Home Installation Manual

Thank you for selecting *Scorpion* as your antenna!

Ron Douglass, NI7J
http://www.scorpionantennas.com
scorpionantennas@cox.net
623-326-8780

All Scorpion antennas, SA- 680, SA-680S "shorty" and the SA6-160 are supplied with a 6 foot whip, allowing efficient operation 10 through 80 or 160 meters. In addition, all antennas are shipped with 20 feet of antenna control cable, control box with two #31 type material split beads for the antenna coax control cable decoupling, a cigarette lighter adaptor with fuse holder, and shunt coil for antenna impedance matching. The Home install units are supplied with 50 feet of two conductor cable. Four conductor cable may be substituted for a marginal fee.

Our antenna body is .065 inch wall 304 Stainless Steel, the strongest in the industry!

We use Acetal better known as DuPont Delrin® for the base of the antenna, the Pittman motor support, the ball bearing support and the upper coil cap that supports the whip. This material is extremely expensive, it is dense and heavy.

Our finger stock and coil support housing is polished 6061-T6 Aluminum. It houses the tin plated finger stock and a one inch wide phenolic coil support. The housing also works as a heat sink during high power operation. The finger stock is very expensive special order tin plated Beryllium Copper that maintains 37 pounds of combined pressure on the coil at all times.

Our antenna coil drive motor is the commercial grade Pittman quality motor that uses all steel gears in its gear box, not plastic. We install capacitors on our motors so tuning the antenna by ear is static free.

Our coil is driven with a piece of polished 316 grade 3/8-16 thread pitch stainless threaded rod. The threaded rod is lubricated with very expensive Teflon grease that will withstand -40 to a plus 475 degrees Fahrenheit.

Our coil form is 1/4 inch wall Industrial grade phenolic that has a special resin base formula that is manufactured to our specs. Our coil alone weighs 4.5 Lbs wound with wire.... so we use two double sealed ball bearings for the coil support.

Our coil cover wall is the thickest in the industry, it is made of .125 inch Lexan. This is the same type material that is used for bullet proof windows on armored trucks, only a lot thicker.

We are the only manufacture that includes counterpoise or radial wire connecting bolts built into the base of our antennas. This makes backyard, field day or camping install of counterpoise or radial wires a snap.

Our antennas have a reed switch installed for use with digital display antenna controllers. We use two magnets mounted on the motor coupling that generate two pulses per revolution.....this equates to better antenna positioning from a Digital Antenna Controller.

The SA-680 coil has a Q of 410 and is wound with #10 gauge tinned wire, at 6 turns per inch.
The SA-680S and SA6-160 coils have a coil Q of 380 and are wound with #14 gauge tinned wire, at 10 turns per inch.

Unpacking and Installing the ***Scorpion*** Antenna

Please read these instruction sheets completely before opening the shipping tube!

Your ***Scorpion*** antenna was carefully packaged to prevent damage during shipping. Failure to follow the directions could damage your antenna. Damage thus caused is not covered under warranty.

1). Remove the packing tape from both ends of the shipping tube.

2). There are 15 Phillips head wood screws safely holding the antenna in the shipping tube. Eight at the bottom of the tube, 3 in the middle of the tube and 4 at the top of the tube. All were located under the packing tape that you just removed. Please remove all of these screws.

3). Using two of the removed screws, partly thread them into the end caps. These screws can then be used to pull out the end caps.

4). Remove the end caps carefully!

5). AT THIS POINT DO NOT TRY TO REMOVE THE WHIP, IT WILL NOT SLIDE OUT!

6). Remove all the contents at the top end of the tube. This includes the Antenna Controller, Shunt Coil, and antenna control cable.

7). At this point, you should see the ¾ inch threaded rod, washer and nut at the bottom end of the tube. The whip is at the top end of the tube.

8). Place the shipping tube in the upright position. Note the arrows and the word Top printed on the tube.

9). The antenna will be stuck in the shipping tube from the indents of the wood screws on two more wood supports that hold the antenna inside the shipping tube. Slightly bump the tube on the floor. This should release the antenna from the tube.

10). Lay the tube on the floor, and pull the antenna out of the tube 3/4 inch threaded rod end first!

11). The 6 foot whip can now be removed from the body of the antenna.

12). Hold the wood support with one hand and remove the ¾ inch nut from the threaded rod.

