ADDING AN INTERNAL REED SWITCH TO THE HI-Q ANTENNAS 4/80-RT, 5/80-RT and the 5/160-RT HF MOBILE ANTENNA

by: Tom Hammond (NØSS), and Marc Stroom (PA3FVB)

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BACKGROUND

The Hi-Q line of HF mobile antennas are very efficient and extremely sturdy. They are easy to install and use, but they are not sold with a matching turns-counting indicator which would enable the operator to achieve reliable resetting of pre-determined tuning points.

The antennas are provided with an integral magnet, attached directly to the rotating coil-tuning shaft, but no magnetic reed switch sensor is included with the antenna. Thus, the user is left to his own ingenuity with regard to how to add the necessary reed switch sensing required to provide turns-count data to a remote tuning indicator, such as the MFJ-1922, or any one of several other similar devices.

When I originally received my Hi-Q 4/80-RT HF mobile antenna, I needed to use it almost immediately in a CW contest while mobile. I didn't have the time necessary to install a remote turns counter, so I made do by carefully watching the SWR indicated on the rig as I adjusted the length of the antenna via a DPDT toggle switch from the driver's seat. On most of the lower frequency bands I found that the dip in SWR was sharp enough that it required me to pull off the road, come to a full stop, and then carefully watch the SWR meter as the antenna was tuned. This not only took time to accomplish, but it also meant that I had to find a safe place along the road to be able to pull my car off and stop without posing a safety risk to passing vehicles. It didn't take me long to realize that a remote turns counter would be a bit benefit to changing bands while operating mobile.

Following my first mobile operation with the Hi-Q 4/80-RT I ordered and received an MFJ-1922 remote control for remotely-tunable HF mobile antenna. This is not a 'smart' device, but it gave me the ability to obtain a degree to tuning point repeatability with my new antenna which I'd not had before.

Initially, I installed a pair of reed switches on the *outside* of the aluminum base section of the 4/80-RT. These reed switches were taped in place with black plastic tape which more or less matched to black anodizing of the mast, so they didn't stand out to the eye too badly. Though I must admit that I didn't particularly care for this method of mounting, it was effective and quick to install. I liked it well enough that I posted an application note to the Hi-Q web site. The application note also included what I'd hoped would be some helpful hints for others planning to install external reed switch(es) on their Hi-Q antennas.

Shortly after I posted the application note to the Hi-Q web site, I received a note from Marc Stroom (PA3FVB/m), including some links to a few pictures of his mobile installation and showing how he had successfully managed to install a single reed switch *inside* the mast of his Hi-Q mobile antenna. With Marc's encouragement, I decided to attempt a similar installation. What follows is a chronicle of my efforts.

Should you decide to undertake such a modification, know that READING the documentation is much more difficult than actually performing the mods.

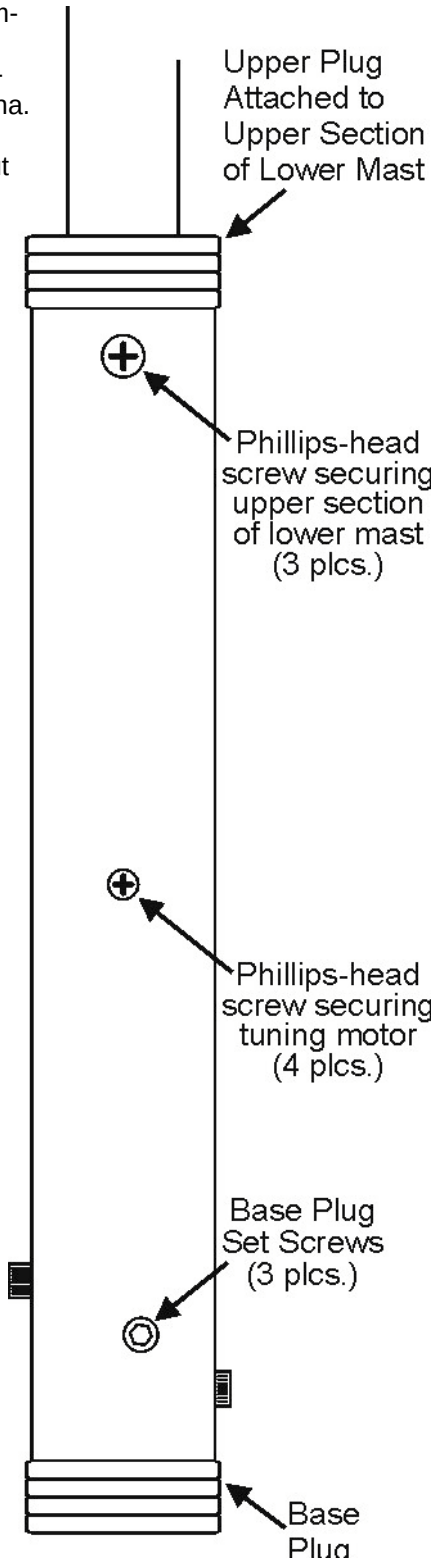
DISASSEMBLY OF THE HI-Q 4/80 MOBILE ANTENNA

You do not have to completely disassemble the antenna! However, you will have to disassemble the *base section* of the mast which houses the gear-head motor.

