SG-231 Smartuner®

Microprocessor Controlled Automatic Antenna Coupler

Installation and Operations Manual

POWER TOOLS

Getting the most from every watt of HF-SSB Power

MADE IN USA

SG-231 Smartuner ™

Slim Design with Simple Mounting

The SG-231 is a slim design that will easily fit in the most compact installations. The unit measures only 11.5D x 9.5W x 1.7H inches, and weighs 3.8 lbs. The SG-231 is waterproof and is designed to be mounted at the antenna feed point for maximum efficiency. Easily configured for tower mounting.

Antenna Applications:

- End-fed wires
- Center-fed dipoles
- Inverted "L"s
- Loops
- Mobile whips
- Vee Beam
- Many others

SGC SMARTUNER™ Family

SG-230 SG-237 SG-235

SG-231

SG-230	SG-237	SG-235	SG-231
1.6 - 30 MHz 3 to 200watts	1.8-60 MHz 3 to 100watts	1.6 - 30 MHz 3 to 500watts	1 - 60 MHz 3 - 100 watts

SG-231 Specifications

Frequency Ranges:	1 to 60MHz
Power Input Range:	3 to 100 watts (PEP)
Input Impedence Range:	45 to 55ohms
VSWR:	Typical - less than 1:1.4
DC Input Requirement:	+13.6VDC
Input Current:	Average-.9 amps
Random Set Times:	Typical- less than 4 seconds
Recurrent Set Times:	Typical-less than 10 milliseconds
Non-volatile Memory Addresses:	170 BINS
Antenna Length:	Min. length 8 ft., 3.5 to 60 MHz Min. length 23 ft., 1 to 60 MHz
Installation:	Any position
Operating Temperature:	-35° to +70° C
Environmental:	Waterproof at immersion of 1 meter for 24 hours
Size Overall:	11.5D x 9.5W x 1.7H 29.2D x 24.1W x 4.32 H centimeters
Weight:	3.8 pounds (1.6 kilos)
Case Construcion:	Plastic ABS weatherproof case
Cable:	10 ft. Power Cable 10 ft. RG-58 coax cable with PL259 connectors

SGC
No Compromise Communications

The SGC Building, 13737 S.E. 26th Street,
P.O. Box 3526, Bellevue, WA 98009 USA
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SG-231 ANTENNA COUPLER

Installation and Operations Manual

Updated: November 2000

CAUTION: Carefully read the "Quick Start" on the following page and all pertinent sections of this manual prior to operating your Smartuner for the first time. This unit will provide outstanding service if you follow the detailed recommendations within this manual.

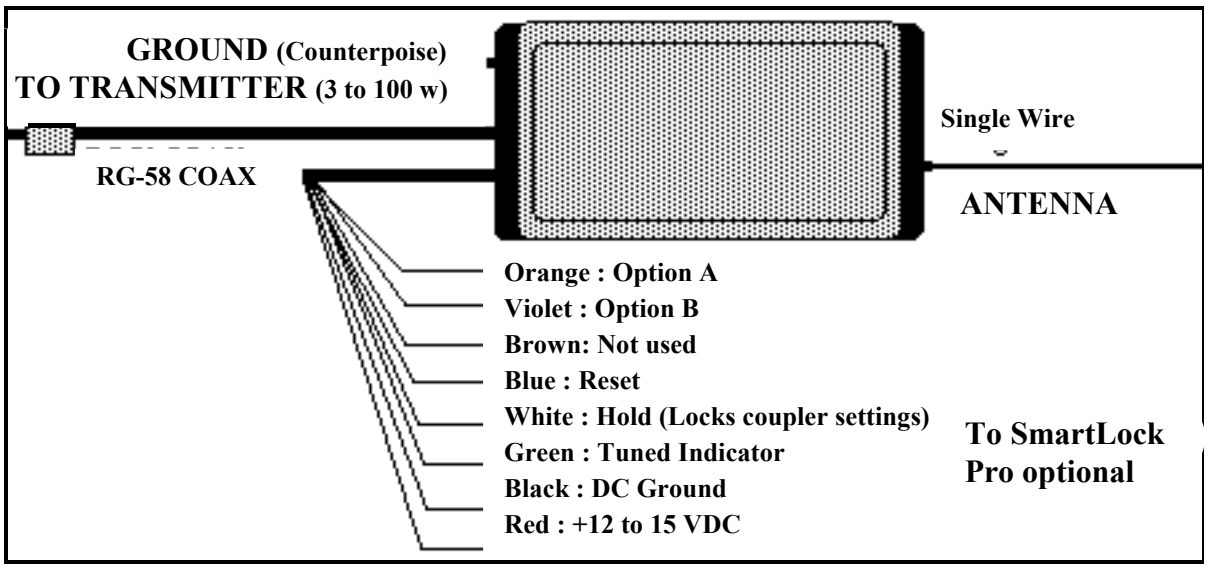
Quick Start Guide

To quickly install your antenna coupler you will need the following:

1. An HF/VHF radio with 3 to 100 watts output.
2. An HF antenna with a wire feed (not coax fed).
   Minimum length of 7 feet (to 3.5 MHz) or 23 feet (1.8 MHz).
3. A good ground (counterpoise) for the antenna and coupler.
4. +12 VDC and ground for the coupler.
5. SmartLock Pro coupler controller (optional).

Connections:

Connect the Smartuner as shown in the following diagram:



Operation:

1. Turn on Radio. Apply +12 VDC power to the coupler.
2. As power is applied, coupler should make one "click" sound.
3. Coupler should come up in the bypass (un-tuned) state.
4. To tune, speak normally, whistle or use CW (CW is recommended).
5. Tuning should be done at full power. Clicking is heard.
6. When tuned, clicking stops and Green wire goes low.

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Table of Contents

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1.0 General Information

The Smartuner™ reputation has grown to legend status because it is simple to use and a highly reliable piece of electronic equipment. A Smartuner will provide maximum transfer of radio energy from any HF/VHF transmitter to any loop, end or center fed HF antenna within the frequency and power limits of its specifications. The SG-231 builds upon the renowned reputation of the SG-230 by adding many advanced features, among them: a new, highly technological micro controller which has built in A/D functions, non-volatile memory; improved immunity to RF interference; improved tuning precision; and the ability to be used on 6 meters.

This document is designed to guide the SG-231 Smartuner user through installation and operation of the unit. This document will also recommend various steps that may be undertaken in the field to provide correct operation of the SG-231 should difficulty be encountered. Smartuners are extraordinarily reliable. But you should be aware that there are scores of fine points to any HF/VHF installation that are easily overlooked and may cause difficulty. Our goal in this manual is to help you quickly obtain the best possible performance from your HF radio installation. By reading this manual carefully, you can avoid most of the pitfalls that can degrade the performance of your HF system.

1.1 Users Experience

The Smartuner may be installed successfully by anyone with the help of this manual. However, if you are inexperienced in HF radio installation and operation, do not be shy about seeking advice from people with more experience than yourself. They will help you achieve good results quickly and with minimum frustration. Even the most experienced professional HF users will occasionally run into difficulty.

Regardless of the level of your experience, SGC stands ready to offer you installation suggestions and help you resolve any aspect of Smartuner operation that is not entirely satisfactory. If you have a specific question, please send us a fax at our Bellevue, Washington (USA) headquarters. The number is (425) 746-6384. If you require telephone assistance, please call us at (425) 746-6310 during business hours, 8:00 A.M. to 5:00 P.M. Pacific Time.

1.2 What Is an Antenna Coupler?

Antenna "couplers" are placed at the antenna and precisely match conditions of the antenna to the feed line. Antenna "tuners," on the other hand, are generally located at the transmitter output at the radio end of the coaxial feed line. Do not be confused by the term "coupler" or "tuner."

- A tuner placed *at the transmitter* fools a transmitter into working correctly.

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• A coupler *installed at the antenna* eliminates feed line losses by providing a proper match of the antenna to the feed line. The Smartuner is a true antenna coupler.

The several key points, which we will emphasize throughout this manual, will result in the best possible operation of your Smartuner. These include:

- The coupler must be located *at the antenna*.
- No coax may be connected to the coupler output.
- The coupler must have clean +12 VDC power supplied to it.
- The ground system must always be *larger* than the antenna.
- The antenna wire should be of the largest gauge practical.
- Capacitance at the coupler output must be minimal.
- The antenna should be of sufficient length for your lowest operating frequency.

Strictly observing these basic rules will insure good operations under the widest range of conditions.

This manual should be thoroughly studied if you plan to have the best possible signal and most reliable operation of your HF system.

Please make note of the following information for your records:

Date unit was purchased: _____

Dealer from whom Purchased: _____

Date Installed: _____

Type of Antenna used: _____

1.3 Overall Description

The SG-231 is a general-purpose coupler that can operate with any type of radio and almost any type of antenna configuration. The coupler network configuration is of a **pi** or **L** type; sensors continually monitor the state of the tuning and relay this information to the processor.

The initial (first time) tuning may take several milliseconds to a few seconds depending on the complexity of the tuning process for a specific antenna configuration. After tuning the first time for a specific frequency and antenna, this information is entered in the non-volatile computer memory that will store up to 170 tuning solutions.

When the same conditions are encountered again, re-tuning is accomplished within 20 milliseconds by recalling the information from the non-volatile memory. Special software has been designed by SGC to allow accurate and fine-tuning of the coupler. For software description, refer to the MicroTune™ section of the manual.

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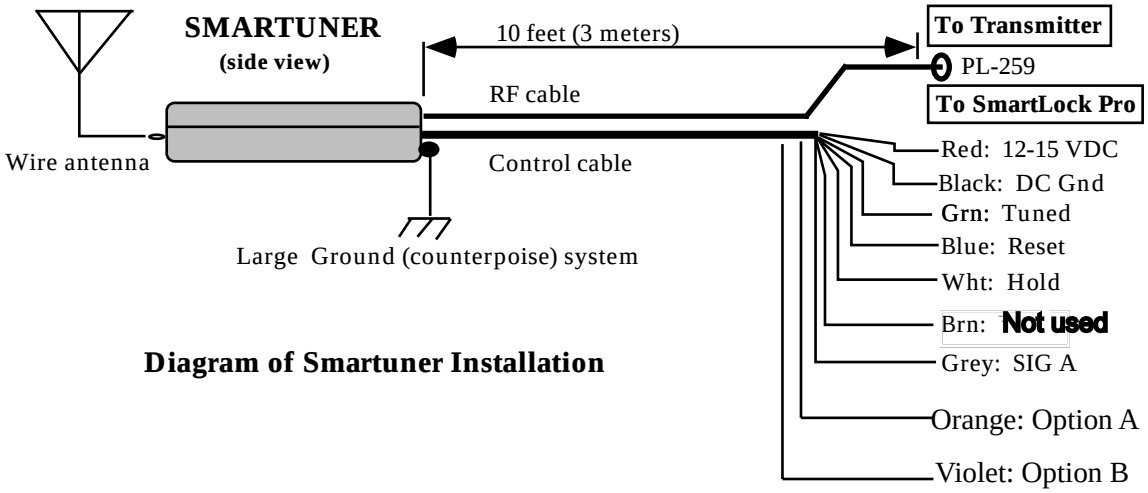

Diagram of Smartuner Installation

If antenna or transmitter conditions have changed since the information was stored in memory, the coupler re-tunes and a new tuning solution is achieved. This new information is stored to memory for future reference. The Smartuner will always look for the *best possible tuning solution* and will improve existing tuning solutions whenever possible.

The SG-231 may be bypassed and your antenna used as a broadband receiving antenna. To do this, turn off the power to the coupler for two seconds and then turn it back on, or simply press the reset button on the SmartLock Pro. In this situation, the coupler is reset to stand-by waiting for the first RF power to be transmitted before providing a tuning solution. In the stand-by mode, the antenna bypasses tuning elements and connects the antenna directly to the receiver with no tuning elements engaged. This allows for receiving signals throughout the HF range.

The coupler will cease to operate normally if input voltage drops below 10.5 VDC. This situation may occur if a marginal battery is used or if you are transmitting at high power with an inadequate power supply or battery. Batteries must be fully charged for proper operation. Large gauge wiring to the transmitter and coupler must be used to avoid re-tuning.

If broadband operation is required during scanning operations, jumper JP-1 on the printed circuit board inside the coupler may be set to the "YES" mode. This will bypass tuning elements on receive. Jumper JP-1 is located along the edge of the printed circuit board near U2.

In some cases, it may be desirable to re-tune the coupler and bypass the memory information. If you wish to bypass the recalled tuning solutions, place jumper JP-2, also located near U2, to the "NO" position.

1.4 Coupler Network Configuration

The coupler network configuration is designed with 128 different input capacitor values, 64 output capacitor values, and 512 inductor values, thus providing about a four

million different pi or L configurations. The coupler requires an input of 5 to 100 watts to operate. The unit operates on +12 VDC.

1.5 Operation Indicators

Operational status of the coupler and the onboard computer's tuning decisions is displayed by five LED's, which are located on the main printed circuit board (PCB). These indicators are only visible when the cover of the coupler is removed. These five LED's are not designed to be interpreted by other than factory and trained service personnel.

CAUTION:

Dangerous high voltages exist inside the Smartuner when it is operated with an HF transmitter. High RF voltages in excess of 10 kv may be expected in normal operation of this unit. In addition to shock hazard, these RF voltages may produce burns that are very painful if you come in contact with exposed components. Therefore, DO NOT operate without the cover secured in place unless you are a well experienced radio technician or engineer.

As a matter of good installation and engineering practice, exposed metal antenna elements should be located in such a manner as to prevent accidental contact with people (especially young children), pets, and small animals.

1.6 Mechanical Design

The SG-231 is supplied in a weatherproof case with mounting holes. RF and DC power is supplied to the unit through the separate cables. One cable is a 10 foot 50 ohm coax for RF. The other is a 10 foot 8 conductor cable with wires for ground, power, optional SmartLock controls, and optional LED indicator.

The SG-231 antenna coupler's weatherproof case is designed to withstand the environmental conditions encountered aboard ship when mounted on the weatherdecks. The internal construction is designed to withstand the shock and vibration of marine service. Corrosion-resistant hardware and passive alloys are employed throughout. We do not recommend opening the Smartuner case unless it is necessary. For 99% of installations, the factory settings for jumpers will be correct. **The coupler must be installed in an area not directly exposed to the sunshine or rain. Should you have occasion to open the case, it must be re-sealed under low humidity (below 35%) and care used to ensure the gasket that seals the unit is placed properly to maintain watertight integrity of the unit.**

Although the Smartuner is built very solidly, it is good installation practice to provide additional protection from the elements. SGC makes the following recommendations:

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1.6.1 Marine Mounting

The Smartuner should be located inside the house or under the aft lazaret on a sailboat. On powerboats, the coupler may be mounted outside, but an additional protective housing is recommended. The preferred installation if vertical is with the RF screw pointing upward.

RF and DC cables are provided for on the lower edge of the weather housing, along with a 1/4-20 stainless steel ground stud. The antenna connects to the screw on the top of the weather housing.

The SG-231 may be mounted in any position including inverted without any degradation of performance.

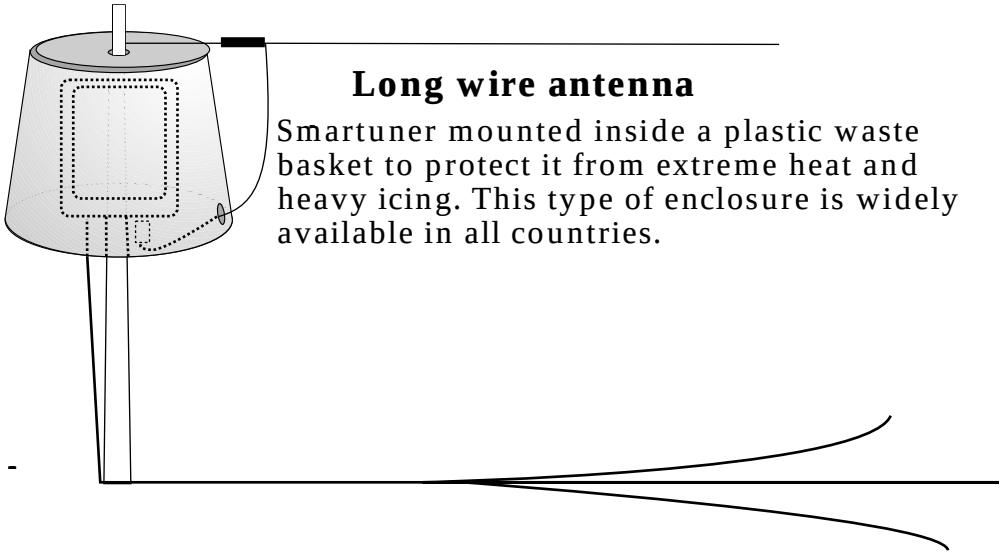
1.6.2 Desert and High Temperature Installations

The Smartuner may be used in very hot climates on a continuous basis if some additional protection from direct sunlight is provided. The best protection for a mobile installation is provided by the QMS (Quick Mounting System) that keeps the antenna coupler outside of a vehicle. Temperatures inside a vehicle may exceed 212°F (100°C). If a QMS is not used, it is desirable to keep the coupler in the shade if possible. Please refer to the diagram in the following section.

1.6.3 Direct Weather Protection Installations

We recommend placing the Smartuner under some kind of protective housing other than having the case directly exposed to sunlight and to prevent heavy build up of ice. If you are mounting it on a tower in a hot or cold climate, a plastic wastebasket (such as those made by Rubbermaid™) makes an excellent weather cover and costs only a few dollars.

Figure 1.6.3.1 Direct Weather Protection



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1.6.4 Warranty Note

It is important to have protection from the elements as common weather conditions can reach beyond the capabilities of the coupler. Although the SG-230 coupler is fully waterproof and was created to withstand normal weather conditions, warranty will be voided if left exposed directly to extreme weather such as snow, rain, and ice or prolonged sun exposure. Even in milder climates, direct and constant sunlight can exceed the safe operating temperature and can shorten the lifespan of your coupler.

1.7 Remote Installations

The SG-231 is supplied with ten feet of standard RF cable. SGC has two standard lengths of antenna extension cable available in the event you need to mount the cable farther than ten feet from the transmitter. A 25-foot extension cable is available (SGC Part Number 54-67) as is a 50-foot cable (SGC Part Number 54-68).

If you need to install the antenna coupler more than 50 feet from the transmitter site, up to two extension cables may be used for a total of 75 or 100 feet. However, SGC does not recommend installing the Smartuner more than 100 feet from the transmitter because two losses must be considered.

- The first loss in long distance installations is normal attenuation of the radio signal coming from the antenna to the radio via the coax. As you may be aware, the longer the coaxial cable run, the higher the loss will be. The amount of loss depends on frequency. At 2 MHz, the loss is approximately .5 dB, while at 30 MHz the loss in 100 feet of coaxial cable is over 2 dB. This means that a 100-watt transmitter would actually deliver about 70 watts to the antenna after running through 100 feet of coax at 30 MHz.
  If you are seeking the utmost performance at 30 MHz and you cannot avoid a run of 100 feet, or longer, we recommend using a larger low loss type of coax such as RG-8 (foam dielectric) or Belden type 9943 coax. Both of these will reduce attenuation to less than 1 dB per 100 feet. However, this heavier cable is harder to work with and may be quite expensive.

- The second loss which must be considered involves the losses in the DC power and reset control line. At any distance other than the 10-foot cable that is supplied by SGC, we recommend that the DC voltage at the antenna coupler be measured, because if the coupler voltage drops below 10 volts, the coupler may not operate properly.
  For this reason, if distances are great, SGC recommends that the input DC voltage at the transmitter site be adjusted to provide for +12 to +14 volts at the coupler site.

We do specifically advise against use of a different power supply than the one used to power the radio because of the danger of creating ground loops which may cause oscillation of the final amplifiers or other undesired side effects. If you decide to use a

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separate power supply mounted at the antenna coupler location, please be advised that SGC does not provide technical support in this area

1.8 Upgrade Sequence

The current version of the SG-231 coupler will have a revision letter located on the printed circuit board. To continue moving forward in coupler design, the SG-231 may be revised as needed. Later revisions of the coupler will be denoted by the subsequent letters of the alphabet.

SGC will continue making incremental improvements in the Smartuner product. When you buy your product today and a new feature is added, you can always upgrade for modest fees to the latest version of the unit. If you would like to upgrade to the latest version of the unit, contact SGC because special discounts are always provided to our valued customers.

2.0 Specifications

HF Frequency Range:	1 to 60 MHz
Power Input Range	3 to 100 watts (PEP) — 50 watts max. on CW
Input Impedance Range:	45 to 55 ohms
VSWR: (Typical)	Typically less than 1.4:1
DC Input Requirement:	+13.8 VDC
DC Operating Range:	+10.5 to 15 VDC
Input Current: Average:	.9 amps
Random set time:	Typical: less than 2 seconds
Recurrent set time:	Typical: less than 10 milliseconds
Antenna Length:	Minimum length of 7 ft. —3.5 to 60 MHz
	Minimum length of 23 ft. —1 to 60 MHz
Installation:	Any position
Operating Temperature:	-35° to +70°C
Size:	9 x 9 x 2 inches
Weight	3 pounds
Case Construction:	ABS plastic cover on an anodized aluminum base
Control Cable:	Shielded 9 conductor 24 AWG with 8 pin female Mic connector on one end

2.1 Accessories

SGC Part Number 54-67	25 foot Extension cable
SGC Part number 55-68	50 foot Extension cable

2.2 Recommended Antennas

SG-105 Marine and Base station antenna. This is a 60-foot end fed long wire type antenna. SGC Part Number 55-10.

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SG-107 Delta Loop Antenna. This is a delta loop 11 meters high by 11 meters wide at the base. SGC Part Number 55-12.

SG-203 Marine 28 foot whip antenna. This antenna is used for most powerboat installations. SGC Part Number 55-24.

SG-303 High performance 9-foot whip antenna. This dual element antenna is designed for severe marine and land mobile service. SGC Part Number 55-27.

SG-307 — 3.5 to 60 MHz.

