



VHF Vehicle Roof-Top Antennas

HAD4021A

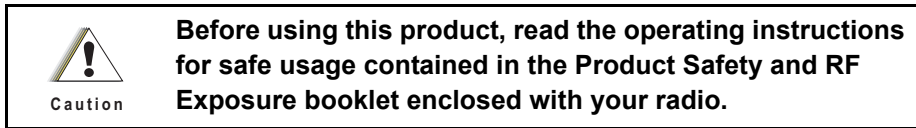
HAD4022A

Installation Manual

Foreword

This manual applies to mobile radios, unless otherwise specified. It includes instructions for installing antennas in a vehicle roof-top configuration.

Product Safety and RF Exposure Compliance



ATTENTION!

This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with your radio (Motorola Publication part number 6881095C99) to ensure compliance with RF energy exposure limits.

For a list of Motorola-approved antennas, batteries, and other accessories, visit the following website:
<http://www.motorolasolutions.com/governmentandenterprise>

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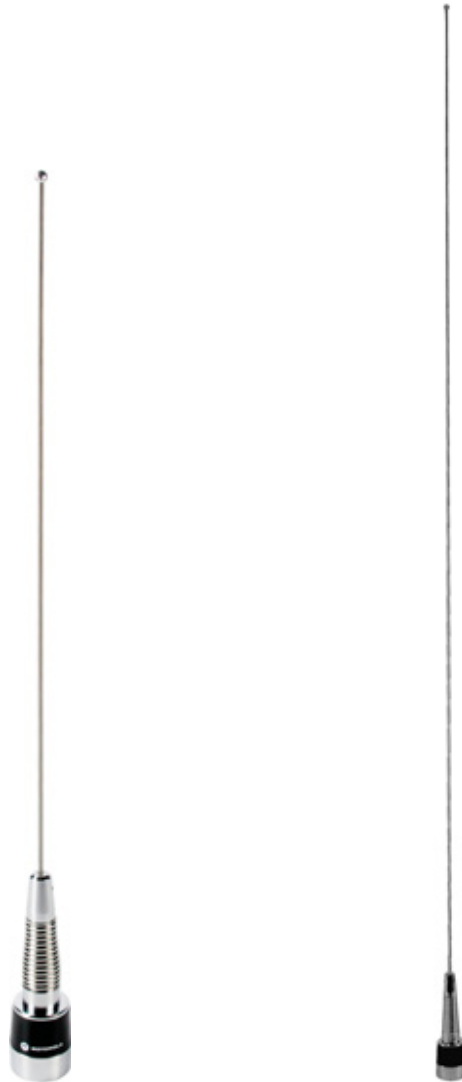
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Introduction

The vehicle roof-top antennas are each supplied with a coaxial lead-in cable and connector. In the completed installation, the cable is concealed between the headlining and the roof of the vehicle, with minimum disturbance to the headlining and the upholstery. [Figure 1](#) shows the two roof-top antennas.



HAD4021A
Unity Gain Quarter-Wave
136 – 174 MHz

HAD4022A *
3 dB 5/8th Wave
132 – 174 MHz

** Requires tuning in the field as per the tuning instructions.*


Figure 1. VHF Roof-Top Antennas

Tuning Instructions for the HAD4022A Gain Antenna

The HAD4022A antenna must be trimmed in order to tune the antenna to cover the 132 – 174 MHz frequency range. Perform the following to trim the antenna:


1. Remove the rod from the base of the antenna by unscrewing the two setscrews.
2. Cut the bottom portion of the rod, located below the ferrule, as per “ [Tuning Chart for HAD4022A](#)” on page 12.
3. Re-insert the rod into the base of the antenna and secure by tightening the two setscrews.
4. Check the antenna and fine-tune it with an in-line watt meter, if a problem is suspected. Tune for minimum reflected power at the frequency of interest and ensure the VSWR is less than 1.5:1.

FCC Requirements



To comply with FCC regulations when installing the antenna lead-in cable, *DO NOT* shorten the cable.

Caution



Advise the radio owner to unscrew the upper antenna assembly from the base before entering an automatic car wash to prevent damage to the antenna or roof of the vehicle. When unscrewing the antenna, be sure only the upper section, not the locking nut, is removed. If the locking nut becomes loose, retighten it securely against the mounting surface.