NOTE: Hi-Q uses a corrosion-preventing compound (anti-oxidant) on most aluminum-to-aluminum joints which are not already epoxy-glued together. Keep a few shop towels, or paper towels handy to wipe your hands and to clean the anti-oxidant from the aluminum components as you remove them from the antenna.

Additionally, the inside ridge of the upper plug will have a shallow channel cut around the inside edge. When the antenna was originally assembled, this channel was filled with a narrow bead of RTV (silicone sealer) just before it was installed into the top of the base section. Use a knife or double-edged razor blade to remove all of the remaining RTV from this channel so it can again be filled when the antenna is reassembled.

As you remove it, clean each part and set it aside in a safe place.



1. Run the coil shorting wiper up within the coil to within 1-2 turns of the top (the point just before it stalls the motor).

2. Using a 3/16" Allen wrench, remove the (3) Allen-head cap screws at the bottom of the antenna, and carefully pull out the base plug, taking care to not nick or cut the wires which exit from the base of the antenna via a notch in the base plug.

3. Remove the (4) Phillips-head screws which internally secure the hear-head motor within the base section of the mast. DO NOT attempt to remove the gear-head motor at this time.

4. In this step, you will separate the upper part of the lower mast from the base section. **The tuning shaft (in the upper sections) will still be attached to the motor (in the base section) so use extreme care when separating the two pieces of the mast. It is wise to perform this separation on a table where the tabletop can support both sections of the antenna once they are apart.**

   Remove the (3) Phillips-head screws which secure the upper section of the lower mast to the base section. CAREFULLY separate the upper section of the lower mast from the base section.

5. At this point, the gear-head motor should no longer be secured by its (4) mounting screws, however the protective nylon casing around it may have been slightly deformed by the screws, so pushing or pulling the motor up or down may require a bit of effort. Use common sense when exerting force on the motor.

   Separate the upper and base sections of the lower mast enough that you can grasp the threaded tuning shaft which is attached to both the coil wiper and the gear-head motor. **Pull** upward on the shaft in an effort to pull the motor ***partially*** out the top of the base section. Pull the motor up until the black tuning shaft/motor shaft connector is above the top of the base section.

6. Using a 3/32" Allen wrench, ***remove*** the ***top and center*** set screws from the black tuning shaft/motor shaft connector and carefully separate the threaded tuning shaft from the connector. Set the upper mast and coil assembly aside.

7. If the wires from the motor, which should still extend out the bottom of the base section, have nothing attached to them (such as large toroidal cores, etc.) which would prevent them from being pulled completely through the base section and out the top of the tube, grasp the black tuning shaft/motor shaft connector and carefully pull the gear-head motor and its associated wires out of the base section tube. If the motor wiring cannot be pulled up through the tube, then use a length small-diameter wooden dowel to push the motor out the bottom of the base section tube. Note that this is the *least desirable* of the two removal options.

8. Once the motor has been removed, check to see if there is a dark horizontal line marked about half way up on the body of the motor cover. DO NOT erase this mark! It is there to help you find the proper insertion point for the motor when you reassemble the antenna later. If this mark has been wiped off or is not present, use a permanent ink felt-tipped marker to make a long horizontal mark around the body of the motor cover at the level of the points where the four motor mounting screws dug into the cover.

9. In order to help protect the gear-head motor from water damage, the area around where the motor drive shaft enters the motor body is double-protected:

   A. Silicone sealer has been used to close any gaps between the inside of the nylon cover top and the top of the gear-head motor, and

   B. A very thick (and sticky) marine grease has been applied to the top side of the nylon motor cover, where the drive shaft exist the case.

   Using a small-bladed screwdriver, carefully scrape away as much of the thick grease as you can and ***SAVE*** this grease for re-application later, when the modifications are completed. I used the inside side a small pill bottle to scrape the grease from the screwdriver blade. Then I capped the pill bottle so the grease would not become contaminated by dust or metal shavings during the rest of my building process.

   When you have removed most, if not all, of the grease, use a paper towel to wipe away any small amount which may remain.

DISASSEMBLY OF THE HI-Q 5/80 and 5-160 MOBILE ANTENNAS

By: Marc Stroom, PA3FVB/m

You do not have to completely disassemble the antenna! However, you will have to disassemble the *lower section* of the mast which houses the gear-head motor.

For the HiQ 5/80 and 5/160 antennas, the lower section of the antenna (the part below the coil housing) is one single piece of (40.8mm) mast, instead of the 2-piece mast used for the 4/80 design. This requires slightly different disassembly and re-assembly instructions.