QMS A Quick Mounting System which houses SG-231 Smartuner and also provides a sturdy mounting platform for the SG-307 antenna system. Designed for fly away installations requiring no holes installation of high performance HF antenna system.

3.0 Parts and Technical Support

SGC supplies SG-231 equipment; the user supplies suitable radio and antenna.

3.1 Parts Furnished

1. Antenna Coupler.
2. 10 foot RF cable with connectors on each end.
3. 10 foot control cable with connector to coupler on one end.
4. Instruction Manual.

3.2 User Supplied Items

The user of the SG-231 will need to supply a suitable HF radio antenna. Such an antenna may be as simple as an 8-foot-long piece of wire and several ground/ counterpoise radials of 8 feet or longer. The longer the antenna, up to about 80 feet, the better all around performance will be. Longer antennas may be used, but please refer to the sections on antennas for discussion of limitations.

The user will also have to supply a good counterpoise. Such a counterpoise is a large metal surface (much larger electrically than the antenna). Generally, the bigger the counterpoise, the better your signal will be.

3.3 Technical Support

Before contacting SGC for technical support, please take a few minutes to think through your installation and ask if there is anything obvious that you have overlooked in the installation. Check to make sure your ground system is both adequate and tight and that proper voltage is supplied to the coupler.

In the event you experience difficulty with your SG-231 antenna coupler, you should contact SGC for technical advise. Before calling, we ask you to have the following information ready so that we may readily assist you.

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Coupler Information. Please have the serial number of your coupler, the name of the dealer from whom the unit was purchased, and the approximate date of purchase.

Antenna Information. Please be ready to describe your antenna installation. You will need to advise us whether the antenna is a wire type, a dipole, V, vertical, long wire, or whip antenna.

Ground System. You should be ready to describe your ground system in detail. If you are dealing with a marine installation, you should have a description of the vessel's bonding system. If you are using the coupler in a mobile setting, you should be able to describe bonding of the hood, trunk, and other vehicle parts that may have been done. In an aircraft, you should be able to describe the location of the coupler and the type of ground connection used.

Power supply voltage. One of the common mistakes made when installing couplers is to assume that a connection is good when it hasn't been measured. If you experience any type of erratic or intermittent operation, please measure the power supply voltage *inside the coupler*.

Describe Coupler behavior. If you are having a problem, determine if it is happening all the time or only part of the time. Does the problem occur only on certain frequencies? Does the problem happen only in certain modes? This type of information is extremely useful in quickly isolating your problem.

Be patient. Finding the reason for less than ideal system operation may take one telephone call or it may take several calls. Regardless of how complex the problem is, your SGC representative will be able to walk you through the process of solving your problem in a logical step-by-step manner. The Smartuner and accessories will always give top performance when carefully installed.

4.0 Antenna Types

The automatic antenna coupler is designed for use with end-fed unbalanced antennas such as whips and long wires. The radiating portion of the antenna is connected directly to the coupler through a stainless steel screw. It is extremely important that the antenna type, site location, and grounding technique be correctly chosen so that the system will radiate effectively.

Broadband resonant antennas (e.g., log periodic) that cover the full range of the system may be used with the coupler if desired. Narrow band resonant antennas, such as dipoles, Vs, and inverted Vs may only be used if the antenna VSWR (including coaxial feeder) is less than, or equal to 3:1 at the operating frequency.

Note that if a dipole or V type antenna is used, the antenna may be operated at any frequency within the range of the coupler if each side of the V or dipole is 23 feet or

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longer. In addition, the SG-231 is just as happy feeding a conventional V antenna as an inverted V. The coupler is flexible in this regard.

4.1 Antenna Selection

The automatic antenna coupler will operate into almost any end-fed antenna with a length of 2.5 meters or more, provided an effective ground is used. The antenna efficiency will be proportional to length and in most applications will be maximum at a length of 1/4 wavelength. This means that the longest possible antenna should be selected for each installation.

Very short antennas are only recommended when there is no other alternative such as in a vehicular mobile installation. The performance of short whip antennas is usually very poor, particularly at the lower frequencies, and radiation efficiency will be only a few percent of a full sized antenna. However, a special electrically long antenna such as the SG-303 9-foot mobile antenna overcomes much of the radiation problem.

4.2 Whip Antenna

2.0 TO 3.0 Meters (7 to 9 feet)

This antenna is recommended only for vehicular mobile installations. The short length will result in poorer performance compared with the longer antennas. A special high performance 9-foot antenna, the SG-303, is manufactured by SGC specifically for this problem. (SGC Part Number 55-27.)

7.0 to 8.5 Meters (28 feet)

This antenna is recommended for marine installation on smaller vessels. It may also be used in base stations if there is no way of using a longer antenna. The SG-203 is this type of antenna. (SGC Part Number 55-23.)

10.7 Meters (35 feet)

This is the preferred antenna for marine installation when there is no room for a long wire antenna. It will also provide reasonable efficiency for base station use and is the shortest recommended base antenna. (SGC Part Number 55-24 for the SG-204 35 foot whip antenna.)

4.3 Long wire Antenna

23 Meters (75 feet); 46 Meters (150 feet)

For most applications, the long wire antenna will give the best results and is recommended when practical. The diagrams at the end of this section show some recommended methods of installation. These are only a few of the many possible methods of installation, and frequently a different configuration will be the best at a particular site. SGC's long wire antenna, 60 feet in length, provides efficient operation on low frequencies and high frequencies alike. (SGC Part Number 55-10.)

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4.4 Back Stay Antenna

8 Meters (28 feet) and Longer

Although we would love to sell everyone a high performance marine whip antenna, the back stay of a sailboat is almost impossible to improve upon in most installations.

4.5 Typical Installations

Figures 4.5.1 through 4.5.11 show some typical installations for the automatic antenna coupler.

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Figure 4.5.1 Jeep installation

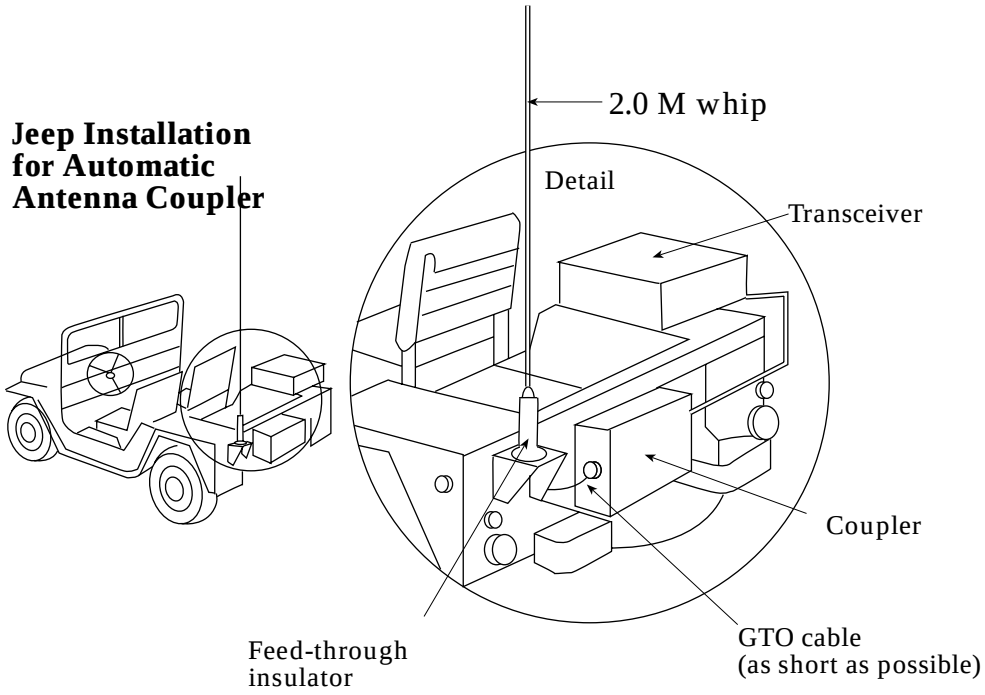

Figure 4.5.2 Vehicle installation

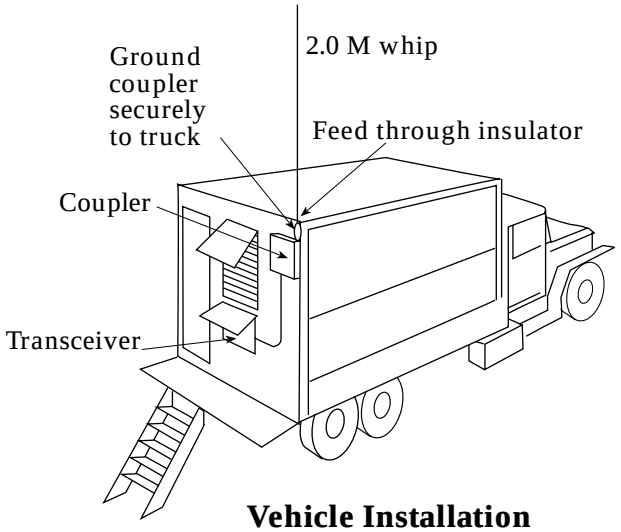

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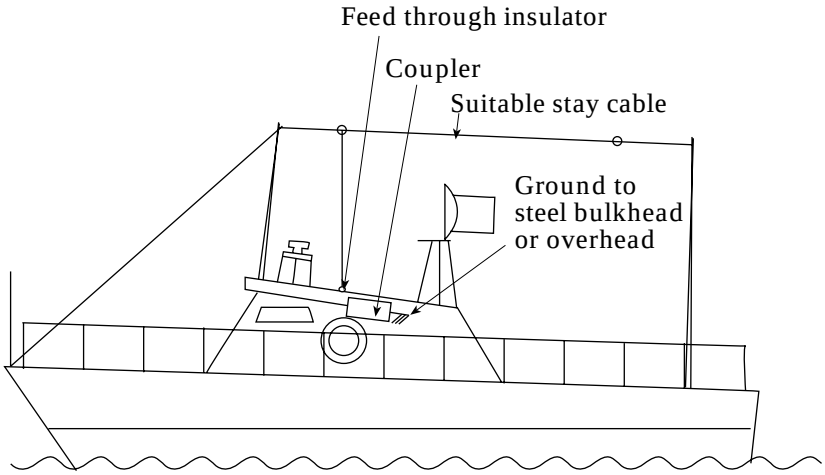
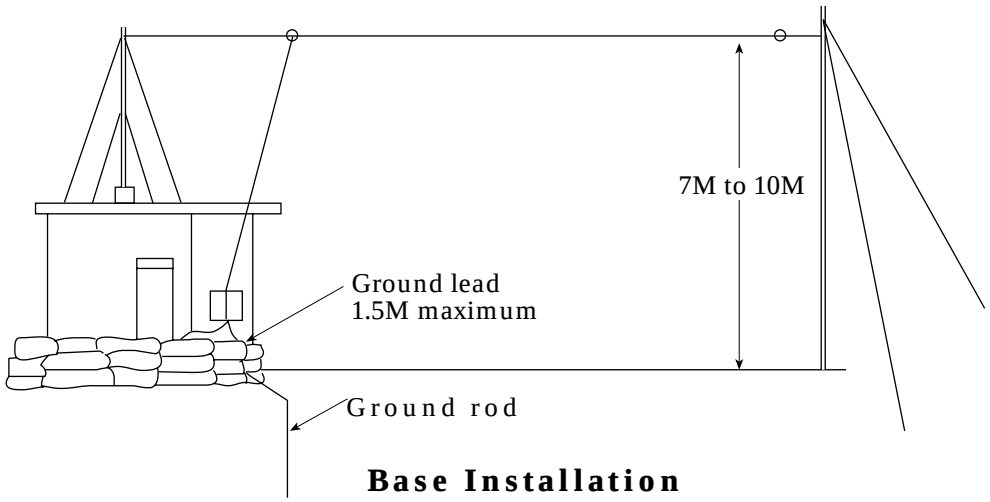
Figure 4.5.3 Motor Vessel installation



Motor Vessel Installation

Figure 4.5.4 Base installation



Base Installation

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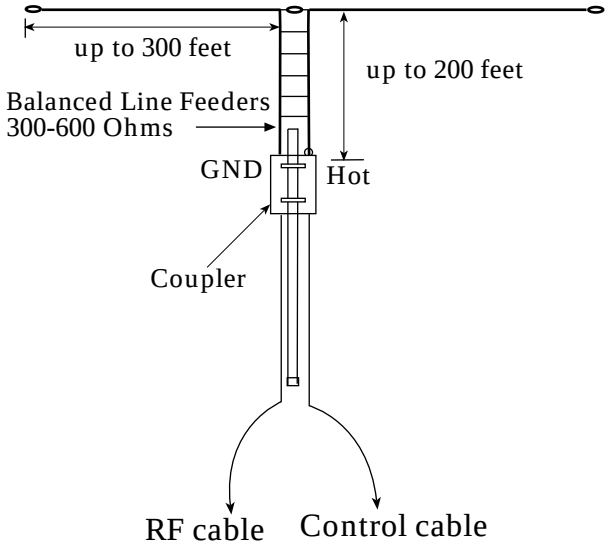
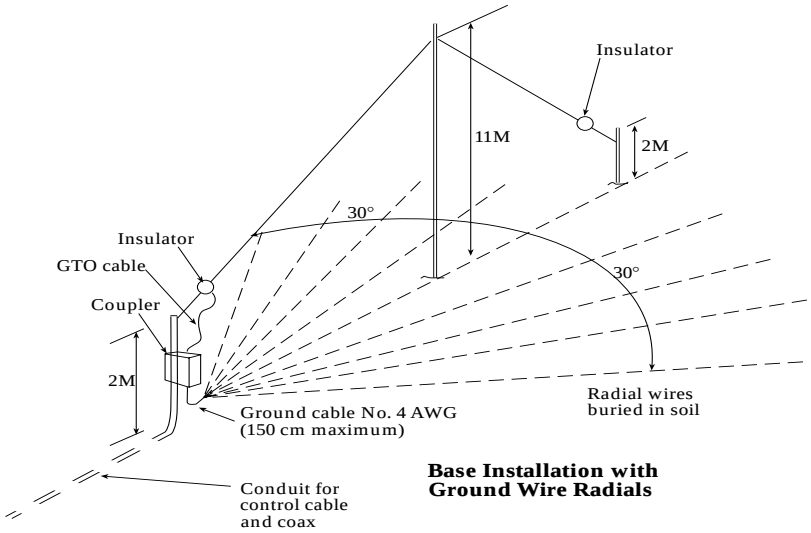
Figure 4.5.5 Base ladder installation



Base Ladder Installation

Figure 4.5.6 Base installation with ground wire radials



Base Installation with Ground Wire Radials

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Figure 4.5.7 Base dipole installation

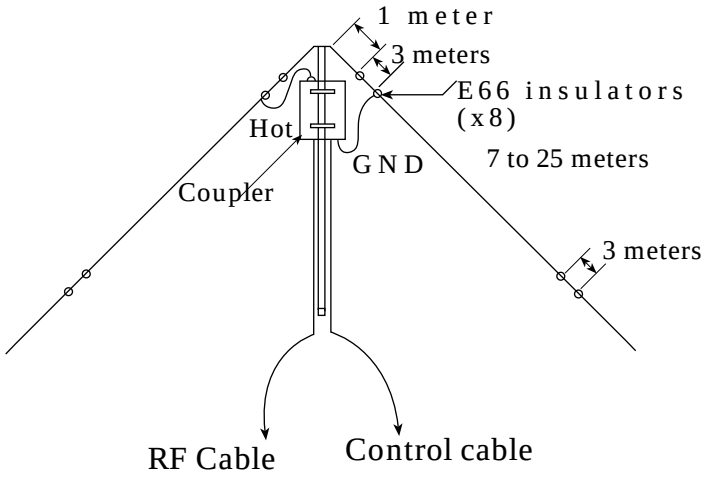
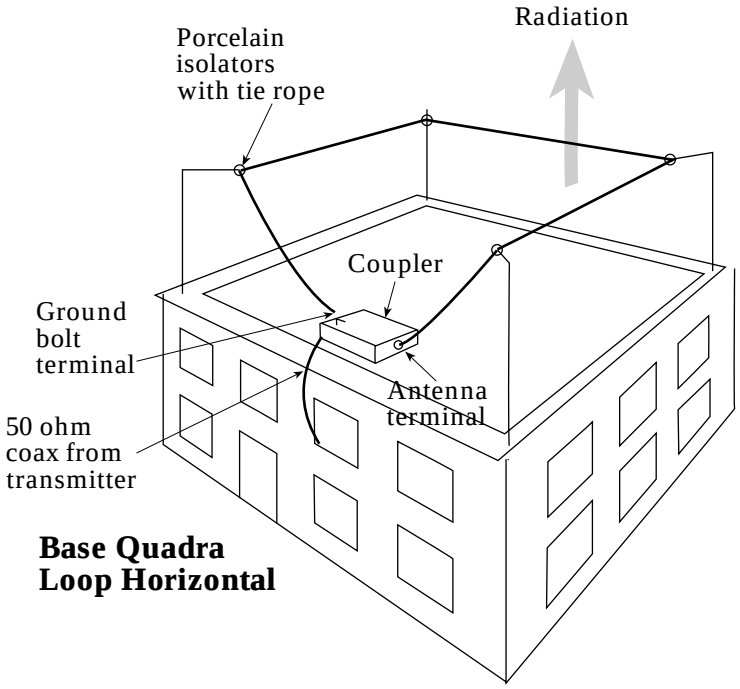


Figure 4.5.8 Base Quadra Loop Horizontal



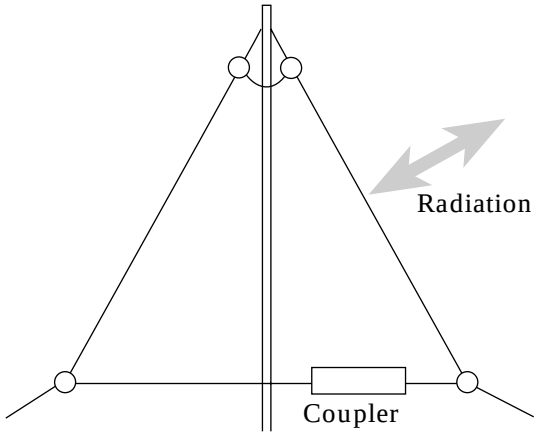
The horizontal quad loop is a groundless antenna for high angle radiation and is ideal for HF communications up to 500 miles in the frequency range of 2 to 10 MHz. This configuration provides optimum near-right angle reflection to the ionosphere for short-range communications.

A square base can be from 8 to 15 meters long and can be configured to the shape of the structure as necessary, to provide the best arrangement. The height of the supporting

poles should be 20 to 40 feet. Supporting poles should be as tall as possible to provide the antenna with the greatest isolation from industrial noise generated by the building, such as fluorescent lights and electrical motors. Loop antennas are also less susceptible to industrial RF noise generated by the building, because they are isolated from the ground system of the building.

Loop wires are attached at one end on the high voltage active side of the coupler and on the other end at the groundside of the coupler.

Figure 4.5.9 Base Delta Loop



Base Delta Loop

The delta loop antennas are ideally suited to long range communications due to their low angle. This configuration is best for communications ranging from 500 to 5000 miles in the HF frequency range of 4 to 22 MHz. Noise rejection is excellent, as stated for the quad loop antenna. Because the antenna system is not connected to a ground, noise rejection is enhanced. If mounted on the rooftop of the building, it is further isolated from the building, which generates RF noise.

The supporting mast should be 8 to 14 meters tall to provide good overall HF performance.

Note that with this type of antenna, the coupler may be mounted in the middle of the horizontal portion of the loop or it may be mounted at the corner. If mounted at the corner and the lead from the coupler attached to the vertical leg, the polarization of the loop tends to be vertical and is slightly better for low angle long distance communications.

Loops in the horizontal plane may also be used. This type of antenna provides exceptionally good performance on the low frequency bands for short to intermediate range communications.

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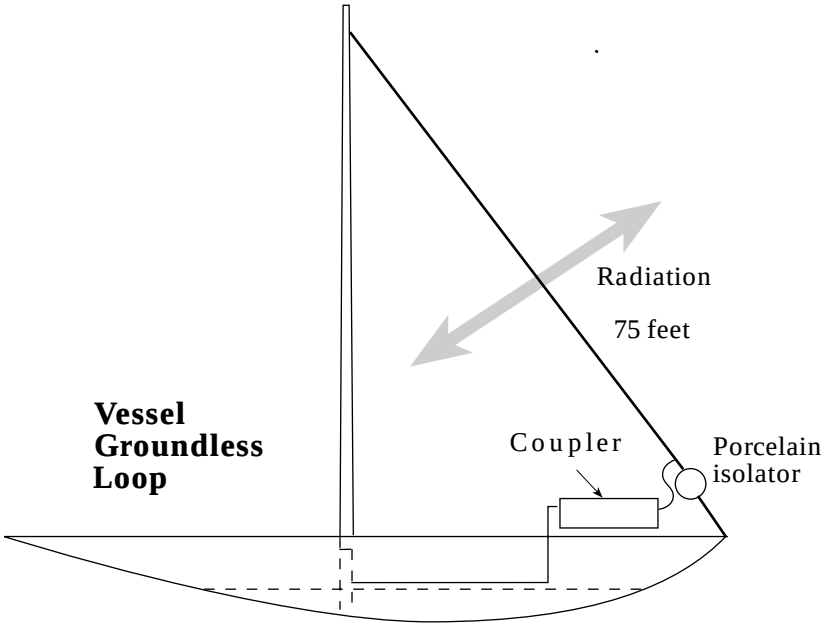
Figure 4.5.10 Vessel Groundless Loop



The triangular loop antenna for sailboats is designed to operate in a groundless environment and still provide high performance. This type of installation will require only one insulator point on the bottom back stay and an electrical connection on top of the mast and the stay. The grounded side of the coupler should be connected to the bottom of the mast. Although not our best recommendation, this antenna will provide a workable solution in some installations.