13). Located on the top of the antenna, is a 3/8 x 24 shipping bolt and washer holding the wood support. Under the wood support is a 1 inch long stainless steel coupling nut.
Use a backup wrench on this stainless steel coupling nut, carefully remove the shipping bolt and washer.

Warning: Do not try to remove the 3/8 X 24 all-thread stud at the top of the antenna! Doing so will damage the antenna, and will not be covered under warranty. This stud keeps the Lexan® cover held in place by the large stainless steel coupling nut, and is permanently attached to the Delrin® coil end cap with a locking set screw. The wire from the coil is also attached to this stud on the other side of the Delrin® end cap.

Note: The stainless steel coupling nut should not turn. If the coupling nut becomes loose, hold the clear Lexan coil cover and retighten it. When removing any whip or capacitance hat from the antenna, always use a backup wrench on this coupling nut to prevent loosening.

Advisory: There is a bead of clear silicon sealer that has been applied under the Lexan® coil cover to keep out water. If the Lexan® coil cover needs to be removed and/or replaced, please call our Customer Service department for detailed instructions.

Scorpion Antenna Home Installation

Connect the supplied bonding straps to the base of the antenna using one of the eight ¼ -20 button head bolts. This requires a 5/32 inch Allen wrench. Install the Counterpoise Adaptor Ring then connect the other end of the bonding straps to the two 1/4-20 bolts located on the counterpoise adaptor ring.

Screw on the white Delrin insulating bushing and tighten. Install the whip.
For the SA-680 our 80 meter antenna uses an 8 turn shunt coil when operating from 10-80 meters .

For the SA6-160 our 160 meter antenna uses a 8 turn shunt coil when operating from 10-80 meters.
Switch to the 16 turn shunt coil when operating on the 160 meter band.

The antenna mast or tripod must have a 3/8 inch hole drilled in it approximately 1 inch from the top edge of the mast. Slide the mast clamp on to the mast. Install the antenna into the end of the mast, then slide mast clamp into place. Gently tighten down on the 3/8-16 threaded rod onto the Delrin insulating bushing, just a small amount of pressure is needed to keep the antenna from rotating.

Warning: Do not over tighten the bolt or you may break through the Delrin® bushing. Install the antenna on the mast and test it to make sure it will travel up and down with no issues. This will test for any shipping damage which might have gone undetected. Using the antennas control box, move the coil all the way up so the entire coil is exposed “80 meter position”. Now move the coil down inside the antennas stainless housing to the “10 meter position”.

Install the supplied pipe clamps onto the Nema 4 enclosure, this is the common mode choke for the coax.
Next, install the supplied clamps onto the enclosure, then onto the mast or tripod that is to be used.
This common mode choke decouples the coax from the antenna and helps to stop the common mode from traveling back into the shack.
Warning: If power of over 200 watts is going to be used, another common mode choke for the control cable will be needed. We sell a common mode choke in the same style NEMA 4 PVC enclosure for the control cable that will decouple it from the antenna and will help stop the common mode from traveling back to the shack. We offer this choke for your control cable for only $49.00. Please see our accessories page.

Remember: If the common mode choke is too small for the amount of RF power being generated, the ferrite material will saturate, become very hot and could break into two pieces! "We have seen 2.4 inch ferrites split under high reactive loads!" Once this happens common mode currents will flow on the control cable or coax outer shield. This can cause RFI problems, RF burns and could damage your antenna controller, regardless of make or model.

An old style CB SWR meter or the MFJ-812B that has the built in Field Strength function can be used to test your control cable and coax for common mode currents returning back into the shack. Transmit a carrier at 100 watts, or at the power you will be operating.

Do not use AM, 25 watts is not enough! With the radio transmitting, and the field strength meter's short whip next to the control cable, turn the SWR adjusting knob fully clockwise for maximum sensitivity. You should see almost no deflection on the meter. If you do, you still have a common mode issue which must be resolved. Vertical antennas need to be decoupled at the antenna and either before or just after entering inside the shack to stop common mode current.

Remember: After decoupling the coax and control cable from the antenna, both are still in the near field of the antenna. The stronger the RF field "higher power used" the greater the near field and the greater the coupling to both the coax and antenna control wires. This RF current that is present on the outside of the coax shield and control wire should be stopped at the shack using 31 type material beads, toroid or by using an home made ugly balun.
The *Scorpion* Antenna control box can be connected to any DC power source ranging from 12 to 24 volts. Some power supply manufactures have a 12 volt accessory outlet build into the front of the power supply that the antenna power can be plugged into. If yours isn't so equipped, replace the accessory plug with the proper type to match your supply. Install a 1 amp fuse in the antenna control power line.

