



SG-235 Smartuner[®]

Microprocessor Controlled Automatic Antenna Coupler

Installation and Operations Manual



Getting the most from every watt of HF-SSB Power



HF-SSB COMMUNICATIONS: THE POWER TO LOCK IN THE WORLD.

Globally, HF-SSB has literally changed the world. For a minimal investment, it has allowed millions of people - often in amazingly remote settings, often in emergency conditions - to reliably bounce clear voice and data signals across a state, across a continent, over an ocean, or around the world. Without satellites, relay stations, cellular nets, stadium sized antennas or huge user fees. Just some fine equipment, a smart operator and nature's own ionosphere make this possible.

For nearly 30 years, the perfection of HF SSB has been the focus and the life of our company. Our efforts have not gone unnoticed. Today, SGC is a prominent choice of leading corporations, governments, relief agencies, paramilitary organiza-



tions, mariners, aviators, explorers, and scientists - all over the world. They trust our engineering and they value our experience.

A vital part of our company's strategy centers around new product development, with an emphasis on providing quality equipment which remains rugged, reliable and competitively priced. We are focused on providing customer service of the highest standard. Our commitment is to product training and comprehensive after sales support. Today, SGC is recog-

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At SGC we build communications power tools. Next generation HF-SSB radios, antennas, amplifiers and coupler systems that squeeze more range and clarity out of every watt of HF SSB communications power, are the technology and innovations that have helped SGC emerge as a cutting edge player in the expanding world of HF-SSB.

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Pierre B. Goral, President

SG-235 ANTENNA COUPLER

Installation and Operations Manual

Prepared: September 1998

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.

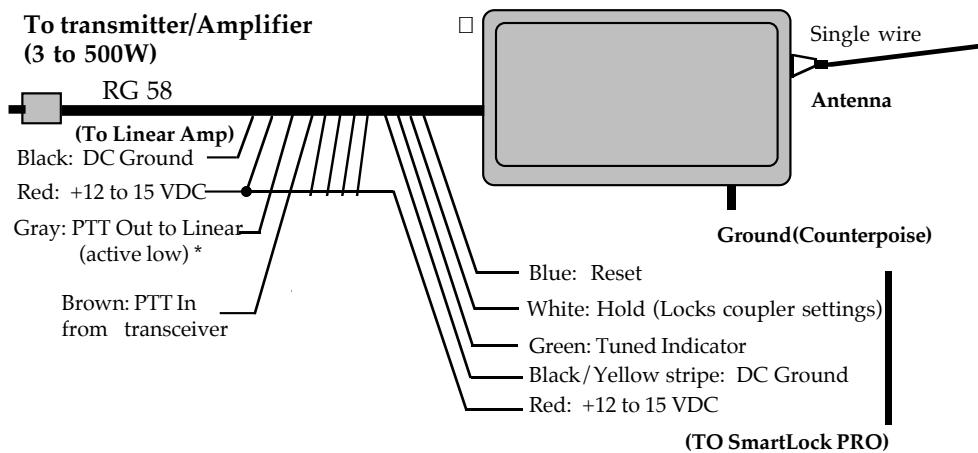
Quick Start Guide

Remote Manual Tuning

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

1. An HF radio installation with 3 to 500 watts output.
2. An HF antenna with a single wire feed (not coax fed).
Minimum length of 50 feet (from 3.0 MHz) or 300 feet (from 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

Connect the coupler to the system as shown in the following diagram:



12 conductor plus RG-58 coax

Optional connection not required for normal use.

Operation:

1. Turn on radio. Apply +12 VDC power to the coupler.
2. As power is applied, coupler should make one "click" sound. Coupler comes up in the bypass (untuned) state.
3. To tune, speak normally, whistle, or use CW (CW is recommended).
4. Tuning is done at a maximum of 100 watts. Once radio is tuned, the Gray wire transitions from 5V to GND and acts as a switch to turn on a 500W linear amplifier.

Note: Coupler must be used in manual PTT mode.

5. When tuned, clicking stops and Green wire goes low.

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1.0 General Information

The Smartuner™ reputation has grown to legend status because it is simple to use and highly reliable. A Smartuner will provide maximum transfer of radio energy from any HF transmitter to any end-fed HF antenna within the frequency and power limits of its specifications. The SG-235 is a high-powered cousin of the SG-230PRO. It provides many of the same features: a new micro-controller which has built-in A/D functions, non-volatile memory, and serial communications capabilities which allow manual tuning using an RS-232 connection and PC. The optional RS-232 should be used only for special applications and is not necessary if used in normal applications.

This document is designed to guide the SG-235 user through installation and operation of the unit. This document will also recommend various steps which may be undertaken in the field to provide correct operation of the SG-235 should difficulty be encountered. Smartuners are extraordinarily reliable. But you should be aware that scores of fine points to any HF installation can easily be overlooked and may cause difficulty. This manual should help you quickly to obtain the best possible performance from your HF radio installation and to avoid most of the pitfalls which can degrade the performance of your HF system.

1.1 Experience Levels of Users

The Smartuner™ may be installed successfully by anyone who follows the instructions in this manual. However, if you are inexperienced in HF radio installation and operation, seeking advice from people with more experience 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 to help you resolve any aspect of Smartuner™ operation which 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 match conditions of the antenna to the feed line in a very precise manner. Antenna “tuners,” on the other hand, are generally located at the transmitter output end of the coaxial feed line. Do not be confused by the term “coupler” and “tuner.”



- A tuner placed at the transmitter loads up the feedline as well as the antenna (so that the feedline radiates).
- 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.

We will emphasize these key points throughout this manual to yield 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 must be of sufficient length for your lowest operating frequency.

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

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-235 is a general purpose coupler which can operate with any type of HF radio and almost any type of antenna configuration. The coupler network configuration is of a π or L type; sensors continually monitor the state of the tuning and relay this information to the processor.

Tune. 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 nonvolatile computer memory, which will store up to 170 tuning solutions.

Retune. When the same conditions are encountered again, re-tuning is accomplished within 10 milliseconds by recalling the information from the nonvolatile memory. Special software designed by SGC assures accurate and fine tuning of the coupler. For software description, refer to the MicroTune™ section (9.0) of the manual.

If antenna or transmitter conditions have changed since the information was stored in memory, SG-235 retunes and achieves a new tuning solution. This new information is stored to memory for future reference. Important: the Smartuner™ will always look for the best possible tuning solution and will improve existing tuning solutions whenever possible.

The SG-235 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). The coupler is now 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 directly to the receiver with no tuning elements engaged, allowing reception of signals throughout the HF range.

The coupler will cease to operate normally if input voltage drops below 10.5 VDC

- 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 retuning.

If broadband operation is required during scanning operations, jumper JP-2 on the printed circuit board inside the coupler may be set to the “YES” mode. This will bypass tuning elements on Receive. Jumper JP-2 is located adjacent to the shield along the edge of the printed circuit board.

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-1, also located near U2, to the “NO” position.

Note: The SG-235 can be forced to retune in every new frequency, even if JP-1 is set to “Yes,” by the following operations of the Smartlock:

1. Engage “Tune lock.”
2. Press Reset once.
3. Disengage “Tune lock.”

(See Section 9.2.)

1.4 Coupler Network Configuration

The coupler network configuration is designed with 64 different input capacitor values, 32 output capacitor values, and 256 inductor values, thus providing about a half million different π or L configurations. The coupler requires an input of 5 to 500 watts to operate.

1.5 Operation Indicators

Operational status of the coupler and the onboard computer’s tuning decisions is displayed by five LEDs, which are located on the microcontroller unit (MCU) printed circuit board (PCB). These indicators are visible only when the cover of the coupler is removed. These five LEDs 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 which 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-235 is supplied in a weather proof case with two mounting brackets. RF and DC power are supplied to the unit through the same cable. This special cable comprises a 50-ohm coaxial cable and 12 conductors. The 12 conductor wires include the ground, the positive power lead, the optional SmartLock control, and the optional LED indicator.

The SG-235 antenna coupler's weatherproof case will withstand the environmental conditions encountered aboard ship when mounted on a weatherdeck. 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. Should you have occasion to open the case, use care to ensure the sealing gasket is placed properly to maintain watertight integrity of the unit.

Although the Smartuner is solidly built, good installation practice calls for additional protection from the elements.

SGC makes the following recommendations:

1.6.1 Marine Mounting

The Smartuner should be located inside the house or under the aft lazaret on a sailboat. On power boats, the coupler may be mounted outside, but additional

protective housing is recommended. The preferred installation if vertical is with the standoff insulator pointing upward.

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

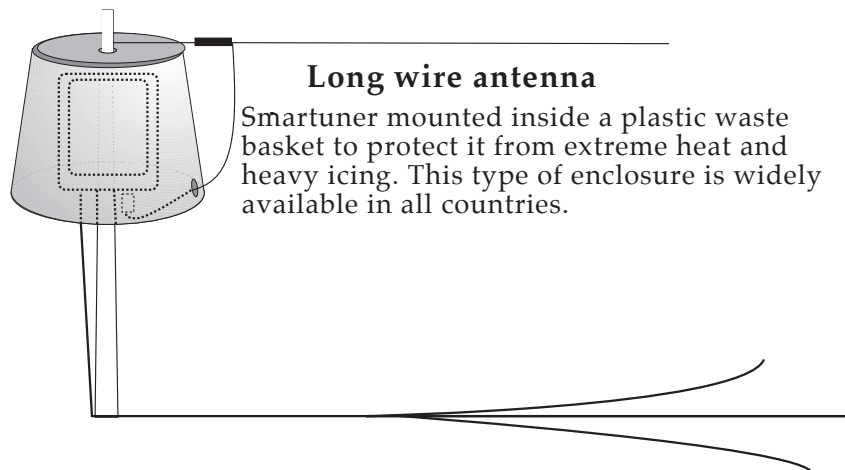
The SG-235 may be mounted in any position, including inverted, without any degradation of performance. If the coupler is to be exposed to long periods of high vibration, such as aboard helicopters or tug boats, installation of the optional shock mounting is recommended.

1.6.2 Hot climate and High Temperature Installations

The Smartuner may be used in 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) which keeps the antenna coupler outside of a vehicle. Temperatures inside a vehicle may exceed 212°F (100° C). If a QMS is not used, keep the coupler in the shade if possible. Please refer to the diagram in the following section.

1.6.3 Extremely Cold Temperature Installations

Your Smartuner will operate down to specified temperatures. We recommend placing the Smartuner under some kind of housing other than the case to prevent heavy build up of ice. If you are mounting on a tower in an extreme climate, a plastic wastebasket (such as those made by Rubbermaid™) makes an excellent weather cover and costs only a few dollars.



1.7 Remote Installations

The SG-235 is supplied with a standard 25 feet of cable.

If necessary, the coupler can be installed up to 100 feet from the transmitter. 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 transmitter to the antenna via the coax. (The longer the coaxial cable run, the higher the loss.) 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. (A 100 watt transmitter at 30 MHz would actually deliver about 70 watts to the antenna after running through 100 feet of coax.)

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 under 1 dB per 100 feet at frequencies below 30 MHz. You should be aware that this heavier cable is less easy to work and may be quite expensive.

- The second loss which must be considered is that in the DC power and reset control line. At any distance other than the 25 foot cable which is supplied by SGC, we recommend that the DC voltage at the antenna coupler be measured. (If the coupler voltage drops below 10 volts, the coupler may not operate properly.) For this reason, SGC recommends that if distances are great, 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. Ground loops may cause oscillation of the final amplifiers or other undesired side effects. If you decide to use a 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-235 coupler will have a revision letter located on the printed circuit board. To continue moving forward in coupler design, the SG-235 may be revised as needed. Later revisions of the coupler will be denoted by the subsequent letters of the alphabet. The SG-235 contains all the latest revisions of the standard SG-230PRO to ensure the user is acquiring all the benefits of the SG-230PRO along with the added benefits of the SG-235.

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 - SG-235

HF Frequency Range: 1.8 to 30.0 MHz

Note: The SG-235 may be operated as low as 1.6 MHz and is commonly used as an antenna matching unit for differential GPS transmitter site antennas. However, when operated under these conditions, a longer antenna is recommended, such as a 360 foot tower section for operation in the 1700-1710 kHz band and an appropriately larger counterpoise. In addition, inductor heating may become pronounced at high power levels in the SG-235's inductors that are commonly used at these frequencies. To extend your frequency range, we recommend 350 watts at 1700 kHz and 250 watts at 1600 kHz on a continuous basis.

Power Input Range:	3 to 500 watts (PEP)
Input Impedance Range:	45 to 55 ohms
VSWR: (Typical)	Typically less than 1.4:1
DC Input Requirement:	+13.6 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 50 ft. —3.0 to 30 MHz Minimum length of 300 ft. —1.8 to 30 MHz SG-303—9 feet from 3.5 to 30MHz
Installation:	Any position
Operating Temperature:	-35° to +70°C
Size:	16 x 12 x 3 inches
Weight:	8 pounds (3.5 kilos)
Case Construction:	Plastic ABS weatherproof case
Control Cable:	SGC special cable, 25 ft. coaxial and 12 interconnect wires (replaceable by any standard cable plus remote tune LED wire)

2.1 Accessories

Shock Mounting Tray. SGC Part Number 54-50

3.0 Parts Furnished (unpacking)

Antenna Coupler

25 foot special cable (RG-58 plus 12 conductors in a single jacket)

Instruction Manual

SmartLock PRO coupler controller with 25 foot cable.

3.1 User Supplied Items

The user of the SG-235 will need to supply a suitable HF radio antenna. Such an antenna may be as simple as an 23 foot long piece of wire and several ground/counterpoise radials of 23 feet or longer. The longer the antenna, up to about 300 feet, the better all around performance will be. Longer antennas may be used, but please refer to sections on antennas 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.

3.2 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 which 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-235 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.

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, vee, 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 which 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 Tuner 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 only happen 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. There is nothing magic about HF. Although it may seem so at times, the rules of physics don't change. The Smartuner and accessories will always give top performance when carefully installed.



4.0 Antenna Types

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.

SG-114 - Base station antenna. 200 feet SGC Part Number 55-14

SG-203 - Marine 28-foot whip antenna. This antenna is used for most power boat installations. SGC Part Number 55-23.

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.

QMS-3 - Quick Mounting System which houses SG-235 Smartuner and also provides a sturdy mounting platform for the SG-303 antenna system. Designed for rapid installations requiring no-holes installation of high performance HF antenna system. SGC Part Number 55-48.

The automatic antenna tuner 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 tuner through a high voltage insulator. 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 tuner if desired. Narrow band resonant antennas, such as dipoles, vee's and inverted vee's 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 Vee type antenna; is used, the antenna may be operated at any frequency within the range of the coupler if each side of the vee or dipole is 23 feet or longer. In addition, the SG-235 is just as happy feeding

a conventional Vee antenna as an inverted Vee. The coupler is very flexible in this regard.

4.1 Antenna Selection

The automatic antenna tuner 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 ft. mobile antenna overcomes much of the radiation problem.