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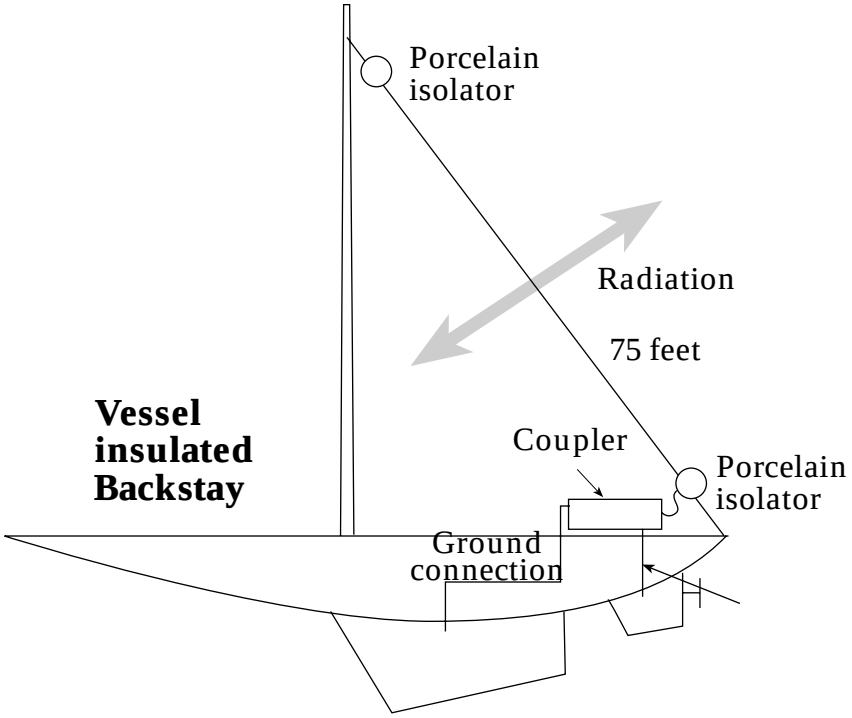
Figure 4.5.11 Vessel insulated back stay



The insulated backstay antenna requires two porcelains isolators. The coupler must be placed as close as possible to the base of the backstay antenna. Proper grounding of the coupler is very important. Connect the RF ground terminal of the coupler to all of the metal parts or structures of the boat (keel, engine, etc.).

4.6 Apartment Loop Antenna

Loop antennas can be used very effectively in small apartments, offices, and rooms. Radiation for a loop antenna is always efficient but highly directive. Therefore, the orientation of the loop is very important. Generally, the vertical loop antenna with horizontal radiation is much preferred for a general application throughout the 1.8 to 30 MHz band. However, loop antennas can be effective when mounted horizontally to the ground to radiate vertically and provide efficient short-range communications on higher frequencies. Generally HF connections are difficult to establish in the distance range of 50 to 250 miles. In a large room (such as 20 x 30), we would recommend the installation of a single wire loop antenna mounted on the ceiling with the coupler against the wall directly below the antenna. The wire gauge should not be less than 16 AWG with insulation.

When operating in a small room, install a small multiple wire loop (six loops) on a rectangular configuration three by four feet (as illustrated in Figure 4.6.1). This configuration allows operation from 1.8 to 60 MHz, and the SG-231 will tune and load all frequencies well below a ratio of 1.4:1 VSWR. Directivity will be high from 3 to 12 dB depending upon the frequency. If this is a problem, two loops at 90 degrees can be

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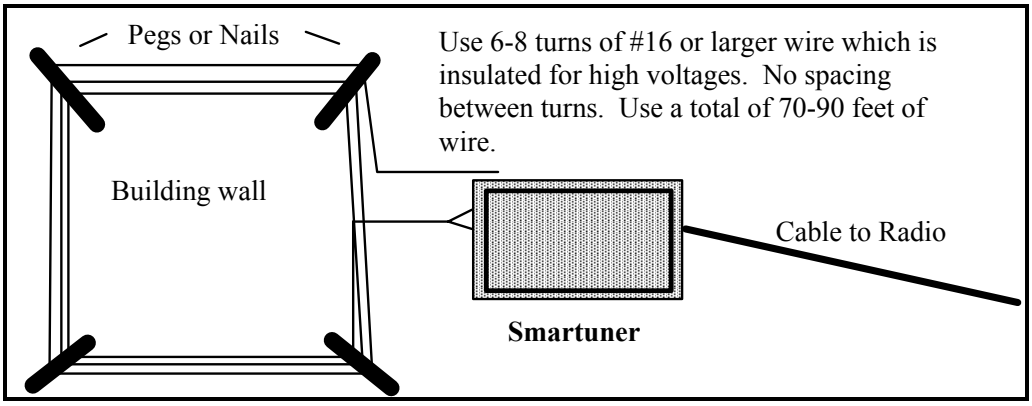
installed to communicate at 90 degrees off direction of the first loop antenna. Loop antennas are low noise antennas. However, because they are used in apartments and crowded cities, high industrial noise can be expected. Avoid using neon or fluorescent lights within 50 feet of the loop antenna, as they may completely jam one or several frequency bands.

Figure 4.6.1 Small loop antenna (3x4 feet)



Loop antennas of much larger sizes can be used; however, while the low frequency operation of such antennas may be quite good, the larger antennas may not work well at very high frequencies when located in a plane parallel to the earth. This is because large loop antennas generally radiate their maximum lobe (field strength) at right angles to their plane.

This means that a large loop, say 60 feet on a side, mounted 20 feet above the ground, would radiate much of its energy upward. While during the day this would work well for close in communications, longer distances would be achieved with the loop mounted vertically. The vertical loop antenna of 1/4 wavelength is the basis of the "quad" type directional antenna.

Loop antennas represent a DC short circuit and for this reason are much less susceptible to noise than are other kinds of antennas. In certain residential and industrial areas where high noise levels occur, the loop antenna may provide a substantial improvement in both receiving and transmitting performance at very little cost.

4.7 Recreational Vehicle (RV) Antennas

RVs or trailers provide an excellent base to install effective low cost antennas, and in both configurations, end feed or loop antennas can be used.

An end-fed antenna could be effectively used if a metal cabin structure is available. Loop antennas have the advantage of not requiring a ground system but are highly directive. The antenna can be mounted simply on short (18" long by .5" diameter) plastic plumbing pipes. Make the end-fed antenna as long as possible in an "L" shaped configuration, as illustrated in Figure 4.7.1.

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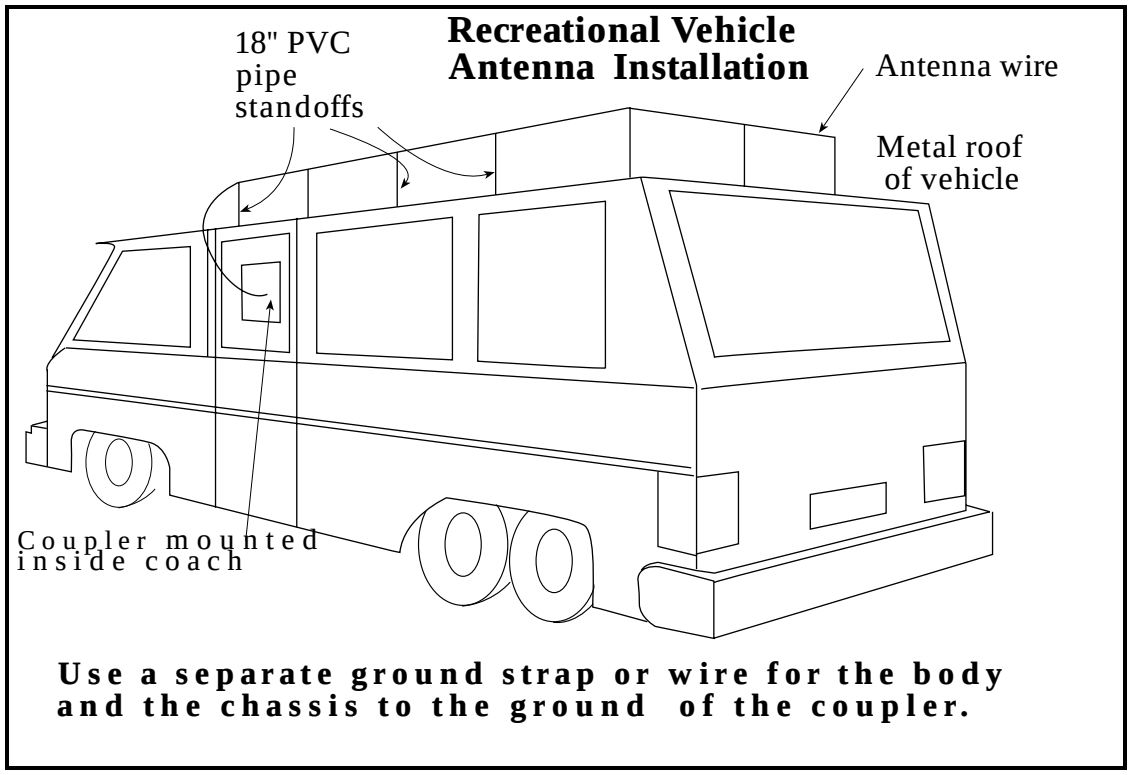
Figure 4.7.1 Recreational vehicle, bus, or truck detail



4.8 Aircraft Antennas

When installed in high performance turboprop or jet aircraft, the Smartuner will operate well with a shunt-fed antenna.

This is generally a 13-foot piece of metal that mounts on the fuselage of the aircraft and is grounded to the aircraft at one end. The device looks something like a towel bar on the underside of the aircraft.

The Smartuner will also match well the more common wire antenna from fuselage to vertical stabilizer (and continuing to a wing tip, if desired) and a long wire antenna under the tail rotor of helicopters. This long wire approach has proven effective on Bell Jet Rangers and Long Rangers in particular.

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Figure 4.8.1 Aircraft installation detail

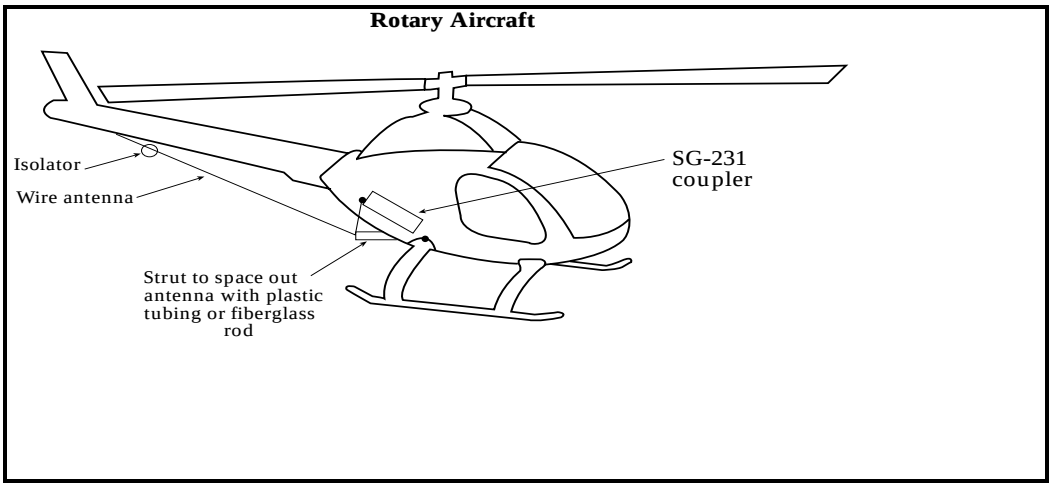
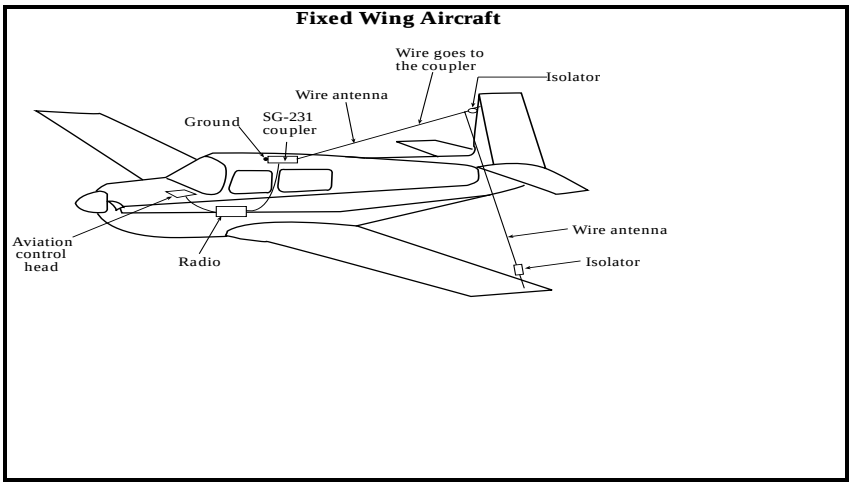


Figure 4.8.2 Aircraft Installation Detail



4.9 Low Profile, Hidden and Covert Antennas

There are two users of low profile, hidden, and covert antennas:

- The paramilitary user who will wish to operate from a residence or commercial building without drawing attention to long range HF communication in progress.
- Commercial building without drawing attention to the fact that long range HF communication is in process.
- The amateur radio community (a larger group) finds itself more restricted by covenants, building codes, and tenant requirements.

In a typical residential building, covert antennas have been used successfully for intercontinental communications. The antennas used include both groundless loop type antennas and those that require a counterpoise (ground).

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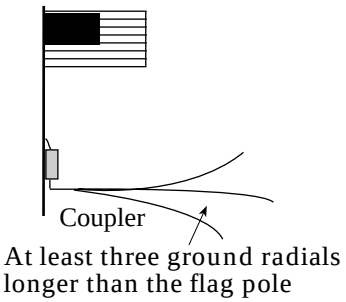
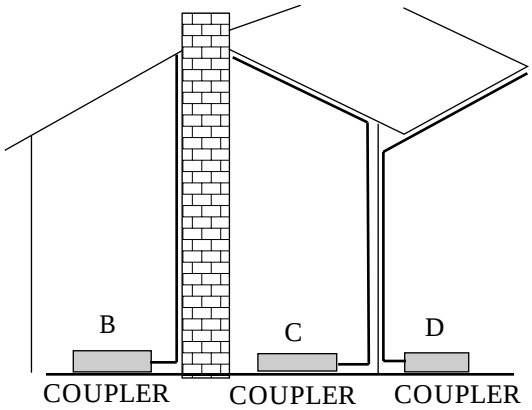
A. If a flagpole is made of PVC pipe, it is easy to tape a large gauge wire to the inside of the pipe and use a good counterpoise. Typical flagpoles are 25 to 35 feet in height and offer excellent performance on all bands.



B. Masonry chimneys are visually "busy." You can run a #10 copper wire parallel to the chimney with little risk of detection. Some short standoffs and you have a support for a vertical dipole type antenna.

C. Along the edge of the roof, held off by some inexpensive TV twin-lead standoffs, you can hide 25 to 40 feet of antenna on virtually any house.

D. The Inverted "L" antenna may work slightly better if it is installed clear of a building, but for covert operations, this type of installation is a favorite. If the feed-point is at ground level adjacent to an iron or copper water line entering the house that will provide an excellent counterpoise.



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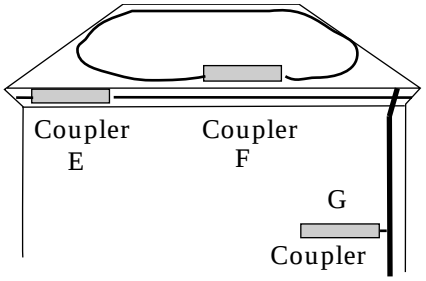
E. Under the roof overhang, all kinds of wire antennas may be installed.
F. All types of antennas may be hidden inside the roof of a building that uses non-metallic roofing materials.
G. The downspout, rain gutter antenna works well if the piping and gutter are aluminum. You may wish to assure low electrical resistance connections between gutter sections with hose clamps or plumber's tape.

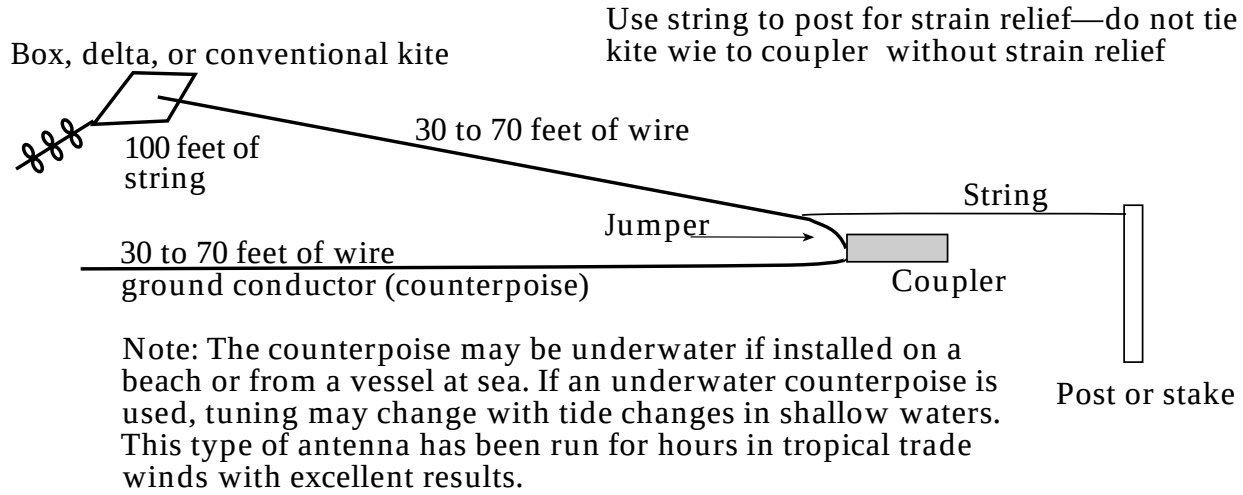


4.10 Emergency Antennas

There are a couple of antennas which don't fit into any category in particular, but which should be mentioned because when used with a Smartuner, they will deliver spectacular results.

4.10.1 Kite Antenna

Figure 4.10.1 Kite Antenna



Note: The counterpoise may be underwater if installed on a beach or from a vessel at sea. If an underwater counterpoise is used, tuning may change with tide changes in shallow waters. This type of antenna has been run for hours in tropical trade winds with excellent results.

This is our recommended antenna to be carried aboard all types of vessels. This is because when a wind strong enough to damage a boat occurs, it is easy to fly a kite and this may lift fifty to one hundred feet of antenna wire. For good emergency communications, you will only need 30-70 feet of antenna and a strongly built (Mylar or nylon) kite.

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Remember that when a mast comes down, you have easy access to the high voltage feed line that may be secured to a kite antenna. Offshore power boats can use this antenna as well, since 10-20 knot winds are almost always available when underway at sea.

4.10.2 Tactical Installations

Over the course of nearly 25 years of HF communications, SGC equipment has been used everywhere from camel back in the desert to Antarctic expeditions. Along the way we have collected a number of tips to get maximum system performance from your radio system when you are operating in a tactical or disaster situation. These tips, by the way, also apply when you go camping or are involved in amateur radio Field Day activities:

Tactical Antenna Supports. Except for a barren desert, just about all landscapes have structures (natural and man made) that can be used for antenna supports. All it usually takes is several hundred feet of rope and some creativity. Here are some examples to consider. If you wonder which structure would work best, remember the one with the greatest height and greatest distance from grounded metal will generally give the best performance.

Natural rock formations such as cliffs and bluffs.

Tall trees.

Water towers.

Church spires and minarets of mosques.

Rooftops of buildings—strung between.

Sign posts such as for banks and gasoline stations.

Telephone (*not power)* poles. There's no power line noise on telephone poles.

Railroad trestles

Highway structures: signs, overpasses, and bridges.

Flag poles at public buildings, schools, and hospitals.

Tactical Grounds And Counterpoises. Just as antenna opportunities abound, so do ground and counterpoise opportunities to the professional eye. Some of our favorite examples that correspond to the antennas above include:

Cross country water and petroleum transmission pipes (e.g., as it passes under a bluff)

Long steel cables along a mountain highway (e.g., one with nearby trees)

Chain link fencing (e.g., around a water tower)

Metal lawn sprinkler piping (e.g., in a church yard)

Fire department standpipes (required in most big city building codes)

Underground metal petroleum storage tanks (e.g., at a gasoline station)

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Metal fencing of any type (e.g., a barbed wire fence along a pasture or under telephone pole)

One hundred feet of wire thrown into a river or sea (e.g., under a trestle)

Metal drain culverts (e.g., along a highway)

Four to five cars parked with their metal bumpers touching

A sheet metal roof (e.g., hospital or public building)

As you can see from this list, there are an almost limitless number of options available to install a high performance antenna system with only a small amount of wire and an SG-231 Smartuner.

5.0 General Notes on Antennas and Couplers

1. The longer the antennas, the better the antenna performance. By doubling the length of the antenna, an improvement of 3 to 6 dB can be expected in your radiation or receiving characteristics. This is the equivalent of transmitting with 400 watts, when actually you are using only 100 watts.

2. A ground for end-fed antennas can be effectively created by running radial wires from the coupler point and laying them onto the ground. We recommend for a good ground that 12 radials should be used and they be about 1/3 longer than the antenna length. The number of radials can be reduced; however, you need at least one. Efficiency pattern and radiation will decrease in proportion.

3. Antennas will always perform better if the wire is of a large gauge. Never use anything less than gauge 16. If gauge 6 is used, an improvement of 6 dB can be expected over the 16 gauge. The radial ground wire should be at least the same size as of the antenna wire.

4. The SG-231 coupler can handle antennas beyond the specified minimum range of 8 to 80 feet and should be extended as much as possible. In some cases, the antenna can be 300 feet or longer. In this situation, you may find some tuning holes. The antenna can be made a little shorter or longer to overcome the tuning hole on the frequency band you may have wanted to use.

5. Always install the antenna system as far away as possible from any electrical or industrial noise source. Electrical appliance, electric motor, or fluorescent lighting noise may cover up weak or even strong signals.

