

# **FM60-VSAT**

**with Integrated Control Modem (ICM)**



# **Installation Guide**



# FM60-VSAT

## With Integrated Control Modem

This guide explains how to install the FM60-VSAT satellite communications system. Operation instructions are provided in the Quick Start Guide.

*NOTE: Your antenna might have parts that differ from those pictured in this document. Such differences have no bearing on the instructions unless noted otherwise.*

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### Installation Steps

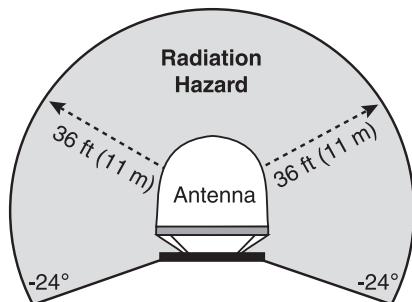
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### CAUTION - RF Radiation Hazard



The antenna transmits radio frequency (RF) energy that is potentially harmful. Whenever the system is powered on, make sure everyone stays more than 36 feet (11 m) away from the antenna. As shown in the illustration, no hazard exists directly below the antenna.



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### Who Should Install the System?

To ensure a safe and effective installation, only a certified technician should install the FM60-VSAT system.

The unique light-colored dome with dark contrasting baseplate (Reg. No. 2,864,752) is a trademark of KVH Industries, Inc. All other trademarks are the property of their respective companies. The information in this document is subject to change without notice.

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# Important Safety Information



This icon indicates a danger, warning, or caution notice. Be sure to read these carefully to avoid injury.



## WARNING

### Risk of Electric Shock

Potentially lethal voltages are present within the ICM when it is connected to AC power. To avoid electric shock, do not open the chassis enclosure. There are no user-serviceable parts inside.



## WARNING

### Risk of Electric Shock

If any component of the FM60-VSAT system becomes damaged and/or no longer functions normally, disconnect it from vessel power, secure it from unintended operation, and contact Technical Support. All repairs or modifications must be performed by a trained, certified technician. If you are a certified technician, you still must contact Technical Support prior to conducting any repairs or modifications to the equipment.



## WARNING

### Risk of Explosion

Do not operate the ICM (or any other electrical device) in an environment where flammable gases, vapors, or dusts are present. In addition, do not operate the ICM in an environment with a temperature outside its 5° F to 131° F (-15° C to 55° C) temperature range.



## WARNING

### Risk of Electric Shock

Failure to ground the FM60-VSAT system properly to ship's ground will cause an unsafe floating ground condition, risking potentially lethal electric shock. See "Connect Power" on page 24 for details on the proper grounding of the equipment.



## CAUTION

### RF Radiation Hazard

The antenna transmits up to 4 watts of radio frequency (RF) energy that is potentially harmful. Whenever the system is powered on, make sure everyone stays more than 36 feet (11 m) away from the antenna. No hazard exists directly below the antenna. See illustration on page 1.

# 1

# Inspect Parts and Get Tools

Before you begin, follow these steps to make sure you have everything you need to complete the installation.

- a. Unpack the box and ensure it contains everything shown in Figure 1.

**IMPORTANT!**

Always lift the antenna by the baseplate and never by the radome or any portion of the internal antenna assembly (see Figure 1).

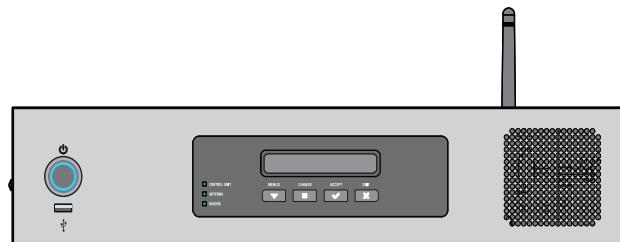
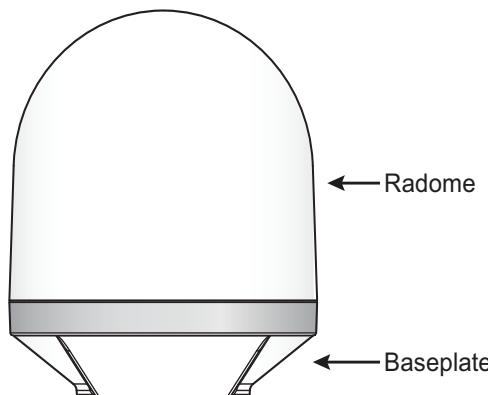
- b. Carefully examine all of the supplied parts to ensure nothing was damaged in shipment.

- c. Gather all of the following tools and materials that you will need:

- Flat-head and Phillips-head screwdrivers
- Electric drill and 5/8" (16 mm) bit
- 3.75" (95 mm) hole saw
- 5/16" hex driver
- 7/8" socket
- 7/16" open-end torque wrench set to 20 in.-lbs
- Light hammer and center punch
- Adhesive tape
- Silicone sealant, self-vulcanizing tape, or equivalent
- Heat gun (for heat shrink)
- Eye protection
- Shop towels
- Voltmeter
- Utility knife
- Flush cutters
- Needle-nose pliers

Figure 1: FM60-VSAT System Components

**Antenna**



Integrated Control Modem (ICM)

- Wire stripper/terminal crimper
- File
- Two 75Ω RF coax cables, "F" connectors, and associated termination tools (see page 12)
- NMEA 0183 talker and interface cable (see page 22)
- Isolation transformer, if required (see page 24)
- Laptop PC with the latest FM60-VSAT ICM/antenna software (acquired from your service provider)

Before you begin, consider the following antenna installation guidelines.

## Choose a Suitable Location

- Select a location that is as close as possible to the intersection of the vessel's centerline and midships.
- Temperature must be within the operating range (-30°C to 55°C (-22°F to 131°F)).
- Avoid placing the antenna near any magnetic compasses or other onboard antennas to prevent potential interference.

## Meet Mounting Structure Requirements

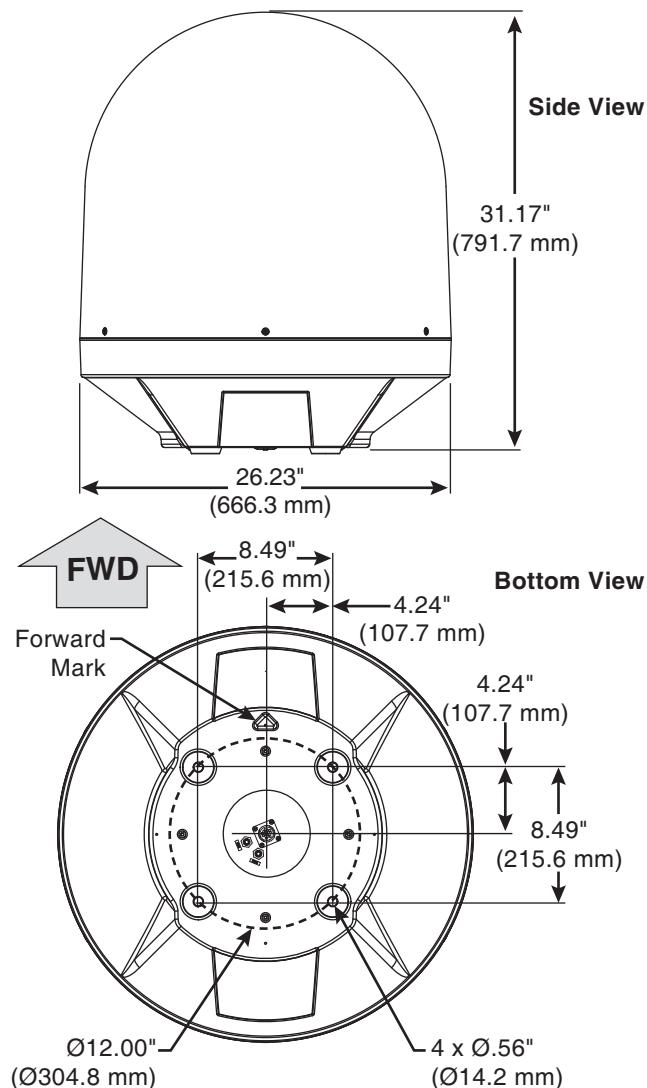
Make sure the mounting surface is flat, level (within  $\pm 2^\circ$ ), and wide enough to accommodate the antenna's base (see Figure 2). Also make sure the mounting structure is strong enough to withstand the weight of the antenna (55 lbs, 25 kg) as well as other cumulative forces related to expected operating conditions, such as ice, snow, wash down, and maximum expected values of pitch, roll, and wind pressure (including gusts).

Vibration of the mounting surface should measure less than 0.51 gRMS total, and also less than 0.11 gRMS at the following resonant frequencies and axes:

- 19.67 Hz and 36.03 Hz in Horizontal Forward X-Direction
- 17.09 Hz and 46.7 Hz in Horizontal Side Y-Direction
- 63.31 Hz in Vertical Z-Direction

Please consult with your shipyard to ensure that the antenna mounting surface vibration never exceeds the above stated conditions at any time during its life.

Figure 2: Antenna Dimensions



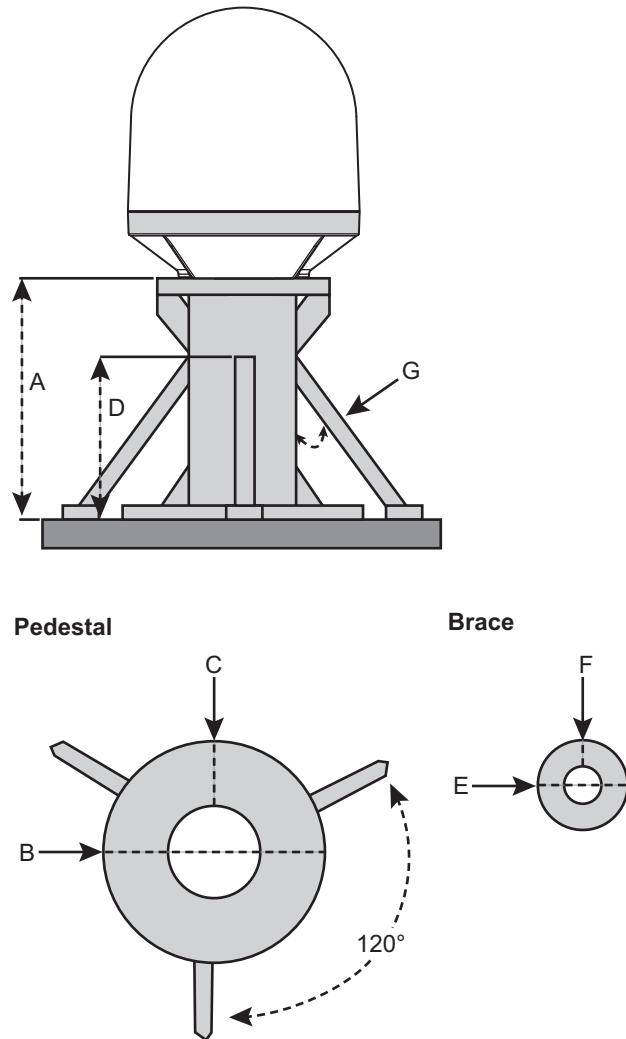
## Meet Pedestal Structure Requirements

If a pedestal is going to be used, it must meet the following minimum requirements. Refer to Figure 3.

Pedestal Height (A)	3.28 ft 1 m	6.56 ft 2 m	9.84 ft 3 m
Tube OD (B)	5.0" 127 mm	5.0" 127 mm	5.0" 127 mm
Tube Wall Thickness (C)	0.38" 9.5 mm	0.38" 9.5 mm	0.5" 12.7mm
Brace Height (D)	N/A	5.56 ft 1.7 m	7.38 ft 2.25 m
Brace OD (E)	N/A	2.0" 50.8 mm	4.0" 101.6 mm
Brace Thickness (F)	N/A	0.25" 6.35 mm	
Brace Angle (G)	N/A	25°	

*NOTE: If the pedestal exceeds 3.28 ft (1 m), braces must be placed at 120° intervals. Sizing is based on Structural Steel Tubing 60,000 psi (415 MPa) minimum yield.*

Figure 3: Pedestal and Brace Dimensions



## Prevent RF Radiation Exposure

Select a location that is well above any areas accessible to passengers and crew to reduce the risk of RF radiation exposure. (See page 1 for an illustration of the hazard area.) If mounting the antenna near an accessible area is unavoidable, you may configure one or two no-transmit zones to prevent transmissions in hazardous directions. (See “Set Up No-Transmit Zones” on page 29 for details.)

## Minimize Satellite Blockage

The antenna requires a clear view of the sky to transmit and receive satellite signals (see Figure 4). The fewer obstructions, the better the system will perform.

## Avoid RF Interference

Although many variables determine the exact distance required between the antenna and radar/high-power radio transmitters, including transmitter beam properties and the reflective properties of nearby surfaces, consider the following general guidelines when selecting a safe antenna location:

**IMPORTANT!**

RF emissions from radars and high-power radio transmitters may damage the antenna or impair its performance if it's improperly positioned within the beam path.

- Mount the antenna as far away as possible from the radar and high-power radio transmitters.
- Do not mount the antenna at the same level as the radar. Most radar transmitters emit RF energy within an elevation range of -15° to +15° (see Figure 5). Therefore, mount the antenna outside this elevation range and at least 10 ft (3 m) away from the transmitter.

**IMPORTANT!**

Never place the antenna in the beam path of the radar regardless of distance. Radar energy may damage the antenna.

Figure 4: Blockage from Obstruction

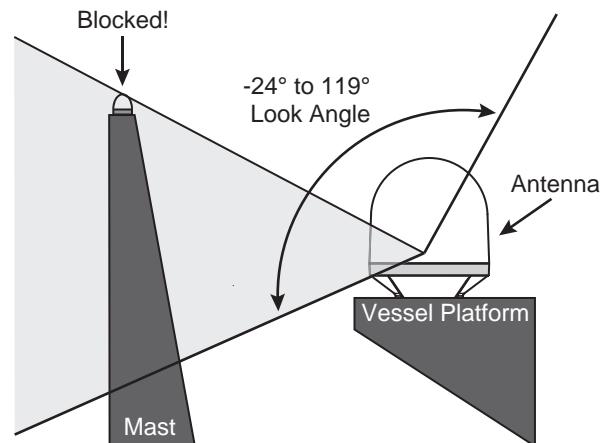
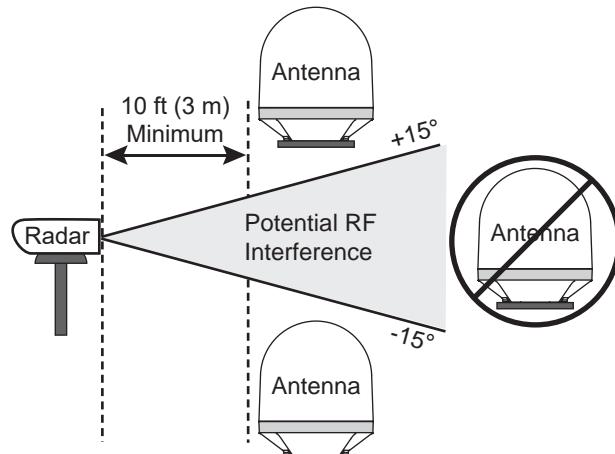


Figure 5: Avoiding RF Interference



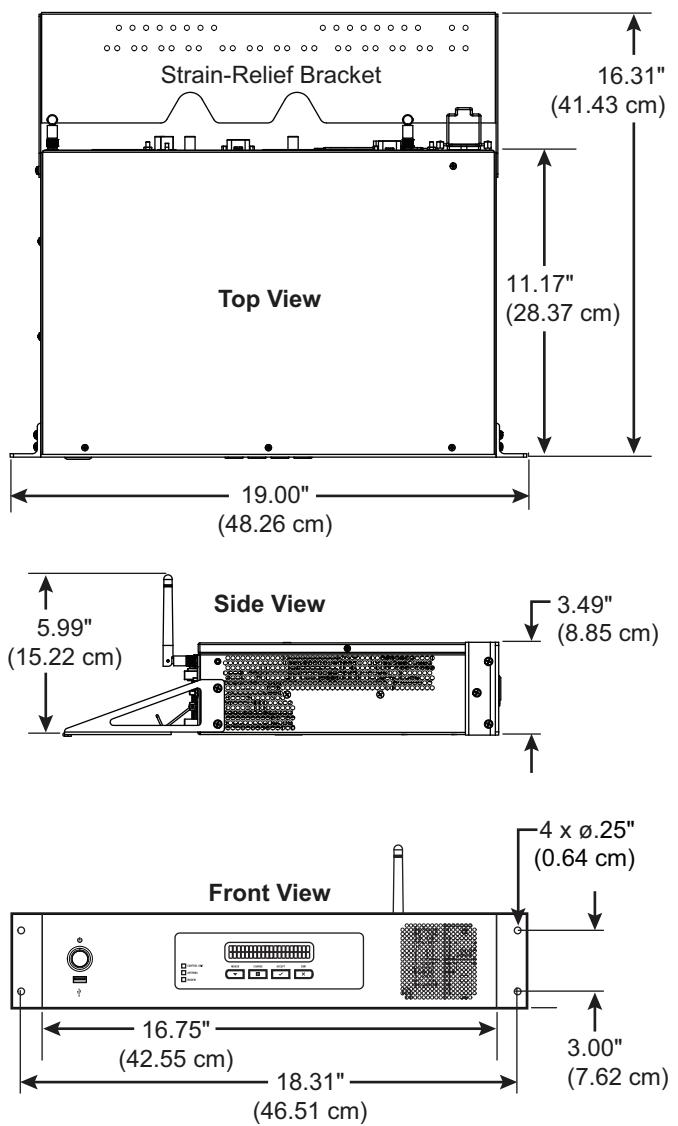
# 3

# Plan the ICM Installation

Before you begin, consider the following installation guidelines for the ICM.