4.2 Whip Antennas - 2.5-3.0 meters (8-9 ft)

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

4.3 Whip Antenna - 7.0 to 8.5 Meter (28 ft)

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. Order SGC Part Number 55-23.

4.5 Longwire Antenna - 23 meter (75 ft) and 46 meter (150 ft)

For most applications the longwire 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. Order SGC Part Number 55-10.



Antenna Length vs. Lowest Tunable Frequency

<u>Antenna Length</u> <u>in Feet (approximate)</u>	<u>Lowest Frequency</u> <u>in KHz</u>
350 feet	1650 KHz
335 feet	1700 KHz
315 feet	1800 KHz
285 feet	1900 KHz
275 feet	1950 KHz
220 feet	2000 KHz
100 feet	2500 KHz
50 feet	3000 KHz

4.6 Backstay Antennas - 8 meters (28 ft) and longer

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

5.0 Typical Installations

Figures 5.01 through 5.3.1 show some typical installations for the automatic antenna tuner.

Figure 5.01 Jeep Installation

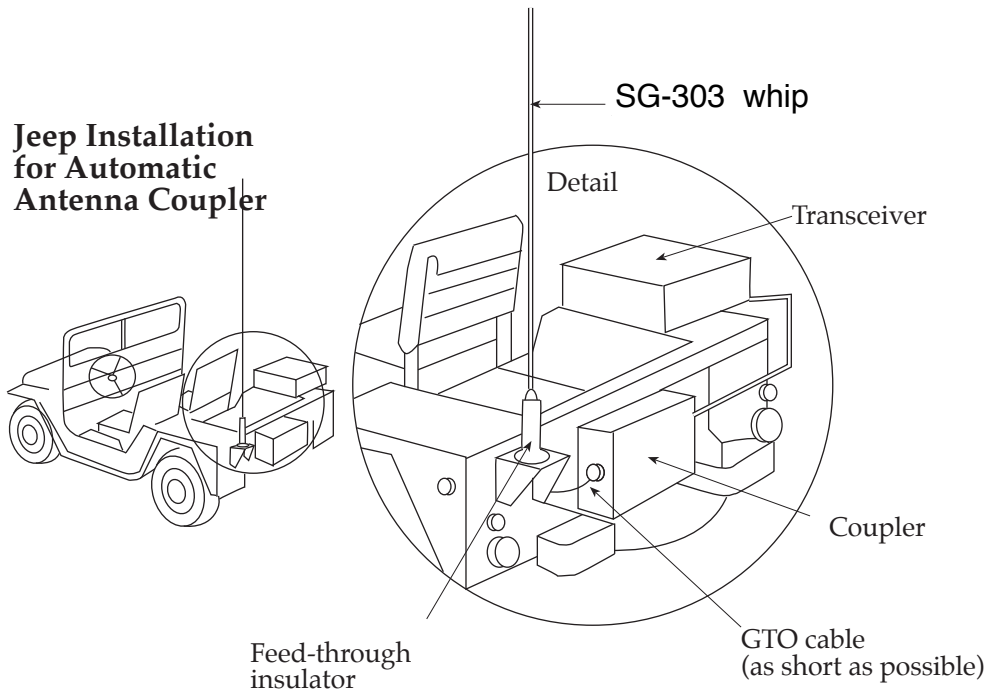


Figure 5.02 Vehicle installation

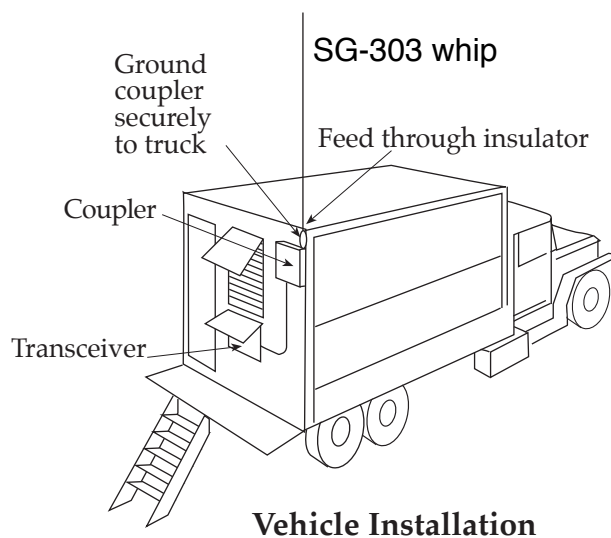
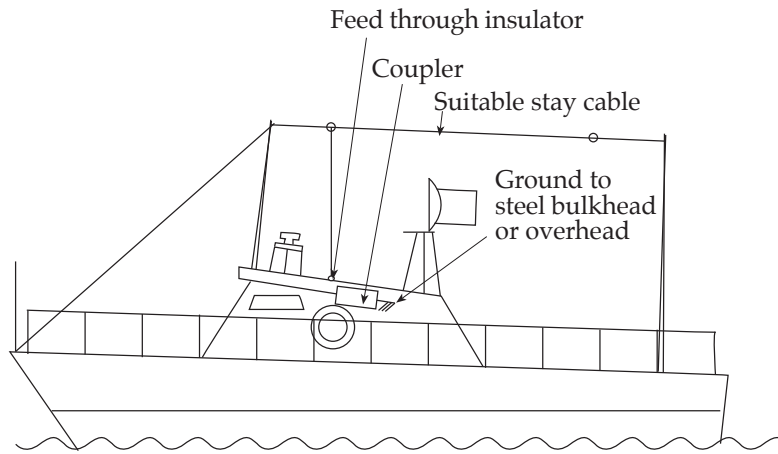


Figure 5.03 Motor Vessel installation



Motor Vessel Installation

Figure 5.04 Base installation

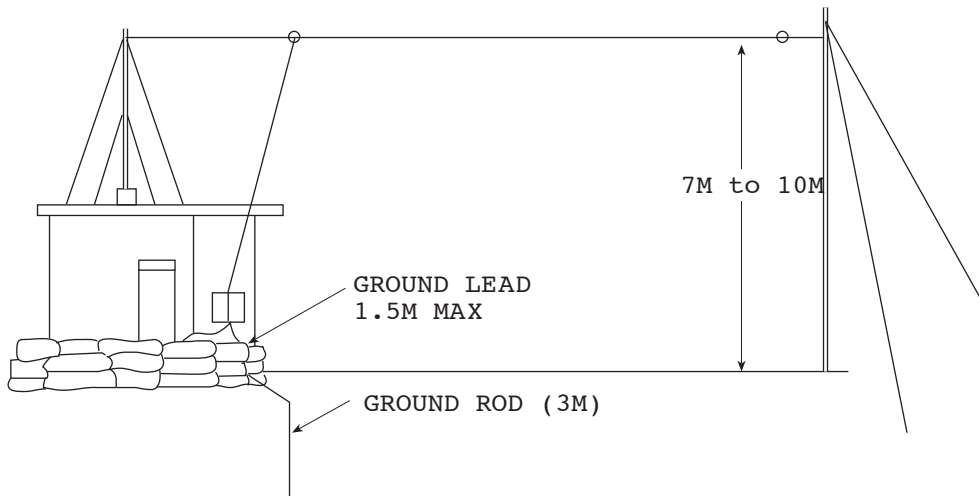


Figure 5.05 Base installation with ground wire radials

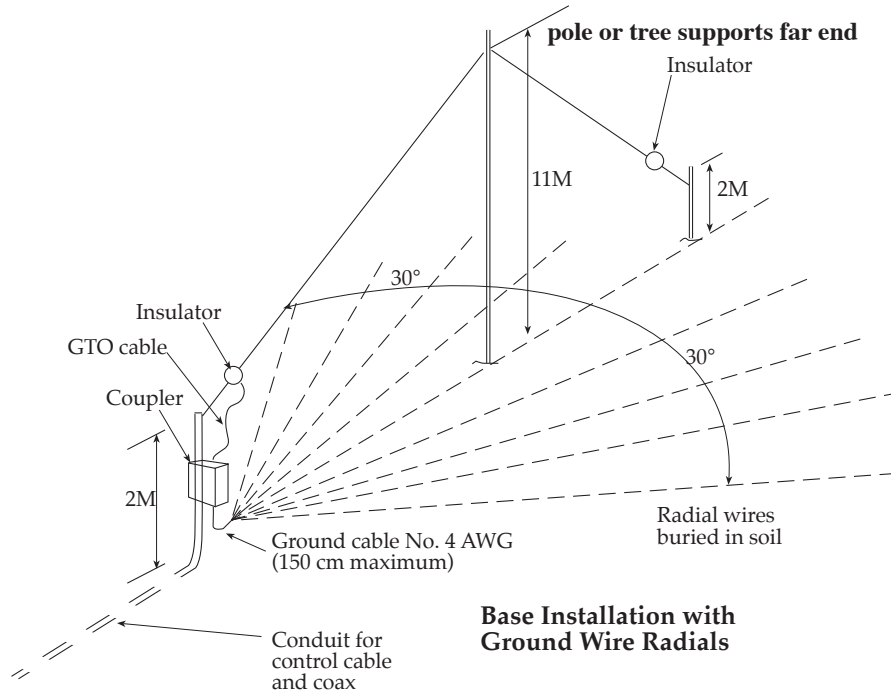


Figure 5.06 Base dipole installation

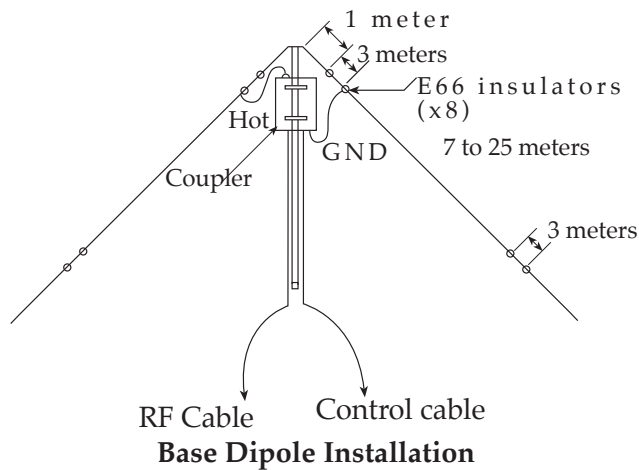
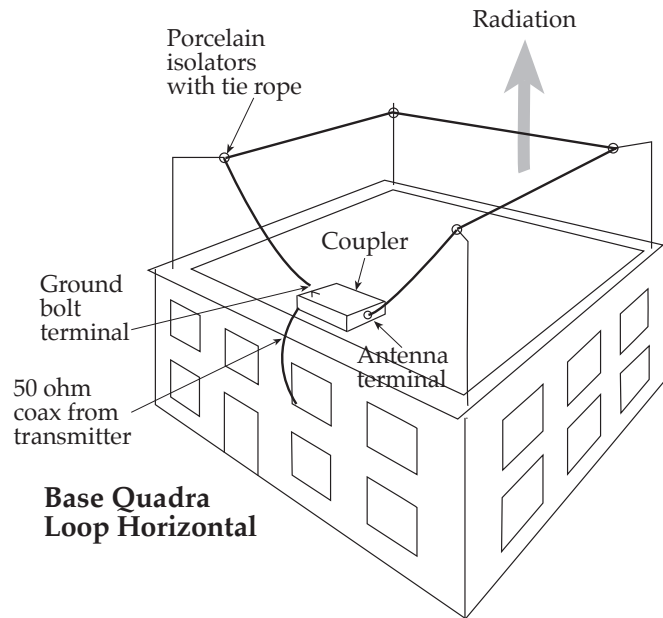


Figure 5.07 Base Quadra Loop Horizontal



The horizontal quad loop is a groundless antenna for high angle radiation and is ideal for HF communications from zero 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 ground side of the coupler.

**Figure 5.08
Base Ladder
Installation**

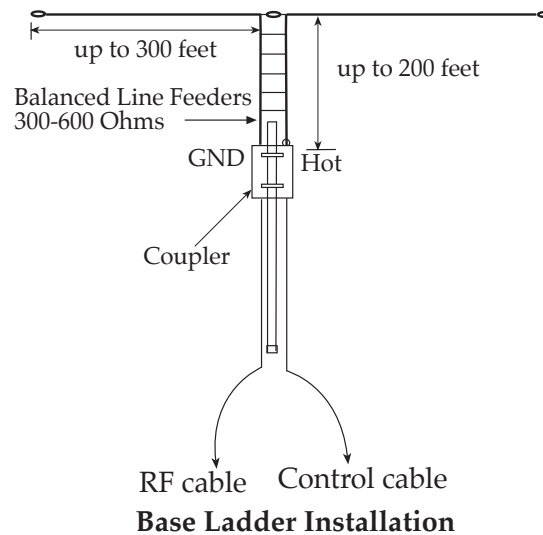
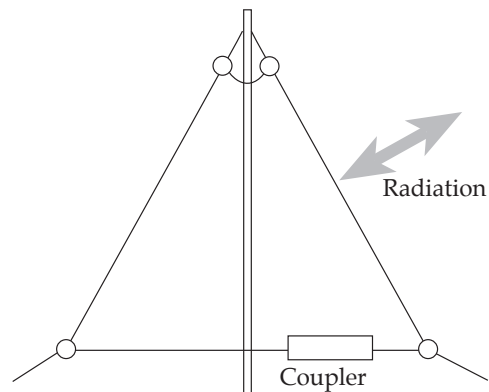


Figure 5.09 Base Delta Loop

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 roof-top 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.

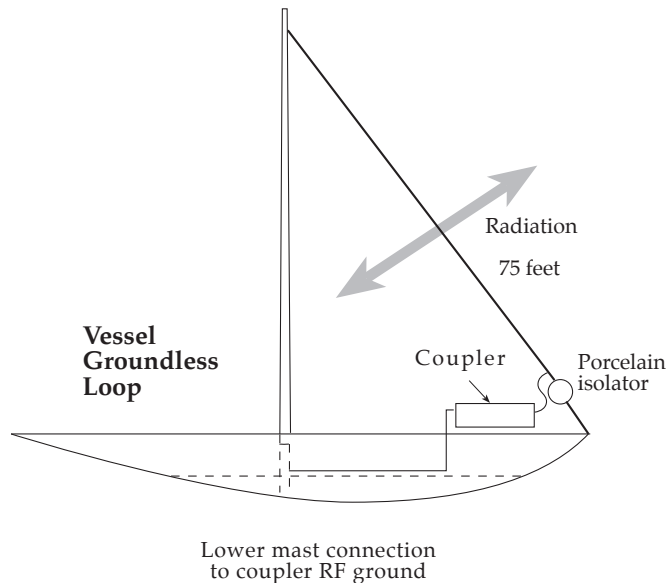


Base Delta Loop

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.