6. A remarkable antenna coupler, the SG-231 will tune practically any antenna good or bad. Keep in mind that it is not the coupler that will radiate the RF energy, it is the antenna. Therefore, use only good size wire and long antennas.

7. Never use a feed line or coaxial cable at the output of the antenna coupler. The coupler functions to couple the radio to the antenna, not to act as a

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midpoint connector. Because the antenna system starts at the output of the coupler, the antenna lead from the coupler to the hypothetical antenna is part of the antenna system. Avoid having the led end wire touch any other metal structure: it will capacitively short your antenna to ground.

8. The backstay of your mast is the *only* viable antenna on a sailboat. The SG-231 coupler is specifically designed to be used for such applications.

9. For vehicular installation, do not use any inexpensive CB antennas and/or mounts. These antennas will not perform well from 1.8 to 10 MHz even though the coupler will load and tune the antenna whip. A high voltage of 15,000 to 30,000 volts RF will be applied to the antenna depending on the RF power level and frequency. The inexpensive ball mounts for CB antennas are not designed for so stringent a purpose. We recommend the use of an antenna system such as the SG-303: it was specifically designed for such extreme applications.

5.1 Steps to Antenna Installation

System installation is a three-part process covering the following steps:

1. Selection and installation of the antenna.

2. Mounting the antenna coupler.

3. Connecting the appropriate interface cables between the coupler and the transceiver.

This manual section will discuss the three steps mentioned above in detail and will provide sufficient information to enable the user to confidently install a complete system properly.

The antenna system is a key part of the communication system. For satisfactory operation the system must be carefully selected and then installed correctly. The unbalanced antennas used with the automatic antenna coupler, use the ground (counterpoise) as half of the antenna system. The ground forms an "image" antenna and is a critical part of the system. It is essential to consider both the ground and the antenna when designing the system installation.

5.2 Antenna Location

The figures in Section 4.0 illustrate several different antenna installations. The following points should be carefully considered when designing the antenna system.

1. The antenna should be located in a position free of obstructions, particularly in the desired direction of communication.

2. The antenna should be kept as far away as possible from buildings, trees, and vegetation. If metallic masts or supports are used, arrange the insulators so that the antenna is spaced at least 2 meters from the mast.

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3. Remember that the radiating part of the antenna starts at the coupler. The location of the bottom portion of the antenna is important.

d. Vertical antennas have an omni directional radiation pattern, providing equal performance in all directions.

4. Horizontal wire antennas have maximum radiation broadside to the antenna when the frequency is less than 1/4 wavelength. As the frequency increases beyond 1/4 wavelength, lobes will appear in the radiation pattern with the principal lobes becoming closer to the plane of the antenna as the length increases. At all times, radiation will be minimal at the end of the antenna; therefore, it should be located so that the ends point in directions where communications are not required.

5. The V antenna construction minimizes the directivity of the horizontal antenna and is recommended for all around coverage. In addition, the V antenna is a compromise between vertical and horizontal polarization and will give good results for communications with land or marine mobiles using vertical whip antennas.

6. High voltages (sometimes exceeding 30,000 volts RF) are present on the antenna. All parts of the antenna and coupler must be located or protected so that there is no possibility of accidental contact.

7. Do not locate the antenna close to other antenna systems.

8. Make sure that the antenna is rigidly supported. The antenna will de-tune if it sags or sways.

9. The connection from the coupler to the ground must be a small percentage of the total length of the antenna. Do not let the length of the ground strap exceed one meter. Use heavy gauge wire or strap for ground connection.

10. Whip antennas should be connected with the minimum length of wire. (Do not exceed 0.6 meters).

11. Do not locate the coupler farther from the transceiver than necessary. If the distance exceeds 10 meters (30 feet), we recommend you use low loss coaxial cable, such as RG-8 or RG-213.

5.3 Ground Systems—General

The ground system (also called a counterpoise) is a key part of the overall antenna system and is the primary cause of poor performance and the difficulty of adjusting the coupler. A good ground is essential.

5.3.1 Vehicle Grounds

Connect the coupler directly to the frame of the vehicle. Ensure that a heavy strap is used from the coupler ground lug and that the connections are cleared of all paint and dirt so that the shiny metal is exposed. SGC always recommends that two grounding bolts with star washers be used to ensure no ground resistance is encountered. Make sure that the grounding point is not insulated from other parts of the vehicle by non-metallic couplings, bushings, fiberglass panels, etc. Modern vehicle assembly techniques that use spot welding may not always adequately connect various body parts. Use an ohmmeter and insure your vehicle is electrically bonded.

Another area to watch is trunk lids and hoods. Because many body parts are dip painted, they may float above the RF ground when assembled. Use of short heavy braid to insure all doors and hatches are grounded is good installation practice. Although this is tedious work, the benefit is that once completed you will have a much superior radiated signal and lower noise floor on receive.

5.3.2 Marine Grounds

A metal hull vessel in salt water provides an almost ideal ground. The coupler should be connected directly to the hull using the shortest possible ground strap or 2 to 3 inch wide 2 mil copper foil. Make sure that the contact point is free from paint and dirt. Ensure a good contact area for minimum resistance.

Wooden and fiberglass hulled vessels present more of a grounding problem. It is normally necessary to bond all large metallic parts such as the stove, fuel tanks, engine, and propeller shaft; sometimes an external grounding plate should be connected to the hull. The bonding and grounding plate should be chosen with consideration for the problems of electrolysis. Severe damage may result if dissimilar metals are connected together.

Our experience is that sacrificial zinc's, which double as radio grounds, may help, but are not by themselves a complete solution. If you use one (or more) of these devices, remember to provide for a large physical counterpoise in addition.

In a sailboat installation, we generally place the Smartuner in the aft lazaret and then run at least three runs of foil forward. One runs up the port chine, just below the waterline, another up the starboard chine below the waterline, and the third up the center of the vessel.

The center foil is generally connected to the rudderpost, transmission, engine, and keel bolts. The chine foils are attached to through hulls, the stove, tankage and so forth. The idea is to get as much metal inside the vessel connected as possible. Metal toe rails and lifelines work well as do keel coolers on motorized craft.

Here is a tip for attaching foil to keel bolts. When a large keel bolt is exposed, drill into the keel bolt and tap the hole for a suitable stainless steel machine screw. Attach with suitable copper washers for a solid electrical connection.

Although it is not mandatory that ground foil be glued into place, we consider it a good idea to keep the space below decks neat and orderly under all conditions.

If you are using a backstay antenna, try to visualize your ground as you look down from the top of the mast. Ask yourself if you see 100 square feet of metal below you. The closer to this figure you can get, the better your radiated signal will be. What you are trying to do is make a large capacitor to the seawater. Consider the salt water of the sea to be one plate of a capacitor, the ground system the other, and the hull to be the dielectric.

On marine installations, you should also be aware of potential noise sources that may need to be bypassed to ground. We have encountered just about every source of noise imaginable in vessel installations. The best time to track down annoying noise sources is when you are laying in a ground system. Not only will you get much better voice communications, but Weatherfax, Navtex, and Loran reception will improve as well if they are also tied into the ground system.

Particular attention should be paid to any device that uses an electric motor. This means to turn on the water pressure pump, bilge pump, hot water forced air heater fans, refrigeration, and auto pilot motors. A few small capacitors to ground (.01 micro farads at 100 VDC) can resolve many issues. Bypassing of the vessel's alternator is also a good idea.

5.3.3 Base Station Grounds

In areas of high ground conductivity, an effective ground can be made through a grounding rod. The rod should be approximately 3 meters in length and should be installed as close as possible to the coupler. It may be necessary to use several ground rods bonded together to improve the ground contact. Water pipes are sometimes recommended as grounds and may be used provided plastic pipe is not buried as part of the system and the following conditions are met:

1. The water pipe is close to the coupler.
2. The water pipe enters the ground close to the coupler bonding point.
3. There are no joints or couplings in the pipe that will increase the resistance path to ground.
4. The water pipe enters soil with good conductivity.
5. A low resistance contact is made to the water pipe.

Earth requiring a counterpoise. Frequently the ground conductivity will not suffice to provide satisfactory operation of the coupler—almost certainly the case with well-drained sandy, rocky, or loamy soils. Therefore, a counterpoise (artificial ground) must be used as the ground system.

Rooftop installation requiring a counterpoise. In a rooftop installation where there is no existing ground plane, the ideal ground would be a conducting surface extending several wavelengths in all directions around the antenna. On a rooftop, this situation

may be approximated by placing a screen of chicken mesh, copper hardware cloth, or similar material over the roof of the building. More frequently, a counterpoise system of radial wires must be used. SGC recommends the use of at least 8 to 12 radials bonded together in the center. If the antenna is at ground level, the radials should be buried a few inches below the surface.

5.4 Corrosion

Ground connections are subject to corrosion and oxidation. All joints must be clean and the hardware adequately tightened. Joints should be well soldered wherever possible. The joints may be protected by an application of silicon grease and, under severe conditions, covered with electrical tape and waterproof varnish or a durable brand of silicon caulking.

If you are mounting your Smartuner on a vessel where a lot of salt spray is encountered, it is a good idea to put the wire connections that are exposed to weather on your six-month periodic maintenance plan. Then, every six months, you will be reminded to undo each of the connections, clean, re tighten, and reseal.

Use jumpers around metal back stay triangles on split backstay antennas. Corrosion may cause up to several hundred ohms of resistance to occur even though you may think that a metal-to-metal connection would be a good one.

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5.5 Antenna Coupler Mounting

Shown without protection from direct sunlight or rain.

Please refer to page 5

(Section 1.6.3)

The coupler is mounted using the proper mounting holes on the base plate. Choose a location immediately adjacent to the antenna feed point. In trunk-mounted mobile installations, locate the coupler so that the antenna insulator is within a few centimeters of the antenna exit hole. Note also that the antenna lead must pass through an insulated bushing. High voltage connecting cable must be used. (RG-8U cable with solid insulation may be used if the outer shielding is removed). When the coupler is installed on the outside, or on the deck, we recommend a protective housing.

5.6 Antenna Connection

The antenna lead is connected to the high voltage screw. During operation, use two wrenches when tightening the nut to prevent the stud rotating. A potential of several thousand volts may be present at the antenna terminal and adequate protection must be made against accidental contact. It is also necessary that the antenna be spaced at least 3 centimeters from the conducting surface. Sharp points in the lead-in wire should be avoided to prevent corona discharges.

6.0 Installation Procedures

The following diagrams will assist you with installing the Smartuner with SGC equipment.

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6.1 Installation with SG-2000

The SG-2000 is shipped with all necessary connectors for installation of a Smartuner™ and for installation of peripherals by means of the audio input/output jack on the rear panel. You will see the connectors when you remove the Philips head screws that hold the protective sheet metal cover over the rear panel connectors.

From left to right, these jacks provide the following:

J-502 SG-231 connections

J-301 Aux. Audio input/output and PTT line

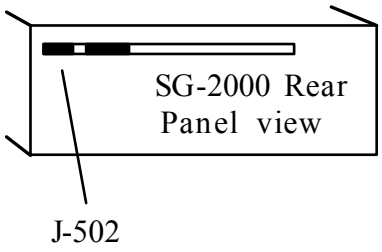
J-503 Remote control head or multiple head junction box

J-504 Remote control head or multiple head junction box
(Head mounted on radio is normally connected here.)

Ext. SPK External Speaker

Oven Turns oven On-Off (Shipped with oven ON as default)

SG-2000 to SG-231 Coupler Connections



SG-2000	SG-231
J-502-1	J1-2 (Ground)
J-502-2	J1-1 (+12 VDC)
J-502-3	J1-3 (TND)

6.2 Installation on ALINCO DX-70

1. You may use the 'TUNE' function on the ALINCO by wiring the two units as follows:

SG-231	**DX-70**	**Signal Name**
control cable	Coupler conn.	on coupler
Pin 1	Pin 2	+13.6 VDC
Pin 2	Pin 1	Ground
Pin 7	Pin 3	Option A
Pin 8	Pin 5	Option B

2. The built in coupler **TUNE** function will now work as follows:
   A. Depress the <FUNC> button.
   B. Depress the <TUNE> button.
   C. 'TUNE' will be displayed on the DX-70 LCD as the SG-231 tunes.

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D. When the SG-231 has finished tuning, the 'TUNE' indicator on the DX-70 will extinguish.

6.3 Installation on other Radios

The SG-231 requires only a source of +12 VDC, an RF transmission line (RG-58/U up to 30 ft., RG-8 OR RG-213/U if over 30 ft.), plus suitable ground and antenna systems. No band switch information, low power tuning, or handshake is required, since the coupler tunes on RF voice or carrier. Power consumption is normally less than 1 amp, allowing for use of small gauge wire. The PCB is fully protected against power reversal. The output for a remote mounted tune indicator, if desired, is strictly optional.

When installing your SG-231, remember to allow for the power to be disconnected from the battery during periods when equipment is not being used. This will prevent draining the battery unnecessarily.

6.4 SmartLock Pro Installation

The SmartLock Pro is an accessory for the SG-231. This gives the user additional control over the coupler. It is not required for normal operation of the coupler and does not need to be installed. It allows the coupler settings to be held in place so no tuning or re-tuning will occur, has an LED indicator which will light when the coupler is tuned, and provides a manual reset of the coupler without turning the power off and on.

Connections:

SmartLock Pro	to	**SG-231 Smartuner**
Red	-	J1-1 Red wire (**+12 VDC**)
Green	-	J1-3 Green wire (**Remote tuned indicator line)**
White	-	J1-5 White wire (**Hold Settings)**
Blue	-	J1-4 Blue wire (**Reset)**
Black/drain	-	J1-2 Black (**Ground**)

The other wires are not used. We recommend soldering the wires together and insulating the exposed wires with heat shrink or electrical tape; however, other methods may suffice as long as the connections are firm and there is no exposed wiring. The unused wires should be terminated in a manner that leaves no exposed wires. A schematic drawing is provided as an aid to understanding the operation of the SmartLock Pro.

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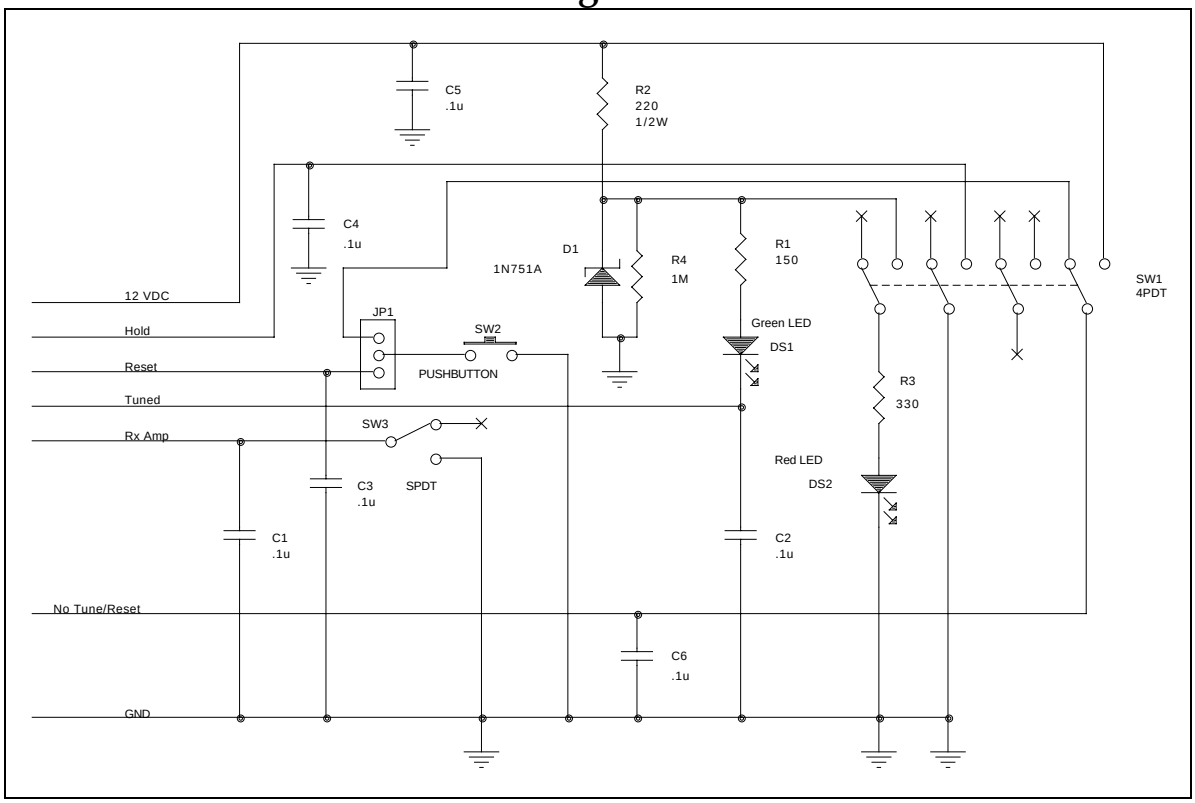
SmartLock Pro Schematic Diagram



6.5 Weatherdeck Mounting

Weatherdeck mounting can be used. Years of experience have shown that inside mounting or even splash-proof mounting is preferred, particularly in cold, damp environments. In tropical use, shielding from direct sunlight is desirable.

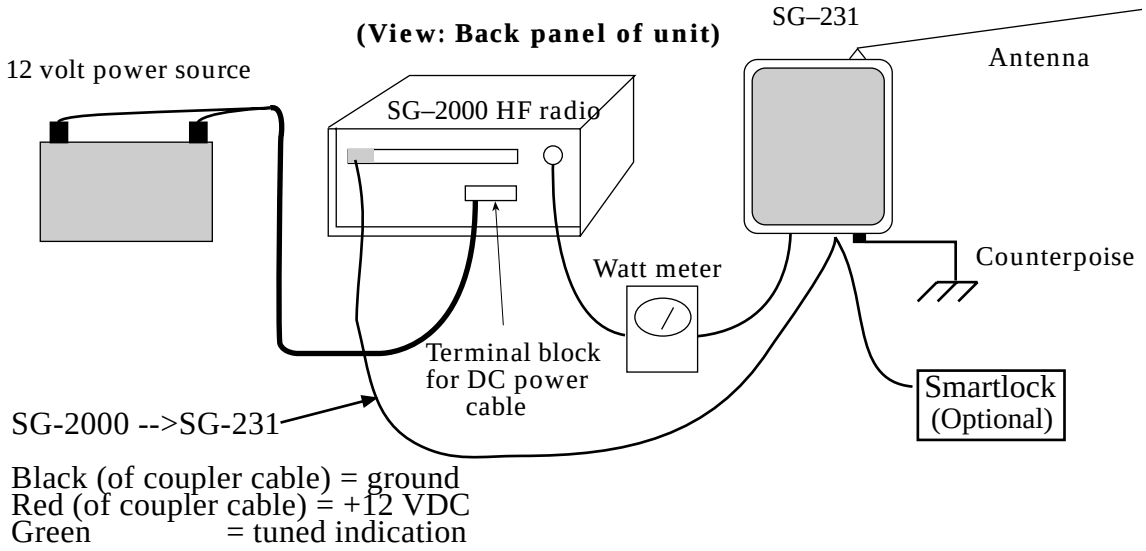
The base of the antenna should be connected to the high voltage feed-through screw on the housing. Note that this screw is not designed to support heavy mechanical loads. If such loading is encountered, use a strain relief.

The ground system should be connected to the 1/4-inch stainless steel stud protruding from the bottom of the housing. Connection to the ground system is extremely important to a successful installation. Ground runs of over a few inches should be made from 4-inch-wide copper strap or larger. The actual ground system should be as good as possible, as the ground is an integral part of the antenna system. See section 5.3 on grounding. However, couplers in general require the antenna parameters to be within the range of the tuning parameters or the coupler will not find a satisfactory match. The computer in the SG-231 cannot second-guess the installer.

A proper antenna/ground installation is of great importance: regardless of whether your station is a base station, marine, or land mobile.

6.6 Electrical Checkout

After the SG-231 antenna coupler has been installed, the SSB transmitter should be adjusted to the *highest* frequency desired, and a directional watt meter (e.g., Bird Model 43) should be inserted into the transmission line. The transmitter should then be powered. The SG-231 will begin to tune when RF power is applied, and you will hear a "clattering" of PC-mounted relays. If the antenna length and ground parameters are within range, the relay noises will stop when just a few words are spoken, and the reflected power on the watt meter would indicate a value of better than 2:1 VSWR. The "TUNED" LED, which is mounted on the PC board, will light, and if there is a remote "TUNED" indicator, it will also light.



Next, the SSB transmitter should be adjusted to the *lowest* desired frequency, and the test as outlined above should be repeated. The SG-231 should immediately sense the mismatch and switch to the tune mode to re-tune the antenna system. Since the algorithm must search through more possible values of L and C to find an appropriate combination at the lower frequencies, the tune cycle may take longer. A few spoken words should achieve an "all tuned" indication. The SG-231 installation and tune-up are considered complete if the above tests have been successfully performed.

The SG-231 will probably not be supplied from SGC with memory data appropriate to your installation, and the memory feature may not seem impressive at first. Allow the SG-231 to "learn" your antenna's requirements by proceeding from frequency to frequency and allowing the normal tune-up to occur. As the SG-231 computer memorizes more and more frequencies, you should then be able to return to a previously tuned frequency and find that the coupler immediately responds "ALL TUNED," even before the first word is completed.

The memory system is capable of storing hundreds of individual frequency/relay combinations, mostly in the lower operating frequencies, providing better memory

resolution at the lower frequencies where antenna systems are inherently narrow band. Usually, only one or two memory positions are needed to provide satisfactory coverage at higher frequency bands.

6.7 Do-It-Yourself Light-Bulb Dummy Load

Any time that a transmitter is used, it must be outputting into a load. A load is anything that the output power can be pumped into. If the transmitter is operated without any sort of load connected, the final amplifier stage could become severely damaged. The problem is that you should never test a transmitter on the air for the first time, if you are unsure about how to operate it, and if you are unsure whether it is working properly. You could create harmful interference to other stations.

