

SeaSonde®

Long Range Transmit Antenna Installation Guide



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Introduction

This guide describes how to install a CODAR Long Range SeaSonde® transmit antenna.

The following chapters include:

Preparation

Site planning, parts inventory, parts inspection, pre-installation assembly.

Installation

On-site assembly and installation.

Checklists

Parts inventory and tools checklists.

Drawings

Drawings and plans for mounting bases and bolt hole patterns.

Preparation

In this section:

- Site Planning
- Inventory
- Inspection
- Tuning Coil Jumper Strap
- Ready to Go

Site Planning

Summary procedure:

- Plan antenna location with respect to receive antenna and other vertical structures.
- Plan cable routes between SeaSonde transmitter and transmit antenna.
- Plan antenna support.
- Plan for protection against animal damage.
- Plan to protect area around antenna.

The long-range transmit antenna should be located at least one transmit signal wavelength away from the receive antenna and other vertical metal structures, for example, fence posts and light poles. If possible, the antenna should also be at least the same distance away from large trees, buildings and other structures.

The wavelength depends on the operating frequency and ranges from 56 m (at 5.4 MHz) to 70 m (at 4.3 MHz). Use this equation to estimate the wavelength:

$$\text{wavelength (meters)} = 300 / \text{frequency (MHz)}$$

Or use this table: [OK? Can it be improved by providing other commonly used frequencies?]

Frequency (MHz)	4.4	4.6	4.8	5.0	5.2	5.4
Wavelength (m)	69	66	63	61	58	56

Ensure that the cable can reach the transmitter. The standard long-range transmit antenna cable is 75 meters long. Three to five loops will be made in the cable during installation, reducing its length by three to five meters. Account for any other reductions in length imposed by the cable route. [If I did my trig right, the angle between the Tx and Rx cables must be at least 45 degrees to separate the antennas by 70 m. Should we bother mentioning this as a rule of thumb?]

Animals (rodents in particular) can gnaw through cables. Plan to avoid this potential damage. Covering the cable with plastic split loom tubing is an inexpensive way to protect the cable. Running the cable through conduit [Is metal bad?] is also an option. [Split loom size?]

If the site is accessible to the public, people should not touch the antenna or risk tripping over the nine wires on the ground that radiate in a semicircle from the base of the antenna. Consider a non-metallic fence, markers and/or signage. A minimum “keep-out” area is a seven meter radius circle centered at the antenna. [Warning about not touching the antenna not be touched while running?]

Plan how to support the antenna. Antenna support varies depending on the characteristics of the site. If the site’s soil can be excavated, it is common to use a reinforced-concrete in-ground pier. Plans for such a pier are included in this guide. A drawing of the antenna feed is also included and shows the mounting bolt hole pattern. For temporary or short-term installations, the antenna can be bolted to a sturdy plywood base (not supplied) which sits on the ground and stabilized with guy ropes. The base should be 0.75 - 1 m in diameter (or square), with four holes drilled in the center and matching the antenna feed bolt hole pattern. [Azimuthal orientation guidelines or instructions later to reorient the ground plane wires.]

Decide whether guy ropes will be needed. If the support is very stable (for example, a concrete pier), guy ropes are not needed. Guy ropes should be made of non-conductive material; **do not use metal guy wire or cable**. If guy ropes are needed, plan how they will be anchored. Simple stakes or cork screw stakes are commonly used. [Should we warn against metal stakes or state that metal is OK?]

Inventory

If the installation site is remote, a missing part or tool will delay the installation. Ensure that you have all the required parts, tools and support equipment before departure. Checklists are provided in this guide.

Pack a clean work surface in your field kit. A piece of cardboard, paper, or cloth will work. The surface will be placed under threaded antenna parts to keep them clean. In addition, many small parts are used to assemble the antenna. The small parts are difficult to find if dropped in grass or dirt. A surface under the work area makes it easy to find dropped items.

Include spare fasteners in your field kit, in case any are lost. Spare fasteners must be made of the material specified in the checklists. In particular, do not replace stainless steel parts with non-stainless steel.

Inspection

Summary procedure:

- Inspect physical condition.
- Perform electrical continuity checks.

A damaged or malfunctioning part will delay installation. The following inspections and tests should be performed prior to departure to a remote installation site.