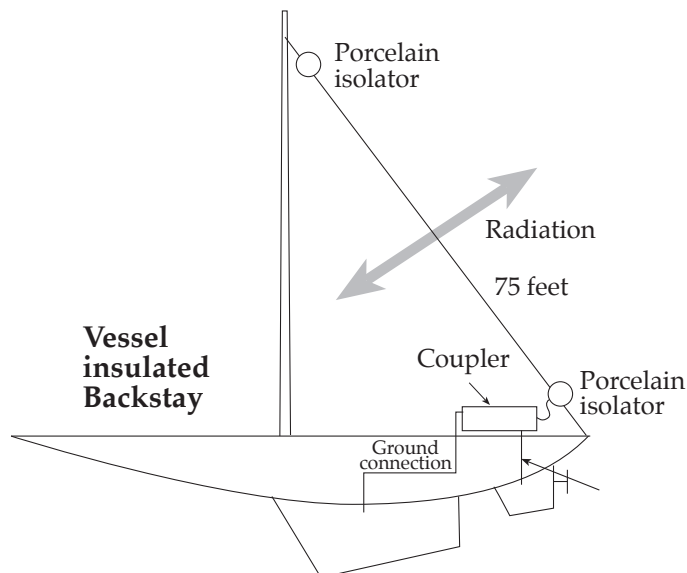
Loops in the horizontal plane may also be used. This type of antenna provides exceptionally good performance on the low frequency bands for short to intermediate range communications.

Figure 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 backstay and an electrical connection on top of the mast and stay. The grounded side of the coupler is connected to the bottom of the mast. Although not our best recommendation, this antenna will provide a workable solution in some installations.

Figure 5.11 Vessel insulated backstay



The insulated backstay antenna requires two porcelain 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 metal parts or structures of the boat (keel, engine, etc.).

5.1 APARTMENT LOOP ANTENNA

Loop antennas can be used very effectively in small apartments, offices and holding 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 very 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 operation is for a small room, it is recommended that a small multiple wire loop (6 loops) on a rectangular configuration 3 by 4 feet be installed (as illustrated in the figure below).

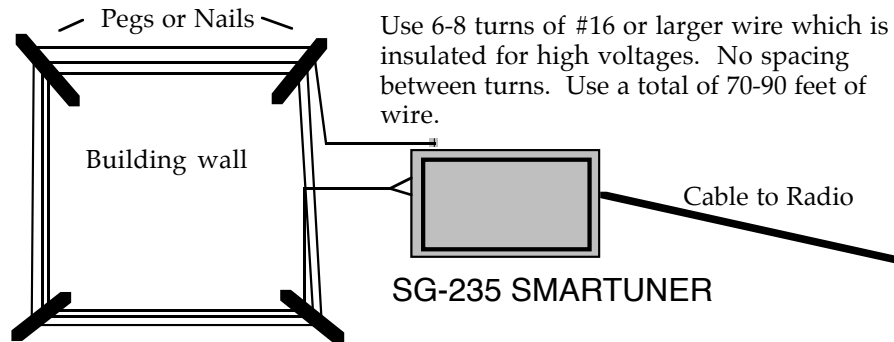
This configuration allows operation from 3.0 to 30 MHz and the SG-235 will tune and load all frequencies well below a ratio of 1.1:5 VSWR. Directivity will be high from 3 to 12 dB depending upon the frequency. If this is a problem, two loops at 90 degrees can be installed to communicate at 90 degrees off direction of the first loop antenna. Loop antennas are low noise antennas. However, because they are used in apartments and urban cities, high industrial noise can be expected. Avoid using neon or fluorescent lights within 50 feet of the loop antenna, they may completely jam one or more frequency bands.

Loop antennas of much larger sizes can be used, however, please remember that 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 one quarter wavelength is the basis of the "quad" type directional antenna.

Figure 5.12 Small loop antenna (3 x 4 feet)

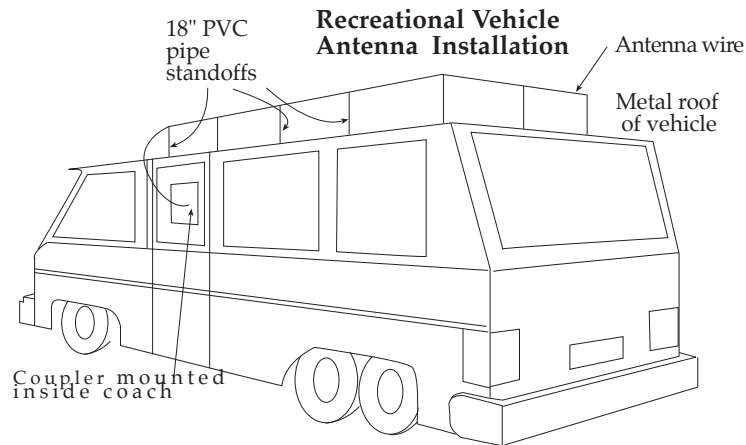


Loop antennas represent a DC short circuit and for this reason are much less susceptible to noise than are other kinds of antennas. In certain residential and industrial areas where high noise levels occur, the loop antenna may provide a substantial improvement in both receiving and transmitting performance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

5.2 RECREATIONAL VEHICLE (RV) ANTENNAS

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

Figure 5.2.1 Recreational vehicle bus or truck detail:



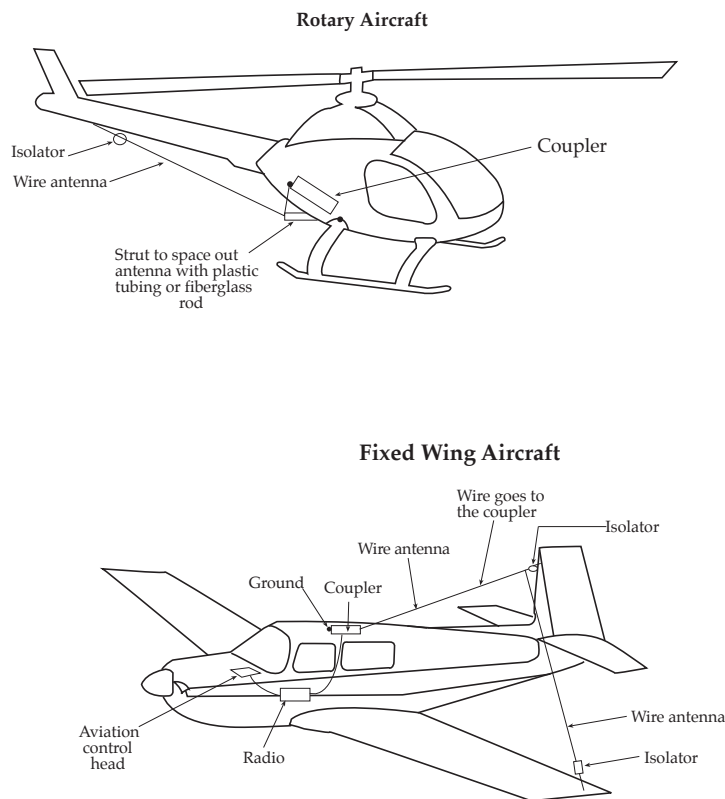
Use a separate ground strap or wire for the body and the chassis to the ground of the coupler.

An End fed antenna could be very effectively used if a metal cabin structure is available. Loop antennas have the advantage of not requiring a ground system, but are highly directive. Mounting the antenna is relatively simple and can be mounted on short (18 inches 1/2 inch diameter) plastic plumbing pipes. In the end fed antenna, it is recommended that the antenna be as long as possible in an "L" shape configuration, as illustrated in the following diagram.

5.3 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 23-foot piece of metal which 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.

Figure 5.3.1 Aircraft Installation Detail:



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 which 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 wingtip if desired) and a long wire antenna under the tail rotor of helicopters. This long wire approach has proven very effective on Bell JetRangers and LongRangers in particular.

5.4 LOW PROFILE, HIDDEN AND COVERT ANTENNAS

There are two general types of low profile, hidden and covert antennas.

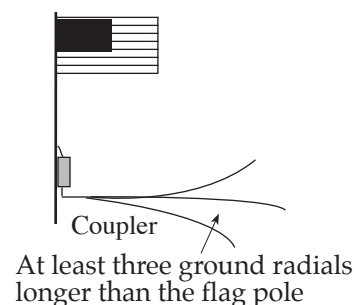
- The first group is the paramilitary user who will wish to operate from a residence or commercial building without drawing attention to the fact that long range HF communication is in process.
- The second class of covert antenna user (and a larger group) is the amateur radio community which finds itself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

We will consider a typical residential home and point out covert antennas which have been used very successfully for intercontinental communications.

As you review the diagram on the following page, remember that the antennas used include both groundless loop type antennas and those which require a counterpoise (ground).

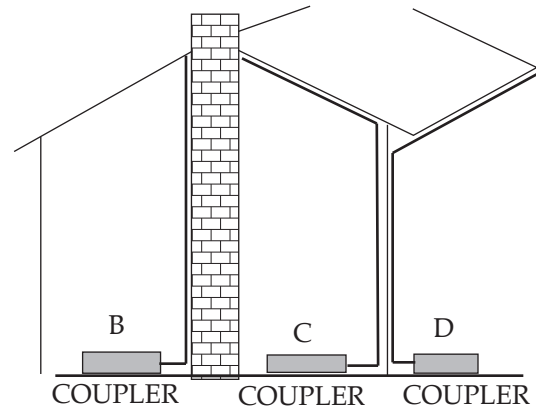
A. If a flag pole is made of PVC pipe, it is easy to tape a large gauge wire to the inside of the pipe and use a good counterpoise. Typical flag poles are 25 to 35 feet in height and offer excellent performance on all bands.

B. The down spout, rain gutter antenna works well if the piping and gutter are aluminum. You may wish



to secure the joints with hose clamps or plumbers tape to assure low resistance connections.

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



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. Especially if the feedpoint is at ground level adjacent to an iron or copper water line entering the house which will provide an excellent counterpoise.

E. Along the edge of the roof, held off by some inexpensive TV twinlead stand offs, you can hide 25 to 40 feet of antenna on virtually any house.

F. Under the roof overhang, all kinds of wire antennas may be installed.

G. Loop antennas installed on the inside or outside wall work well at higher frequencies and provide some directional characteristics. These antennas are also less prone to man made noise.

H. All types of antennas may be hidden inside the roof of a building which uses non-metallic roofing materials.

5.5 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.

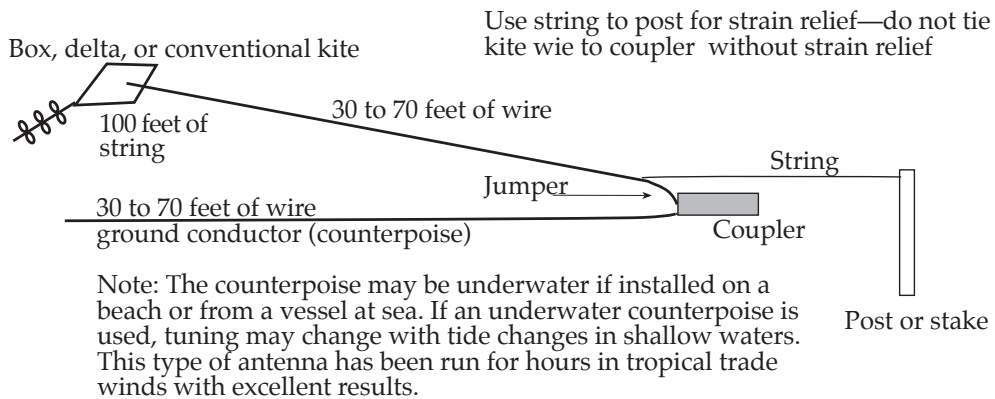
5.6 KITE ANTENNA:

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.

Remember that when a mast comes down, you have easy access to the high voltage feedline which 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.

5.5.1 Kite Antenna



5.7 Tactical Installations

Over the course of nearly 30 years of HF, SGC equipment has been used everywhere from camelback 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:

5.8 TACTICAL Antenna Supports

Except for a barren desert, just about all landscapes have structures (natural and man made) which 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.

1. Natural rock formations such as cliffs and bluffs.
2. Tall trees.
3. Water towers.
4. Church spires and minarets of mosques.

5. Strung between rooftops of buildings.
6. Sign posts such as for banks and gasoline stations.
7. Telephone (not power) poles. There's no line noise on telephone poles.
8. Railroad trestles
9. Highway structures - signs, overpasses and bridges.
10. Flag poles at public buildings, schools and hospitals.

5.9 TACTICAL Grounds and counterpoises

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

1. Cross country water and petroleum transmission pipes.
(As it passes under a bluff?)
2. Long steel cables along a mountain highway. (With nearby trees?)
3. Chain link fencing. (Around the water tower?)
4. Metal lawn sprinkler piping. (In the church yard?)
5. Fire department stand pipes. (Required in most big city building codes!)
6. Underground metal petroleum storage tanks. (At the gasoline station?)
7. Metal fencing of any type. (A barbed wire fence along a pasture under telephone pole?)
8. 100 feet of wire thrown in a river or sea. (Under a trestle?)
9. Metal drain culverts. (Along a highway?)
10. 4-5 cars parked with their metal bumpers touching or a sheet metal roof. (Hospital or public building.)

As you can see from this list, there are an almost limitless number of options available for the trained professional to install a high performance antenna system with only a small amount of wire and an SG-235 Smartuner.

6.0 General Notes on Antennas and Couplers

1. The longer the antenna, the better the antenna performance. By doubling the length of the antenna, an improvement of 3 - 6 dB can be

expected in your radiation or receiving characteristics. This is the equivalent of transmitting with 400 watts, when in actuality you are using only 100 watts.

2. A ground for "end fed" antennas can be very effectively created by running radial wires from the coupler point and laying them onto the ground. It is recommended that for a good ground, 12 radials should be used and they be about 1/3 larger 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-235 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 that are of no importance to the present application. However, if this is not the case, 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 very strong signals.
6. The SG-235 is a remarkable antenna coupler that 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 function of the coupler is to couple the radio to the antenna and not to use it as a mid point connector. The antenna system starts at the output to the coupler. Therefore, the lead end from the coupler to the hypothetical antenna is part of the antenna system. Avoid having the lead end wire touch any other metal structure, as it will capacitively short your antenna to ground.
8. The backstay of your mast is the only viable antenna on a sailboat. The

SG-235 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 between 1.8 to 10 MHz even though the coupler will load and tune the antenna whip. A very high voltage of 15 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 this stringent a purpose. The use of an antenna system, such as the SG-303, is highly recommended as it was specifically designed for extreme applications.

6.1 STEPS TO ANTENNA INSTALLATION

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

- a) Selection and installation of the antenna
- b) Mounting the antenna tuner
- c) Connecting the appropriate interface cables between the tuner 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 and for satisfactory operation the system must be carefully selected, then installed correctly. The unbalanced antennas used with the automatic antenna tuner 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.

6.2 Antenna Location

The figures in Section 4 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 the antenna is spaced at least 2 meters from the mast.
3. Remember that the radiating part of the antenna starts at the tuner. The location of the bottom portion of the antenna is very important.
4. Vertical antennas have an omni-directional radiation pattern and will provide equal performance in all directions.
5. 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 and should be located so the ends point in directions where communications are not required.
6. The "V" 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.
7. High voltages (sometimes exceeding 30,000V RF) are present on the antenna. All parts of the antenna and tuner must be located or protected so that there is no possibility of accidental contact.
8. Do not locate the antenna close to other antenna systems.
9. Make sure that the antenna is rigidly supported. The antenna will detune if it sags or sways.
10. The connection from the tuner 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 1 meter. Use heavy gauge wire or strap for ground connection.
11. Whip antennas should be connected with the minimum length of wire. (Do not exceed 0.6 meters).
12. Do not locate the tuner farther from the transceiver than necessary. If the distance exceeds 10 meters (30 ft), it is recommended that low loss coaxial cable, such as RG-8 or RG-213 be used.