To test transmitters without actually operating into an antenna, dummy loads were created. A dummy load is a load that will dissipate the energy from the transmitter instead of emanating it into the ionosphere. Nearly all commercial dummy loads are large oil-filled cans. These dummy loads change the transmitted energy into heat, which is absorbed by the oil. Because different transmitters output different amounts of power, different sizes of dummy loads must be used. Dummy loads for typical amateur powers (under 500 watts) are relatively inexpensive and are readily available.

Unfortunately, when you use a can-type dummy load, you can't see "what's happening" with your transmitter. In this case, you can use a light-bulb dummy load to test your transmitter. Here, the light bulb is directly connected to the output of the transmitter and it dissipates the RF energy as light. The light bulb dummy load is more useful than the oil-can type because you can guess how much power is being output, you can see the voice modulate the SSB (the light will flicker with your voice peaks), and you can tune the transmitter for maximum output (if the transmitter is an older model that requires tuning).

Before building or using the light-bulb dummy load, remember that these models typically don't dissipate the transmitter's output as well as an oil-can dummy load. The result is that RF will "leak" out; I have heard a few stories of amateurs who were heard around town while operating their transmitters into a light-bulb dummy load. If you use this system, make sure that you test the equipment on a clear, harmless frequency (NEVER test with the transmitter set on an emergency frequency, such as 2182 KHz).

SGC recommends that you build the light-bulb dummy load with the following parts (although I have made one with an old light fixture and a makeshift version with just alligator clip leads and a light bulb):
* AC socket to cable with a PL-259 connector (for transceiver)
* AC socket to cable with alligator clips (needed with coupler)
* Light bulb to AC adapter
* 75 to 125 watt light bulb, 120 to 220 VAC
* 100 watt radio transceiver

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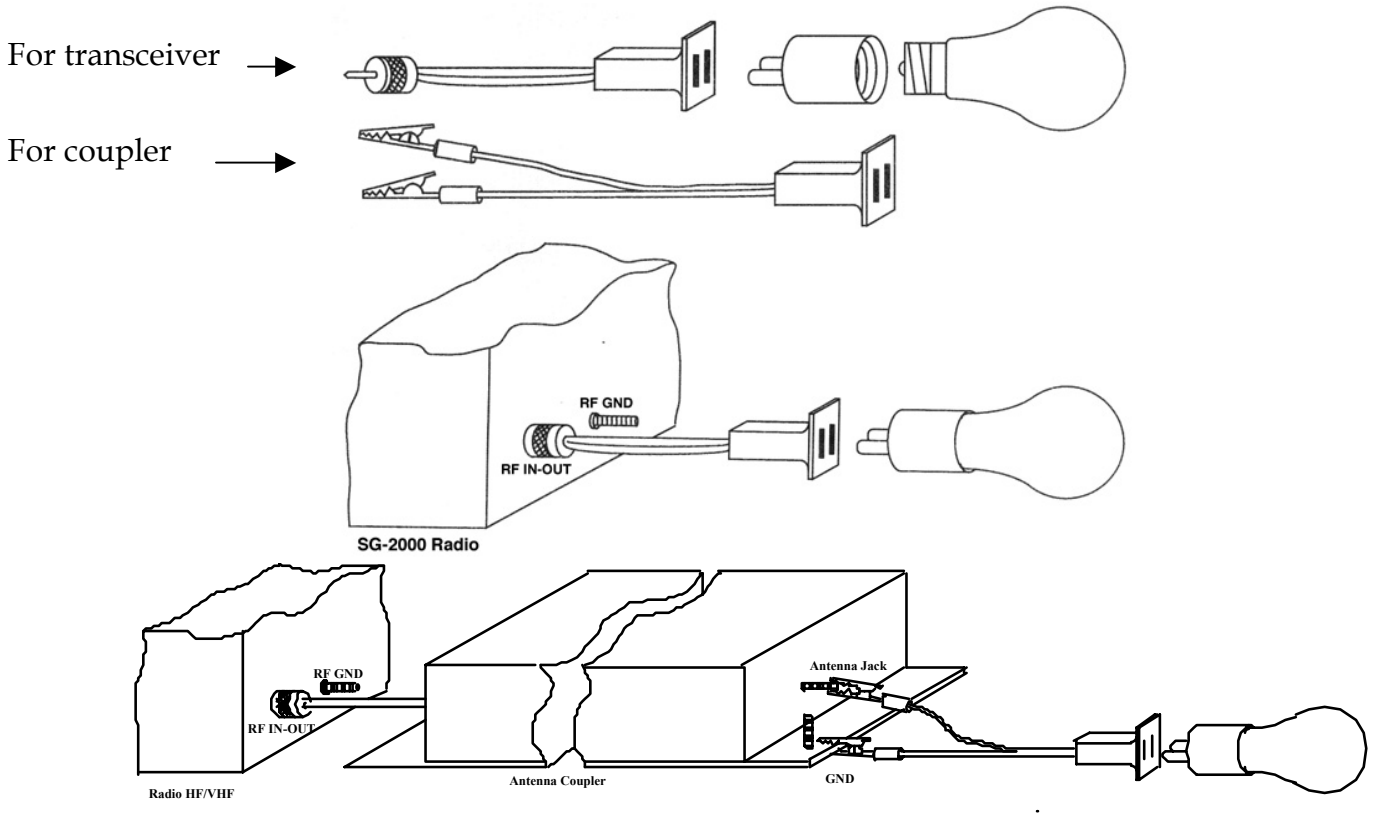
* SG-231 coupler (optional)



RADIO TEST PROCEDURE

1. Connect the transceiver light bulb load to the radio RF in/out jack.
2. Turn on the radio and set the CW mode.
3. Key the PTT switch on the microphone and look at the light bulb. If the light bulb load is connected and the radio is transmitting, the light should turn on.
4. Set the power to LO.
5. Set the radio to SSB mode.
6. Key the PTT switch on the microphone and talk into the microphone. Notice that the light turns on when you talk.

COUPLER TEST PROCEDURE

1. Connect the coupler to the radio.
2. Connect the coupler light bulb load to the SG-231 antenna jack.
3. Turn on the radio and the SG-231.
4. Set the radio to the CW mode.
5. Key the PTT switch on the microphone and look at the light bulb. The light should turn on if the coupler has completed its' tuning cycle and if the radio is transmitting.
6. For further testing, follow steps 5-6 of the radio test procedure.

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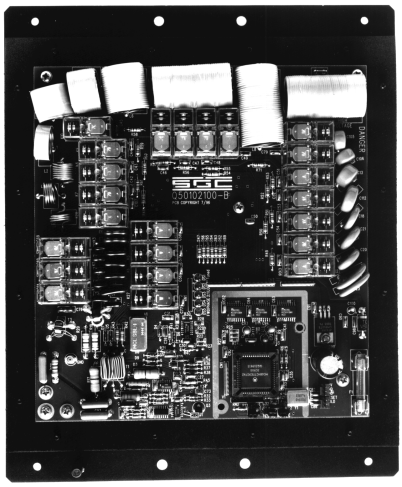
Note: The light bulb might not turn on immediately if the coupler has not yet been tuned for the frequency of the transmitter. The output power (light-bulb brightness) is greatest when the coupler is properly tuned.

This test will ensure that the radio and coupler are working properly.

7.0 Coupler Configuration



Schematic Q30102100, sheet 3 is the schematic diagram of the two basic coupler networks. Note that the **L** network as viewed from the generator, may be configured as either "C in" or "C out," whichever is required by the load. In either case, the end of the network containing the shunt C element will be the ***higher*** impedance end of the network.

7.1 Schematic Diagrams

Schematic Q30102100, sheets 1, 2, 3, and 4, are the schematic diagrams of the antenna coupler. RF input is applied to terminals marked GND and RF on J6, +13.6 VDC is connected to the terminals marked GND and +13.6 VDC on J10, and an appropriate antenna and ground system are connected to the high voltage screw and stainless steel ground stud respectively. The TND line on J10 is connected to the SG-2000 or the SmartLock Pro. This line **cannot** be connected to both units simultaneously.

7.2 Tuning Process

An array of detector devices in the SG-231 monitor the antenna system impedance, reactance signal, and the VSWR load when RF power is applied to the unit. The coupler also monitors forward power, since the control computer requires an indication of both forward and reflected power in order to allow tuning to proceed. The computer uses the forward power detector as a check to ensure that the measurements made are applied RF and are not spurious levels from the data conversion system. The SG-231 will proceed to tune *only* when enough forward power is present to confirm this check.

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After RF is applied to the coupler array, it then passes through the detector system. The detector system consists of seven capacitors in shunt on the input arm of the network, nine inductors in the series arm, and six more capacitors in shunt on the output arm, all arranged in binary increments. Relays are provided in conjunction with each lumped constant and allow removal or entry as desired. A network having 128 values on input shunt C, 64 values of output shunt C, and up to 512 values of series L is possible with the manipulation of these 23 relays.

7.3 Impedance Detector

RF transformers T1 and T2 drive the impedance bridge that is balanced at 50 ohms. T2 samples the line current and thus D4 outputs a negative DC level proportional to line current. A tertiary winding on transformer T1 provides a line voltage sample to D9 which provides a positive voltage proportional to line voltage. R35 and R36 act as a summing network for the current and voltage signals, with ratios chosen, such that at 50 ohms, the summed signals result in a balanced or zero voltage condition.

If the line impedance goes to ***high,*** the signal from the *voltage* sensor will be relatively higher than the *current* sensor, which will result in a net ***positive*** output voltage from the summing network. Similarly, a ***low*** line impedance will result in more output from the *current* sensor, resulting in a net ***negative*** output voltage from the summing network. The summing network output is shifted to a 0 to 5v range, then fed to the processor's A to D converter ports, and used within the micro-controller.

7.4 VSWR Detector

A directional coupler is made up of a current transformer T3 and a voltage transformer T1, in conjunction with termination resistors R17 and R18. The coupler is inserted in the 50-ohm transmission line between the input connector, J6, and the tuning network. The ***forward*** power is measured across termination R18 and ***reflected*** power is measured across termination R17. Diode D3 generates a positive DC voltage proportional to ***forward*** power and D8 generates a positive DC voltage proportional to ***reflected*** power. The ***forward*** DC output is fed to a voltage divider consisting of R45 and R34. These voltages are input to the RF power detector and to an A to D converter port of the processor. The ***reflected*** DC output passes through a voltage divider consisting of R39 and R40, and then it also goes to an A to D converter port of the processor.

7.5 Phase Detector

A phase detector is formed by T2, A1, and their associated components. This detector indicates the state of any reactance associated with the antenna coupler as noted from the generator. A line current sample is compared in phase with a voltage sample in a double balanced mixer. The output of the phase detector A1 is shifted to a 0 to 5v range, then fed to the processor's A to D converter ports and used within the micro controller.

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7.6 Central Processing Unit

A tune-up algorithm, which is contained in the memory of the microprocessor, actually implements the antenna matching. It is designed around the MC 68HC711E9 CPU that features a versatile instruction set, RAM, and EEPROM (memory which is saved after the coupler is turned off). The antenna coupler relays are controlled by latches U8, U6, and U7, which receive serial data input directly from the CPU.

During operation, data is transferred into the CPU from the A to D ports and Input Capture port (measures RF frequency). Basically, the program monitors the status of the input sensors and—starting from a preset condition—uses a built-in algorithm to achieve a tuned condition. When the tuning algorithm is complete, the CPU saves the settings in its EEPROM, which is addressed by the applied RF frequency.

This non-volatile memory table is the basis of the exclusive *learning* feature of the SG-231. After it has stored and latched the network status, the CPU waits for RF to cease transmitting and returns to the ***Stop*** mode. When RF is re-transmitted, the first step in the tuning algorithm is to measure the frequency of the signal passing through the coupler. From the frequency data, the computer then searchers its EEPROM for previously stored data. If data is found, it is tested for validity, and the required "end of tune" conditions will be sensed by the RF sensors. Then the data will be latched in place, and the CPU will again wait for RF to cease transmitting and return to the ***Stop*** mode. This process takes about 20 milliseconds, which is the same length of time that is required to close the network relays.

7.7 Initialization

The microcomputer is usually in the ***Stop*** mode and requires an interrupt signal (XIRQ) to start program implementation. The XIRQ is obtained from the RF detector circuitry. This line, going low, will wake the CPU from the ***Stop*** mode.

7.8 Bypass Operation, Jumpers

The SG-231 may be bypassed for broadband (un-tuned antenna) scanning listening. All you need to do is press the reset button of the SmartLock PRO (if installed) or turn power to the coupler off and on. When the coupler comes back on, the tuning elements remain out of the circuit until the Smartuner is activated by a *transmitted* signal.

If broadband operation is required during receive for scan operation, jumper JP1 may be set to the ***Yes*** position. This will drop the tuning elements out of the circuit on receive only. Jumper JP1 is located adjacent to shield along the edge of the printed circuit board. If you open your Smartuner to access this jumper, please use caution to ensure that the waterproof seal is carefully placed prior to refitting the coupler cover.

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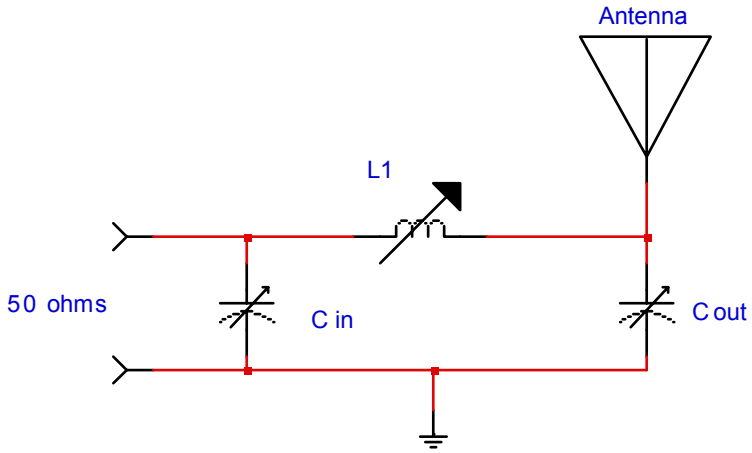
Setting JP1 to the ***Yes*** position is recommended if you are using a radio for split band communications, for scanning selective calling protocols, or for Automatic Link Establishment (ALE). The default is: Tuning Out In Rcv: [no].

Jumper JP2 bypasses the coupler's memories. This means that each time the coupler is used on a different frequency, it will re-tune rather than use previously stored information. The default is: Tune From Memory: [yes].

MicroTune™
Software

8.0 Tuning Process and Options

The SG-231 MicroTune™ Software is unique software which allows precise tuning of the digitally controlled **pi** and **L** network to tune a wide variety of antennas.



The versatile MicroTune™ software offers its user these special functions:

1. The coupler is activated whenever forward power is present.

2. In addition to sampling VSWR to determine if the coupler should re-tune, frequency comparison is employed. This causes the coupler to tune whenever the transmit frequency changes independent of the VSWR reading.

3. Extensive tuning paths are used to test different antenna situations. The initial tuning of a new frequency (or switched antenna) will require up to two seconds. Any further tuning is accomplished in a matter of milliseconds if jumper JP2 (Tune From Memory) is in its default position.

4. Facilities and algorithms are used which enable accurate tuning at the low end of the frequency band—even on shorter antennas than previously possible.

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5. The BITE (Built-In-Test-Equipment) Indicator Tune LED includes a safety feature that alerts the operator to a mismatched condition, with blinking indicators, when proper tuning conditions have not been met. In this situation, the software will "time out" within 20 seconds unless a new frequency is sensed, which will cause an immediate time out, and the coupler will attempt to match the new frequency.

The microprocessor of the coupler "wakes up" every time the coupler has for-ward power. However, re-tuning takes place only if the frequency has changed or the VSWR exceeds 2:1.

8.1 Program Description

When DC power is applied, the computer initializes the processor registers in accordance with the hardware. All tuning elements are then removed and the 'tune' indicators are turned off. At this time the computer reverts to a "sleep" mode awaiting RF power.

Detecting no forward power. When RF power is detected, the CPU will perform a test to verify forward power is present. If no forward power is detected, the computer will revert to the ***Stop*** mode. If forward power is detected, the CPU next checks the ***Hold*** signal from the SmartLock. If the user has switched on the Tuned Lock function of the SmartLock Pro, the ***Hold*** line will be low and the CPU will not proceed with the tuning algorithm. It will wait for forward power to be shut off and return to ***Stop*** mode.

Detecting forward power. Once forward power is detected and the SmartLock Pro is switched to Normal, the current coupler settings are sent to the relays. Next, the VSWR is checked and the frequency is measured. If the VSWR is greater than 2:1 or a difference in frequency is detected, the program branches to the re-tune program. If it is determined that the VSWR is less than 2:1 and the frequency has not changed, the computer returns to the ***Stop*** mode.

Re-tuning. Once it is determined that re-tuning is necessary, a test is made to see if JP2 is set to tune from memory. If the result is re-tuning from memory, settings are recalled from the EEPROM based on the frequency measured.

The recalled data is then tested for validity. If the data proves invalid, it is bypassed and re-tuning is performed. If the data recalled proves valid, the data is sent to the relays and the VSWR is checked. If the VSWR is less than 2:1, the program branches to the "OK Tuned" section of the program. If the VSWR is found to be greater than 2:1, the program branches to the "re-tune" program.

Selecting tuning path. Several tests are made to determine which tuning algorithm or path should be used to tune the coupler. These tests are based on frequency, antenna input impedance, antenna phase, and VSWR. Numerous sub-routines are executed repeatedly, depending on the status of the criteria mentioned above, in order to achieve proper tuning.

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Signaling "no-tune." Should the initial primary tuning sequence prove unsuccessful, secondary algorithms are attempted until all possible routines have been exhausted. If, after the secondary attempts, the coupler still cannot achieve a proper VSWR, the program branches to a "no-tune" program. Here, the LED's and remote tune indicator will blink on and off for about 15 seconds to tell the user a proper VSWR could not be found. After the indicators stop blinking, the program waits for forward power to cease (if it has not ceased already) and returns to stop mode. At this point the user should try several other frequencies. If the "no-tune" condition persists, check the installation of the antenna, coupler, radio, and ground system for possible problems.

Signaling "OK tune." If the coupler achieves a good VSWR during the tuning sequence, the program branches to the "OK Tune" section of the code. Here, the tune indicators are engaged. A test is then made to check if JP2 is set to tune from memory. If so, the frequency is measured and the tuning elements used are saved in memory coupled with a verification code.

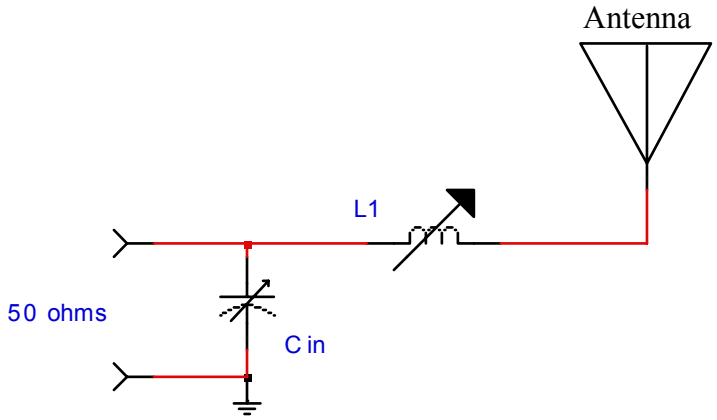
Once saved, a test is made on JP1 to check if the duplex mode has been selected. If so, the transmit tuning elements remain in circuit until the receive mode is verified. At this time, all tuning elements are removed.

The frequency is then saved for future comparison and the CPU reverts back to the STOP mode.

8.2 Tuning Paths

As mentioned previously, various tests are executed to determine the most logical tuning sequence to be performed. Dependent on the test results, additional tests and appropriate sub-routines are executed throughout the tuning process. Following are examples of the activity that occurs when the coupler must be matched to a frequency that requires a slightly longer or shorter antenna:

8.2.1 Antenna Too Short



Once the coupler has verified RF power, the tuning sequence proceeds as follows:

1. Series inductance is added until the phase is deemed as being inductive. At this point it is normal for the input impedance to be low.

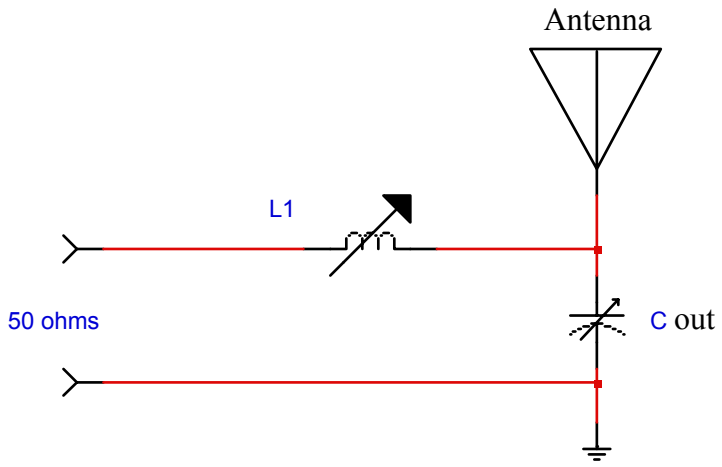
2. Input capacitance is added until the antenna is no longer inductive.

3. The program will continue to increment the series inductance in .125 µH steps—each time normalizing the input impedance with input capacitance until a low VSWR is measured of less than 2:1. This process will continue until the VSWR has climbed back to higher than 2:1 or the impedance has become high.

4. The settings that gave the lowest VSWR have been kept in memory and are now recalled to verify it is a low VSWR

5. At this point the tune indicators are engaged. The current relay data is saved if JP2 is set to tune from memory; if JP1 is set to the tune elements out during receive position, the program waits until forward power is no longer present, then removes all tuning elements. The frequency is saved for future frequency comparison, and the computer reverts to the ***Stop*** mode.