Caution

Motorola Recommendations for Vehicle Roof-Top Antenna Locations

Recommended vehicle roof-top antenna installations are limited to metal body vehicles at the center of the roof and center of the trunk deck locations. Refer to [Table 1](#).

Additionally, the antenna installation must be in accordance with the following:

- Requirements of the antenna manufacturer/supplier
- Instructions in the radio installation manual

NOTE: To comply with RF Safety standards, HAD4021A and HAD4022A *must only* be mounted on the roof.

Table 1. Recommended Antenna Installation Locations

Vehicle Type	Recommended Location
Standard metal passenger vehicles	Center roof or center trunk lid
Vans, pickups, and other light trucks (metal roofs)	Center roof
Heavy duty equipment with metal roofs (heavy duty trucks, semi-tractors, heavy refuse trucks, cement mixer trucks)	Center cab roof
Specialty vehicles (such as T-roofs, sun roofs, or convertibles)	Center trunk lid—recommended only for transmitter output of less than 7 W

Table 1. Recommended Antenna Installation Locations (Continued)

Vehicle Type	Recommended Location
Other vehicles	Contact your Motorola Field Technical Representative. Do not install closer than the distances stated in the safety publication referenced in the section, " Product Safety and RF Exposure Compliance " on page ii, for the relevant transmitter output power, from occupants or without proper antenna ground plane.

Consider the following factors when installing an antenna.

- Install the vehicle antenna external to the vehicle and in accordance with the requirements contained in this manual.
- The best mounting location for the antenna is in the center of a large, flat, conductive surface. In almost all vehicles, mounting the antenna in the center of the roof will satisfy these requirements. A good alternative location is in the center of the trunk lid. If you choose to use the trunk lid, ensure that the trunk lid is grounded by connecting grounding straps between the trunk lid and the vehicle chassis.

NOTE: The antenna should be mounted on a flat metal roof with a thickness of 0.020 to 0.040 inches.

- Ensure the antenna cable can be easily routed to the radio.
- Ensure that the antenna cable is routed separately and not in parallel to any other vehicle wiring or mobile radio cable wiring.
- Check the antenna location for any electrical interference.

NOTE: Any two metal pieces rubbing against each other (such as seat springs, shift levers, trunk and hood lids, exhaust pipes, etc.) in close proximity to the antenna can cause severe receiver interference.

- If the vehicle is equipped with an electronic anti-lock braking system (ABS), mount the antenna at the center of the roof or trunk lid and do not route the antenna cable near the ABS modulator box. Mount the radio as far away from the modulator box as physically possible. This minimizes radio interference to the modulator box from the radio.
- Make sure the mobile radio antenna is installed at least one foot (30.48 cm) away from any other antenna on the vehicle.

Required Tools and Materials

The following tools and materials are needed to properly install the motorcycle radio antennas:

- 10-inch adjustable wrench, or 1-inch open-end wrench
- 15/16-inch open-end wrench
- Antenna hole-cutting tool, Motorola RPX-4378A
- Center punch
- Crimping tool 66-80388A26
- Hammer
- Large hand drill
- Pliers
- Round file
- Side cutters
- Soldering station & solder

Installation Procedure

The installation procedure that follows is for a typical passenger car. The procedure may vary slightly with the type of vehicle on which the antenna is to be installed. Generally, however, the procedure outlined below is universal in nature.

Antenna Installation

To install an antenna, do the following:



Caution

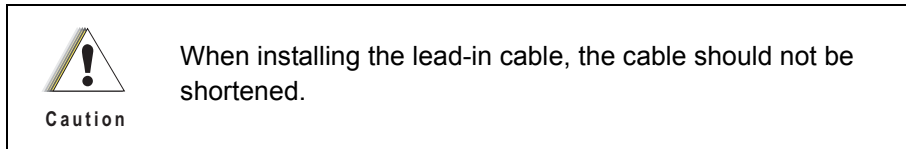
Observe the safety precautions given in this instruction manual. Do not adjust the whip length of any of the antennas, except the HAD4022A as previously described. These antennas have wideband performance and do not require any tuning.

1. Select a location for the antenna as near the center of the roof as possible. Probe the headlining with your fingers to make sure that all points of obstruction are avoided.
2. Drill a pilot hole at selected location, and then drill a 3/4-inch hole from the top (outside the vehicle only) with the Motorola 01-80382A25 holecutting saw (or equivalent) until it bottoms.
3. Clean the roof metal in a neat circle to ensure good contact with the bushing assembly and its locking nut.