[Description and figure of N connector, pointing out the two conductors and backshell.]

Inspect the physical condition of all electrical connectors:

- Connector backshells and bodies should not be bent or damaged.
- Connectors should be securely attached.
- Connector pins, sockets and outer conductors should not be bent.
- Connector pins and outer conductors should not extend beyond the connector shell.

Perform electrical continuity checks with an ohmmeter or multimeter. Remember, zero or low resistance indicates continuity, the ability to conduct electricity. Infinite or large resistance indicates no continuity. Some meters have a continuity test mode.

- On the spool of antenna cable, check for cable continuity by measuring the resistance between the center connector pins at the two ends of the cable. There should be continuity (very low or zero resistance) between the pins.
- [Measure continuity from outer coax conductor to outer coax conductor?]
- Measure the continuity between a connector pin and its corresponding backshell on the antenna cable. There should be no continuity (very high or infinite resistance). Repeat for the other antenna cable connector.
- [Measure continuity between center pin and outer conductor? And between outer conductor and backshell (shield)? (There should be no continuity.)]

- A lightning arrester with a female N-type connector is mounted on the steel spool-shaped ground-plane feed subassembly, attached to the lower antenna section. Measure the resistance between the center socket of the connector and the lightning arrester housing. Be careful. Do not bend or damage the center socket when measuring. There should be no continuity.
- There is an exposed metal fitting on the lower antenna section, 0.75 m above the base. [Figure or photo] Measure the resistance between the center socket of the lightning arrester connector and the metal fitting. Be careful. Do not remove or damage the epoxy that seals the wire connection opposite the [metal fitting?]. There should be continuity.

Tuning Coil Jumper Strap

The tuning coil is shipped with a metal jumper strap installed. If you plan to transmit at a frequency less than or equal to 4.6 MHz, leave the tuning coil installed. [Figure/photo]

If you plan to transmit at a frequency greater than 4.6 MHz, the jumper strap must be removed.

The tuning coil jumper is held in place by a screw and a retaining nut at its upper and lower end. To remove the jumper strap:

- Loosen the lower retaining nut (nearest the female end of the tuning coil).
- Remove the upper retaining nut (nearest the male end of the tuning coil).
- Rotate the strap 180 degrees around the lower screw.
- Replace and tighten the upper retaining nut.
- Tighten the lower retaining nut so the strap does not move.

Ready to Go

A crew of at least three strong people is needed to raise the antenna.

Transport all the parts and tools to the installation site.

Installation

Summary procedure:

- Locate antenna site.
- Install cable.
- Assemble tophat adapter.
- Lay out antenna sections.
- Install tuning coil, mating antenna sections.
- Install guy rope collar and guy ropes if needed.
- Install tophat.
- Orient antenna.
- Install temporary base if needed.
- Raise antenna.
- Tie down and adjust guy ropes if used.

- Lay out ground plane.
- Stake ground plane wires if desired.
- Install protection against damage by animals.
- Install optional lightning protection kit if used.

Install Cable

- Find the desired transmit antenna location. Pace off the distance or measure with a rangefinder or tape. Alternatively, locate the position with a map or GPS unit.
- Start at the SeaSonde electronics and ensure the transmit cable can be mated to the transmitter (or optional electrical protection kit) and is properly routed.
- Unspool the transmit cable from the SeaSonde electronics to the antenna site. The easiest way is to insert a 1 meter pipe through the spool and have two people walk the pipe and spool to the antenna site.
- Double-check the routing and ensure there is enough slack to make three to five 0.3 meter diameter loops (about 1 meter of cable length per loop) at the antenna base and to mate to the connector at the antenna base.
- If needed, install split loom tubing or other protection around the cable to avoid damage by animals.

Assemble Tophat Adapter

The tophat adapter is so named because it fits over the top of the antenna. It consists of a metal sleeve and four stiff wire elements. The wire elements are held in place by a washer-like retainer and four fasteners.

Injury warning: the wire elements may cause injury to eyes or other parts of the body. Mark the end of each wire, so that it is seen easily. Safety glasses are recommended.