NOTE: Hi-Q uses a corrosion-preventing compound (anti-oxidant) on most aluminum-to-aluminum joints which are not already epoxy-glued together. Keep a few shop towels, or paper towels handy to wipe your hands and to clean the anti-oxidant from the aluminum components as you remove them from the antenna.

As you remove it, clean each part and set it aside in a safe place.

1. Run the coil shorting wiper up within the coil to within 1-2 turns of the top (the point just before it stalls the motor).

2. Using a 3/16" Allen wrench, remove the (3) Allen-head cap screws at the bottom of the antenna, and carefully pull out the base plug, taking care to not nick or cut the wires which exit from the base of the antenna via a notch in the base plug.

NOTE: At the bottom of the coil housing you should find two center-punched marks, one on the bottom of the lower coil housing bracket and a matching one on the lower mast section. Note that these marks (circled at right) will be used during the re-assembly of the antenna.

3. Remove the (4) Phillips-head screws which internally secure the hear-head motor within the base section of the mast. DO NOT attempt to remove the gear-head motor at this time.

4. Remove the 3 Phillips-head screws which secure the coil housing to the lower antenna section.

5. At this point, the gear-head motor should no longer be secured by its (4) mounting screws, however the protective nylon casing around it may have been slightly deformed by the screws, so pushing or pulling the motor up or down may require a bit of effort. Use common sense when exerting force on the motor.

   Separate the lower section of the antenna from coil housing enough that you can grasp the threaded tuning shaft which is attached to both the coil wiper and the gear-head motor. **Pull** upward on the shaft in an effort to pull the motor ***partially*** out the top of the base section. Pull the motor up until the black tuning shaft/motor shaft connector is above the top of the base section.

6. Using a 3/32" Allen wrench, ***remove*** the ***top and center*** set screws from the black tuning shaft/motor shaft connector and carefully separate the threaded tuning shaft from the connector. Set the upper mast and coil assembly aside.

7. If the wires from the motor, which should still extend out the bottom of the base section, have nothing attached to them (such as large toroidal cores, etc.) which would prevent them from being pulled completely through the base section and out the top of the tube, grasp the black tuning shaft/motor shaft connector and carefully pull the gear-head motor and its associated wires out of the base section tube. If the motor wiring cannot be pulled up through the tube, then use a length small-diameter wooden dowel to push the motor out the bottom of the base section tube. Note that this is the *least desirable* of the two removal options.

8. Once the motor has been removed, check to see if there is a dark horizontal line marked about half way up on the body of the motor cover. DO NOT erase this mark! It is there to help you find the proper insertion point for the motor when you reassemble the antenna later. If this mark has been wiped off or is not present, use a permanent ink felt-tipped marker to make a long horizontal mark around the body of the motor cover at the level of the points where the four motor mounting screws dug into the cover.

9. In order to help protect the gear-head motor from water damage, the area around where the motor drive shaft enters the motor body is double-protected:

   A. Silicone sealer has been used to close any gaps between the inside of the nylon cover top and the top of the gear-head motor, and

   B. A very thick (and sticky) marine grease has been applied to the top side of the nylon motor cover, where the drive shaft exist the case.

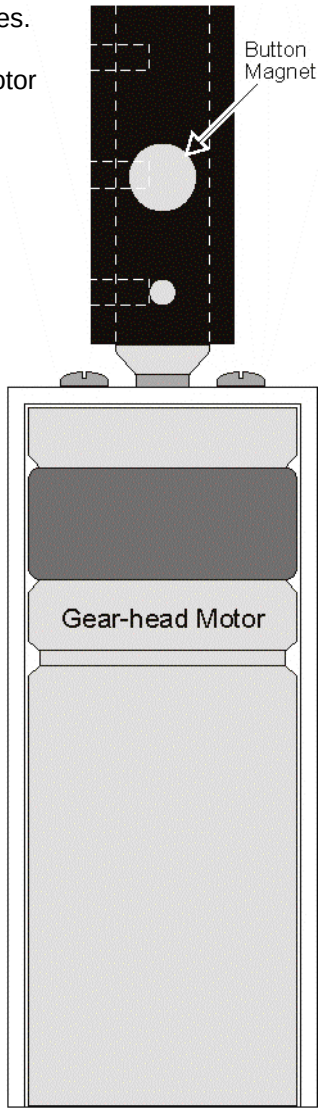
   Using a small-bladed screwdriver, carefully scrape away as much of the thick grease as you can and ***SAVE*** this grease for re-application later, when the modifications are completed. I used the inside side a small pill bottle to scrape the grease from the screwdriver blade. Then I capped the pill bottle so the grease would not become contaminated by dust or metal shavings during the rest of my building process.