8.2.2 Antenna Too Long



Once the coupler has verified RF power, the tuning sequence proceeds as follows:

1. Output capacitance is added until the phases switches to capacitive.

2. At this point, series inductance is added until the antenna is no longer capacitive.

3. Fine tuning is performed by trying a small amount of input capacitance (this may or may not be required).

4. At this point, the program executes the same as step 5 (above).

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The preceding gives a simplified program flow on only two possible antenna conditions. Much more complex tuning is normally the case. Further detailed description, however, is beyond the scope of this manual.

8.2.3 JP1—Tuning Elements Out During Receive

(Factory Default Setting: *No*)

YES In this position the software will retain data required in transmit to match the coupler while removing all tuning elements when no forward power is detected.

NO In this position the coupler will retain the required tuning data and will change nothing whether in receive or transmit.

If typical operation is out of band duplex, ***Yes*** would be most likely to give better performance. If in band operation is typical and duplex or simplex is the predominant mode of operation, then ***No*** is usually the better choice.

8.2.4 Jp2—Tune From Memory

(Factory Default Setting: *Yes*)

YES In this position the coupler will recall data previously saved and try this data before attempting to re-tune. If the data is valid and the VSWR is less than 2:1 the tune is completed. In this position the coupler will save any new data in its memory for any frequency. A new frequency must first be learned, while in this mode, before it can be recalled.

NO In this position, the coupler will not use previously saved tuning data. Each time a different frequency is selected, the coupler will proceed through a complete tuning sequence.

Clearly, the advantage of ***Yes*** is speed. The coupler will seem to be matched instantly when in this position, if the frequency being used has previously been saved in EEPROM. Disadvantages include a difference in frequency too small for the computer to detect. This would result in recall of valid data that may not necessarily present the best match.

We suggest starting with JP2 in the ***Yes*** position. If operation is as expected, don't change it.

Note: The SG-231 does provide a way to by-pass tuning from memory even with JP2 set to ***Yes***. To do this the SmartLock Pro must be installed. If the coupler tunes from memory and you want the coupler to try to find a better setting, do the following:

1. Switch the SmartLock Pro to Tune Lock.
2. Press the reset button whiled the Tune Locked LED is flashing.

3. Switch Tune Lock back to Normal.

Now when RF power is applied, the coupler will proceed through the tuning algorithm and when a solution is achieved, these settings will overwrite previous settings for that particular frequency. To return to normal tuning from memory, simply press the reset button while the SmartLock Pro is set on Normal.

9.0 SmartLock Pro Operation

The SmartLock Pro allows the operator to have additional control over the SG-231. It is not required for normal operation of the coupler.

9.1 Tune, Tune Lock, and Reset

Tuned (green LED)	Turns on when the coupler has successfully tuned.
Normal/Tune Lock	Toggle switch that allows user to prevent coupler re-tuning by switching to the **Tune Lock** position. When in the Tune Lock position, the red LED blinks to notify the user that the coupler is locked on the current setting.
Reset	Pushing the red reset button allows the coupler to be reset. This is preferable to the other method of turning the input power off and on.

9.2 SmartLock Pro Notes

The **Tune Lock** function is in most cases unneeded. Inadvertent re-tuning is a rare occurrence. Re-tuning may occur when the environment or antenna system has changed. In this case, re-tuning is within normal operation of the coupler. However, the function is still provided with the SG-231 to be used if desired.

The SG-231 can also override the Tune From Memory jumper setting. In some cases, a recalled setting from memory may yield a VSWR less than 2:1 but may not be the best setting attainable. For this situation, the coupler can be forced to re-tune and store the new settings in memory.

To do this, first switch to the **Tune Lock** position and then push the reset button. Now, switch back to **Normal** position. This activates the Tune From Memory by-pass. Every new frequency transmitted on will cause the coupler to re-tune and store the new setting in memory, overwriting any previous settings. To return to normal Tune From Memory, simply push the reset button while in **Normal** Position.

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10.0 Troubleshooting

Only a small number of installation mistakes can be made. These will fall into one of several categories: ground fault, cable fault, and antenna fault. There is also a slight chance of an electrical fault in the coupler.

When you are troubleshooting the SG-231 and you understand that there are three variables, you should change each variable, in sequence, to determine where the problem lies. If you change the ground, antenna, or supply voltage, you are bound to change the performance of the coupler.

10.1 Ground Faults

Common ground faults include faulty counterpoise, indecisive ground, differing resistance, improper bonding, and problems resulting from inaccurate assumptions.

Faulty counterpoise. The most common problem encountered here is when an installation has been made without a proper counterpoise. If the counterpoise is electrically smaller than the antenna, the system may load "upside down"—where the antenna acts as the counterpoise and the counterpoise radiates. When this condition occurs, the operator may encounter "RF Bites" from touching metal objects connected to the counterpoise.

Indecisive ground. A second kind of ground fault occurs when the decision whether the ground or the antenna should radiate is difficult. When this condition is encountered (usually at a frequency where the counterpoise is near resonance), the coupler may cycle repeatedly. This condition may be addressed as follows:

- You may give short bursts of CW and when the coupler stops in a tuned condition, as indicated by the remote tuned LED, you may invoke the SmartLock Pro Tune Lock function, thus forcing the coupler to retain correct settings.
- You may simply change the ground system so that it becomes larger than the antenna at the problem frequency.

Differing resistance. The third kind of ground fault that we encounter occurs when a ground system and an antenna have very different electrical resistance. This happens when you install a very conductive copper antenna wire in an aircraft. When the fuselage is used as a counterpoise, the aluminum must be *much bigger than* would a copper ground because the internal resistance of aluminum is significantly higher than copper.

By the way, this is why we don't like to use aluminum ground wires as radials. Just as when aluminum is used in house wiring, several gauges larger are needed to carry the same amount of current the same need applies here.

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Improper bonding. The fourth kind of ground fault you may encounter occurs where the ground is not properly bonded to the coupler. We go to considerable effort to make sure the stainless steel ground stud is well connected to the coupler.

Particularly in automobiles and aircraft, a single ground connection ***will not do***. It is mandatory that at least two ground bolt connections are used.

Inaccurate assumptions. The fifth situation to check for is what we call *"dangerous assumptions"* about the ground system. When you bond from the antenna coupler to copper or iron water pipes, you might make an assumption that the water pipes are a good ground. But in many installations, copper pipes are used in the building but a plastic main connects to the municipal system just outside the service entrance. So much for a good ground.

10.2 Antenna Faults

The key to getting the most out of your Smartuner is to realize the antenna begins right at the high voltage screw on the SG-231 case. In other words, this is the feed point of your antenna system. Failing to install your coupler accordingly will result in unsatisfactory operation. With this concept in mind, you can easily avoid some of the common troubles with a properly planned installation.

Coaxial cable on output. Coax on the output is probably the single most commonly asked question about the coupler and is the most misunderstood. Let us reiterate: The Smartuner was not designed to feed a piece of coax.

Stray ground capacitance. Stray ground capacitance is the next largest cause of malfunctioning installations. If you have a long lead wire from the coupler to a feed-through (on a wall or bulkhead), you significantly increase your chance of problems. Wire running parallel to a grounded surface may represent a significant capacitance to ground and, just as with coax, this will cause problems.

To give you an idea how these two points can cause problems, let us relate an incident that happened in late 1992. A Smartuner user had a coupler installed in a mobile ham radio installation. The coupler could not find a lock on several bands. After going through his installation carefully, the user called SGC for technical support. This user was nearing wit's end.

In working through the logical troubleshooting process with him, we discovered that he had used coaxial feed line from the insulator on the coupler to the antenna feed point. Because he had read about the dangers of capacitance to ground in an earlier edition of this manual, he did not have the coax shield grounded. We had him remove the ungrounded braid and the installation worked fine.

Experiences like this have taught us to be fanatical about using the shortest possible wire and no coax on the output of the coupler.

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Another key lesson here is that even if you have a low capacitance lead, a high capacitance antenna will not work well. If you have a whip type antenna, mounted on the back of a van, you will have a large portion of the antenna running right next to grounded sheet metal. This causes a high loss to ground, one reason why we do not recommend CB type whip antennas. The other reason is the base insulation in ball mounts is inadequate for everything but extremely low power.

Long lead lines. If you have a Smartuner feeding a 9-foot antenna with a 1-foot feed line located inside a hull or inside a vehicle, you have 10% of the antenna where it will do you no good. If you have more than 5% of the antenna inside a grounded cabin, you will begin to lose performance.

A good rule of thumb is that under one foot of feed line is a good installation, one to two feet aren't very good installations, and over two feet means you are asking for trouble.

"Odd reactance." The next category of antenna fault is what we call the "odd reactance" problem. Although the Smartuner is an exceptionally well-designed product, you may from time to time find an antenna length that just won't quite work right. Generally this occurs when the Smartuner is having a tough time making up its mind about which of two tuning solutions is better. If it is a very close call, you can have an antenna which causes cycling and just won't stay locked.

The solution in such cases is to add or subtract a couple of feet of wire from the antenna. This generally cures the problem.

As part of your check-out of an HF system, you should operate on all channels and frequencies which you plan to use on a regular basis to insure the coupler and antenna which you have provided work well.

Antenna insulators. Sporadic operation may be caused by poor antenna insulators. We have seen on sailboats, for example, people trying to save money by expecting the fiberglass hull to act as an insulator and not using a lower insulator. The hull is not a good insulator and a thin layer of wet salt water will degrade the ground further. Similarly, mobile HF users who rely on a poor quality ball-mount find these are especially prone to arc over inside the ball mount where it is difficult to detect.

The point we are making here is simply this: you should have a leakage path of 2 inches at all points on your antenna and especially in the area of the feed point: 10,000 to 30,000 volts of RF energy will not be adequately confined by inexpensive insulators.

10.3 Transmitter Faults

Some vexing problems don't relate directly to the antenna or the ground system but may nonetheless cause difficulties. Here are two of the most common types:

Oscillation. The transmitter may have a tendency to oscillate. The general symptom is that the coupler will work well with another radio but will not tune correctly when the

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desired radio is in place. The coupler finds a tuning solution, as indicated by the remote tune indicator going on, but then resumes hunting. In a majority of cases this will be caused by an overly sensitive transmitter final amplifier section or by inadequate shielding around the amplifier.

We know of several radios that oscillate relatively easier than most radios because they are housed in a plastic case. A plastic case does not provide an adequate shield for serious RF components. In some of these cases, putting grounded foil around the radio, or changing the radio location and orientation, has changed the symptoms. But if you want quality performance, select a solid radio.

Power supply. Power supplies have been known to cause problems for HF users because they change voltage when the load on them changes. If the transmitter is drawing heavy current, as transmitters do when they are running at peak input power, the voltage to the antenna coupler may change enough to cause the coupler to either drop into a reset mode (under +11 VDC being present) or, the transmitter final amplifier impedance may change greatly, thus changing the tuning solution.

To alleviate this condition, remember to use a power supply that has both adequate current handling capacity and good dynamic regulation. Better yet, use a regulated power supply of an adequate rating.

10.4 A Final Pointer on Troubleshooting

Remember that the SG-231 is an excellent piece of equipment that will give outstanding performance. If you have a problem with the coupler finding a tuning solution, you should *change one variable at a time*.

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11.0 Index

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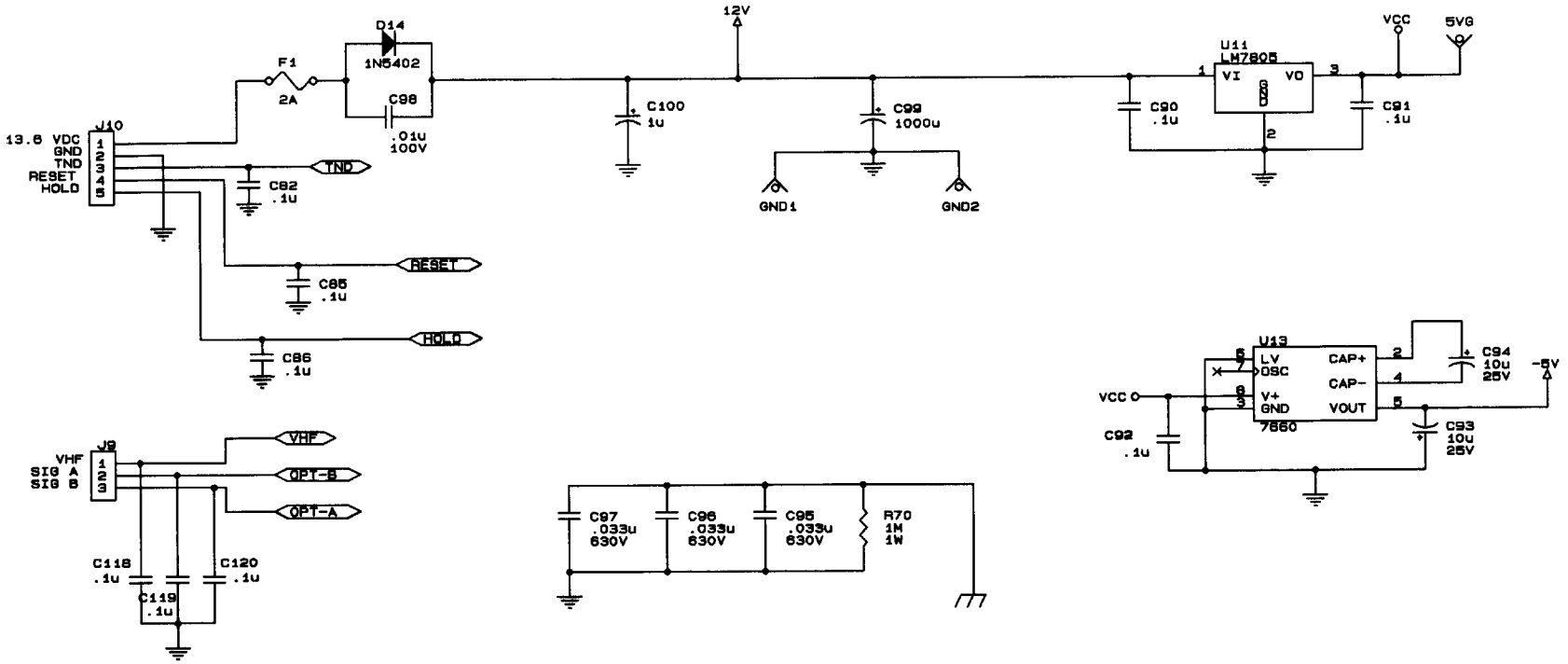

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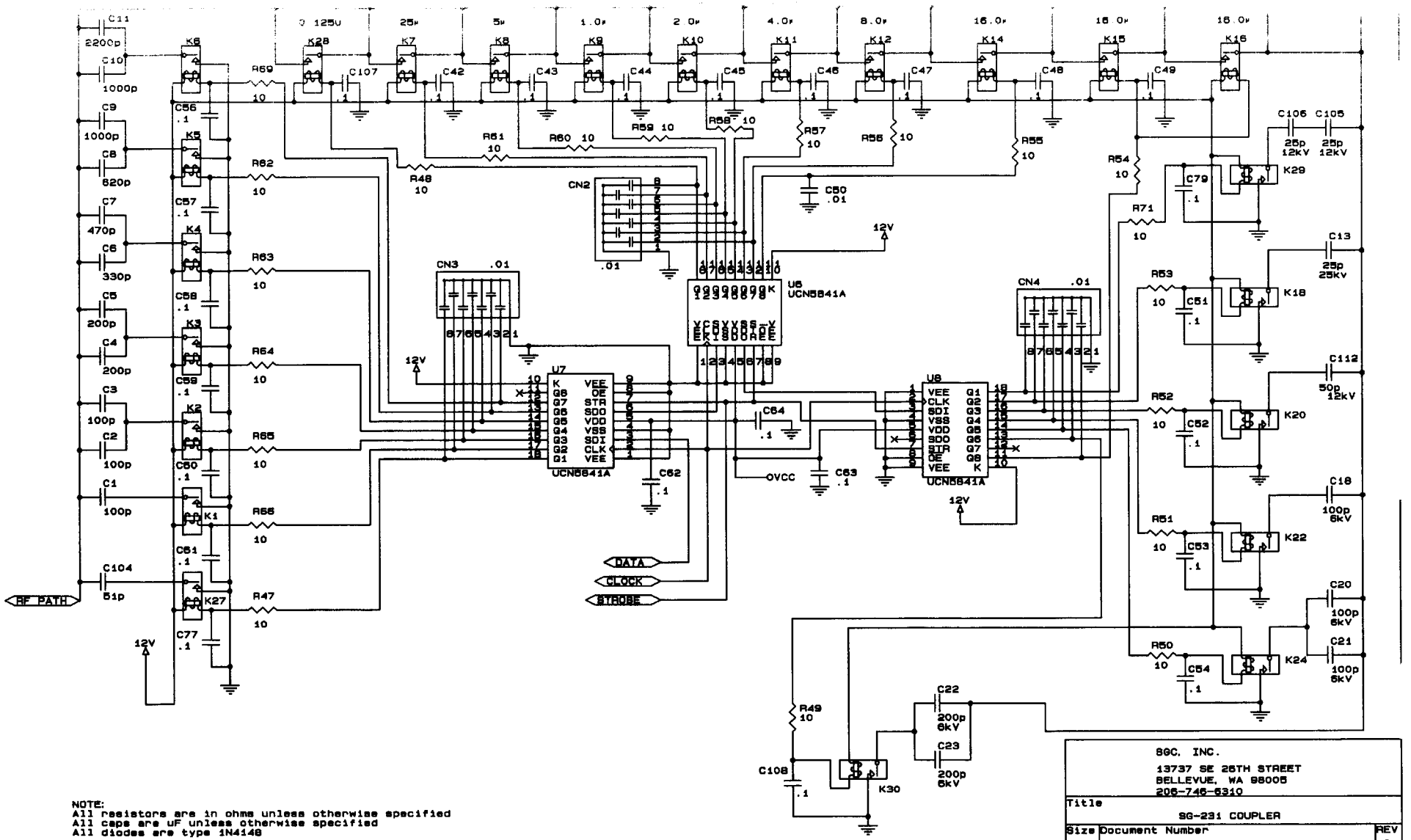
Size: B	Document Number: 030102100 — REV: D
Date: April 18, 1997	Sheet 4 of 4



NOTE:
All resistors are in ohms unless otherwise specified
All caps are uF unless otherwise specified
All diodes are type 1N4148

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Title: SG-231 COUPLER

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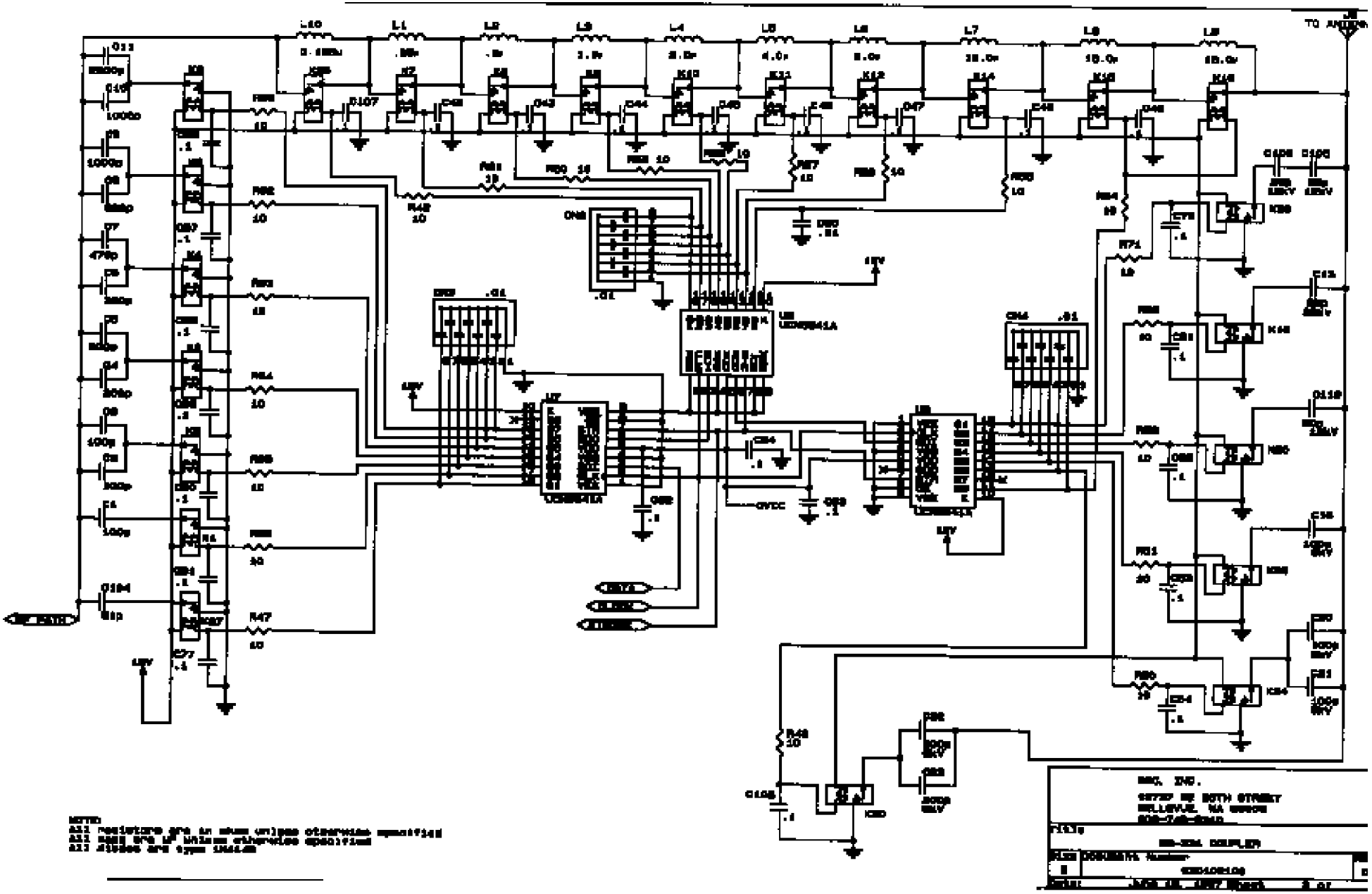