- Place a piece of adhesive tape on one end of each wire, so that it is seen easily.
- Insert three cup point set screws (red threads) in the threaded holes at the upper (closed) end of the tophat adapter. Rotate the screws one turn. The cup points enter the hole first, leaving the hex-socket exposed for later tightening. (The set screws may already be in place.)
- Insert three dog point set screws (green-tipped) in the threaded holes at the lower (open) end of the tophat adapter. Rotate the screws one turn. The dog point enters the hole first, leaving the hex socket exposed for later tightening. (The set screws may already be in place.)
- Fasten the retaining washer to the upper end of the tophat adapter with four cap screws and internal star washers. The star washers go between the retaining washer and the screw heads. [figure?] Finger tighten the screws just enough to slip

wire elements snugly between the retaining washer and one of the grooves in the tophat adapter.

- Insert a wire element between the retaining washer and a groove in the tophat adapter. Repeat for all four wire elements.
- Tighten the four cap screws on the tophat adapter using a 9/64 inch hex (Allen) driver or key.
- Set the tophat adapter aside. It will be installed on the antenna a few steps later.

Assemble Antenna

- Lay out the two antenna sections on the ground and arranged end-to-end for assembly. The tuning coil is installed between the lower and upper antenna sections. [figure?] Ensure that the connecting parts remain clean by placing a clean surface (cardboard, paper, a towel or rag, etc.) under them.
- Ensure that the tuning coil jumper strap is in the correct position. It should be installed (secured to both screws) when transmitting less than or equal to 4.6 MHz. It should be uninstalled (removed from the upper screw) when transmitting greater than 4.6 MHz.
- Liberally coat the female threaded section at the bottom of the upper antenna section with a moisture-proof insulating lubricant. Dow Corning 4 Electrical Insulating Compound is recommended.
- Liberally coat the male threaded section of the tuning coil with moisture-proof insulating lubricant.
- Tightly screw the tuning coil onto the upper antenna section.
- Tighten the two set screws at the bottom of the upper antenna section using a 3/32 inch hex (Allen) driver or key.
- Liberally coat the female threaded section of the tuning coil with moisture-proof insulating lubricant.
- Liberally coat the male threaded section at the top of the lower antenna section with moisture-proof insulating lubricant.
- Tightly screw the tuning coil with upper antenna section onto the lower antenna section. Use a strap wrench if necessary.
- Tighten the two set screws at the bottom of the tuning coil using a 3/32 inch hex (Allen) driver or key.

- (Optional.) If using guy ropes, slip the top of the mast through the center hole of the guy rope collar. The eye bolts on the guy rope collar should point downward, i.e., the eyes should be closest to the ground when the antenna is raised. [Figure?]
- (Optional.) If using guy ropes, attach four **non-conductive** guy ropes to the four guy-rope-collar eye-bolts.
- Begin installing the tophat adapter by placing it over the top of the upper antenna section. Ensure that the top of the antenna is completely inserted in the tophat adapter.
- Tighten the three upper tophat adapter set screws (cup point with red marking) using a 3/32-inch hex (Allen) driver or key.
- Tighten the three lower tophat adapter set screws (dog point, green-tipped) using a 3/32-inch hex (Allen) driver or key.
- Remove the adhesive tape markers from the tophat adapter wire elements.

Raise Antenna

- There are nine ground-plane wires connected to the ground-plane feed assembly and secured with bolts. Locate the center bolt of the nine. Rotate the antenna so that, when it is raised, the head of the center bolt will be toward the sea. [figure?]
- If needed, attach a temporary base to the ground plane feed assembly base.
- Hold the antenna base in position while another person (or people) lifts the antenna at its middle (near the tuning coil) and raises the antenna by walking it toward the base.
- If using a permanent support, lift the antenna and place the ground plane feed assembly over the support bolts. Install and tighten support nuts.
- If using guy ropes, secure them while one or more people hold the antenna in place.
- The ground plane wires are wrapped around and secured to the ground plane feed assembly. Remove the material that secures the ground plane wires.
- Unwrap the ground plane wires from the ground plane feed assembly.
- Arrange the ground plane wires so that they are evenly spaced and fan out in a 180 degree arc. The loose end of the center ground plane wire should be closest to the sea. [figure]
- If needed, secure the ends of the ground plane wires with long nails or irrigation hose stakes to keep them in their proper orientation. [Any material specs for stakes?]