   When you have removed most, if not all, of the grease, use a paper towel to wipe away any small amount which may remain.

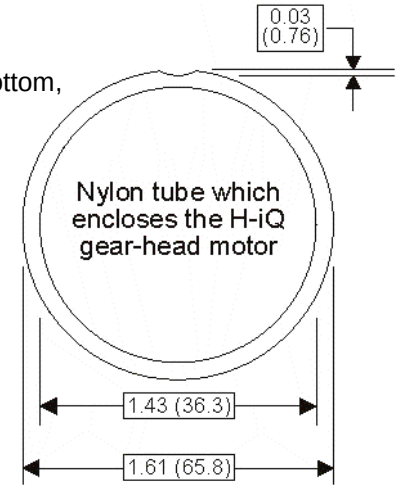
HERE ARE THE ANTENNA PARTS YOU NOW HAVE TO WORK WITH

NOTE: All measurements are in inches, values enclosed in parentheses () are in millimeters. Additionally, from this point on, all diagrams are shown as full-size, so they can be printed and taped/glued to the working material to be used as cutting / grinding / filing templates.

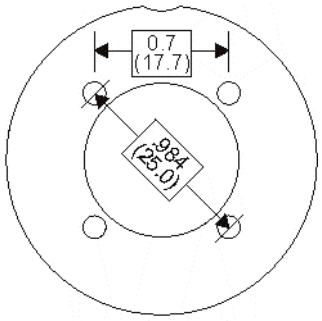
1. Gear-head motor, enclosed by a protective nylon cover, and attached at the top of the motor shaft, a coupler to attach the tuning screw drive. One or two small button magnets are housed within the coupler, at its center.



2. Looking at the nylon (tube) motor cover from the bottom, you will notice that the wall thickness of the tube is about 0.1" (2.54 mm).



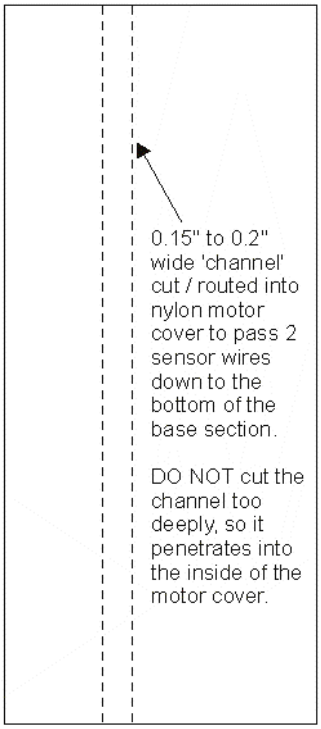
3 You may also find that there is a slight 'channel' running vertically up the side of the tube. This channel will be made deeper in a later step, to allow two wires to pass from the top of the motor housing down to the base plug. I am not sure whether this channel is present in all of the Hi-Q motor covers. If it is, then it can be used to advantage. If not, a channel can be created, later.



Nylon tube as viewed from top

CREATING A REED SWITCH SIGNAL WIRE CHANNEL IN THE NYLON MOTOR COVER

If your motor cover came with a shallow dip (channel) already created along one side of the tube, you can deepen this channel in order to allow two signal wires (from the reed switch) to run along the side of the motor cover and down to the base of the antenna once the motor has been replaced inside the bottom section of the antenna mast. If your motor cover does not have this channel you must create one, using the same method used to deepen an existing channel.



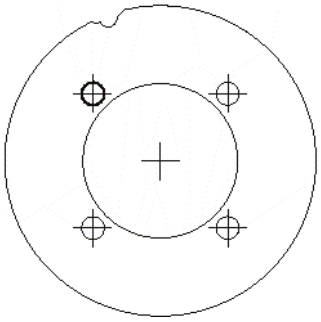
1. It is necessary for two wires (preferably #22 stranded, insulated wire) to be run down the length of the nylon motor cover so the signal from the reed switch can be sent back to the turns counting device. In order to accomplish this task, you will have to create or enlarge a narrow vertical 'channel' along the full length of the motor cover. This channel need be no wider than that required to safely allow the two wires to pass.

2. I used a Dremel hand-held grinder, with a ball-shaped router bit to grind out a channel in the side of the motor cover. My motor cover already had a very shallow channel as a result of the manufacturing process, so I just continued to increase its depth a bit.

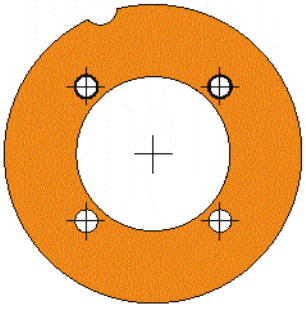
   You ***MUST TAKE CARE*** to not cut through the approximately 0.1" (2.5 mm) thickness of the tube wall when you create this channel... This is by far the most difficult part of the modification process. But as long as the wires are deep enough into the channel that you can insert the motor cover (and the two wires) into the lower section of mast tube without stripping the insulation from the wires, the channel is deep enough.