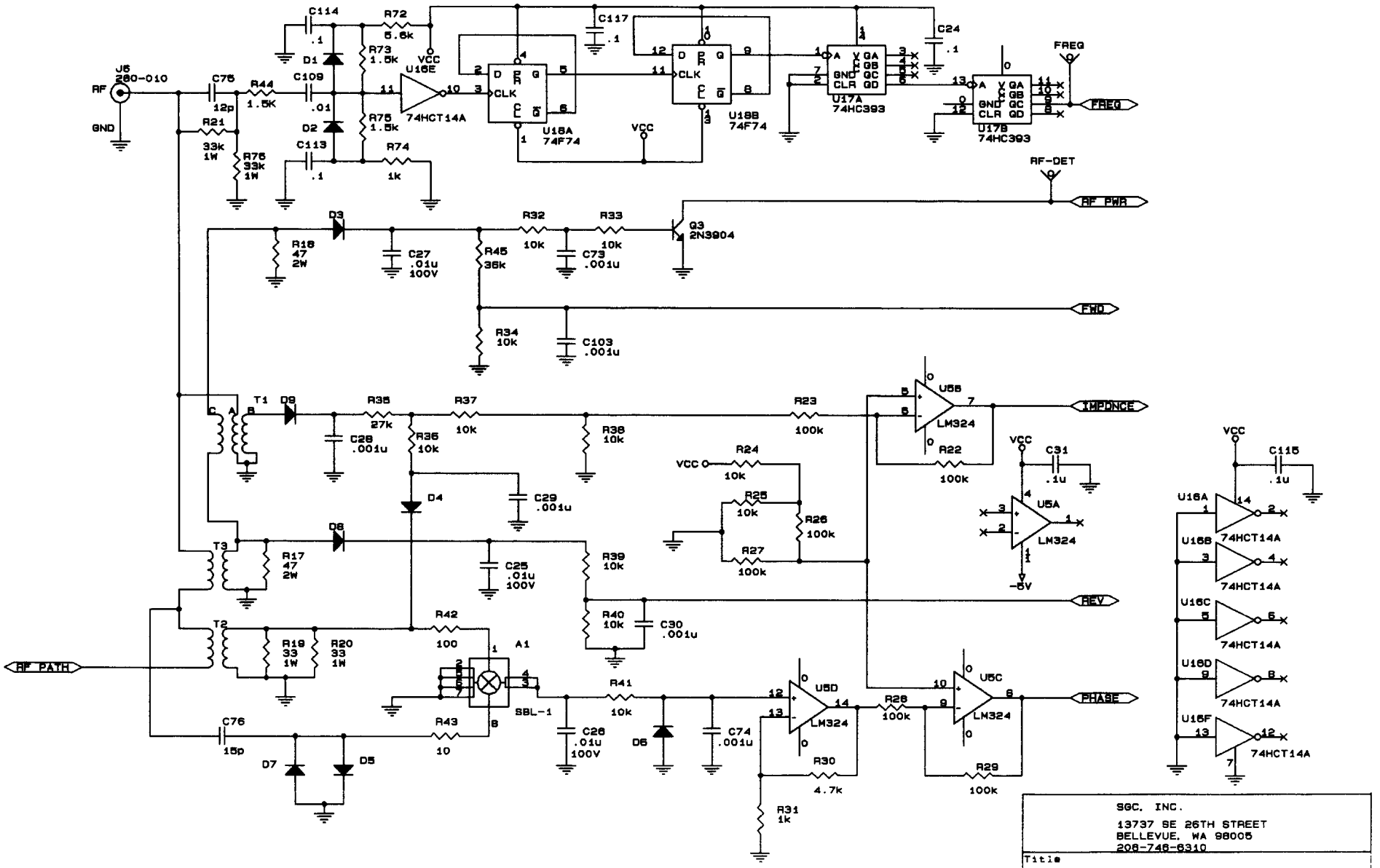

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Date: March 7, 1997	Sheet 2 of 4	

Appendix— QMS System

Note: This is general information on our QMS Systems and is not specific to this particular product.

Introduction

SGC's QMS (Quick Mount System) is the newest addition to the many outstanding products manufactured by SGC, Inc. that incorporate the latest technological developments in both design and craftsmanship. Featuring state of the a technology in microprocessor-based communication equipment, the QMS represents high reliability backed by over 28 years of communication experience.

NOTE: SGC, Inc. retains the right to change, modify, delete and add to the QMS series at any time without notice.

Unpacking QMS

We recommend unpacking the QMS antenna system and inspecting the contents. This is necessary to ensure that no damage has occurred due to shipping and that all items are accounted for as verified from the packing list as follows:

- **One QMS Manual**
- **One Warranty Card**
- **One QMS Black Anodized Assembly complete with four straps (each two feet long)**

Note: If the QMS is purchased in a package configuration, please refer to the coupler and antenna manuals for their packing lists of the items supplied.

QMS Installation Instructions

The QMS (Quick Mount System) antenna and coupler system can be mounted in virtually any location convenient to the user. Some consideration may given, however, to the items listed below:

Installation Considerations

1. Locate the QMS system as far from the engine as possible. This should reduce interference generated by the engine, spark plug noise, etc. from getting into the antenna system.

2. If possible, mounting your QMS in an area clear of objects will reduce the danger of damaging the QMS. For instance, if driving in rough terrain, the QMS is likely to be hit by trees, stumps, or rocks. If the unit were mounted on the back of the vehicle, damage would be less likely to occur than if a si

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3. If you will be traveling in an area where overhead restrictions prevent use of your SG-303 antenna, the antenna should be folded down a secured to prevent damage from brush, trees, or low structures.

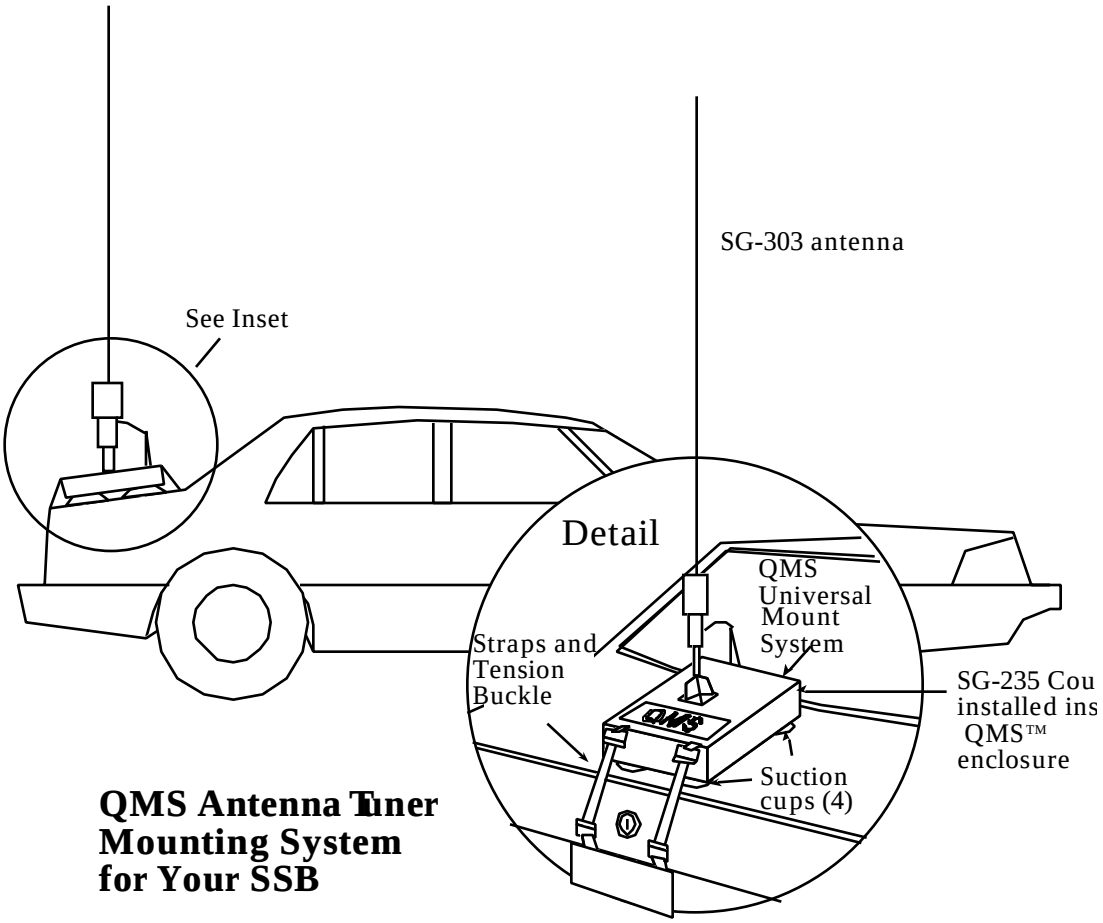

Figure A-1—QMS installation on the rear deck of a sedan

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4. When connecting the coupler to the radio/transceiver, a passageway for the contro (consisting of an RG-58 coax cable, control wire, power, and ground, plus the optional tune cator wire) will need to be provided.
Note: By removing the four screws for the ratchet mount base of the SG-303 antenna, the can be installed or reinstalled to provide the user with the set-up most suitable for the applica Insure the screws are tightly secured after reinstallation.

5. Once a location for the QMS has been selected, mounting becomes a simple ta enclosure mounts in virtually any attitude and the straps can be moved to either side of the sure to accommodate the vehicle (see Figures A-1, A-2, and A-3 for typical installations).

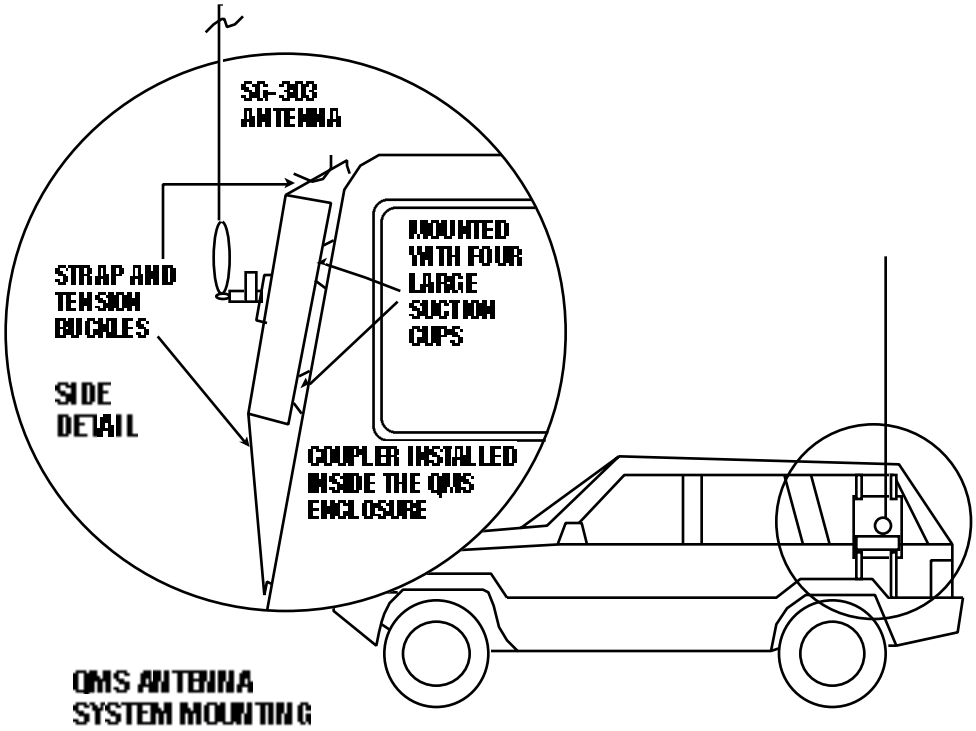

Figure A-2—Side view of QMS installation on the side of a small van

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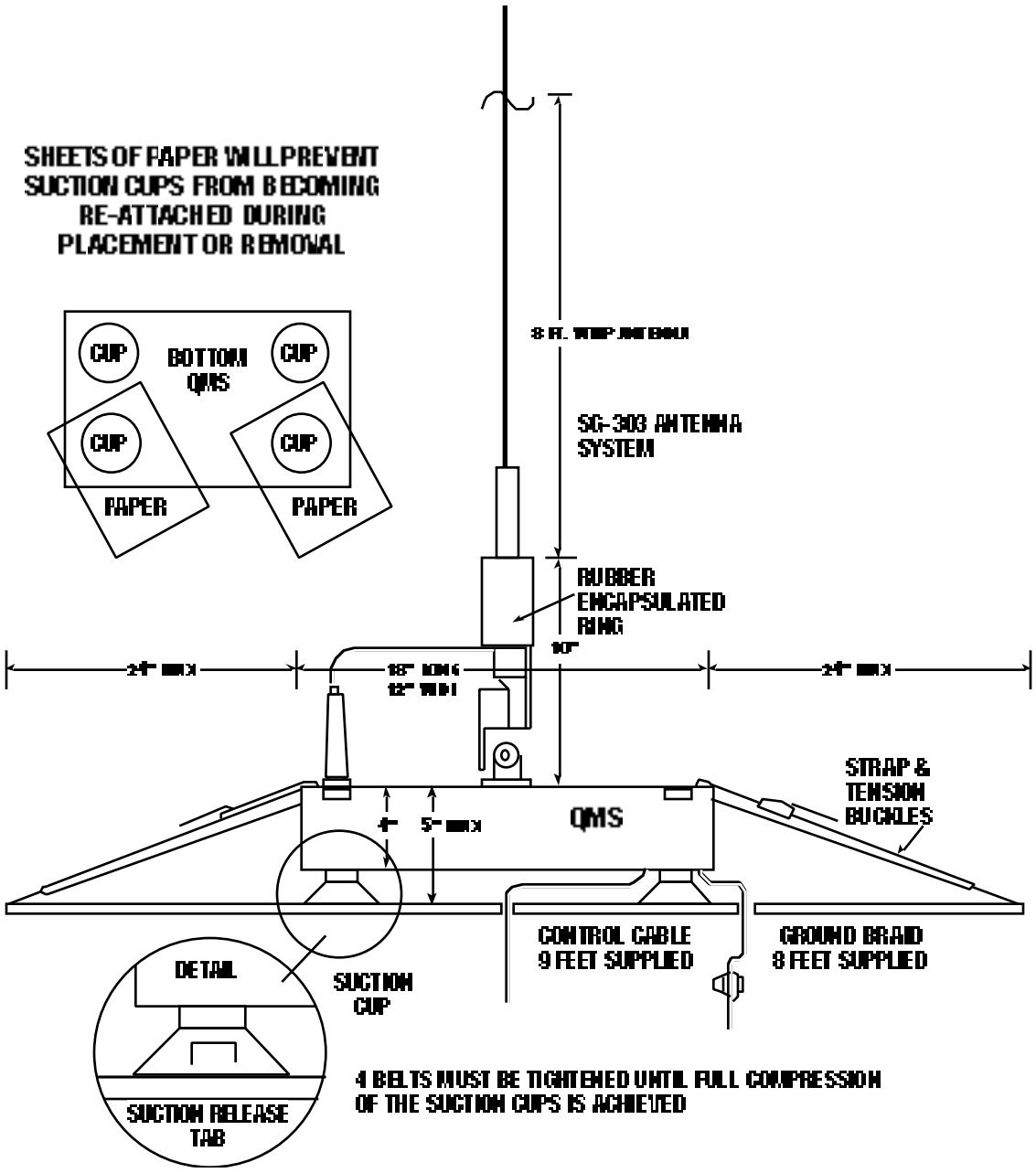

Figure A-3—Mounting atop large truck cab

Installation Precautions

To ensure safe operation of your QMS system, the following in mechanical, and electrical precautions should always be taken:

1. Insure that all four straps are pulled down tightly and the suction cup feet have been securely compressed.

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2. Insure that the high voltage wire protruding from your antenna system is not routed near any metallic objects such as your vehicle's frame or metal posts. This wire is part of the flexible insulator of your QMS system.

3. Insure that the ground braid is attached to a good vehicle ground system. Do not run ground currents through any hinges. Be sure to make th ground braid as short as possible. Remove all paint and rust from your grounding area. Remember, your ground system is one half of your antenna system.

4. Locate the control wire to the QMS, from the transceiver/radio, away from any other wiring inside your vehicle. This control wire contains a high power RF coax cable which can radiate into other wires (such as your head-to-transceiver control cables) causing feedback in your transceiver.

5. The webbing, buckles, and hooks of your QMS have a rating of 1,00 pounds. Ensure that the hooks are attached to a suitable structure, such as a trunk lid, or something that will not cave in when the straps are pulled tightly to secure the unit.

> **In no case should the operator use fewer than the four straps provided to secure the unit. The suction cups alone will not provide sufficient mounting for the QMS.**

6. When locating the gutter clip (which secures your SG-303 anten when not in use), mount the unit in a location where the tip of the SG-3 antenna is easily accessible for threading through the "O" ring. Failure t thread the SG-303 antenna could result in damage both to the antenna and to your vehicle.

7. When the QMS system is securely fastened to your vehicle, route the control cable to your transceiver. Any 150 watt PEP, 50 Ω transceiver may be used. The control cable consists of four wires: one RG-58 coax cable and three small wires (for connections, refer to the SGC coupler manual).

8. Refer to QMS system illustration for dimensions and mounting details. When you are confident that items 1 through 8 have been th checked, you are ready to install the tip of the SG-303 antenna. Be su secure all items with the appropriate tool and to read all product manuals prior to installation or operation.

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SG-231 Manual

WARNING: If you do not properly and securely attach this unit to the vehicle and it comes loose, the speed of the vehicle may cause the unit to injure others.

General Installation Information

The mobile communication tips found below apply to any mobile installation, not merely to the QMS or other SGC product.

- **For the best performance and radiation, always mount your antenna system on the highest part of the vehicle. Approximately 3 to 15 dB in radiation performance may be gained in simply re-positioning your antenna system from a low to a high point.**
- **Never use your antenna system while the antenna is reclining against the body or the roof of the vehicle. In this situation, you may find your antenna system performance varies from 6 to 15dB making it difficult or impossible for your coupler to find a proper tuning position.**
- **The noise generated in your vehicle can, in some cases, totally obliterate your receiving signal. A noise blanker cannot eliminate the noise; it can only help reduce the consequences associated with the noise generated. It may in some cases give you a clearer signal.**
- **The most efficient way to approach a vehicular noise problem is to eliminate the noise at its source. Upon finding the source, use the appropriate technique to eliminate the noise, replacing the defective item if need be. Use only the appropriate filter component to filter out any noise (before it radiates to your antenna).**
- **For the connection to the battery system of your radio, use a heavy gauge wire (not less than six gauge). Never use your chassis ground return for your negative line connection.**
  Doing so will cause you to lose too much in line voltage and pick up un necessary electrical vehicle noise. Always make a direct connection from the radio to the battery. Remember you need as much input power as possible to generate the most output power possible.
- **If you use your radio system often, you may consider the use of a small sealed 40 AH gel cell battery, which requires no service, mounted directly next to your radio. It will provide you the best overall performance and will eliminate a great deal of electrical noise you might find in your line.**

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Use of the gel cell battery may require a lesser gauge wire to recharge, in comparison to the large wire required to connect the radio directly to the main battery.

- In the charging line of this auxiliary battery, you may want a diode of 100 Amp. capacity to allow the battery to be charged, so as not to discharge with the rest of the electrical system. (You could use this auxiliary battery, in an emergency situation, to jump the main battery. To do this, however, you must provide a local or remote switch to allow the battery to operate the electrical system of the vehicle (temporarily) start the engine.)

Additional Installation Suggestions

Suction Cups

Protecting Painted Surfaces When applying the high suction devices incorporated into the QMS, it is important to observe two important rules:

- Surfaces must be cleaned prior to installation to prevent scratching.
- Surfaces must be protected during removal to prevent marring.

Eliminating Damage to Painted Surfaces. The suction cups on your QMS are of extremely high quality. They will provide excellent service for many years provided you follow certain basic cautions when using them:

- When you are applying the suction cups, prepare the surface by cleaning with mild detergent and rinsing thoroughly. The clean surface, free of scratches, will provide superior holding power.
- If the QMS being applied has been used previously, the suction cups should be cleaned with mild detergent and water, then rinsed thoroughly.
- Spread a thin layer of silicon grease, or pharmaceutical grade lubricant such as "Vaseline," around the edge of the suction cup where it comes in contact with the surface of the vehicle.

Refer to Figure A-4 on the following page:

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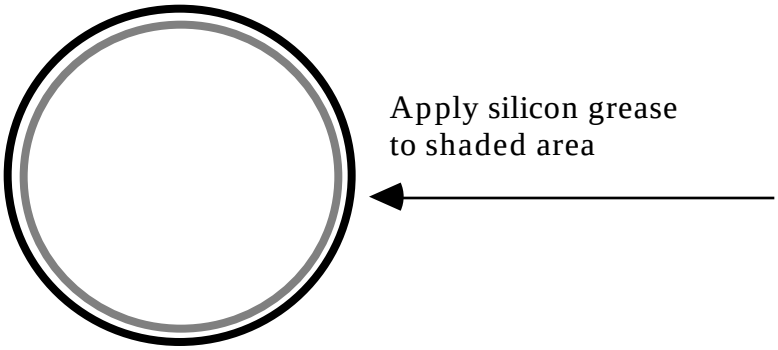
Figure A-4—Suction Cup (underside view)



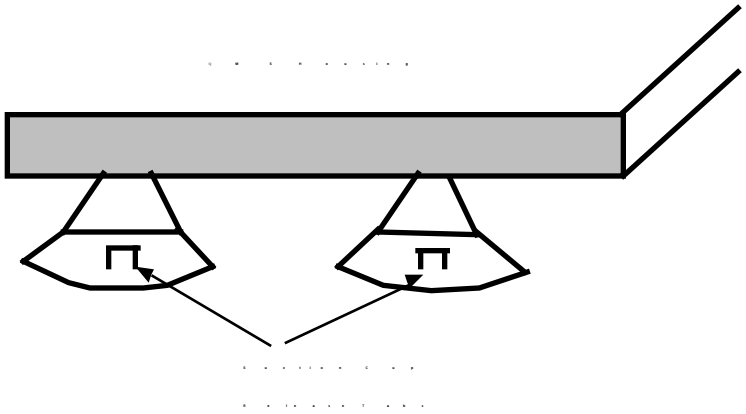
This will prevent slow leakage of air, which will reduce the holding power of the suction cups over time. It will also protect the painted surface.