NOTE: In installations involving a double roof with no dome light, a second 3/4-inch hole must be drilled. However, a deepwell type of 3/4-inch hole saw (with pilot drill bit) must be used to cut the second (or bottom) roof section. This provides access to the area where the coaxial cable is routed between the second roof section and the headlining.

4. Drill the second 3/4-inch hole if required. Be very careful, though, to prevent puncturing the headlining.

- For proper seating of the bushing assembly and locking nut, remove any burrs and/or foreign matter from above and below the (top) 3/4-inch mounting hole. This should be done for at least 1/8 inch out from the hole edge. For double-roof construction vehicles (without dome light), also be sure to clear the second (or bottom) 3/4-inch hole of any burrs.



- Determine the routing of the cable from the antenna bushing assembly to the radio set, and then remove the molding and trim necessary to facilitate pulling the cable through.
NOTE: To ensure ease of assembly, thread the locking nut on the end of the bushing assembly a few times before installing. This removes any burrs that might be present.
- Insert the end of the coaxial cable into the mounting hole, and then route the cable between the roof and headlining to the radio.
NOTE: If you experience difficulty with cable routing, use an electrician's fishtape to perform this step.
- Refer to [Figure 2 on page 5](#). Apply a generous amount of silicone grease (supplied) to the inner and outer threads of the locking nut. In addition, be sure to apply some silicone grease to the rubber "O" ring washer and the groove in the locking nut in which the "O" ring washer is seated.

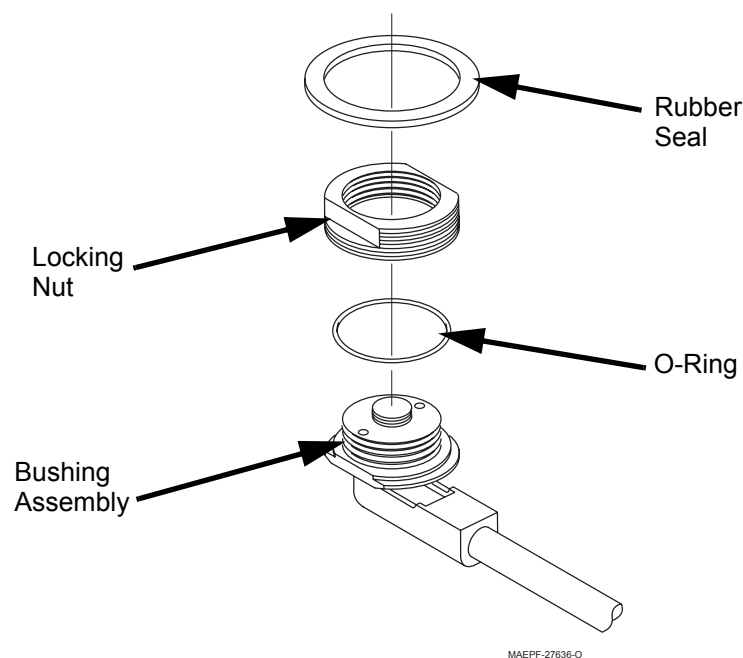



Figure 2. Bushing Assembly Parts

9. Refer to [Figure 3](#). Insert the bushing assembly into the mounting hole as shown, tilted slightly. Be sure that all of the cable has been pulled through to the radio. The threaded portion of the bushing assembly will not fall through the mounting hole.

 Caution	In double-roof vehicles, which have no dome light, DO NOT attempt to secure the base mount to both roof layers. Secure it to the top, outer roof layer only.
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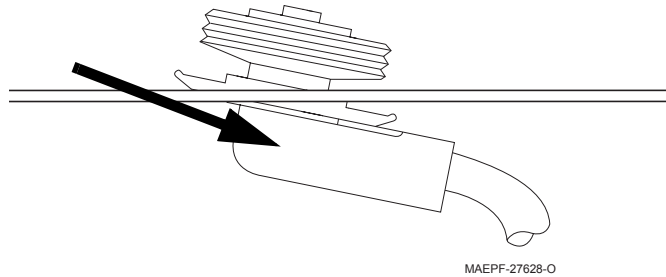


