



StealthIR Antenna Assembly Manual



REV 1.31 10/23/2023

TABLE OF CONTENTS

SteppIR - Why Compromise?	3
Preparing For Assembly	4
Antenna Specifications	5
Antenna Overview	6
Parts Checklist	7-9
Vertical mounting post Overview	10
EHU Overview	11
Section 1: Wiring and EHU/Coil assembly	12-21
Section 2: EHU/Coil wiring tests	22-24
Section 3: Prepare the 15' fiberglass pole	25-28
Section 4: CPVC/EST extension/Architectural rock/Mounting	29-31
Section 5: Installing the 15' fiberglass pole	32-33
Counterpoise/Radial system overview - Ground mounted	34-35
PTT Lockout Tuning Relay (included)	36
Optional 1:1 Balun	37
Optional voltage/surge suppressor	38
How to tune your vertical (Mandatory)	39-40
Product warranty claim	42

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 both the controller and antenna 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 10 ft x 25 ft would be ideal.
- For the StealthIR we recommend doing as much of the assembly process as possible in an area that is not visible to neighbors. When it is time to mount the antenna to its mounting post you may use the architectural rock to block your neighbors view of the antenna until it is time to put the architectural rock over the EHU/Coil assembly.

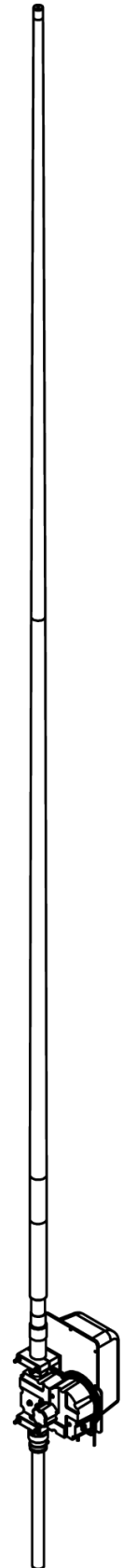
IMPORTANT NOTES!

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	18ft (5.49m)
Weight	18.5 lbs (16.78 kg), 24 lbs (19.28 kg) with coil (excludes rock)
Wind rating	100mph
Adjustable elements	1-2
Power rating	3.0 kW 20-6m (1500W limit with 40/30m coil, 500W limit with 80/60/40/30m coil on loaded bands)
Feed points	1
Frequency coverage	3.4-55 MHz with 80/60/40/30m loading coil, 7.0-54MHz with 40/30m coil, 13.85-54MHz without
Control cable	2 x 4 conductor with coil, 1x without



ANTENNA OVERVIEW

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

The antenna comprises two primary subsystems:

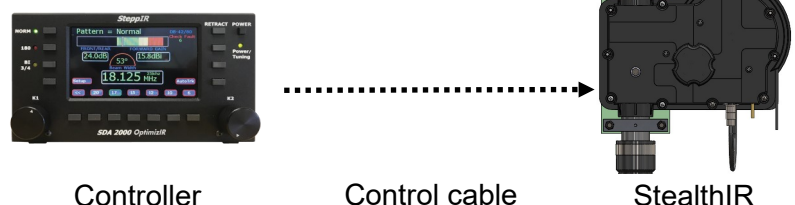
1. The Element Housing Unit (EHU) contains the stepper motor, copper-beryllium tape and wiring interface. The optional coil attaches to this unit as well.
2. The Element Support Tubes (EST) provides guidance and protection of the copper-beryllium tape as it extends or retracts.

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 vinyl cap ensures that rain and moisture is prevented from entering the EST.

If one of the loading coil accessories 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, 60, 40, and 30 meters or 40 and 30 meters. The antenna with that option is designated the StealthIR/80 or StealthIR/40. Both the EHU and loading 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.



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	70-3419-01	EHU, StealthIR 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	QR code sheet containing manuals
	1	72-0044-31	Kit, StealthIR Hardware/Heat Shrink
	1	72-0044-12	Kit, BigIR/StealthIR EHU Wind Reinforcing Kit/Hardware, Plastic Saddles
	1	10-1157-01	Extra Large Architectural Rock, 2.5" output hole
	1	70-6010-01	Adapter, 25pin Dsub Field Splice
	1	10-1013-21	15' Fiberglass Pole, 2 sections
	1	70-2018-01	StealthIR EST extension with aluminum coupler and pole adapter
	1	70-2023-01	CPVC Liner for StealthIR, 31"x3/4", with coupler
	1	70-2023-11	CPVC Liner for StealthIR, 83" x 3/4", w/o coupler
	1	10-1109-22	Antenna Support, 1-1/2, Vertical, Fiberglass
	1	09760	OptimizIR Controller
		21-601_-01	Transceiver Interface Cable
		06025	80/60/40/30m loading Coil for the SmallIR/StealthIR (500W on loaded bands)
		06023	40/30m loading Coil for the SmallIR/StealthIR (1500W on loaded bands)
		60-0194	American Flag, 3'x5', All Weather Outdoor
		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

72-0044-31

Kit, StealthIR Hardware/Heat Shrink

✓	QTY	PART #	DESCRIPTION
	1	60-1006-22	QUICK DISCONNECT, 1-1/2" to 1-1/4", Fernco
	2	10-1059-51	Polyolefin Heat Shrink 1.1" x 3"
	1	72-0009-03	Kit, Glue
	1	10-1029-01	Connector Protector Cat, 0.14 oz, (silicon goop for terminals)
	1	10-1059-61	Polyolefin Heat Shrink 2" x 18"
	1	10-1059-71	Polyolefin Heat Shrink 2" x 12"
	1	60-0044-41	Vinyl Cap, 1-1/16" to 1-1/8" OD x 1.5" long, Black, StealthIR
	1	60-9001	Allen Key, 3mm
	2	60-0191	Nylon Tip S/S Set Screw, M6 x 1mm Thread, 10mm long
	1	60-0192-01	Plastic Flagpole Mounting Ring, Anti Wrap, 1.25"
	1	60-0192-11	Plastic Flagpole Mounting Ring, Anti Wrap, 1.5"
	2	60-0193	Flagpole Flag Clip, Nylon
	1	09-0001	Electrical tape 3/4" PVC MERCO 307

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

06024

80/60/40/30m loading Coil for the SmallIR/StealthIR (500W on loaded bands)

✓	QTY	PART #	DESCRIPTION
	1	70-2100-11	Coil, SmallIR/StealthIR, 80m
	1	72-0044-20	Kit, BigIR/StealthIR Coil Hardware

06022

40/30m loading Coil for the SmallIR/StealthIR (1500W on loaded bands)

✓	QTY	PART #	DESCRIPTION
	1	70-2100-01	Coil, SmallIR/StealthIR, 40m
	1	72-0044-20	Kit, BigIR/StealthIR Coil Hardware

72-0044-20

Kit, BigIR/StealthIR 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
	8	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.

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 as shown in **Figure 1.01**. Directly burying in concrete or the use of a conduit sleeve in the ground are common methods. **IF YOU ARE USING A RADIAL PLATE DO NOT USE THE COAX PASS THROUGH ON THE PLATE.**

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.

* Side view

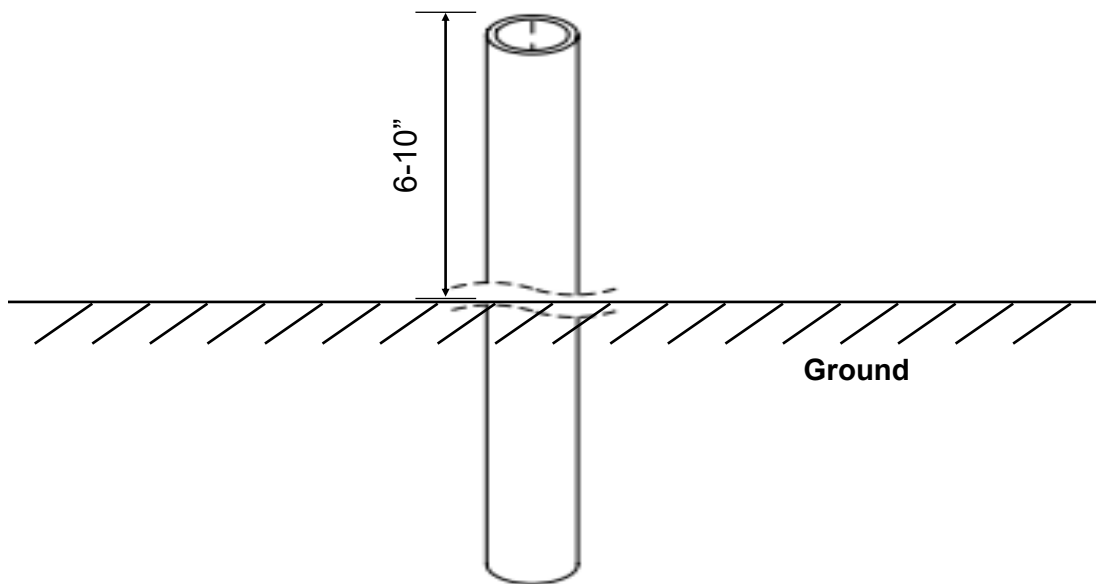
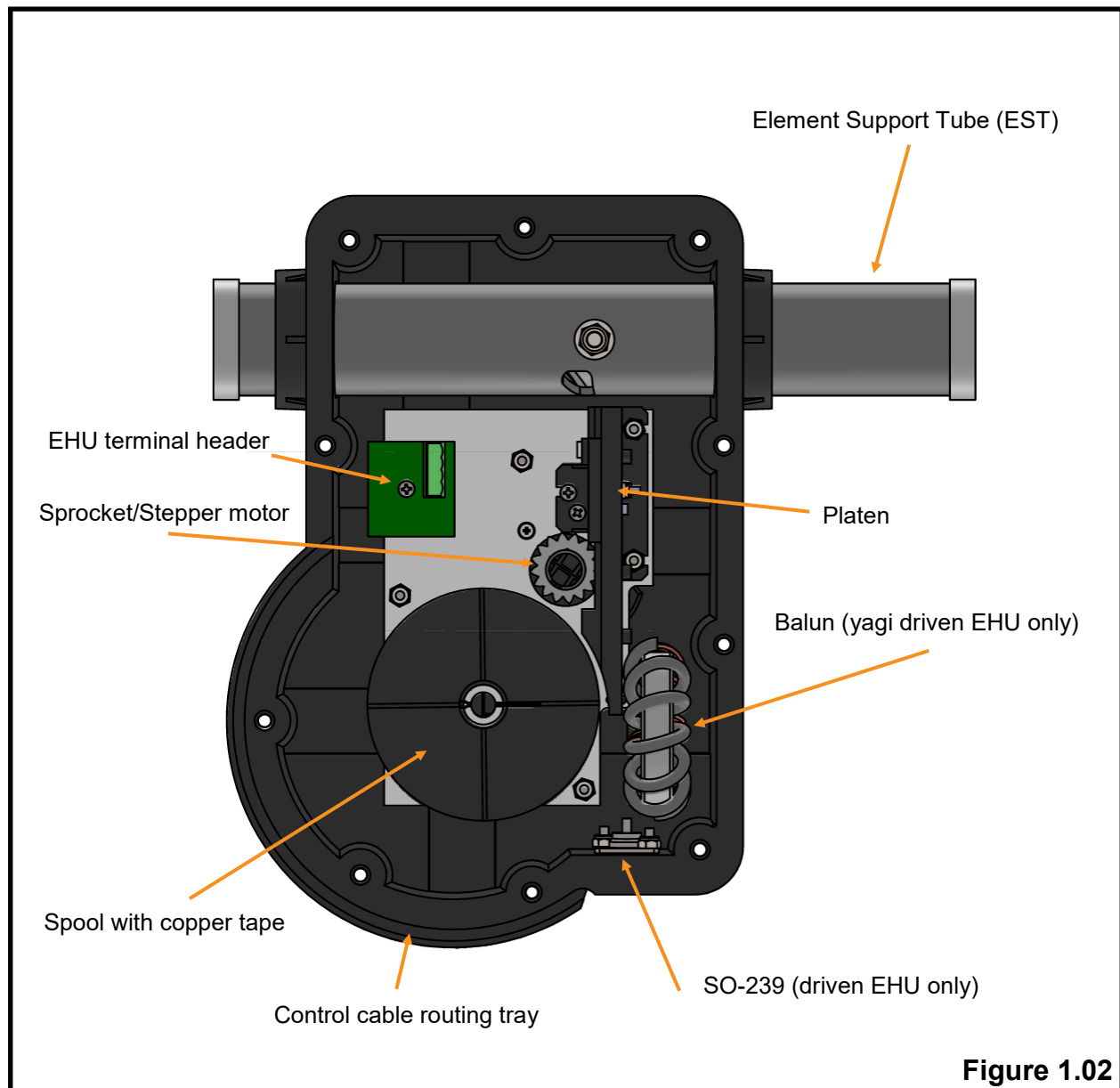


Figure 1.01: Vertical mounting post

EHU OVERVIEW

Figure 1.02 provides an overview of a SteppIR EHU (the specific model shown is a 20m driven).



