

Shively Labs[®]

Circularly Polarized FM Broadcast Antenna

Model 6812B



Instruction Manual
Installation, Operation, &
Maintenance

Congratulations!

Thank you for purchasing one of the finest FM broadcast antennas on the market today. The Shively Labs Model 6812B is widely recognized as the top-of-the-line in its class for its superior performance and durability.

Your purchase is backed by the best technical support in the industry. Shively is a leading manufacturer in the broadcast industry, providing an extensive range of antennas, filters, transmission line and components. Our technical staff has a wealth of experience in the broadcast industry and is standing by to serve you in any way.

This manual is intended to give you a basic understanding of your antenna: its proper and safe installation, startup, and operation, and troubleshooting and maintenance information to keep it working satisfactorily for years to come. *Please have everyone involved with the antenna read this manual carefully, and keep it handy for future reference.*

Meanwhile, please feel free to contact your sales representative at Shively Labs at any time if you need information or help. Call or write:

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ISO 9001 Certified

Publication No. im6812B (170516)

IMPORTANT

Please read this manual in its entirety before beginning installation of your antenna!

Failure to follow the installation and operation instructions in this manual could lead to failure of your equipment and might even void your warranty!

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Precautions and Preparation

Precautions

WARNING

Don't expose personnel to the medical hazards of intense radio frequency (RF) radiation. Whenever working on the tower in the area of the antenna, turn off all transmitters and lock them out so that they cannot be turned on accidentally.

For reference on RF safety, see CFR 29, Section 1910.97, the OSHA standard for exposure to non-ionizing radiation.

Check the System

CAUTION

It is YOUR responsibility to ensure that your installation meets all applicable codes and the centerline-of-radiation requirements of your FCC construction permit.

Check the parts to be sure that they will fit the support pipe. Have a reliable tower person, familiar with antennas and coaxial line, inspect the tower and review the installation drawings before the full rigging crew arrives. If design problems are found, contact Shively Labs immediately.

Pay particular attention to:

- Frequency of the antenna.
 - Freedom from interference by gussets, leg flanges, guy wires and their attachment points, tower face members, obstruction lights, and other components.
 - Compatibility of coax connectors and antenna input terminals.
 - Use of non-metallic guy sections on the tower in the region to be occupied by the FM antenna. Ensure that there are no metal guy wires within ten feet (three meters) of any radiator.
 - Proper electrical service for antenna deicers, if applicable.
 - The adequacy of the tower structure and guy wires to carry the windload placed upon them by the antenna, particularly if radomes are used.
-

Storage prior to installation

Keep the antenna system dry. Never store it outdoors. If the antenna gets wet, you will need to dry it before applying transmitter power.

Bay spacing

Table 1. Bay spacing chart

Frequency	"0.85-Wave" Spacing	"Half-Wave" Spacing	Special Spacing
88 - 98 MHz ("Low-Band")	108 in (2.74 m)	63-1/2 in (1.61 m)	11803 x spacing ÷ frequency ; round to closest 1/8"
98 - 108 MHz ("High-Band")	98 in (2.49 m)	57 in (1.45 m)	11803 x spacing ÷ frequency ; round to closest 1/8"

Special spacing example:

For an antenna at 99.3 MHz and 0.75 spacing:

$$11803 \times 0.75 / 99.3 = 89.146 \text{ inches spacing; round to } 89\text{-}1/8\text{'}$$

Bolt tightening

NOTE

Use an anti-seize compound to minimize galling on stainless steel threads.

Table 2. Torque specifications

Hardware size	Torque (dry)	Torque (lubricated)
1/4-20 (radome flanges)	75.2 in-lbf (8.5 N-m)	63.9 in-lbf (7.2 N-m)
5/16-18 (1-5/8" EIA flanges)	132 in-lbf (14.9 N-m)	112 in-lbf (12.7 N-m)
3/8-16 (3-1/8" EIA flanges)	236 in-lbf (26.7 N-m)	201 in-lbf (22.7 N-m)

Precautions

WARNING

Don't expose personnel to the medical hazards of intense radio frequency (RF) radiation. Whenever working on the tower in the area of the antenna, turn off all transmitters and lock them out so that they cannot be turned on accidentally.

Installing the support pipe

The 6812B antenna is designed to mount on a customer-supplied vertical pipe, which in turn is mounted on the tower. Mounting is a little different for side-mounted poles and top-mounted poles.

The pipe must be between 2-3/8" and 3-1/2" (60 and 89 mm) nominal outside diameter. It must extend at least five feet (1500 mm) above the top bay and five feet below the bottom bay.

NOTE

Shively can accommodate other pipe sizes if necessary by special order.

Side-mounted support pipe

Mount your support pipe securely as shown in [Figure 1](#). It must stand off from the tower as described in [Table 3](#).

Figure 1. Support pipe installation

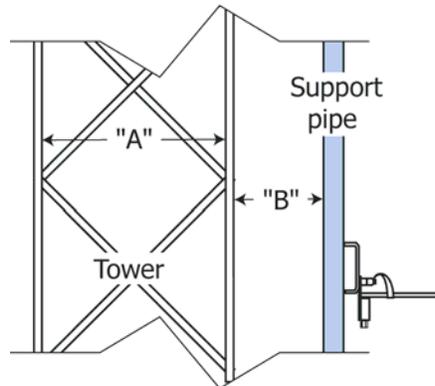


Table 3. Side-mounted support pipe standoff from tower

Tower Face "A"	Standoff "B"
less than 24" (610 mm)	12" (305 mm)
24" - 60" (610 - 1500 mm)	24" (610 mm)
over 60" (1500 mm)	36" (915 mm)

Follow these guidelines:

- a. To ensure good electrical contact between the support pipe and the tower, remove the tower paint and any rust at the support pipe mount locations before installing the mounts. After installing the mounts, be sure to touch up the paint where you removed it.
- b. Starting at the top of the support pipe, mark the location of each bay in accordance with the installation drawing.
- c. Also, mark the specified location of any accessory mounts (eg: de-icer box mounts), to make sure they will fit as planned.