Figure 3. Inserting the Bushing Assembly

10. Refer to [Figure 4](#). While holding the bushing assembly down, thread the locking nut onto it.

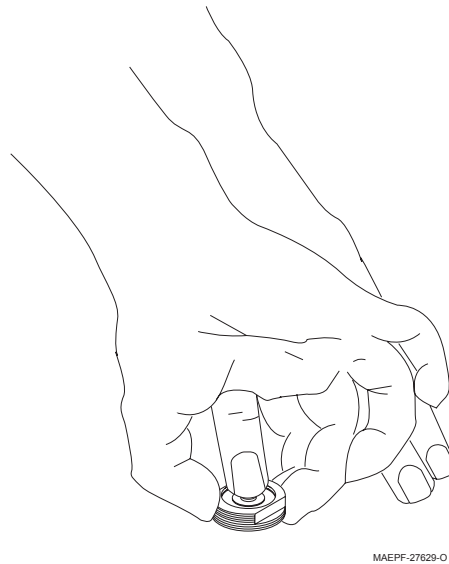
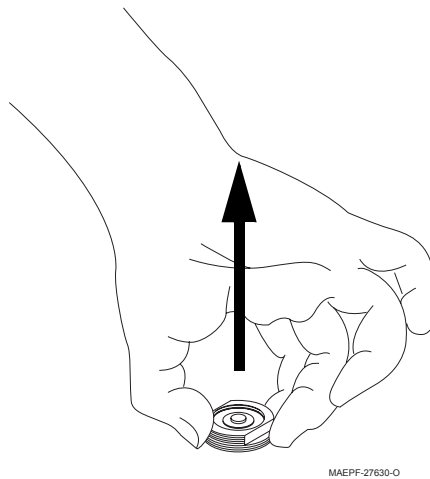


Figure 4. Threading the Locking Nut

11. When the nut is well onto the bushing assembly, pull upward on the entire assembly as shown in [Figure 5](#).

Make sure the bushing assembly is centered in the hole and seated properly with both shoulders inside the mounting hole.



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Figure 5. Pulling Upward on the Bushing Assembly

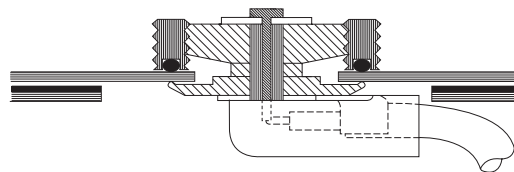


Caution

The locking nut must come into contact with the vehicle roof to ensure the proper antenna radiation pattern is created. This can only be accomplished when the rubber O-ring is fully compressed.

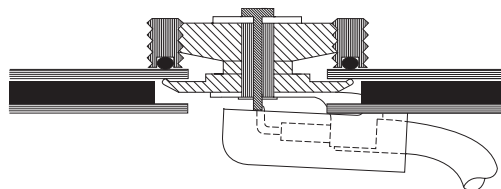
- Using a 15/16-inch open-end wrench, tighten the locking nut until it bottoms firmly against the roof top.

[Figure 6](#) shows how the base mount should be installed in a vehicle with double-roof construction and a dome light. [Figure 7](#) shows how the base mount should be installed in a vehicle with double-roof construction and no dome light. Single-roof installations are similar to [Figure 6](#), except there is no second roof layer present.



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Figure 6. Double-Roof (With Dome Light) Installation



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Figure 7. Double-Roof (Without Dome Light) Installation

13. Apply silicone grease to the weatherproof rubber seal (see [Figure 2](#)).
14. Slide the rubber seal down and around the locking nut so that it sits immediately on top of the roof.
15. Refer to [Figure 8](#). Position the antenna over the locking nut, and secure the metal cap to the external threads of the locking nut.