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. 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.

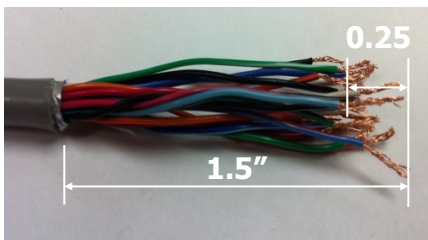


Figure 1.10



Figure 1.11

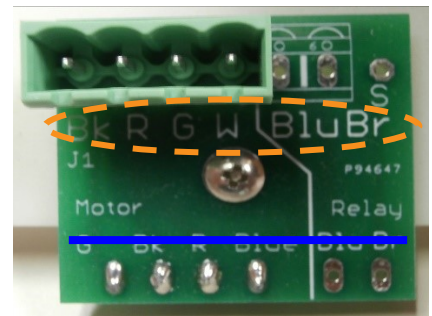


Figure 1.12

4 Pin Header Wiring Sequence

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

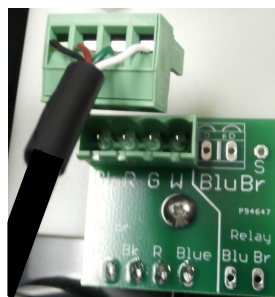


Figure 1.13

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 sealed with the gasket and lid, secured to the high wind reinforcing kit, and optional loading coil.