Important
 Improper antenna mounting is a leading cause of poor performance in 6812B antennas. It is very important to install the antenna as indicated and to position it away from other metallic structures.

CAUTION
 If you don't get good electrical contact between the mounts, the support pipe, and the tower, the antenna may not perform as designed and may produce stray signals that will interfere with other services on the tower.

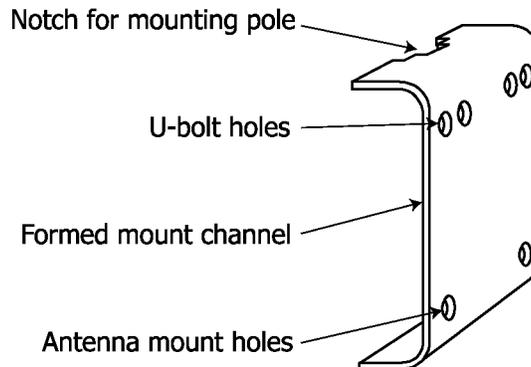
Top-mounted support pipe

If your support pipe is mounted on top of a tower or building, locate the antenna with at least ten feet (3.1 m) of vertical clearance between the bottom antenna bay and the top of the tower or building. Then mount the pipe in accordance with the guidelines above.

Installing the radiators

Radiators are mounted to the support pipe by means of formed mount channels (Figure 2). One formed mount channel is required for each bay without radomes (Figure 3 on page 5); two channels for a bay with radomes (Figure 5 on page 6).

Figure 2. Formed mount channel



Important!

Feedstrap orientation is critical to performance. In general, all the feedstraps in a Model 6812B antenna will be oriented the same. *Install each radiator in accordance with its stenciled bay numbers and its "up-arrow" sticker.*

Also, be very careful not to disturb or damage the feed strap when handling the radiator.

CAUTION

Radiators are stenciled with their respective bay numbers (bay #1 is the topmost bay). Install the radiators in accordance with their match-markings. If you don't, the antenna may not perform as expected.

Installation procedure

- Remove any paint or corrosion on the support pipe where the formed mount channel will be located, to ensure good electrical contact.
- Position radiator #1 at the topmost mark you made on the support pipe.
- (Antennas without radomes) Using the U-bolt, nuts, and washers, clamp the formed mount channel and the radiator assembly to the support pipe, as shown in Figure 3 on page 5.

NOTE

Radomes are pre-installed and need not be removed for installation.

CAUTION

Install the backplate with the long slots at the top, as shown in Figure 4 on page 5.

- (Antennas with radomes) Using two U-bolts with nuts and washers, clamp two formed mount channels, a backplate, a spacer, and the radiator/radome assembly to the support pipe, as shown in Figure 5 on page 6.
- Repeat for the remaining radiators, ensuring they are in the proper sequence and oriented correctly per the installation drawing.

Antenna Installation

Figure 3. Installation of radiator without radome, exploded view

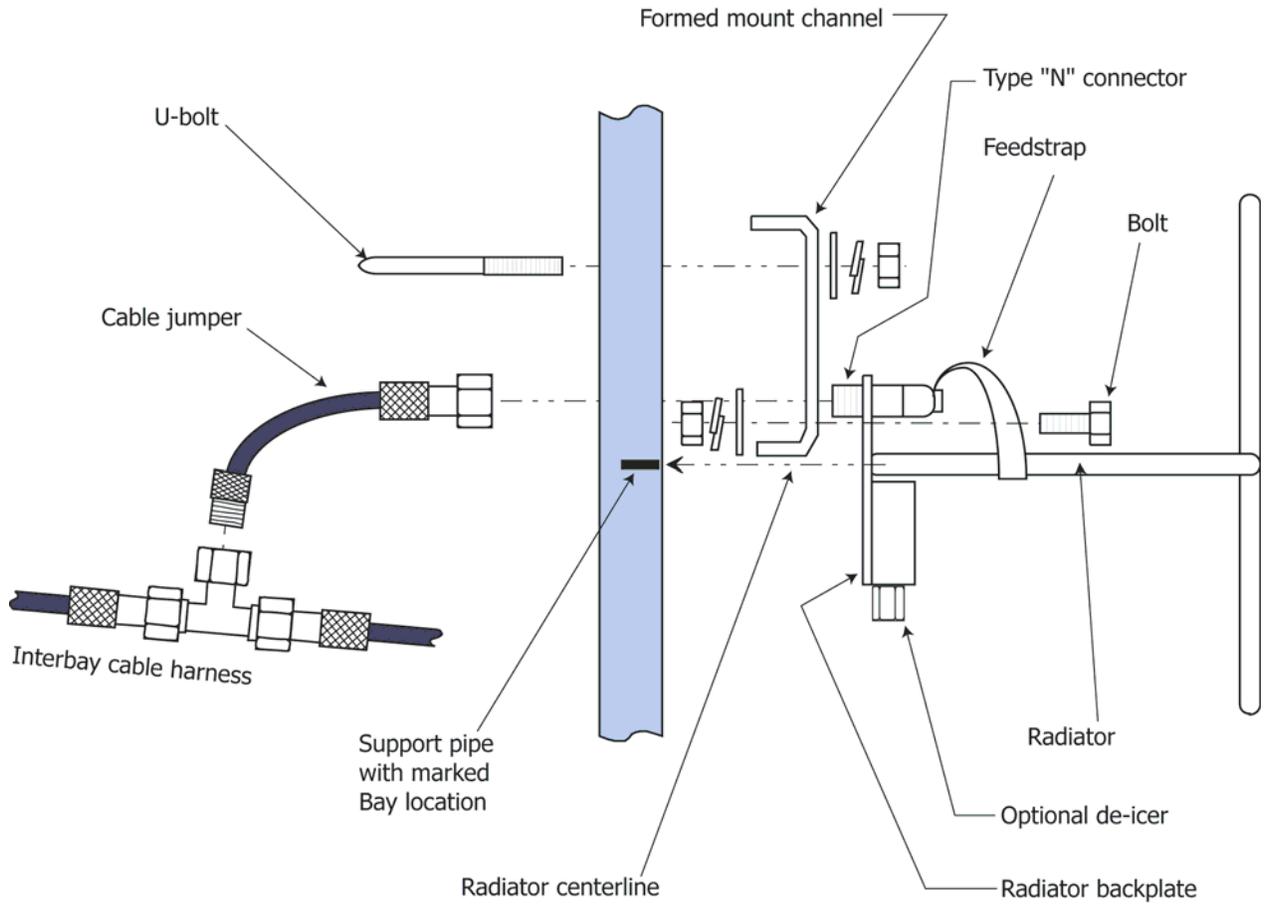
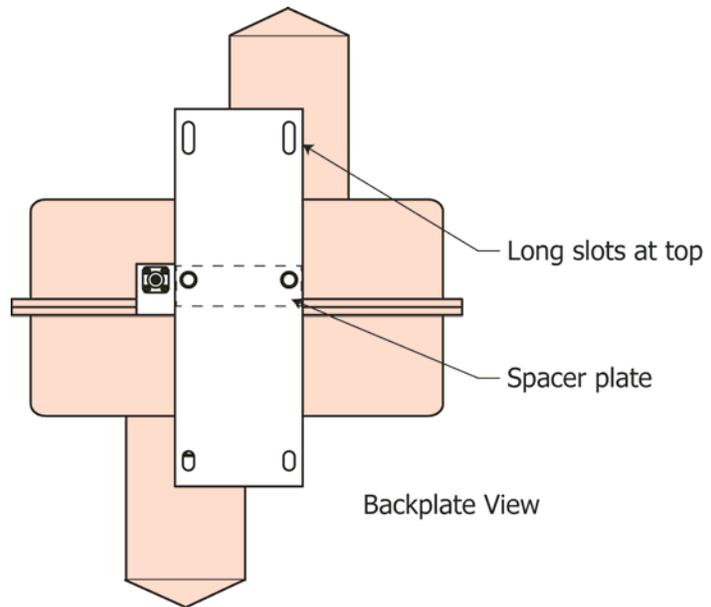


