous frequency selection from 40m to 6m (depending on the model). There are also 17 ham and 6 non-ham band memories and you can select a 180° direction reversal\* or bi-directional\* mode and it will adjust in just about 3 seconds (\* yagi only).





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## SteppIR Antennas - 2 Element

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## 2 Element Yagi Installation

The 2 element SteppIR Yagi boom consists of two sections of aluminum tubing that are 57 inches long x 1-3/4" OD x 1/8" wall, along with two aluminum antenna housing brackets as shown in **Figure 1**. The element housing brackets are pre-installed at the factory. To assemble your antenna, you will need a 1/2" (13 mm) and 7/16" (11 mm) wrench and / or socket drive. We double check the fasteners for proper tightness before shipping but it is always a good idea to check them yourself before installing the antenna. Put anti-seize grease on all bolts 1/4" or larger, especially on the u-bolts because it greatly increases their gripping power. Anti-seize grease (molybdenum based) is available at most auto part stores.

### Assemble the Boom & Connect to Mast Plate

The boom is completely assembled and drilled at the factory to assure precision element alignment. Pre-drilled holes are quite snug to align almost perfectly. In some cases you may find it necessary to assist the bolts with a tap of a hammer, or "thread" them in by turning with a wrench.

Connect the boom by sliding the two sections together and align the pre-drilled holes (**Figure 3 and 5**). Refer to **Figure 9** for correct configuration. It is advisable to spray a small amount of WD-40 on the male sleeve before sliding the female section onto it. Do not twist the aluminum excessively, as this can cause binding - the WD-40 will help keep the two pieces lubricated. Insert the included bolts into the pre-drilled holes, and tighten the Nylok nut securely (**Figure 7**).

Note: If you are not installing the 40m-30m dipole kit you can remove the return bracket if you want to. If you do remove the bracket it is a good idea to mark both the boom and the bracket so that it can be reinstalled correctly later if needed.

