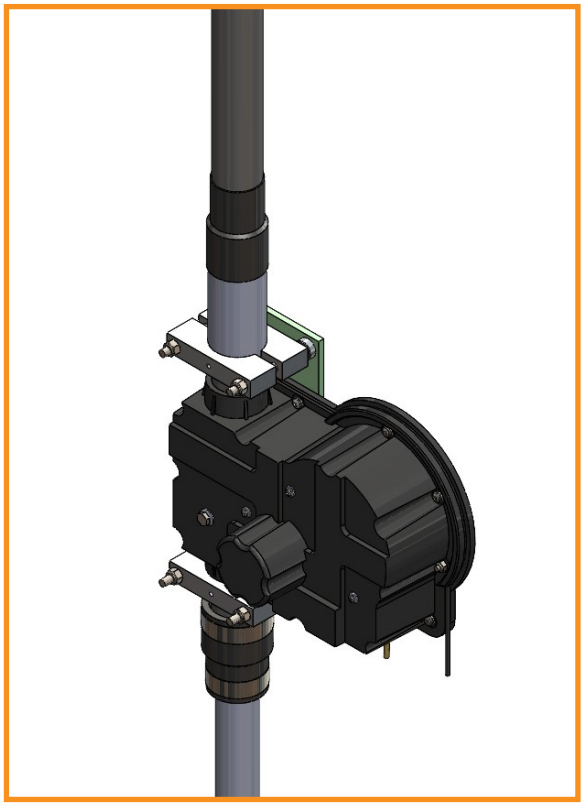
steppIR
COMMUNICATION SYSTEMS

BigIR Antenna Assembly Manual



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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,

John Mertel

John Mertel, WA7IR

President/CEO

PREPARING FOR ASSEMBLY

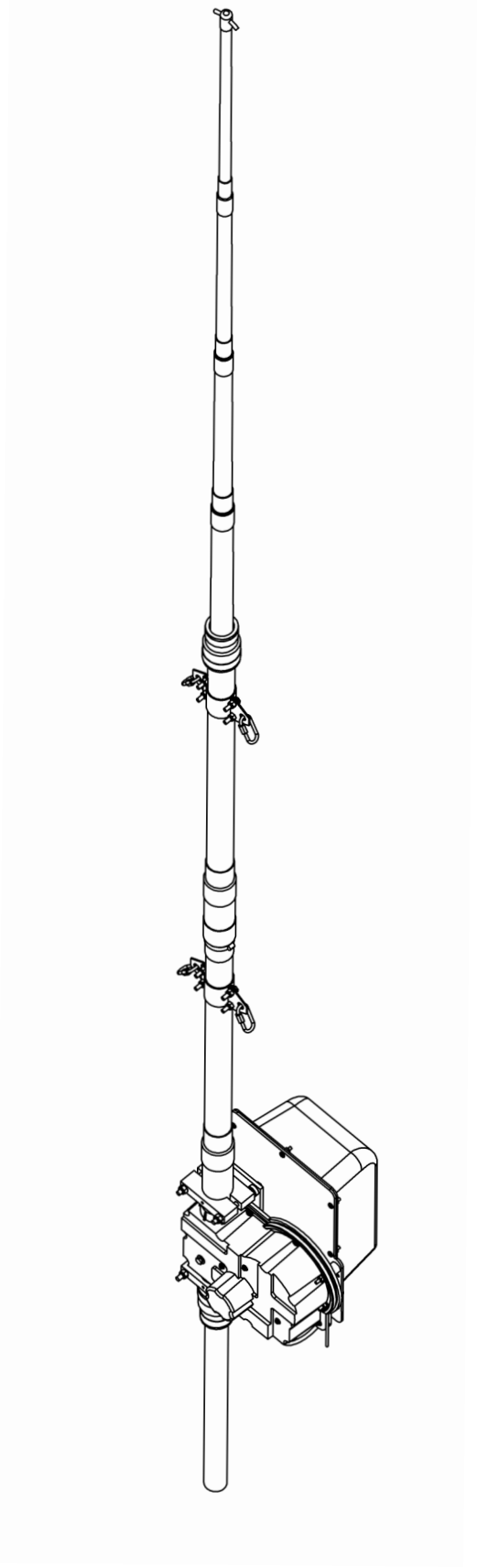
- Before beginning assembly of this antenna, please read the manual in its entirety to familiarize yourself with the task at hand. Doing so will eliminate potential confusion.
- Be sure to do an inventory of your parts as soon as possible after receipt of the antenna, and well before your intended installation date — this way we can get you the parts required before it's too late.
- A large, cleared flat area is recommended for assembly of the antenna. Typically, an area of 40 ft x 25 ft would be ideal.

IMPORTANT NOTES!

Be sure to use the anti-seize compound supplied to prevent the galling of the stainless steel fasteners. If you do not use the anti-seize, you will experience issues with the stainless steel hardware galling. Heat is one of the primary culprits with galling, so if you use a ratchet, using steady speed as you tighten will help minimize galling. We have found that when the anti-seize is applied to the bolt portion of the hardware, it will eliminate any galling issues. Rubber or nitrile gloves are recommended when applying the anti seize to the stainless steel fasteners.

Always disconnect power from the controller, then unplug the control cable before attempting to wire or change wiring on the antenna, even if the controller is turned off! This is the number one cause of installation failures for our products. Even with power off, damage can occur. When the power is "off" on your controller, there is still a very small amount of power feeding to the stepper motors, to effectively "lock" them in place. This leads to less need for calibration of the antenna.

ANTENNA SPECIFICATIONS



Antenna	
Longest element	34ft (10.5m)
Weight	15lbs (6.8kg)
Wind load	1.9 sq. ft./0.17 sq. m.
Wind rating	100mph w/two guys
Adjustable elements	1-2
Power rating	3.0 kW (1500W limit on 60/80m bands)
Feed points	1
Frequency coverage	3.4-55 MHz with loading coil, 7.0-54MHz without
Control cable	2 x 4 conductor with coil, 1x without

ANTENNA OVERVIEW

The BigIR is a vertical antenna that can be adjusted for resonance on the 40, 30, 20, 17, 15, 12, 10 and 6 meter ham bands, including frequencies in between. With the addition of the 80 meter coil accessory, the BigIR/80 will also provide coverage on 80 and 60 meters, including frequencies in between.

The antenna comprises two primary subsystems:

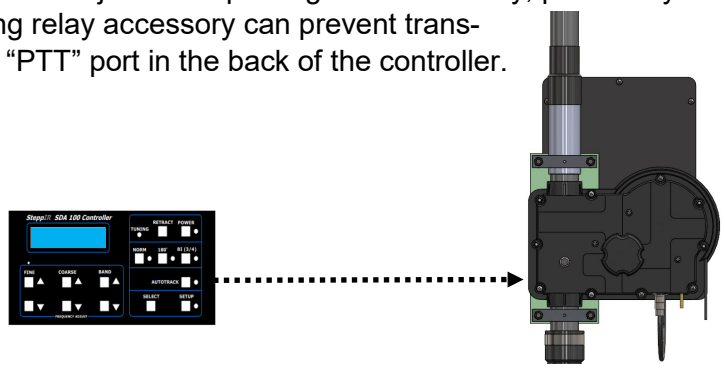
1. The Element Housing Unit (EHU) contains the stepper motor, copper-beryllium tape and wiring interface. The optional 80m coil attaches to this unit as well.
2. The Element Support Tubes (EST) provides guidance and protection of the copper-beryllium tape as it extends or retracts.

With the EST subsystem affixed to the EHU subsystem, the antenna is complete (except for mounting and radials).

Once the EHU and EST are coupled, under control of the controller unit, the element can be extended or retracted within the EST. The EST consists of an outer portion of light-weight fiber composites and an inner element-guidance portion of Chlorinated Poly Vinyl Chloride (CPVC). The CPVC portion is where the tape extends and retracts, and the outer EST portion provides physical support and weather protection for the inner portion. At the topmost end of the EST, a special rain cap ensures that air can move in and out of the EST as the tape is retracted or extended, and that rain and moisture is prevented from entering the EST.

If the 80 meter coil accessory has been purchased, it attaches to the EHU and provides a tapped inductor at the EHU feed point allowing the antenna to be made resonant on 80 and 60 meters. The antenna with that option is designated the BigIR/80. Both the EHU and 80 meter coil accessory are controlled by the in-station controller unit and each has its own 4-conductor control cable that interfaces with the in-station control unit.

Once the antenna is mounted and radials have been installed, the user controls the extension and retraction of the radiator (copper-beryllium tape) by selecting the appropriate controls on the in-station controller. The controller also provides operational modes whereby adjustments to tape-length memory points can be made to fine tune for best SWR match. The in-station controller can communicate with a transceiver such that a change in frequency prompts the controller to adjust the tape length automatically, provided you have the correct interface cable. In addition, the tuning relay accessory can prevent transmitting power to the antenna while it is tuning via the “PTT” port in the back of the controller.



Controller Control cable BigIR

PARTS CHECKLIST

It is important that you do an inventory of the items that were shipped to you. Nothing is worse than discovering a day before a planned installation that there are missing parts! We do our very best to ensure that you receive everything needed for construction of your antenna, but better to be safe than sorry—inventory your parts well in advance of your installation. The items in blue represent available options — you will need to check these items off only if you purchased them.

What Comes in the Box

✓	QTY	PART #	DESCRIPTION
	1	70-3410-01	EHU, BigIR Assembly
	1	10-1501-22	Cover for Black EHU, No drain hole
	1	70-3000-01	33 Volt supply with cord
	1	21-6040	Splitter, 6" 3-1/2mm, Stereo Male to Two RCA Female
	1	N/A	Orange Flash Drive containing manuals
	1	72-0044-04 or -05	Kit, BigIR Mark IV Hardware/Heat Shrink
	1	72-0044-11 or -12	Kit, BigIR EHU Wind Reinforcing Kit/ Mark IV Hardware
	2	72-0046-01	Kit, BigIR MK III/IV Guy
	1	70-6010-01	Adapter, 25pin Dsub Field Splice
	1	10-1013-02	Telescoping Pole, 18 foot 4 section
	1	70-2019-01	BigIR EST extension with aluminum coupler - Lower
	1	70-2020-01	BigIR EST extension with aluminum coupler and ring - Upper
	1	70-2021-01	CPVC Liner for BigIR, 89"x3/4", with coupler
	1	70-2022-01	CPVC Liner for BigIR, 89" x 3/4", w/o coupler
	1	10-1109-22	Antenna Support, 1-1/2, Vertical, Fiberglass
	1	09729	SDA 100 Controller w/ TX Interface and SDA All Relay Board
			or
		09760	OptimizIR Controller
		21-601_-01	Transceiver Interface Cable
		06021	80m Base loading Coil for the BigIR
		21-5001-01	Control cable, 4 conductor
		21-7008-01	Balun 1:1 SO239 Connector, External Vertical or Dipole
		20-8052-41	Filter, suppressor unit, 8 position, 65v
		21-6002-09	Kit, Ground Mounted Vertical Radials, 4 wire, 9', (20-6m)
		21-6002-16	Kit, Ground Mounted Vertical Radials, 4 wire, 16', (40-6m)
		21-6002-40	Kit, Ground Mounted Vertical Radials Kit, 4 wire, 40', (80-6m)

PARTS CHECKLIST

72-0044-04 or –05

Kit, BigIR Mark IV Hardware/Heat Shrink

✓	QTY	PART #	DESCRIPTION
	2	60-1006-22	QUICK DISCONNECT, 1-1/2" to 1-1/4", Fernco
	1	60-6000-20	Hose Clamp, 1.16" to 2" ID, Used for BigIR, S/S
	3	10-1104-11	O-Ring, 1-3/4" x 2", EP DM
	1	72-0009-03	Kit, Glue
	1	10-1029-01	Connector Protector Cat, 0.14 oz, (silicon goop for terminals)
	2	10-1059-01	Polyolefin Heat Shrink 1-1/2” x 6”
	1	10-1059-21	Polyolefin Heat Shrink 1.1” x 6”
	3	10-1059-11	Polyolefin Heat Shrink 2.05” x 4”
	2	10-1059-51	Polyolefin Heat Shrink 1.1” x 3” **(Only in –05 kit)**
	1	10-1105-11	Vertical Pole Rain Cap

PARTS CHECKLIST

72-0044-11

Kit, BigIR EHU Wind Reinforcing Kit/ Mark IV Hardware

✓	QTY	PART #	DESCRIPTION
	8”	09-1022	Coax Seal, 12' x 1/2"
	1	10-1021-54	Reinforcing Plate, for High wind kit EHU, 10-7/16" x 4-1/4" x 1/4"
	1	10-1028-01	Anti-seize single packets, TMP-1
	2	10-1601-03	Saddle, 1-3/4" x 3/4"
	2	10-1601-22	Saddle, 2" x 3/4"
	4	10-1613-11	AL Spacer, 1/4" X 5/16" ID X 3/4" OD
	4	60-0017	Screw, 10-32 x 3/4", Panhead, S/S
	1	60-0017-10	Screw, 10-32 x 7/8", Flathead, Phillips
	15	60-0018	Washer, 10-32, Flat, S/S
	10	60-0019	Nut, 10-32, Nylock, S/S
	10	60-0033	Washer, 5/16", Flat, S/S
	4	60-0046	Nut, 5/16" -18, Nylock, S/S
	2	60-0066	Bolt, 5/16" x 4", S/S
	5	60-0071	Screw, 10-32 x 1", Panhead, Phillips, S/S
	2	60-0114	Bolt, 5/16" x 3-3/4", Hex Head, S/S

OR

72-0044-12

Kit, BigIR/StealthIR EHU Wind Reinforcing Kit/Hardware, Plastic Saddles

✓	QTY	PART #	DESCRIPTION
	8”	09-1022	Coax Seal, 12' x 1/2"
	1	10-1021-54	Reinforcing Plate, for High wind kit EHU, 10-7/16" x 4-1/4" x 1/4"
	1	10-1028-01	Anti-seize single packets, TMP-1
	2	10-1611-51	Plastic Saddle, 2" - BigIR/StealthIR
	2	10-1611-31	Plastic Saddle, 1.75" medium - BigIR/StealthIR
	4	60-0017	Screw, 10-32 x 3/4", Panhead, S/S
	1	60-0017-10	Screw, 10-32 x 7/8", Flathead, Phillips
	22	60-0018	Washer, 10-32, Flat, S/S
	10	60-0019	Nut, 10-32, Nylock, S/S
	4	60-0033	Washer, 5/16", Flat, S/S
	4	60-0046	Nut, 5/16" -18, Nylock, S/S
	4	60-0115	Bolt, 5/16" x 4-1/2", Hex Head, S/S
	5	60-0071	Screw, 10-32 x 1", Panhead, Phillips, S/S
	2	10-1614-01	Plastic Saddle Reinforcement Plate

PARTS CHECKLIST

72-0046-01

Kit, BigIR MK III/IV Guy

✓	QTY	PART #	DESCRIPTION
	2	10-1429-21	Element Truss Guy Clamp, BigIR
	4	60-0027	Bolt, 1/4"-20 x 1", S/S
	4	60-0030	Nut, 1/4"-20, Nylock, S/S
	2	60-0094	Quick Link, 3/16", S/S

06021

80M Base loading Coil for the BigIR

✓	QTY	PART #	DESCRIPTION
	1	70-2101-01	Coil, 80m, BigIR
	1	72-0044-20	Kit, BigIR Mark IV 80m Coil Hardware

72-0044-20

Kit, BigIR Mark IV 80m Coil Hardware

✓	QTY	PART #	DESCRIPTION
	4	60-0095	Screw, 10-32 x 2", Panhead, Phillips, S/S
	4	60-0019	Nut, 10-32, Nylock, S/S
	4	60-0018	Washer, 10-32, Flat, S/S
	4	60-1004-01	Spacer, 1/2", Nylon
	2	10-1613-11	AL Spacer, 1/4" X 5/16" ID X 3/4" OD
	4	20-6043-01	Ring Terminal, 18-22 AWG, #6 stud
	4	60-1025-125	Heat Shrink, 1/8", Waterproof

VERTICAL MOUNTING POST OVERVIEW

The provided vertical mounting post (PN 10-1109-22) is a 2' long piece of fiberglass tube which is 1.5" OD - 1/4" wall. One end of the tube has been turned down to an outer diameter of 1.48" such that it will fit into the EHU assembly. Note that most 1.5" OD tubes/pipes will not fit in the SteppIR EHU due to the tight fiberglass tolerances, so it is recommended to use ours. Using a metal mounting post is NOT RECOMMENDED if using the optional loading coil as the high voltage created by loading the antenna can cause the element to arc to the metal mounting post.