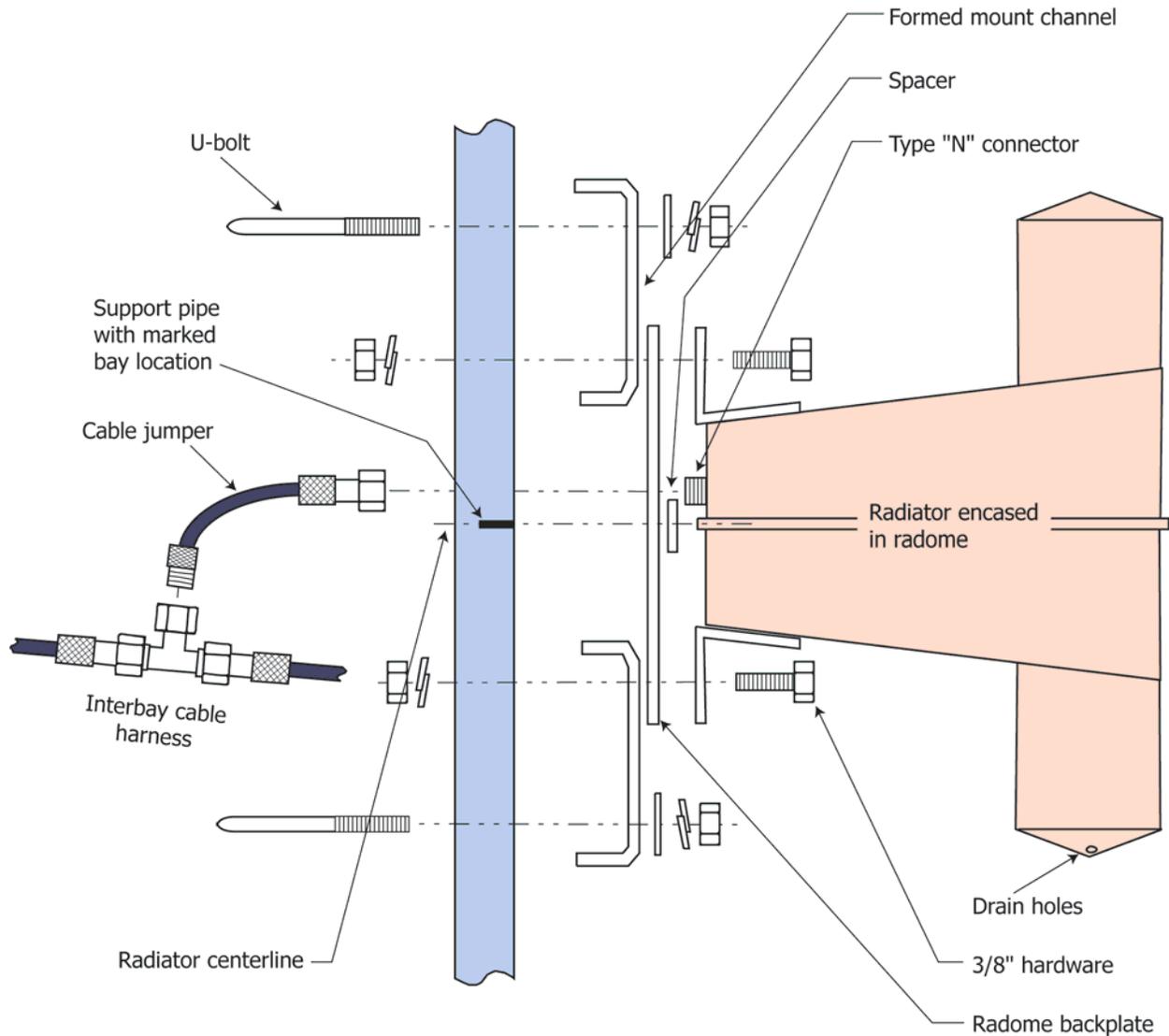
Figure 4. Radome backplate installation



Antenna Installation

- f. Sight vertically along the installation to ensure the radiators are aligned before finally securing them to the support pipe.
- g. Touch up the paint on the support pipe as necessary to protect from corrosion.