- Select a mounting location in a dry, well-ventilated area belowdecks away from any heat sources or salt spray.
- Temperature must be within the operating range (-15°C to 55°C (5°F to 131°F)).
- Be sure the front panel will be easily accessible to the user.
- Leave enough room at the rear panel to accommodate the connecting cables.
- To use the supplied power/data cable, the ICM must be located within 100 ft (30 m) of the antenna.
- Be sure the location provides adequate Wi-Fi reception. Do not install it in an area surrounded by metal or near any electrical devices that emit RF noise.

Figure 6: ICM Dimensions



Follow these steps to prepare the ICM for installation.

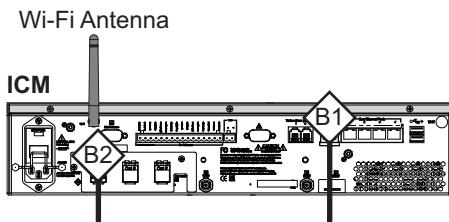
## Connect the ICM Jumper Cable

Connect the supplied straight-through Ethernet jumper cable from the “B2” jack to the “B1” jack on the rear panel of the ICM (see Figure 7).

## Attach the Wi-Fi Antenna

Connect the one supplied Wi-Fi antenna to the rear panel of the ICM (see Figure 7).

Figure 7: Jumper Cable and Wi-Fi Antenna Connection



# 5

# Mount the ICM

There are two options for mounting the ICM:

**Option 1 -** Inside an equipment rack

**Option 2 -** To a horizontal surface

*NOTE: You may choose to wait to mount the ICM until after you have completed all system wiring.*

## Option 1 – Rack Mount

The ICM is sized to fit a standard 19" (48.26 cm) rack, occupying 2U of space. Follow these steps to secure the ICM in an equipment rack.

- a. Attach the supplied strain-relief bracket to the back of the ICM using four supplied #6-32 screws and washers (see Figure 8).
- b. Insert the ICM into the rack and secure its front mounting brackets to the rack using four M6 screws and washers (see Figure 9).

## Option 2 – Horizontal Surface Mount

Follow these steps to mount the ICM to a horizontal surface.

- a. Remove the six #6-32 screws and washers securing the two rack-mount brackets to the front of the ICM (see Figure 10). Remove the brackets.
- b. Attach the supplied strain-relief bracket to the back of the ICM, and attach the supplied "L" mounting brackets to the sides of the ICM, using six supplied #6-32 screws and washers (see Figure 11).
- c. Mount the ICM to the vessel using fasteners appropriate for the mounting surface.

Figure 8: Attaching the Strain-Relief Bracket

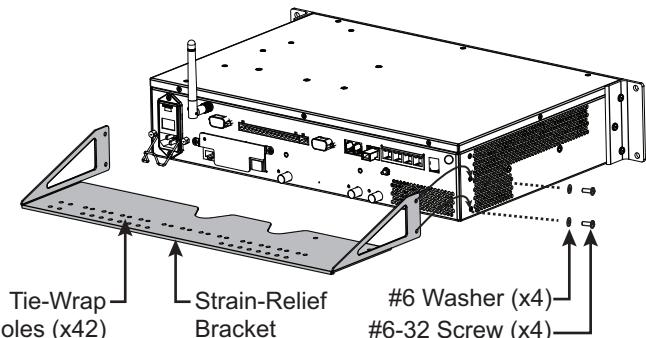


Figure 9: Securing the ICM in the Rack

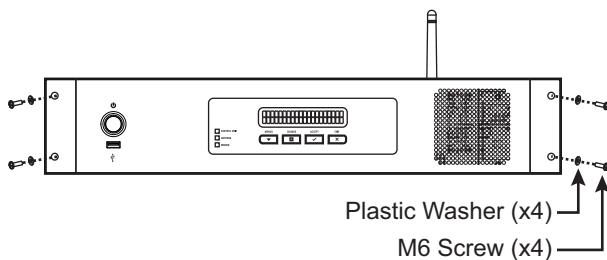


Figure 10: Removing the Rack-Mount Brackets

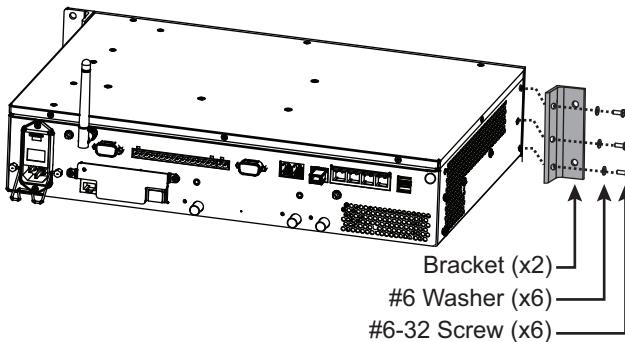
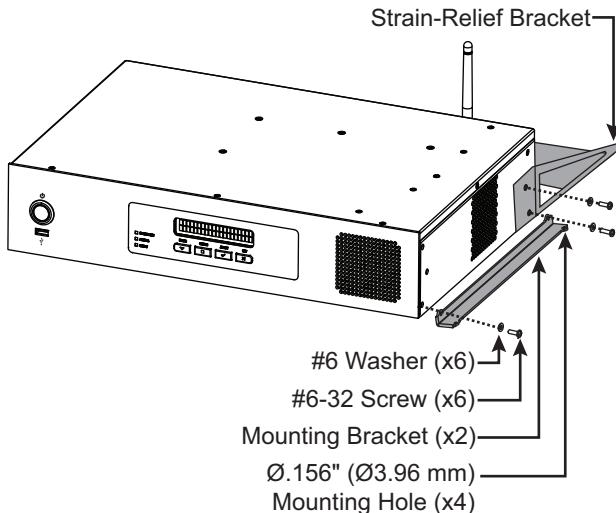


Figure 11: Attaching the Mounting and Strain-Relief Brackets



## 6

# Prepare the Antenna Site

Once you have identified a suitable antenna mounting site, according to the guidelines provided in Step 2 on page 4, follow these steps to drill the mounting holes and cable access hole to prepare the site for installation.

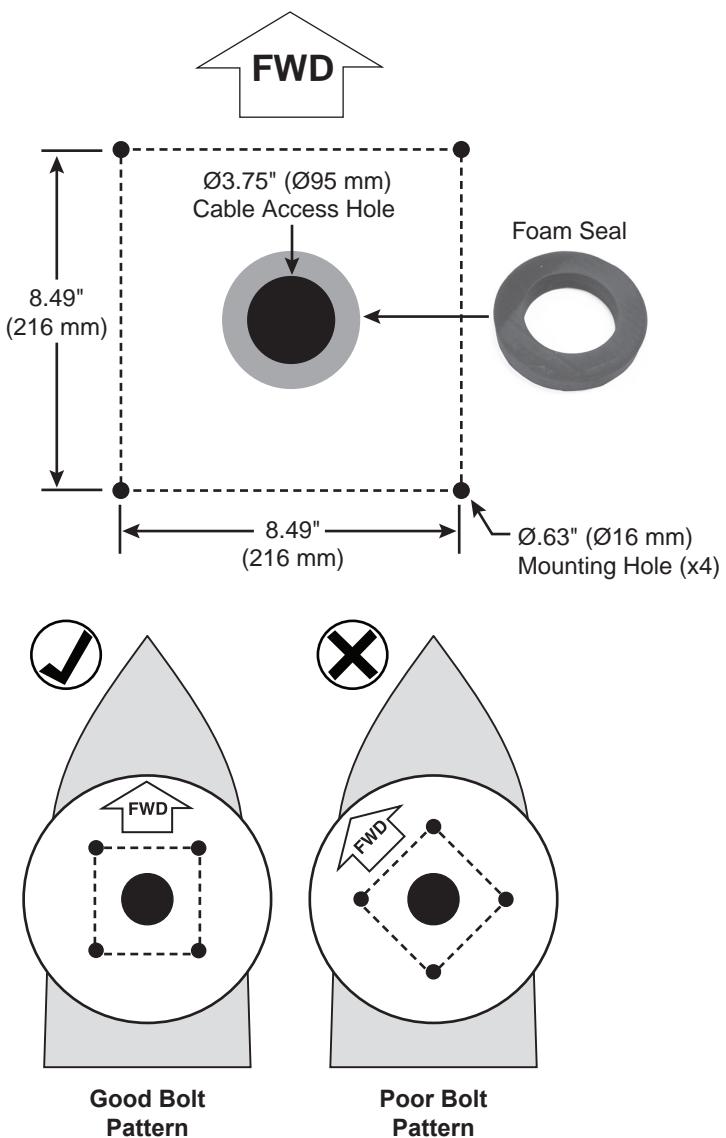
- Unfold the antenna mounting template (supplied in the Customer Welcome Kit) and place it onto the mounting surface. Make sure the "FWD" (forward) arrow points toward the bow and is parallel to the vessel's centerline (see Figure 12).

**NOTE:** You don't need to mount the antenna exactly on the vessel's centerline, but the antenna's forward arrow must be parallel to it.

- Using a light hammer and center punch, mark the locations for the four mounting holes and cable access hole on the mounting surface in the locations indicated on the template.
- Drill a 5/8" (16 mm) hole at the four mounting hole locations you marked in Step b. Later, you will insert four 1/2"-13 bolts through these holes to secure the antenna to the mounting surface.
- Cut out the 3.75" (95 mm) cable access hole in the location you marked in Step b. Smooth the edges of the hole to protect the cables. Later, you will route the power/data and RF cables through this hole and into the vessel. (You may also apply anti-chafe material around the cables to protect them from abrasion.)
- Clean and dry the antenna mounting surface.
- Peel off the paper backing from the supplied foam seal to expose the adhesive. Then press the foam seal down firmly onto the mounting surface, ensuring the hole in the foam seal aligns with the cable access hole in the mounting surface (see Figure 12).

**NOTE:** Apply the foam seal to the vessel mounting surface, not to the antenna's baseplate. You will have difficulty connecting the cables to the antenna if the foam seal is attached to the baseplate.

Figure 12: Antenna Mounting Holes Layout



# 7

# Remove the Shipping Restraints

Inside the antenna, a foam shipping restraint prevents the antenna assembly from moving during shipment. In addition, four bolts secure the antenna to the shipping pallet. Follow these steps to remove these restraints.

- a. Remove the six #10-32 screws securing the radome to the baseplate (see Figure 13). Carefully lift the radome straight up until clear of the antenna assembly and set it aside in a safe place. If you keep the radome topside, secure it with a lanyard to prevent it from falling overboard.
- b. Carefully remove the foam shipping restraint that is wedged underneath the reflector (see Figure 14). Save this restraint for future use.

## **IMPORTANT!**

Once you have removed the foam restraint, handle the antenna carefully, as its internal assembly will rotate freely. You will need to rotate the antenna assembly slowly by hand to remove the second pair of shipping bolts, but only **after** you have removed the first pair of bolts that are initially visible. If the antenna assembly hits a mechanical stop with excessive force, or it hits the head of a shipping bolt that wasn't removed, the limit switch might become damaged.

- c. Four 1/2" bolts secure the antenna to the shipping pallet (see Figure 14). Completely remove the two 1/2" shipping bolts that you can see without rotating the antenna assembly.
- d. Rotate the antenna assembly slowly by hand to reveal the other two 1/2" shipping bolts. Remove these bolts.
- e. Transport the antenna to the mounting location.

**NOTE:** The two hoisting eyelets on the antenna frame may be used to lift the antenna, if necessary (see Figure 15). After they have been used once, make sure they are undamaged and free of cracks before using them again.

Figure 13: Removing the Radome

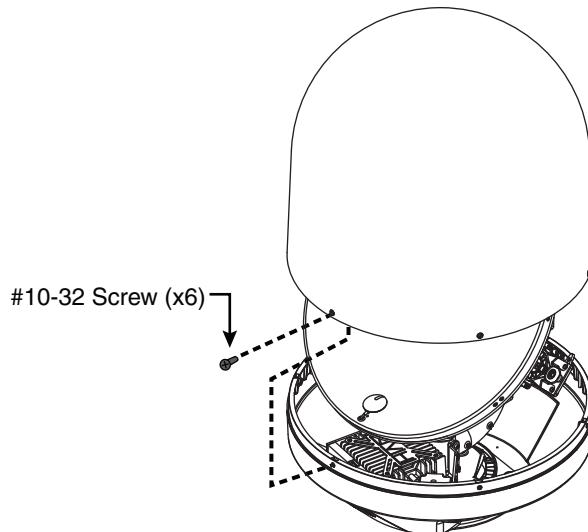


Figure 14: Foam Shipping Restraint and Bolts

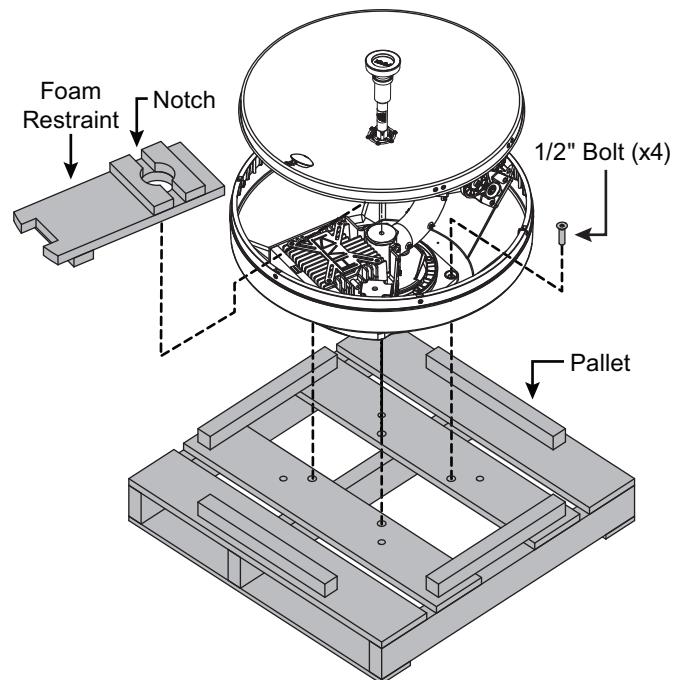
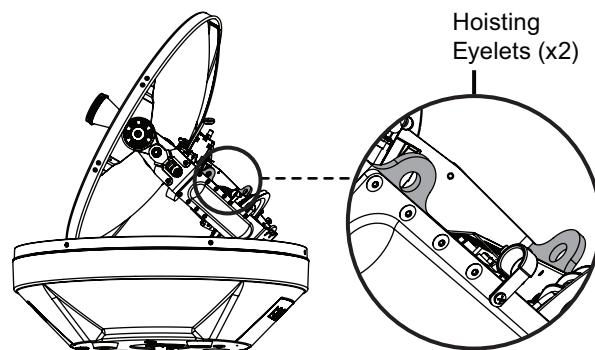


Figure 15: Antenna Hoisting Eyelets



Follow these steps to prepare and route the RF and power/data cables.