Interaction considerations: Mounting the antenna near structures may introduce interaction to the antenna from nearby metal objects (gutters, electrical wiring, metal beams, etc). The further away from the structure the better. For peak performance you may need to test different locations to find the least amount of interaction possible. If you do decide to test multiple locations, do not concrete your mounting post into the ground until the very end.

Ground mounting: Mount the fiberglass mounting post in the ground such that the top of the mounting post is 6-10 inches above the ground. Directly burying in concrete or the use of a conduit sleeve in the ground are common methods.

IF YOU ARE USING A RADIAL PLATE YOU MUST KEEP THE PLATE ELECTRICALLY DISCONNECTED FROM THE VERTICAL MOUNTING POST (IF CONDUCTIVE) TO PREVENT ARCING. DO NOT USE THE COAX PASS THROUGH ON THE PLATE.

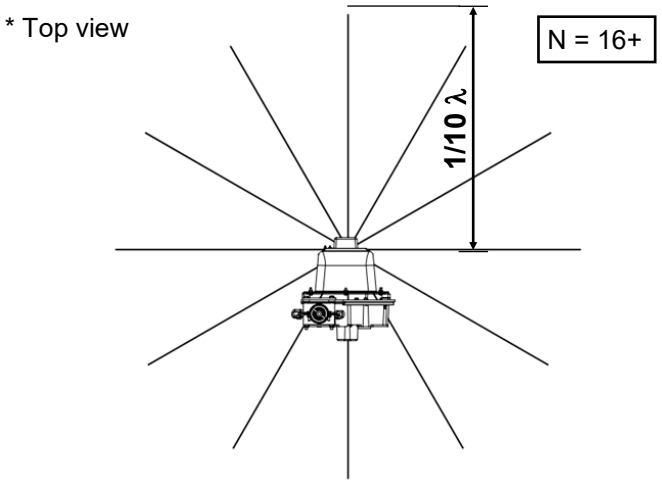


Figure 1.01: Ground radials

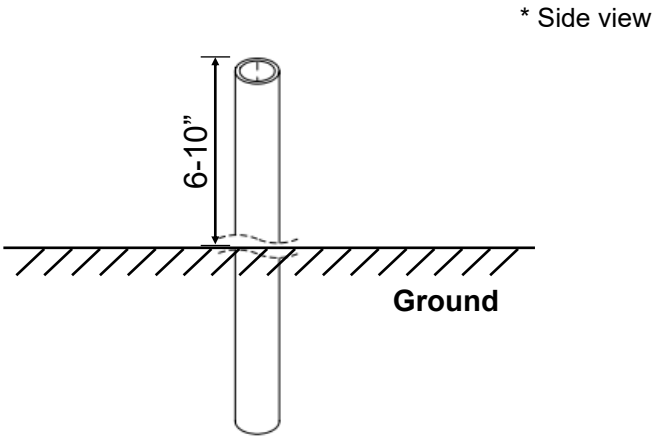
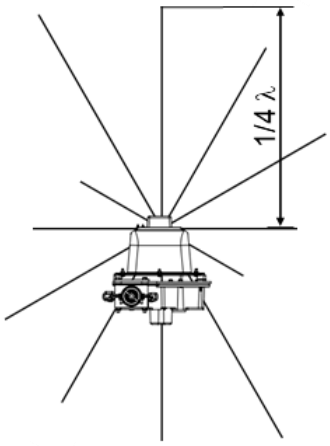


Figure 1.02: Vertical mounting

Elevated mounting: For those who are experienced with tuning elevated vertical antenna radial systems (more info on pg. 37-38) it is possible to mount the BigIR with its base raised off of the ground. This can be done in a number of ways, however **it is crucial that the vertical mounting post (if conductive) is electrically disconnected from the radials/counterpoise to prevent arcing.**

* Top view



N = 2/band

Figure 1.03: Elevated radials

* Side view

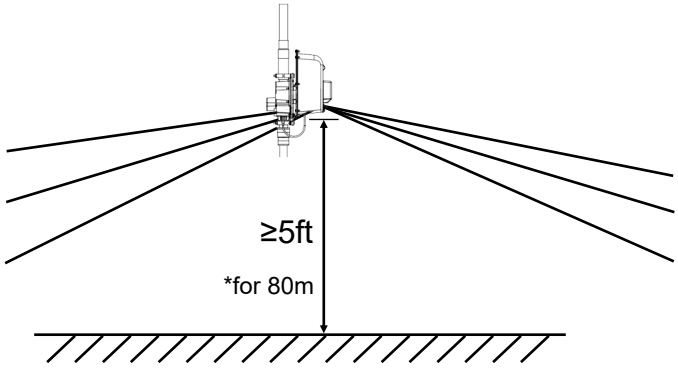


Figure 1.04: Example of elevated radials

EHU OVERVIEW

Figure 1.05 provides an overview of a SteppIR EHU (the specific model shown is a 20m driven).

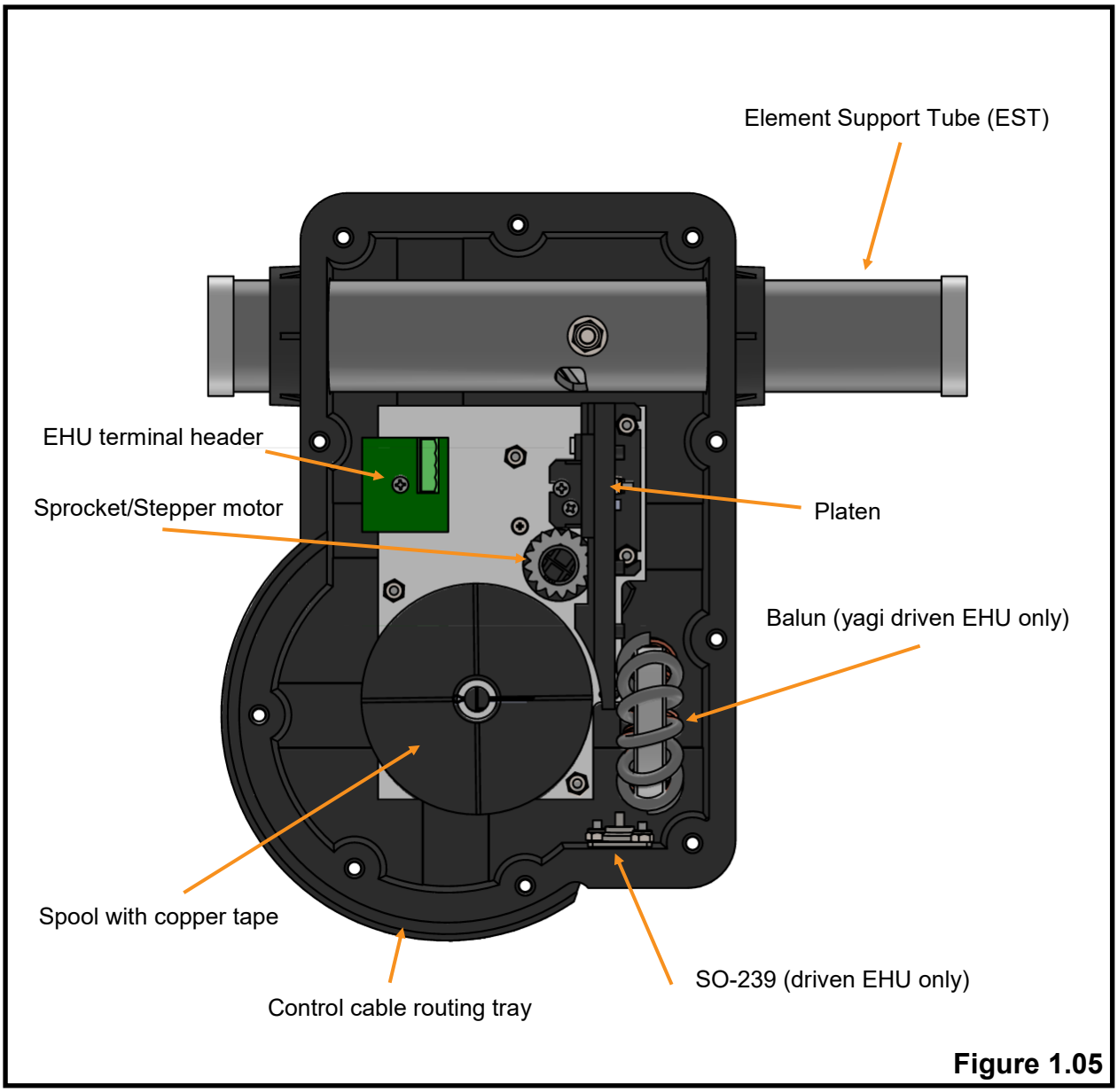


Figure 1.05

WIRING/EHU/COIL ASSEMBLY

Section 1.1: Wiring the EHU (skip if you have pre-wired cable)

1. Trim approximately 1.5 inches of the outer jacket of the control cable.
2. Remove the outer foil shield, the support thread, and cut the shield wire off.
3. Attach electrical tape at the end of the trimmed control cable jacket so that there is no chance for a short.
4. Remove 0.25 inches of the insulation from each of the individual 22 AWG wires, leaving bare copper. *Tinning of the copper wire ends with solder is NOT recommended by the connector manufacturer.* **Figure 1.10** shows the control cable should look like when you are finished with the trimming.
5. Dip each of the copper wires into connector protector before inserting into the terminal plug. **Figure 1.11** shows what the connector protector will look like.
6. The terminal header assembly consists of the terminal header and the terminal plug as shown in. The plug is shipped loosely attached to the header. Remove this plug when wiring and firmly plug back in when completed (use dielectric grease on this terminal plug to prevent moisture ingress/corrosion).
7. Follow the wire sequence in **figure 1.13.** *Be careful to ensure that there are no bare wires protruding out from the terminal clamps, to avoid potential shorts. Also make sure you are clamping down on bare wire, and not the insulation of the wire* The wiring sequence for the EHU is also imprinted on the PCB that the terminal header is mounted on (located inside the EHU), as shown in **figure 1.12**. Pay no attention to the second row of imprinted text, these pins are for use in the manufacturing of the board itself and are of no use to you. **Figure 1.12** shows a blue line crossing out the text in question. The orange circle shows the correct wiring sequence.

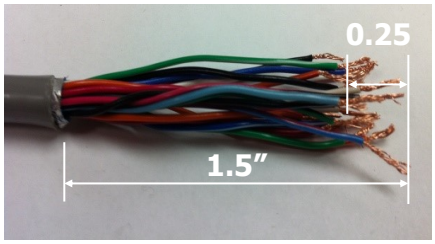


Figure 1.10

Figure 1.11

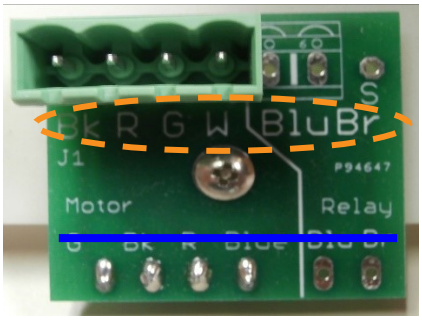


Figure 1.12

4 Pin Header Wiring Sequence

BLACK **RED** **GREEN** **WHITE**

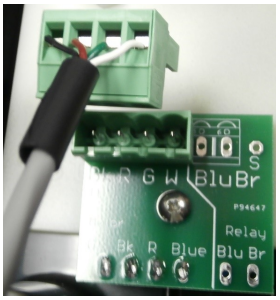


Figure 1.13

8. Check to be sure the terminal plug is firmly inserted into the terminal header.
9. Cut three 1-inch strips of coax seal for each EHU as shown in **figure 1.15,** and place them at each end of the wire tray of the EHU, as well as one in the center (**figure 1.16)** . This trough acts as a strain relief so that the cable will not be pulled out of the EHU. The remainder can be used to seal the driven element/ loading coil SO239 connector and 4 conductor control cable.
10. Lay the control cable wire inside the wire tray of the EHU as shown in **figure 1.17**. It is a good idea to leave a small amount of slack between the plug and the point which the tray starts as shown in the circled region of **figure 1.17**.
11. Wrap the coax seal around the control cable as shown in **figure 1.18**. This will help keep water from entering into the EHU. Repeat this process to the remaining areas of the wire tray as shown in **figure 1.19**.
12. When finished, the EHU will be secured to the high wind reinforcing kit and optional loading coil.