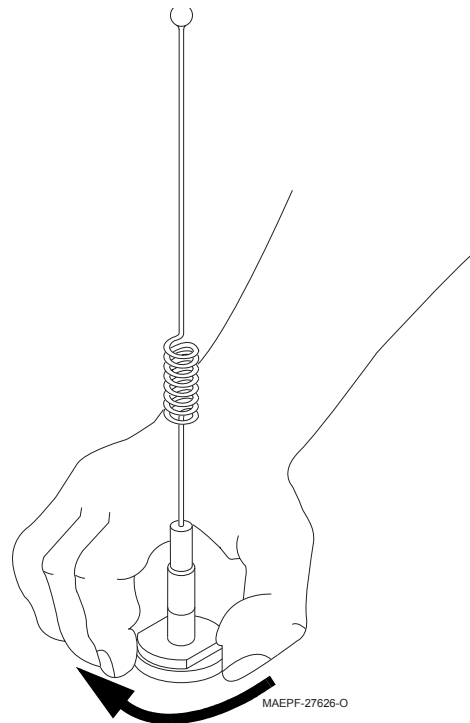


Figure 8. Attaching the Antenna

16. With the antenna rod in a perfectly vertical position, tighten the metal cap by hand as much as possible.
17. With a 10-inch adjustable wrench or a 1-inch open-end wrench, tighten the metal cap no more than an additional 1/2 turn.
18. Replace the headlining and dome light, if removed.

Connector Fabrication (Mini-UHF)

Refer to [Figure 9](#). Use the Motorola crimping tool (part number 66-80388A26) in the following procedure.

FIVE CRIMP AREAS

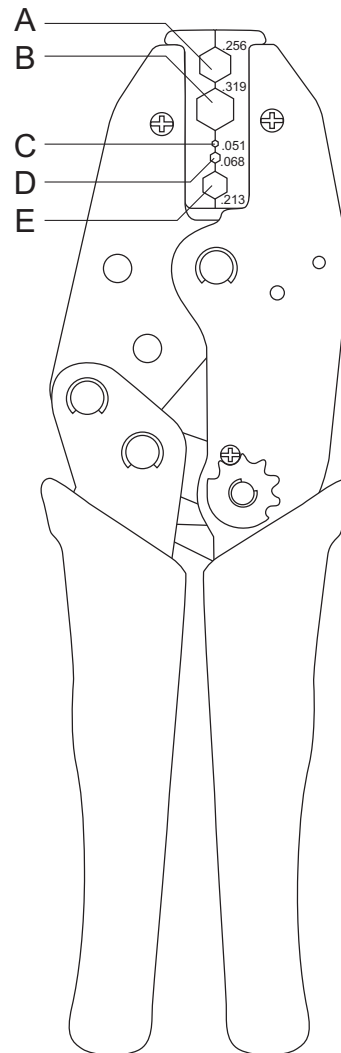


Figure 9. Motorola Crimping Tool 66-80388A26

Figure 10 illustrates the order in which the mini-UHF connector items must be assembled on the antenna cable.

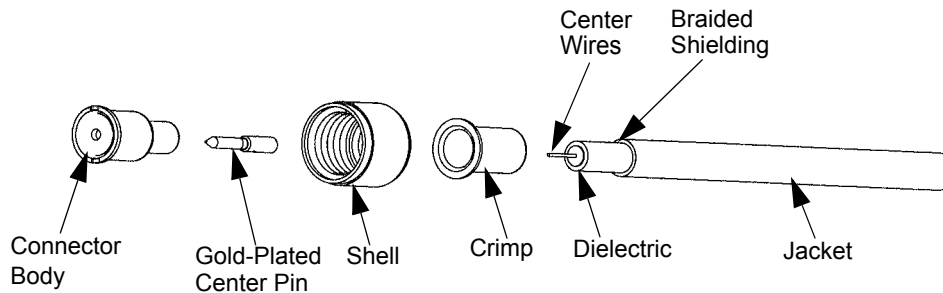
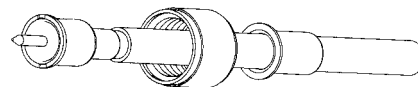
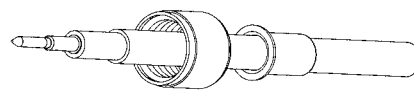
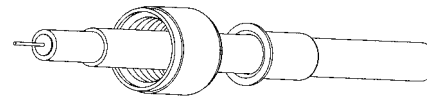


Figure 10. Mini-UHF Connector Components

To assemble the mini-UHF cable connector, do the following:

1. Trim the jacket, the braided shielding, and the dielectric of the cable to 6 mm (0.24 in.) from the end of the cable in order to expose the center wires.
2. Trim the jacket back an additional 10 mm (0.4 in.)
3. Insert the cable into the crimp making sure that the flange of the crimp is facing towards the end of the cable, and then insert the cable into the shell. Be sure that the shell end with the larger diameter opening is facing towards the end of the cable.
4. Solder the gold-plated center pin to the center wires by adding solder to the hole in the back of the pin. Then, while heating the center pin so that the solder remains melted, insert the wires fully into the pin.
Note: Ensure that no solder is allowed to adhere to the outside of the center pin.
5. Insert the cable into the connector body while ensuring that the center pin is pushed as far forward as possible and allowing the braided shielding to extend on the outside of the connector body.