6.3 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 tuner. A good ground is essential.

6.3.1 Vehicle Grounds

Connect the tuner directly to the frame of the vehicle. Ensure that a heavy strap is used from the tuner 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 insure 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 which use spot welding may not always adequately connect various body parts. Use an ohm meter 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.

6.3.2 Marine Grounds

A metal hulled vessel in salt water provides an almost ideal ground. The tuner 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, propeller shaft, etc., and sometimes an external grounding plate should be connected to the hull. The bonding and grounding plate should take into consideration the problems of electrolysis. Severe damage may result if dissimilar metals are connected together.

Our experience is that sacrificial zincs, 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 lazarette 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 rudder post, 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 life lines 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 sea water. 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 very aware of potential noise sources which may need to be bypassed to ground. We have encountered just about every source of noise imaginable in vessel installations. When you are laying in a ground system is the best time to track down annoying noise sources. 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 which uses an electric motor. This means to turn on the water pressure pump, bilge pump, hot water forced air heater fans, refrigeration and autopilot motors. A few small capacitors to ground (.01 microfarads at 100 VDC) can resolve many issues. Bypassing of the vessel's alternator is also a good idea.

6.3.3 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 tuner. 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:

- a) The water pipe is close to the tuner.
- b) The water pipe enters the ground very close to the tuner bonding point.
- c) There are no joints or couplings in the pipe that will increase the resistance path to ground.
- d) The water pipe enters soil with good conductivity.
- e) 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 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 8-12 radials bonded together in the center. If the antenna is at ground level, the radials should be buried a few inches below the surface.

6.4 Corrosion

The 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 which are exposed to weather on your 6-month periodic maintenance plan. Then, every six months, you will be reminded to undo each of the connections, clean, retighten and reseal.

Use jumpers around metal backstay 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.

6.5 Antenna Coupler Mounting

The coupler is mounted using the proper mounting ears on the case. Choose a location immediately adjacent to the antenna feed point. In trunk mounted mobile installations, it is very important that the tuner is located 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). A protective housing is highly recommended when the coupler is installed on the outside, or on the deck.

6.6 Antenna Connection

The antenna lead is connected to the high voltage insulator. 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 is spaced at least 3 centimeters from the conducting surface. Sharp points in the lead-in wire should be avoided to prevent corona discharges.

7.0 Installation Procedures

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

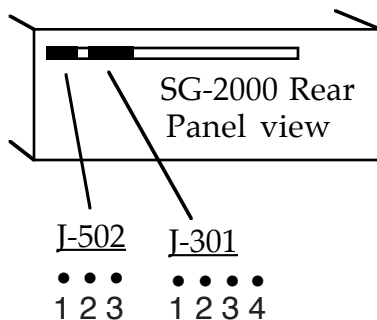
7.1 Installation with SG-2000

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

From left to right, these jacks provide the following:

- J-502 SG-235 Smartuner™ 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
(active only if control head is attached to chassis.)
- Oven Turns oven On-Off (Shipped with oven ON as default)

SG-2000 TO SG-235 Coupler CONNECTIONS



SG-235 Coupler Wires

- J502ack wire of coupler cable (Ground)
- J502eofcouplercable(+12VDC)
- J502en wire = TUNED indication
- J301 4- Brown wire = PTT "in"

On All Radios:

The SG-235 requires only a source of 13.6 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 fully PCB is protected against power reversal. The output for a remote mounted tune indicator, if desired is strictly optional.

When installing your SG-235, 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.

7.2 Installation with SG-500 or other 500-watt amplifiers

The SG-235 requires only a source of +13.6 VDC, an RF transmission line (RG-58/U up to 30 ft., RG-8 or RG-213/U if over 30 ft.), and 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. The gray wire acts as the 500W amplifier transmit engage, if a linear amplifier is used.

Automatic amplifier switching. During tuning, the amplifier is in by-pass operation, indicated by a +5V on the gray wire. Once the coupler is tuned, the gray wire is pulled to ground and the amplifier is switched on.

Manual amplifier switching. If your amplifier does not have a PTT or other control line, you must switch the amplifier on manually, after the coupler has tuned. Then each time you change frequencies, the amplifier must be turned off so the coupler can tune at a lower power. Failure to follow these guidelines could result in permanent damage to the coupler.

When installing your SG-235, 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.

7.3 Smartlock Pro Installation

The SmartLock Pro, a standard accessory with the SG-235, 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 returning will occur, it has an LED indicator which will light when the coupler is tuned, and it provides a manual reset of the coupler without turning the power off and on.

Connections:

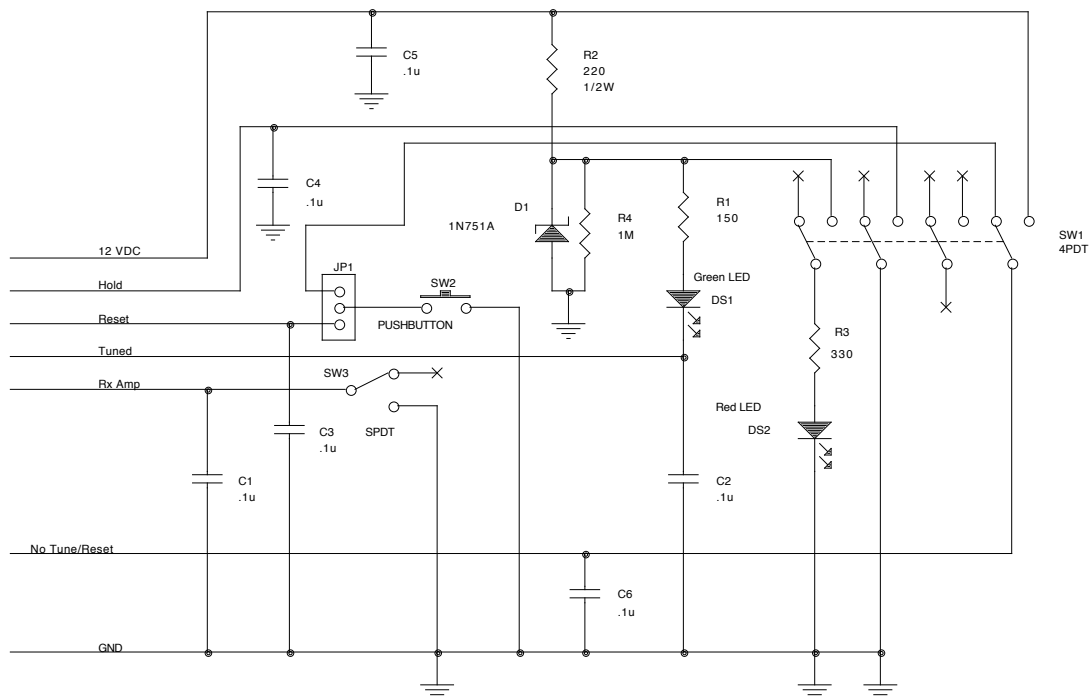
SmartLock Pro to SG-235 Smartuner

Red	—	Red wire (+12 VDC)
Green	—	Green wire (Remote tuned indicator line)
White	—	White wire (Hold Settings)
Blue	—	Blue wire (Reset)
Black	—	Black/Yellow (Ground)

We recommend soldering the wires together and insulating the exposed wires with heat shrink or electrical tape. Other methods may suffice as long as the connections are firm and no wiring remains exposed.

A schematic drawing is provided as an aid to understanding the operation of the SmartLock Pro.

Smartlock Pro Schematic Diagram



7.4 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 insulator on the housing. (Note: this insulator is not designed to support heavy mechanical loads. If such loading is encountered, the use of a strain insulator is desirable.)

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 of extreme importance for 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 5.2.2 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. It should always be remembered that the computer in the SG-235 is unable to second-guess the installer.

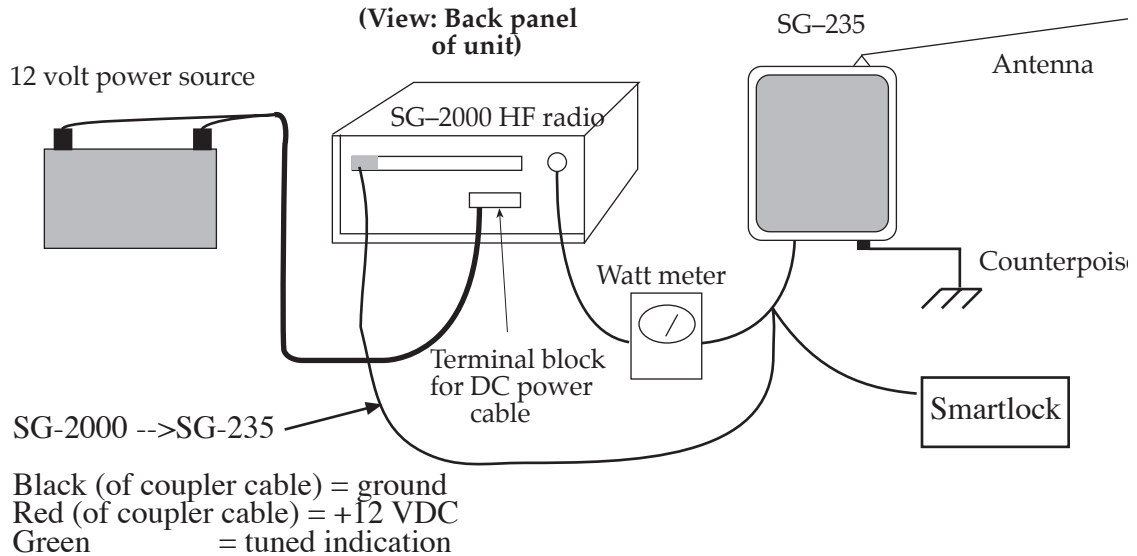
A PROPER ANTENNA/GROUND INSTALLATION IS OF GREAT IMPORTANCE. REGARDLESS OF WHETHER YOUR STATION IS A BASE STATION, MARINE, OR LAND MOBILE.

SETUP FOR ELECTRICAL CHECK OUT:

8.0 ELECTRICAL CHECKOUT

After the SG-235 antenna coupler has been installed, the SSB transmitter should be adjusted to the highest frequency desired, and a directional watt meter (i.e. Bird Model 43) should be inserted into the transmission line. The transmitter should then be powered. The SG-235 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.

Note: When changing to a new frequency, the SG-235 has a 4 second time delay before it will initiate a retune cycle. This can be bypassed by connecting Brown wire (PTT IN) to your radio external PTT output.



Next the SSB transmitter should be adjusted to the lowest desired frequency, and the test as outlined above should be repeated. The SG-235 should immediately sense the mismatch, and switch to the tune mode to retune 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-235 installation and tune-up is considered complete if the above tests have been successfully performed.

The SG-235 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-235 to "learn" your antenna's requirements by proceeding from frequency to frequency and allowing the normal tune-up to occur. As the SG-235 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. This provides 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.

8.1 Alternate Electrical Checkout

On Site Radio HF/SSB Transmitter & Coupler Test Procedure

Light bulb test.

If you suspect that there is a problem with your transmitting equipment, here is a simple test that you can perform to find out if your station equipment is operating properly. All that is required is some hook up wire, a PL-259 connector, 2 alligator clips, a lamp socket, 100 watt lamp or a minimum 200 watts for 500 watt system (two may be paralleled if necessary), and adapters as shown in the diagram. In a real emergency, you can simplify this arrangement to suit the materials that you have on hand.

1 - The light bulb test is used to verify basic operation of the transmitter, and antenna coupler. The lamp will present a load to the transmitter, and antenna coupler that is similar to an antenna. This test will provide a visual indication of the power output from the transmitter, and verify operation of the antenna coupler.

2 - The transmitter should be tested first. Note that the lamp may be dim on some frequencies. This is because the lamp is not an ideal load for the transmitter, and the SWR protection circuitry in the transmitter will automatically reduce transmitter power. If the lamp does not light on any frequency, there is high probability that the transmitter is in need of service, and there is no need to proceed to the coupler test.

3 - If the transmitter passes the test, proceed to the 'coupler test procedure'. Make sure that the antenna and ground are first disconnected from the coupler. Note that you should be able to hear the relays clicking in the coupler as the tuning cycle begins. This should stop within a few seconds, and the lamp should light brightly. If you are using the tuned indicator option, it should illuminate when the coupler is tuned.

4 - This test should be repeated on all bands of intended operation. Note that the coupler will probably not tune the lamp from memory. This because the impedance of the lamp changes with temperature, and therefore presents a dynamic load to the coupler.

5 - Note that the lamp will not be as bright on the higher frequencies. This is due to the fact that some radiation from the hook up wiring will occur on the higher bands, that is, some of the power will go 'on the air' and not be available to the lamp.



6 - If the coupler operates as described above, it is almost certain that it will give satisfactory service with a proper antenna. If you are still having trouble, we hope that you will contact us for a free copy of our HF SSB User's Guide and Products Catalog which contains much additional information.

If the lamp does not light: (be sure light bulb is good)

1 - Make sure that the radio is set to the CW mode. Some transceivers may not provide CW output unless a CW key is connected to the appropriate connector. If you are not sure about this, refer to your equipment manual. You may use FM or AM instead if necessary.

2 - Check the voltage at the transceiver DC power terminals. Also, verify that there is at least 12 volts available at the antenna coupler.

3 - You can check the SSB output of your transceiver by speaking into the microphone. The lamp will not be as bright as in CW. This is normal.

4 - Keep in mind that most troubles with these installations will be found in the wiring, coax connectors, and antenna/ground system.

5 - If there is no indication of transmitter output you will need to make arrangements to have the unit serviced.

6 - If transmitter output is good, but the coupler does not tune up the lamp, you should contact SGC for help.

If your equipment passed these tests:

1 - Your equipment is capable of producing a strong signal. If you are having trouble, it is probably either in the antenna system, or your operating procedure.

2 - Make sure that your antenna and ground system are installed correctly, contact SGC for a copy of our HF User's Guide for much additional information on this subject.

3 - If you are new to HF radio, we strongly suggest that you set up a schedule with another station for your initial tests. A helpful operator at the other end can provide useful information about your station performance.

5 - The technical support staff at SGC has many years of experience in all facets of HF radio communications. If you need help with your SGC equipment, please contact us. We stand ready to provide solutions to your communications challenges.

A light bulb connected to the antenna jack of a radio is simple and effective method to test if your radio is transmitting. The instruction below explain how to test the SG-2000 HF Radio and optionally the SG-235 Coupler.

This test can be modified and adapted to work on any other radio.

Equipment Required:

SG-2000 Radio or any HF SSB and AM/FM Transmitters.