## Prepare the Customer's RF Cables

You need to connect two  $75\Omega$  RF coax cables from the antenna location to the ICM. Refer to Figure 16 to determine the type of cables and connectors you can use for your cable run. Then prepare the cables as described below.

### **IMPORTANT!**

- If you use RG-11 RF cables 80-100 ft (25-30 m) in length, you can avoid the modem commissioning step. See “Commission the Modem” on page 31.
- RF cables must be rated for  $75\Omega$ , not  $50\Omega$ .
- Low-quality, poorly terminated, or improperly installed RF cables are the most common cause of system problems. Terminate all RF cables with high-quality “F” connectors using the proper stripping/crimping tools, exactly to the manufacturer’s specifications. *See page 43 for instructions on terminating LMR cables.*
- Do not use RG-6 cable, as it will damage the system. Use of any cables not specified in Figure 16 will void the warranty.
- Make sure the center conductor pin at each end of the finished cables is free of burrs and  $1/4"$  (0.20"-0.28") (5-7 mm) in length, measured from inside the nut to the tip, to ensure proper engagement.
- (*LMR cables only*) Make sure there is no gap between the end of the cable jacket and the start of the connector.
- When determining cable lengths, don’t forget to account for service loops, 14" (35 cm) in diameter, at each end.

Figure 16: RF Cable Options

<b>RG-11</b>	
<b>Max. length</b>	<b>100 ft (30 m)</b>
Connector	Belden EX11N716WSPLUS
Tools	Belden CST596711, VT200
Strip lengths	
<b>LMR-400-75</b>	
<b>Max. length</b>	<b>200 ft (60 m)</b>
Connector	Times Microwave EZ-400-FMH-75
Tools	Times Microwave TK-400EZ-75
Strip lengths	
<b>LMR-600-75</b>	
<b>Max. length</b>	<b>325 ft (100 m)</b>
Connector	Times Microwave EZ-600-FMH-75
Tools	Times Microwave TK-600EZ
Strip lengths	

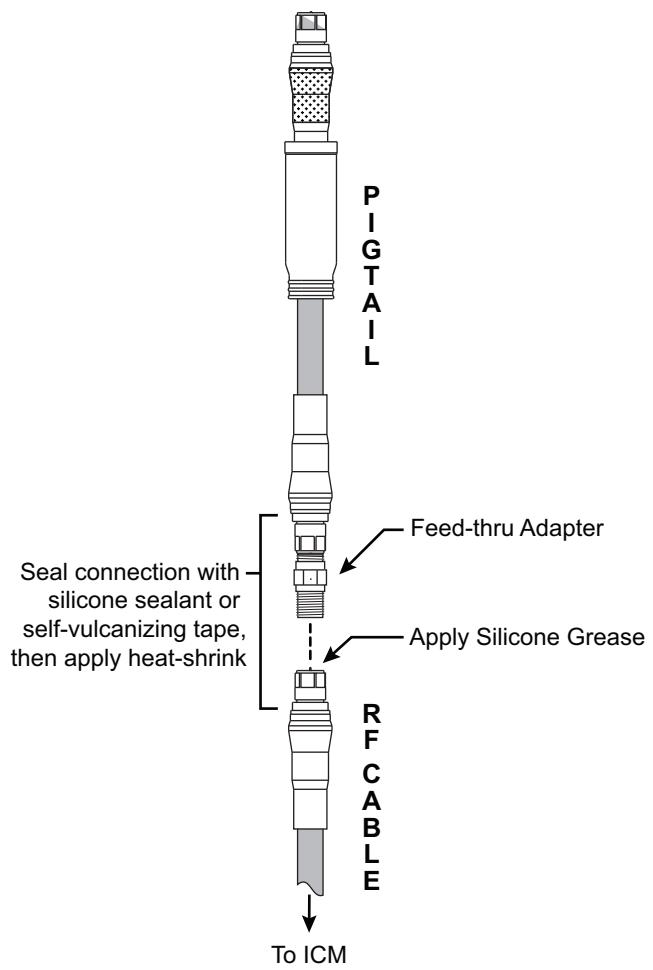
## Connect the Customer's RF Cables to the Supplied Pigtail Cables

**IMPORTANT!**

Use of the supplied pigtail cables is **mandatory**. Do not connect the customer's RF cables directly to the antenna.

- a. Clean and dry the RF cables' connectors.
- b. **Label both ends** of the customer's RF cables. Label one cable "TX," and label the other "RX."
- c. Heat shrink is supplied with each 3 ft (90 cm) pigtail cable to protect the connection between the customer's RF cables and the pigtail cables. Slide a heat shrink sleeve onto the end of each 3 ft (90 cm) pigtail cable (opposite the boot end) for later use.
- d. Fill half of the inner body of the customer's "TX" RF cable's connector with the supplied silicone grease to prevent moisture and corrosion.
- e. Connect and **SLOWLY** hand-tighten the "TX" RF cable to the feed-thru adapter of one of the supplied LMR-400-75 pigtail cables, allowing the grease to diffuse and settle into the entire space within the connector (see Figure 17).
- f. Make sure the RF cable's connector is tightened all the way into the pigtail cable's feed-thru adapter. Then tighten it with a 7/16" torque wrench set to 20 in.-lbs.
- g. Seal the RF cable-to-pigtail connection using silicone sealant, self-vulcanizing tape, or equivalent. Then protect the connection with the heat shrink (see step c).
- h. Repeat steps d-g to connect the "RX" RF cable to the other pigtail cable.

Figure 17: Connecting the Pigtail Cables to the RF Cables



## Route the Cables Belowdecks

- a. Keep the connector end of the power/data cable and the pigtail ends of the RF cables at the antenna location.
- b. Route the opposite ends of the power/data and RF cables belowdecks through the 3.75" (95 mm) cable access hole. Leave an adequate service loop, at least 14" (35 cm) in diameter, at the antenna location for easy serviceability. (Total extra length of RF cables should not exceed 6.5 ft (2 m) at each end.)
- c. Route the cables to the ICM. Be sure to always maintain the minimum bend radius in the RF cables (see Figure 18). Later, you will connect these cables to the ICM.

Figure 18: Minimum Bend Radius of RF Cables

Cable Type	Minimum Bend Radius
RG-11	4.5" (11.5 cm)
LMR-400-75	4.5" (11.5 cm)
LMR-600-75	6" (15.3 cm)

Follow these steps to connect the antenna cables.

## Connect the RF Pigtail Cables

- a. Clean and dry the antenna's two RF connectors, labeled "MTX" and "MRX" (see Figure 19).
- b. Place one of the supplied rubber connector washers over the "MTX" jack on the bottom of the antenna, as shown in Figure 20.
- c. Fill half of the inner body of the "TX" pigtail cable's male connector with silicone grease.
- d. Connect and **SLOWLY** hand-tighten the "TX" pigtail cable to the antenna's "MTX" jack, allowing the grease to diffuse and settle into the entire space within the connector.
- e. Make sure the "TX" pigtail cable's connector is tightened all the way into the antenna's connector and the rubber washer is compressed against the antenna's base. Then tighten the connector with a 7/16" torque wrench set to 20 in.-lbs.
- f. Apply a thin layer of silicone grease to the jacket of the "TX" pigtail cable, along the wider segment at the base of the connector.
- g. Slide the rubber boot up the cable until it covers the entire connector and mates with the rubber washer. This will protect the connection from the elements.
- h. Wipe off any excess grease from the cable.
- i. Repeat steps b-h to connect the "RX" pigtail cable to the antenna.

Figure 19: Connectors on Bottom of Antenna

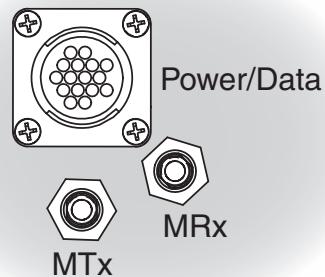
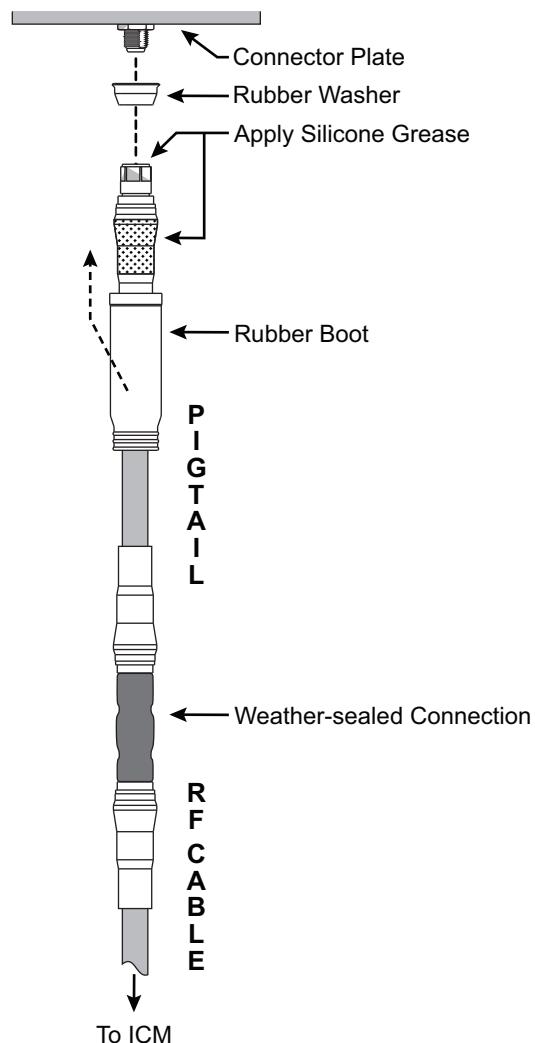


Figure 20: Connecting the RF Pigtail Cables to the Antenna



## Connect the Power/Data Cable

- a. Connect the power/data cable to the "Power/Data" jack on the bottom of the antenna (see Figure 21). Hand-tighten until the connector locks in place; do not use excessive force.
- b. Connect the power/data cable's ground strap to the 1/4"-20 ground screw on the bottom of the antenna (see Figure 21). Be sure to secure the ground strap's ring terminal between the screw and the washer.

## Protect the Cables

- a. Secure the cables near the antenna connectors to relieve stress (see Figure 22).
- b. Weatherproof and seal the cable access hole, as required.

**IMPORTANT!**

The integrity and reliability of the RF cables and their connections are critically important. Make certain that these cables are properly terminated, sealed against seawater and corrosion, strain-relieved, protected from abrasion, and free of stress.

Figure 21: Antenna Power/Data Cable Connections

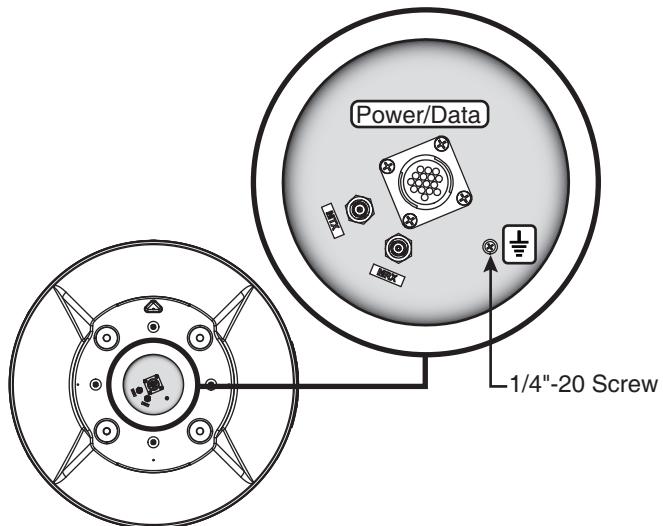
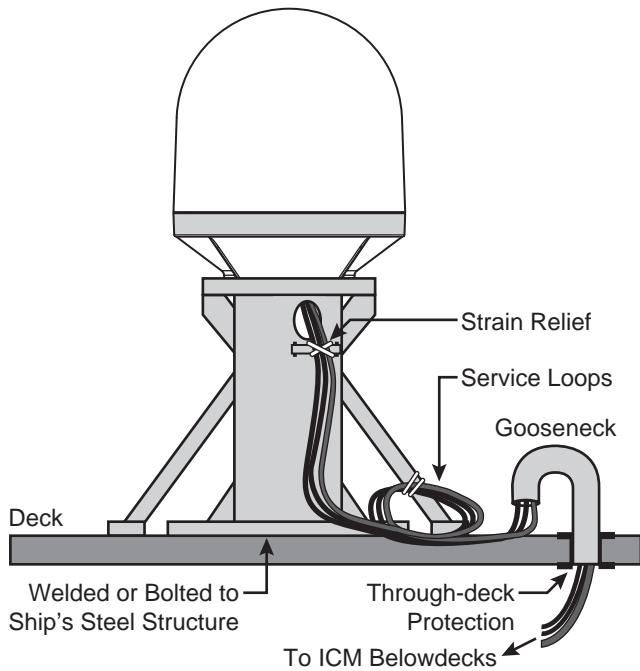


Figure 22: Strain-relief Example



# 10

# Mount the Antenna

Follow these steps to mount the antenna to the mounting surface.

- a. Place the antenna baseplate over the holes drilled in the mounting surface and make sure the forward arrow inside the baseplate points toward the bow and is parallel to the vessel's centerline (see Figure 23). The antenna's baseplate should rest squarely atop the foam seal.



## CAUTION

Be sure to observe the safe handling instructions in the Material Safety Data Sheet (MSDS) provided with the anti-seize lubricant.

- b. Apply a thin layer of the supplied anti-seize lubricant to the threads of the four 1/2"-13 bolts to prevent galling.

### IMPORTANT!

You will need to rotate the antenna assembly slowly by hand to see all four mounting holes. You will also need to fully install the first pair of mounting bolts prior to rotating the antenna assembly to install the second pair of bolts. If the antenna assembly hits a mechanical stop with excessive force, or it hits the head of a mounting bolt that wasn't secured in place, the limit switch might become damaged.

- c. At each of the two baseplate mounting holes that you can see without rotating the antenna assembly, insert a 1/2"-13 bolt from above and secure it to the mounting surface using a 1/2" flat washer and a 1/2"-13 lock nut from below (see Figure 24). Make sure both bolt heads are flush with the antenna's mounting plate before proceeding.
- d. Rotate the antenna assembly slowly by hand to reveal the other two mounting holes then repeat step c at these two holes.

Figure 23: Forward Arrow in Antenna Baseplate

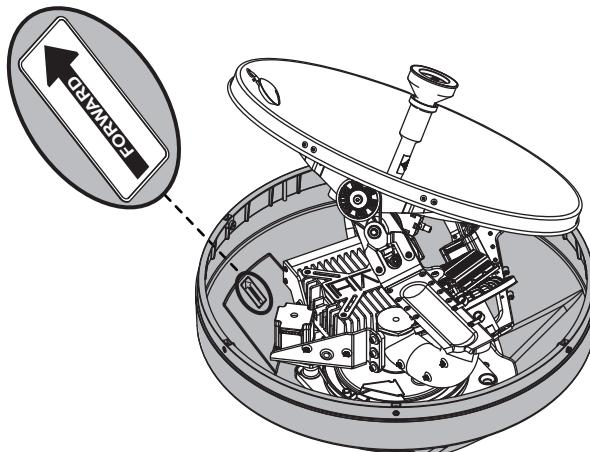
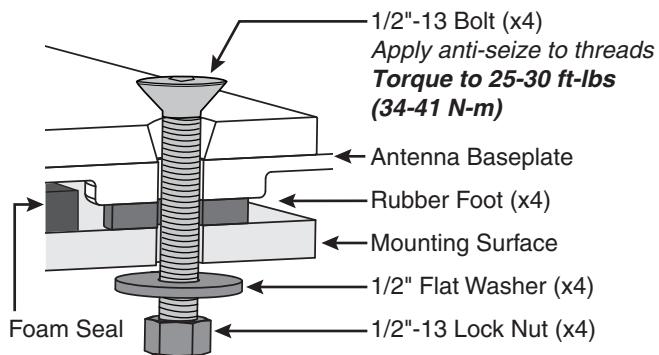


Figure 24: Mounting the Antenna (Side View)



- e. Tighten all four bolts until the four rubber feet on the baseplate are bottomed against the mounting surface and the foam seal is fully compressed. It is recommended that you tighten the nuts to between 25 and 30 ft-lbs (34 and 41 N-m) of torque.
- f. Reinstall the radome onto the antenna. Secure in place with the six #10-32 screws you removed earlier (see Figure 13 on page 11).
- g. Install a protective plastic cap (supplied in the kitpack) over each radome screw.