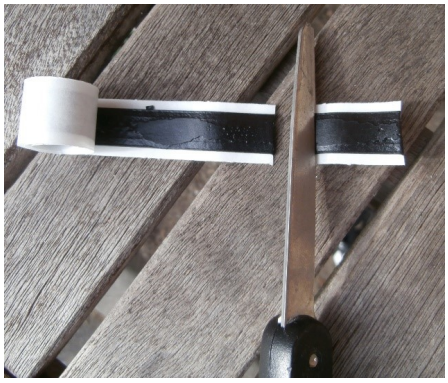


Figure 1.15

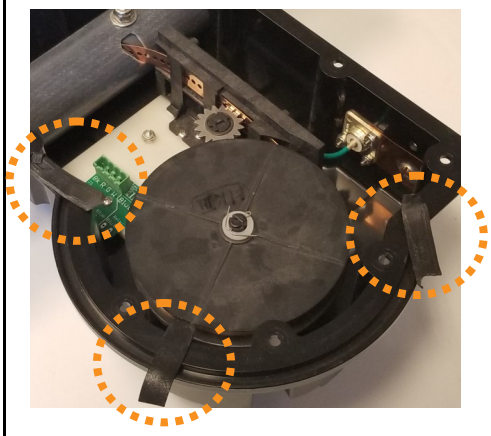


Figure 1.16

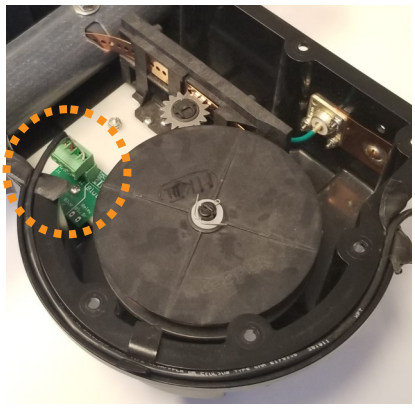


Figure 1.17

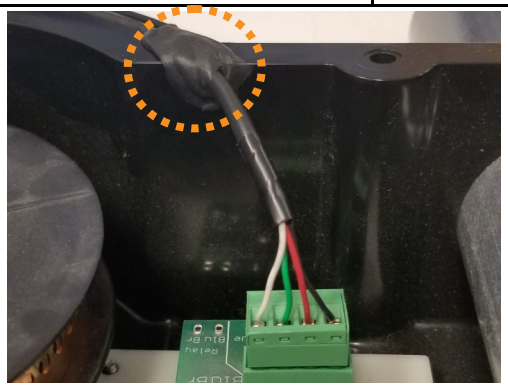


Figure 1.18

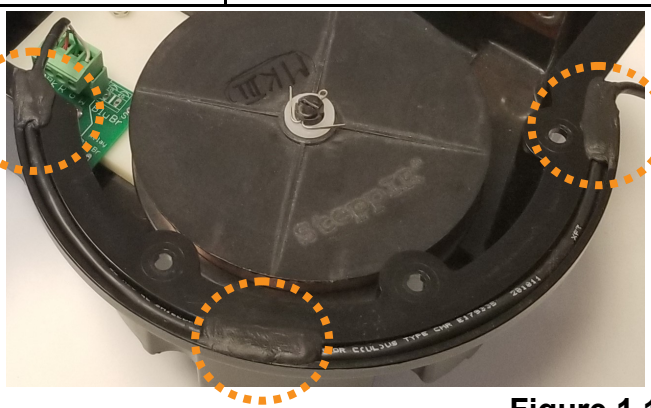
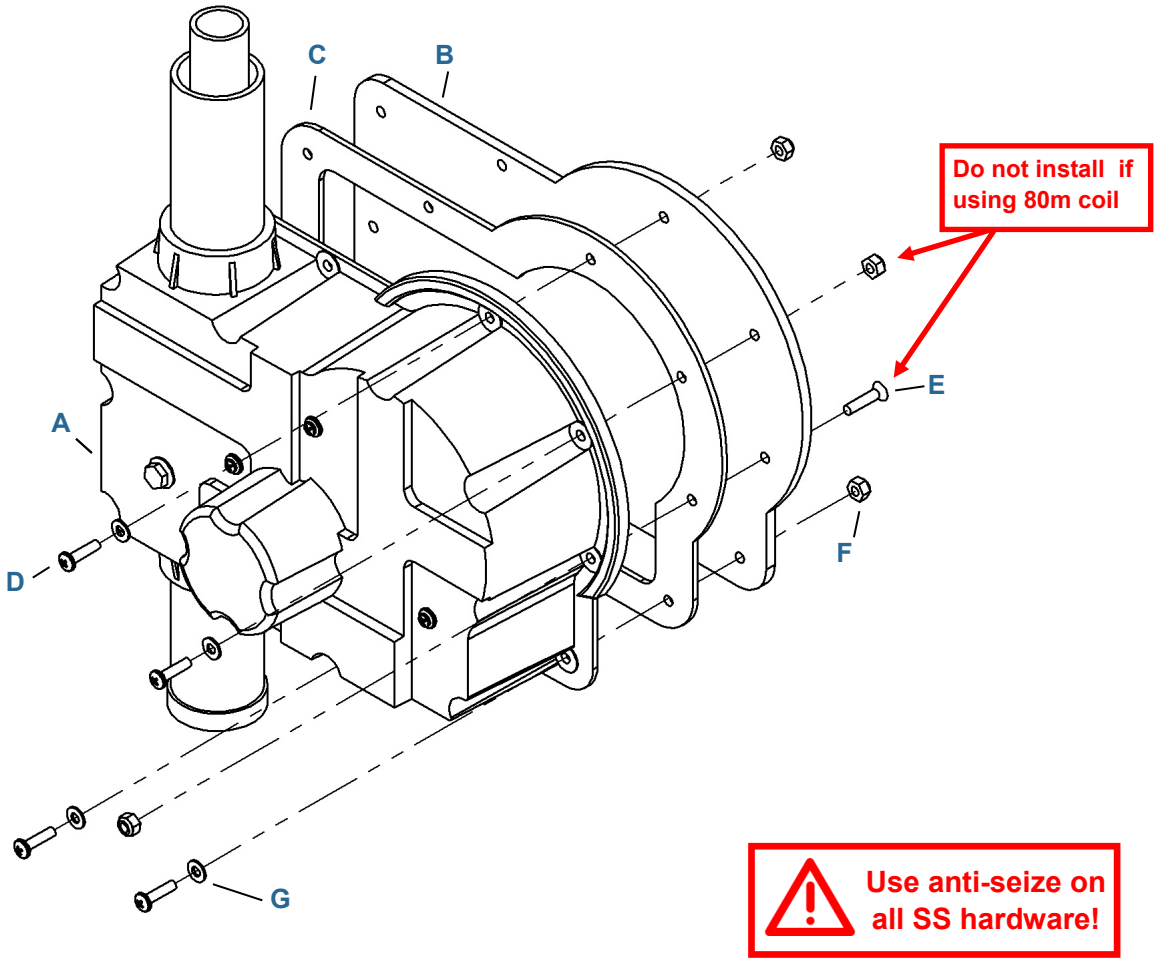


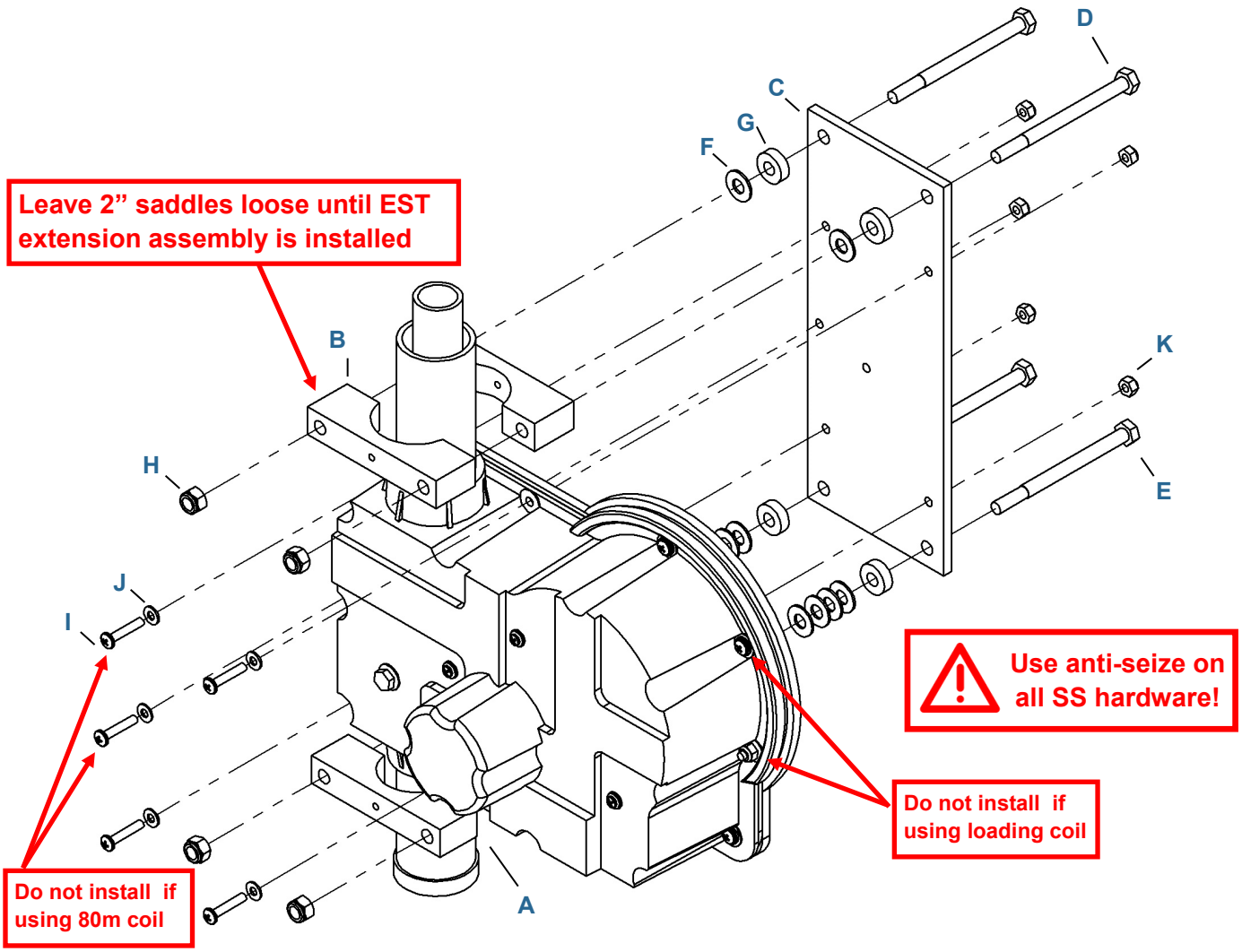
Figure 1.19

Section 1.2: EHU assembly



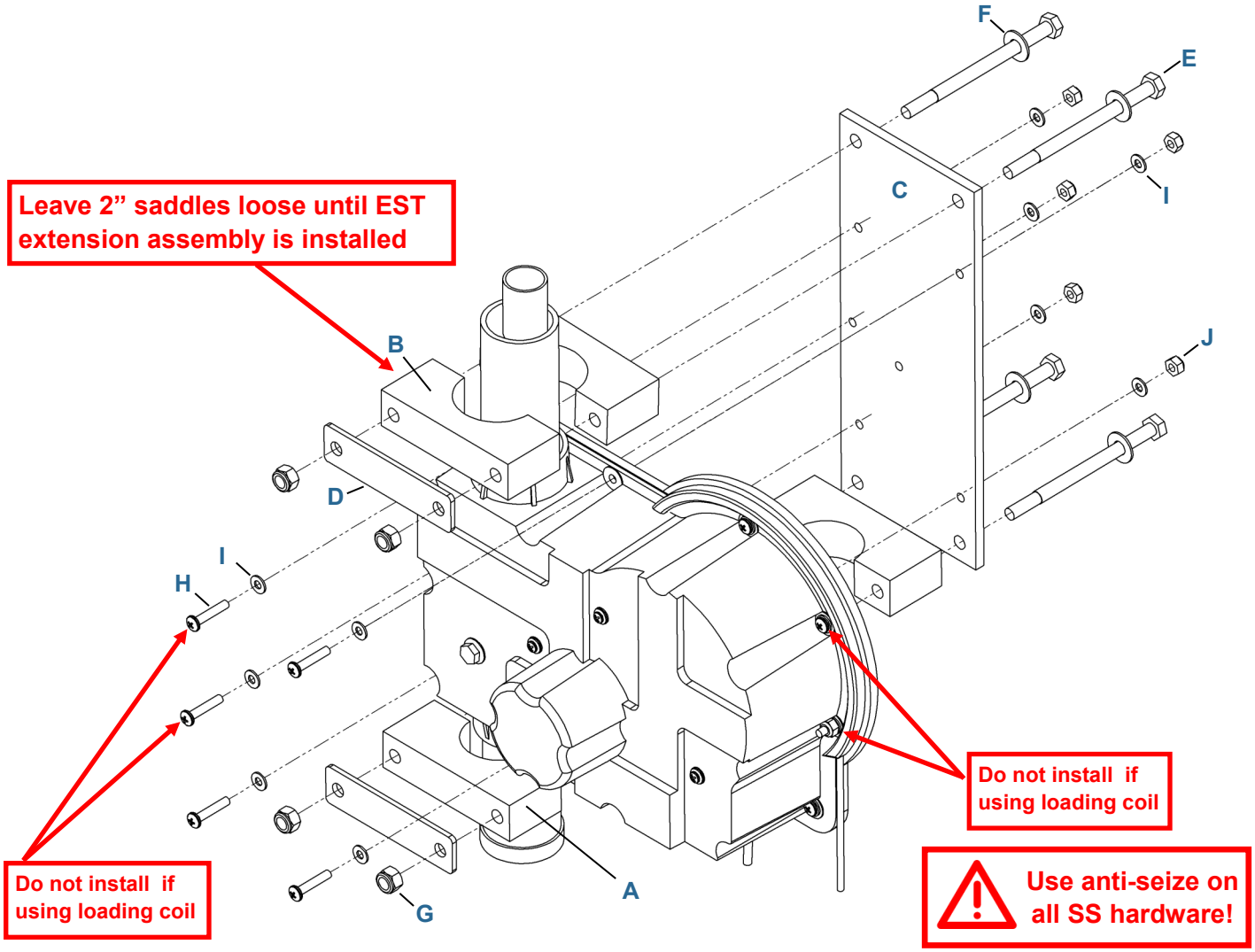
Key	QTY	Part Number	Description
A	1	-	EHU, BigIR (with control cable & coax seal)
B	1	10-1501-22	Cover for EHU, no drain hole
C	1	10-1502-12	EHU Gasket
D	4	60-0017	Pan Screw, 10-32 x 3/4”
E	1	60-0017-10	Flat Head Screw, 10-32
F	5	60-0019	Nut, 10-32, Nylock
G	4	60-0018	Washer, 10-32, Flat

Section 1.3: High wind kit assembly (only follow if you have aluminum saddles)