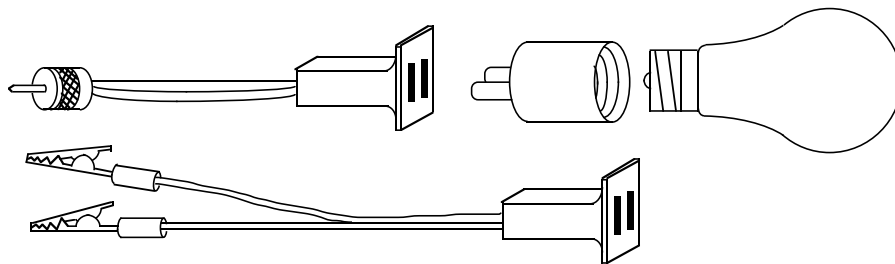
SG-235 Coupler

AC to UHF Connector Cable [see figure below]

AC to Alligator Clips Cable (needed with Coupler) [see figure below]

Light Bulb to AC Adapter [see figure below] (be sure light bulb is good)

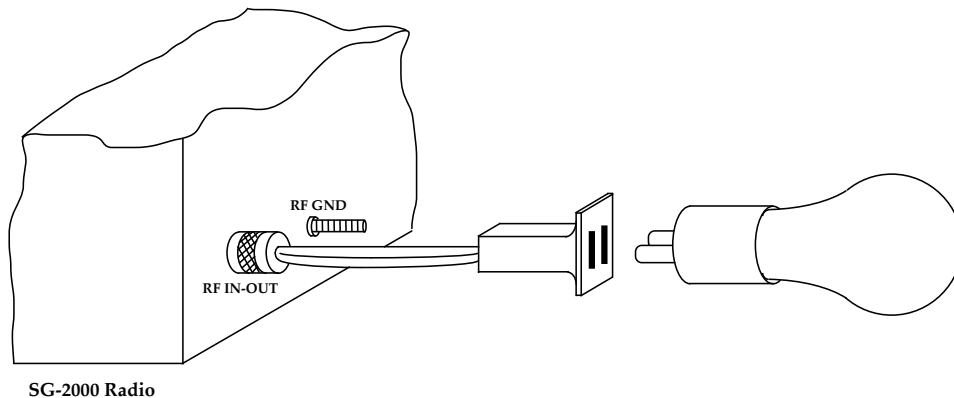
Light Bulb; 75 to 200 watt, 120 to 220 VAC



Radio Test Procedure:

1. Connect "AC to UHF Connector Cable" to SG-2000 RF IN/OUT Connector.
2. Screw light bulb into "AC Adapter"
3. Plug AC Adapter and light bulb into "AC to UHF Connector Cable" that is attached the radio [see figure below]
4. Turn on the radio and set to CW mode and PWR to HI
5. Key "push to talk" switch on microphone, and observe the light bulb. The light should come on if the radio is transmitting.
6. Set power to LO
7. Key "push to talk" switch on microphone, and observe the light bulb. The light should come on if the radio is transmitting. Observe that the light is not as bright as step 5.

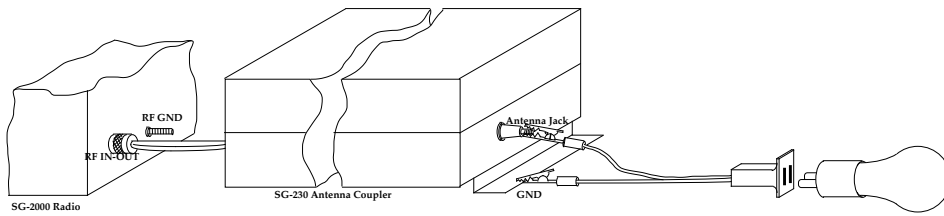
8. Set power to HI
9. Set the radio to AM mode or CW and any carrier.
10. Key "push to talk" switch on microphone, and observe the light bulb. The light should come on if the radio is transmitting. Observe that the light is not as bright as step 5.
11. Set the radio to SSB mode
12. Key "push to talk" switch on microphone and talk into the microphone. Observe the light bulb comes on when you talk.

**Coupler Test Procedure:**

1. Connect coupler to the radio and disconnect antenna from coupler.
2. Connect "AC to Alligator Clips Cable" to the SG-235 antenna jack.
3. Screw light bulb into "AC Adapter"
4. Plug AC Adapter and light bulb into "AC to Alligator Clips Cable" that is attached the coupler. [see figure below]
5. Turn on the radio and set to CW mode. Turn on the coupler
6. Key "push to talk" switch on microphone, and observe light bulb. The light should come on if the radio is transmitting.

Coupler Test Procedure Continued

Note: The light bulb may not come on immediately if the coupler has not yet been tune for that frequency. The light bulb brightness is greatest when the coupler is tuned for that frequency.



8.2 COUPLER CONFIGURATION

Schematic Q30102500, sheets 1 and 2, are the schematic diagrams of the antenna coupler. RF input is applied through connector J5; +13.6VDC is connected between the terminals marked +12V and GND on J7, and an appropriate antenna and ground system are connected to feed through insulator and stainless steel stud respectively.

Schematic Q3330102501 is the digital design of the antenna coupler. J4 is a connector for the Smartlock Pro and PTT out signal to the amplifier. J3 is for RS-232 connection to control the tuner remotely with a PC.

8.3 TUNING PROCESS

An array of detector devices in the SG-235 monitors the antenna system impedance, reactance signal, and the VSWR load when RF power is applied to the unit. 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-235 will proceed to tune only when enough forward power is present to confirm this check.

After RF is applied to the coupler, it then passes through the detector system. The detector system consists of six capacitors in shunt on the input arm of the

network, eight inductors in the series arm, and five 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 64 values on input shunt C, 32 values of output shunt C, and up to 256 values of series L is possible with the manipulation of these 38 relays.

8.4 IMPEDANCE DETECTOR

RF transformers T3 and T2 drive the impedance bridge which is balanced at 50 ohms. T2 samples the line current and thus D2 outputs a negative DC level proportional to line current. A tertiary winding on transformer T3 provides a line voltage sample to D7 which provides a positive voltage proportional to line voltage. R34 and R26 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 microcontroller.

8.5 VSWR DETECTOR

A directional coupler comprises a current transformer T1 and a voltage transformer T3, in conjunction with termination resistors R22 and R19. The coupler is inserted in the 50-ohm transmission line between the input connector, J5, and the tuning network. The forward power is measured across termination R22 and reflected power is measured across termination R19. Diode D1 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 R35 and R23. 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.

8.6 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 cou-

pler as noted from the generator. A line current sample is compared in phase with a voltage sample in a double balanced mixer. Output polarity is positive for a net capacitive reactance. 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 microcontroller.

8.7 THE CONTROL DEVICE (CPU - 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 which 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 U1, U2, and U3, 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). 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-235. 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 retransmitted, 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 searches 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, the same length of time required to close the network relays.

8.8 INITIALIZATION

The microcomputer is usually in the stop mode and requires an external interrupt request signal (XIRQ or IRQ) to start program implementation. The interrupt request comes either from the RS-232 remote manual tuning IRQ or the RF detector circuitry. The RF detector line goes into the XIRQ pin of the CPU and when it goes low, wakes up the CPU from the STOP mode.

8.9 INFORMATION READ

The data sensors are interfaced with the CPU through input ports PA3 through PA7. After an IRQ, the tune algorithm program can access any desired variable by simply searching for the desired input port (lacking any applicable pre-stored data). Since the comparators effectively preprocess the desired data, to read any specific variable, the CPU need only look at the required port for the desired variable.

8.10 Bypass Operation Jumpers

If broadband operation is required during receive for scan operation, jumper JP2 may be set to the “YES” position. This will drop the tuning elements out of the circuit on receive only. Jumper JP2 is located on the far left side of the Q50102501 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.)

- Setting JP2 to the “YES” position is recommended if you are using a radio for split band communications, for scanning selective calling protocols, or for ALE (Auto-matic Link Establishment).

The default is: Tuning Out In Rcv: [**no**].

- Jumper JP1 set to “No” bypasses the coupler’s memories. This means that each time the coupler is used on a different frequency, it will retune rather than use previously stored information.

The default is Tune From Memory: [**Yes**].

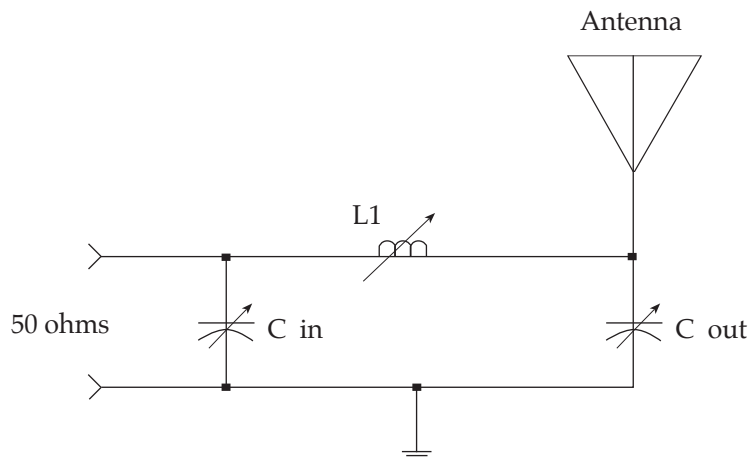
- Jumper JP3. Set to “Yes,” JP3 keeps the 500-watt amplifier in the transmit mode as long as the PTT signal from the radio is asserted and whether or not RF power is applied to the coupler. Set to “No,” JP3 keeps the 500-watt amplifier in the transmit mode as long as RF power is applied to the coupler. The default is PTT control: [**Yes**].

SG-235 MicroTune™ Software

Copyright November-1991

9.0 Tuning Process and Options

The SG-235 MicroTune™ Software is unique software which allows fine and precise tuning of the digitally controlled π & L network antenna coupler configurations.



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

- The coupler is activated whenever forward power is present.
- In addition to sampling VSWR to determine if the coupler should re-tune, frequency comparison is employed, causing the coupler to tune when the transmit frequency changes independent of the VSWR reading.
- Extensive tuning algorithms are used to test and verify different antenna situations. Initially, the first tuning cycle will require several hundred milliseconds. Any further tuning is accomplished in a matter of milliseconds when recalled from memory.

- Facilities and algorithms are used, which enable accurate tuning at the low end of the frequency band, and the use of even shorter antennas than previously possible.
- The BITE (Built-In-Test-Equipment) Indicator Tune LED includes a safety feature which alerts the operator to a mismatched condition, via 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 sophisticated MicroTune™ software of the SG-235 enables precise tuning of the coupler components and tuning of a wide variety of antennas.

The microprocessor of the coupler is turned on every time that the coupler has forward power. However, re-tuning takes place only if the VSWR is greater than 2:1, or if the frequency has changed. Upon initiation of the tuning, one of the five tuning paths is selected for the initial tuning, depending on the condition of the tuning indicators.

9.1 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.

When RF power is verified, the computer will perform a test to verify forward power is present. If no forward power is detected, the computer will revert back to the "sleep" mode.

Once forward power is detected, the current transmit tuning element data is sent to the relays and the VSWR is checked. If the VSWR is greater than 2:1, the program branches to the 're-tune' selection. If the VSWR is less than 2:1, the current frequency is compared to the most recent frequency employed. If a difference in frequency is detected, the program again 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 "sleep" mode.

Once it is determined that re-tuning is necessary, a test is made to see if 'J3' is set to tune from memory. If the result is re-tuning from memory, the frequency is measured and tuning data is recalled from the memory 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.

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 subroutines are executed repeatedly, depending on the status of the criteria mentioned above, in order to achieve proper tuning.

Should the initial primary tuning sequence prove unsuccessful, secondary algorithms are attempted until all possible routines have been exhausted. If, at this point, an acceptable VSWR has not been achieved, the tuner status acquisition time is increased, and the tuning process is repeated.

If, after the second attempt, the tuner still cannot achieve a proper VSWR, the program branches to a "no-tune" program. Here, the tune indicators will blink on and off, all tuning elements will be removed, and the tuner will go into a 20 second time delay. During this time delay, the transmit frequency is monitored. Should a change in frequency occur, the tuner will revert to the beginning of the interrupt segment of the program and attempt to tune the new frequency.

If the tuner 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 'J3' 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 'J2' 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.

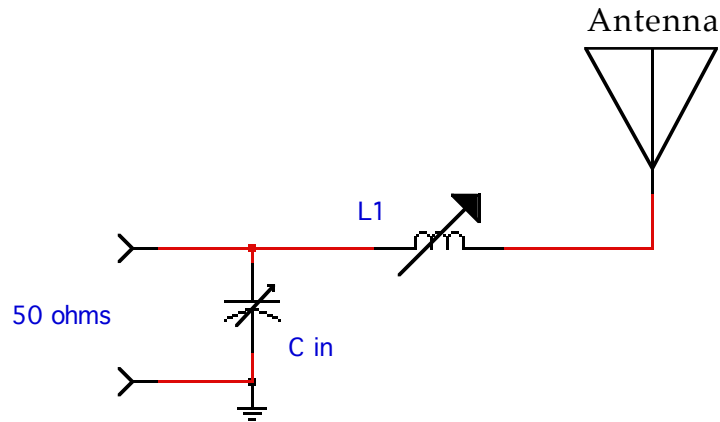
The current frequency is then saved for future comparison and the computer reverts back to the "sleep" mode.

9.2 TUNING ALGORITHMS OR 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 subroutines are executed throughout the tuning process. Following are examples of the activity that occurs when the tuner must be matched to a frequency that requires a slightly longer or shorter antenna:

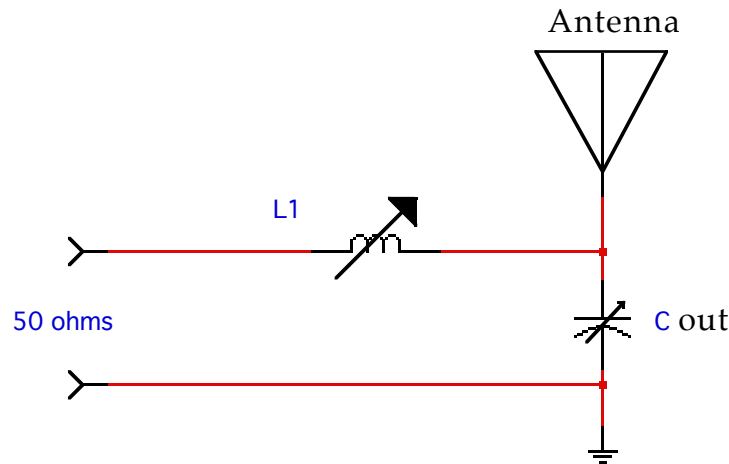
9.3 Antenna Too Short



Once the tuner has verified RF power, the tuning sequence is 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. Tests are conducted continuously on the VSWR phase and input impedance. As long as the VSWR is greater than 4:1, the program will continue to increment the series inductance in .125 μ h steps - each time normalizing the input impedance with input capacitance.
4. When the VSWR goes below 4:1, the computer will retain the data it determines is less than 2:1 until input impedance is no longer low or VSWR climbs higher than 2:1. The previous data is then tested once again to verify validity.
5. At this point the tune indicators are engaged. The current relay data is saved if 'J-3' is set to tune from memory, and if 'J-2' is set to the tuning elements out during receive position, the program waits until forward power is no longer present, then removes all tuning elements. The current frequency is saved for future frequency comparison, and the computer reverts back to the "sleep" mode.