Figure 5. Installation of radiator with radome, exploded view



Installing the interbay cable harness

CAUTION

Tighten the connector nuts finger-tight only. Using pliers or other mechanical means to tighten the connectors may damage them.

CAUTION

The minimum bend radius of RG-214 cable is 2 inches (50.8 mm).

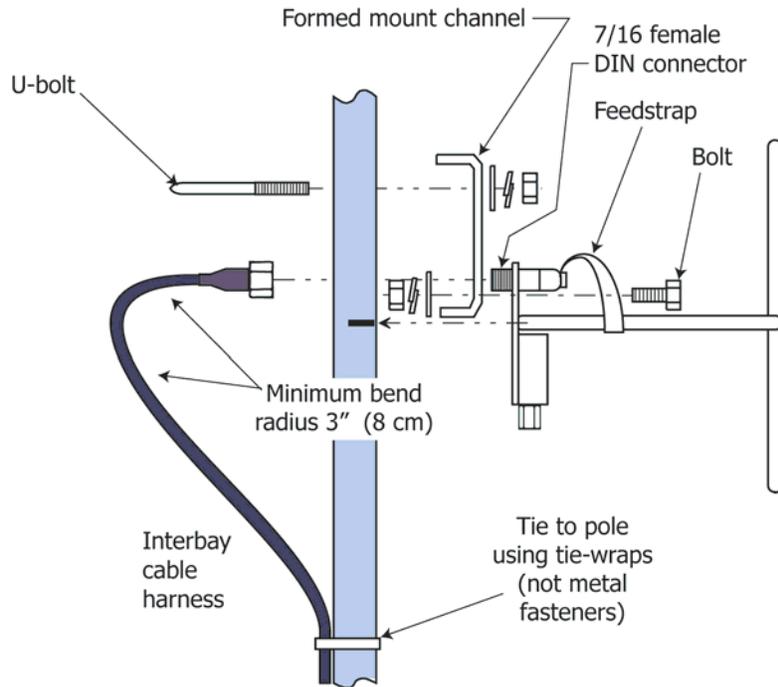
- a. Locate the end of the harness that is marked "Bay 1." Form the cable as shown in [Figure 6](#) and attach that end to radiator #1.

Antenna Installation

- b. The rest of the interbay cable harness should naturally fall into place. Attach the tees on the harness to the remaining radiators, as shown in [Figure 3](#) or [Figure 5](#). For antennas with radomes, use the cable jumpers as shown.
- c. Repeat step a for the bottommost connection.

The design of the antenna requires that the interbay feedline be about 50% longer than the bay-to-bay spacing. To protect the slack cable from wind and vibration damage, it must be wrapped and secured to the support pipe.

Figure 6. Installation of top and bottom bays



CAUTION

To ensure proper antenna performance, the excess feedline must be wrapped in a particular fashion, as shown in [Figure 7](#) on page 8. DO NOT make a continuous spiral wrap around the pipe, as shown on the left. Doing so will ruin the VSWR of the antenna.

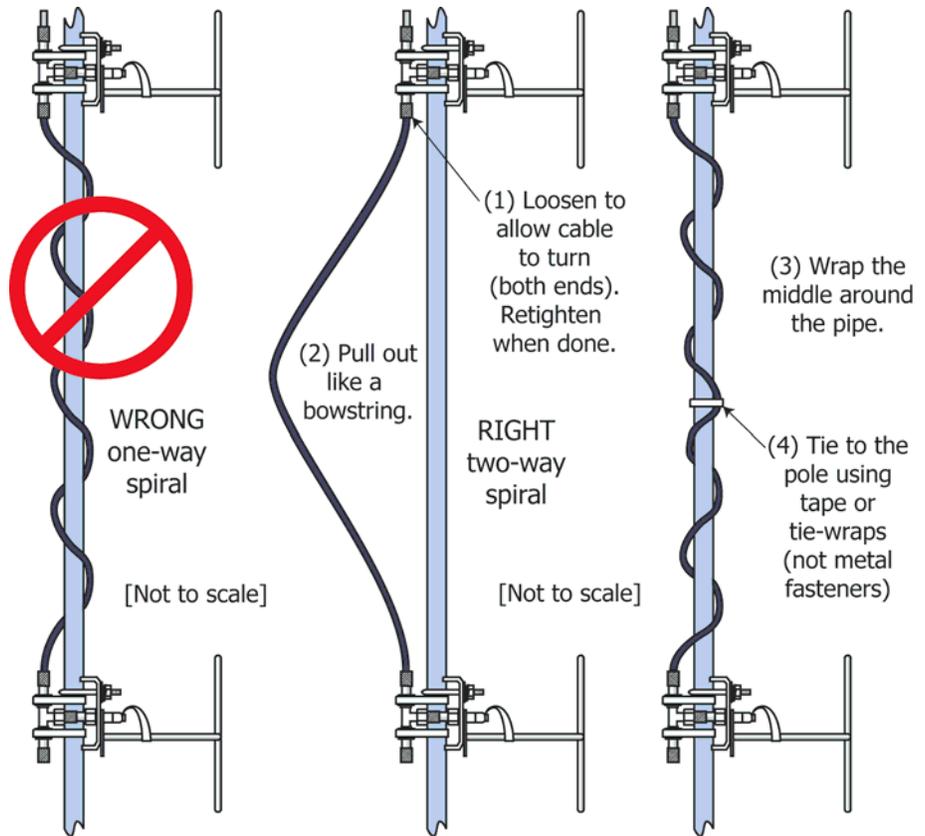
- d. Wrap and secure the interbay feedline cable as follows ([Figure 7](#)):

CAUTION

Do not put too much tension on the feedline; just make it snug.