# Prepare the Power/Data Cable

If you cut the power/data cable to a certain length, perform all of the steps below. If the belowdecks end of the cable is intact as provided from the factory, skip to step j on the next page.

- a. Measure 10" (25 cm) back from the end of the cable. Then, using a utility knife to carefully cut in a rocking motion, sever just the cable's plastic jacket (outermost layer). Twist off the length of the plastic jacket (see Figure 25).
- b. At the end closest to the jacket, carefully pinch the cable braid to create a bulge. Then extract the silver drain wire from the braid (see Figure 26).
- c. Cut the braid at the center of the bulge and trim the braid up to the edge of the jacket (see Figure 27).
- d. Trim the foil insulation and fiber to the edge of the jacket so that only the power/data and drain wires remain (see Figure 28).
- e. Slide the supplied Ø0.063" (Ø1.6 mm) heat shrink sleeve onto the drain wire. The wire should protrude from the end of the sleeve.
- f. Using a heat gun, apply heat evenly to the drain wire's heat shrink sleeve from one end to the other until it conforms to the wire.
- g. Insert the drain wire into the supplied ring terminal and crimp it into place (see Figure 29).

Figure 25: Stripping the Jacket

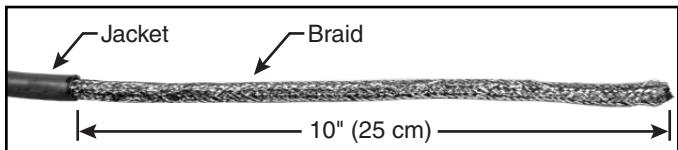


Figure 26: Extracting the Drain Wire

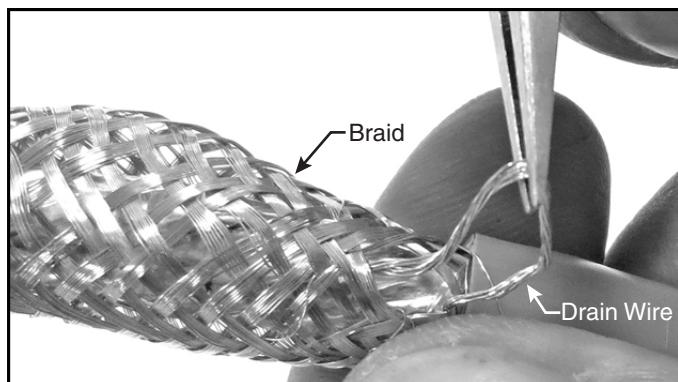


Figure 27: Trimming the Braid

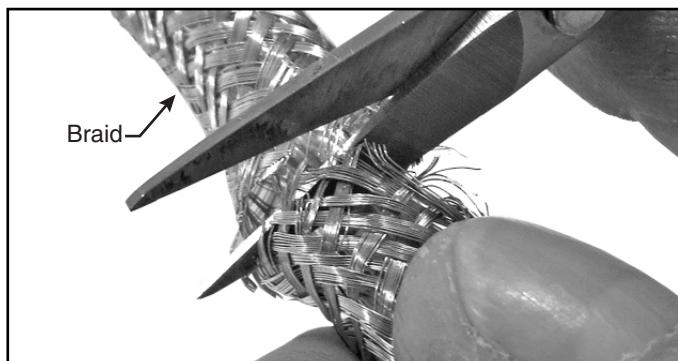


Figure 28: Trimming the Foil and Fiber

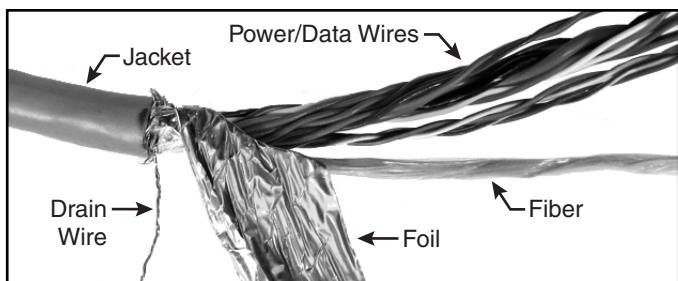
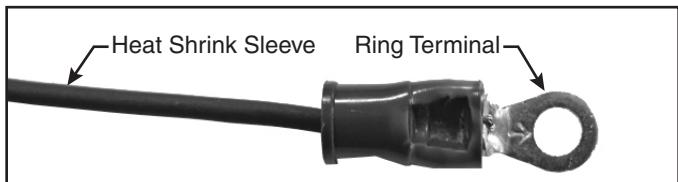


Figure 29: Crimping On the Ring Terminal

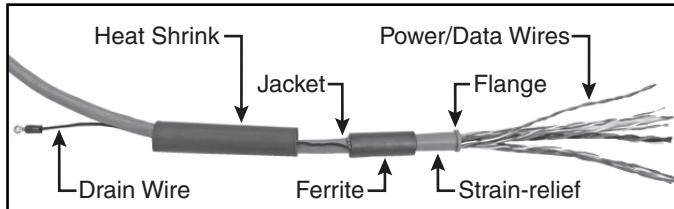


- h. Trim approximately 3" (75 mm) from the ends of the power/data wires.
- i. Strip back the insulation of each wire approximately 1/4" (6 mm) and gently twist each wire to ensure a good electrical connection.
- j. Thread the power/data wires through the supplied Ø1.0" (Ø25.4 mm) heat shrink sleeve, ferrite cylinder, and plastic strain-relief tube, in that order (see Figure 30). Do not pass the drain wire through these components.

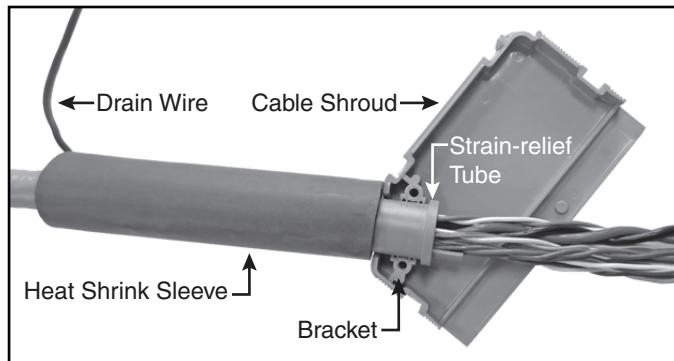
Be sure the ferrite cylinder abuts the edge of the jacket at one end and the edge of the strain-relief tube (opposite the flange) at the other end.

- k. Place the cable onto the base of the supplied cable shroud so that the strain-relief tube is seated properly in the bracket (see Figure 31). Later, you will secure the cable here with a clamp.
- l. Slide the heat shrink sleeve up the cable until it abuts the edge of the cable shroud. Hold the heat shrink sleeve in this position.
- m. Remove the cable from the shroud.
- n. Using a heat gun, apply heat to the heat shrink sleeve evenly, from one end to the other, until it conforms to the cable (see Figure 32).

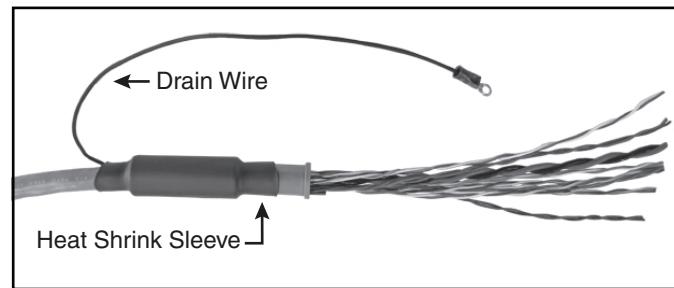
**Figure 30: Positioning the Ferrite Cylinder and Strain-relief Tube**



**Figure 31: Positioning the Heat Shrink Sleeve**



**Figure 32: Prepared Power/Data Cable**



# 12 Wire the ICM

Follow these steps to wire the belowdecks equipment (see page 47 for a complete wiring diagram).

## Connect the Antenna Power/Data Cable

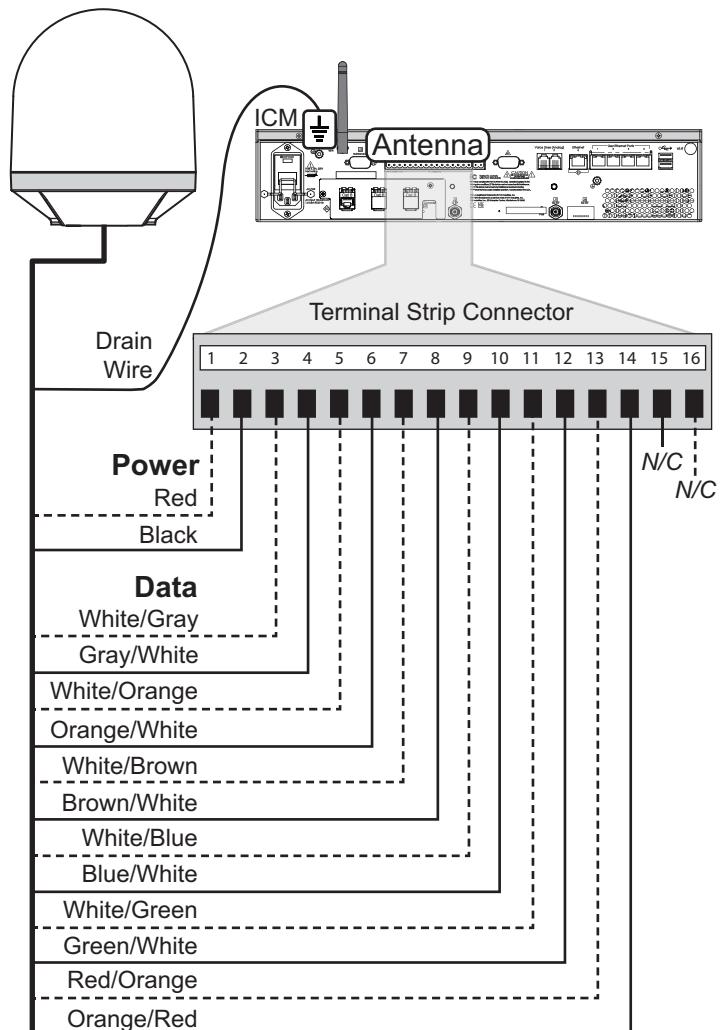
- Connect the antenna power/data cable to the supplied 16-position terminal strip connector as shown in Figure 33.

### IMPORTANT!

The diagram refers to wires by **body color/stripe color**. For example, "Brown/White" means the brown wire with white stripe.

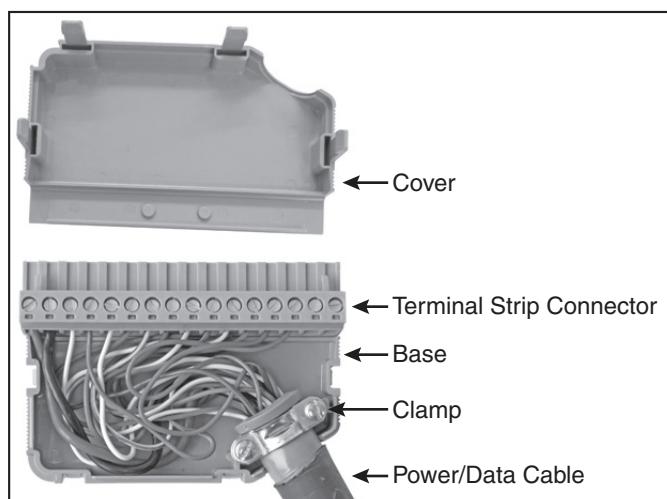
- Place the terminal strip connector into the base of the supplied cable shroud as shown in Figure 34.
- Secure the end of the power/data cable to the base of the shroud using the supplied clamp. This clamp will help relieve stress on the cable. Secure the clamp in place with the two screws.
- Carefully fit all of the power/data cable's wires (except the drain wire) within the base of the shroud.
- Snap the shroud's cover onto the base. Be sure not to pinch any wires between the cover and the base.
- Plug the terminal strip connector into the rear panel of the ICM.
- Connect the drain wire of the power/data cable to either ground point on the rear panel of the ICM.

Figure 33: Antenna Power/Data Wiring



Two unused wires are reserved for future use; N/C = Not Connected

Figure 34: Power/Data Cable Shroud



## Connect an NMEA 0183 Talker

The antenna requires a vessel heading input from a customer-supplied NMEA talker. Optionally, you can also provide a vessel position input to serve as a backup to the antenna's internal GPS.

To supply both the required heading and the optional position to the ICM, you can either connect an NMEA 0183 talker that transmits both messages, or connect two devices using an NMEA data multiplexer, such as Actisense® model NDC-4.

- Configure the customer's NMEA 0183 talker(s) to transmit a compatible message or messages at 4800 baud (see Figure 35).

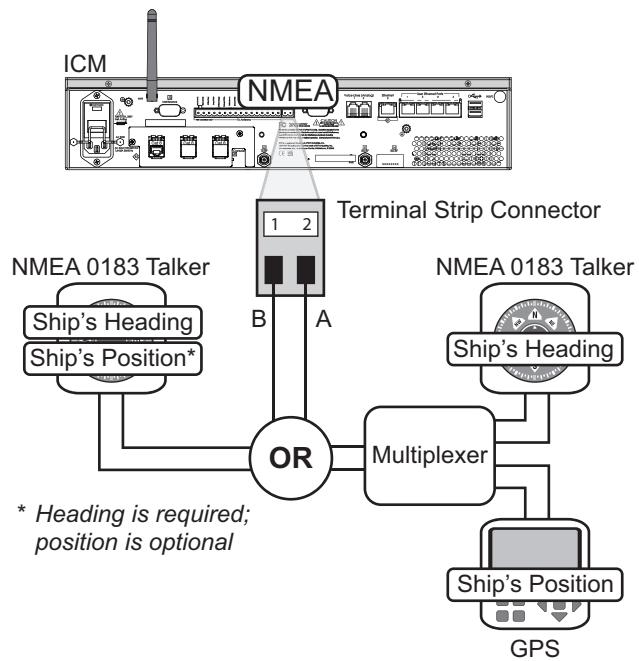
*NOTE: The system does not accept messages that conform to the NMEA 2000 standard.*

- Make sure the data message(s) includes the checksum, identifiable by a \*xx field at the end of the data sentence (e.g., \$HEHDT,123.4, T\*1F). Do not exceed a 10 Hz input rate.
- Connect the NMEA 0183 talker or NMEA data multiplexer to the supplied 2-position terminal strip connector as shown in Figure 36.
- Plug the terminal strip connector into the rear panel of the ICM.

Figure 35: Compatible NMEA 0183 Inputs

Data Type	Compatible Messages
True or Magnetic Heading	\$--HDG \$--HDM \$--HDT \$--OSD \$--THS \$--VHW
Position	\$--RMC

Figure 36: NMEA Wiring



## Connect the RF Cables

**IMPORTANT!**

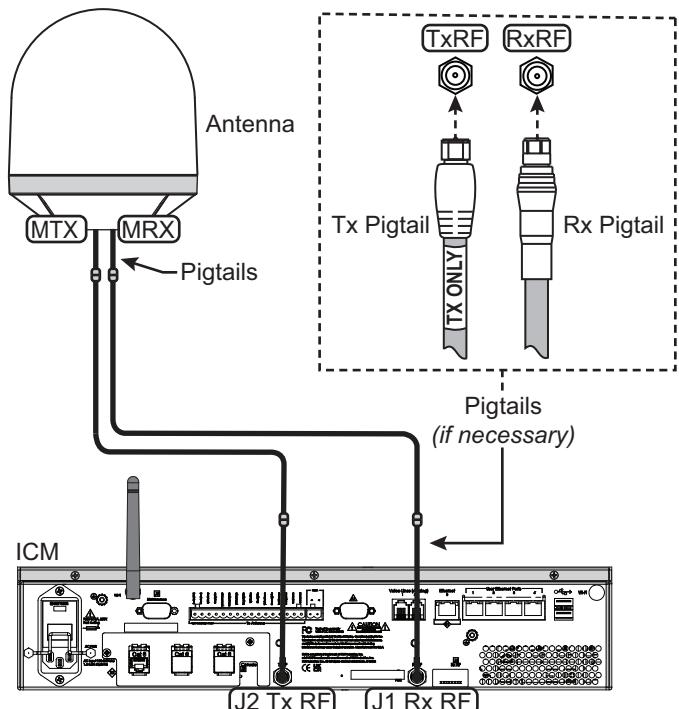
If you are using LMR-600-75 RF cables, do not connect them directly to the ICM. Connect the supplied 1 ft (30 cm) pigtail cables between the RF cables and the ICM. Be sure to use the pigtail cable labeled "TX ONLY" at the ICM's "J2 Tx RF" jack.