Figure 1.15

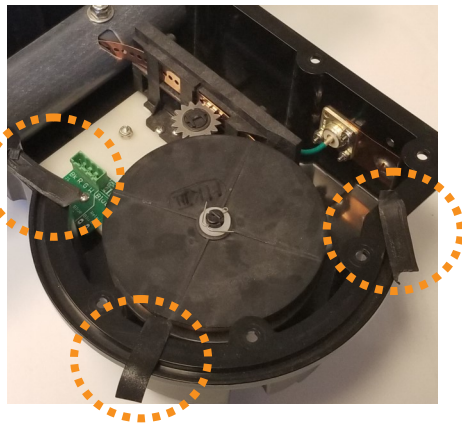


Figure 1.16

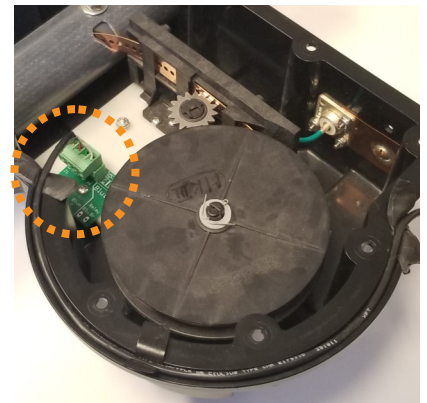


Figure 1.17

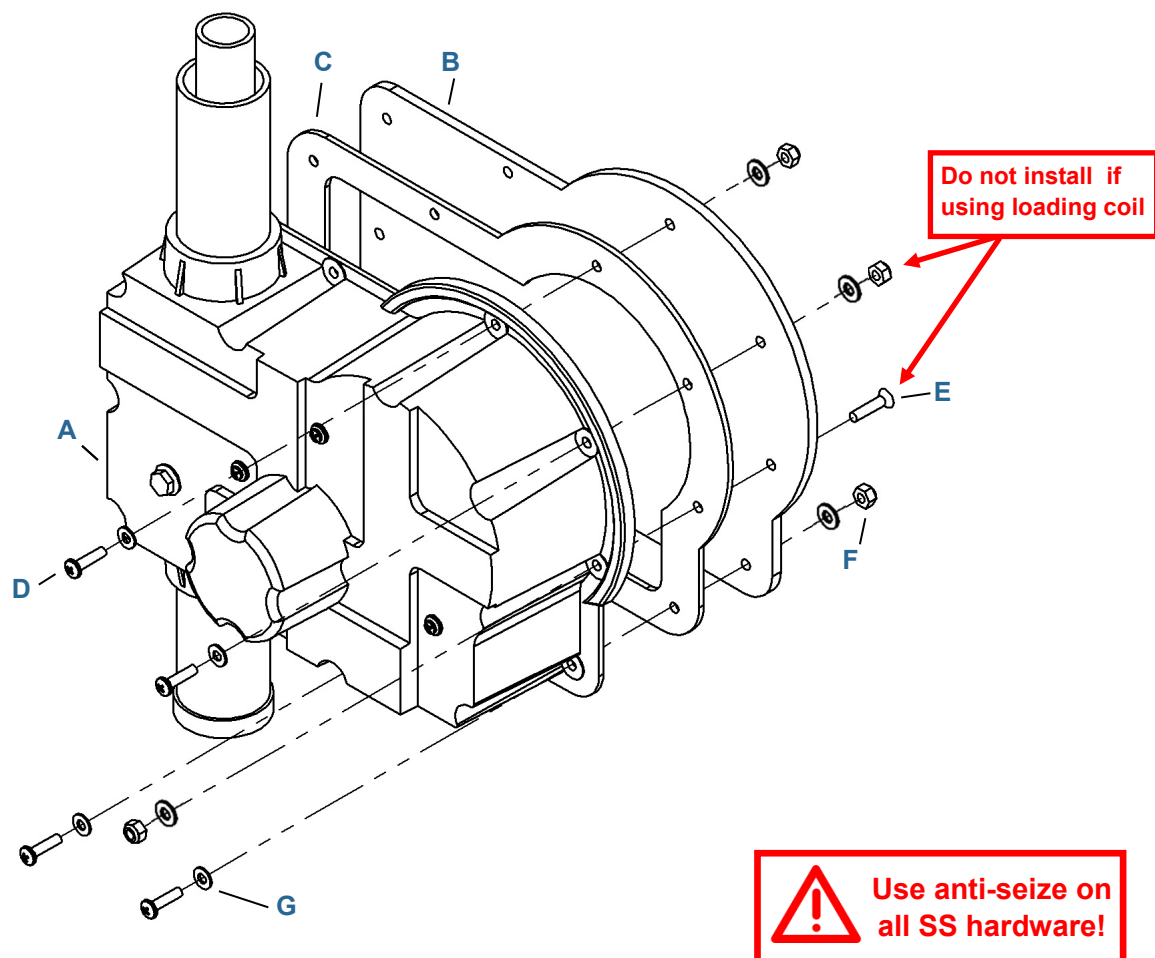


Figure 1.18



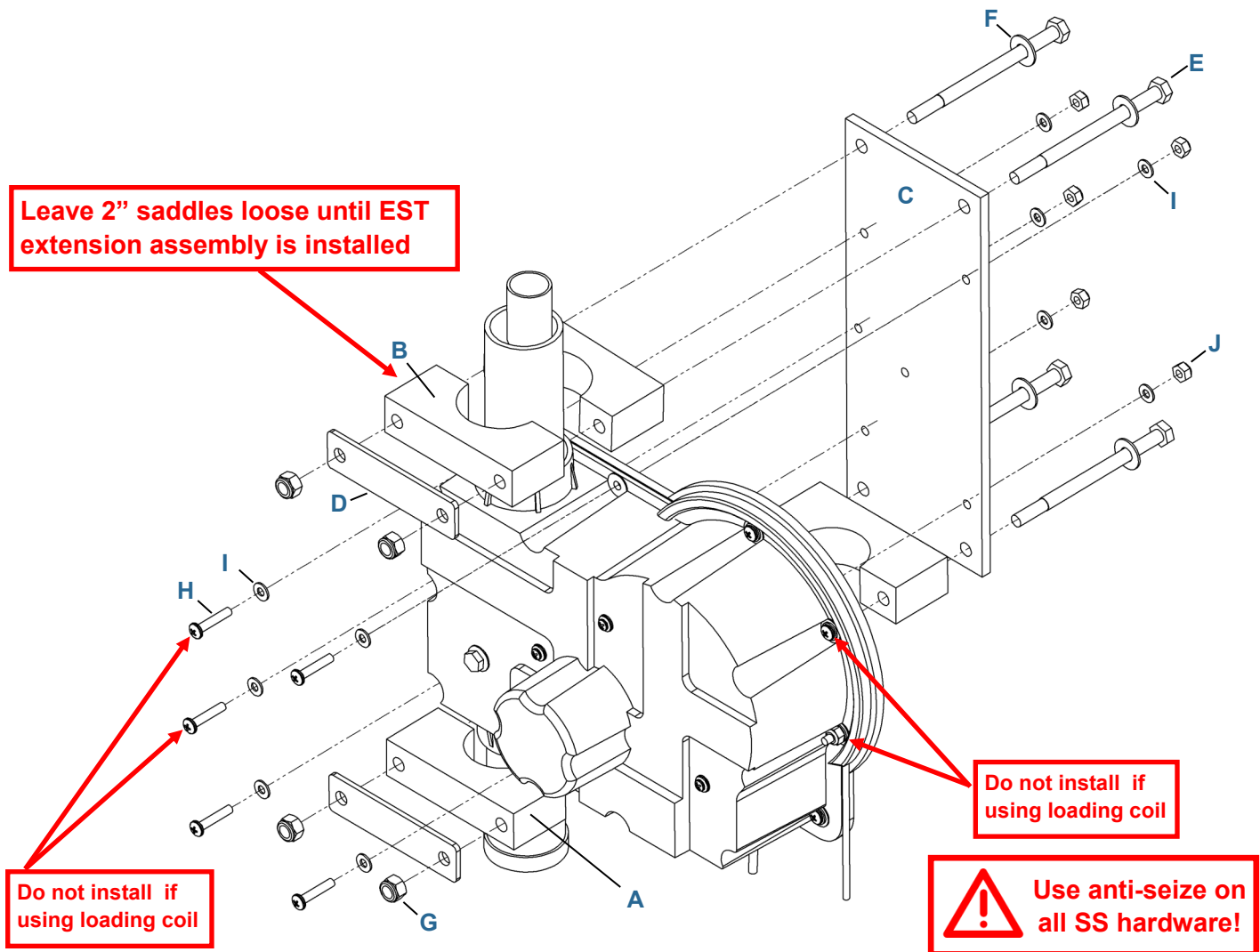
Figure 1.19

Section 1.2: EHU assembly



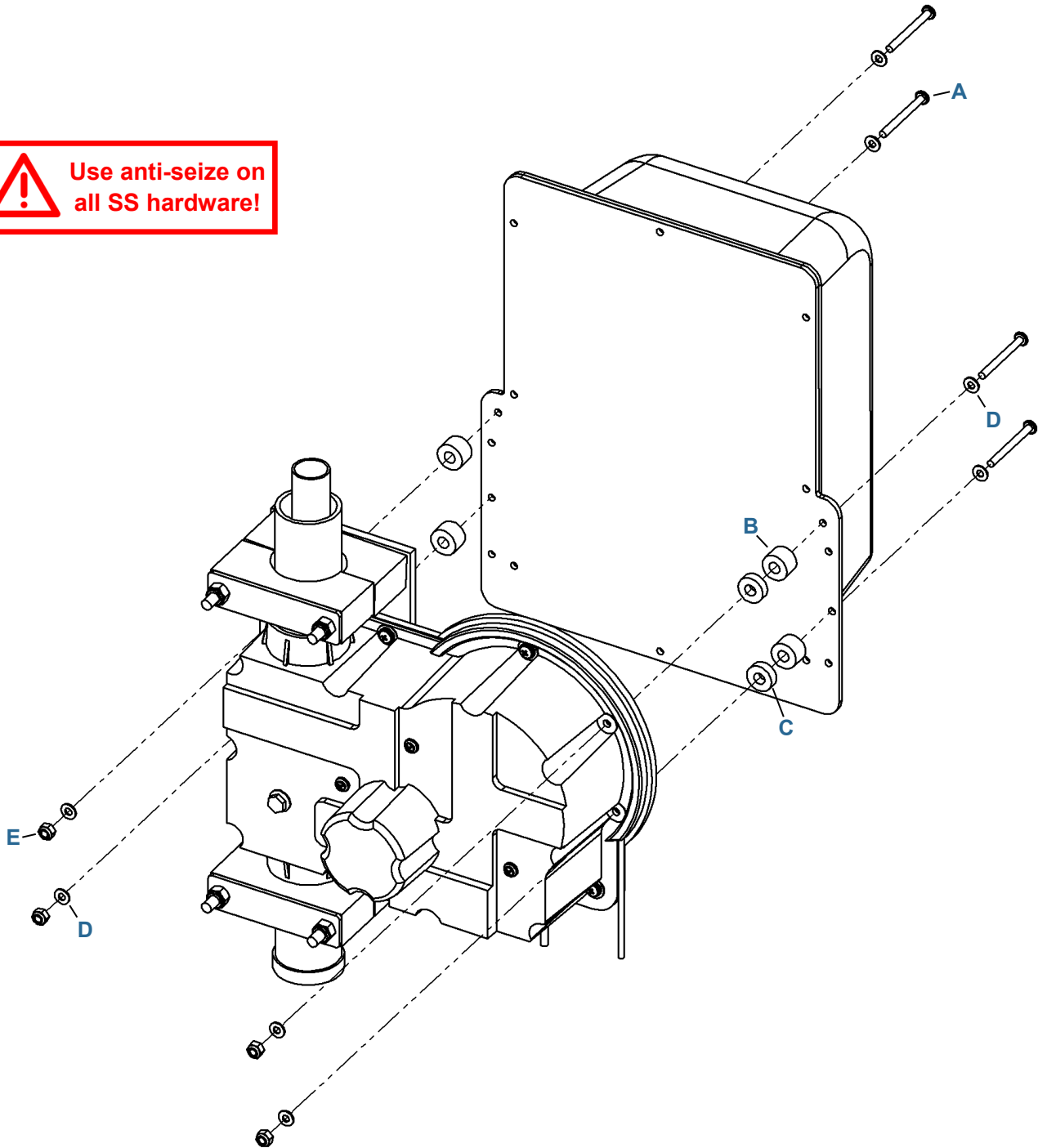
Key	QTY	Part Number	Description
A	1	-	EHU, BigIR (with control cable & coax seal)
B	1	10-1501-22	Cover for EHU, no drain hole
C	1	10-1502-12	EHU Gasket
D	4	60-0017	Pan Screw, 10-32 x 3/4"
E	1	60-0017-10	Flat Head Screw, 10-32
F	5	60-0019	Nut, 10-32, Nylock
G	8	60-0018	Washer, 10-32, Flat

Section 1.3: High wind kit assembly



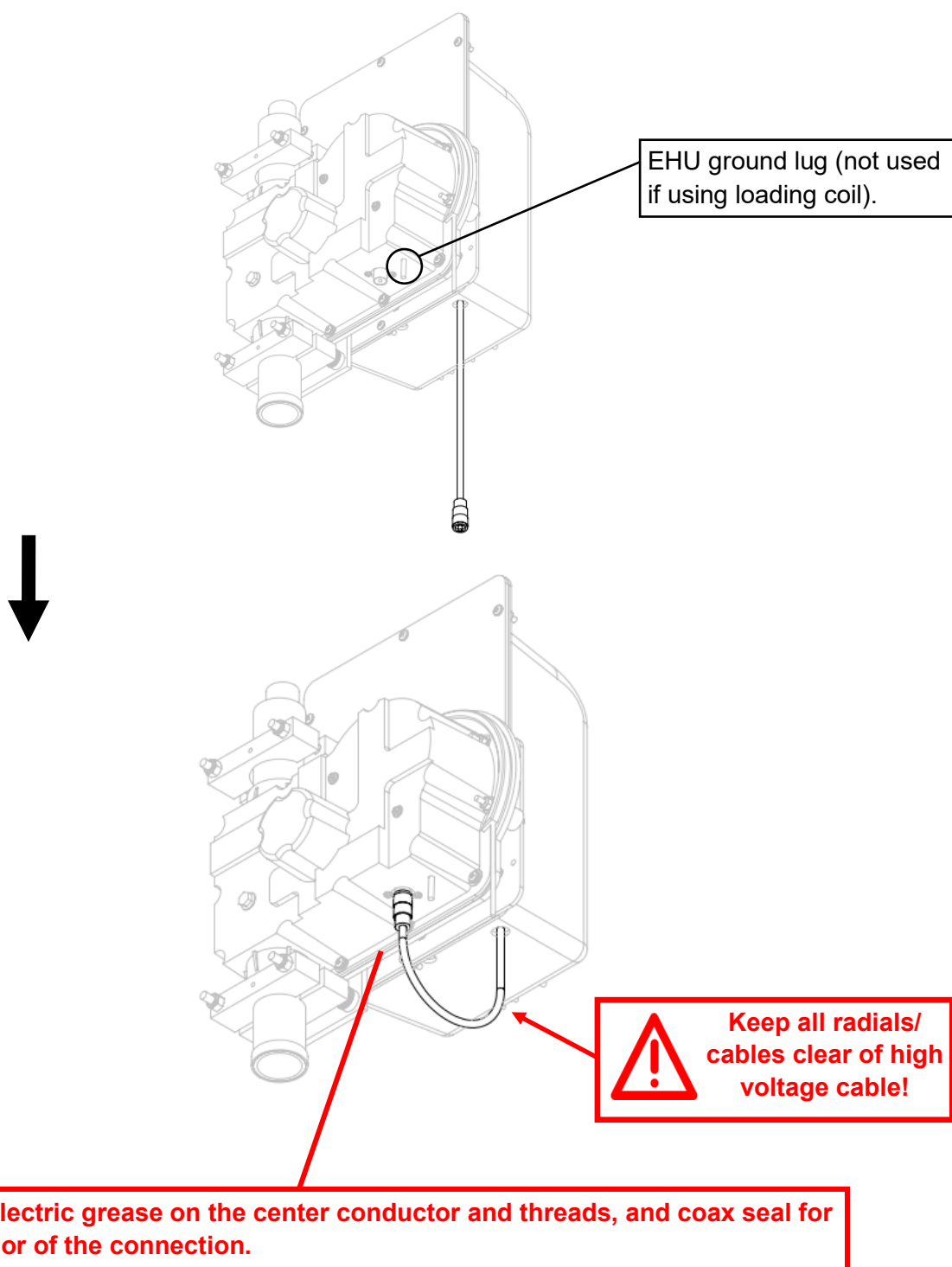
Key	QTY	Part Number	Description
A	2	10-1611-31	Plastic Saddle, 1.75" medium - BigIR/StealthIR
B	2	10-1611-51	Plastic Saddle, 2" - BigIR/StealthIR
C	1	10-1021-54	Reinforcing Plate, for High wind kit EHU
D	2	10-1614-01	Plastic Saddle Reinforcement Plate
E	4	60-0115	Bolt, 5/16" x 4.5", S/S
F	4	60-0033	Washer, 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	8	60-0018	Washer, 10-32, Flat
E	4	60-0019	Nut, 10-32, Nylock

Section 1.3 (continued): Loading Coil Installation (skip if coil is not purchased)



Section 1.4: Loading Coil Wiring (skip if coil is not purchased)

(skip if you have pre-wired cable)

The 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

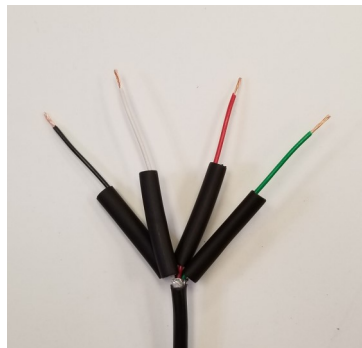


Figure 1.42



Figure 1.43

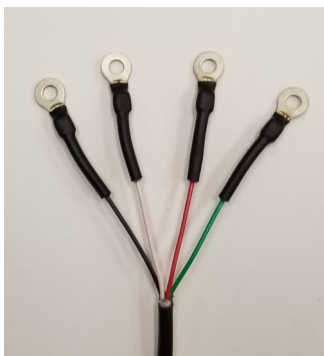


Figure 1.44

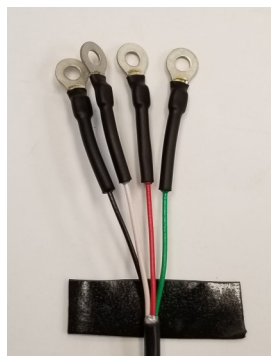


Figure 1.45

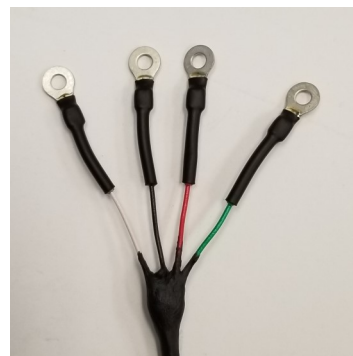
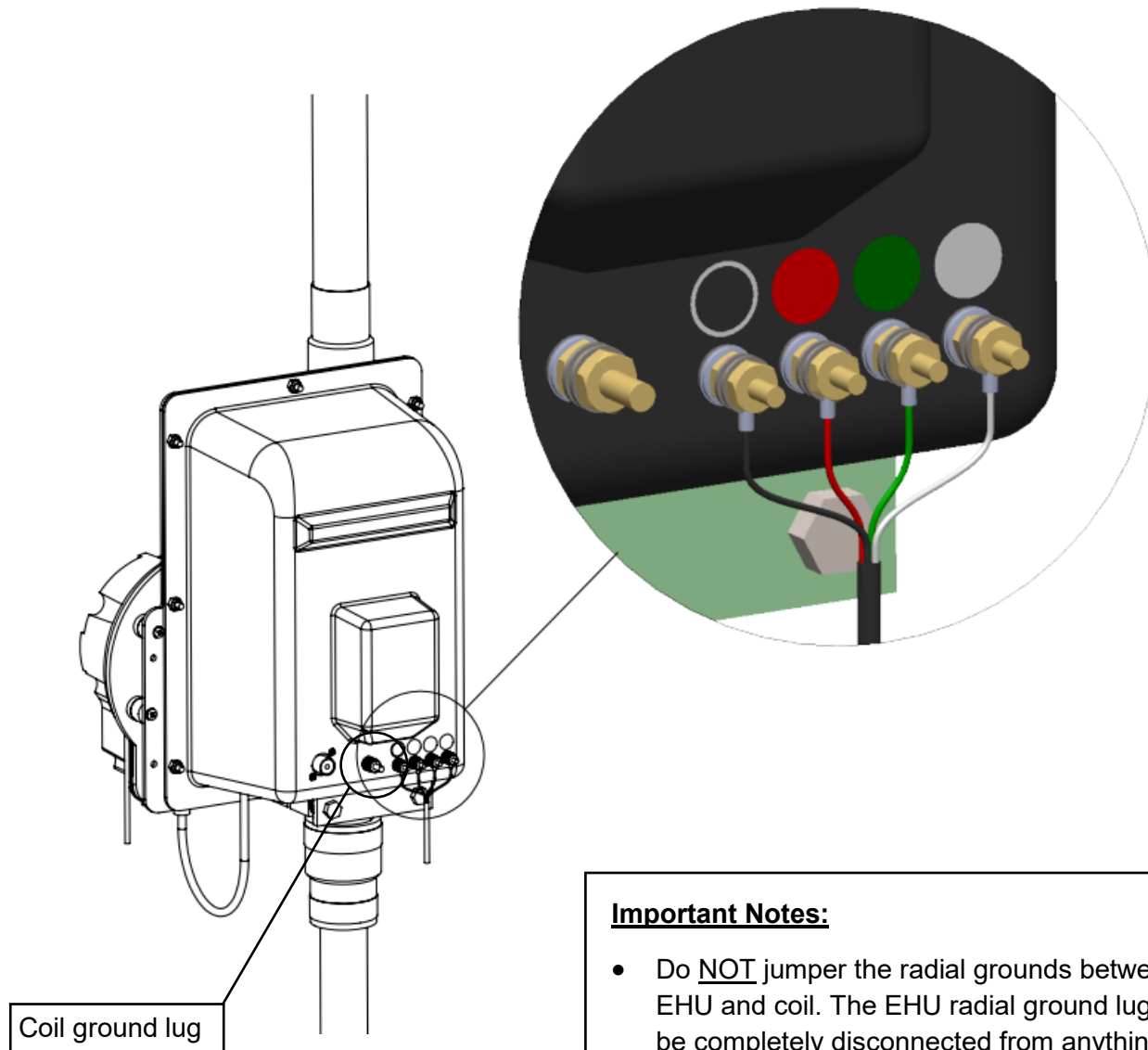