3. If possible, especially if you are creating a new channel, where none previously existed, try to offset the channel a bit from being centered between two holes in the top of the cover. This will allow you to have more available PC board for soldering the reed switch plate to the ring while allowing the wires to drop down along side the cover, slightly off to the left or right of the reed switch plate. See illustration below. This applies to step 1 in the next section (FABRICATING A MOUNT FOR THE REED SWITCH)

Top of motor cover with channel cut offset to left



PC board ring for reed switch plate with offset matching notch



4. Reassemble the motor into the nylon cover. Sometimes, if you twist the motor slightly as you insert it into the cover, you may find a spot where it will insert very easily. Use that to your advantage when you insert the motor.

FABRICATING AND INSTALLING A MOUNT FOR THE REED SWITCH

I wanted to nice, solid (low-mass) mount for my reed switch. It had to be low-mass, and it had to allow the reed switch to be located as far from the button magnet as possible while still being inside the base section of the lower mast. It also had to physically attach to the gear-head motor and motor cover, so it could be installed as part of the motor assembly.

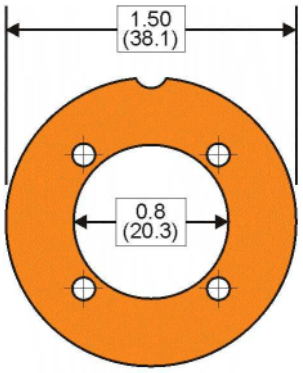
I happen to have an abundance of surplus PC board material available, so I decided to made the reed switch mount from a spare piece of double-sided PC board. I used double-sided board so I could solder to both sides of the board, for stability.

1. Refer to the illustration at right.

   Cut a ring of 1/16" (1.58 mm) thick fiberglass PC board to a diameter of 1.50" (38.1 mm).

   Once the ring has been cut and a test-fit performed, ensure that the outer circumference of the ring, when installed, does not extend (anywhere) past the outer edge of the white motor cover... it should reside slightly INSIDE the outer diameter of the motor cover on all sides by approximately 0.05" (1.27 mm). If not, file any dimension which does not meet this criteria to ensure that there is NO CHANCE that the copper foil on the ring might short out against the inside of the antenna mast when it is eventually installed on the motor and the motor inserted into the antenna base section.

   Cut a small 'notch' in one side to ***match*** the 'channel' found in the motor cover of your Hi-Q 4/80 antenna. Then route out a 0.8" (20.3 mm) center hole and punch (or drill) four (4) 1/8" (3.2 mm) screw mounting holes, as shown at right.



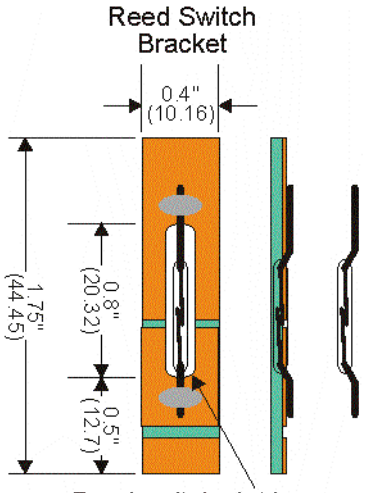
PC board ring to mount reed switch bracket

   NOTE: If it is present, the 'channel' in your motor cover may not match exactly the diagram I have shown above, or on the previous page. It may be rotationally offset one way or the other. Create your notch to match the channel of your particular motor cover.

2. Cut a small rectangle, 0.4" x 1.75" (10.16 x 44.45 mm) of double-sided PC board to which the reed switch will be attached, and which will be soldered to the top of the PC board mounting ring which will be screwed onto the top of the motor.

3. Cut a narrow, 0.15" x 0.8" (3,8 x 20.3 mm) slot in the center of the rectangular reed switch mounting plate as shown at right. The reed switch will be installed ***in*** this slot so it is protected by the PC board, and so it can be mounted as close to the inside circumference of the base section tubing as possible. This will be insulated from the antenna itself in a later step.

   The reason for mounting the reed switch as far from the button magnet as possible is the help ensure regular closure of the reed switch contacts with no erratic operation.



Reed switch slot is 0.1" (2.54mm) wide. Adjust reed within slot for best response.

   During testing of a number of reed switches, it was found that the positioning of the reed switch itself, with regard to the position of the button magnet, is rather critical. Centering the reed switch on the button magnet will generally result in the reed switch failing to operate at all.

   Positioning the reed switch too far below the button magnet results in the reed switch becoming effected by the magnetism of the gear-head motor itself, generating either erratic switch closures or a continuously closed switch.

   Positioning the reed switch too close to the button magnet resulted in erratic switch closures as well.