- (1) Between each pair of antenna bays, loosen the connectors at both ends just enough to allow the cable to swivel as it is wrapped. This will prevent kinking.
- (2) Grasp the feedline in the middle and pull it gently out like a bowstring.
- (3) Then wrap the middle around the pipe, resulting in the "two-way spiral" shown in [Figure 7](#).
- (4) Fasten the feedline to the pipe with plastic ties or electrical tape. Do not use metal ties, which can cut the line.
- (5) Retighten the connectors at both ends.
- (6) Repeat for each interbay section.

Figure 7. Wrapping and securing the interbay cables



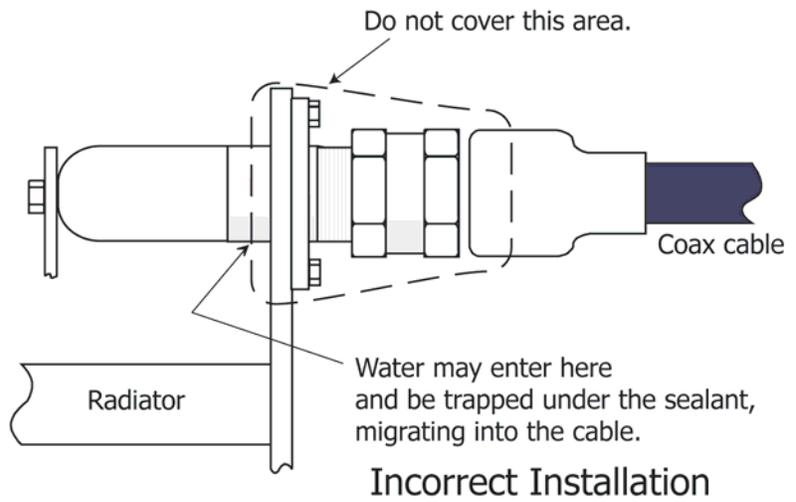
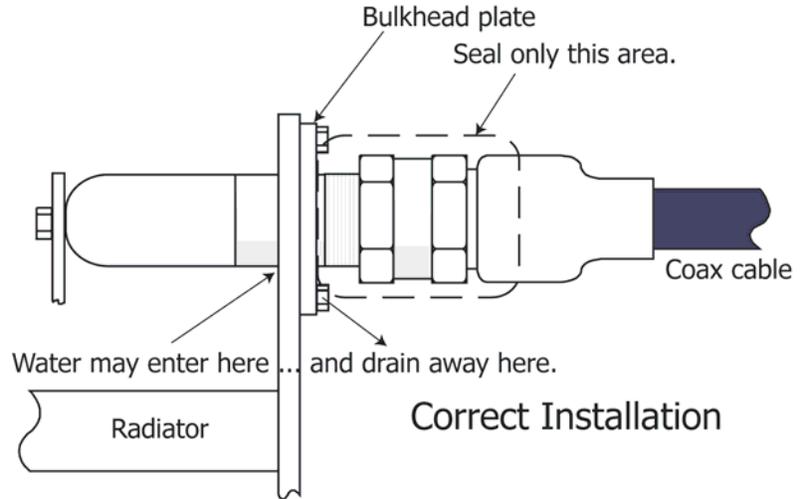
CAUTION

If splicing tape is not applied correctly, water can get into the coax connections and affect the performance and reliability of your antenna.

- e. Apply splicing tape as follows ([Figure 8](#) on page 9):
 - (1) Make sure the fittings and coax are clean and dry.
 - (2) Apply Scotch 130C Linerless Rubber Splicing Tape with the tacky side up.
 - (3) Stretch tape and apply half-lapped to form a smooth, void-free splice. Wrap tightly in and around the area where the connection is made. Make sure the joint is fully covered, but do not seal up against the bulkhead plate.
 - (4) Inspect the connection carefully, ensuring that the joint is fully sealed. If more splicing tape is needed, simply add it to the existing wrap. It adheres well to itself.
- f. Stretch tape and apply half-lapped to form a smooth, void-free splice. Wrap tightly in and around the area where the connection is made. Make sure the joint is fully covered, but do not seal up against the bulkhead plate.
- g. Inspect the connection carefully, ensuring that the joint is fully sealed. If more splicing tape is needed, simply add it to the existing wrap. It adheres well to itself.

Antenna Installation

Figure 8. Proper and improper application of splicing tape



CAUTION

To prevent damage, secure all coax to minimize wind-induced motion and chafing.

- h. Tie all coax to the mounting pipe to prevent it from damage.

3 Installing the De-icer System (if applicable)

Precautions

WARNING

Installation should be performed only by personnel experienced in RF systems, qualified in electrical work, and familiar with this equipment.

WARNING

Don't expose personnel to the medical hazards of intense radio frequency (RF) radiation. Whenever working on the tower in the area of the antenna, turn off all transmitters and lock them out so that they cannot be turned on accidentally.

CAUTION

All parts of the de-icer system within approximately 20 feet (6 meters) of any radiator must be shielded from RF energy, and the entire outdoor portion of the system must be made waterproof.

CAUTION

An improperly installed de-icer can overheat and damage your antenna.

De-icer system description

The de-icer system consists of the heating elements in the bays, their branch cables, and the main harness. The main harness consists of a bay junction box for each antenna bay, interbay cables, and a "pigtail" of wires about 10 feet (3 meters) long which you will connect to the tower junction box you are to provide. The following will help in installation:

- System electrical schematic: [Figure 9](#) on page 12.
- Electrical specifications: [Table 4](#) on page 13.
- Bay junction box: [Figure 10](#) on page 14.
- Thermostat readings: [Table 5](#) on page 15.

Your system may also include specially-ordered items, such as a ground-mounted main control box, a power cable extending up the tower, or a tower-mounted dual-setting thermostat.