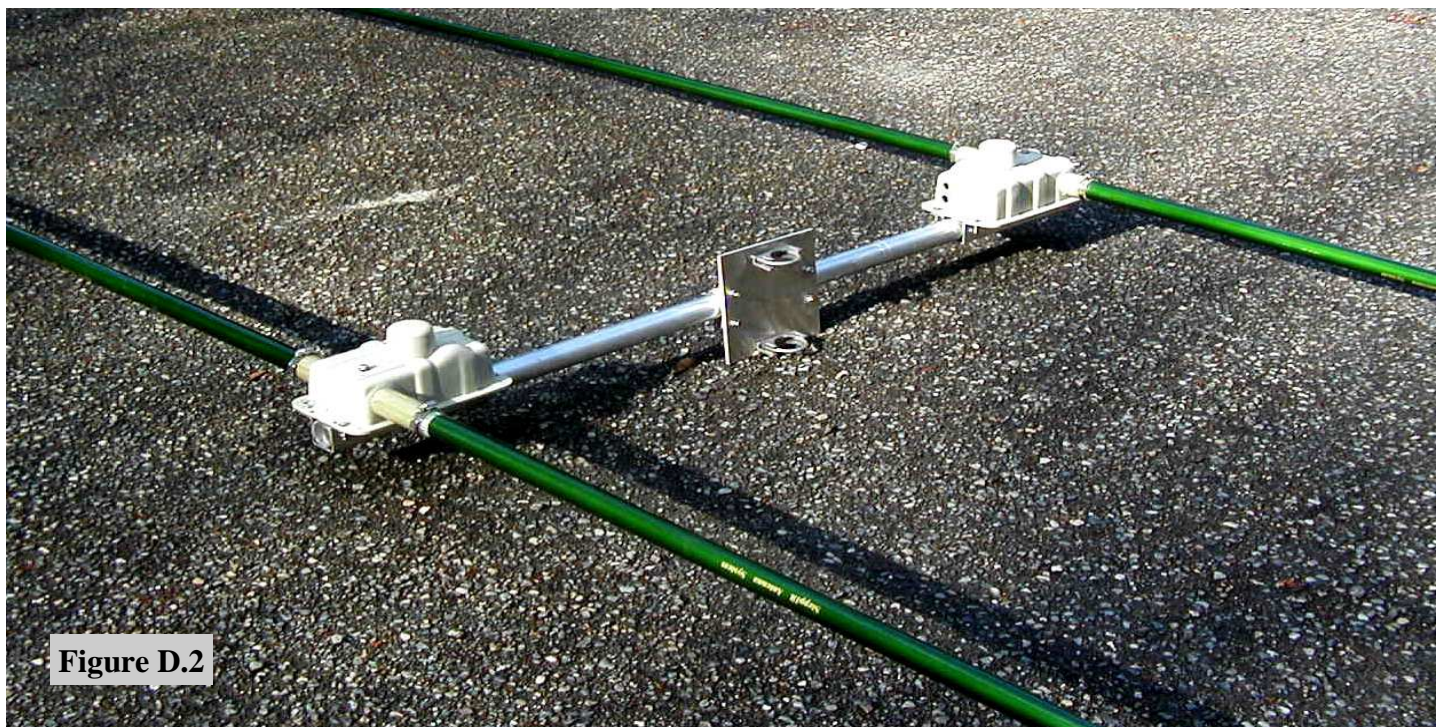
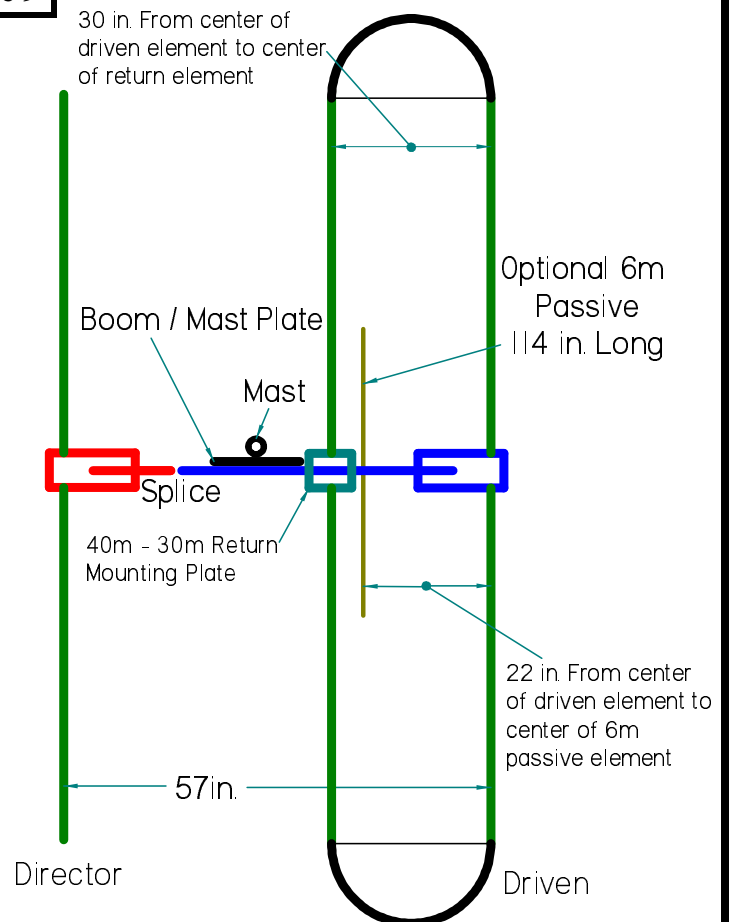
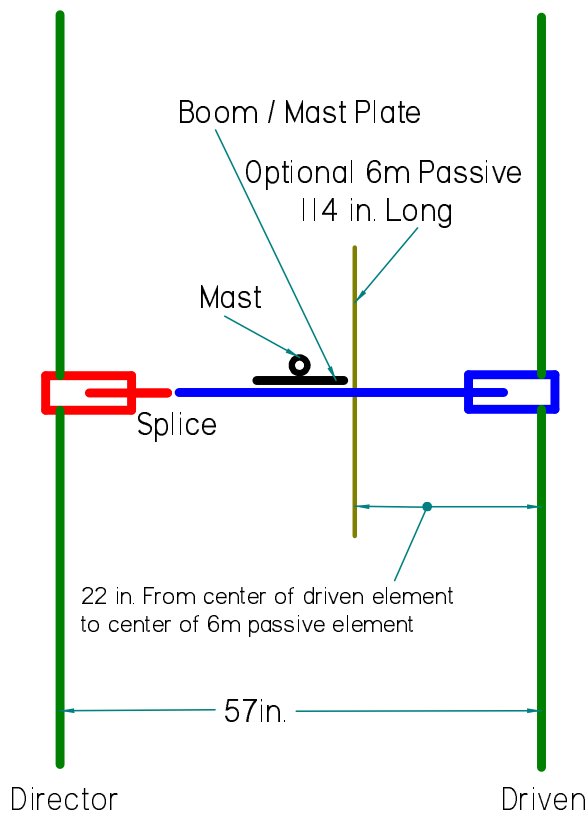