   Positioning the reed switch as far away from (horizontally) and with one (but not both) of the switch 'leaves' centered on the button magnet seemed to provide the most consistent and well-defined reed switch closures.

I tested about five (5) different reed switches before I chose my final candidate. The reed switch I found to be least 'sensitive' when is close proximity to the button magnet, and which yielded the most consistently reliable closures was the Coto Technology Dry Reed Switch, model RI-07A (Mouser Electronics part # 816-RI-07A. Other Coto reed switches I tested were their models RI-01CAA, RI-01BA, RI-02A, and RI-05A. For some reason, the RI-07A seemed to be the most reliable performer of the group.

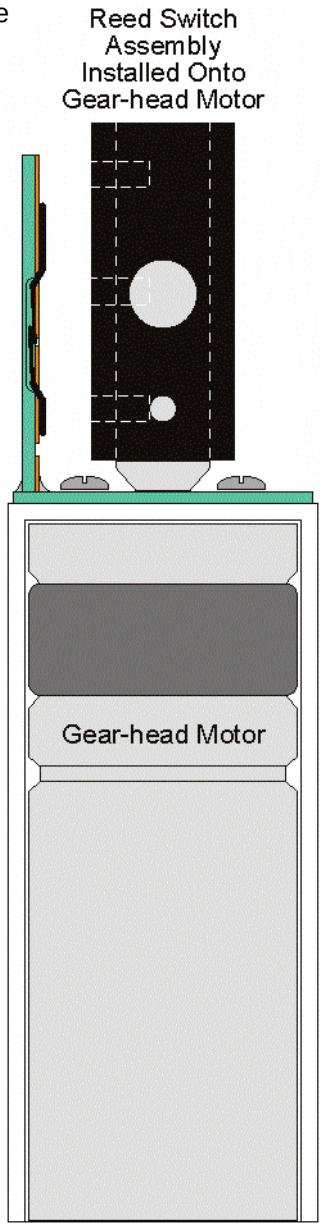
4. Once the reed switch mounting plate has been cut, and the slot has been cut, separate (horizontally) the copper foil into three pieces. The first cut is made 0.25" (6.4 mm) up from the bottom end of the plate (see illustration above) and the second cut should be made somewhere near the horizontal center of the reed switch slot (see illustration). This allows the bracket to be soldered directly to the mounting ring without being electrically connected to it, and it allows for #22 insulated wires to be soldered to the copper foils to which the reed switch leads will be attached.

   Lightly tin the areas of the PC board where the reed switch leads and connecting wires will eventually be soldered.

5. **NOTE:** The glass envelope of reed switches is ***very fragile*** and can be broken if excessive force is exerted at the point where the device lead enters the glass envelope. If this happens, the reed switch must be discarded. When bending the reed switch leads, be sure to hold the lead right up against the glass envelope with needle-nosed pliers and then bend the wire just out past the tip of the pliers. This will eliminate excessive stress on the glass envelope.

   Grasp the reed switch lead just past the end of the glass envelope and hold it secure while you bend the lead at a 45 degree angle. Repeat this step with the other reed switch lead, bending both leads to the same side of the reed switch.

   Lay the reed switch mounting plate on a table top and drop the reed switch down into the slot. Test-measure the point at which the leads must be bent back to their vertical position to permit the reed switch to reside within the mounting plate slot while having their leads soldered to the PC board. See the illustration of the Reed Switch Bracket, previous page.



6. Locate the reed switch mounting bracket ring. Place it on the table top and test-position the reed switch bracket on top of the ring. You will want the reed switch bracket to be located just to the left of right of the notch you cut into the PC ring, to allow sensor wires to be soldered to the reed switch bracket and then to drop down and into the channel cut into the nylon motor cover.

   Position the reed switch bracket vertically and on top of the PC board ring, leaving a small amount of space between the outer edge of the ring and the back side of the PC board (so you can solder to BOTH sides of the PC board if at all possible).

   Hold the PC board in place, and tack-solder the bottom of the vertical board to the top of the PC board ring. Solder the other side of the vertical PC board as well.

7. Temporarily mount the reed switch assembly onto the motor (you may have to remove the shaft connector in order to install the PC board ring), using all four (4) screws.

   Do a test-fit of the reed switch into the slot of the vertical PC board. If possible, use test clips connected to the reed switch leads and to an oscillator (or the KEY jack of your radio set to NOT transmit, but to allow you to hear the sidetone when keyed). Then apply DC power to the motor and listed to the 'keyed' output from the reed switch. Slide the switch up/down along the mounting plate until you locate a point where the output pulses are consistently made, with no errors in keying. Mark this point, or at least make a mental note, of where the reed switch envelope is positioned within the slot.