Dual-setting thermostat

CAUTION

Remember that conditions may be favorable for icing on the tower, even if they are not on the ground.

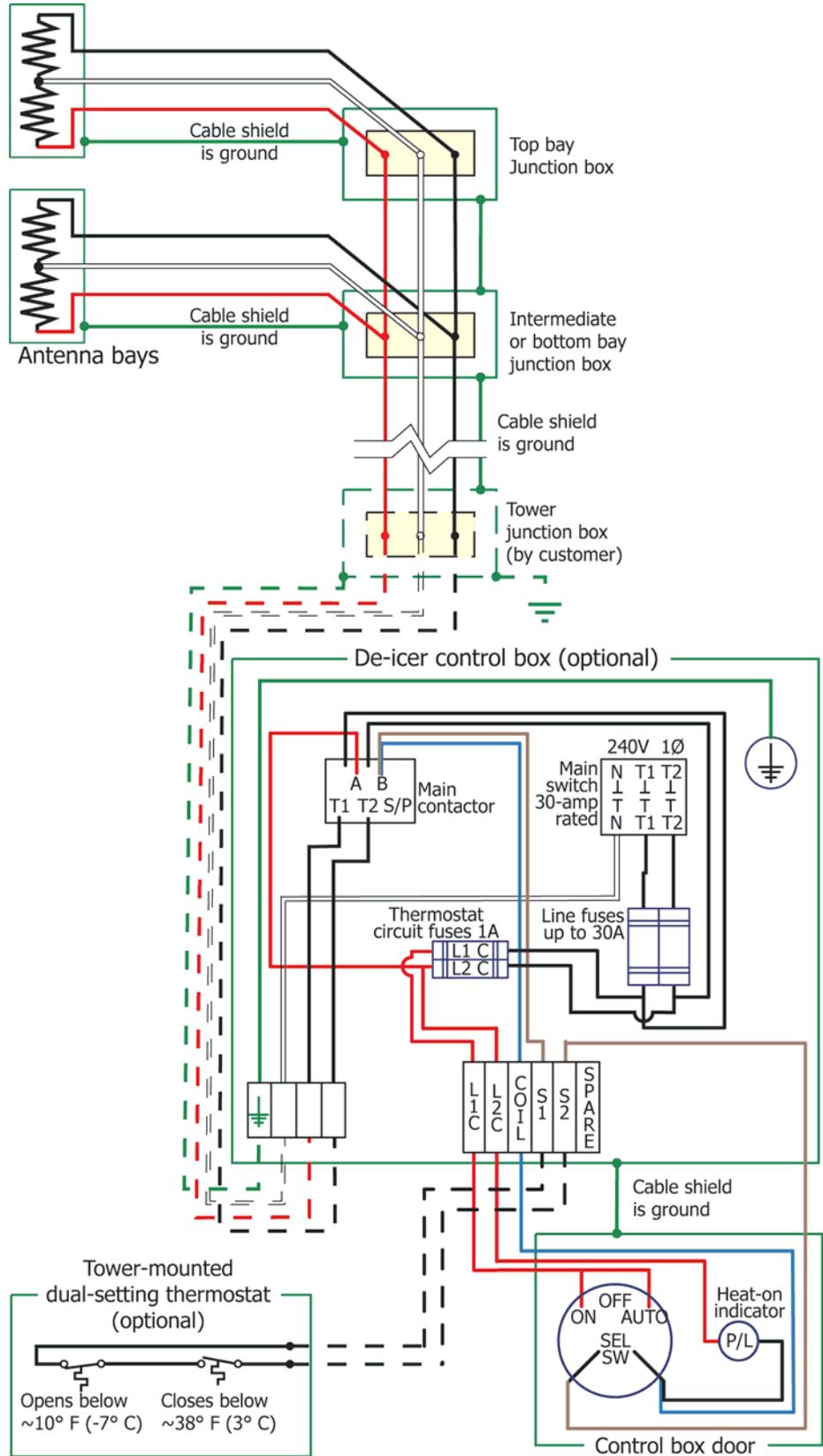
Shively Labs deicers are designed to prevent ice from forming on antenna elements and are not designed to melt ice that has already formed. For this reason, Shively Labs recommends that the system be installed with a tower-mounted dual-setting thermostat assembly (Shively Labs Model 55522-G502) and de-icer control box (Shively Labs Model 94068) that ensure the deicers are operated in the temperature range ice is most likely to form.

Electric power

The de-icer system requires 220 VAC, 50 - 60 Hz., single-phase. [Table 4](#) shows approximate heater leg resistances and current draw, respectively.

Installing the De-icer System (if applicable)

Figure 9. De-Icer electrical schematic diagram



NOTE

Customer-supplied items are shown in broken lines.

NOTE

A liquid-tight conduit connector (3/8" conduit size by 1/2" hub size) for the harness entry to the tower junction box, is packed loose with the de-icer harness.

NOTE

Shively recommends the use of shielded braided polyethylene-covered wire or rubber-sheathed flexible metal conduit and weather-tight fittings at all junctions.

Table 4. De-Icer specifications

	Heater Leg Resistance, Ω	Heater Leg (T1 or T2) Current Draw, amps
1-Bay	203	0.6
2-Bay	101	1.2
3-Bay	68	1.8
4-Bay	51	2.4
5-Bay	41	3.0
6-Bay	34	3.6
7-Bay	29	4.1
8-Bay, single circuit	25	4.7
10-Bay, single circuit	20	5.9
12-Bay, single circuit	17	7.1
14-Bay, single circuit	14	8.3
16-Bay, single circuit	13	9.5

De-icer installation

Installing the de-icer harness

CAUTION

Shively Labs's de-icer control box, Model 94068, is designed for interior installation only.

- a. Install the main de-icer harness with its bay junction boxes as shown in [Figure 9](#) on page 12 and [Figure 10](#) on page 14. Connect the leads from each bay's de-icer pigtail to the main harness in that bay's junction box as shown.