## 2E Without 40m-30m Dipole Kit (not to scale)

## 2E With 40m-30m Dipole Kit (not to scale)

Figure 9





## Connect the Boom to the Mast Plate

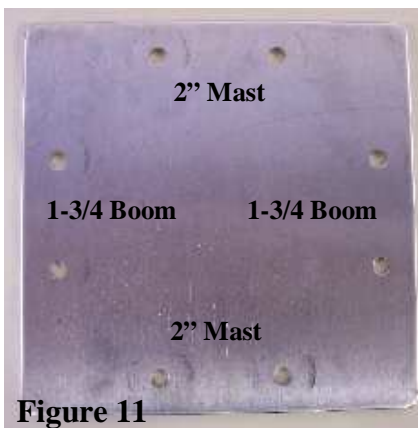
The mast plate (**Figure 11**) has a total of eight pre-drilled holes. Four are used for the 2" stainless steel mast clamps and four more are used for the 1-3/4" stainless steel boom clamps.

**Note: If you are installing a 40m-30m Dipole kit reference the 40m-30m Instruction manual for proper mast plate placement.**

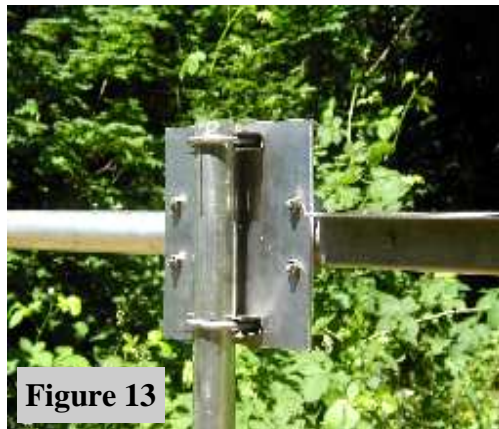
Connect the mast to the mast plate using the included 2" stainless steel U-Bolts, with saddles, and Nylok nuts as shown in **Figure 13**. Tighten securely.

**Note: If you are going to do this on the tower it is advisable to test each U bolt for a proper fit, Before you go up the tower, and bend if necessary to ensure ease of assembly when you are on the tower.**

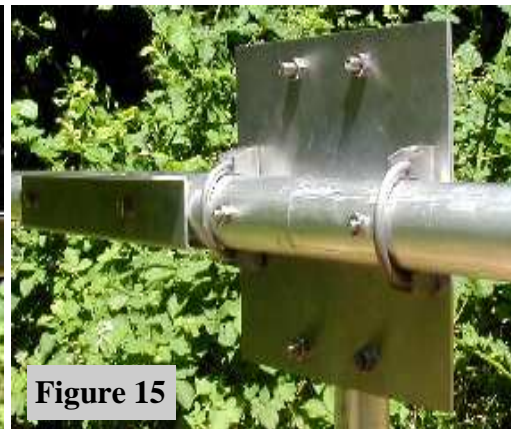
Connect the boom to the mounting plate on the opposite side of the mast ( **Figure 13** and **15**), using the 1-3/4" U-bolts, saddles, and nuts. Align the boom so that the element brackets are level, then tighten securely. The antenna balance point is at the center of the boom. To ensure a balanced weight load, the center of the mast plate should be at the center balance point of the boom.



**Figure 11**



**Figure 13**



**Figure 15**

## Determining the Direction of the Antenna

The SteppIR Yagi has three “directions” in which it can be used. Normal, 180 degree and bi-directional. When the antenna is installed on its mast the passive element should be facing the direction the rotator indicates.

- In the **normal** mode the antenna directs RF energy towards the passive element (the element that does not have the coax attached to it), giving gain in that direction and rejecting signals coming directly at the driven element from the opposite direction.
- In the **180°** mode the gain is now directed from the driven element end and rejected from the passive end.
- In the **Bi-Directional** mode, your antenna is directing RF in both directions.