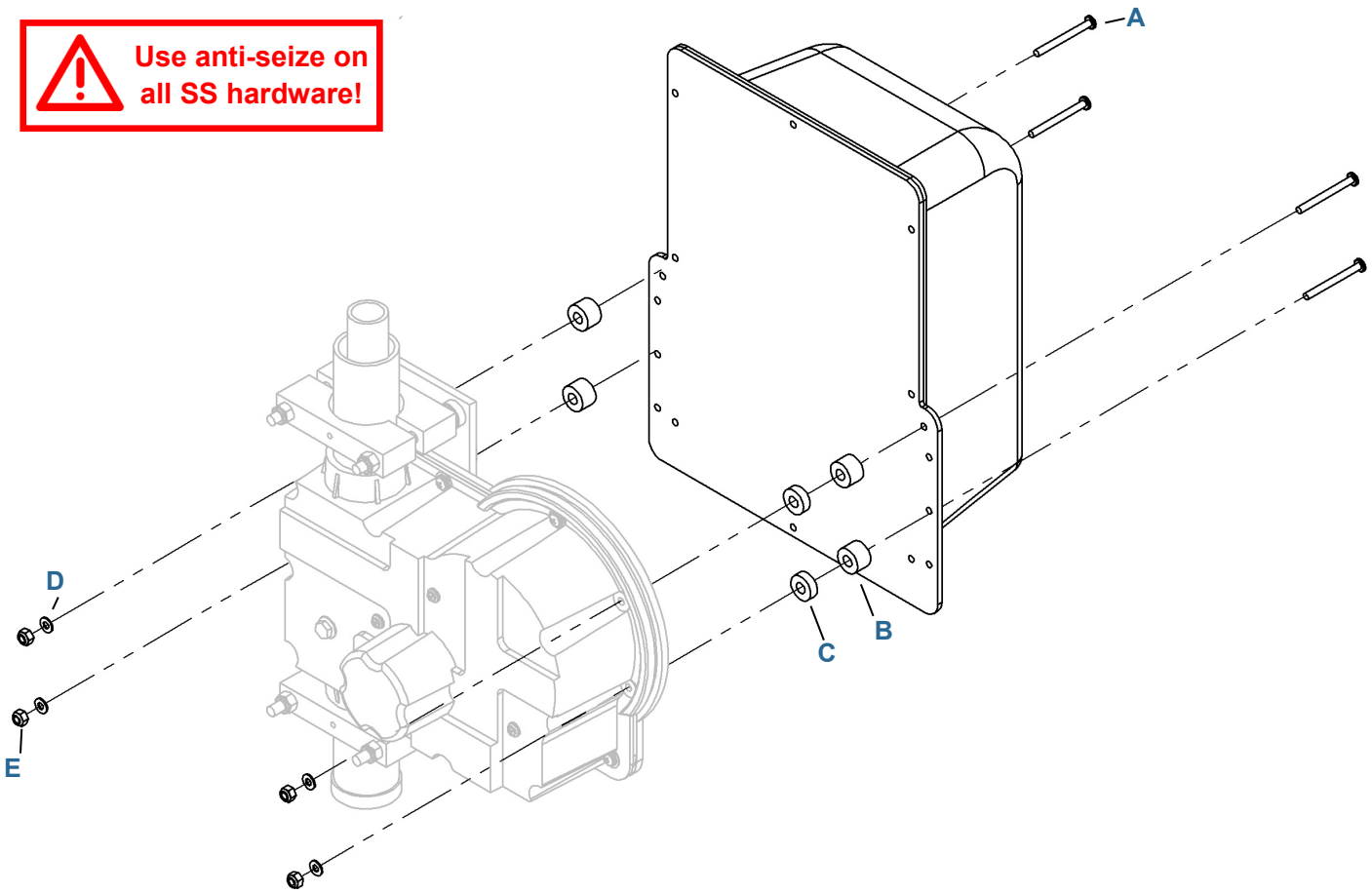
Key	QTY	Part Number	Description
A	2	10-1601-03	Saddle, 1-3/4" x 3/4”
B	2	10-1601-22	Saddle, 2" x 3/4”
C	1	10-1021-54	Reinforcing Plate, for High wind kit EHU
D	2	60-0066	Bolt, 5/16" x 4", S/S
E	2	60-0114	Bolt, 5/16" x 3-3/4", S/S
F	10	60-0033	Washer, 5/16", Flat, S/S
G	4	10-1613-11	AL Spacer, 1/4" X 5/16" ID X 3/4" OD
H	4	60-0046	Nut, 5/16" -18, Nylock, S/S
I	5	60-0071	Screw, 10-32 x 1", Panhead, Phillips, S/S
J	5	60-0018	Washer, 10-32, Flat
K	5	60-0019	Nut, 10-32, Nylock

Section 1.3: High wind kit assembly (only follow if you have plastic saddles)



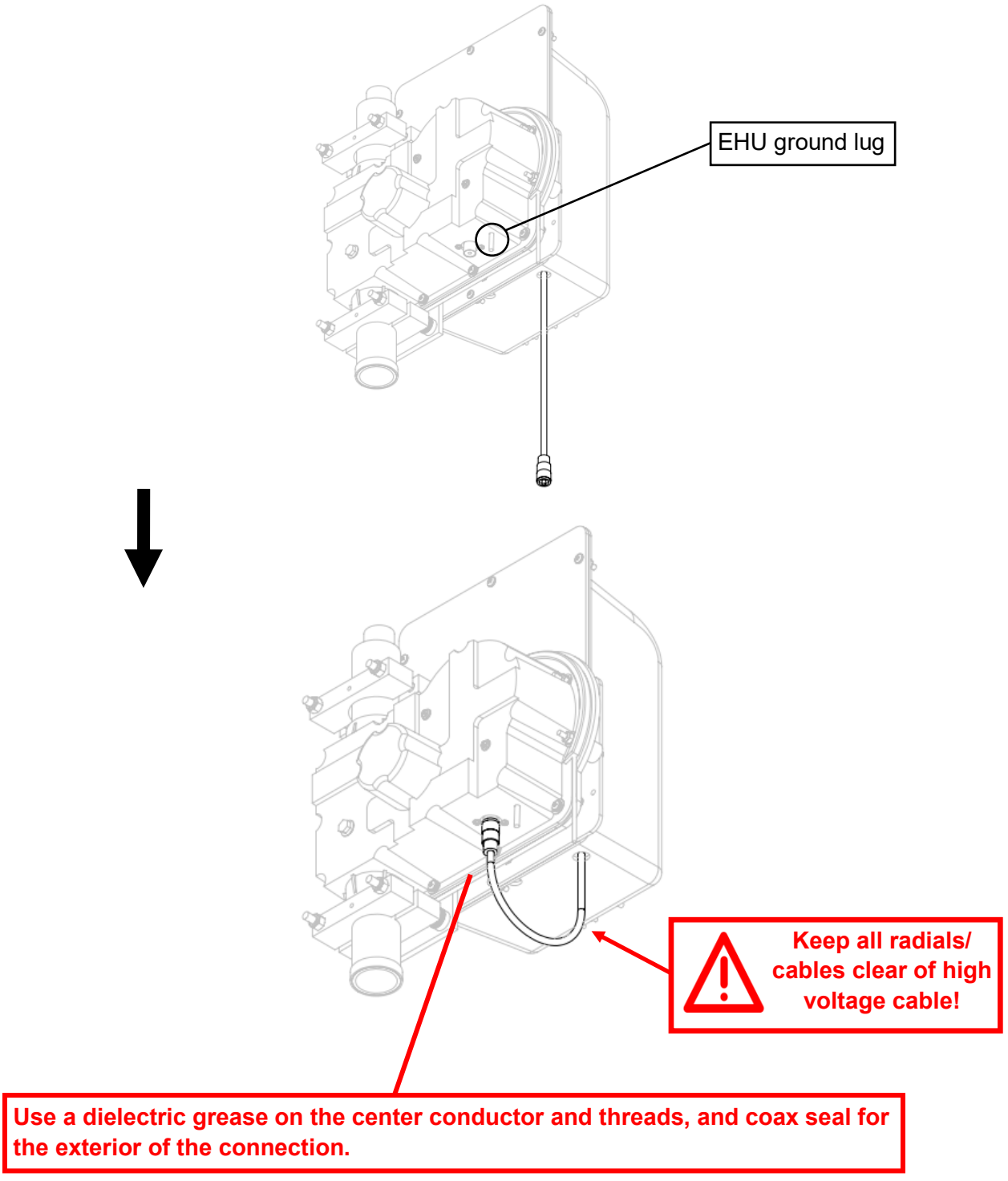
Key	QTY	Part Number	Description
A	2	10-1611-31	Plastic Saddle, 1.75" medium - BigIR/ StealthIR
B	2	10-1611-51	Plastic Saddle, 2" - BigIR/StealthIR
C	1	10-1021-54	Reinforcing Plate, for High wind kit EHU
D	2	10-1614-01	Plastic Saddle Reinforcement Plate
E	4	60-0115	Bolt, 5/16" x 4.5", S/S
F	4	60-0033	Washer, 5/16", Flat, S/S
G	4	60-0046	Nut, 5/16" -18, Nylock, S/S
H	5	60-0071	Screw, 10-32 x 1", Panhead, Phillips, S/S
I	10	60-0018	Washer, 10-32, Flat
J	5	60-0019	Nut, 10-32, Nylock

Section 1.3: 80m Base Coil Installation (skip if 80m coil is not purchased)



Key	QTY	Part Number	Description
A	4	60-0095	Screw, 10-32 x 2", Panhead, Phillips, S/S
B	4	60-1004-01	Spacer, 1/2", Nylon
C	2	10-1613-11	AL Spacer, 1/4" X 5/16" ID X 3/4" OD
D	4	60-0018	Washer, 10-32, Flat
E	4	60-0019	Nut, 10-32, Nylock

Section 1.3 (continued): 80m Base Coil Installation (skip if 80m coil is not purchased)



Section 1.4: 80m Base Coil Wiring (skip if 80m coil is not purchased)

(skip if you have pre-wired cable)

The 80m base loading coil is wired to a separate piece of 4 conductor control cable, we recommend labeling both ends to distinguish it from the EHU control cable. A piece of tape is often an easy way to do this.

1. Strip approximately 2 inches of jacketing off of the end of the 4 conductor control cable closest to the coil, being careful not to damage the insulation of the inner 22awg wires (figure 1.41). Trim off the foil shield, support thread, and shield wire.
2. Strip 0.25 inches of insulation off of the 22awg wires, and place heat shrink over the wires (figure 1.42).
3. Using the provided ring terminals (PN 20-6043-01), crimp and solder them to the ends of the control cable (figure 1.43).
4. You may now use the provided heat shrink (PN 60-1025-125) to weatherproof these connection points (figure 1.44).
5. A small piece of coax seal should be used to seal the outer insulation of the 4 conductor control cable as well (figure 1.45).

Figure 1.41

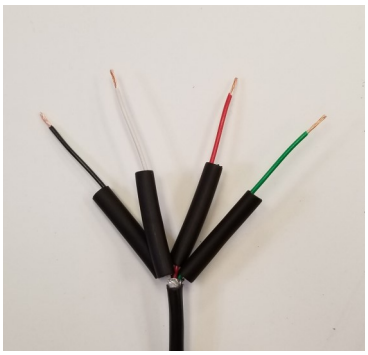


Figure 1.42

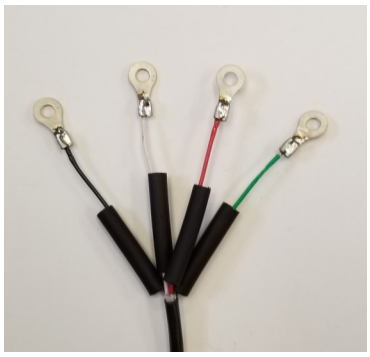


Figure 1.43

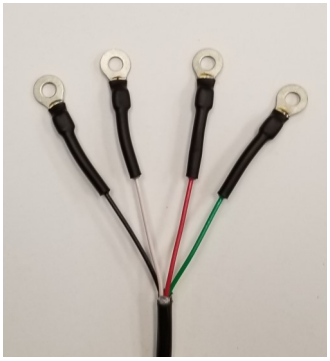
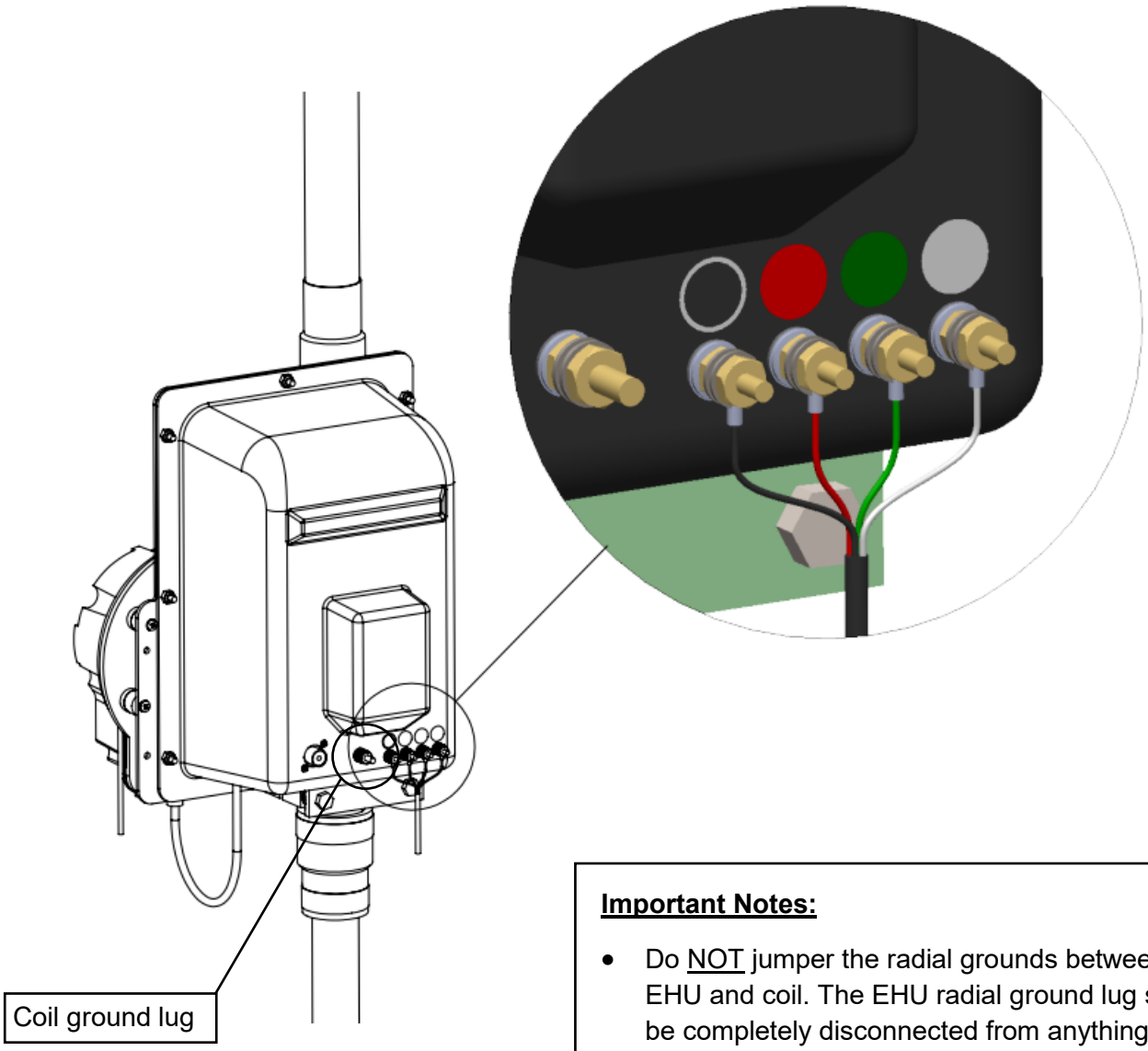


Figure 1.44

Figure 1.45

Figure 1.46

Section 1.4 (continued): 80m Base Coil Wiring (skip if 80m coil is not purchased)



Important Notes:

- Do NOT jumper the radial grounds between the EHU and coil. The EHU radial ground lug should be completely disconnected from anything.
- Once the antenna is mounted and your radial set-up is prepared, the radials can then be attached to the ground lug on the coil, and coax seal can be applied to all external electrical connections on the EHU/coil.