With the yellow wire positive and the green wire negative the antenna coil will travel down going towards 10 meter band. With the green wire positive and the yellow wire negative the antenna coil will travel up towards 80 meter band.
With the control box in your hand and the cable towards your body, pushing the top of the rocker switch the antenna coil should go up; this is going towards the 80 meter band! If the antenna goes the opposite direction the connection of the yellow and green wire should be reversed.

Warning: Do not apply DC voltage across the brown and white wires you will damage the reed switch.

These wires go to a Normally Open reed switch that closes two times per revolution of the Pittman motor. This reed switch is compatible with all currently manufactured controllers which require a switch closure to return a voltage pulse to the controller that will update a digital display.
If the Brown and White wires are not used, DO NOT CONNECT THEM TO THE BODY OF THE ANTENNA!
RF coupling to these wires by close proximity of the RF HOT Stainless tube is not an issue.
Connection of these wires to the RF HOT Stainless tube or antenna body will transmit either 100 watts or 500 watts if an amp is used, into the reed switch with severe RF CURRENT coupling to the Motor.

IF YOU CONNECT THESE WIRES TO THE BODY OF THE ANTENNA , YOU WILL VOID YOUR WARRANTY!

Installing the Counterpoise Antennas

Tuning can be accomplished using a standard SWR meter. However, it is an exhausting exercise requiring several hours of live transmitting, at low power. The easiest method is to use an antenna analyzer like the MFJ 259B/269 or similar. To speed tuning, have DC battery power available at the antenna. *Check out the harbor freight #38391 Jump Starter, works good for this tuning application*!
Do not use a 120 volt AC extension cord and power supply; it will act as part of the antenna and disrupt the tuning process.

There are eight supplied counterpoise antennas. Their loading coils vary in length, from just a couple of inches as is the case of the 17 meter ones, to the full length as is the case of the 80 meter ones. The protruding part of the whip should be set at the lengths shown in the chart, but there is a caveat. **The tail end of the whip must not protrude into any part of the loading coil or it will become a heating element.** Therefore, their overall length will need to be trimmed. Here's how to do it correctly.

10 meters @ 28.500 MHz. Adjust to 42 inches
12 meters @ 24.950 MHz. Cut whips to 24 inches. Adjust to 19 inches. Single 12 meter antenna used adjust to 42.5 inches.
15 meters @ 21.200 MHz. Adjust to 42 inches. NOTE: 15 meter antennas not required if 40 meter antennas are installed, 15 works on harmonic of 40 meters.
17 meters @ 18.125 MHz. Cut whips to 42 inches. Adjust to 36.5 inches.
20 meters @ 14.200 MHz. Cut whips to 42 inches. Adjust to 30.5 inches.
40 meters @7.2 MHz. Cut whips to 39 inches. Adjust to 36 inches.
80 meters @ 3.6 through 4.0 MHz see text.

Mark each whip with a permanent marker using the length shown in the chart. Cutting the whips to shown measurements assures you will not have any part of the whip inside the counterpoise coils if properly adjusted to the above measurements.

For the 80 meter antennas the full 48 inch whip leaving just enough of the whip to be held with the two set screws will put you at about 3.6 MHz. 38 inch whips will put you at about 3.8 MHz. 35 inch whips will put you at about 3.9 MHz. These measurements will get you really close. An SWR of 1.1:1 can be obtained by making whip length adjustments to your favorite frequency on any band.

Cutting the whips is best done with small bolt cutters or a cutoff wheel. Do not use Diagonal cutter pliers "Dykes" or electrician side cutters for cutting the whips; you will ruin the cutting edge of the pliers!

When installing the whips, lightly tighten down just one of the set screws. Both set screws will be tightened later, once the SWR is set for each band.

Use a small amount of NoOx® or similar anti-corrosive compound on the threads of the counterpoise antennas. Take your time when screwing in the counterpoise antennas, as the threads are easily damaged, and please don't over tighten them, just snug is fine! *We use quick disconnects on our counterpoise antennas for fast setup and breakdown at swap meets and Amateur functions. We stock quick disconnects for our customers.*

Note: After you have cut and installed the whips as per the listed measurements'. Install the 17 meter adjustable antennas on the Counterpoise Adaptor Ring first. They should be 180 degrees from each other.