## Attach the Element Housing to the Element Bracket

Place the flat side of the element housing unit (EHU) on top of the element to boom brackets (**Figure 17**). The housing without the SO-239 coax connector is the director, the one with the SO-239 connector is the driven element (the balun is on the inside of this housing). The driven and reflector elements should be positioned so the actual fiberglass element are the furthest away from each other (**Figure 9**). Fasten each element housing to the element bracket, using eight 10-32 x 7/8" screws, flat washers, Nylok nuts and tighten. **The flat washer needs to be placed between the screw head and the plastic element housing.**

**Warning:** Tighten the element housing unit screws securely, but not too tight (if you over-tighten the nut, you may split the plastic flange on the element housing).

The olive green element housing tube (EHT) on each antenna housing will appear uneven in length - it is actually centered on the inside of the antenna housing .

**Note:** The reflector element and the driven element will have the EST (offset tube) lined up so that the short side and long side of the each EST are facing in the same directions. The director element EST configuration will be the opposite. This is normal.



Figure 17



Figure 19



## Connect the Wiring and Secure it to the Boom

**WARNING:** Make sure the 25-pin sub-D connector is not connected to the controller if the DC supply is energized and plugged into the controller. There is voltage present on the control cable wires even when the power button on the controller is turned “off”. Shorting the control wires with power on them will destroy the driver chips. Either unplug the DC power supply or disconnect the 25-pin sub-D connector before making any connections or cutting or splicing the cable.

Note: If you have more than 200’ of control cable you should use the optional 33 VDC power supply. This will then allow any length control cable up to 500’ with no problems.

**Be sure** to connect the controller case to your station ground using the #8-32 lug on the back of the controller. This is important for RFI immunity as well as lightning static protection. If you are in a high lightning area take the appropriate precautions. The controller can be damaged by lightning. The surest protection against lightning is to disconnect the 25-pin sub-D connector and power supply, then move them well away from the controller during a storm.

Each antenna housing will have an installed 4 conductor cable attached to it using a waterproof strain relief fitting (**Figure 21**). There will be a 12 position terminal strip included with the antenna, and a single position terminal strip for the ground connections as shown in **Figure 23** and **27**.

First, dip each bare wire into the provided blue connector protector pouch. Connect each wire of the 4 conductor cable to it’s respective location on the 12 position terminal strip (**Figure 25** and **Figure 27**). You will need to repeat this on the opposite side of the terminal strip for the 12 conductor cable as well. Each cable (both of the four conductor cables and the 12 conductor cable) will have a bare silver wire, which is the ground. You will need to connect all three of these to the single terminal strip (**Figure 27**, **Figure 25**).

**WARNING:** While the 2 element Yagi has only 8 wires that are used, it is still extremely important that you hook up the remaining 4 wires. Even though these wires are not used, they still have power being supplied to them, so hooking them to the terminal strip will eliminate the chance of shorting.



Figure 21

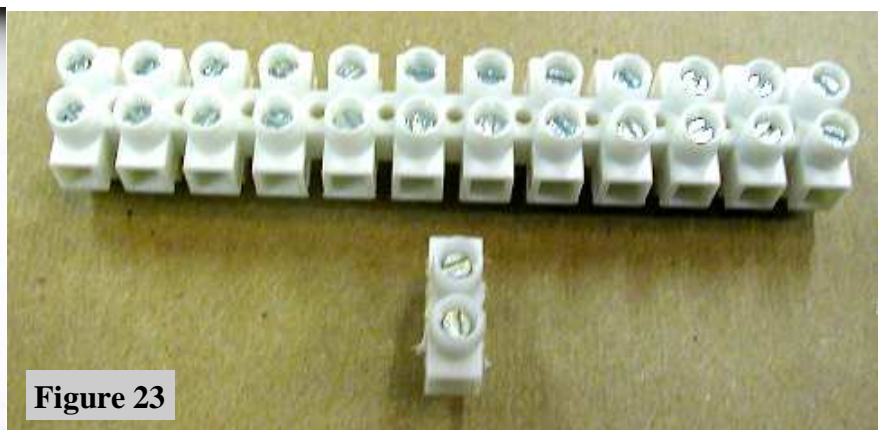


Figure 23



To Antenna

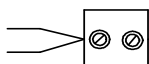
TERMINAL BLOCK 1



Male 25 Pin Dsub.