Section 1.5: Preparing the control cable (skip if you have pre-wired cable)

1. Strip the jacket and aluminum shielding off of the control cable as shown in **figure 1.20**, approximately 2.75” from end of control cable, being careful not to damage the individual wires.
2. Strip the plastic insulation off of each of the control cable wires, approximately 0.25” in length should be bare wire.

Section 1.6: Connecting control cable to the DB25 Field Splice

(skip if you have pre-wired cable)

1. Apply the provided dielectric grease to the exposed copper portion of each wire.

The terminals may be closed by default. If so, turn the terminal screw counter clockwise ~10 turns to open it before inserting the wires.

2. Connect each wire to the appropriate terminal and tighten using a flat head screwdriver.
3. Consult the table on the next page for the correct wiring sequence.
4. Position the control cable between the cable clamp halves as shown in **figure 1.31**. Electrical tape can be wrapped around the cables to increase their thickness if necessary.
5. Tighten the two pan head screws until the cable is snug, but do not over-tighten.
6. Thread the two thumb screws into the connector face as shown in figure 5.23.
7. Plug the DB25 splice into the back of the controller, ensuring that it is fully seated, and twist the thumb-screws to secure it. For first time setups it is common for this to be only partially installed, resulting in fault codes on the controller.

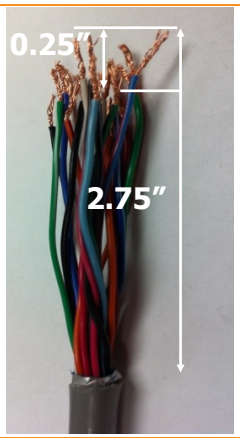


Figure 1.20

Figure 1.30

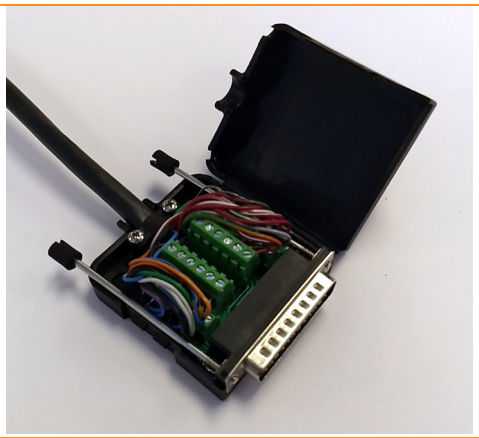
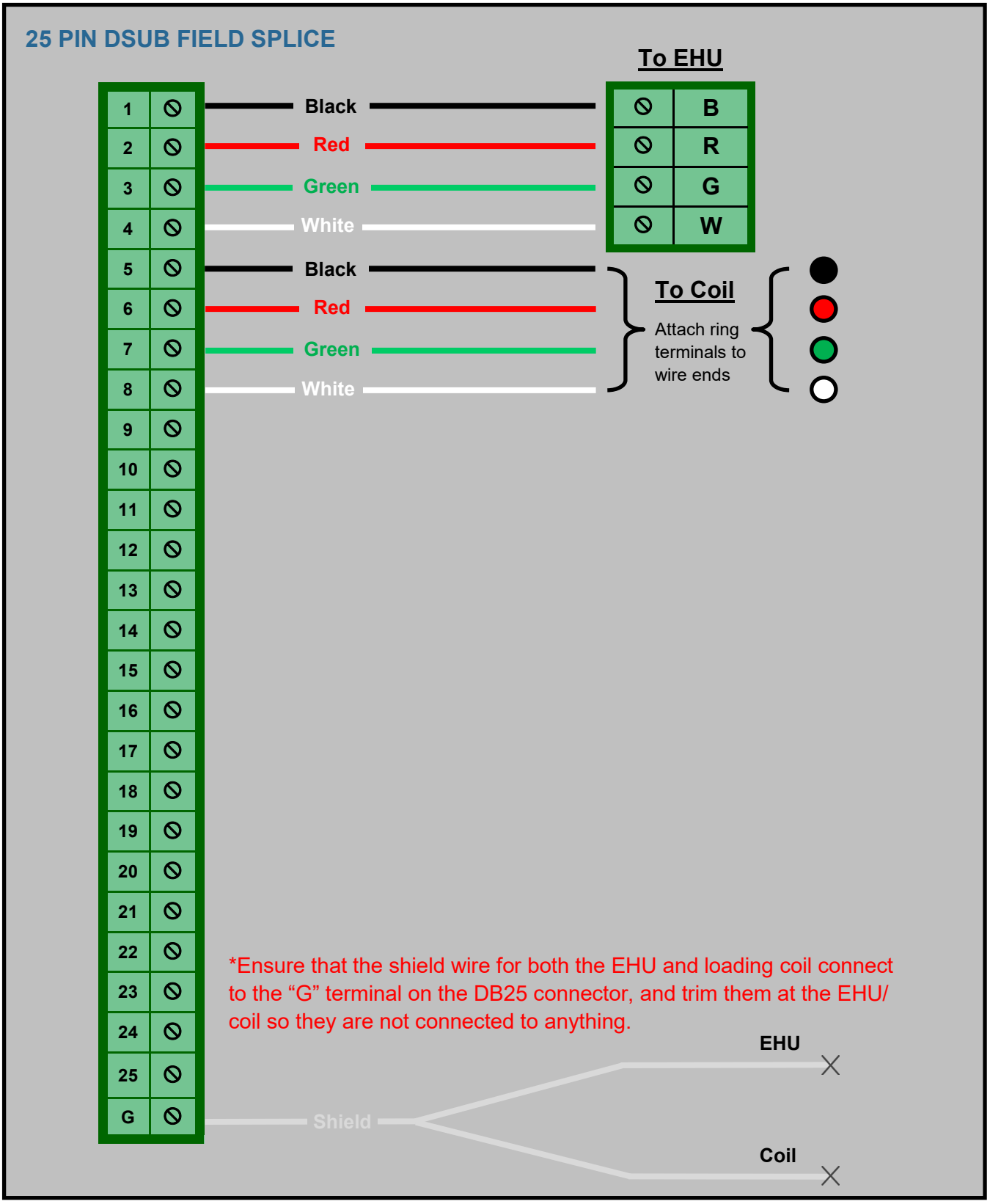


Figure 1.31

Section 1.7: BigIR Wiring Diagram (skip if you have pre-wired cable)



EHU/COIL WIRING TESTS

Section 2.1: BigIR Resistance Test (mandatory)

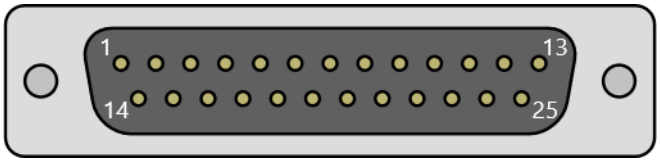


Figure 2.11

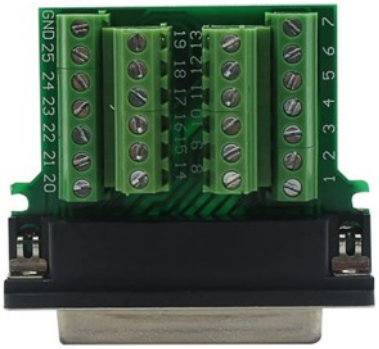


Figure 2.12

The control cable uses 4 wires per motor (one motor in each element housing unit (EHU) or loading coil). Each motor has two wires for each of its two motor windings. This test assumes the antenna is connected to one end of the control cable and the measurements are taken at the 25-pin connector that mates to the controller (disconnected from controller). You need an ohmmeter capable of measuring 15 – 35 ohms with reasonable resolution or at least one that you can tell the difference between a dead short and 15 ohms.

Step 1: Be sure the 25-pin DSUB control cable connector is disconnected from the controller (your control cable should not be plugged into the controller until the Resistance/Open Circuit test is completed).

Step 2: Hold the DB25 connector so you are looking at the pins with them pointing at you or open the back shell of the DB25 field splice. If prodding the pins directly, orient the connector so the row with 13 pins is on top, now the upper left-hand pin is pin 1. See **figure 2.11** (above) for reference. If you decide to open the case of the connector, reference the pin number marking on the PCB (see **figure 2.12** above).

Step 3: Measure the resistance between the pin pairs indicated. You only need to measure the resistance of wires that correspond to the elements on your antenna. For example: if you don't have the loading coil, measure the pin pairs associated with the BigIR EHU only. You should read between about 15 ohms to 30 ohms depending on cable length between the pins listed below. Record your results in the "Results" column. (100' is about 23 ohms).

Resistance Test Table			
Pin Pair	Antenna Element	Expected Resistance	Results (Ohms)
1-2	BigIR EHU	~ 20 Ohms	
3-4		~ 20 Ohms	
5-6	80/60/40/30m Coil	~ 20 Ohms	
7-8		~ 20 Ohms	

Section 2.2: BigIR Open Circuit Test (mandatory)

Step 4: Next make sure there is an open circuit between the following pins. Record your results in the "Results" column. (Any reading < 100 K ohms is bad)

Open Circuit Test Table		
Test Pins	*Expected Resistance*	*Results (Ohms or Open Load*
Connector metal case to any pin	Open Load (OL)	
Pin 1 to any pin except 2	Open Load (OL)	
Pin 3 to any pin except 4	Open Load (OL)	

Conclusion

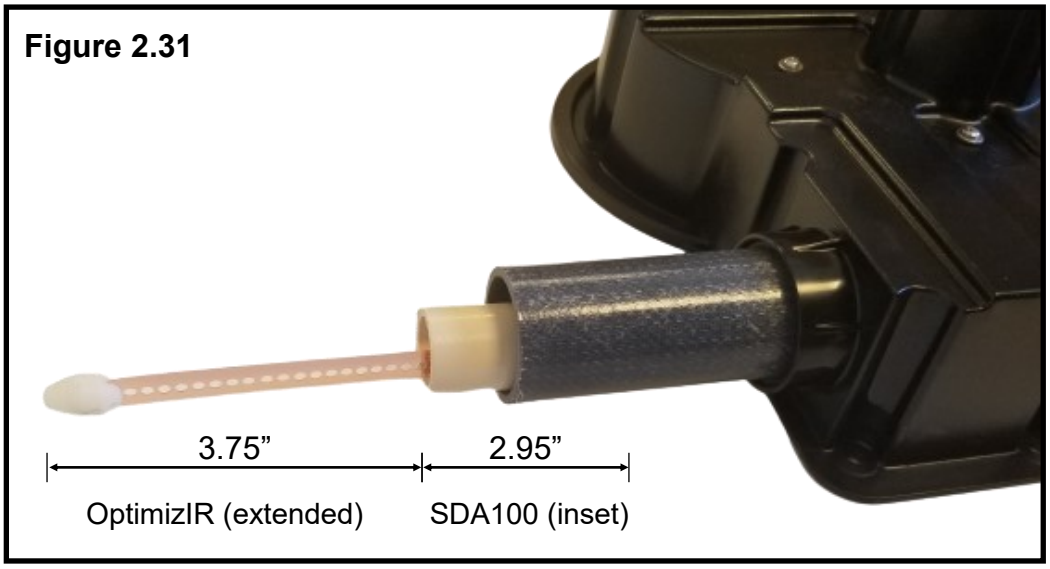
If your antenna passes this test it does not mean it is wired correctly. You could have an intermittent short or a short that requires higher current than what the ohmmeter can supply to reveal itself. You may have also swapped two elements or even wired the whole thing backwards (started at the wrong end of the terminal strip) and it will still measure correctly because each connector pair has a motor winding connected to it, but it is the wrong one. This test just takes you to the next step of trying to determine if the antenna is wired correctly and then finally determining if the elements are physically moving. This is an open loop system and the controller has no way of knowing if the elements are really moving when commanded to.

Section 2.3: EHU mechanical test (mandatory)

Read the controller operator manual so that you are familiar with its operation. At this time the controller should NOT be connected to your radio or computer. Also the fiberglass pole should NOT be installed on the antenna.

1. With the control cable NOT CONNECTED to the controller, turn the controller on. It should indicate that the elements are home. If not, push the RETRACT button. After the controller is finished tuning it may turn off. If it does, you will need to turn the controller back on. The controller will now indicate that the elements are home".
2. Turn off controller, remove the power cable.
3. Now CONNECT the control cable to the controller. Plug in the power cable and power on the controller
4. *ENSURE THAT ALL THE ELEMENTS ARE CLEAR OF ANY OBSTRUCTIONS.* The copper tape will be extended into the cpvc stub of the EHU.
5. Go into Setup mode by pressing the SETUP button and navigate to the "Motors Test" menu.
6. Ensure that the driven element is selected *(DE = DVR = driven),* then select "out" to extend the copper from the CPVC stub of the EHU (see figure 2). For the OptimizIR controller, this will stick out approximately 3.75 inches, with the SDA100 the copper will still be inside of the CPVC stub.
7. At this point you may select "switch" (OptimizIR only) in order to audibly confirm the operation of the 80m coil.
8. If any of the tapes do not extend, or the individual EHU/element does not correspond to the correct controller description, (I.E.: the antenna coil is controlled by the DE/DVR position on the controller.) STOP, retract the elements, disconnect the control cable and correct any wiring errors. Then start at the beginning of these instructions.
9. If the tape extends properly, press the retract button to retract the elements and proceed to the next assembly step.