9.4 Antenna too long



Once the tuner has verified RF power, the tuning sequence is as follows:

1. Output capacitance is added until input impedance test results are low.
2. At this point, the antenna will be capacitive. Therefore, 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 "OK Tuned" sequence, reacting to 'J-3', 'J-2', etc., eventually reverting to the "sleep" mode.

The preceding gives a simplified overall 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 publication.

The actual program is copyrighted and is not available.

9.5 J-2 - Tuning elements out during receive

(FACTORY default SETTING: NO)

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

NO In this position the tuner will retain the required tuning data and will not change anything 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.

9.6 J-1 - Tune from memory

(FACTORY default SETTING: YES)

YES In this position the tuner 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 tuner is done. In this position the tuner will save 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 tuner will not use previously saved tuning data. Each time a different frequency is selected the tuner will proceed through a complete tuning sequence.

Clearly, the advantage of "YES" is speed. The tuner will seem to be matched instantly when in this position, if the frequency being used has previously been memorized in this mode. Obvious 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.

It is suggested to start with 'J-1' in the "YES" position. If operation is as expected, don't change it.

- Note: The SG-235 does provide a way to by-pass tuning from memory even with JP1 set to "YES". To do this, the SmartLock PRO must be installed. If the coupler tunes from memory and you want the coupler to find a better setting, do the following:

1. Switch the SmartLock PRO to Tune Lock.
2. Press the reset button while in 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 setting 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**.

9.7 JP3 - PTT out Control

(Factory default setting: YES)

YES In this position, the SG-235 will keep the 500-watt amplifier in the transmit mode (after the coupler has found a match) as long as the PTT signal from the radio is asserted (low), whether or not RF power is applied to the coupler.

NO In this position, the SG-235 will keep the 500-watt amplifier in the transmit mode (after the SG-235 has found a match) as long as RF power (more than 5 watts) is applied to the coupler.

10.0 Smartlock PRO Operation

The Smartlock PRO allows the operator to have additional control over the SG-235.

10.1 Tune, Tune Lock, and Reset

Tuned (green LED)- Turns on when the coupler has successfully tuned.

Normal / Tune Lock - Toggle switch allows user to prevent coupler retuning 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.

10.2 Smartlock Pro Notes

The Tune Lock function is in most cases unneeded. Inadvertent retuning is a rare occurrence. Retuning may occur when the environment or antenna system has changed. In this case, retuning is within normal operation of the coupler. However, the function is still provided with the SG-235 to be used if desired.

The SG-235 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 retune 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, activating the Tune From Memory by-pass. Every new transmitted frequency will cause the coupler to retune

and store the new setting in memory, over writing any previous settings. To return to normal Tune From Memory, simply push the reset button while in Normal Position.

Quick Start Guide

Remote Manual Tuning

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

1. An HF radio with 3 to 500 watts output.
2. An HF antenna with a single wire feed (not coax fed).
Minimum length of 50 feet (from 3.0 MHz) or 300 feet (from 1.8 MHz).
3. A good ground (counterpoise) for the antenna and coupler
4. +12 VDC and ground for the coupler.
5. An IBM compatible desktop or laptop computer with MS Windows 3.1 or better and a 386 or better microprocessor.

Connections: Connect the Smarttuner to the PC cable as shown in the following diagram:

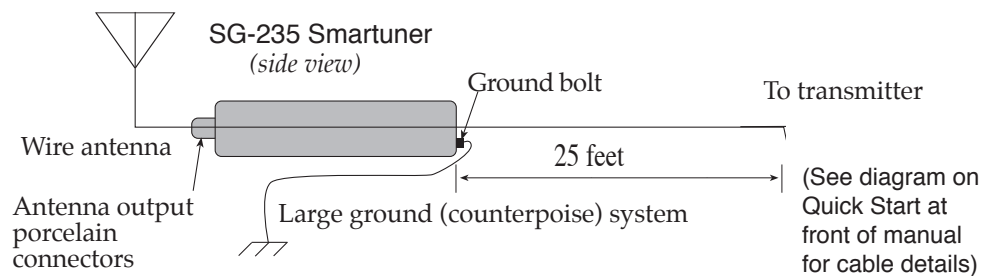


Diagram of Smarttuner Installation

Operation:

1. Install the software on your computer by running the setup file.
2. Connect cables to the coupler, PC, and radio.
3. Turn on power to the coupler and radio.
4. Coupler should come up in the bypass (untuned) state.
5. Double click the "SGC SmartTuner" icon.
6. In the Manual Tuner program, select proper COM port under the Ports menu.
7. In the Manual Tuner program, select Establish Link under the Run menu.
8. Radio may be placed in transmit if it is emitting less than 30 watts.

11.0 Troubleshooting the SG-235

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-235 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.

11.1 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 which 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.

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 outside the service entrance. So much for a good ground.

11.2 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-235 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 which 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 wits 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.

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 which 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 checkout 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 Insulator. 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 ballmount 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.

11.3 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 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 which has both adequate current handling capacity and good dynamic regulation. Better yet, use a regulated power supply of an adequate rating.



11.4 A Final Pointer on Troubleshooting

Remember that the SG-235 is an excellent piece of equipment which will give outstanding performance. If you have a problem with the coupler finding a tuning solution, you should *change one variable at a time*.



SGC Equipment Standard Warranty

SGC wishes you to be satisfied with your new equipment purchase. This SGC product therefore is 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.

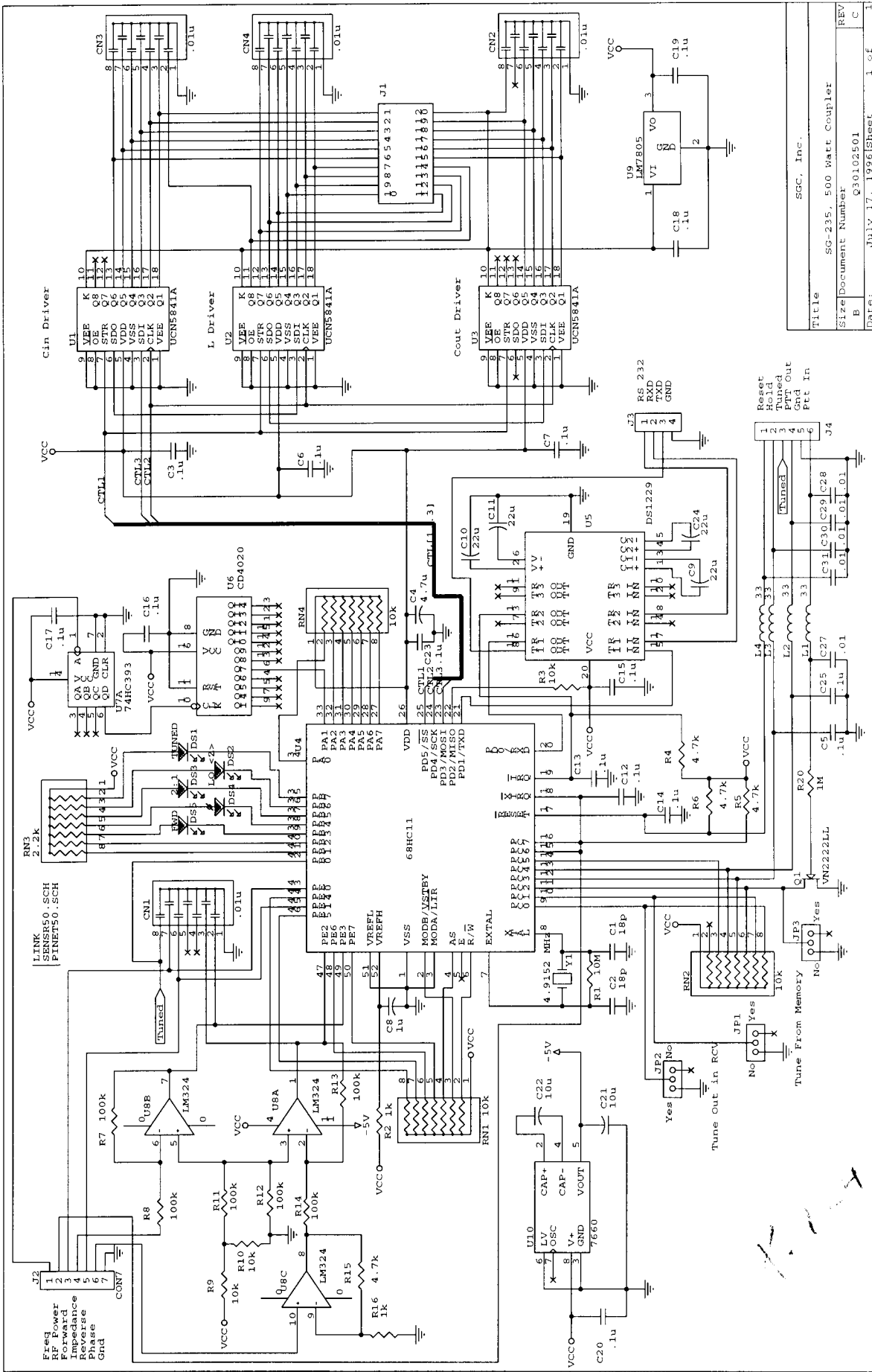
The warranty registration card which is furnished with this product should be returned immediately to provide evidence of purchase and to assure receipt of important notices regarding your SGC equipment and related services.

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; or
 - 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.