To Controller

Drain Wires from Each Element

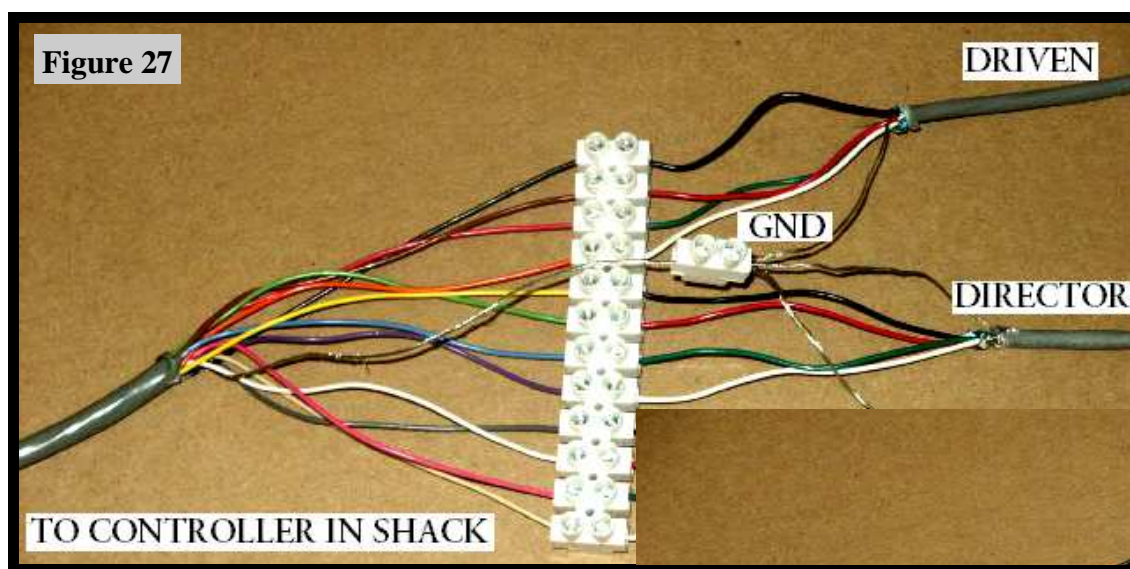


TERMINAL BLOCK 2

Shield (drain wire)

12 Conductor Cable  
(2 Element to Controller)

Figure 25



When the connections have been secured, you will want to position the cables so that they are parallel with the 12 position terminal strip (**Figure 29**). The 12 conductor cable will be at one side, and the 2 four conductor cables will be at the other. You will then want to slide the cables and terminal strips into the provided plastic enclosure (**Figure 31**). Position the 3 cables into the groove in the plastic cap (**Figure 33**) and thread the enclosure onto the cap.

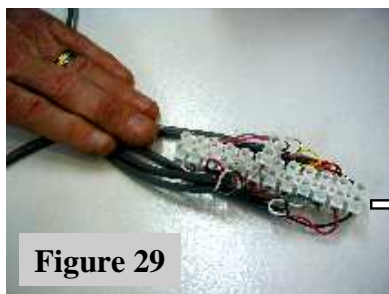


Figure 29



Figure 31



Figure 33

## Attach the Wiring Enclosure and Control Cable to the Boom

Position the plastic enclosure in a convenient position on the boom or mast (the terminal housing mounting location is not critical) making sure that the groove in the cap is facing downward. We do not seal the cap so that in the event there is water accumulation inside the enclosure from condensation, it will be able to escape. Secure the enclosure to the boom or mast using the 4" worm gear clamp, taking care to not trap the cables in between. Tape the cables to the boom.

**Note:** Be careful **NOT** to tape the cables over a sharp edge unless you provide extra protection to prevent eventually cutting through the sheath and shorting the wires.

**Warning:** We strongly recommend that you perform the “Test Motor” procedure at this point to verify the wiring is correct and the elements are in the right location, see the operations section of the manual.