6. Push the shell forward until it rests on the connector body, and then push the crimp forward allowing the braided shielding to be compressed between the crimp and the body of the connector.
7. Use crimp area E of the crimping tool shown in [Figure 9 on page 9](#) to form the crimp into place.



Tuning Chart for HAD4022A

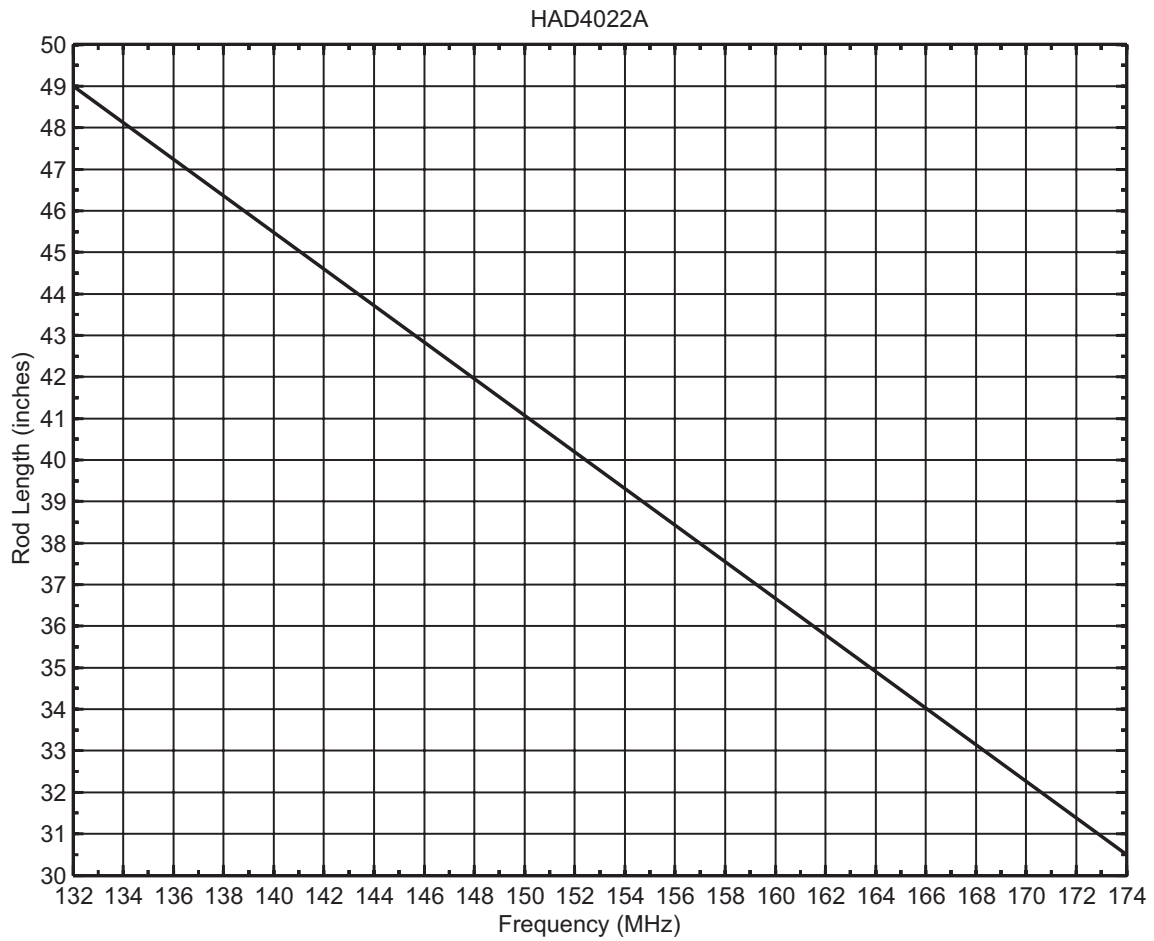


Figure 11. Rod Cutting Chart



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