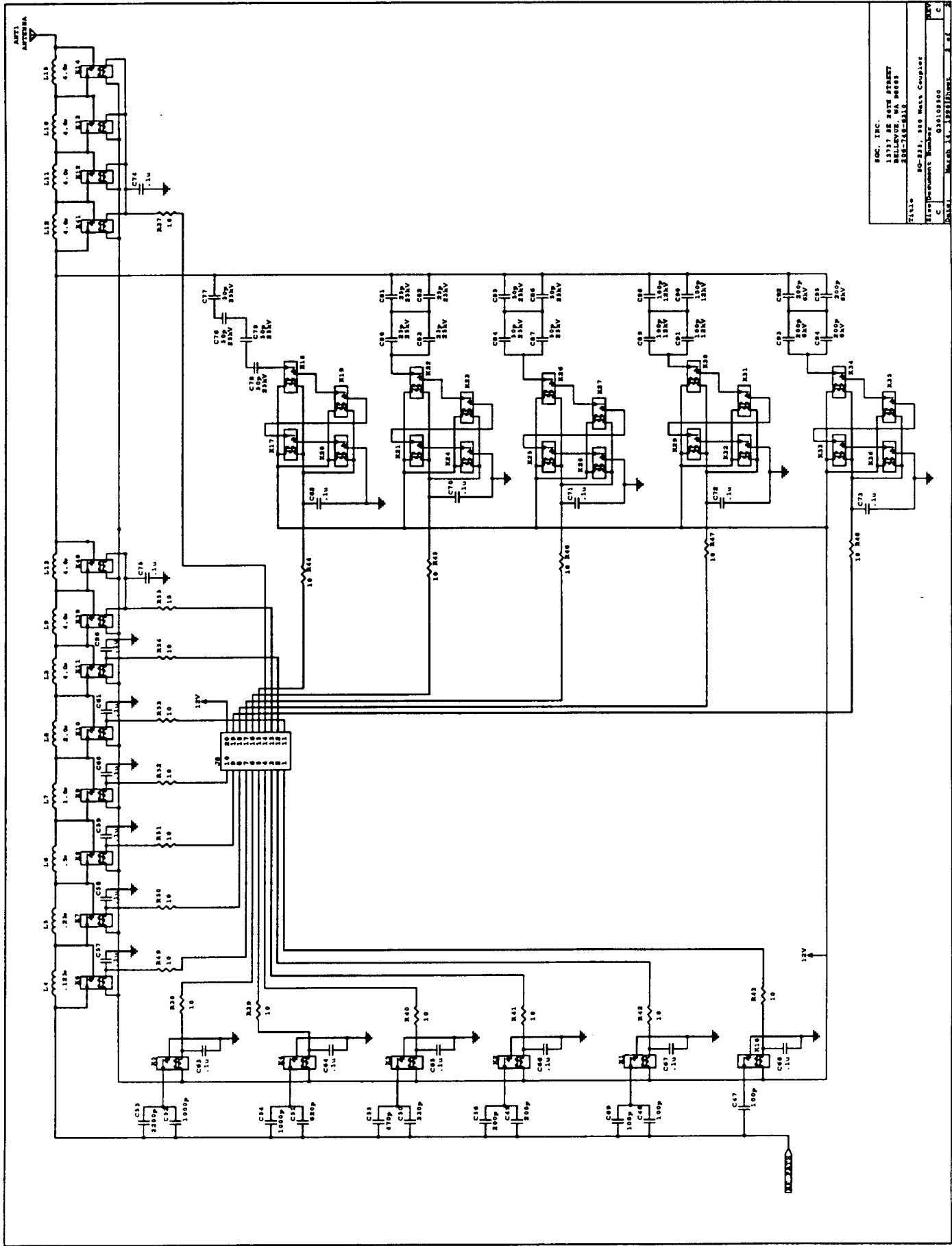


Notes

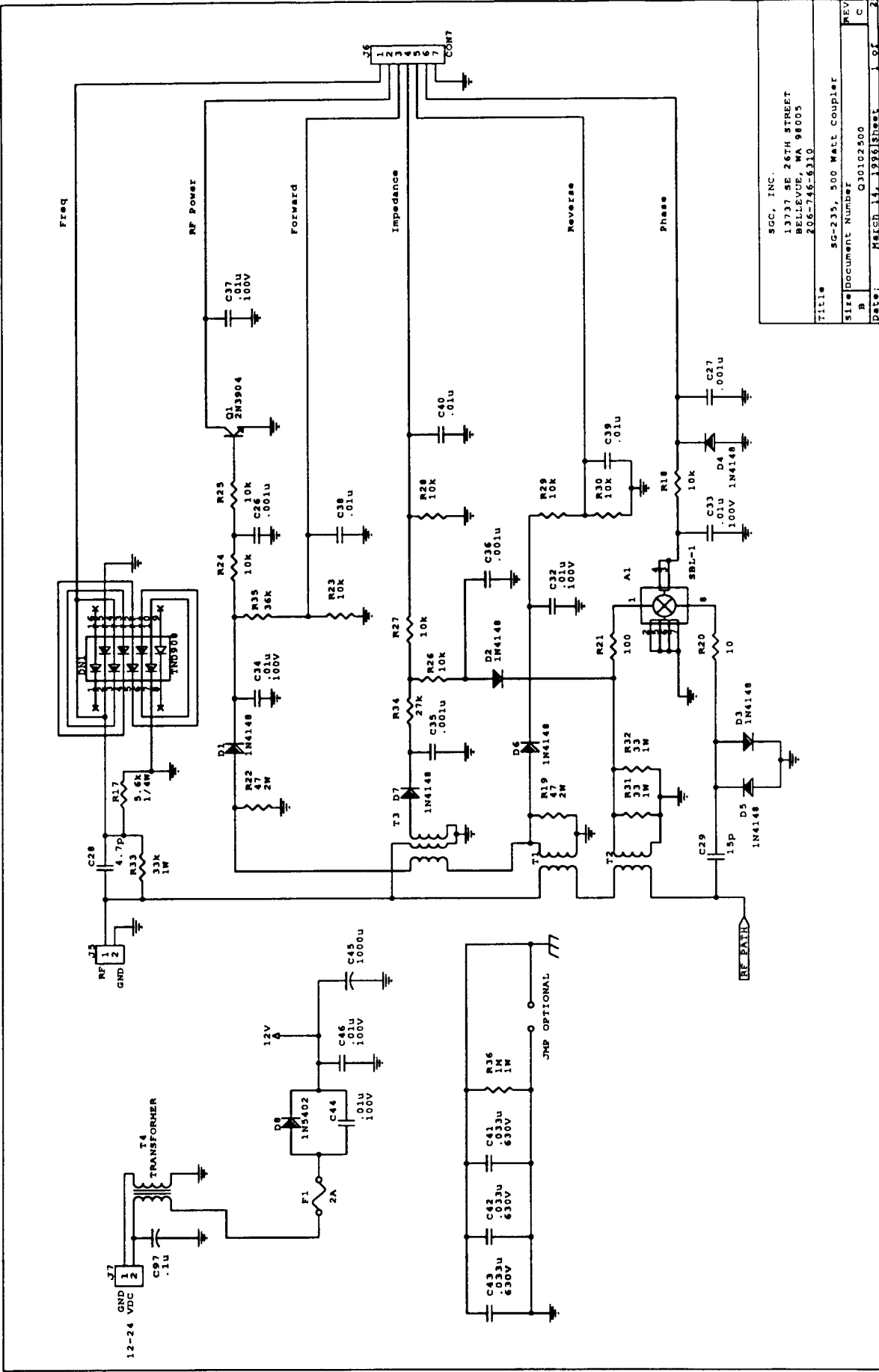


Title	SG-235, 500 Watt Coupler
Size	Document Number
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Date:	July 17, 1995 Sheet 1 of 1

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DOC. INC.
 13737 SE 34TH STREET
 BELLEVUE, WA 98005
 Title: 300-WATT COUPLER
 Part Number: 300-WATT COUPLER
 Revision: 1.0



SGC, INC.
 13737 SE 26TH STREET
 BELLEVUE, WA 98005
 206-746-6310

Title: SG-235, 300 Watt Coupler
 Size: Document Number Q30102500
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 Date: MARCH 14, 1998 Sheet 1 of 2



Appendix— QMS System

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 art 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 be 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 side mount was used.

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

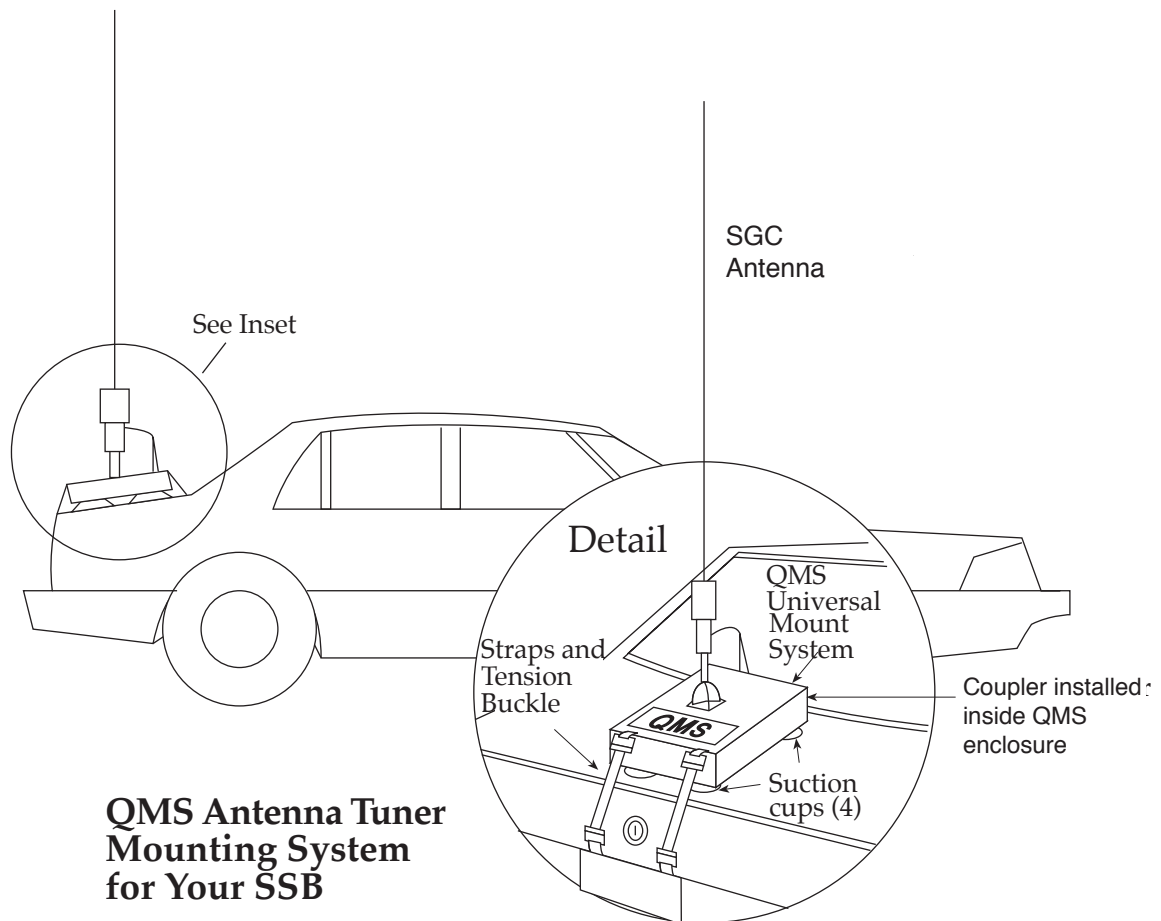


Figure A-1—QMS installation on the rear deck of a sedan

4. When connecting the coupler to the radio/transceiver, a passageway for the control cable (consisting of an RG-58 coax cable, control wire, power, and ground, plus the optional tuned indicator wire) will need to be provided.

Note: By removing the four screws for the ratchet mount base of the SG-303 antenna, the mount can be installed or reinstalled to provide the user with the set-up most suitable for the application. Insure the screws are tightly secured after reinstallation.

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

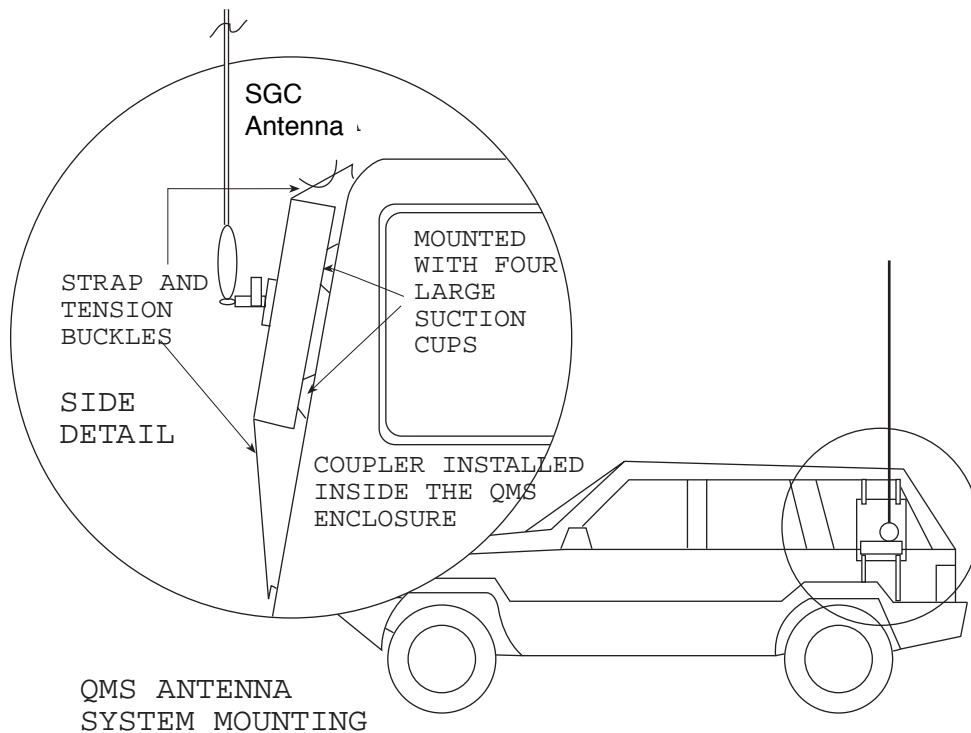


Figure A-2—Side view of QMS installation on the side of a small van

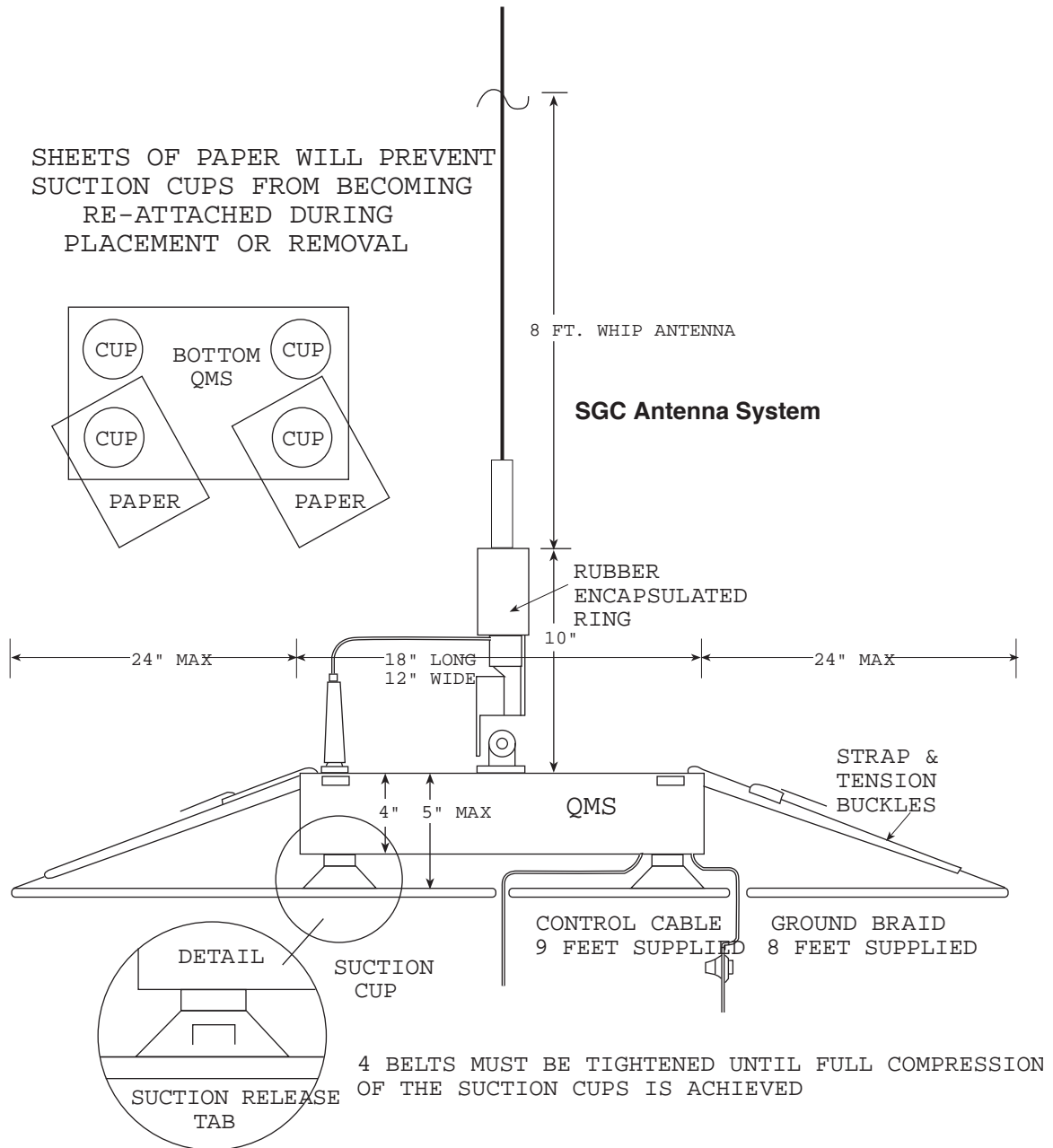


Figure A-3—Mounting atop large truck cab

Installation Precautions

To ensure safe operation of your QMS system, the following installation, 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.



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 the 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 1,000 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 antenna when not in use), mount the unit in a location where the tip of the SG-303 antenna is easily accessible for threading through the "O" ring. Failure to 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 thoroughly checked, you are ready to install the tip of the SG-303 antenna. Be sure to secure all items with the appropriate tool and to read all product manuals prior to installation or operation.

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 unnecessary 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.



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) to start the engine.)

Additional Installation Suggestions

Suction Cups

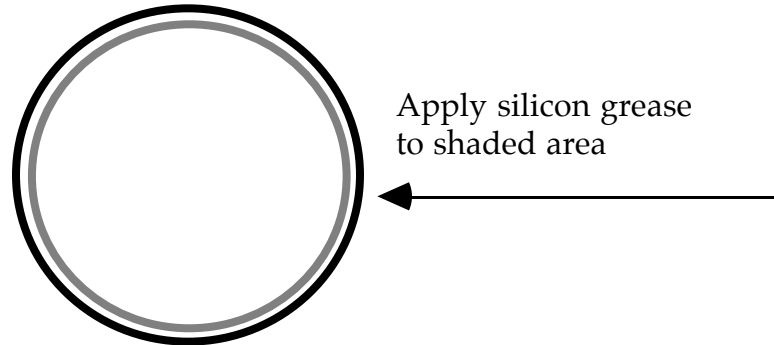
Protecting Painted Surfaces When applying the high suction devices incorporated into the QMS, it is important to observe two important rules:

- 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:

Figure A-4—Suction Cup (underside view)



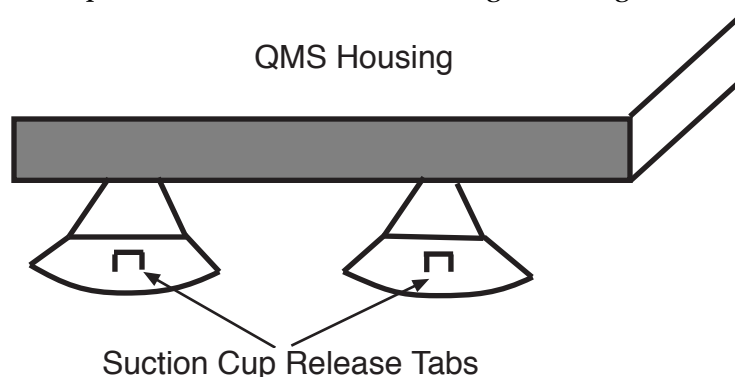
This will prevent slow leakage of air, which will reduce the holding power of the suction cups over time. It will also protect the painted surface.