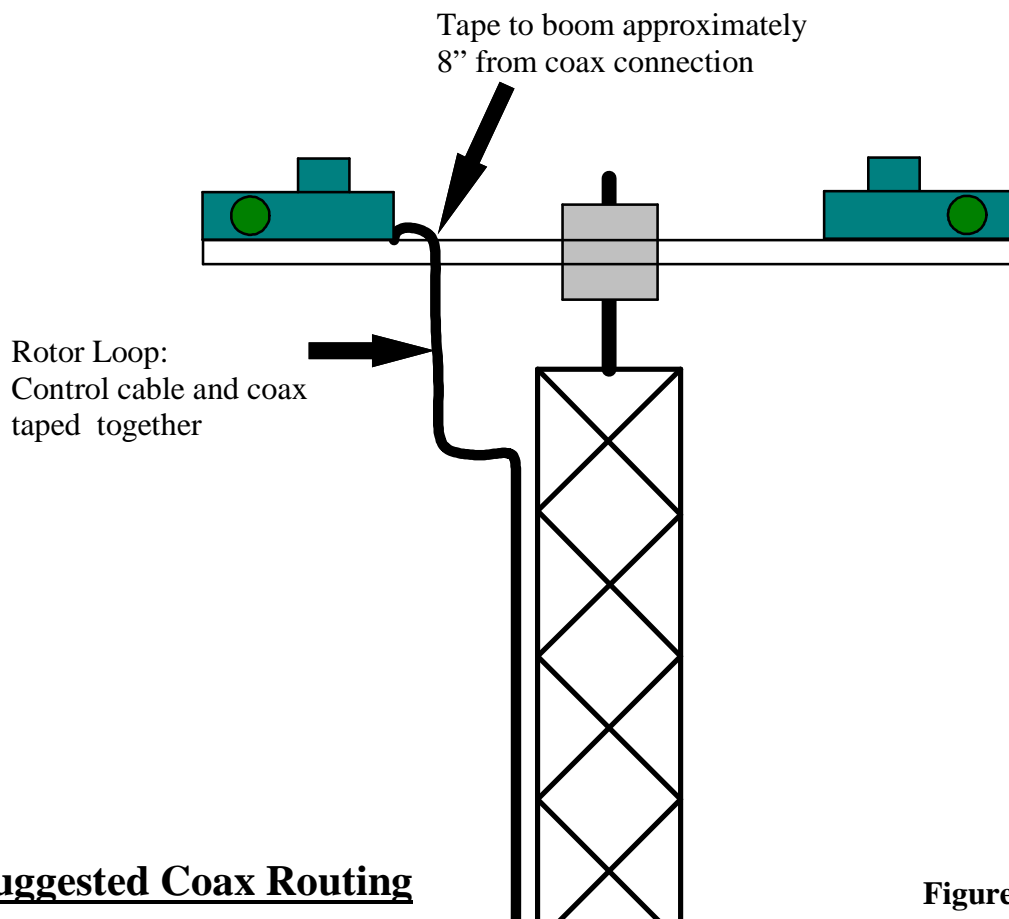


Figure 35

## Prepare the Telescoping Fiberglass Element Support Tubes (EST)

### Locate:

- Four dark green fiberglass telescoping poles (**Figure 37**)
- Four black rubber boots with clamps
- One roll of black electrical tape
- Rolls of black silicone self-curing tape (30 ft total) \*
- Your tape measure

\* Large rolls are 20 ft, small rolls are 10 ft.



Rubber Boots

**Note:** The steel reinforcing rings on the first two pole sections provides extra strength in potential high wind conditions.



Electrical Tape



Silicone Tape

The green fiberglass poles are all assembled in the same manner, and when extended, become element support tubes (ESTs) for the flat strip copper beryllium elements themselves. The copper-beryllium strips are shipped retracted inside their respective element housing units (EHUs).

## Repeat the Following Procedure for each Telescoping Pole

Telescope a pole to full length by pulling each section out **firmly** in a twisting motion until it is extended as far as possible. **Each segment is tapered and should lock securely in place when fully extended.** Pole lengths may vary but, when fully extended, each pole must be at least **17 feet 8 inches** in length as measured from the butt end of the pole to the tip (**Figure 37**). **Verify the length for each pole before installation or wrapping the joints.**

If a pole comes up a little short (1/2" to 1") try collapsing the pole and starting over, this time aggressively "jerk" each section out instead of twisting. The pole cannot be damaged and you may gain a minimum of 1/2" or more. If you have trouble collapsing the pole try carefully striking one end on a piece of wood or other similar surface placed on the ground.