CAUTION

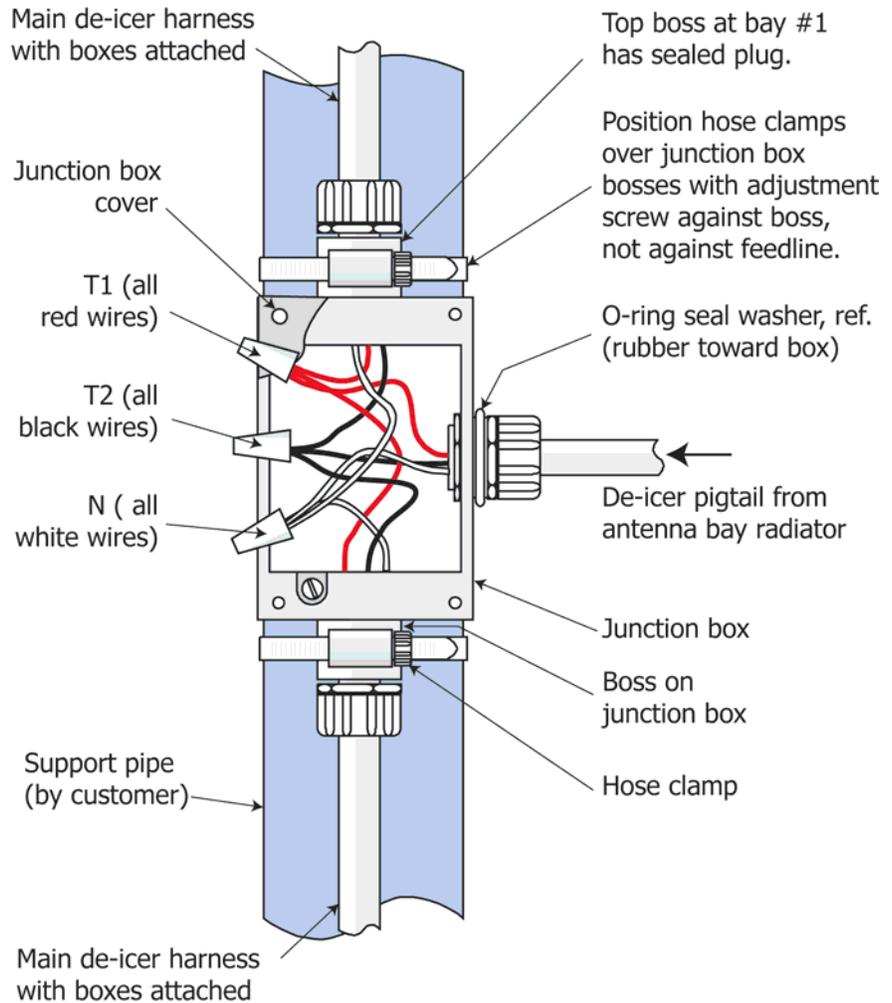
It is important to ground both the tower junction box and the control box, as shown in the schematic diagrams.

- b. Furnish a tower junction box as shown schematically in [9](#) to connect the antenna's de-icer harness to the main power.
- c. Using tie-wraps, secure the entire length of the de-icer harness to the RF feedline at about 24" (60 cm) intervals. Run the ten-foot de-icer pigtail along a feedline mount to the tower junction box and secure it to the mount and the tower.

Installing the De-icer System (if applicable)

Figure 10. Bay junction box installation

NOTE
Wire nuts, cover with screws, and gaskets, and tie-wraps are provided with the de-icer cable harness.



Installing the thermostat (if applicable)

If you are using a thermostat, you may locate and mount it at your discretion. We recommend mounting it as close as practical to the antenna.

CAUTION

When testing the thermostat, be sure to have one or both thermostat leads disconnected before taking resistance readings. Otherwise, readings may be affected by other components.

- Before you connect the thermostat, measure the resistance across the thermostat circuit and from it to ground to ensure that there are no short-circuits. Thermostat readings should be as shown in [Table 5](#) on page 15.
- Mount the thermostat near the antenna and connect the thermostat leads to points S1 and S2 in the control box as shown in the schematic diagram, [Figure 9](#) on page 12.

Installing the De-icer System (if applicable)

Table 5. Thermostat readings

Reading Location	Ambient Temperature	Resistance = 0 ohms (short circuit)	Resistance = infinite ohms (open circuit)
Leg-to-Ground	Any	Defective thermostat or shorted leads	OK
Leg-to-Leg	Above about 38° F (3.3° C)	Defective thermostat or shorted leads	OK
	Between about 10° and about 38° F (-6.7° to 3.3° C)	OK	Defective thermostat or broken leads
	Below about 10° F (-6.7° C)	Defective thermostat or shorted leads	OK

Precautions

CAUTION

A high voltage standing wave ratio (VSWR) may indicate damaged transmission line or incorrectly assembled components. This condition will cause serious damage to your equipment when full power is applied.

The antenna

System sweep (recommended)

Shively Labs strongly recommends that you perform a system sweep of your transmission line and antenna while you have the installation crew on site. Should any problems arise later with your antenna, it will be extremely helpful to know what the system's characteristics were when it was new. We recommend you perform a system sweep after installation.

Many riggers can sweep your system after installation or recommend a contractor to perform it. Alternatively, Shively Labs makes available instructions for system sweep on our Web site, www.shively.com.

Checkout

Before beginning checkout of the antenna system, be sure the following items have been done:

- The antenna system has been installed in accordance with this manual and the installation drawing.
- The de-icer system, if purchased, has been checked out in accordance with [Chapter 3](#).
- All radiators are operating and VSWR is low.
- System sweep data, if desired, have been recorded.

Check the system out as follows:

- a. Bring up RF power slowly and observe transmitter readings, stability, and general operation.
- b. Run at about half power for at least an hour, reading forward and reflected power, stability, etc.
- c. If the system is stable and seems to be operating properly, bring it up to full power. Take initial and periodic readings.
- d. Performance readings should not change, and there should be no evidence of heating in the antenna system.