Next, install the 20 meter adjustable antennas at 90 degrees from the 17 meter adjustable antennas. You can now add the 40 meter adjustable antennas then the 80 meter adjustable antennas to the counterpoise adaptor ring but make sure they are 180 degrees from each other. Note: The 40 and 80 meter adjustable antennas should always be 90 degrees apart from each other. Example: 40 meter east/west and 80 meter north/south!

We recommend to our customers either use the MFJ-259/269 antenna analyzer or use a radio powered by a battery and not a power supply that requires an extension cord at the antenna site. The extension cord will act like part of the antenna and cause tuning issues. This will save you many trips to the shack readjusting the main antenna each time you make an adjustment to the adjustable counterpoise whips.

Note: One tuning issue that we ran into was the DC motor power line and the main antenna control box cable were acting as an antenna when tuning a 15 meter counterpoise antenna. This was only after we had lengthened the power lead and control cable to reach the portable battery.
We were using an MFJ-269 that's transmitting microwatts. Each time we moved the main antenna coil the 269 analog SWR meter would deflect. 31 material clamp on type RF Chokes from Amidon were installed on both cables. This stopped the 269 analog SWR meter deflection and the SWR of over 2.0:1 dropped to less than 1.5:1. This same type of problem has been seen on mobile installs also! We have also used a long screwdriver pushed into the ground with a bonding strap connected to the MFJ units ground lug...works good!

With the eight adjustable antennas of your choice installed, check the SWR on all bands that you have installed. If all bands tested are under 1.5:1 SWR you can stop and use the antennas as is or go to the following tuning procedure and make further adjustments to try and lower your SWR even further. Remember: Tuning the adjustable antennas you always start at 10 meters and end at 80 meters.
If you do not have 10 meter adjustable antennas installed go to the next band 12 meter antennas than the 15 meter antennas than to the 17 meter antennas until you have finished at the 80 meter band.

Make sure the whip on each similar band of the adjustable antennas has the same measurements.
80 meters being the only exception, only if you want to try the whip offset adjustments listed below.

If you have set the antennas to the measurements listed and cannot get them under a 1.5:1 SWR then you will have to remove all of the adjustable antennas and start with a single 10 meter antenna. If you do not have a 10 meter adjustable antenna, install the next band that you do have.

Always start off tuning with 10 meters and work your way to 80 meters!
Run the main antenna all the way down so no coil can be seen.
"Let's use 17 meters" it's a popular band!
Install one 17 meter counterpoise antenna on the counterpoise ring.
If you have an MFJ-259/269 set it for the middle of the 17 meter band.
While monitoring the SWR meter or the MFJ- 259/269 run the main antenna coil up until you see the meter deflect. Adjust the main antenna up and down until you have the lowest SWR reading, if above 2.0:1 the counterpoise antenna whip will need to be adjusted.

Now adjust the counterpoise antenna whip inward about an inch. Adjust the main antenna up and down to find the lowest SWR, if the SWR went up, you will have to pull the whip out and retest. You are trying to reach an SWR of about 1.5:1 or less with only one antenna "the lower the better" this will make tuning easier when the second counterpoise antenna is installed. Once you have a low SWR with one antenna measure the whip and use this data to set the whip length for the second 17 meter antenna.

Remember: Every time you adjust one of the whips you have to retune the main antenna to see where the new resonant point is.

Once you install the second 17 meter antenna and test it you will see the SWR will increase slightly. With both 17 meter antennas installed you will have to shorten both of the antennas to the same length then retest. Properly tuned antennas will be close to 1.1:1 SWR. If you cannot get to at least 1.5:1 SWR, something is not right. Make sure the counterpoise antennas are set to the same length.

Moving and tuning the next band.
Now that you have the two 17 meter antennas installed and with a low SWR, let's do the same for the next band…20 meters!
Start with one 20 meter antenna; watch the SWR meter while operating the main antenna up and down to find the lowest SWR. Adjust the whip either in or out for lowest SWR reading. Do not forget to adjust the main antenna up and down for the lowest SWR every time you adjust the counterpoise whip. Now add the second 20 meter antenna, both antennas will be too long, shorten the same amount and make sure they are the same length. Monitor MFJ- 269 or the radio SWR meter until you have both antennas at 1.2:1 or less. Follow the instructions above for tuning all bands.

DO NOT GO BACK AND RETUNE THE PREVIOUS BANDS UNTIL ALL BANDS HAVE BEEN INSTALLED AND TUNED FIRST!
Here is why! As you add antennas to the counterpoise ring the Capacitance and Inductance changes. Yes they interact. One band will affect the tuning of another band!
Always start at the"*10 meter band*" and work your way to the "*80 meter band*"!