Figure 1.46

Section 1.4 (continued): loading Coil Wiring (skip if 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 1.60**, 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 1.62**. 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 1.62**.
 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.

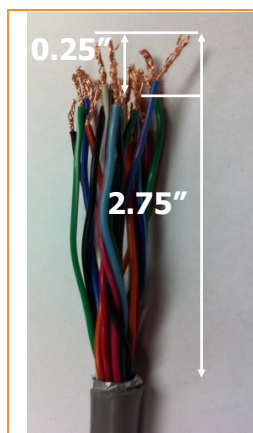


Figure 1.60



Figure 1.61

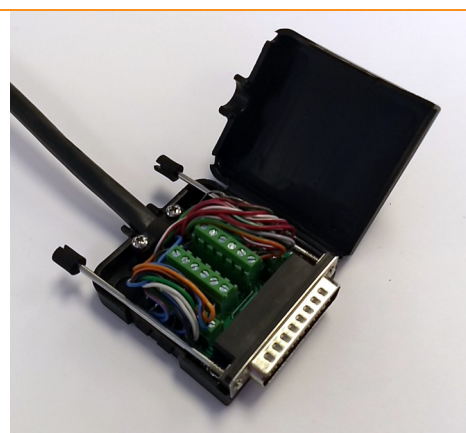
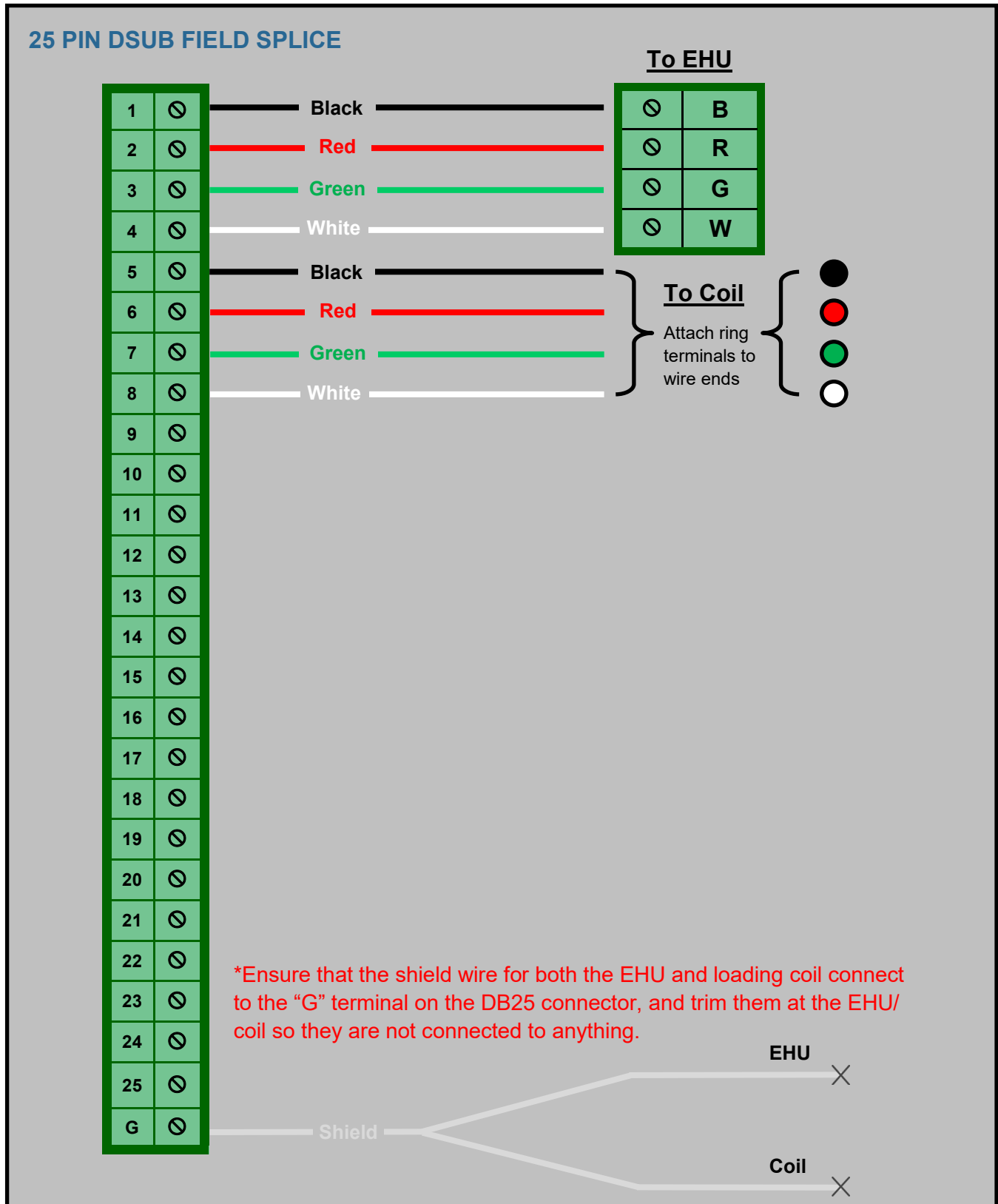


Figure 1.62

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



EHU/COIL WIRING TESTS

Section 2.1: StealthIR Resistance Test (mandatory)

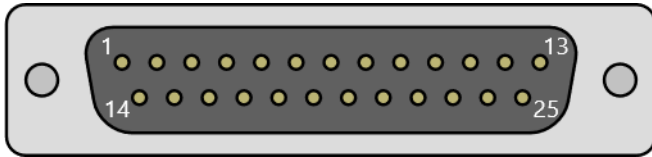


Figure 2.11

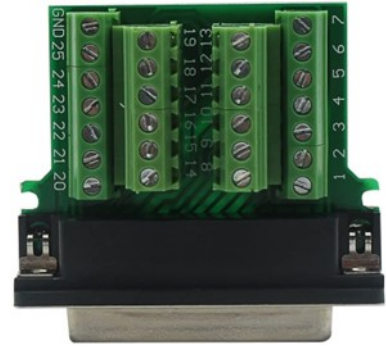


Figure 2.12

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 StealthIR 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	StealthIR EHU	~ 20 Ohms	
3-4		~ 20 Ohms	
5-6	80/60/40/30m Coil	~ 20 Ohms	
7-8		~ 20 Ohms	

Section 2.2: StealthIR 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		
<i>Test Pins</i>	<u>Expected Resistance</u>	<u>Results (Ohms or Open Load (OL))</u>
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)	

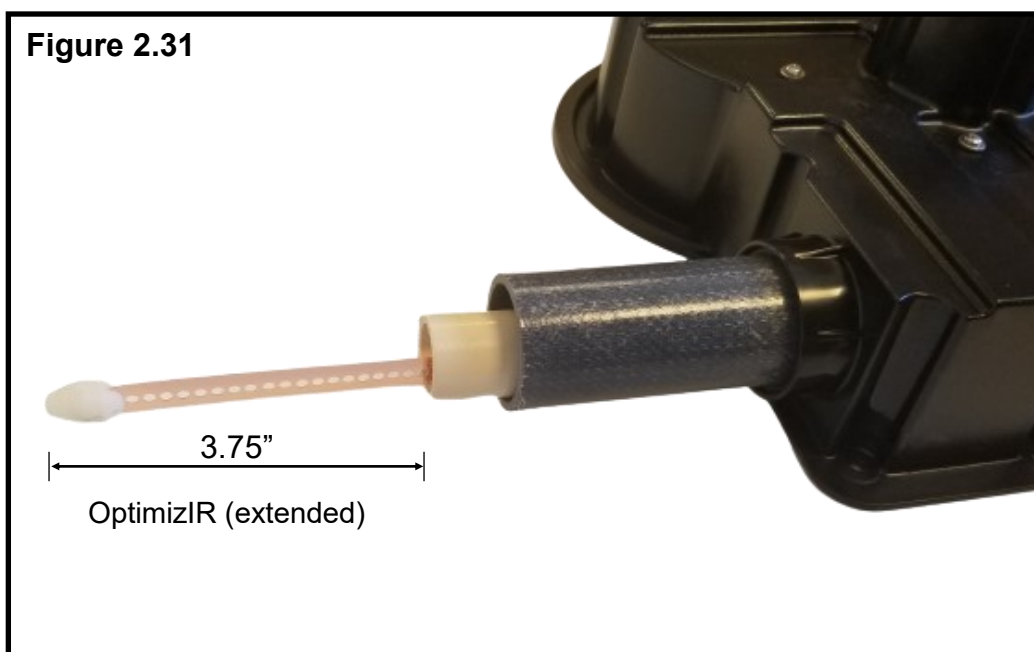
Conclusion

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/Coil 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. 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.
7. At this point you may select “switch” (OptimizIR only) in order to audibly confirm the operation of the loading 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.