Operation

CAUTION

Don't exceed the rated power capacity of the antenna.

To obtain the best performance and dependability, read and follow the maintenance and troubleshooting recommendations in [Chapter 5](#) of this manual.

The de-icer system

CAUTION

Don't leave the de-icer on for extended periods when the weather is above 60° F (16° C); doing so may shorten the life of the heater element(s).

Startup and Operation

There is a generous margin of safety built into the de-icer system, and operation for prolonged periods below 60° F (16° C) will not harm the system. If icing conditions are expected, the heaters should be turned on in advance as a preventive measure. It is much easier to prevent ice formation than to remove a heavy coating.

Shively Labs de-icer control system

If you have the Shively Labs de-icer control box and dual-setting thermostat, you have the choice of manual or automatic operation. There are three switch settings: AUTOMATIC, OFF, and MANUAL.

- When the switch is set to AUTOMATIC, the thermostat turns the heaters on and off according to the temperature.
- When the switch is set to OFF, the thermostat is overridden and the heaters will stay off no matter what the temperature.
- When the switch is set to MANUAL, the thermostat is overridden and the heaters will stay on no matter what the temperature.

5

Maintenance and Troubleshooting

Precautions

WARNING

Maintenance should be performed only by personnel experienced in RF systems and familiar with this equipment.

WARNING

Don't expose personnel to the medical hazards of intense radio frequency (RF) radiation. Whenever working on the tower in the area of the antenna, turn off all transmitters and lock them out so that they cannot be turned on accidentally.

Maintenance log

Shively recommends that you keep a maintenance log, recording important performance parameters such as VSWR readings, de-icer current draw, maintenance done on the tower and the antenna, and severe weather events. This information can be valuable for identifying and solving problems. [Sample maintenance log](#) on page 22 shows a suggested log form.

Physical inspection

Important

Give your antenna a full inspection at least once per year!

The antenna system should operate for years if properly installed and maintained. Shively Labs recommends that as a minimum, the antenna should be physically inspected *at least once a year*.

In addition, inspect the antenna after severe weather events, and after climbers have been on the tower working on equipment above the antenna.

In addition to checking the general condition of the antenna and coax:

- Replace dented, broken or bent components.
- Inspect radomes for cracks and plugged drain holes.
- Re-tighten all hardware, hose clamps, and U-bolts to installation specifications.
- Inspect hose clamps and U-bolts carefully for signs of wear or fatigue caused by vibration or tower movement.

Paint

The radiators should never be painted (a coating of paint affects VSWR), and they need no surface protection, since they are made of copper and brass. This includes Teflon or other "ice-prevention" coatings.

It is not necessary to paint the feedline, although no harm will result from doing so.

Radome removal and reinstallation

If it becomes necessary to remove a standard radome to gain access to the radiator, first remove the radiator as described above and bring it to the ground. If the antenna is to be operated without that radiator, be sure to observe all precautions.

On the ground, merely remove the ten bolts that secure the radome halves together, and the four additional 3/8" bolts securing the formed channel to the radome backplate, and lift the radome away from the radiator. Reinstall the radome and the radiator in the reverse order of removal. Re-seal the radome, using Dow Corning 732 Multipurpose RTV or equivalent.

Return policy

When returning any material to the factory, be sure to call your salesman and obtain an returned material authorization (RMA) number first. Use this number in all correspondence. This number helps us to track your returned item. It will expedite repair or replacement and prevent loss of your material.

Troubleshooting

Contact Shively Labs if necessary to help find the cause of your problem. Outside of 8:00 AM to 5:00 PM Eastern Time, call (207) 329-5118.

Internal arcing

Internal arcing is caused by physical damage to transmission line, feedline, or radiators. Damage may have been caused by ice, lightning, tower work, or many other factors. Replace damaged components.

Broad spectrum RF noise

Any metal part in poor contact with the tower will constitute a non-linear junction and cast a broad-spectrum signal. This includes antennas, transmission line, mounts, ladders, and other electrical components. Check your antenna mounts and other tower components to be sure that the tower paint was scraped away during installation and that all mounting hardware is tight.

High VSWR at startup or during operation

High VSWR (Voltage Standing Wave Ratio) is caused by any factor which changes the impedance match between the transmitter and the antenna system. Possible causes include:

- Wrong antenna for the application and frequency. Occasionally incorrect frequency information is provided to Shively or an antenna designed for another application is used.
- Defective cable connector in the cable harness.
- Incorrect assembly of the antenna (for example, an upside-down radiator; radiators out of sequence). The assembly must be exactly as shown in the installation drawing.
- Damaged radiator feed strap(s). The feed strap is the metal strip that extends back from the end seal. The length, angle, and straightness of the feed strap are critical to the radiator's performance.
- Components of other services in the RF field (later installations or broken components).
- Physical damage to the transmission line, feedline, or radiators. This may be from ice, lightning, tower work, or any other source. (Check with the tower owner to see whether anyone has been working on the tower.)
- Paint applied to the radiators, for example during a recent tower painting.
- De-icer failure may have allowed ice buildup or melted the solder from the domes, spacers, and bushings at the ends of the vertical arms.

Change in coverage

Changes in broadcast coverage may be caused by the same factors that produce VSWR changes. If coverage seems to have changed, look for VSWR changes and use [High VSWR at startup or during operation](#) on page 20 for troubleshooting.

Maintenance and Troubleshooting

It is important to recognize, however, that apparent changes in coverage may be due to subjective factors or faults of the receiving equipment. Before doing more than checking the VSWR, be sure that an actual coverage change has occurred.

Sample maintenance
log

DATE	DE-ICER CURRENT (or resistance)			VSWR	OBSERVATIONS Visual Inspection of Antenna, Obstruction Lighting; Hardware Checked; Tower Repairs Accomplished; etc.
	BLACK (b-neut)	NEUT (red-bl)	RED (r-neut)		