- a. Connect the RF coax cable labeled "RX" to the "J1 Rx RF" jack on the back of the ICM (see Figure 37). Hand-tighten, then tighten with a 7/16" torque wrench set to 20 in.-lbs.
- b. Connect the RF coax cable labeled "TX" to the "J2 Tx RF" jack on the back of the ICM. Hand-tighten, then tighten with a 7/16" torque wrench set to 20 in.-lbs.

**IMPORTANT!**

Be sure the RF cables are terminated properly with type "F" connectors.

Figure 37: Antenna RF Transmit and Receive Wiring



# 13 Connect Power

Before you begin, be sure that you understand the following important requirements:

## AC Power Requirements

The FM60-VSAT system is designed to run on 3-wire single-phase AC power (hot, neutral, and ground). Voltage between hot-neutral and hot-ground should each measure between 100-240 VAC.

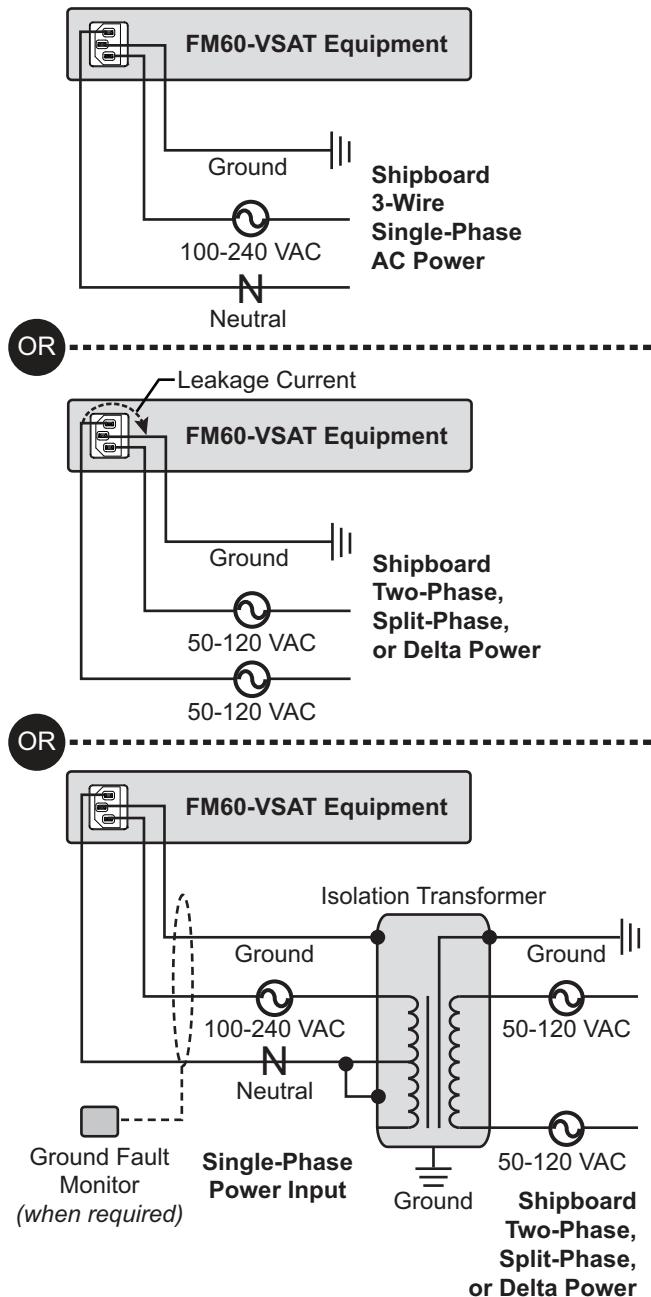
Many large ships use two-phase, split-phase, or delta power instead (3 wires: hot, hot, and ground; no neutral). In this case, voltage between hot-hot measures the proper voltage (100-240 VAC); while hot-ground measures only half the voltage (50-120 VAC). Although the FM60-VSAT system can operate on this type of power, the excess voltage present on the second phase will cause a small amount of current to leak onto ship's ground. This leakage current might be unacceptable on some vessels. So check with the customer or ship's electrician and get permission before you run the system on two-phase power. Also be sure to ground the system, as explained below.

If two-phase power is the only available power source onboard, and if leakage current is unacceptable, it is recommended that you install a suitable isolation transformer to supply single-phase power to the antenna system and run a ground wire from the transformer to ship's ground. In addition, since ground fault protection devices cannot detect faults behind a transformer, you will also need to install a ground fault monitoring device between the isolation transformer and the antenna system if ground fault protection is required on the vessel.

## Grounding Requirements

Proper grounding of the FM60-VSAT system to ship's ground is critically important, as it protects the equipment from electrostatic discharges (ESD). Failure to ground the chassis of the ICM risks damage to the antenna and electric shock.

Figure 38: AC Power Options



Once you have read and understand the requirements described on page 24, follow these steps to connect power to the FM60-VSAT system.

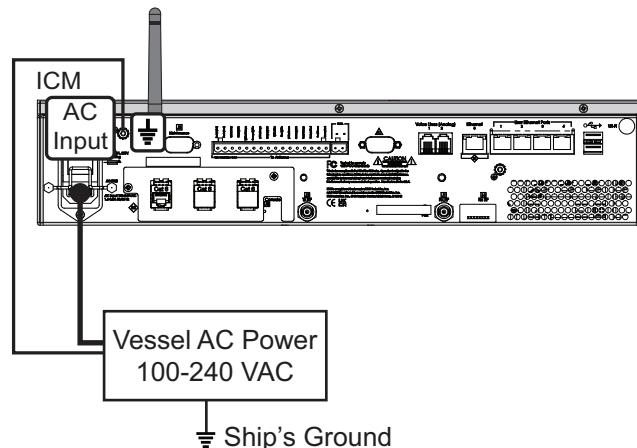
- a. Before you begin, disconnect vessel power and be sure the vessel is properly grounded in accordance with marine standards.
- b. Connect the supplied ground wire from the ground point on the ICM rear panel to ship's ground (see Figure 39).
- c. Connect the supplied AC power cord to the ICM.



#### WARNING

**Failure to ground the FM60-VSAT system properly to ship's ground will cause an unsafe floating ground condition, risking damage to the antenna and electric shock, potentially resulting in DEATH.** In a floating ground condition, the difference between the equipment's chassis ground and the ship's ground can measure well over 100 volts, when it normally should not exceed 2 volts. Therefore, always measure the difference in potential between chassis ground and ship's ground to make certain that there is no dangerous floating ground condition, even if the ground pin of the vessel's AC power plug appears to be intact.

Figure 39: Power Wiring



- d. Using tie-wraps, secure all wires to the strain-relief bracket at the back of the ICM. Leave enough slack for easy serviceability.
- e. Double-check all of your wiring.
- f. Plug the ICM power cord into the vessel's 100-240 VAC supply.

*NOTE: Consider installing an uninterruptible power supply (UPS) to avoid service interruptions during power outages and transitions to/from shore power.*

# 14 Turn On the System

Follow these steps to turn on the system.

- a. Ensure the antenna has a clear, unobstructed view of the sky.
- b. Apply vessel power to the FM60-VSAT system.
- c. Press the power button on the front of the ICM (see Figure 40). The button's light should illuminate blue.
- d. Measure the AC and DC voltages between the ground point on the ICM's rear panel (chassis ground) and ship's ground. Make sure you measure less than 2 VAC/2 VDC.
- e. Wait at least 5 minutes for system startup.
- f. After the startup sequence is complete, verify that the ICM's Control Unit status light is lit solid green and the Antenna and Modem lights are lit solid or flashing green (see Figure 41).
- g. Connect your PC to the User Ethernet 1 port on the rear panel of the ICM (see Figure 42).
- h. Turn off the Wi-Fi on your PC and keep it turned off while connected to the ICM.
- i. Open a web browser on your PC and enter the ICM's IP address (*you can find this address on the LCD: go to Settings > Network Settings > IP Assignments*) and make sure your PC is configured for DHCP.

Figure 40: Power Button

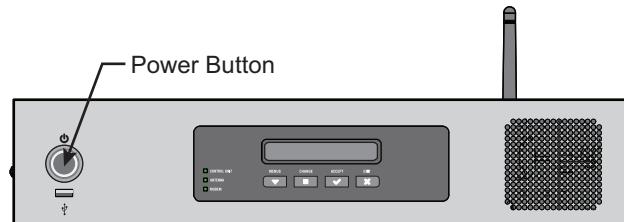


Figure 41: Status Lights

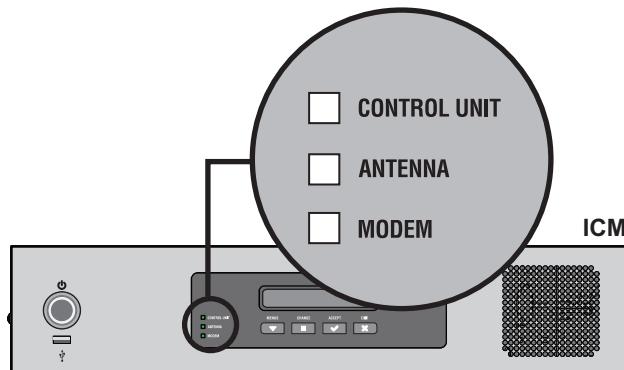
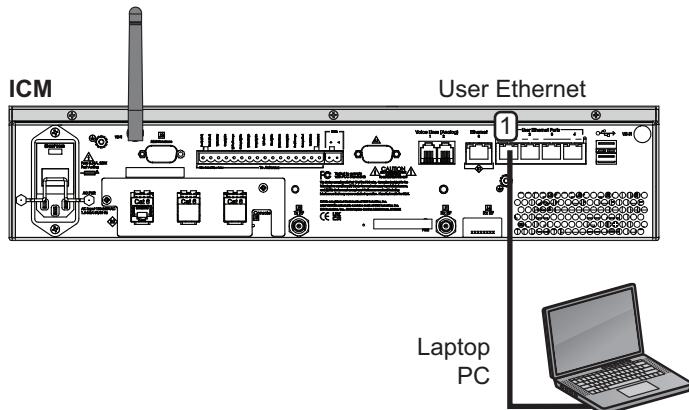


Figure 42: Connecting Your Laptop to the ICM



Follow these steps to install the latest software acquired from your service provider in the FM60-VSAT system.

## Update the Software

- a. Click **Choose File**.
- b. At the Login window, enter the default password: “**password**”.
- c. Click **Browse** and navigate to the file you saved on your laptop (see Figure 44).
- d. Click **Check File**.
- e. At the confirmation message, click **Update**.
- f. Wait for the software update to complete. It might take up to 40 minutes.

Figure 43: Updates Page on Web Interface

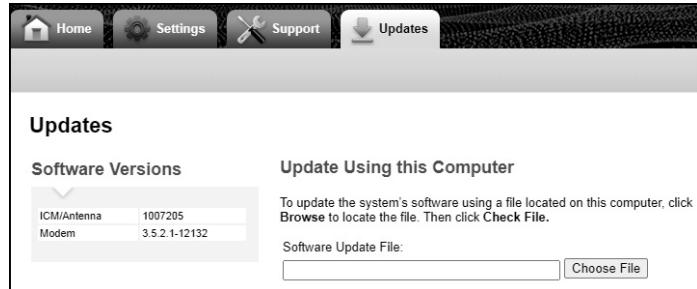
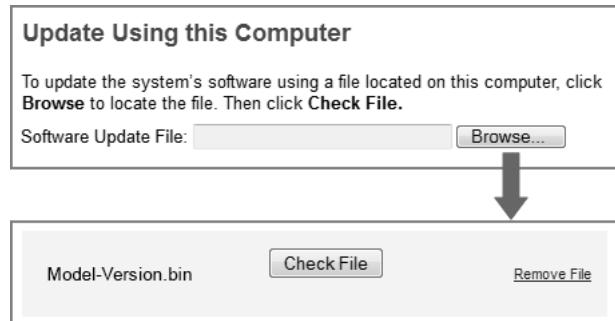


Figure 44: Update File Selected for Upload



Follow these steps to customize the web interface for the customer's use.

## Set the Administrator Password

The user must be logged in as an administrator to make changes to the system's configuration. Follow these steps to change the administrator password to something unique.

- a. At the FM60-VSAT web interface, click the **Settings** tab. Then click **Account**.
- b. In Security, click **Edit**.
- c. For the current password, enter the default password: “**password**” (see Figure 45).
- d. Enter and then re-enter the new password. Then click **Save Settings**.

## Enter the Vessel Name

The vessel name is displayed on the home page and in all support communications. Follow these steps to enter the correct vessel name.

- a. At the FM60-VSAT web interface, click the **Settings** tab. Then click **Account**.
- b. In Vessel Name, click **Edit**.
- c. Enter the vessel name (see Figure 46). Then click **Save Settings**.

Figure 45: Setting the Administrator Password

The screenshot shows a 'Security' settings page. It has three input fields: 'Enter the current password' containing '\*\*\*\*\*', 'Enter the new password' containing '\*\*\*\*\*' with a note '(between 4 and 20 characters long, with at least one letter and one number, case sensitive)' and a checked 'Strong' checkbox, and 'Re-enter the new password' containing '\*\*\*\*\*'. Below the fields are 'Cancel' and 'Save Settings' buttons.

Figure 46: Entering the Vessel Name

The screenshot shows a 'Vessel Name' settings page. It has a single input field 'Vessel Name' containing 'Britanic'. Below the field are 'Cancel' and 'Save Settings' buttons.

To prevent exposure to RF energy, which may be harmful to people who stand within 36 feet (11 meters) of the antenna, you can configure up to two no-transmit zones for areas where crew and/or passengers frequent (see Figure 47). The system will disable the transmitter whenever the antenna is pointing within one of these zones.

Follow these steps to set up a no-transmit zone.

- Determine the necessary azimuth range for the no-transmit zone(s). You will need to enter, in clockwise order, beginning and ending azimuths that define the outer boundaries of the zone(s) **relative to the antenna's forward arrow**, which should be pointing toward the bow (see Figure 48).
- Determine the necessary elevation range for each no-transmit zone(s) (see Figure 49).