PREPARE THE 15' FIBERGLASS POLE

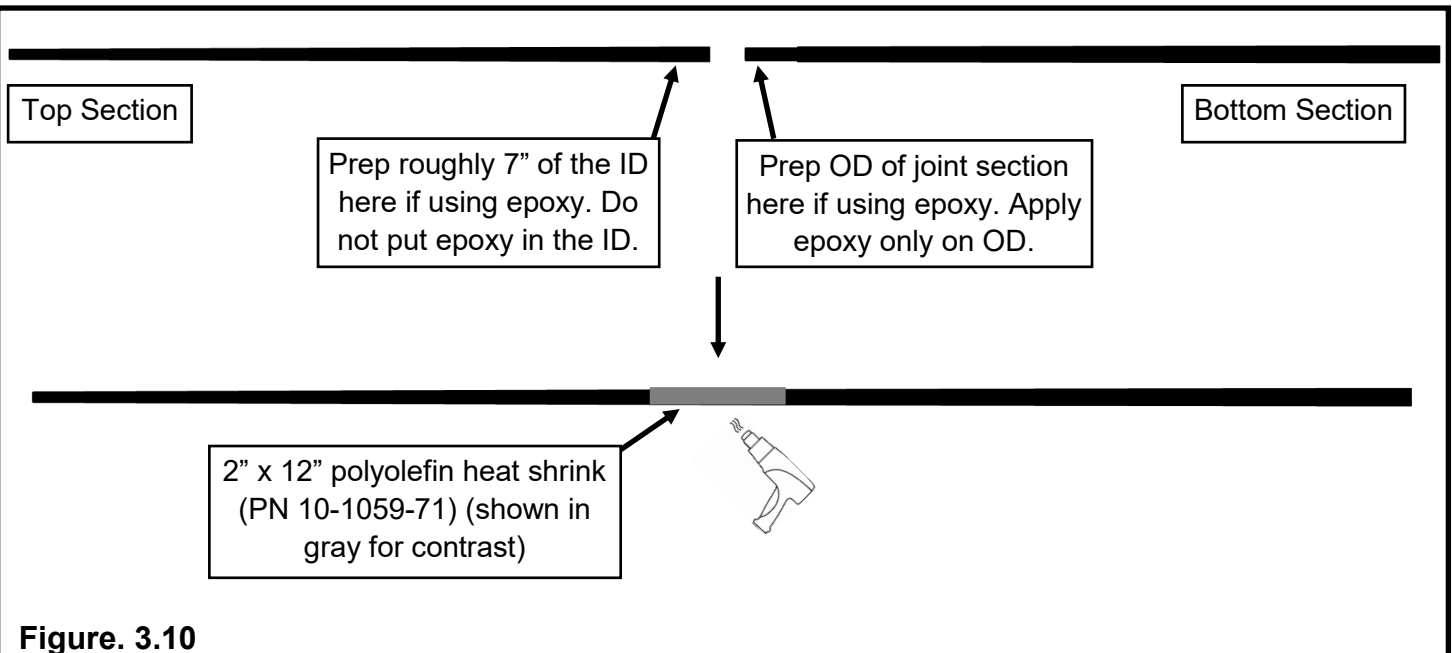
Section 3.1: Connecting the 15' fiberglass pole together



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.



1. The 15' fiberglass pole (PN 10-1013-21) comes in 2 sections and can either be joined with a 2 part epoxy (not included) for a more stealthy look or with the provided 2" OD x 12" adhesive lined polyolefin heat shrink (PN 10-1059-71). If you decide to use epoxy it will not be able to be separated back into 2 pieces down the road for removal/transportation. If you decide to use epoxy be sure to prep the joint with some sand paper and some sort of degreaser (Isopropyl alcohol or Acetone) on both the exterior of the tip of the bottom section and interior of the base of the top section.
2. The fiberglass pole uses one 2" OD x 12" long polyolefin heat shrink piece to secure the 2 sections together. This creates a secure and waterproof seal. This product requires a heat gun for activation of the adhesive.
3. When positioning the heat shrink, place it so that the joint of the 15' pole is centered in the middle of the heat shrink as shown in **figure 3.10**.
4. Using a heat gun (hair dryers will NOT work), apply heat evenly around the entire circumference of the heat shrink, we recommend starting at one end (length wise) and working your way to the opposite side. The joint is considered done being heated and waterproof when the heat shrink has fully shrunk against the pole and a small amount of adhesive is oozing out of the ends as shown in **figure 3.11**.
5. The heat shrink may 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!**

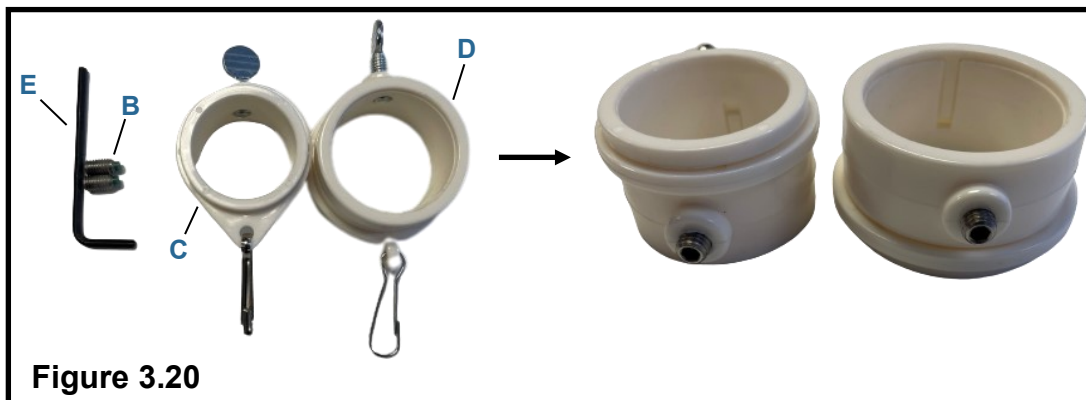


Section 3.2: Install the flag mounting rings and vinyl cap

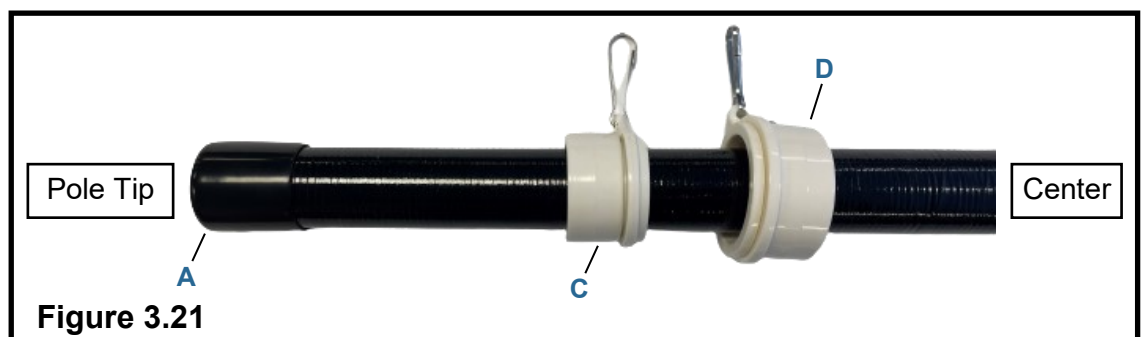
- Each fiberglass pole requires a vinyl cap (A) to protect from water ingress, 2 different flagpole mounting rings (C&D), and 2 nylon tipped set screws (B) to be installed before mounting the flag.
- The fit of the vinyl cap on the pole tip is purposely very tight, so that the cap will stay in place. Before attaching the cap, you may spread a small amount of dish soap around the inside edge of the cap. This helps the cap slide on easily, and the soap will eventually evaporate, leaving you with a firm interference fit.

Key	QTY	Part Number	Description
A	1	60-0044-41	Vinyl Cap, 1-1/16" to 1-1/8" OD x 1.5" long, Black StealthIR
B	2	60-0191	Nylon Tip S/S Set Screw, M6 x 1mm Thread, 10mm long
C	1	60-0192-01	Plastic Flagpole Mounting Ring, Anti Wrap, 1.25"
D	1	60-0192-11	Plastic Flagpole Mounting Ring, Anti Wrap, 1.5"
E	1	60-9001	Allen Key, 3mm
F	5 wraps	09-0001	Electrical tape 3/4" PVC MERCO 307

1. Remove the metal thumbscrews from the flagpole mounting rings (you may discard these) and replace them with the nylon tipped set screws (B) as shown in **figure 3.20**. This is so that the pole does not get marred up when installing the flagpole mounting rings.



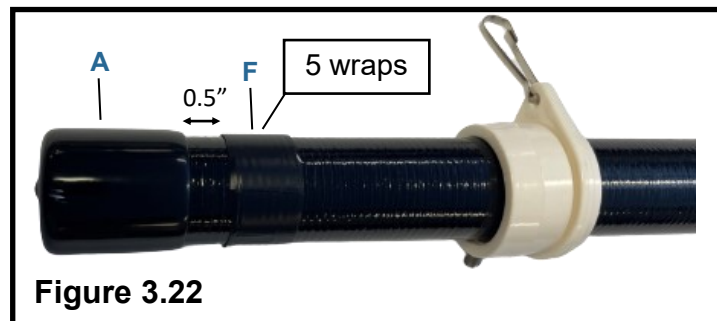
2. First slip the 1.5" flagpole mounting ring (D) onto the pole with the rotating ring closer to the tip of the top section, then the 1.25" flagpole mounting ring (C) with the rotating ring closer to the center, then install the vinyl cap (A) onto the tip of the pole as shown in **figure 3.21**.



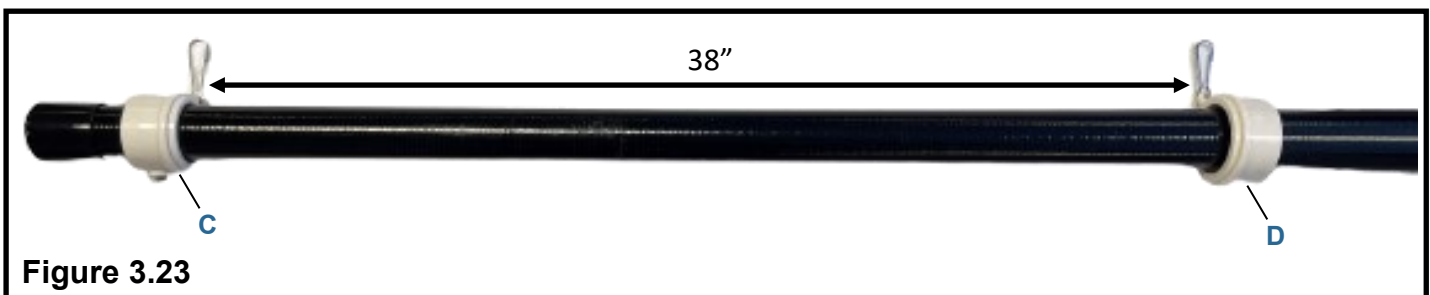
Section 3.2: Install the flag mounting rings and vinyl cap cont.

Key	QTY	Part Number	Description
A	1	60-0044-41	Vinyl Cap, 1-1/16" to 1-1/8" OD x 1.5" long, Black StealthIR
B	2	60-0191	Nylon Tip S/S Set Screw, M6 x 1mm Thread, 10mm long
C	1	60-0192-01	Plastic Flagpole Mounting Ring, Anti Wrap, 1.25"
D	1	60-0192-11	Plastic Flagpole Mounting Ring, Anti Wrap, 1.5"
E	1	60-9001	Allen Key, 3mm
F	5 wraps	09-0001	Electrical tape 3/4" PVC MERCO 307

3. Place 5 wraps of electrical tape (F) near the base of the vinyl cap (A) roughly 0.5" below as shown in **figure 3.22** so that the top ring does not oval (this will prevent the ring from turning freely) when tightened down onto the pole.



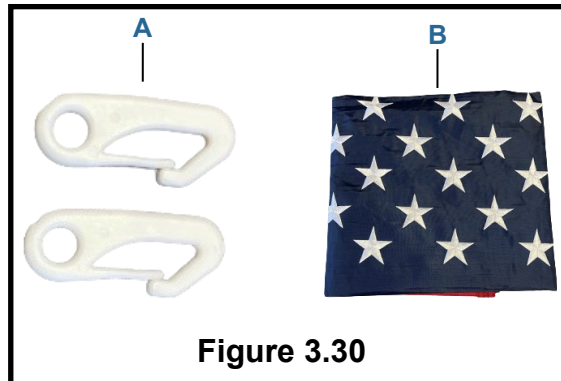
4. Place the 1.25" flagpole mounting ring (C) over the electrical tape (F) and tighten down the nylon tipped set screw (B) with the 3mm Allen Key (E) until the flagpole mounting ring is securely on the pole. **DO NOT OVER TIGHTEN OR YOU WILL STRIP THE PLASTIC THREADS OR OVAL THE PART.** Move the 1.5" flagpole mounting ring (D) so that it is about 38" away from the 1.25" flagpole mounting ring (C), tighten in the same manner as the first mounting ring. See **figure 3.23** below.