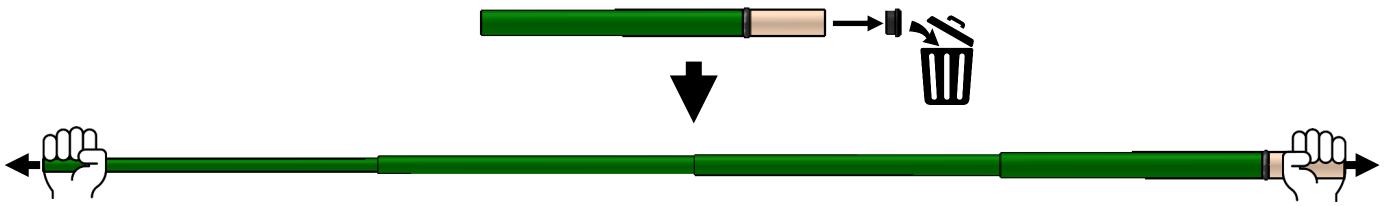
Figure 2.31



PREPARE THE TELESCOPING POLE

Section 3.1: Prepare the telescoping pole

1. Extend the telescoping pole (PN 10-1013-02) to full length by firmly locking each section of the pole in place. A good methodology is to position each half of the joint so that they are several inches apart (while still within each other), and then pull quickly and firmly. There are rubber plugs inside the base section of each telescoping pole. These make it easier for handling, but they MUST BE REMOVED BEFORE ASSEMBLY. VERIFY THE FOAM INSERT IN THE PLUG HAS NOT MADE ITS WAY DOWN THE POLE AND THAT THERE IS NO OTHER FOREIGN DEBRIS INSIDE THE POLE.



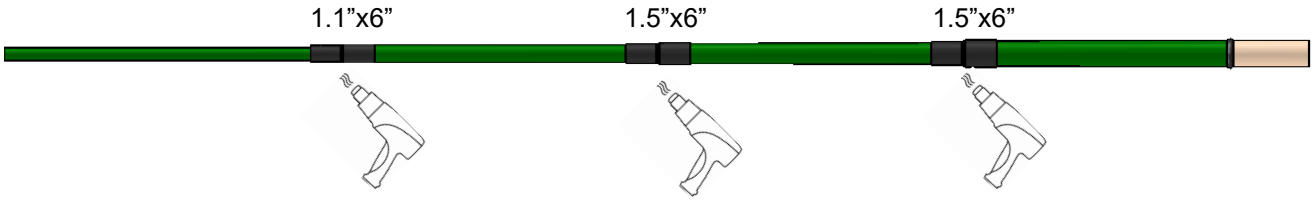
LOOK INSIDE OF THE TELESCOPING POLE TO VERIFY NOTHING IS BLOCKING IT. YOU SHOULD BE ABLE TO SEE LIGHT AT THE OTHER END IF THE POLE IS KEPT STRAIGHT.

4. The telescoping pole uses 3 total polyolefin heat shrink pieces. 2qty 1.5” x 6” (PN 10-1059-01) for the two largest joints, and 1qty 1.1” x 6” (PN 10-1059-21) for the smallest joint. One covering each joint after it has been pulled tight. This creates a secure and waterproof seal. This product requires a heat gun for activation of the adhesive.

5. When positioning the heat shrink, place it so that the joint of the telescoping pole is centered in the middle of the heat shrink.

6. Using a heat gun (hair dryers will NOT work), apply heat evenly around the entire area of heat shrink. Note: there are 4 blue colored lines imprinted on the tubing. The joint is considered done being heated and water-proof when the lines change color to a yellowish green. Each line needs to change color to ensure even adhesion temperatures.

7. The heat shrink will want to slide as it is heated so wear gloves and reposition the heat shrink to keep it centered on the joint as needed. Caution: The heat shrink will be HOT, wear insulated gloves!



Section 3.2: Install the rain cap assembly

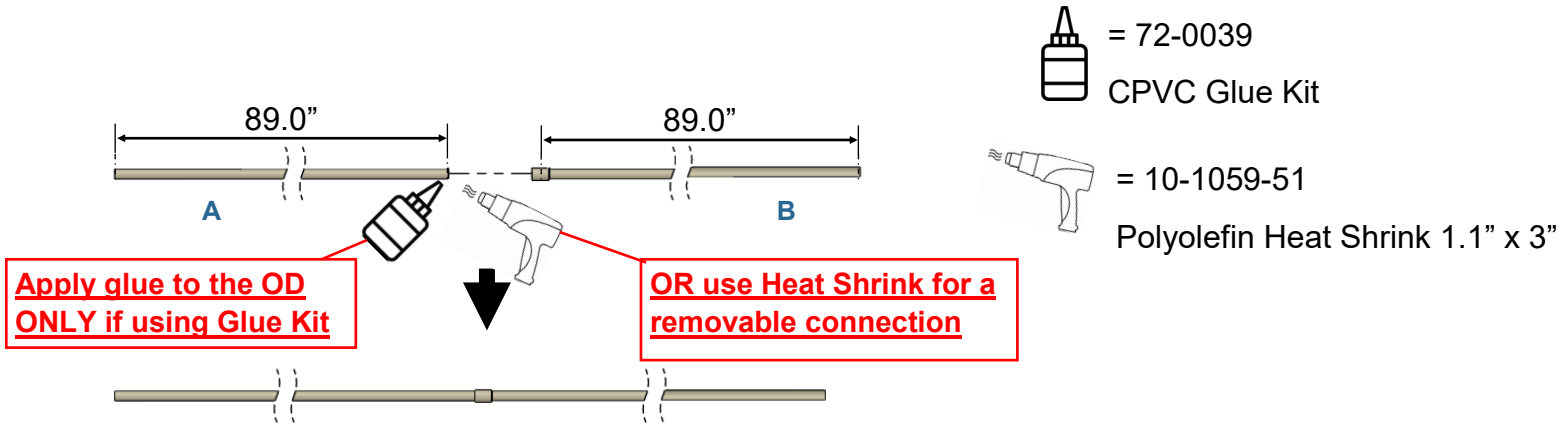
- Each telescoping pole tip requires a breathable rain cap to allow for venting of the EHU as well as protection from water ingress. The rain cap assembly (PN 10-1105-11) consists of a specially cut vent hose, and a vinyl housing as shown in **figure 3.2**.
- The fit of the plastic housing on the pole tip is purposely very tight, so that the rain cap assembly will stay in place. Before attaching the plastic housing, spread a small amount of dish soap or isopropyl alcohol around the inside edge of the plastic housing as shown in **figure 3.2**. This helps the housing slide on easily, and the soap will eventually evaporate, leaving you with a firm interference fit.
- Insert the plastic housing onto the telescoping pole tip as shown in **figure 3.2.** Be sure that the telescoping pole bottoms out on the vent tube.

Figure. 3.2

PREPARE THE CPVC LINER

Section 4.1: Assemble CPVC liner sections

Key	QTY	Part Number	Description
A	1	70-2021-01	CPVC Liner for BigIR, 89"x3/4", with coupler
B	1	70-2022-01	CPVC Liner for BigIR, 89"x3/4", w/out coupler

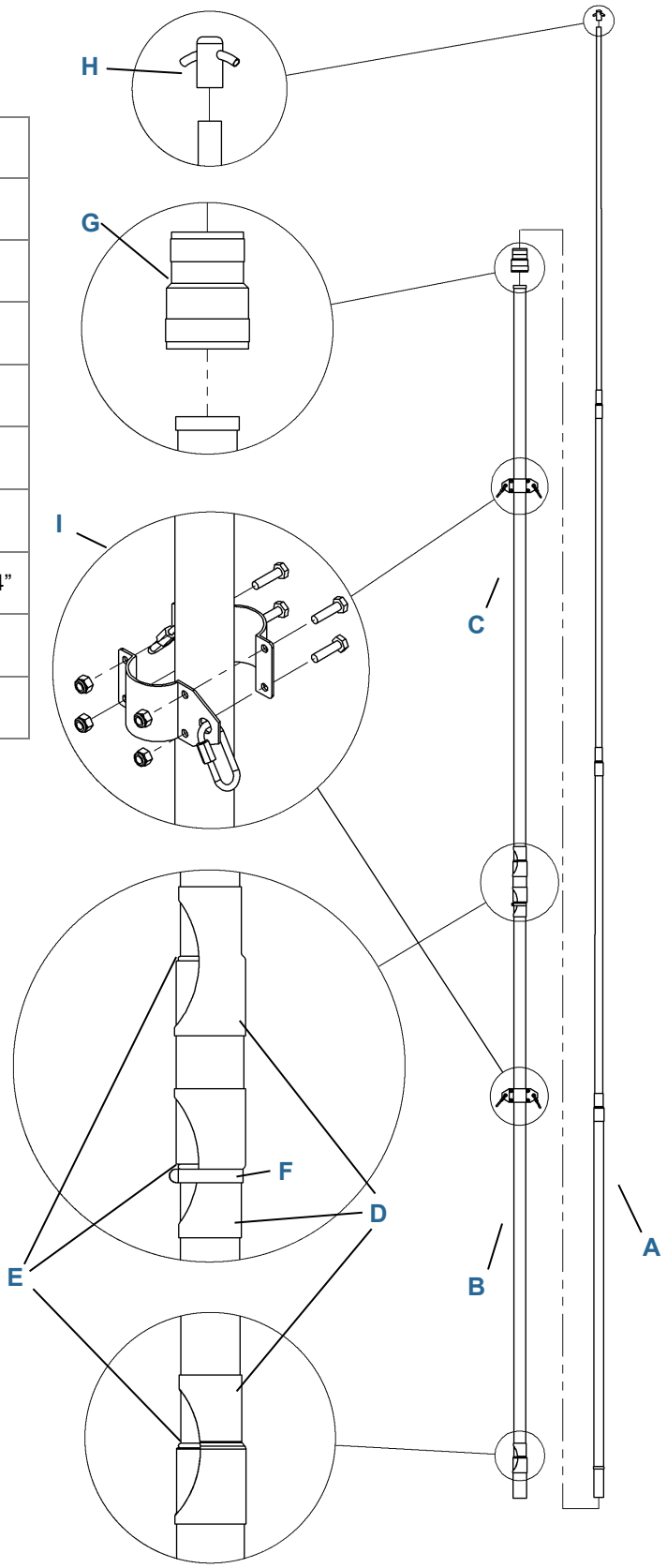


- The CPVC liner can either be bonded using heat shrink (this method is removable if you ever need to disassemble the antenna) or with CPVC glue (this is permanent and the cpvc will need to be cut if you ever need to remove it). If you prefer to use the CPVC glue (permanent) then **apply the glue to the outer diameter (OD) ONLY so that glue does not spread into the inner diameter (ID)** before inserting into the coupler and twisting. Work quickly as the glue will dry quickly and become less effective. There is no need for the heat shrink if you use the CPVC glue.
- Be sure to save some glue for later, as this will be used to install the CPVC liner onto the BigIR EHU during final assembly.

PREPARE THE EST EXTENSION ASSEMBLY

Section 5.0: EST Overview

Key	QTY	Part Number	Description
A	1	-	Telescoping Pole Assembly
B	1	70-2019-01	BigIR EST Extension - Lower
C	1	70-2020-01	BigIR EST Extension - Upper
D	3	10-1059-11	Polyolefin Heat Shrink 2.05” x 4”
E	3	10-1104-11	O-ring, 1-3/4” x 2”
F	1	60-6000-20	Hose Clamp, 1.16” to 2“ ID, SS
G	1	60-1006-22	Quick Disconnect, 1-1/2” to 1-1/4”
H	1	10-1105-11	Vertical Pole Rain Cap
I	2	72-0046-01	BigIR Guy Kit



Section 5.1: Staging the EST Extensions

- From the pole box, identify the upper and lower EST extensions (PN 70-2019-01 & 70-2020-01 respectively) and set on a clean and dry surface.
- From the BigIR Mark IV Hardware/Heat Shrink kit (PN 72-0044-04) remove the following components:

Key	QTY	Part Number	Description
A	3	10-1104-11	O-Ring, 1-3/4"
B	1	60-6000-20	Hose Clamp, 1.16" - 2" ID, SS
C	3	10-1059-11	Polyolefin Heat Shrink 2.05" x 4"

- On the lower EST (PN 70-2019-01):

  - Slide one O-ring from the end opposite to the aluminum coupler, and butt it against the coupler to make a seal on the joint (figure 5.1).

  - Slide one piece of Polyolefin heat shrink tubing directly behind the O-ring in preparation for sealing.

  - Now the hose clamp can be slid over the pole, about halfway down.

  - Follow with the final piece of heat shrink tubing, as well as the final O-ring

- On the upper EST (PN 70-2020-01):

  - Slide one O-ring from the end opposite to the aluminum coupler, and butt it against the coupler to make a seal on the joint.

  - Slide one piece of Polyolefin heat shrink tubing directly behind the O-ring in preparation for sealing.

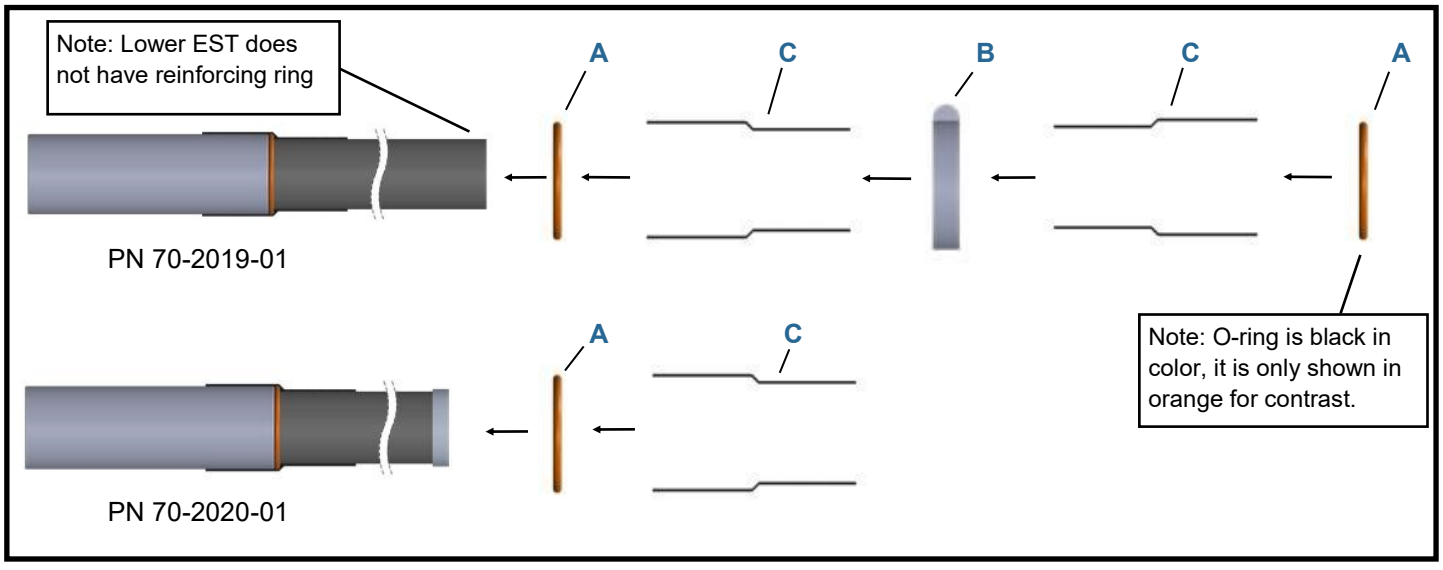


Figure 5.1

Section 5.2: Assembling the EST Extensions

- Begin by butting the O-rings against joint of each EST into the aluminum coupler. Then, insert the lower EST into the upper EST, and slide the remaining O-ring up to the butt of that joint as well.