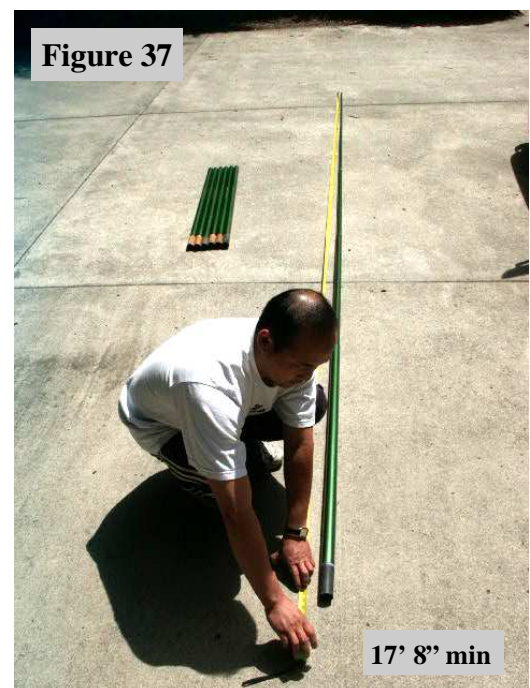


Figure 37

17' 8" min



**Warning:** **Make sure** to remove the black rubber plug from the base section of each of the telescoping element support tubes (poles). This is a shipping plug for handling convenience and will seriously damage the copper-beryllium strips and drive mechanisms if not removed.

Check all four sections of each pole for packing popcorn or any other foreign object that could interfere with the copper tape movement.

**There are foam plugs glued in the small end of each of the dark green telescoping poles. These plugs allow the poles to breathe preventing the buildup of condensation inside. Do NOT remove, block, cover, plug, cap or in any way inhibit air flow through this foam plug filter.**

**Note:** The telescoping element support tubes will not all be the same length, this is not a problem as long as they are a minimum of 17' 8". They are interchangeable and can be used in any element position.



**Figure 39**



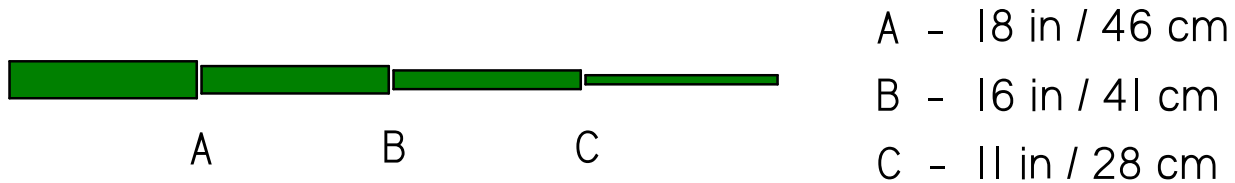
**Figure 41**

Next wrap each joint on the fiberglass poles with the all weather electrical tape, see **Figure 39**. Each joint should have at least the full width of the tape on both sides of the joint. Use common sense on the amount of tape or you will not have enough of the silicon tape used later to cover the electrical tape.

**Exception:** On joints with reinforcing rings, the tape must continue further so it extends a minimum of 3/4" beyond the metal ring and onto the fiberglass pole.

Apply one complete wrap of electrical tape around the fiberglass tube as you begin, and then work your way across the joint and back using half overlap wraps, **so that the entire area is seamlessly covered**. Carefully stretch and smooth the tape with your finger as you apply, and especially when you change directions - this will help avoid ripples and have the tape lie as smoothly as possible. At the end of the run, cut the tape with a knife or scissors and press the end onto the pole. Then run your hand over the tape a couple of times to firm up the bonding.

## Recommended Lengths for Silicone Tape Wrapping



**Figure 43**

Next, you will weatherproof and UV protect each joint with the black self-curing silicone tape see **Figure 41**. **It is important that you pre-cut the silicone tape to the recommended lengths.** If you do so, you will have more than enough for each joint. Refer to **Figure 43** for proper lengths for each joint. In the event you require more silicone wrap you can call us and order more.

**IMPORTANT:** Per the manufactures specifications the silicone tape has a shelf life of 12 months before it is used and should be stored in a cool dry environment. Silicone tape will not stick to just any surface. It only bonds to itself. Be sure to remove all the connector protector residue from your hands before handling silicone tape, as that residue will cause the silicone wrap not to adhere to itself in places. Take care to keep the silicone wrap free of dirt or debris. Also, this tape **MUST** be cut. Do not tear it. Wash your hands before completing the following steps.