Section 3.3: Install the flag clips and flag

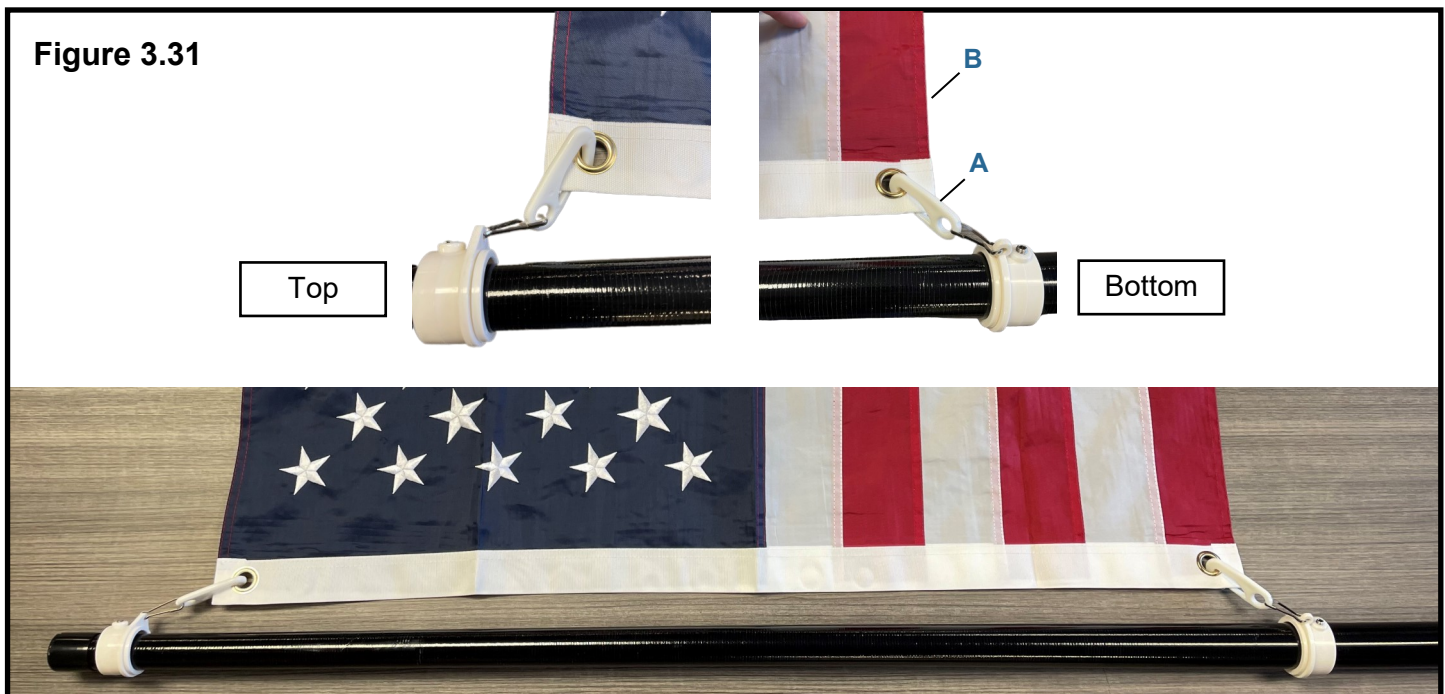
- Once the vinyl cap and flag mounting rings are installed, it is time to install the flag clips (A) and optional flag (B) (shown in **figure 3.30**). If you did not purchase the optional flag you may install a 3'x5' flag of your choice.

Key	QTY	Part Number	Description
A	2	60-0193	Flagpole Flag Clip, Nylon
B	1	60-0194	Optional: American Flag, 3' x 5', All Weather Outdoor



- Install the flag clips (A) onto the flag's (B) eyelets as shown below in **figure 3.31**. You will need to "work" the flag into the clips so that it is fully held within the clip. Once the flag clips are installed onto the flag you may connect the small metal clip on the flagpole mounting rings to the nylon flag clips hole.
- Once completed verify that the flag will turn freely on the flagpole mounting rings. You may either move it by hand or swing it around in the air to test this. If the flag does not move freely you may need to adjust the distance between the flagpole mounting rings (give more slack). If one of the flagpole mounting rings is not moving freely it may be due to overtightening of the nylon tipped setscrew (ovaling of the ring).

Figure 3.31



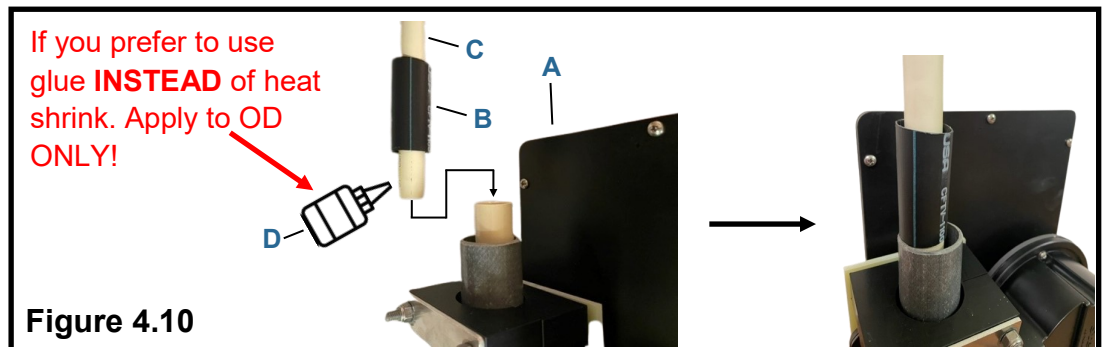
CPVC/EST EXTENSION/ARCHITECTURAL ROCK/MOUNTING

Section 4.1: Installing the CPVC onto the EHU/Coil assembly

- There are multiple different ways to go about mounting the StealthIR antenna, this section will follow the method that SteppIR believes is easiest for the customer (it will require a helper) while also being discrete for HOA installs.
- The CPVC liner can either be installed 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)**. There is no need for the heat shrink if you use the CPVC glue.

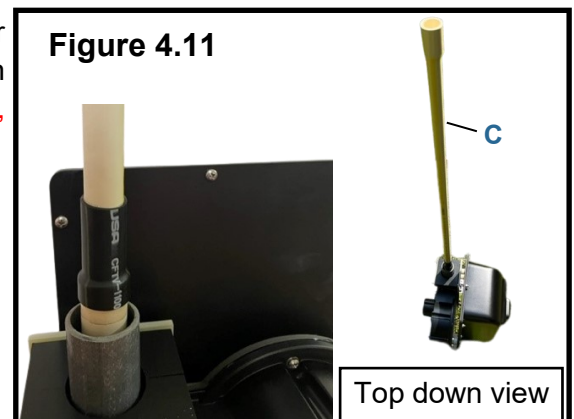
Key	QTY	Part Number	Description
A	1	-	StealthIR EHU/Coil assembly
B	1	10-1059-51	Polyolefin Heat Shrink 1.1" x 3"
C	1	70-2023-01	CPVC Liner for StealthIR, 31" x 3/4", with coupler
D	1	72-0009-03	Kit, Glue (If you don't use heat shrink)

- As shown in **figure 4.10**, slip one piece of 1.1" x 3" polyolefin heat shrink (B) over the 31" long CPVC w/ coupler (C), insert the 31" CPVC end without coupler into the coupler sticking out of the StealthIR EHU (twisting while inserting) until it bottoms out, place the heat shrink over the EHU's CPVC coupler and 31" CPVC joint.



- Using a heat gun (hair dryers will NOT work) apply heat evenly to shrink the 1.1" x 3" heat shrink over the coupler joint so that it secures the 31" CPVC to the coupler sticking out of the EHU. The joint is considered done being heated and waterproof when the blue lines on the heat shrink turn yellowish-green. Each line needs to change color to ensure even adhesion temperatures. The finished result is shown in **figure 4.11**.

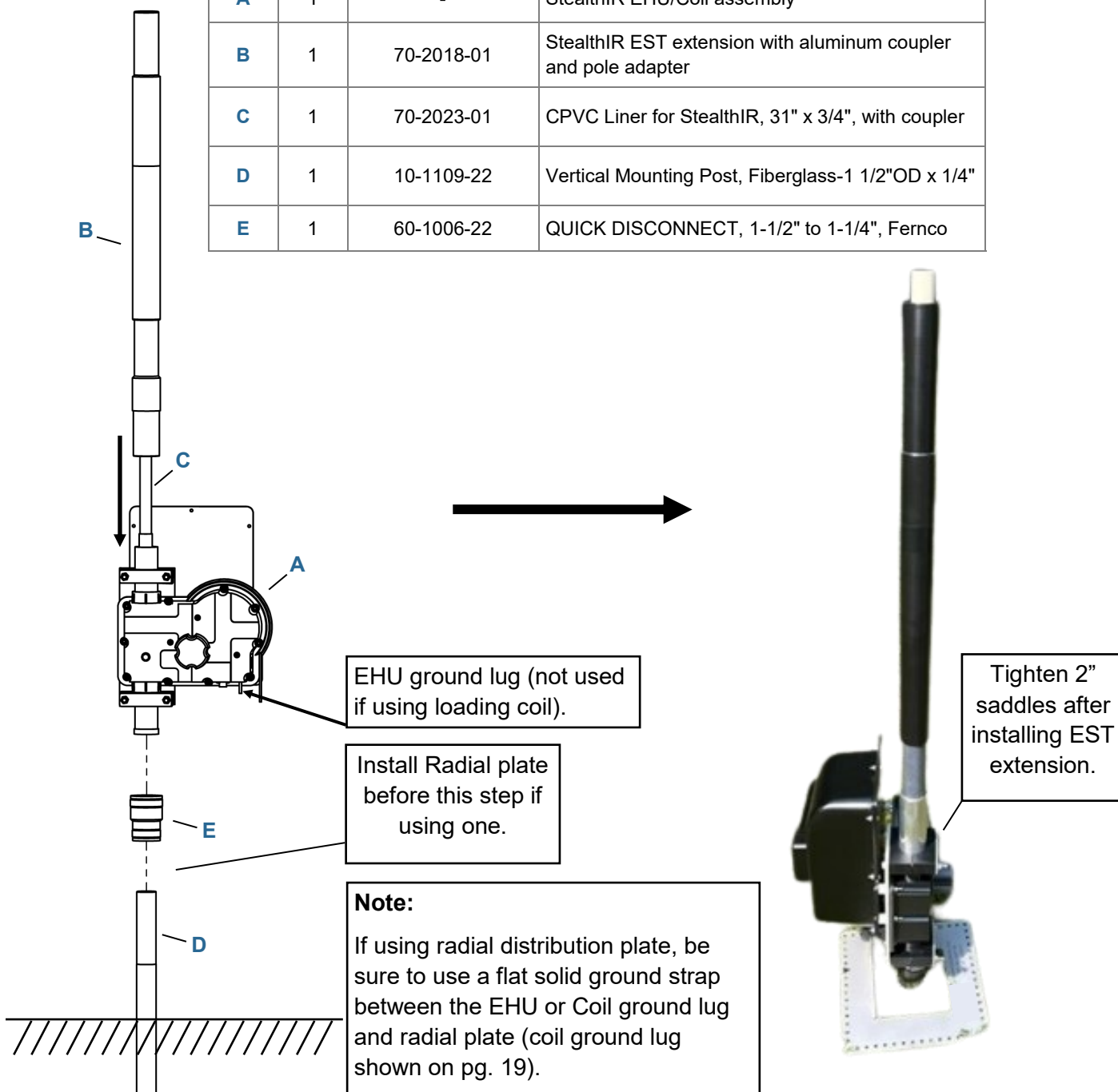
- The heat shrink may want to slide as it is heated so wear gloves and reposition the heat shrink to keep it centered on the joint as needed. **Caution: The heat shrink will be HOT, wear insulated gloves!**



Section 4.2: Installing the EST extension & mounting onto vertical post.