8. Temporarily tack-solder the reed switch into place on the mounting plate and clip the lead lengths as long as possible without having them short out to anything else. This will allow you to make another adjustment in the position if your first attempt turns out to not be the best choice. Once you do decide upon a final position, re-flow the soldered connections so they are smooth and clip off all excess lead length.

9. Once you have permanently mounted the reed switch to the bracket, solder two (2) 12" (304 mm) long #22 insulated (reed switch signal) wires to the top and middle sections of the reed switch plate, form the wires in the wire channel, down the side of the motor.

10. Trim the reed switch signal leads to a length which will allow about 1.5" (38 mm) of wire to extend past the bottom of the motor assembly. "Stagger-trim" the lengths so that the soldered connections (below) will not be at exactly the same point along their length (so one connection will be 1/2" higher than the other). Attach the reed switch signal wires to the two wires which will be used to bring the pulse signal to the turns counter. Insulate the soldered joints with individual pieces of heatshrink tubing, and then insulate BOTH joints with a single length of heatshrink as well.

11. Cut a piece of heatshrink tuning which is large enough to fit over the vertical reed switch mounting bracket and slightly longer than the bracket itself. Slip it over the bracket and then shrink it to fit. This will help to ensure that the (copper-covered) back side of the mount will not short out against the inside of the antenna shaft itself. That might be a bad thing.

12. Locate the thick marine grease you removed from the top of the motor assembly and saved for later.

    Using a small-bladed screwdriver, or other suitable applicator. Ensure that the grease is 'piled up' around the motor drive shaft, and on top of the motor cover.

This completes the addition of the reed switch to the Hi-Q 4/80-RT HF mobile antenna. However, there's more.

REWIRING THE BOTTOM END OF THE HI-Q DRIVE MOTOR

I have never been known for knowing when to quit 'improving' a proven good design...

As received, my Hi-Q 4/80-RT used Teflon®-insulated wire to connect to the drive motor. Teflon insulation is great for installations where heat (which might melt vinyl insulation) is a concern. However, Teflon insulation is also more susceptible to cutting by sharp edges, and it also makes the wire generally less flexible and more prone to fatiguing the wires as the exit the insulation. I've already begun to notice some 'wearing' of the Teflon insulation at the point where the wires exit from the bottom of the antenna. I decided that these wires should be replaced with vinyl-insulated wires.

Since I now had two additional reed switch leads which I had to worry about running out through the same channel through which the drive motor leads exit, I decided that I did not just want to make "flying" (in-line wire-to-wire) connections inside the bottom section of the antenna, where they might be damaged by an accidental 'pull' outside the antenna mast body. I decided to secure all wires (both reed switch wires and drive motor wires) inside the base section by attaching a small PC board to the bottom of the drive motor. This provides a strong connection point for all wires *and* for the internal resettable 0.4A fuse. If you decide to take your mod this far, proceed as follows:

1. Take a hard look at the bottom end of the drive motor. Note that there are two (2) solder terminals which provide DC drive voltage to the motor. If you have a newer version of the Hi-Q 4/80-RT antenna, you should also see a small yellow-orange device which looks somewhat like a capacitor BUT which is actually an in-line resettable fuse. This fuse attaches to the POSITIVE terminal of the drive motor (look for a RED dot on the side of the nylon motor cover, adjacent to the positive DC terminal).

   On my antenna, I was a bit confused that the white (positive) voltage wire to the drive motor appeared to connect directly to the positive motor terminal AND to one end of the resettable fuse as well. I was wrong. Although the white wire passes THROUGH the hole in the positive terminal solder lug, the Teflon insulation prevents it from being actually soldered to (and thus electrically connected) to the lug. The lug is just being used as a support for the wire as it connects to one side of the fuse.

2. Desolder the BLACK wire from the drive motor negative terminal.

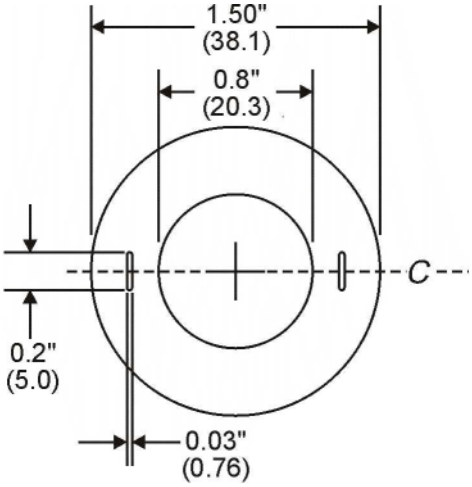
3. Desolder one end of the resettable fuse from the drive motor positive terminal.

4. The junction of the white DC wire and one lead of the resettable fuse have been 'glued' in place with a small blob of black RVT (silicone) sealant.