**NOTE:** Each no-transmit zone must span at least 5° in both azimuth and elevation.

Figure 47: Example of No-Transmit Zone Azimuth Range

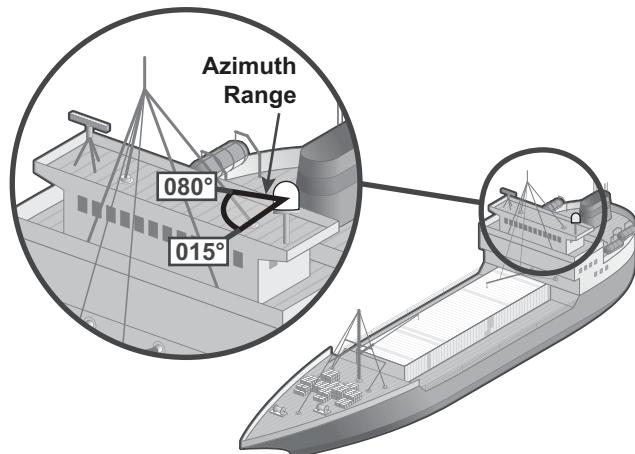


Figure 48: Azimuths Relative to Antenna's Forward Arrow

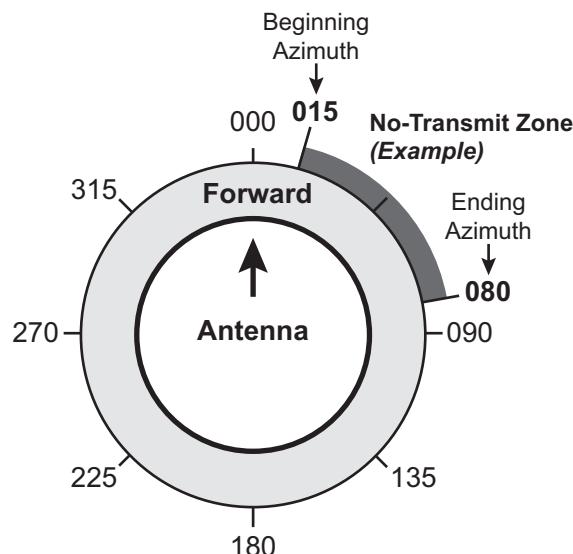
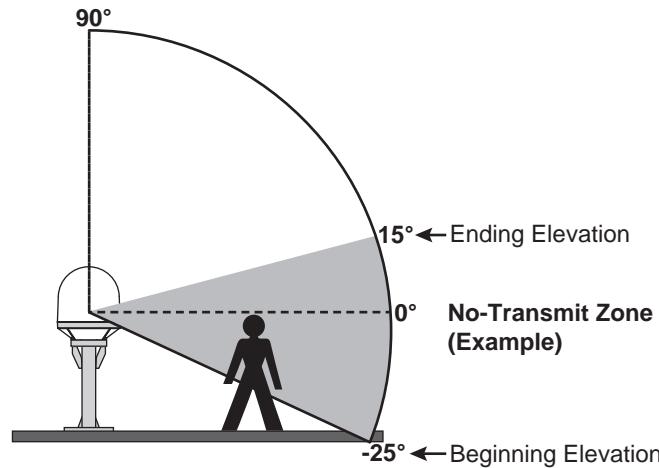


Figure 49: Example of No-Transmit Zone Elevation Range



- c. At the FM60-VSAT web interface, click the **Settings** tab. Then click **No-Transmit Zones**.
- d. Click **Edit**.
- e. Make sure **Enforce Zones** is selected (see Figure 50).
- f. Enter the azimuth and elevation ranges for Zone 1.
- g. If you need to set up a second zone, select Zone 2 from the drop-down menu. Then enter the azimuth and elevation ranges for Zone 2.
- h. Click **Save Settings**.
- i. At the confirmation message, click **Save**.

Figure 50: No-Transmit Zones Page of Web Interface

**No-Transmit Zone Ranges:**

**Enforce Zones**  
*The antenna will not transmit within the zone(s) specified below.*

**Ignore Zones**  
*The antenna will be able to transmit in any direction without restriction. Be sure everyone stays the minimum safe distance away from the antenna.*

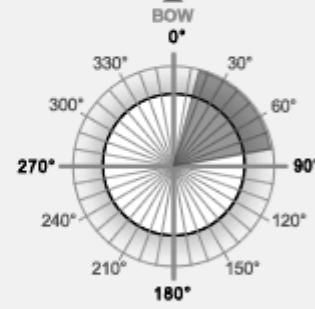
**Choose a No-Transmit Zone:**

Zone 1

**Zone 1**

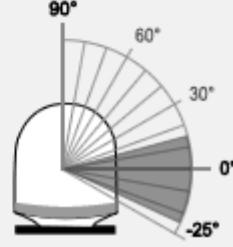
Azimuth Range:  
*Must span at least 5°*

From:  °      To:  °



Elevation Range:  
*Must span at least 5°*

From:  °      To:  °



**Cancel** **Clear Zones** **Save Settings**

Follow these steps to commission the ICM's built-in modem.

This process is required to determine the 1 dB compression point of the BUC (block up-converter) (see Figure 51) and the maximum transmit power. The process takes about 30 minutes to complete.

- a. Ensure the antenna has a clear, unobstructed view of the sky.
- b. At the FM60-VSAT web interface, verify that the antenna is tracking the service satellite (see Figure 52). The system will not go online until the modem is configured for satellite service.
- c. Call Technical Support to coordinate with the Network Operations Center (NOC) to complete the remaining commissioning steps over the air.

*NOTE: If the NOC is unable to access the system remotely over the satellite connection, you will need to assist with the commissioning process by adjusting settings at the modem's local web interface as directed by the NOC. Refer to "Educate the Customer" on page 36 for details.*

Figure 51: BUC's 1 dB Compression Point Determination

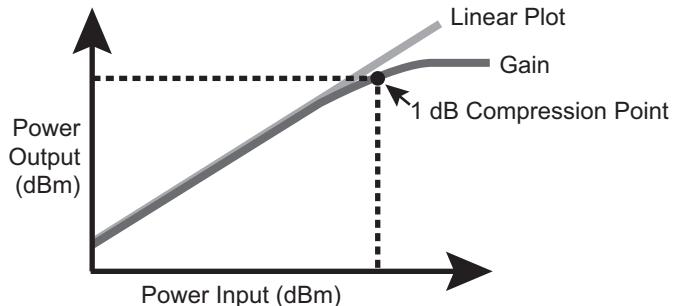


Figure 52: Good Service Connection Indicated on Home Page

My VSAT Status	
Connection Status	Antenna State
<b>ONLINE</b> SNR: 5.80dB	<b>TRACKING</b>

# 19 Test the System

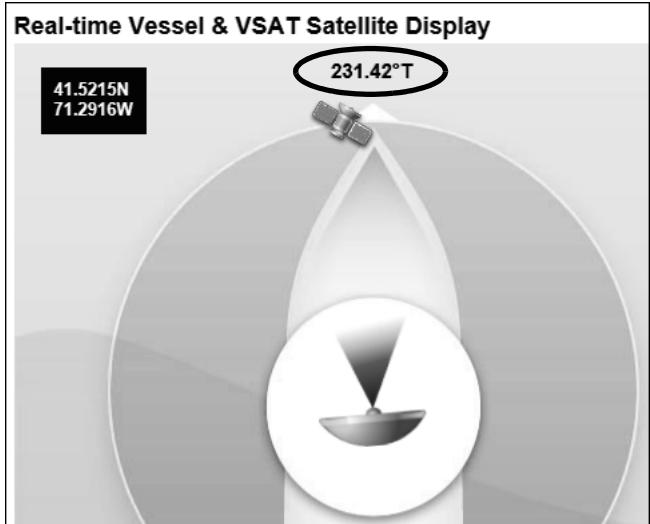
Follow these steps to test the system for proper operation after the modem has been configured for satellite service.

- a. Ensure the antenna has a clear, unobstructed view of the sky.
- b. Verify that the antenna is tracking the service satellite indicated by the Home page of the FM60-VSAT web interface (see Figure 53). The system will not go online until the modem is configured for satellite service.
- c. On the Home page, make sure the vessel's heading is displayed in the Real-time Vessel & VSAT Satellite Display (see Figure 54). If it is not shown, check your wiring to the NMEA 0183 talker.

Figure 53: Good Service Connection Indicated on Home Page

My VSAT Status	
Connection Status	Antenna State
 <b>ONLINE</b> SNR: 5.80dB	<b>TRACKING</b>

Figure 54: Heading Displayed on Home Page



## FLEX HTS Configuration

In a FLEX HTS configuration, User Ethernet ports 1 and 2 provide access to the ICM's web interface (see Figure 55). User Ethernet Port 1 is configured with a DHCP server, and by default, any device connected to this port will be assigned an IP address in the range of 192.168.5.0/24. User Ethernet Port 2 has a static IP address of 192.168.1.9/24 for the ICM and 192.168.1.1 for the modem. When connecting a device to this network, it is recommended to assign it a static IP address of 192.168.1.x/24. Additionally, the Modem ETH1 port provides user access to the Internet. This is the default configuration. Follow these additional steps to configure the network.

*NOTE: DHCP simplifies network management by allowing the ICM to automatically assign IP addresses to devices. In contrast, static IP addresses enable manual configuration of devices with fixed IP addresses. These devices do not rely on the ICM for IP address assignment.*

## Configure the Modem

To access the modem's web interface, connect to the User Ethernet 1 port (see Figure 56). Follow these additional steps to configure the network.

- Open a web browser and enter the modem's IP address. The default is **192.168.1.1**.
- At the modem's login page, enter the admin credentials. The default settings are as follows:
  - User Name: **admin**
  - Password: **iDirect**
- Contact Technical Support for help with uploading a configuration file.

Figure 55: FLEX HTS Configuration

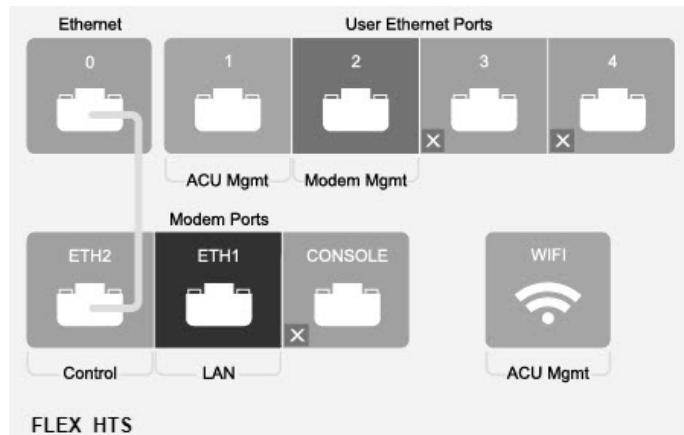
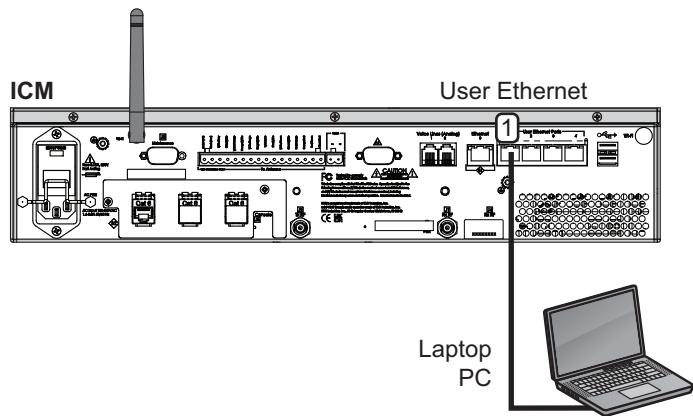


Figure 56: Modem Configuration

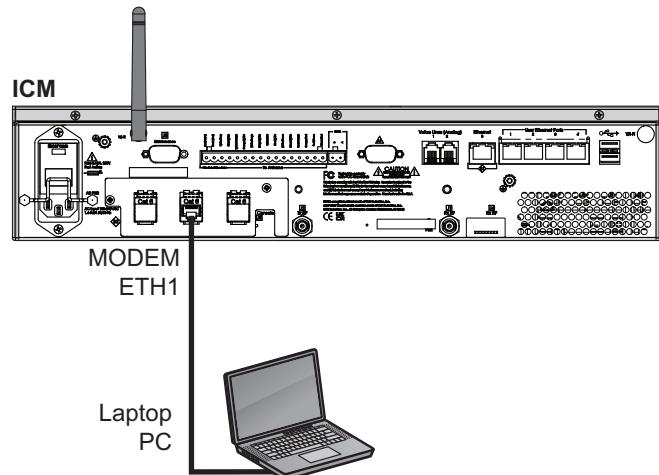


## Connect to the Internet

Follow these steps to connect to the Internet.

- a. Make sure the FM60-VSAT system is online.
- b. Connect your computers and/or other network devices to the ICM's MODEM ETH1 port (see Figure 57).

Figure 57: Internet Access



## ICM Wireless Settings

With Wi-Fi enabled, vessel devices can connect to the ICM's web interface via its built-in wireless access point (WAP) and receive IP addresses from the ICM via DHCP (see Figure 58), or by configuring static IP addresses. Follow these steps to enable and configure the WAP, if desired by the customer.

### **IMPORTANT!**

Establishing a wireless connection onboard a steel vessel might require a special external WAP and advanced networking expertise.

- At the FM60-VSAT web interface, click the **Settings** tab. Then click **Network Settings**.
- In Wi-Fi Settings, click **Edit**.
- Set the following wireless options, then click **Save** (see Figure 59):
  - State:** Select On.
  - SSID:** Enter a unique name for the vessel network.
  - Protocol:** Select either 802.11b or 802.11g.
  - Security:** Select either security type – WPA2 or WEP (128-bit).
  - Password/Passphrase:** If you selected WPA2, enter a password (between 8-20 characters). If you selected WEP, enter a passphrase (must be 13 characters).
  - Channel:** Keep the default, or select any channel for wireless communications.

### **IMPORTANT!**

Failure to apply security settings will make the vessel's wireless network vulnerable to outside intrusion.

Figure 58: Wireless DHCP (Example)

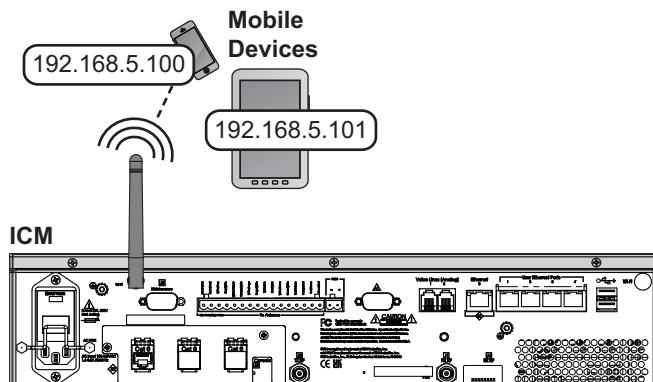


Figure 59: Wi-Fi Settings on the ICM

Wi-Fi Settings	
<b>State:</b>	<input checked="" type="radio"/> On <input type="radio"/> Off (default)
<b>SSID:</b>	FlexHTS <small>(Up to 32 characters)</small>
<b>IP Address:</b>	192.168.5.1
<b>Protocol:</b>	802.11b
<b>Security:</b>	WPA2
<b>Password:</b>	..... <small>(between 8 to 20 characters)</small>
<b>Channel:</b>	6
<input type="button" value="Cancel"/> <input type="button" value="Save"/>	

- At the confirmation message, click **Save**.

Give the Welcome Kit to the customer, make sure to give them the administrator and Wi-Fi passwords, and show them how to use the system. Be sure they understand the following:

- **The antenna transmits RF energy that is potentially harmful.** Whenever the system is powered on, make sure everyone stays the minimum safe distance away from the antenna (see illustration on page 1). If no-transmit zones were set up, make sure the customer understands where they are.
- Keep the radome installed on the antenna at all times. The radome protects the antenna's moving parts from wind, rain, and debris.
- The antenna must have a clear view of the sky to communicate via satellite. Common causes of blockage include masts, trees, buildings, and bridges (see Figure 61). Dirt buildup on the radome can also affect communications.
- The vessel must be located within the coverage area of the satellite.
- The system must be activated for satellite service.

## For More Information

Refer to the Help provided on the web interface's Support page (see Figure 62). The Condensed version is text only and resides on the ICM. The Extended version includes images and resides on the Internet.

Figure 60: Customer Welcome Kit



Figure 61: Example of Satellite Blockage

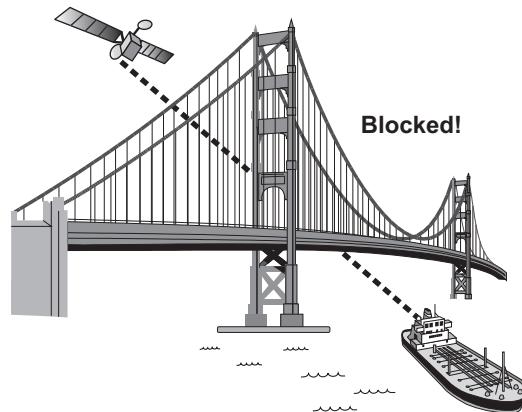
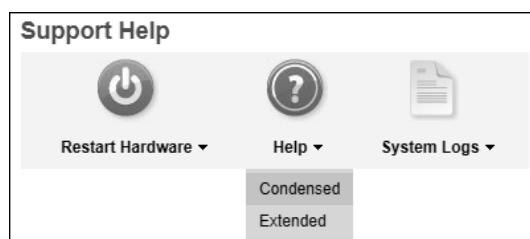


Figure 62: Help Options on Support Page



If you need to commission the modem (see “Commission the Modem” on page 31), and if the NOC is unable to access the FM60-VSAT system remotely over the satellite connection (a rare case), follow the steps below to access the built-in modem’s web interface and assist the NOC with the commissioning process.