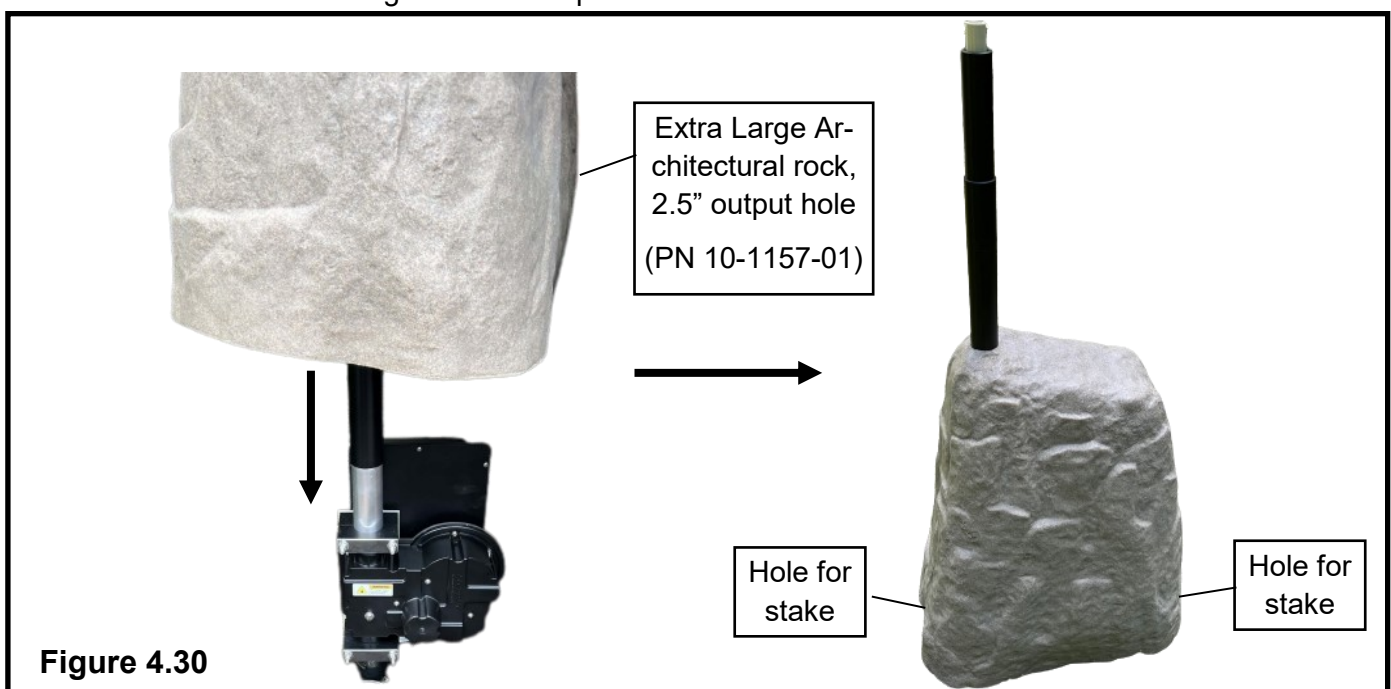
- In this section you will be installing the StealthIR EST extension and mounting the StealthIR EHU/Coil assembly onto the mounting post. **If using a radial plate, place it over the mounting post before installing the EHU/Coil assembly.**
- Use the architectural rock to block the view of this step from neighbors for a stealthy install.
- Verify the 2" plastic saddles are sufficiently loose before installing the EST extension.

Key	QTY	Part Number	Description
A	1	-	StealthIR EHU/Coil assembly
B	1	70-2018-01	StealthIR EST extension with aluminum coupler and pole adapter
C	1	70-2023-01	CPVC Liner for StealthIR, 31" x 3/4", with coupler
D	1	10-1109-22	Vertical Mounting Post, Fiberglass-1 1/2"OD x 1/4"
E	1	60-1006-22	QUICK DISCONNECT, 1-1/2" to 1-1/4", Fernco



Section 4.3: Installing the architectural rock

- In this section you will be installing the architectural rock (PN 10-1157-01) over the StealthIR EHU/Coil/EST extension assembly.
- **There are 2 small stakes that are included with the rock, these are taped to the inside of the rock during shipping.** You will use these to pin the rock in place after installation. There is a small hole at the base of the rock on each side which is shown in **figure 4.30**.
- If using a radial plate be sure to position it so that it is fully covered by the rock.
- In order to rotate the rock for aesthetic reasons you will need to loosen up the hose clamps on the Fernco boot that secures the EHU/Coil assembly to the vertical mounting post and rotate the EHU/Coil assembly. Be sure to tighten the hose clamps back up once the rock/antenna is positioned correctly.
- Once you have verified that the rock will fully cover the radial plate and your rock position is acceptable, it is best to **lay out your radial/counterpoise system before installing the architectural rock**. A minimum of 16qty radials at 0.1wl at the lowest frequency of operation is recommended. See pg. 34-35 for more details on ground mounted radials.
- Before installing the rock you need to connect your coax feed line to the antenna system. **If using the coil both the ground strap/radials and coax should be connected to your coil. If you are not using the coil then both the ground strap/radials and coax should be connected to the EHU.**
- **If using the coil be sure that nothing is near the high voltage jumper cable. You should have at least 1-2" of space between the high voltage jumper cable and anything else (radial plate, control cable, ground strap, etc). Failure to do so may result in arcing from the high voltage jumper cable to other items which will cause failure of the antenna system.**
- There is a 2.5" hole that has been drilled into the architectural rock which is the output hole for the StealthIR EST extension. Slip the rock over the EHU/Coil assembly by lining up the output hole to the EST Extension and lowering the rock into place.



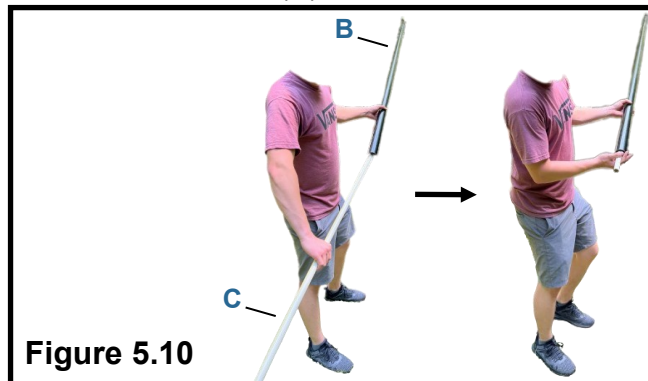
INSTALLING THE 15' FIBERGLASS POLE

Section 5.1: Installing the 15' fiberglass pole

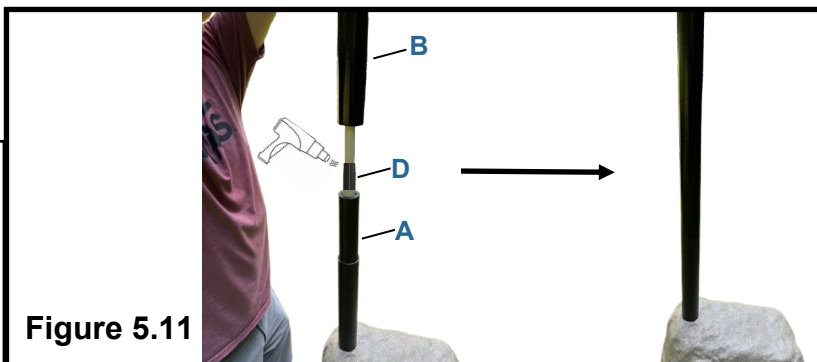
- In this section you will complete the final assembly of your StealthIR antenna system by installing the 15' fiberglass pole onto the EST extension.
- This part of the installation does require a helper. One person will need to hold the 15' fiberglass pole above the EST extension as the other installs the CPVC liner.

Key	QTY	Part Number	Description
A	1	-	StealthIR EHU/Coil/CPVC/EST extension assembly
B	1	-	15' fiberglass pole assembly
C	1	70-2023-11	CPVC Liner for StealthIR, 86" x 3/4", w/o coupler
D	1	10-1059-51	Polyolefin Heat Shrink 1.1" x 3"
E	1	10-1059-61	Polyolefin Heat Shrink 2" x 18"

1. Insert the 86" CPVC liner (C) into the base of the 15' fiberglass pole assembly (B) as shown in **figure 5.10**. Slip the 2" x 18" polyolefin heat shrink (E) over the base of the 15' fiberglass pole assembly (A) and the 1.1" x 3" polyolefin heat shrink (D) over the 86" cpvc liner (C).



2. Have a helper hold the CPVC/15' fiberglass pole above the EST extension. Insert the 86" CPVC liner (C) into the CPVC coupler that is sticking out of the EST extension (twisting while inserting) until it bottoms out. Place the 1.1" x 3" polyolefin heat shrink (D) over the CPVC coupler and 86" CPVC liner (C) joint as shown in **figure 5.11**. Shrink the 1.1" x 3" polyolefin heat shrink over the joint as done in **section 4.1**. You may now lower the 15' fiberglass pole onto the EST extension.



Note:

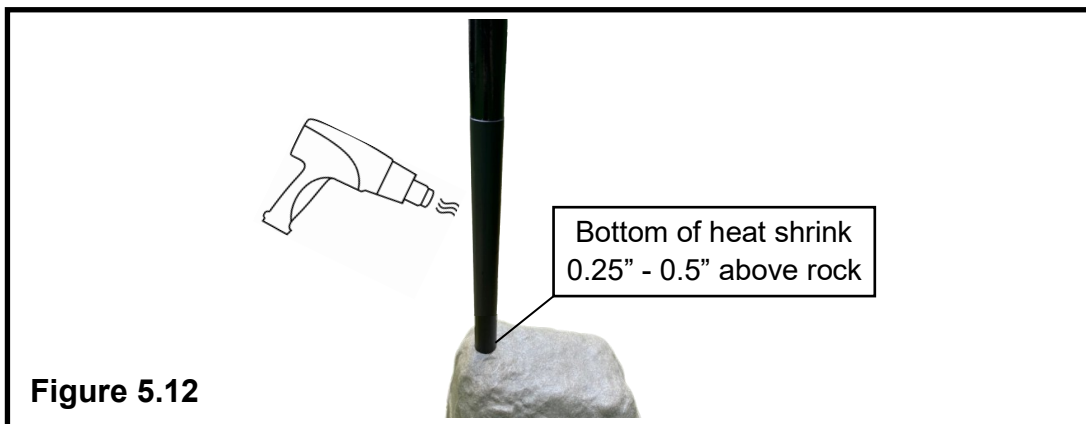
You may use the CPVC glue at this step if you prefer **instead** of the heat shrink.

Section 5.1: Installing the 15' fiberglass pole cont.

Key	QTY	Part Number	Description
A	1	-	StealthIR EHU/Coil/CPVC/EST extension assembly
B	1	-	15' fiberglass pole assembly
E	1	10-1059-61	Polyolefin Heat Shrink 2" x 18"

3. Place the 2" x 18" polyolefin heat shrink (E) over the 15' fiberglass pole (B) and EST extension (A) joint, lower the heat shrink so that the bottom of the heat shrink is about 0.25"-0.5" above the architectural rock.

4. Using a heat gun (hair dryers will NOT work), apply heat evenly around the entire circumference of the heat shrink, we recommend starting at the base and working your way up. The joint is considered done being heated and waterproof when the heat shrink has fully shrunk against the pole and a small amount of adhesive is oozing out of the ends as shown in **figure 5.12**. **Be careful not to melt the architectural rock!**



- You have now completed your StealthIR installation! You will now need to tune the antenna on all of the controller's segments before applying power to the antenna system (see pg. 39-40).



COUNTERPOISE/RADIAL SYSTEM OVERVIEW

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

- The radials are non-resonant so one length (.1wl minimum at lowest frequency) works on all frequencies
- Easy to mount
- Easy access
- Lower visual profile
- Sixteen 0.1 wl (wavelength) radials of lowest intended frequency give 65-70% efficiency

CONS

- Takes 120 radials to equal an elevated vertical with 2 resonant radials (90% efficient)
- Surrounding objects can reduce signal strength

IF YOU ARE USING A RADIAL PLATE DO NOT USE THE COAX PASS THROUGH ON THE PLATE. BE SURE THAT THE RADIAL PLATE IS FULLY COVERED BY THE ARCHITECTURAL ROCK ONCE THE ANTENNA IS INSTALLED BEFORE SECURING THE PLATE TO THE GROUND. SECURE THE RADIAL PLATE IN PLACE BEFORE LAYING OUT RADIALS.