After you have set all of the bands then and ONLY then do you want to go back and check the SWR and make changes. ALWAYS start at the 10 meter band, make adjustments and then go to the next band…continue to "80 or 160 meter band"!
If you pull off the 20 meter antennas and replace them with either 10 or 30 meter antennas you will have to start at the 10 meter band or the next band that you have installed with testing and tuning.
Take the time and tune all of the bands for the lowest SWR!

Here is an option you might want to try! By offsetting the whip lengths by 1 inch or more the antenna will become broader banded on the 75/80 meter band. By this we mean, Example: set one 80 meter adjustable antennas whip to 38 inches and the other 80 meter adjustable antennas whip to 39 inches. One 80 meter counterpoise is good for about 50 KCs of bandwidth. With two 80 meter antennas with the whip lengths offset you can get over 200 KCs of bandwidth!

Remember: If both antennas are not the same length on 80 meters and you are running high power they are not sharing the load. The antenna that is resonant on that part of the band you are operating is going to carry the load. "See more on using High RF Power below!"

Using High Power on the Counterpoise Adjustable Antennas

Depending on the manufacture of these adjustable type antennas all have a power rating. Our antenna manufacture uses a larger #18 gage wire and rates their antennas at only 500 watts SSB!
Hamstick and the ***Valor*** brands use smaller size # 20 gage wire but have different power rating…one is higher the other is lower?

The 80 meter antenna that we have manufactured must use 20 gage wire because of weight. 18 gage wire would have to much horizontal loading for our counterpoise use. We have the manufacture add 6 inches of fiberglass rod to the end of our 80 meter counterpoise antennas so our customers will have a wider range of adjustment on the 80 meter band.

If you try loading and tuning 500 watts of CW power into any of these adjustable antennas with the heat shrink tube on the antenna it will start to melt pretty quickly. We have tested our antennas using 500 watts in CW mode for a very short period of time and then examined to see how much heat is being generated.

Testing has proven that by removing the shrink tubing from the antennas **coil section** they will accept a longer transmit period before extreme heating takes place. The use of larger wire on our antennas also allows a longer transmit time, because the antennas are now able to dissipate more heat!

To increase the wattage rating of these antennas very carefully using a razor knife gently remove the shrink tube from the coil area of the antennas. All of the shrink tubing on our 80 meter antennas will have to be removed because the entire antenna is a coil of wire.

Even though our counterpoise antennas are rated at 500 watts SSB with the shrink tube installed, we recommend using a dummy load for loading and tuning the amp if power over 200 watts is going to be used. CW power will heat the antennas faster than one might think!

Tune the ***Scorpion*** Antenna to the frequency that you will be operating at. Load and tune the amp into a dummy load, then switch over to the antenna. Tuning the ***Scorpion*** Antenna with 1500 watts of CW power applied is not a problem with the amount of pressure generated from the finger stock that we use, but at 1500 watts the counterpoise antennas will get HOT really quick!

We do have customers that operate with solid state amps using 400 to 500 watts and do not use a dummy load. No amp loading and tuning involved…" Their counterpoise antennas are still working with no issues so far". It's better to be safe using a dummy load for tuning your amp, verses smoking your counterpoise antennas!

Remember: If you split tune the 80 meter antennas so they are broad banded, only the antenna that is in resonance will carry the power that is being transmitted.

This can be tested at even 100 watts of CW power.
If the 80 meter antennas are tuned for an offset operation, a quick check can be performed by switching to the CW mode and transmitting on the end of the band that one antenna is adjusted for, lets say 3.8 MHz. Transmit for 20 seconds, then go out and feel the antennas coil. One of them should be getting warm. If you cannot tell any difference than the transmit time will have to be increased. Do the same test at the other end of the band lets say 3.9 MHz. You will now find the other antenna coil getting warm.

This same heating of a single antenna is magnified when using an amp. Take nothing for granted, it gets us into trouble every time. Take a little extra time to test and check to see what is happening with the antennas….SWR ….Heating….we will be glad you did!

If you are having issues with tuning, don't get discouraged, a lot of times its something simply over looked …we know… we still do it!
Please give us a call.
Thank You for purchasing our product!

73
Ron Douglass NI7J
scorpionantennas.com
scorpionantennas@cox.net
623-326-8780