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:





- 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.

QMS Antenna Coupler System

The Quick Mount System
for any mobile HF rig

No Compromise
Communications



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

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)
1.0 to 60 MHz
Includes VHF bands
SG-307 7 ft. antenna
(QMS-7 not shown)



SGC

No Compromise Communications

1-800-259-7331

The SGC Building, 13737 S.E. 26th Street, P.O. Box 3526, Bellevue, WA 98009 USA
Phone: 425-746-6310 FAX: 425-746-6384
E-mail: SGCMKTG@aol.com Website: <http://www.sgeworld.com>

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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.)



No Compromise
Communications

The SGC Building, 13737 S.E. 26th Street, P.O. Box 3526,
Bellevue, WA 98009 USA
Phone: 425-746-6310 800-259-7331 FAX: 425-746-6384 425-746-7173
E-mail: SGCMKTG@aol.com Website: <http://www.sgeworld.com>

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. # 54-12

SG-235 cat. # 54-15

SG-230PRO cat. # 54-16

SG-231* cat. # 54-17

HF Frequency range:

SG-230 1.8 to 30 MHz

SG-235 1.6 to 30 MHz

SG-230PRO 1.6 to 30 MHz

SG-231* 1.0 to 60 MHz

Input Impedance range:

25 to 100 Ω

VSWR: Typical—less than 2:1

DC input Voltage: 13.8 VDC

(SG-230 and SG-230PRO 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: SG-230 = 500

SG-230PRO, SG-235 & SG-231 = 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

* use with QMS-7

SG-500

SMARTPOWERCUBE™

**Microprocessor
Controlled Linear
Amplifier**



(cat. #52-96)

Dramatically boost your power, at low cost.



fault which has occurred. Backing up this user-friendly visual system, the SG-500's microprocessor protects the SmartPowerCube™ from faults with preprogrammed shutdown procedures; in the event of a microprocessor fault, the unit shuts down automatically.

The SG-500 is designed to do exceptional service in fixed, mobile, and marine applications. It's an exceptionally rugged power source with a cast aluminum enclosure and extra heavy duty heat sinks, powder coat finish, and only the most durable electronic components and assembly techniques. In real world applications, it's nearly indestructible.

It's also very compact, taking up less than 1 cubic foot of space. Considering how much power it produces, the SmartPowerCube™ is remarkably light, around 21lb. (9.5kg.). So, it may be heavyweight in performance, but it's slim and trim for installation.

Most significantly, the SG-500 is specifically designed to operate in an unattended manner. In other words, it's ideal for installations where access to the amplifier is limited.

When evaluating the 12 volt SG-500 SmartPowerCube™, the key word is "smart."

because the SG-500 is not just another mindless mass of wire and diodes simply pumping power down the line. It's an *intelligent* -microprocessor controlled- high powered linear amplifier. It constantly monitors your HF-SSB's activities, power needs and antenna condition, and automatically—in less than 15 milliseconds—selects the right broadband filter.

A bank of status LED's on the front panel of the SmartPowerCube™ functions as built-in test equipment (BITE) and allows the operator to quickly determine any

**The SG-500
SmartPowerCube™.**
It's high power,
that's intelligent,
at low cost.



The SmartPowerCube™ produces tremendous power—nearly as much as a 1 kW amplifier. Ample heat sinks help it reliably do the job.



"No Compromise communications"

SGC, Inc., P.O. Box 3526, Bellevue, WA 98009 USA
Tel: 425-746-6310 or 1-800-259-7331 Fax: 425-746-6384
E-mail: SGCMKTG@aol.com Web site: <http://www.sgcworld.com>
SGC reserves the right to modify specifications without notice.

SG-500 SmartPowerCube™



Heavy duty cooling fan option for continuous CW use. (cat. #51-82)



SG-500 features microprocessor controlled LED bank fault indicators and extra heavy-duty input/output connections.



Only premium components and assembly techniques are utilized. The SG-500 is engineered and built to reliably function, essentially unattended, in the most demanding conditions.



"No Compromise Communications"

Full 500 watt output.

- The SG-500 produces enough power to be within 1 "S" unit (3dB) of a 1 kW amplifier.

Microprocessor Controlled:

- Automatically adjusts amplifier input sensitivity.
- Monitors all parameters for faults (Heat, high VSWR, under voltage, etc.).
- Automatically selects the correct filter band.
- Export versions control transmit/receive switching.

Fully compatible with most HF equipment produced by SGC or other HF manufacturers.

Important Installation Tips:

- The SmartPowerCube™ should be located as close as possible to the antenna or coupler.
- When installing the SmartPowerCube™, be absolutely certain that your antenna will handle the power output.
- Since some antennas are overrated, plan on using an antenna system which is designed for at least 1 kW of power. Antennas rated at 500 watts or less are likely to fail.
- Avoid corona discharge by using "corona dope" to coat pointed metal parts on your antenna.
- Antenna wire should be at least AWG #8.
- Feedline should be at least RG-8, with larger cable for runs over 25 feet.

Specifications:

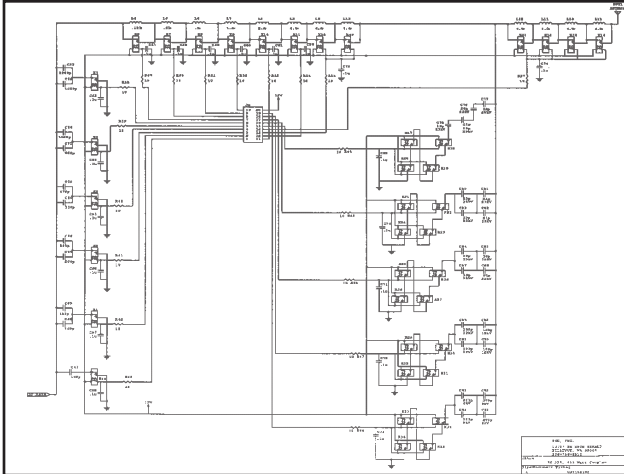
Power Output:	
SSB:	500 watts PEP
CW:	500 watts 10 Min. (no fan) 500 watts Unlimited with fan
AM:	250 watts Carrier max.
Frequency Range:	1.6-24 MHz (U.S.) (For marine and ham use pending FCC approval) 1.6-30 MHz (Export)
Power Input:	50-90 watts (Automatic or preset) 90- 150 watts
Band Switching:	Fully Automatic
Input Voltage:	14.0 VDC
Input Range:	10.0-18.0 VDC
Input Current:	40 amps average (SSB) 90 amps peak, or for CW
Cooling:	Convection standard
Optional Cooling:	Cooling fans
T/R Switching Time:	10 mS nominal
Band Switch Time:	15 mS nominal
Keying:	Via PTT line (U.S. version) PTT or RF Sense (Export)
Protection:	Input overdrive Under voltage (adjustable): Factory default 10.0 VDC Amplifier module current imbalance VSWR faults
Frequency out of Built-In Test Equipment:	specified range Over cur- rent Over temperature
fault indicator Modes Supported:	SSB, CW, RRTY, SITOR, ALE, SSTV, AM at 250 watts
Dimensions:	6Hx12.25Dx11.4W inches
With Optional Cooling Fans:	Changes H to 9.75 inches
Color:	Matte black
Case:	Special aluminum casting
Weight:	21 lb. (9.5Kg)
SG-500:	catalog #52-96
Fan Option:	catalog #51-82

SGC reserves the right to modify specifications without notice.

1-800-259-7331

SGC, Inc., P.O. Box 3526, Bellevue, WA
98009 USA Tel: 425-746-6310
Fax: 425-746-6384
E-mail: SGCMKTG@aol.com
Web site: <http://www.sgeworld.com>

Intelligent Tuning



The SG-235 is designed for maximum flexibility. RF "pi" network has over a **half million** microprocessor combinations

Intelligent Installation Enhancements



QMS Automatic Antenna Coupler System.

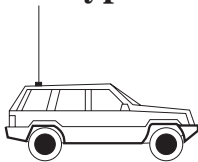
Special external mounting system for SG-235. Gives an incredible boost in receiving and transmitting range—between 3 and 20 dB gain! (Cat. No. 55-47)

SmartLock Option.

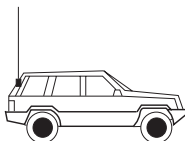
Provides two external controls for the SG-235: **Locking** function prevents re-tuning despite changing antenna loads (e.g., from passing trucks or from driving beneath an overpass); **Reset** function forces the SG-235 into the retune cycle until the signal is transmitted again or allows receiver/scan operation in a broadband antenna mode. (Catalog No. 54-63)



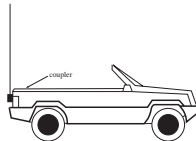
Typical SG-303 Mobile Antenna Installations



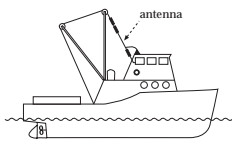
Correct Top Mount Antenna Location



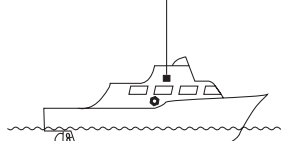
Correct Side Mount Antenna Location



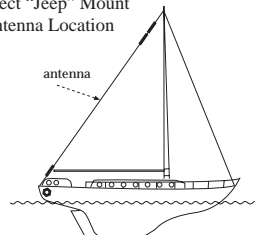
Correct "Jeep" Mount Antenna Location



Correct Workboat (Metal Bridge) Location



Correct Powerboat (Flybridge Cruiser) Location



Correct Sailboat (Sloop Rig) Location



No Compromise Communications

1-800-259-7331

The SGC Building 13737 S.E. 26th Street, Bellevue, WA 98005 USA
Box 3526, Bellevue, WA 98009 USA 425-746-6310 or 1-800-259-7331
FAX: 425-746-6384 E-mail: sgc@sgcworld.com Website: www.sgcworld.com

SG-235

Specifications

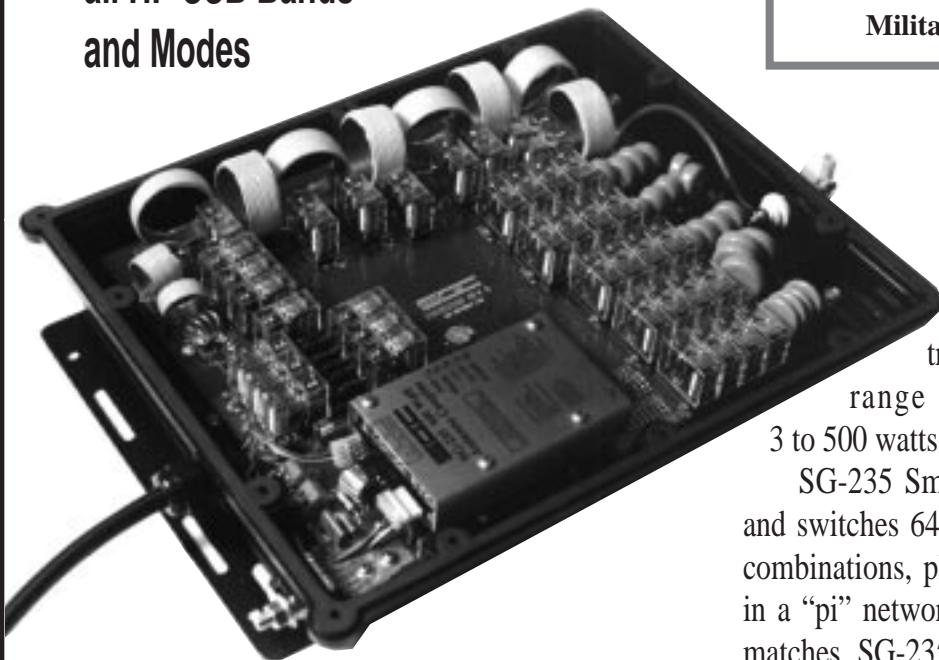
HF Frequency Ranges	1.8 to 30MHz
Power Input Range:	5 to 500 watts (PEP)
Input Impedance Range:	45 to 55 ohms
VSWR:	Typical—less than 2:1
DC Input Requirement:	+13.6VDC
DC Operating Range:	+10.5 to 15 VDC
Input Current:	Average—9 amps
Random Set Times:	Typical—less than 2 seconds
Recurrent Set Times:	Typical— less than 10 milliseconds
Non-volatile Memory Addresses:	170
Antenna Length:	Min. length 50 ft., 3.0 MHz Min. length 300 ft., 1.8 MHz
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 40.6DS x 30.5W x 7.6H centimeters
Weight:	8 pounds (3.5 kilos)
Case Construction:	Plastic ABS weatherproof case
Cable:	SGC special cable, 25 feet coaxial and two power wire input wires, RMT tune and smartlock



SG-235

500 watt Smartuner™

Automatic Antenna Coupler for
all HF-SSB Bands
and Modes



Smart Tuning—Now at 500 watts.

Now you can achieve perfect coupling of your 500-watt HF-SSB to your antenna.

Now you can **go mobile** at 500 watts.

The SG-235 Smartuner™ forms the perfect link with any 500-watt amplifier for high power performance.

The SG-235 Smartuner™ “intelligently” tunes any length antenna from 23 feet! No preliminary tuning or adjustment is required, and the SG-235

- Microprocessor Controlled, Precision, Automatic Antenna Tuning
- Non-Volatile Memory
- Waterproof for All Weather Conditions
- B.I.T.E. (Built-in Test Equipment) indicator
- 1.8 to 30 MHz Range
- 3 to 500 watts Input Power
- 10- ms Retuning Time
- Tunes from 23 ft. Antennas at Full Power
- For Marine, Aviation, Ham, and Para-Military Applications



will operate with any HF transceiver in the 1.8 to 30 MHz range and with output power from 3 to 500 watts.

SG-235 Smartuner™ automatically evaluates and switches 64 input and 32 output capacitance combinations, plus 256 inductance combinations in a “pi” network—over a half-million precision matches. SG-235 Smartuner™ then remembers the chosen frequency and tuning values and automatically reselects those values—in less than 10 ms, each time you select that frequency.

Flexibility is a key feature. It is available with a number of attractive options, including a shock mount for military and extreme applications, plus a 24 VDC option.

For maximum range, clarity, and flexibility, with just about any HF-SSB, the SG-235 Smartuner™ is your smartest choice.

Cat. No. 54-15



The SGC Building 13737 S.E. 26th Street, Bellevue, WA 98005 USA
Box 3526, Bellevue, WA 98009 USA 425-746-6310 or 1-800-259-7331
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