If the surface of the vehicle is very rough, the installation procedure remains the same. The suction cup will have to be pressed against the vehicle surface in the same way, but more lubricant may be necessary.

Tightening the QMS Straps. The QMS enclosure must be tightly strapped to the vehicle. To ensure it is properly strapped, grab the base of the antenna mounted on the QMS and push firmly up and down. The vehicle should move up and down, but the QMS should not. If the QMS moves and the vehicle does not, increase the tension on the QMS straps.

Removing the QMS. Wash the vehicle in the area around the suction cups before removing. This will reduce any chance of surface marring.

- **Release suction by applying a rolling sideways motion to the tabs on the suction cups as shown in the following drawing:**



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- **To make removal of the unit easier, you may slide a piece of paper between the suction cup and the vehicle surface (see Figure A-3). In this way, each of the suction cup tabs may be loosened sequentially as shown:**

Storing Your QMS. To store your QMS unit for long periods of time, apply a thin coating of talcum powder to the suction cups. This treatment increases the life span of rubber products.

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QMS-7
Antenna Coupler System

Quick Mount System
for mobile HF and VHF use

- QMS-7 offers unsurpassed frequency agility without user intervention
- SG-231 Smartuner automatic antenna coupler, SG-307 extended full-range antenna, and weather resistant QMS-7 package
- 3.5 MHz —continuous— instant tuning while you drive
- Rated for use on moving vehicles at up to 75 miles (120km) per hour

It makes no difference where you go or what vehicle you drive, the QMS-7 will provide exceptional auto-tuning with any HF and VHF transceiver.

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The QMS-7 Antenna Coupler System

QMS-7—

Mounting coupler and antenna outside the vehicle reduces engine noise, interference and eliminates feed loss. It can be quickly installed and easily moved from vehicle to vehicle. No drilling or vehicle modifications are required. Industrial suction cups secure the QMS-7 to the vehicle, without damaging the finish, and high strength straps and buckles complete the job and give structural integrity.

Antenna Coupler

SG-231— Smartuner HF/VHF antenna coupler is the working brain inside the QMS-7 system. Use the SG-231 to automatically tune just about any antenna (7 feet minimum) to 3 to 100 watt HF/VHF transceivers from 1 to 60 MHz. It automatically evaluates and switches over 4 million possible combinations of input capacitance, output capacitance, and series inductance to ensure a perfect match between the transceiver and the antenna. The SG-231 Smartuner remembers the chosen frequency and tuning values and will automatically reselect these values—in less than 10 ms—each time you transmit on that frequency. It operates with any HF and VHF transceiver.

Marine and Mobile Antenna

SG-307— a durable and lightweight antenna designed for mobile applications. It's a high efficiency radiator, by virtue of its dual element design. In construction, a single fiberglass whip, helically wound, has a primary resonance at 8 MHz and a secondary resonance at 25 MHz. So at lower frequencies—those under approximately 25 MHz—the SG-307 will vastly outperform a conventional 9-foot whip antenna. The QMS puts the entire antenna system outside the vehicle for high efficiency and low noise.

SG-307 — industrial strength spring and rubber booting allow for 90° flexibility of antenna.

Specifications:

QMS-7

Total QMS system weight: 12.5lb. (5.6kg)

Overall case dimensions: 13.5 x 10 x 4.3 inches (34 x 26 x 10 cm)

Housing finish: Black hard anodized

Maximum strap length: 2 ft.

Maximum strap tension: 2000 lb.

Strap width: 1 in.

Maximum allowable vehicle speed: 75 miles (120 km) per hour

SG-231 Smartuner

Frequency range: 1 to 60 MHz

Maximum RF Power: 100 watts

Input Impedance range: 45 to 55 Ω

VSWR: Typical— less than 1.4:1

DC input requirements: 13.6 VDC

Input current: Average .9 amps

Random set time: Typical— less than 2 seconds

Recurrent set time: Typical— less than 10 milliseconds

Non-volatile memory addresses: 170 BIN

SG-307 Antenna

Frequency range: 3.5 to 60 MHz

Maximum RF Power: 150 watts PEP voice or CW

Length: 7 ft., including adjustable ratchet mount and spring

Equivalent: 23-foot antenna

Design: helically wound

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QMS Antenna Coupler System

- QMS offers unsurpassed frequency agility needing no user intervention
- QMS includes SGC Smartuner automatic antenna coupler, extended full-range antenna, and weather resistant QMS package

The Quick Mount System for any mobile HF rig

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QMS Descriptions:

QMS-b2 cat. #55-47
includes the SG-230
(200W)
1.8 to 30 MHz
SG-303 9 ft. antenna

QMS-b3 cat. #55-48
includes the SG-235
(500W)
3.0 to 30 MHz
SG-303 9 ft. antenna

QMS-a7 cat. #55-49
includes the SG-231
(100W)
3.5 to 60 MHz
Includes VHF bands
SG-307 7 ft. antenna
(QMS-7 not shown)

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The QMS Antenna System

Strap the **QMS** on your favorite family or business vehicle. You'll find it gives any HF-SSB superior frequency agility and exceptional performance.

The SGC Smartuner automatic antenna coupler, the SG-303 extended full-range antenna, and the special exterior QMS mounting package comprise the QMS. Mounting coupler and antenna outside the vehicle reduces engine noise and interference.

It can be quickly installed and easily moved from vehicle to vehicle). No drilling or vehicle modifications are required. Industrial suction cups secure the QMS to the vehicle, without damaging the finish, and high strength straps and buckles complete the job and give structural integrity.

The **SG-303** is a durable and lightweight antenna designed for mobile applications. It's a high efficiency radiator, by virtue of its dual element design. In construction, a single fiberglass whip, helically wound, has a primary resonance at 10 MHz and a secondary resonance at 22 MHz. So at lower frequencies—those under approximately 20 MHz—the SG-303 will vastly outperform a conventional 9-foot whip antenna. The QMS puts the entire antenna system outside the vehicle for high efficiency and low noise.

The **Smartuner** HF antenna coupler is the working brain inside the QMS system. It automatically evaluates and switches 64 input and 32 output capacitance combinations, plus 256 inductance combinations in a π network. The result is over a half-million different ways to ensure a perfect match between the transceiver and the antenna. Smartuner remembers the chosen frequency and tuning values and will automatically reselect these values—in less than 10 ms—each time you transmit on that frequency. It operates with any HF transceiver.

- microprocessor controlled
- non-volatile memory
- 16" D x 12" W x 3" H
- 1.8 to 30MHz range
- water resistant

(See QMS-7 brochure for more options.)

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Specifications:

(QMS-7 specifications included on separate brochure.)

QMS (Quick Mount System)

QMS-b2 cat.# 55-47
QMS-b3 cat.# 55-48

Total QMS system weight: 21 lb.
Overall QMS case dimensions 18 x 12 x 5 in.
Housing finish: Black hard anodized
Maximum strap length: 5.5 ft.
Maximum strap tension: 2000 lb.
Strap width: 1 in.
Maximum allowable vehicle speed: 75 miles per hour

SMARTUNERS

SG-230	cat. # 54-14
SG-235	cat. # 54-15
SG-231	cat. # 54-17
SG-237	cat # 54-18

HF Frequency range:

SG-230	1.8 to 30 MHz
SG-235	1.8 to 30 MHz
SG-231	1.0 to 60 MHz
SG-237	1.8 to 60 MHz

Input Impedance range: 25 to 100 Ω
VSWR: Typical—less than 2:1
DC input Voltage: 13.8 VDC (SG-230 only option: 24 VDC)
Input current: Average .9 amps SG-235: 1.4 amps
Random set time: Typical—less than 2 seconds
Recurrent set time: Typical—less than 10 milliseconds
Non-volatile memory addresses: 170

SG-303 antenna cat. # 55-27

Frequency range: 1.8 to 30 MHz
Maximum Power: 500 watts PEP voice or CW
Length: 9 ft., including adjustable ratchet mount
Equivalent: 23-foot antenna
Design: helically wound

SG-303 Antenna

with

SGC Couplers

The SG-303, a high performance mobile antenna, is designed and built to operate in rough terrain and extreme climactic conditions. It has a lifetime warranty.

The SG-303 antenna is a light-weight and low-cost mobile antenna for operation between 1.8 and 30 MHz. Nine feet in length overall, it consists of two sections of helically wound whip, mounted on a sturdy professional weatherproof rubber spring. Mounts on an adjustable ratchet mechanism:

- the base adjusts for the best attachment to the vehicle.
- the antenna ratchet permits orienting the whip from vertical to horizontal.

The SG-303 stands up to the wind loading at highway speeds, as well as to rain, ice, and the occasional tree branch.

The SGC line of antenna couplers —the famous SGC "Smartuners"—packed into a sturdy case, mount on the vehicle as close as possible to the antenna lead-through. Each one gives almost any HF-SSB a major boost in range and clarity. The Smartuner "intelligently" tunes any length antenna. No preliminary tuning or adjustment is required, and the Smartuner operates with any HF transceiver in the 1.6—30 MHz range and with output power from 3 to 500 watts.

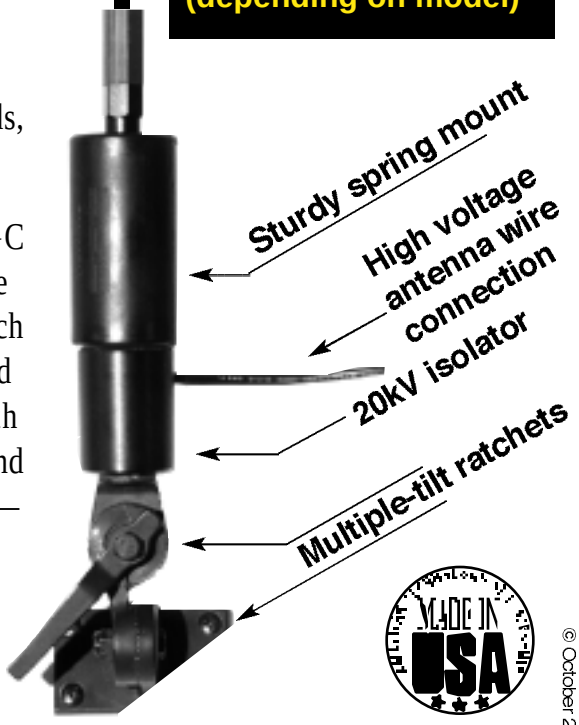
Be sure to see SGC's revolutionary mobile QMS system for mounting antenna and coupler outside the vehicle.

SG-303

- Heavy duty rubber encapsulated spring mount
- Heavy duty whip antenna
- Adjustable 4-way ratchets

Smartuners

- Waterproof for all weather
- Built-in test equipment indicator
- 1.6 to 30 MHz range
- 3 to 500 watts (depending on model)



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SG-303 Specifications

HF Frequency Ranges: 1.8 to 30MHz

Maximum Output Power: 3 to 500 watts (PEP) voice or CW

Dual Frequency Resonance: at 12 and 22 MHz

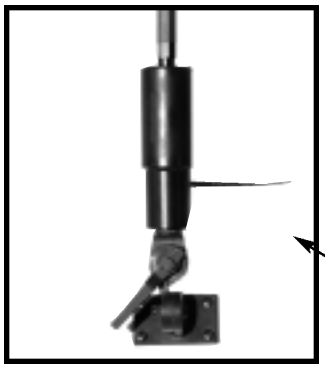
Antenna structure: Two sections, 50 inches each

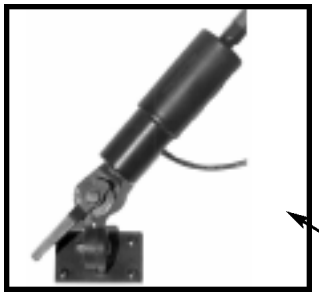
Mount: high voltage insulated 4-way stainless steel ratchet mount

Base: heavy duty rubber encapsulated spring mount

Feed-through: high voltage wall feed-through bushing (hole = .890 in.)

Cable: 3 ft. high voltage wire, one end terminated by a round lug





Combine an SG-303 with an SGC coupler for HF-SSB mobile operation with high radiation performance

Antenna installation. The heavy duty ratchet mount attaches to a flat surface. Mount high voltage cable away from the metal antenna support. Mount the antenna at the highest point of the vehicle. The high voltage waterproof cable feeds through the vehicle body as close to the base of the antenna as possible.

Coupler Installation. The coupler mounts inside the vehicle and close to the base of the antenna. Braided straps make a good ground.

Antenna ratchet mount. The four-way ratchet mount allows the antenna to be adjusted for operation when the vehicle is in motion.

Excellent communication under even adverse weather conditions can be achieved when the vehicle is moving.

Reclining the antenna. When the vehicle is travelling, this will avoid unnecessary exposure to objects like bridges or trees.

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Smartuner Specifications

SG-230 - 200 watts

HF Frequency Range: 1.6 to 30MHz
Power Input Range: 3 to 200watts(PEP)
VSWR: Typical—less than 2:1
DC Input: +13.6 VDC (24 VDC optional)

SG-231 - 100 watts

HF Frequency Range: 1-60 MHz
Power Input Range: 3 to 100watts(PEP)
VSWR: Typical—less than 1.4:1
DC Input: +13.6 VDC (24 VDC optional)

SG-237 - 100 watts

HF Frequency Range: 1.8-60 MHz
Power Input Range: 100watts (PEP)
VSWR: Typical—less than 1.4:1
DC Input: +13.8 VDC (24 VDC optional)

SG-235 - 500 watts

HF Frequency Range 1.8 to 30MHz
Power Input Range: 3 to 500 watts(PEP)
VSWR: Typical—less than 2:1
DC Input: +13.6VDC

General Specifications

Input Impedance Range: 45 to 55 Ω
DC OperatingRange: +10.5 to 15 VDC (24 VDC optional)
Input Current: Average—.9 amps

Random Set Times: Typical—less than 2 seconds

Recurrent Set Times: Typical— less than 10 milliseconds

Non-volatile Memory Addresses: 500

Installation: Any position

Operating Temperature: -35° to +70°C

Environmental: Waterproof at immersion of half meter, half hour

Size Overall: 16 D x 12 W x 3H inches 40.6Dx 30.5W x 7.6H centimeters

Weight: 8 pounds (3.5 kilos)

Case Construction: Plastic ABS weatherproof case

SG-307

FOR MOBILE HF AND VHF USE

(Cat.#55-28)

7 Ft. MARINE AND MOBILE ANTENNA
(coupler required*)

The SG-307 is designed and built to operate in rough terrain and extreme climactic conditions. The SG-307 antenna is a light-weight and low-cost mobile antenna for operation between 1.8 to 60 MHz.

At only seven feet in length overall, the SG-307 is mounted on a sturdy professional weatherproof rubber encapsulated stainless steel spring.

SG-307 stainless steel ratchet mount with rubber encapsulated spring mount

Mounts on an adjustable ratchet mechanism:
- the base adjusts for the best attachment to the vehicle.
- the antenna ratchet permits orienting the whip from vertical to horizontal.

The SG-307 stands up to the wind loading at highway speeds, as well as to rain, ice, and the occasional tree branch.

Accompanying SGC's dedication to customer service and guaranteed product reliability a lifetime warranty is provided with the SG-307 antenna.

SG-307

- **Heavy duty rubber encapsulated spring mount**
- **Adjustable 4-way ratchets**
- **Heavy Duty Whip Antenna**

SG-231 Smartuner
(recommended)

- **Waterproof for all weather**
- **3.5 to 60 MHz range**
- **3.5 to 100 watts**
- **Built-in test equipment indicator**

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*Antenna must be used with an antenna coupler such as the SG-231

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SG-231 Smartuner

Use the SG-231 to automatically tune just about any antenna (7 feet minimum) to HF/VHF transceivers from 1 to 60 MHz. It automatically evaluates and switches over 4 million possible combinations of input capacitance, output capacitance, and series inductance to ensure a perfect match between the transceiver and the antenna. The SG-231 Smartuner remembers the chosen frequency and tuning values and will automatically reselect these values—in less than 10 ms—each time you transmit on that frequency. It operates with any HF and VHF transceiver. (Cat. #54-17)

QMS

(Universal Quick Mount HF Antenna System)

Mounting coupler and antenna outside the vehicle reduces engine noise, interference and eliminates feed loss. It can be quickly installed and easily moved from vehicle to vehicle. No drilling or vehicle modifications are required. Industrial suction cups secure the QMS-7 to the vehicle, without damaging the finish, and high strength straps and buckles complete the job and give structural integrity. (Cat. #55-49)

SG-307 Specifications

HF Frequency Ranges:	3.5 to 60MHz
Maximum Output Power:	150 watts PEP voice or CW
Dual Frequency Resonance:	at 8 and 25 MHz
Radiation:	Omnidirectional
Mount:	90º stainless steel base mount rotator and threaded male stud 3/8-24
Base:	Heavy duty stainless steel base spring with rubber boot, Supplied with high voltage isolated mounting base size 10x7x.5 inches
Feed-through:	high voltage wall feed-through bushing (hole = .890 in.)
Cable:	3ft. high voltage wire, one end terminated by a round lug
Catalog Number:	55-28

Antenna must be used with an antenna coupler such as the SG-231

SG-231 Specifications

Frequency Range:	1 to 60MHz
Power Input Range:	3 to 100 watts (PEP)
Input Impedence Range:	45 to 55ohms
VSWR:	Typical - less than 1.4:1
DC Input Requirement:	+13.6VDC
Input Current:	Average-.9 amps
Random Set Times:	Typical- less than 4 seconds
Recurrent Set Times:	Typical-less than 10 milliseconds
Non-volatile Memory Addresses:	170 BINS
Size Overall:	11.5D x 9.5W x 1.7H 29.2D x 24.1W x 4.32 H centimeters
Weight:	3.8 pounds (1.6 kilos)
Case Construction:	Plastic ABS weatherproof case
Catalog Number:	54-17

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SGC Equipment Standard Warranty

SGC wishes you to be satisfied with your new equipment purchase. Most SGC products are therefore warranted to be without defect in workmanship or materials for a period of one year from the date of purchase. Proof of a date of purchase is required when requesting warranty service.

The warranty registration card which is furnished with this product should be returned immediately to provide evidence of purchase and to assure receipt of important notices regarding your SGC equipment and related services.

In the event of a defect as defined above, SGC shall, at its option, either repair or replace the product free of charge to the purchaser, provided that:

1. The warranty is limited to the original purchaser and is not assignable.

2. As a condition to obtaining warranty services, purchaser must at its own expense deliver the product to SGC's facility in King County, Washington. If purchaser returns a model that is no longer in stock, SGC reserves the option to replace that unit with another model with comparable capabilities. SGC may choose the carrier for return of the unit, provided that purchaser may request an alternative method of shipment.

3. This warranty is void if your SGC product:
   a) has not been operated in accordance with all procedures described in the operating instructions;
   b) has been serviced, adapted or modified without written approval by SGC; or
   c) is improperly installed, used, or otherwise damaged (including without limitation any damage by fire, smoke or water).

4. There is no warranty coverage for any of the following:
   a) costs of removing or reinstalling the product when submitted for warranty service;
   b) incidental, consequential or exemplary damages arising from any defect or failure of the product (except to the extent that applicable state law may not allow exclusions or limitations on such damages, in which case this exclusion may not apply to you);
   c) any non-performance of the product due to an inadequate or improperly tuned antenna or grounding system;
   d) transmission range or geographical coverage of the product, which are highly variable in each application;
   e) routine maintenance, periodic adjustment or performance testing of the product as recommended in the operating instructions;
   f) normal wear and tear on the product.

5. THIS LIMITED WARRANTY SHALL CONSTITUTE THE SOLE AND EXCLUSIVE WARRANTY FOR YOUR PRODUCT. SGC DISCLAIMS ANY OTHER EXPRESS OR IMPLIED WARRANTY, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

6. This limited warranty contains the complete obligations of SGC to purchaser in connection with this product, and it shall supersede all previous oral or written statements or agreements concerning such obligations. This warranty may only be amended by a writing signed by an authorized officer of SGC.

7. After expiration of the warranty herein, SGC may continue to offer repair services to keep your equipment operational. Please inquire as to the prevailing charges for such service.

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SG-231 Smartuner™

Automatic Antenna Coupler for all HF - VHF Transceivers

FEATURES:

- **Fully Automatic Operation with any HF and low-band VHF Transceiver**
- **Perfect tuning solution for almost any antenna**
- **Continuous coverage of 1 - 60 MHz**
- **Complete frequency agility with no operator intervention**
- **Compact design, fits the most restrictive installations**

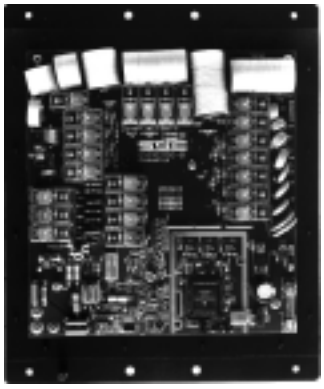
The SG-231 joins the SGC series of "Smartuners" which use microprocessor control of a π (pi) or L network to match virtually any load to any transceiver. The traditional π (pi) network is retained with a combination of more than 4 million steps compared to the SG-230 with a half million steps.

Use the SG-231 to automatically tune just about any antenna (8 feet minimum) to 3 - 100 watt HF and low-band VHF transceivers from 1 to 60 MHz.

Requiring only 13.6VDC input, the SG-231 is ideal for mobile and base station users. Its lightweight, slim design and universal mounting plate allow for quick and easy installation in *any* location. The SG-231's weatherproof design is excellent for outdoor use.

With SGC's years of proven Smartuner™ technology and customer satisfaction, the SG-231 is the superior coupler for any application. Make the "smart" choice today!

SGC Catalog Number: 54-17



SGC uses high quality components in every product

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