Figure 5.2

Figure 5.3

- Now the polyolefin heat shrink tubing can be slid over the joints and heated in order to make a firm seal on the joints.

Figure 5.4

Figure 5.5

- The hose clamp (PN 60-6000-20) can now be slid into position (shown circled in red in figure 5.6) and tightened to further support the EST extension assembly.

Note: press the hose clamp firmly to be butted against the O-ring/coupler.

Figure 5.6

- The completed assembly should look like figure 5.7 below:

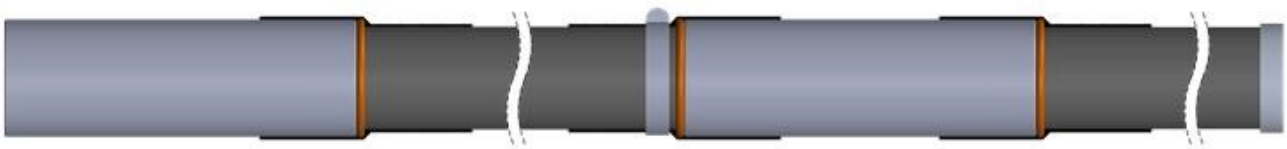
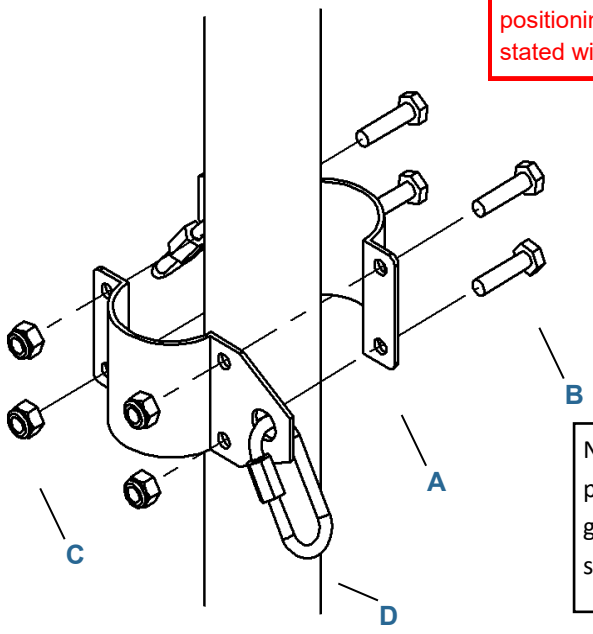


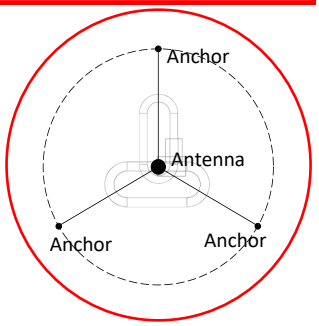
Figure 5.7

Section 5.3: Installing guy kits

Warning:

A 11 ft radius and an even spread (120 deg) are the minimum dimensions required, when positioning the guy anchors, to achieve the stated wind ratings





Note: since there are three guy points and only two quick links, two guy points must be fastened to one side of the guy clamp assembly.

Key	QTY	Part Number	Description
A	2	10-1429-21	Element Truss Guy Clamp, BigIR
B	4	60-0027	Bolt, 1/4"-20 x 1", S/S
C	4	60-0030	Nut, 1/4"-20, Nylock, S/S
D	2	60-0094	Quick Link, 3/16", S/S

Guy configurations:

• 1 guy kit = 70mph wind rating	• Guy mounted at 10ft above the bottom of the EST extension assembly
• 2 guy kits = 100mph wind rating	• First guy mounted at 6.5ft above the bottom of the EST extension assembly • Second mounted at 14ft.

- At this point the CPVC liner assembly can be slid into the EST extension assembly, and the telescoping fiberglass pole assembly can be affixed to the top of the upper EST extension assembly with the use of the provided quick disconnect boot (PN 60-1006-22). See pg. 35-36 for additional reference.

The following sections will use the diagram on pg. 36 for reference:

Section 6.2: Mount BigIR EHU assembly

- At this point we are ready to assemble the antenna. It is easiest to first install the EHU assembly onto the vertical mounting post and then insert the EST assembly into the EHU, clamp down the 2" saddles, and set up your guys.
- Using the remaining quick disconnect boot (60-1006-22), fasten the BigIR EHU assembly onto the vertical mounting post (see figure on next page).

Section 6.3: Install CPVC/EST extension assembly

- With the CPVC inserted into the EST extension, and the telescoping pole affixed to the top, **make sure there are no obstructions for the last time before final assembly**.
- Now the entire assembly must be lifted and inserted into the EHU. Multiple things will happen simultaneously, as the guy lines should already be attached to the guy clamps (and will be raised during install), the CPVC will have to be installed into the EHU, and the EST assembly will have to be clamped to the high wind kit.

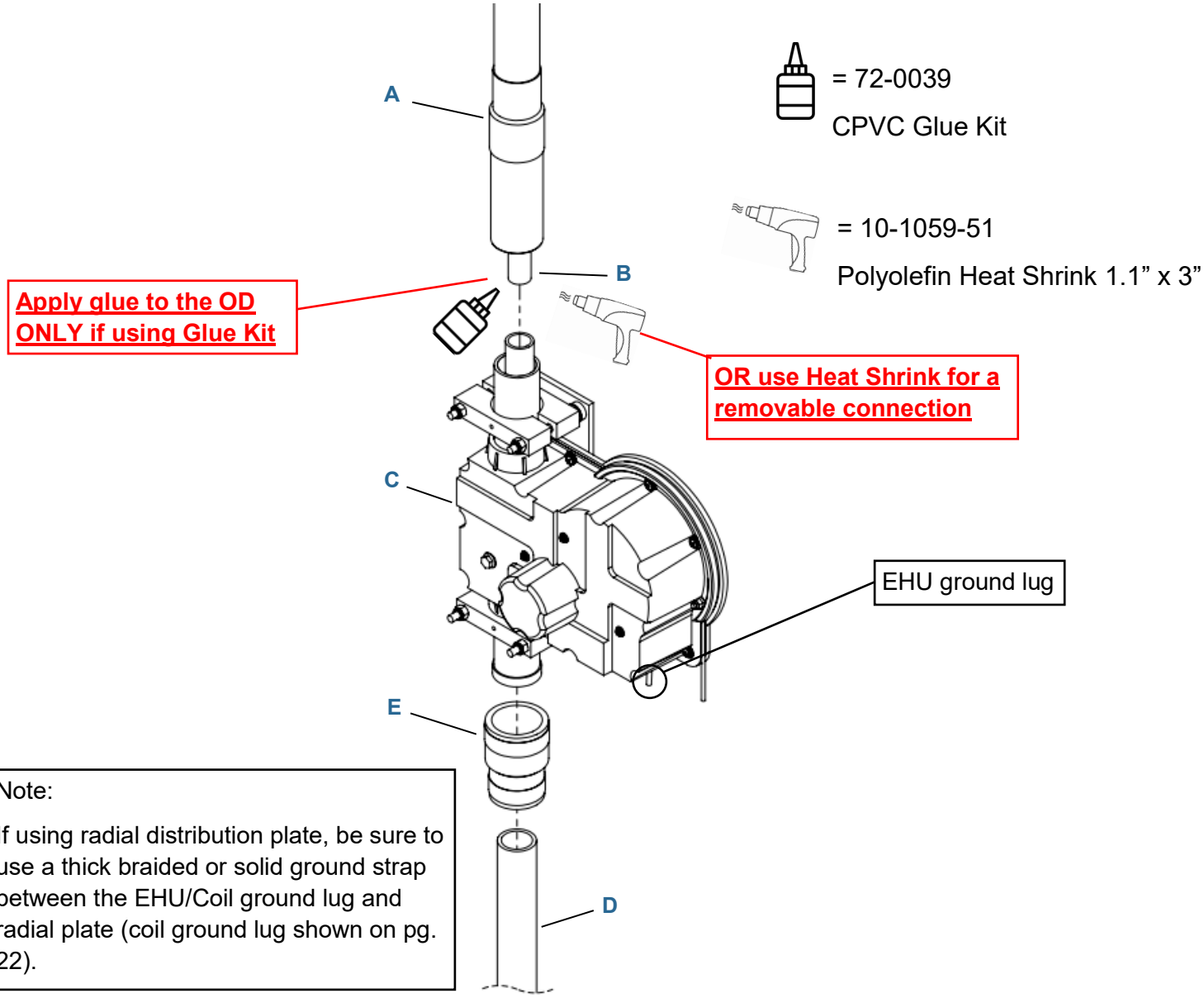
1) Use the provided glue kit (PN 72-0039) or heat shrink (PN 10-1059-51) to bond the CPVC liner to the BigIR EHUs CPVC stub. **Apply the glue to the OD ONLY** (if using the glue kit) before inserting into the coupler and twisting. Work quickly as the glue will dry quickly and become less effective.
2) Insert the EST extension assembly's aluminum coupler over the BigIR EHUs EST. Once it is fully seated, place the 2" aluminum saddles (or plastic) evenly onto the aluminum coupler and tighten the hardware until secure.
3) Tighten all guys, install coax and radials (to EHU if not using 80m coil, to coil if using 80m coil), and weatherproof all connections.

Congratulations, you have successfully erected the SteppIR BigIR vertical antenna system!

Before applying power for the first time, it is mandatory to tune your antenna (see pg. 42-44)

- The CPVC liner can either be bonded using heat shrink (this method is removable if you ever need to disassemble the antenna) or with CPVC glue (this is permanent and the cpvc will need to be cut if you ever need to remove it). If you prefer to use the CPVC glue (permanent) then **apply the glue to the outer diameter (OD) ONLY so that glue does not spread into the inner diameter (ID)** before inserting into the coupler and twisting. Work quickly as the glue will dry quickly and become less effective. There is no need for the heat shrink if you use the CPVC glue.

Key	Part Number	Description
A	-	EST Extension Assembly
B	-	CPVC Assembly
C	-	BigIR EHU/Coil Assembly
D	10-1109-22	Antenna Support, 1-1/2, Vertical
E	60-1006-22	QUICK DISCONNECT, 1-1/2" to 1-1/4", Fernco
F	10-1059-51	Polyolefin Heat Shrink 1.1” x 3”



Note:

If using radial distribution plate, be sure to use a thick braided or solid ground strap between the EHU/Coil ground lug and radial plate (coil ground lug shown on pg. 22).

COUNTERPOISE/RADIAL SYSTEM OVERVIEW

The following charts can help determine what radial setup will work best for you. This is a general overview, for more detailed information please read our complete white paper on radials which can be found here: https://consumer.steppir.com/wp-content/uploads/2018/11/Radial-Systems-for-Elevated-and-Ground-Mounted-Antennas-2.2-12_2018.pdf

Ground mounting:

PROS	CONS
• The radials are non-resonant so one length (.1wl minimum at lowest frequency) works on all frequencies	• Takes 120 radials to equal an elevated vertical with 2 resonant radials (90% efficient)
• Easy to mount	• Surrounding objects can reduce signal strength
• Easy access	
• Lower visual profile	
• Sixteen 0.1 wl (wavelength) radials of lowest intended frequency give 65-70% efficiency	

Elevated mounting:

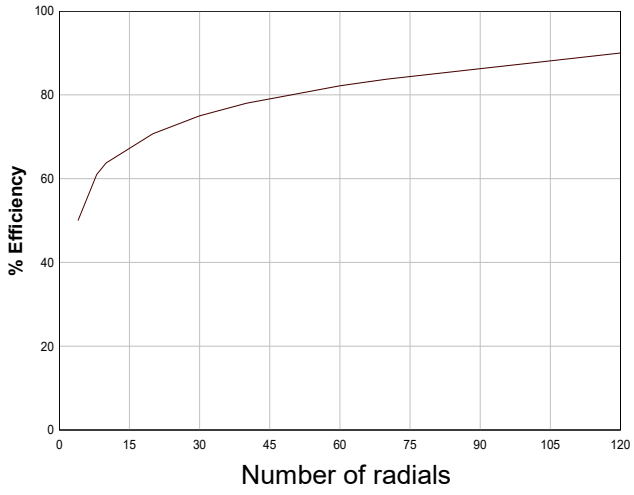
PROS	CONS
• > 90% efficient with two .25 wavelength radials	• Requires two .25 wavelength radials (minimum) for each band of operation (radials interact, so spacing will affect length)
• Antenna is generally more “in the clear”, so surrounding objects don’t cause as much attenuation	• Mounting is generally more involved
• A peaked metal roof will make a very good all-frequency radial system	• Visually higher profile
• Contrary to conventional wisdom the vertical doesn’t have to be elevated very high, even 6” results in much lower losses even on 80m, so 5 feet is just fine for 80m	• Must be mounted high enough that people won’t walk into the radials
	• Elevating lowers the impedance so radials might need up to a 30° downward slope to get a good match

Ground Mounting:

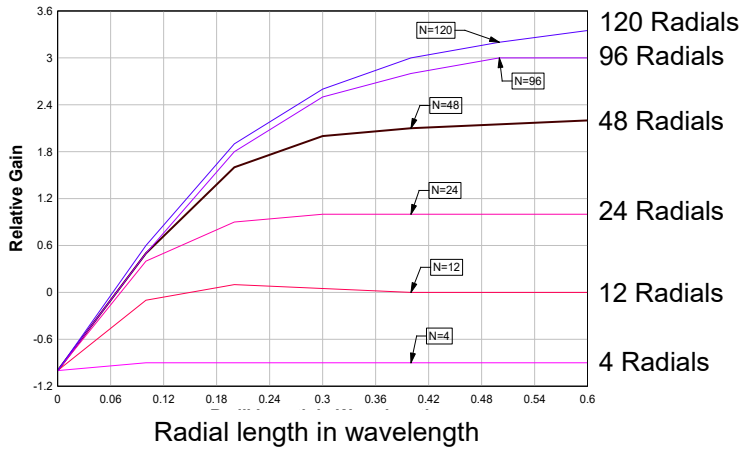
If you choose to ground mount the vertical, pick a spot that will allow you the best chance of spreading your radials evenly around the antenna, and away from trees and other objects if possible. You will need to determine how much effort and wire you are willing to invest in this installation. The tradeoffs are as follows:

1. More radials equals higher efficiency (see **Graph 1**)
2. Match your radial length to the number of radials using **Graph 2,** why waste wire
3. If only a few radials can be used (8 or less) do not make them excessively long, it can reduce gain
4. A vertical antenna is only as good as its radials, as the counterpoise is literally half of the system. 25 – 30 is about where diminishing returns begin, the minimum recommended is 16.