- If needed, mark or secure the area with non-metallic fence, markers and/or signage to keep people from tripping over the ground plane wires or touching the antenna.
- Make a 3-5 loop cable coil at base of antenna. [Is this done now or is the number of loops set later?]
- [Install optional lightning protection. Need details. Should installation be outlined elsewhere in this guide or another?]

Checklists

Antenna Parts Checklist

[Bruce: please check all fastener callouts. Some vary from your write-up.]

Check	Quantity	Description
		<i>UPPER ANTENNA SECTION PARTS</i>
	1	transmit antenna, upper section
	2	set screw, cup point, 10-32 x 3/8", 3/32" hex socket, stainless steel
		<i>LOWER ANTENNA SECTION/ANTENNA FEED PARTS (The lower antenna section and antenna feed are shipped as a single assembly.)</i>
		<i>LOWER ANTENNA SECTION PARTS (The fasteners and gasket listed here mate the lower antenna section to the antenna feed subassembly.)</i>
	1	transmit antenna, lower section
	4	bolt, hex head, [size], stainless steel
	4	flat washer, [spec], stainless steel
	4	lock washer, [spec], stainless steel
	4	nuts, [spec], stainless steel
	1	(optional), teflon gasket (Gasket goes between lower antenna section and antenna feed.)
		<i>ANTENNA FEED PARTS</i>
	1	spool-shaped base, stainless steel
	9	ground plane wires, stainless steel, attached to base with bolts, lock washers and flat washers
	1	antenna feed connector, N-type, attached to base
	1	lightning arrester with N-type connector, attached to antenna feed connector
		<i>TUNING COIL ASSEMBLY PARTS</i>

Check	Quantity	Description
	1	tuning coil
	1	tuning coil jumper strap, stainless steel, with black shrink tube insulation
	2	screw, phillips head, [size], stainless steel
	2	internal star washer, [size]
	2	set screw, cup point, 10-32 x 3/8", 3/32" hex socket, stainless steel
		TOPHAT ASSEMBLY PARTS
	1	tophat adapter, stainless steel sleeve
	4	antenna element, [length, gauge/diameter?], stainless steel
	1	retaining washer, 1" outside diameter, with five holes
	4	cap screw, 9/64" hex socket, stainless steel, 8-32 x 7/16"
	4	internal star washer, #8
	3	set screw, cup point, 3/32" hex socket, 10-32 x 3/16", stainless steel, red marking on threads
	3	set screw, dog point, 3/32" hex socket, 10-32 x 3/16", stainless steel, green tipped
		MOUNTING HARDWARE
	4	bolt, 5/8-11 [eleven?] x ??
	4	nut
	4	lock washer
	4	flat washer
	4	(optional) guy ropes, non-conductive
	4	(optional) stakes or anchors to tie down guy ropes
	1	(for temporary install) base, plywood, 0.75 - 1 m diameter or square, holes drilled with antenna feed bolt hole pattern
		CABLE

Check	Quantity	Description
	1	cable, RG-8 with male N-type connectors, 75m
		<i>OPTIONAL EQUIPMENT</i>
	1	lightning protection kit, LP-100
	as required	non-metallic fencing, markers, and/or signage
	as required	split loom tubing or conduit, plastic, [size], (to protect cables from animal damage)

Tool Checklist

Check	Quantity	Description
	1	hex (Allen) driver or key, 3/32"
	1	hex (Allen) driver or key, 9/64" [any other sizes required?]
	1	strap wrench
	as required	hammer(s) to drive ground plane wire stakes and guy rope stakes
	1	ohmmeter or multimeter for continuity checks
	1	tape measure or rangefinder
	as required	Moisture-proof insulating silicone grease. Dow Corning 4 Electrical Insulating Compound is recommended.
	as required	clean working surface (cardboard, towel, etc.)
	1	(optional) pipe, 1 m long, to put through cable spool

Drawings

[Transmit antenna concrete support pier.]

[Long range antenna feed, showing bolt hole pattern and direction to sea. Will need to modify this drawing to show direction to sea and correct the bolt hole pattern with respect to the N connector. Or maybe a different template for the hole pattern and direction to sea.]