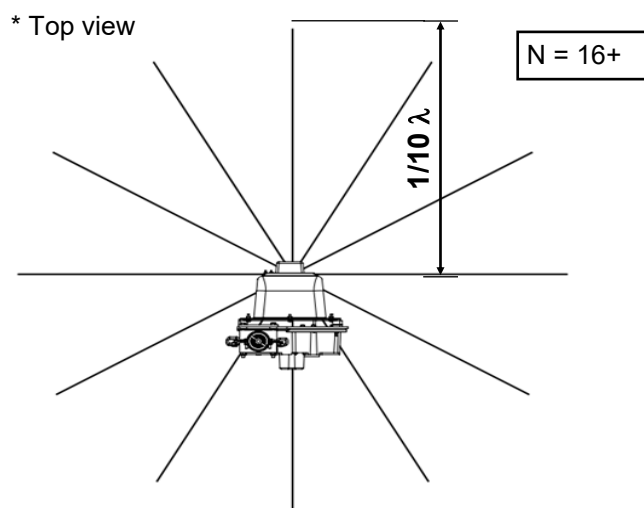


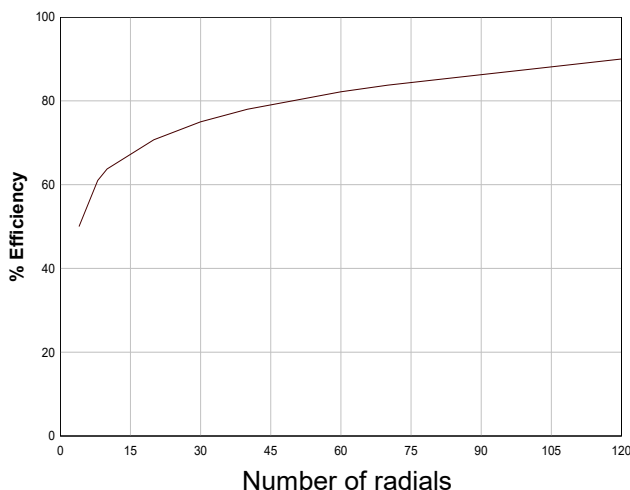
Figure 6.2: Ground radials

Ground Mounting:

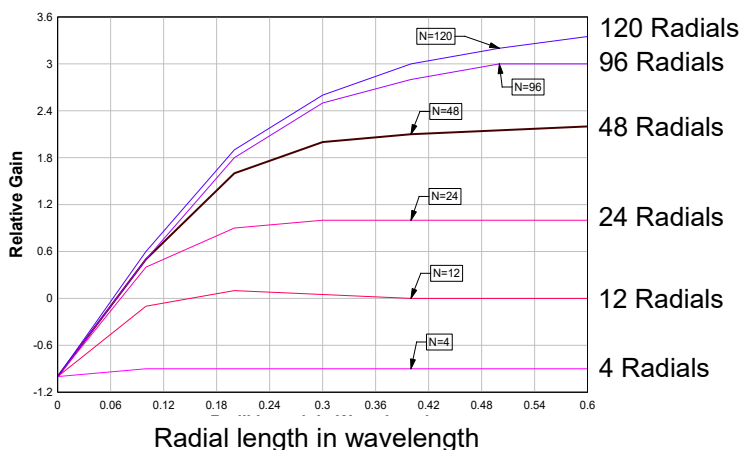
If you choose to ground mount the vertical, pick a spot that will allow you the best chance of spreading your radials evenly around the antenna, and away from trees and other objects if possible. You will need to determine how much effort and wire you are willing to invest in this installation. The tradeoffs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

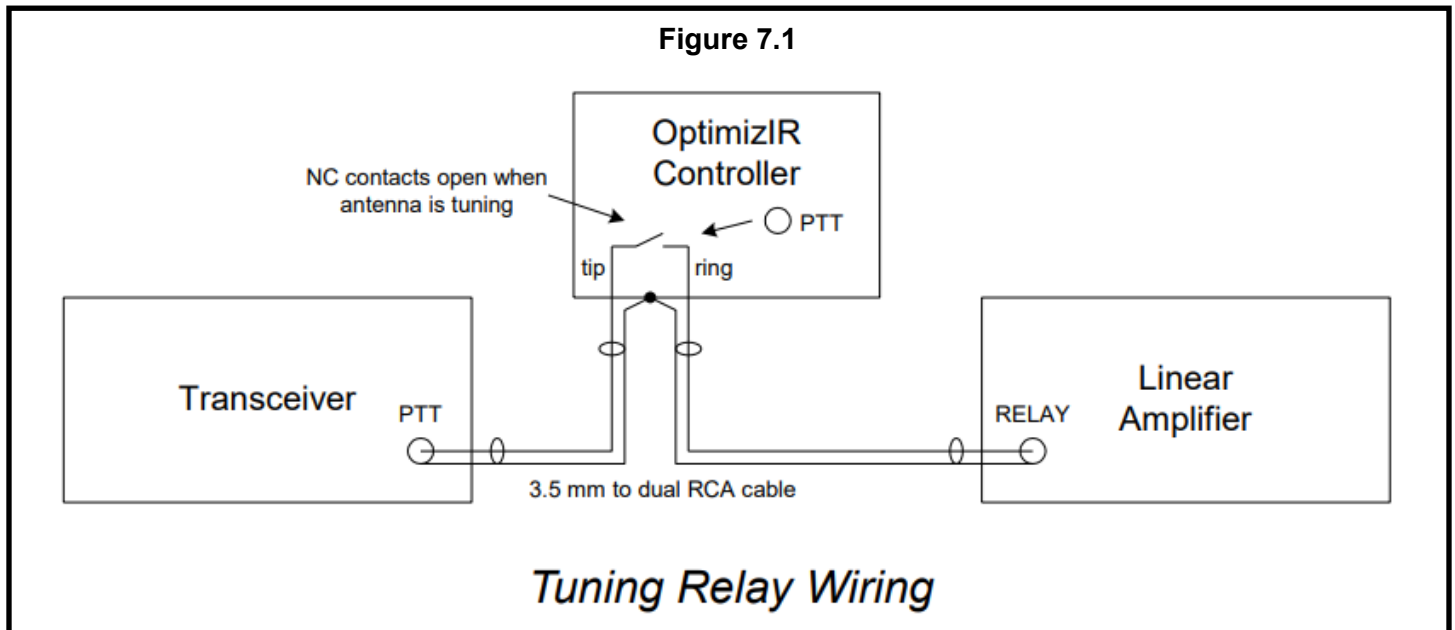


For more detailed information on ground mounted and elevated mounted radial setups, please read our complete white paper on radials:

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.

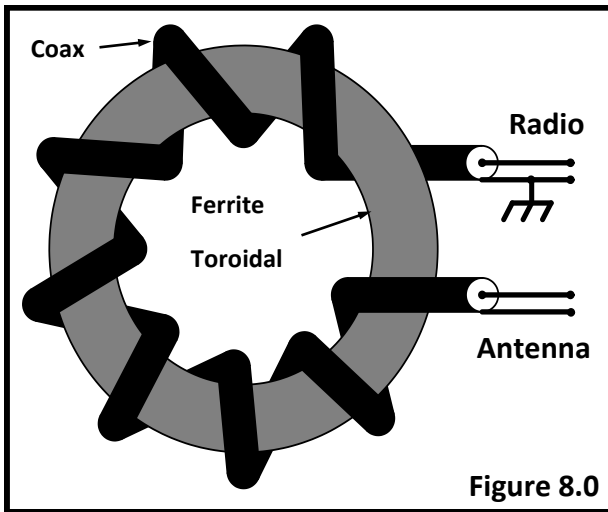


OPTIONAL 1:1 BALUN

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.

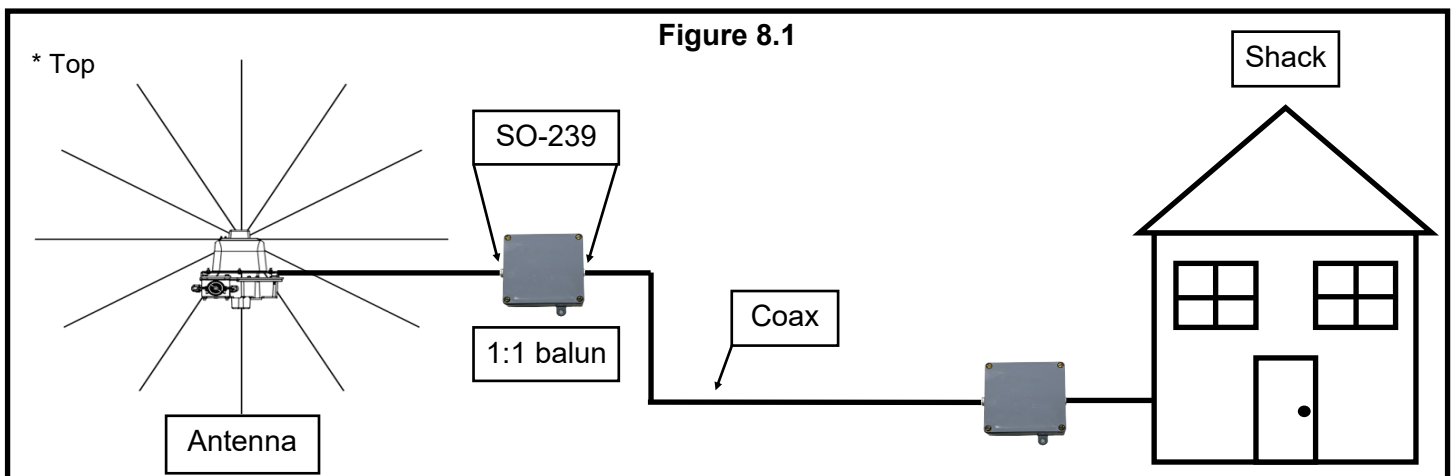


When Should You Use A Balun ?:

- 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**.



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

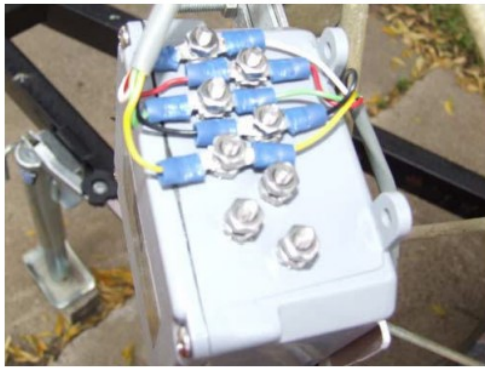


Figure 9.2



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 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 "Yes" to save your changes.
- Adjusting the coil tap position is 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 page are lists of the segments, segment frequencies, and recommended tune frequencies for the StealthIR on the OptimizIR controller.

OptimizIR recommended tuning frequencies

Segment #	Frequency (KHz)	Recommended Tune Frequency (KHz)	Untuned SWR	SWR Minimum Frequency	Tuned SWR
22	51000	52500			
21	49500	50500			
20	41000	41000			
19	34500	34500			
18	29000	29350			
17	27500	28500			
16	24600	24940			
15	20800	21225			
14	17850	18120			
13	15800	15800			
12	13850	14175			
11	11300	11300			
10	10000	10125			
9	8850	8850			
8	7850	7850			
7	6950	7150			
6	5200	5250			
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 and our Tech Support Video section on our website 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

Tech Support Videos:

<https://consumer.steppir.com/support/tech-support-videos/>

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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 repairs. This can be obtained at www.steppir.com/RMA. Shipping instructions will be issued to the buyer for defective components, and shipping charges to the factory will be paid for by the buyer. SteppIR will pay for standard shipping back to the buyer if the repair falls under warranty. The manufacturer assumes no further liability beyond repair or replacement of the product.

Modification of this product is not authorized and may cause product failure, injury or death.