1. At the FM60-VSAT web interface, click the **Support** tab.
2. Click the link on the Support page to open the modem commissioning wizard (see Figure 63). Then log into the wizard using the administrator password you set up earlier. The default settings are as follows:
  - User Name: **admin**
  - Password: **password**
3. At Step 1, click **Enter Commissioning Mode** (see Figure 64).

Figure 63: Support Page Link to Commissioning Wizard and Login

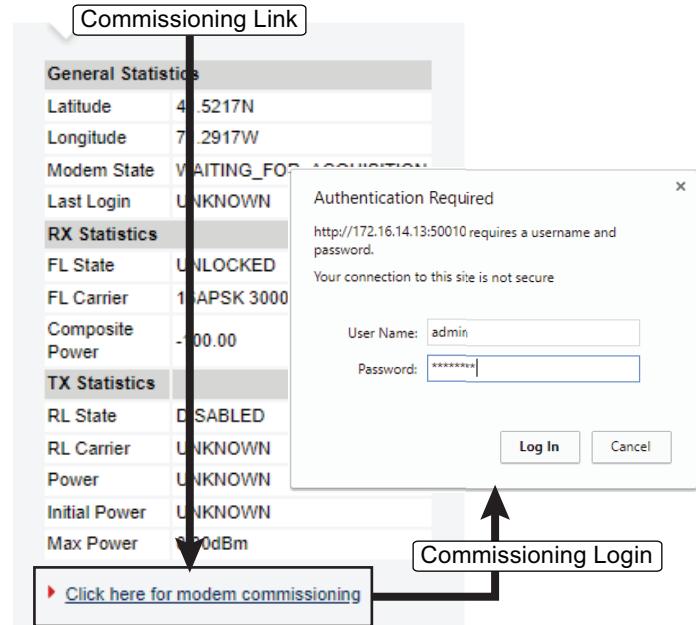
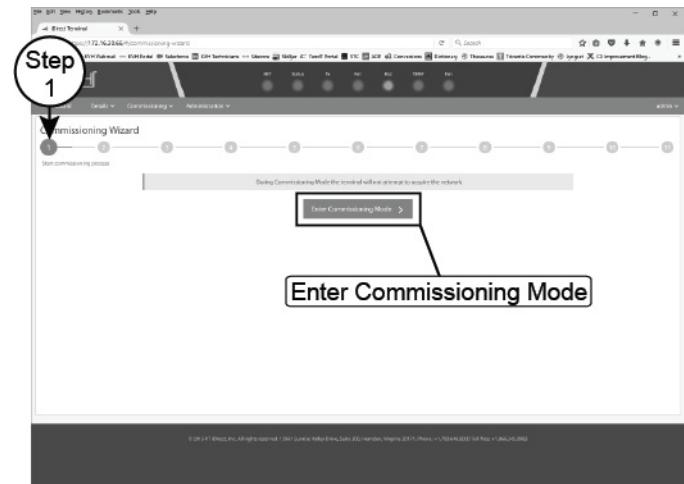


Figure 64: Commissioning Process – Step 1



- At Step 2, click **Continue without changes** (see Figure 65).

**IMPORTANT!**

If you need to abort commissioning at any time, select **Exit commissioning mode**. *Cycling power will not revert the ICM to normal operation mode.*

- At Step 3, enter your latitude and longitude (see Figure 66).

**NOTE:** Select the direction (North/South, East/West) before entering each value.

- Enter the orbital slot (longitude) of the satellite the antenna is tracking.

**NOTE:** Select the direction (East/West) before entering the value.

- Click **Save remote location and continue** (see Figure 66).

## Appendix

Figure 65: Commissioning Process – Step 2

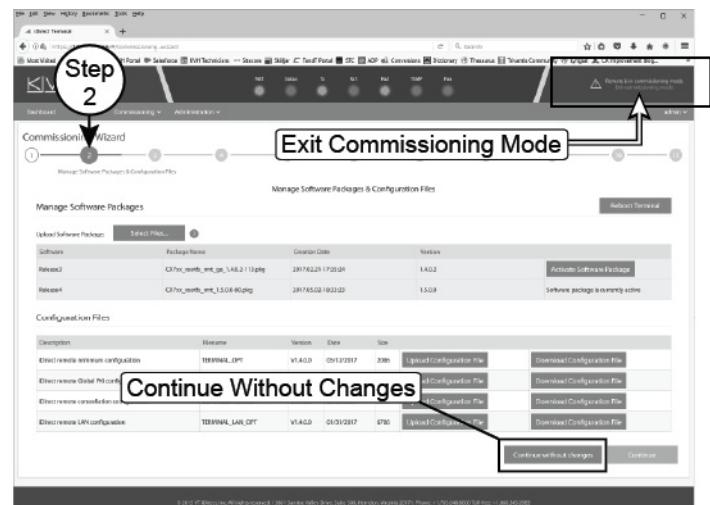
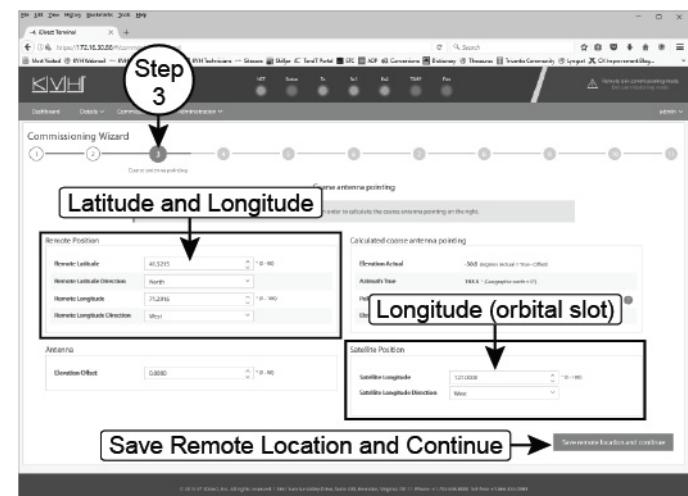


Figure 66: Commissioning Process – Step 3



8. At Step 4, enter the satellite parameters provided by your service provider. Verify that the Frequency and the FL Carrier Symbol Rate match the values provided by your service provider and enter zeros for Latitude Variance and Polarization Skew.

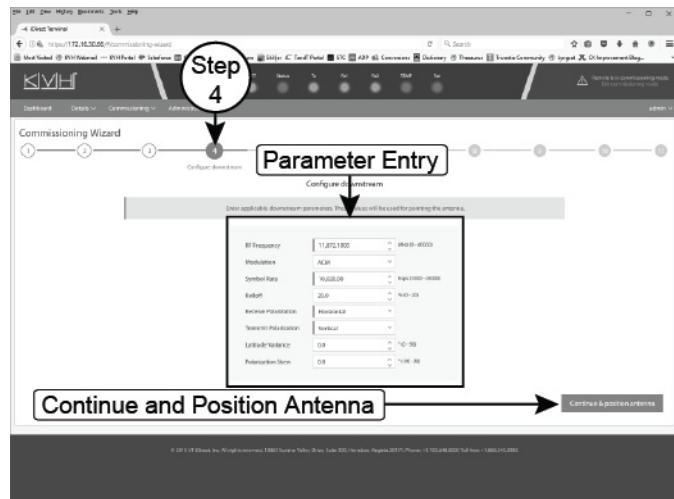
When you are done, click **Continue and position antenna** (see Figure 67).

9. At Step 5, wait until you see the following (see Figure 68):

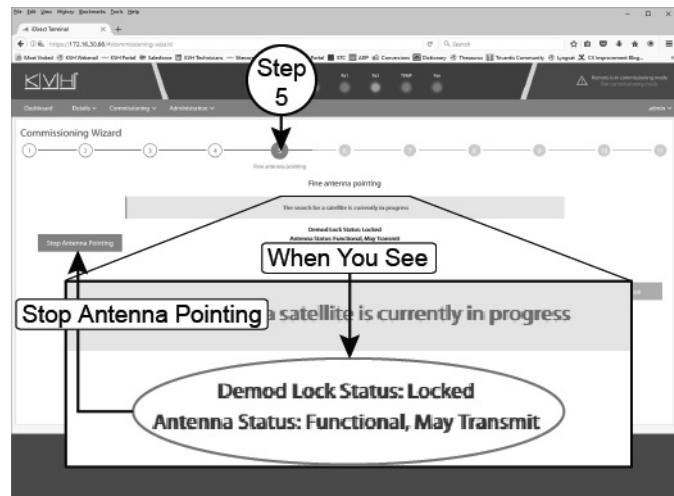
- Demod Lock Status: Locked
- Antenna Status: Functional, May Transmit

Then click **Stop Antenna pointing**.

**Figure 67: Commissioning Process – Step 4**



**Figure 68: Commissioning Process – Step 5**

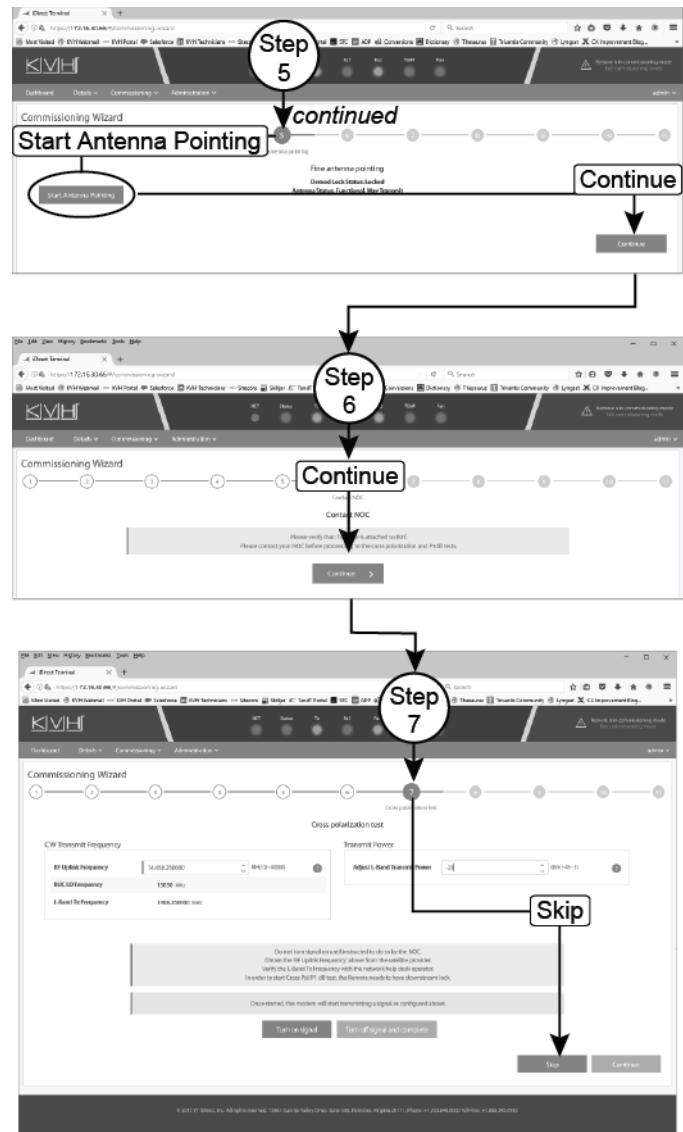


10. When Start Antenna Pointing appears, click Continue (see Figure 69).

11. At Step 6, click Continue (see Figure 69).

12. At Step 7, click Skip (see Figure 69).

Figure 69: Commissioning – Steps 5 Through 7



# Continued Full Commissioning Steps

13. At Step 8, select **CW modulation** and enter the **RF Uplink Frequency** and the initial **Transmit power** that the NOC provided (see Figure 70). Then click **Turn on signal**.
14. Continue by using **Adjust L-Band Transmit Power** to adjust the power in 1 dB increments as directed by the NOC and selecting **Apply changes** after each increment (see Figure 71). When directed, click **Turn off signal and complete**.

**NOTE:** Take note of the P1dB compression value that is also provided by the NOC. You will enter this value later.

15. Next, select **BPSK modulation** and enter the **RF uplink frequency** and the **Starting transmit power** (see Figure 72) provided by the NOC. Then click **Turn on signal**.

## Appendix

Figure 70: Commissioning – Step 8: CW Modulation

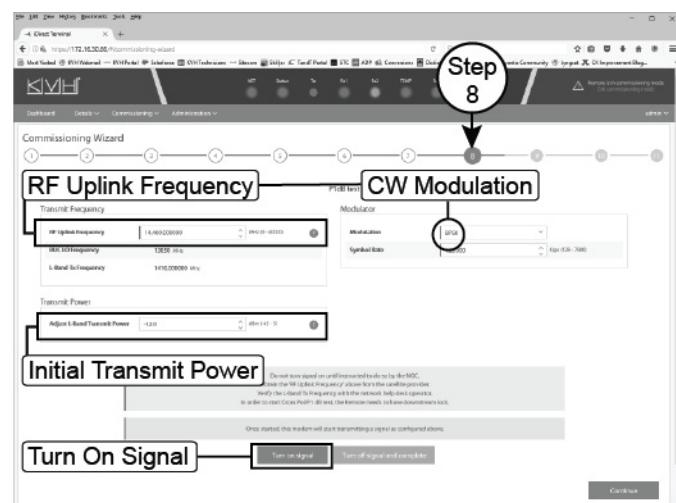


Figure 71: Commissioning – Step 8: CW Modulation *continued*

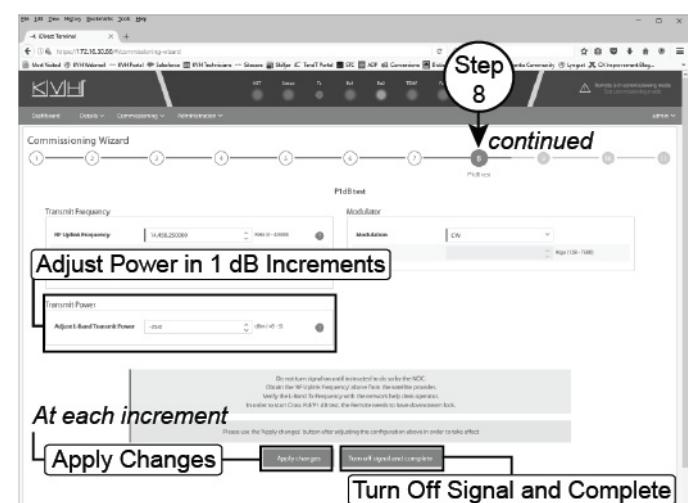
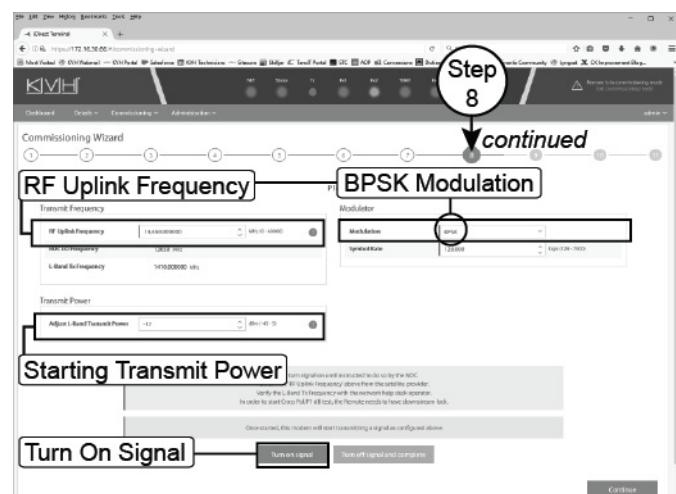


Figure 72: Commissioning – Step 8: BPSK Modulation



# Continued Full Commissioning Steps

16. Continue by using **Adjust L-Band Transmit Power** to adjust the power in 1 dB increments as directed by the NOC and selecting **Apply changes** after each increment (see Figure 73). When directed, click **Turn off signal and complete**.

**NOTE:** Take note of the Maximum transmit (TX) power value provided by the NOC.

17. At Step 9, enter the P1dB compression value and the **Maximum transmit (TX) power** value provided by the NOC.

**IMPORTANT!**

Double-check your entries for the P1dB and Maximum TX Power. Maximum TX Power should **always** be one decibel less than the P1dB value. (For example, if P1dB = -15.0 dB then Max TX power = -16.0 dB.)