Position the black silicone tape about 1/2" to the right of the black electrical tape and wrap one layer, continually stretching the silicone tape a minimum of 100 % its original length, completely around the pole so the tape fully overlaps itself. Then slowly wrap the silicone tape to the left using half overlap wraps, extending about 1/2" beyond the black electrical tape. When you reach the end, wrap one layer completely around the pole so the tape fully overlaps itself just as you did at the beginning of the wrap. If you are stretching the tape correctly you will get about two layers of tape at each joint. As before, carefully stretch and lay the tape down as smooth as possible. The final joint should look like **Figure 41**.

**Important:** After the silicone tape has been applied, be sure to rub each wrap with your hand several times to ensure that it is flat and has adhered to itself.

## Installing the Telescoping Fiberglass Poles (EST)

The butt ends of the green fiberglass poles may vary slightly in outside diameter. Some of them may have been sanded, while others were not. The colors at the ends will be either natural, or black. The difference in colors has no affect on performance. Do not be concerned if they vary slightly in tightness when being installed on the EHUs. This is normal. All poles are tested at the factory prior to shipping, however in the event the pole just won't fit sanding it is okay.

The EHTs on the EHUs have aluminum reinforcing rings attached to provide extra strength in high wind conditions (**Figure 45**).

Locate the four rubber boots and repeat the following procedure for each of the four fiberglass poles.

- Place the narrow end of a rubber boot onto the butt end of an EST. Slide it about 6" out onto the EST (**Figure 47**).



Figure 45



Figure 47



Figure 49



Figure 51

- Insert the butt end of that EST into one of the EHTs on an EHU, as shown in **Figure 49**. **It is very important to ensure that the butt end of the EST firmly bottoms out inside the EHT. Make sure the EST is seated all the way into the EHT. Then push the rubber boot firmly onto the EHT until the hose clamp is past the aluminum ring and will clamp down onto the fiberglass EST.** The correct mounting position of the rubber boot is shown in **Figure 51**. Note that current production antennas now have a narrower aluminum ring (.4"). **It is imperative that the stainless steel hose clamp be located so that the clamp on the outside of the rubber boot on the EHU side of the connection is completely past the aluminum reinforcing ring. This ensures that the hose clamp can grip onto the fiberglass and the ring will prevent the rubber boot from ever coming off.**
- Firmly tighten both stainless steel hose clamps, one over the EHT and the other over the EST. Then test the connection by pulling and twisting it. There should be no slippage at the joints.

NOTE: You should re-tighten each clamp a second time (at least 30 minutes after the first time you tightened them) before raising the antenna to the tower, to be sure that there has been no cold flowing of the PVC material on the rubber boot.



## Optional 6 Meter Passive Element

The 6 meter passive element comes in 3 pieces. The main body with a 1/2" x 58" element section attached to it, and two 3/8" element sections (**Figure 53**). The overall length of the element is approximately 114" for the 2 element when assembled.

The required fasteners will already be attached to each end of the 1/2" element section - remove this hardware, and slide in the short ends of the 3/8" tubing (the end that has the least amount of distance from the edge of the tubing to the drilled hole). Use a small amount of the included Teflon® connector protector solution when connecting the two sections of tubing. Fasten securely. The center of the 6m element should be 22" from the center of the driven element (**Figure 9**). Fasten securely to the boom using the U-bolt, saddle and hardware supplied. Make certain that you have the 6 meter passive element level with the others.

**Warning:** When attaching the 6m passive to the boom be careful not to trap the element control cable under the U-bolts.

**Note:** You will need to enable the 6m passive in the controller. Reference the "Operators manual" under "General Frequency Mode" - "Options Menu" - "6m Passive Selection".

When you are using the 6 meter band, keep the antenna in the forward direction and rotate accordingly. Optimum performance will be from 50.000 MHz to 50.500 MHz. The 180 degree mode is exactly the same as the forward mode since we have no choice when the aluminum passives are used, however, the Bi-Directional works to the same degree by directly reducing the front to back ratio.





### **Limited Warranty**

These products have a limited warranty against manufacturer's defects in materials or construction for two (2) years from date of sale. Do not modify this product or change physical construction without the written permission of SteppIR Antennas Inc. This limited warranty is automatically void if improper selection, installation, unauthorized modifications or physical abuse beyond the manufacturer's control has occurred. Manufacturer's responsibility is strictly limited to repair or replacement of defective components. The manufacturer assumes no further liability.

# *Thank you for choosing SteppIR!!*



# **SteppIR**™ **Antenna Systems**

Yagi • Dipole • Vertical

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