Graph 1



Graph 2



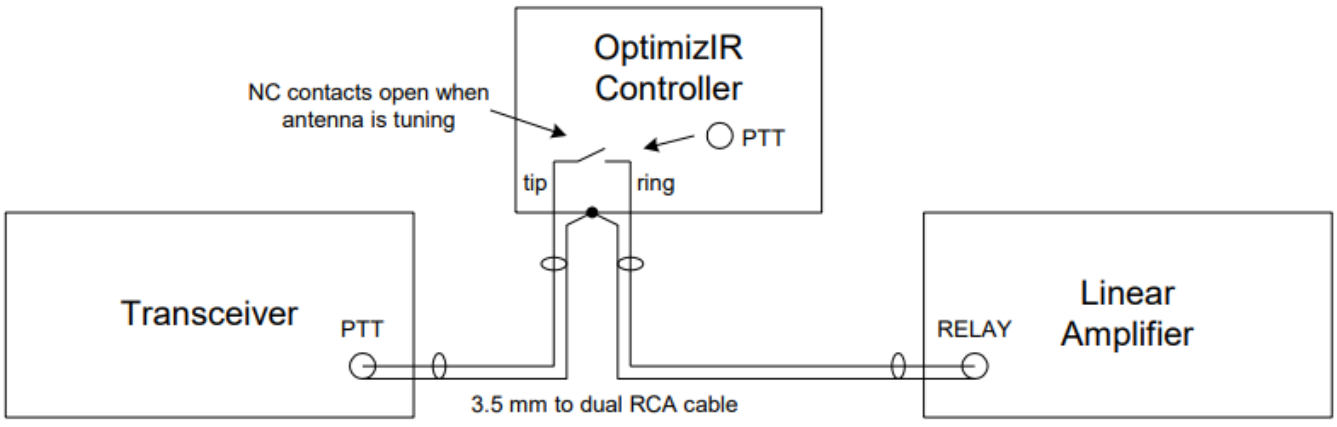
For more detailed information on ground mounted and elevated mounted radial setups, please read our complete white paper on radials:

https://consumer.steppir.com/wp-content/uploads/2018/11/Radial-Systems-for-Elevated-and-Ground-Mounted-Antennas-2.2-12_2018.pdf

PTT LOCKOUT TUNING RELAY (INCLUDED)

To prevent application of unintended, excessive RF power while the SteppIR antenna is tuning, the OptimizIR controller provides an isolated pair of contacts from a 3.5 mm stereo jack to interrupt the PTT relay signal to a linear amplifier. The cable is provided, but any standard 3.5 mm stereo plug to two RCA plug cable sold for audio applications works well in most cases. Some more modern amplifier relay control schemes are different and may not accommodate an RCA plug. Older amplifiers may use high voltage in their PTT circuit which may be a problem for some transceivers. Please read your amplifier and transceiver manuals carefully. The 3.5 mm plug tip and ring connect to isolated relay contacts inside the controller that interrupt the PTT circuit. The sleeve connection serves as a ground/shield.

Figure 7.1



Tuning Relay Wiring

OPTIONAL 1:1 BALUN

A balun is an electrical circuit used to help resolve the inherent problem of feeding an antenna with an electrically unbalanced (coax) feed line. It is intended to present an infinite impedance to any RF current that might otherwise flow on the outer conductor (shield) of the coax producing radiation from the line. This current, if high enough, can cause heat buildup and potential damage to the radio as well as a distorted radiation pattern and RF noise.

Why is it Optional ?:

In the normal configuration, ground mounted with 12 or more radials, the ground will bleed/ drain the unwanted RF signal from the coax shield.

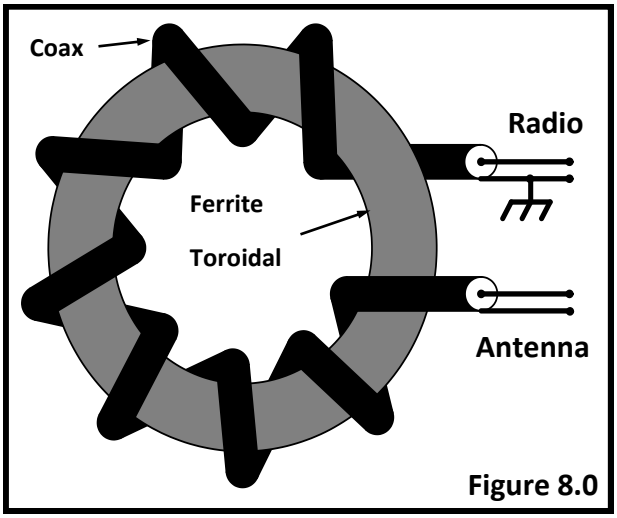


Figure 8.0

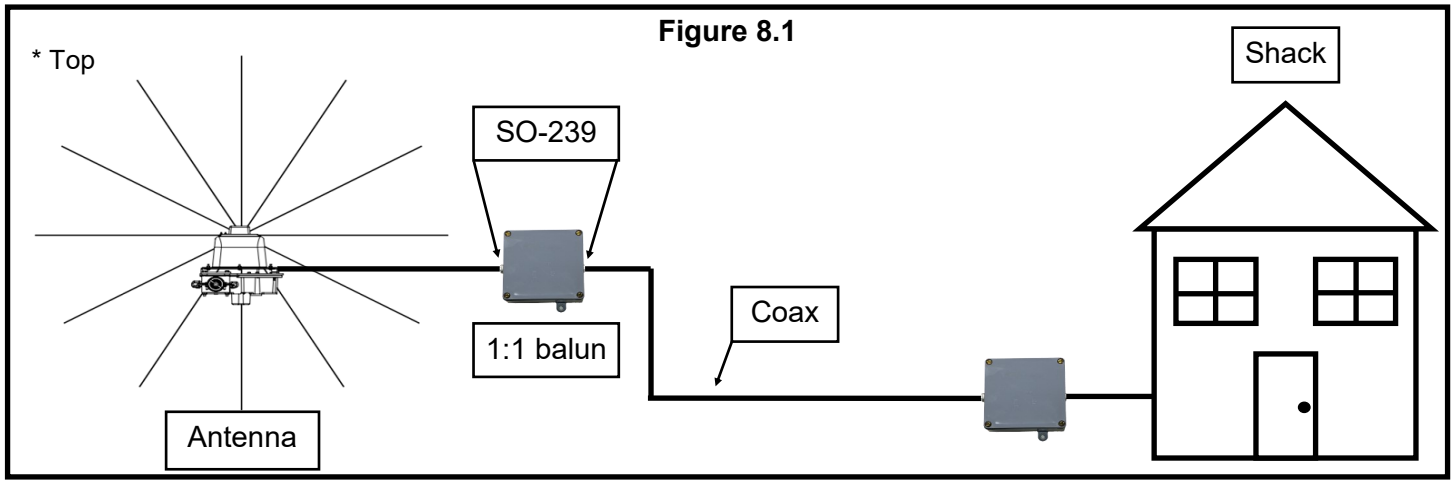
When Should You Use A Balun ?:

- When mounting the vertical antenna in an elevated fashion
- When only a few radials are used
- When the coax run is shorter than the radials
- When the ground condition is poor
- Unusual SWR readings on one band

Balun Installation

There are numerous options for mounting the balun—by far the most popular is to mount the balun on an adjacent post or similar structure via the 2 mounting holes molded in its housing. There are 2 locations SteppIR recommends installing the 1:1 balun. If you have one balun then install it just outside of the radial field. If you have 2 baluns available to you then do both locations shown in **figure 8.1**.

Figure 8.1



OPTIONAL VOLTAGE/SURGE SUPPRESSOR

- The Voltage/Surge Suppressor is can be installed at the base of the tower, or on a well grounded structure (ground post or ground bus bar).
- You will need to cut the control cable in order to install the Voltage/Surge Suppressor. **MAKE SURE THAT THE POWER IS TURNED OFF AND UNPLUGGED ON THE CONTROLLER AS WELL AS THE CONTROL CABLE UNPLUGGED**.
- The Voltage/Surge Suppressor **DOES NOT GO IN SERIES WITH THE CONTROL CABLE**. If you wire it this way, your control box **WILL NOT OPERATE**. The Surge Suppressor is a **SHUNT DEVICE**. To visualize the connection, think of a "T". The control cable is the top of the "T" and the Surge Suppressor is the "leg" of the "T".

Mounting the Voltage/Surge Suppressor:

1. Remove the two Galvanized U-Bolts from the mounting bracket.

2. Install the U-Bolts around the tower leg to suite your installation. If mounting to a ground post or ground bus bar then you may use the holes for the U-bolts as mounting holes to the post/bus bar.

3. Install the Voltage/Surge Suppressor, square washer plates and nuts.

4. Tighten the nuts. Over-tightening of the U-Bolts may result in bending of the aluminum bracket.

5. Visit your local hardware store or home center and pick up some Forked Crimp Style Lugs that will fit the #8 stud. You may either use crimp style lugs that need NO soldering or soldered lugs AND because they are fork style, you don't need to remove the nut to install them (Very handy when working on the tower!). It's a good idea to give the lug a tug to confirm it's crimped properly. **Soldered lugs are preferred if you have the capability to do so.**

The 8 Wire Surge Suppressor will require 16 Lugs. The 12 Wire Surge Suppressor will require 24 Lugs. The 16 Wire Surge Suppressor will require 32 Lugs.

6. If you match the colors of the leads on your control cables per stud, you should have no issues **(figure 9.1).** The Voltage/Surge Suppressor was checked at the factory for defects prior to shipment.

7. Make sure that you secure the control cable with tape or cable ties (aka Tie Wraps) to the tower as shown in **figure 9.2**.

8. We recommend sealing up the connections by either using silicone tape or electrical tape to wrap the entire Voltage/Surge Suppressor and cable connections so that they do not corrode from moisture.

Figure 9.1

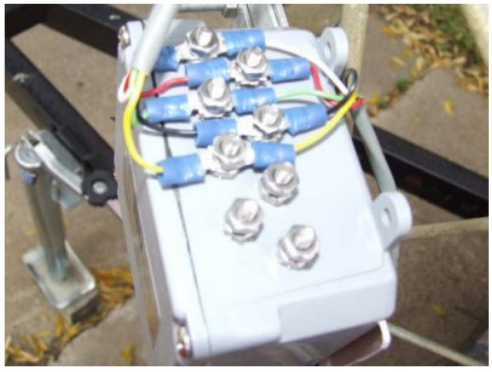


Figure 9.2

HOW TO TUNE YOUR VERTICAL (MANDATORY)

A vertical antenna's resonant frequency is determined by the length of its radiator, radial(s), soil conductivity, as well as a variety of other factors. Since every installation is different, the factory default lengths in the controller for each band/frequency are almost guaranteed to be need adjustment for your particular installation. Because of this, **it is mandatory to tune the length of the antenna on all frequencies of operation before application of high power**.

This is done by pressing "Setup" and selecting the "Create/Modify" menu. In this menu, the operator can adjust the length of the driven element (DVR/DE) until the SWR is at least below 1.4-1.3. An antenna analyzer (Vector Network Analyzer) is extremely helpful for this task as it allows the user to plot SWR over a frequency range, at which you can match the SWR dip in the antenna with the frequency which you are tuning in the create/modify menu. **If you are unable to make a good match by adjusting the length of the driven element, you most likely have an issue with your connections/radials.**

SteppIR antenna tunes are broken up into "segments" which we use to create an ideal antenna at a specific frequency. Each segment consists of a frequency, element lengths, coil switch command, and some miscellaneous display settings like gain, F/R, and beam width. To get the element lengths at frequencies in between segments, the controller utilizes an algorithm to calculate them with the given segment information. The controller can only "store" lengths at the start of each segment, and it calculates the lengths in between. What this means for the end user is that the antenna can only be tuned once in between each segment.

Important notes:

- In order to save a setting in the Create/Modify menu, you can simply exit from the screen by pressing "Setup" again, and when the controller prompts you whether you want to save your changes make sure you select "Y" to save your changes.
- Adjusting the coil tap position is almost never necessary to get a good match, and if you have to do so, you most likely have a problem with your radials that is worth addressing.

On the next few pages are lists of the segments, segment frequencies, and recommended tune frequencies for the BigIR for the SDA100 and OptimizIR controllers.

SDA100 recommended tuning frequencies

Segment #	Frequency (KHz)	Recommended Tune Frequency (KHz)	Untuned SWR	SWR Minimum Frequency	Tuned SWR
17	50900	53000			
16	49500	50500			
15	40900	40900			
14	34900	34900			
13	27900	28900			
12	26900	27500			
11	24850	24900			
10	20900	21200			
9	17900	18100			
8	13900	14200			
7	9900	10100			
6	6900	7150			
5	5200	5350			
4	3750	3875			
3	3600	3675			
2	3500	3550			
1	3400	3450			

Please refer to the create/modify section of the controller manual for more information on tuning

SDA 100 Manual:

https://consumer.steppir.com/wp-content/uploads/2020/10/SDA100-Operators-Guide-MUSTANG.pdf

OptimizIR recommended tuning frequencies

Segment #	Frequency (KHz)	Recommended Tune Frequency (KHz)	Untuned SWR	SWR Minimum Frequency	Tuned SWR
24	51000	52500			
23	49500	50500			
22	41000	41000			
21	34500	34500			
20	29000	29350			
19	27500	28500			
18	24600	24940			
17	20800	21225			
16	17850	18120			
15	15800	15800			
14	13850	14175			
13	11300	11300			
12	10000	10125			
11	8850	8850			
10	7850	7850			
9	6950	7150			
8	5300	5350			
7	5200	5250			
6	4100	4150			
5	4000	4050			
4	3750	3875			
3	3600	3675			
2	3500	3550			
1	3400	3450			

Please refer to the create/modify section of the controller manual for more information on tuning

OptimizIR Manual:

https://consumer.steppir.com/wp-content/uploads/2018/05/SDA-2000-OptimizIR-Manual-Version-1_4-April-17-2018.pdf

STEPPIR COMMUNICATION SYSTEMS

5 YEAR LIMITED PRODUCT WARRANTY

(as of May 22, 2023; Prior to that date warranty is 2 years)

Our products have a limited warranty against manufacturers defects in materials or construction for five (5) years from date of shipment. Do not modify this product or change physical construction without the written consent of Fluidmotion Inc, dba SteppIR Communication Systems.

This limited warranty is automatically void if the following occurs: improper installation, unauthorized modification and physical abuse, customer misuse or damage from weather events or natural disasters that are outside of the stated survivability of the product. For wind damage, proof of winds beyond 100 mph must be presented. Lightning or near-lightning events are not covered under this warranty. Driver chip module replacement is not covered under this warranty. This warranty is not transferrable.

SteppIR Communication System's responsibility is strictly limited to repair or replacement of defective components, at SteppIR's discretion. SteppIR will not be held responsible for any installation or removal costs, costs of any ancillary equipment damage or any other costs incurred as a result of the failure of our products.

In the event of a product failure, a return authorization is required for warranty repairs. This can be