Then click **Continue** (see Figure 74)

18. At Step 10, click **Exit commissioning mode** (see Figure 75).  
 19. At Step 11, click **Return to dashboard** (see Figure 75).

Close the modem commissioning wizard. Commissioning is complete!

## Appendix

Figure 73: Commissioning – Step 8: BPSK Modulation *continued*

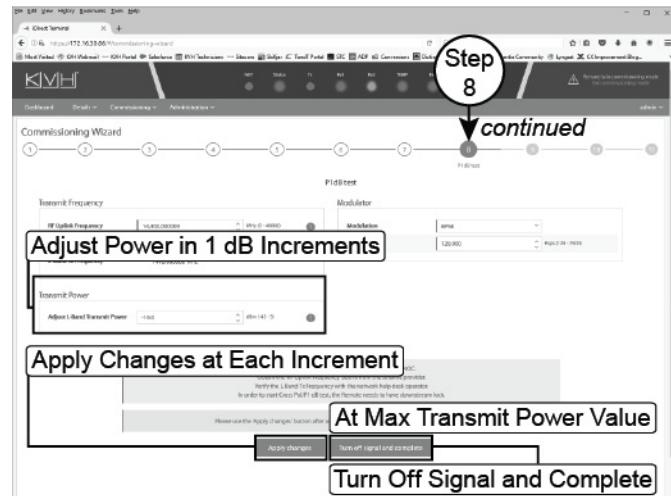


Figure 74: Commissioning – Step 9

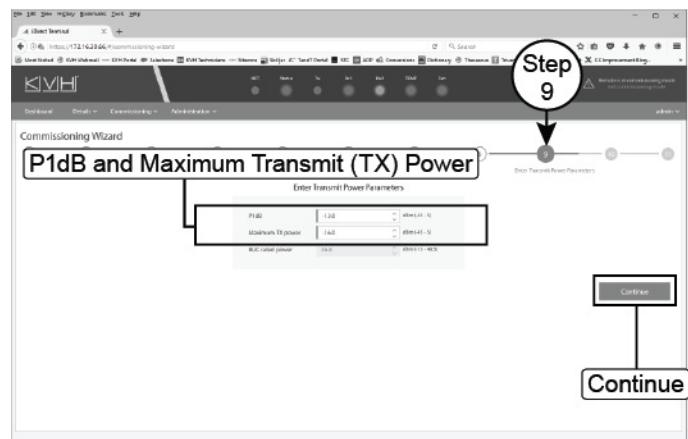
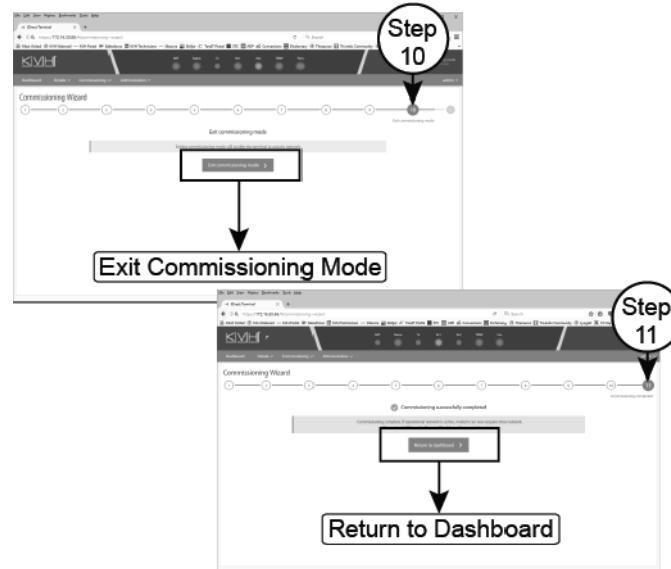


Figure 75: Commissioning – Steps 10 and 11



These instructions explain how to terminate an LMR-400-75 RF cable with an EZ-400-FMH-75 "F" connector using the tools from the TK-400EZ-75 tool kit. The same steps also apply to an LMR-600-75 cable, with the exception of the tools used.

For more detailed instructions, refer to the Times Microwave website: [www.timesmicrowave.com](http://www.timesmicrowave.com).

1. Using the CCT-01 cutting tool, cut the cable evenly (see Figure 76).
2. Since cutting the cable can deform the end, gently round the end of the cable using a pair of needle-nose pliers (see Figure 77). Also make sure the center conductor is centered within the cable.
3. Place the heat shrink sleeve and metal ferrule onto the cable (see Figure 78).
4. Insert the end of the cable into the #1 end of the ST-400EZ stripping tool (see Figure 79). Then rotate the tool clockwise around the cable until the tool turns easily. The end of the cable should now be stripped to expose the center conductor.

Figure 76: Cutting the Cable



Figure 77: Reshaping the Cable

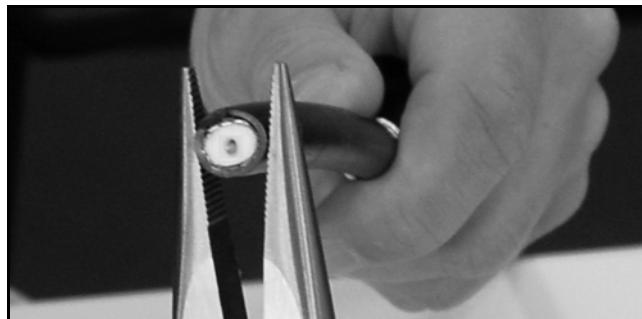


Figure 78: Placing the Heat Shrink Sleeve and Ferrule

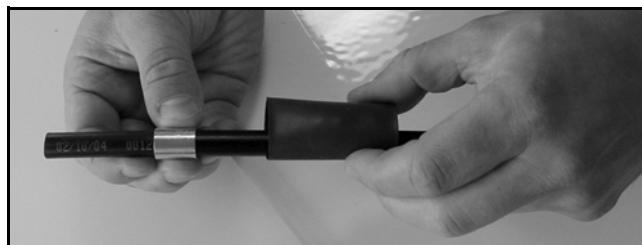


Figure 79: Stripping the End to Expose the Center Conductor



5. Using a utility knife, carefully remove any residual plastic from the center conductor, if necessary (see Figure 80).
6. Insert the end of the cable into the #2 end of the ST-400EZ stripping tool (see Figure 81). Then rotate the tool clockwise around the cable until the tool turns easily. This removes the cable jacket from the end of the cable, exposing the braid and dielectric (see Figure 82).
7. Using the DBT-02 tool, deburr and chamfer the center conductor (see Figure 83). Avoid nicking the aluminum tape covering the dielectric.

Figure 80: Removing Plastic Residue

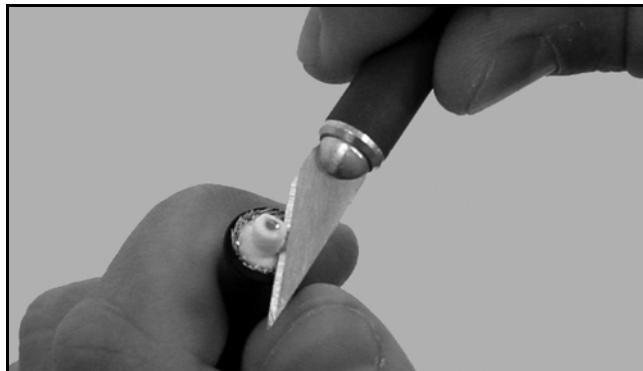


Figure 81: Stripping the Cable Jacket

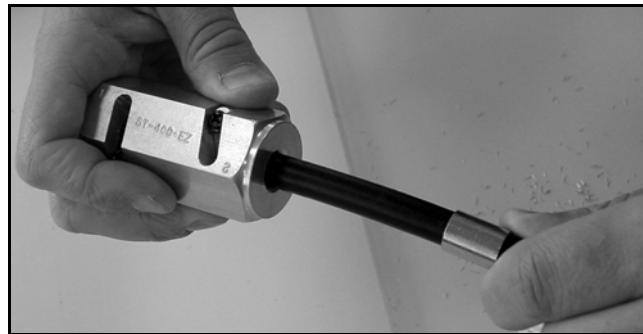


Figure 82: Cable Stripped, Exposing Dielectric



Figure 83: Deburring the Center Conductor



8. Gently flare the braid with your fingers (see Figure 84).
9. Insert the end of the cable into the connector body until the dielectric is firmly seated inside the connector (see Figure 85). Make sure there is no gap between the knurled end of the connector and the cable jacket. Also be sure all braid wires remain on the outside of the connector.

**IMPORTANT!**

A common installation failure occurs when the connector is not seated properly onto the cable. In these cases, the cable's center conductor does not fully engage the electrical contacts inside the connector. To ensure full engagement, make certain that there is no gap between the cable jacket and the knurled end of the connector before you crimp on the ferrule. You may need to deburr and center the end of the conductor to achieve a good fit.

10. Trim any excess braid (see Figure 86), if necessary. The braid should assemble flush to within  $1/16"$  (1.6 mm) of the connector shoulder.
11. Slide the ferrule over the braid until it is flush against the connector shoulder (see Figure 87).

Figure 84: Flaring the Braid



Figure 85: Pushing On the Connector

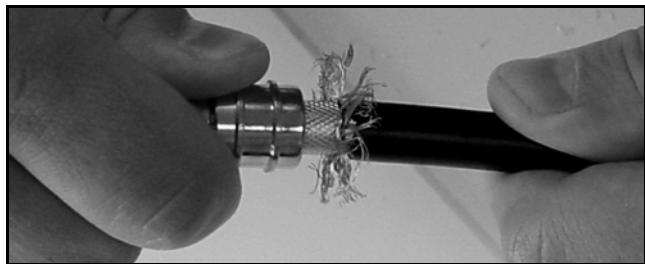


Figure 86: Trimming the Braid

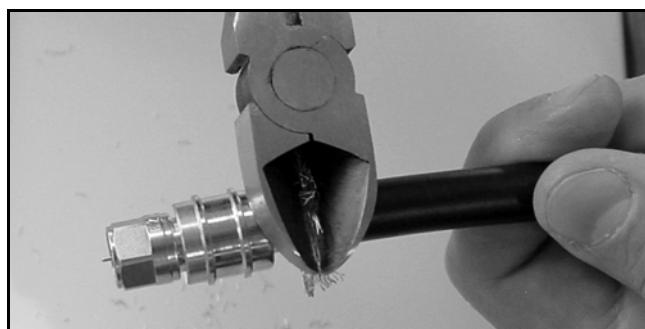
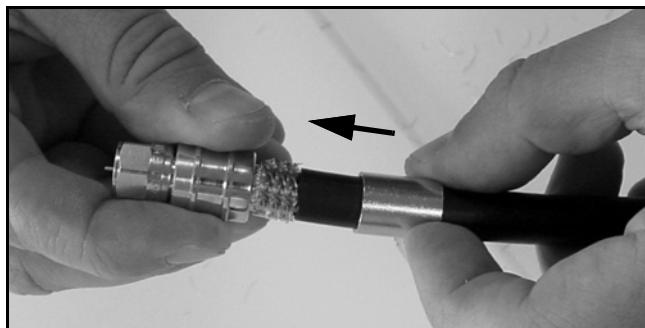


Figure 87: Sliding the Ferrule Over the Braid



12. Using an appropriate crimp tool (either the CT-400/300 or the HX-4 with Y1719 dies), crimp the ferrule in place (see Figure 88). Crimp as close to the connector body as possible.
13. Crimp the ferrule again, but farther back from the connector. However, be careful not to crimp the cable jacket.
14. Slide the heat shrink sleeve over the connector body and heat it to compress it into place (see Figure 89). When you are done, the heat shrink should extend from the rear of the connector to the cable jacket. This forms a weather-tight seal.
15. Using a multimeter or similar device, check the continuity of the cable.
16. Ensure the center conductor pin measures between 0.20" and 0.28" (5-7 mm) in length, to ensure proper engagement with the mating connector (see Figure 90).

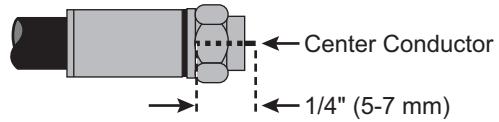
Figure 88: Crimping the Ferrule onto the Cable



Figure 89: Applying the Heat Shrink Sleeve



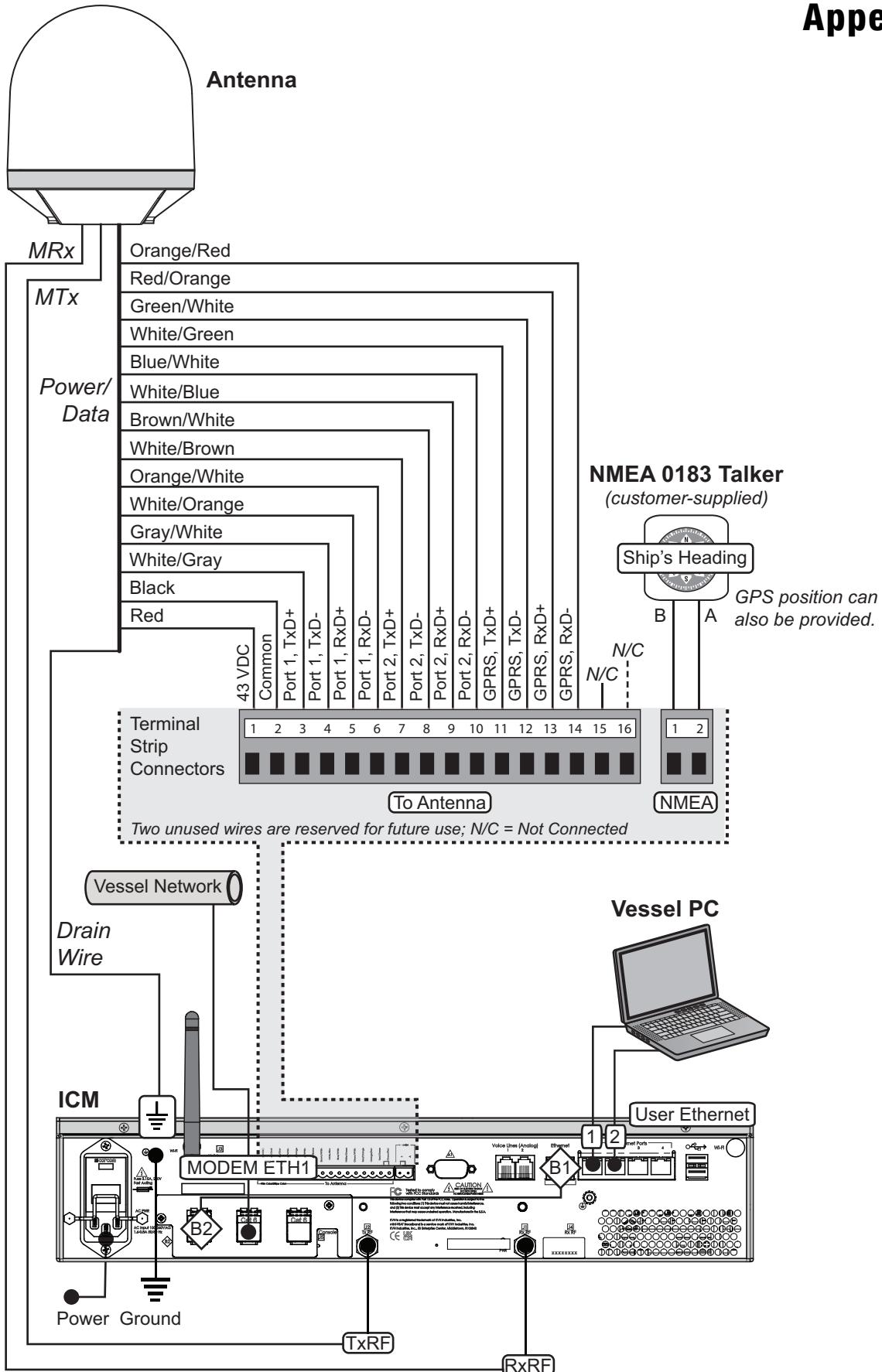
Figure 90: Proper Center Conductor Pin Length



**C**

# Wiring Diagram

## Appendix







CE

UK  
CA