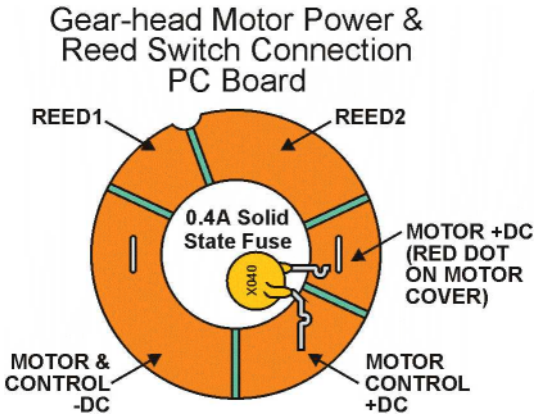
   Carefully lift this junction (RTV and all) free of the base of the motor, and pull the excess RTV sealant free from the fuse lead. **USE CARE** when removing the RTV sealant from the fuse lead to ensure that you do not damage the fuse or its lead.

5. Cut a piece of **single-sided** PC board as shown at right. You may use the illustration at right as a template. The two vertically-centered slots are for the drive motor power lugs. They must be at least 0.03" (0.76 mm) wide, but if you cannot cut a slot such as that shown, a 0.16" (4.0 mm) diameter hole can be drilled as well.

   Once the ring has been cut and a test-fit performed, ensure that the outer circumference of the ring, when installed, does not extend (anywhere) past the outer edge of the white motor cover... it MUST reside slightly INSIDE the outer diameter of the motor cover on all sides by approximately 0.05" (1.27 mm). If not, file any dimension which does not meet this criteria to ensure that there is NO CHANCE that the copper foil on the ring might short out against the inside of the antenna mast when it is eventually installed on the motor and the motor inserted into the antenna base section.



6. Once the PC board ring shown above has been cut to size (it should be just a bit smaller in diameter than the outside diameter of the white nylon motor cover), Slip it over the bottom of the gear-head driver motor (copper side facing out) and mark on the copper the point where the reed switch wire channel has been cut in the motor cover and create a similar indentation in the PC board ring (to pass the reed switch wires). The illustration at right shows an example of this cut. It also shown several additional cuts in the copper of the ring. These added cuts are to separate the copper into several 'pads' which will be used as attachment points for the motor control and reed switch wires which will extend out the bottom of the base of the antenna and connect to control circuitry inside the vehicle. The absolute positioning of these cuts is left up to you because they are somewhat dependent upon the position of the reed switch wire channel with regard to the motor DC lugs.



7. As discussed above, create five (5) lands (pads) on the PC board ring to accommodate the four control wires and the 0.4A solid state fuse (if present on your antenna). Note that if your antenna did not come with a built-in solid state fuse, now would be a good time to consider adding one. The component supplied by Hi-Q is the Raychem Polyswitch RXE040 (0.04A hold, 0.80A trip). Using the illustration above, it would not be difficult to add this device now, if it was not originally provided.

8. Install the ring onto the base of the drive motor, soldering the motor power lugs to their appropriate pads on the ring.

9. Install the solid state resettable fuse as shown above.

10. Attach the two leads from the reed switch coming from the PC board at the top of the gear-head motor to their respective pads on the ring. Leave small 'loops' of wire at these connections, the wires ***do not*** have to be pulled tight before they are soldered into place.

The four wires which will exit the antenna base will be connected at this time. Ensure that you have more than ample lead length for these wires before you attach them to the PC board. Remember that these wires will probably be wrapped several times through a toroidal inductor to form a choke which will assist in removing and RF which might appear on the leads as a result if their close proximity to the transmitting antenna. So be sure to leave additional lead length to accomplish this task. You will not want to have to disassemble the antenna again, just to replace a too-short wire.

BE SURE TO RECORD THE WIRE COLORS AND WHAT THEY CONNECT TO...!

10. Attach the two drive motor DC power leads and the two reed switch output leads at the points shown in the illustration above. It would be best to use 18-16 gauge wire here because they will experience some harsh environments once they exit the base of the antenna. I used #18 vinyl-insulated wire.

    Use cable ties (or a short piece of heatshrink tubing) to gather each pair of wires together about 1" (25.4 mm) from their solder point. Slip a 3" (76.0 mm) piece of heatshrink tubing over each pair of wires and position the heatshrink so it will protect the wire pairs as they exit from the antenna base through the channel cut into the base plug. Of course, if you wish, you may use longer pieces of heatshrink tuning, protecting the wires all the way to whatever type of mating connector you will install at the end of the control wires.

This completes the rewiring of the bottom end of the gear-head drive motor.

REASSEMBLY OF THE HiQ 4-80 RT ANTENNA

1. Carefully insert the motor assembly into the bottom end of the bottom section tube. ***Ensure*** that the two reed switch signal wires are properly formed into their channel in the motor cover, and that they will allow the motor assembly to be slipped inside the base section tube ***without*** stripping the insulation from the wires.

2. ***Exercising great care***, use a wooden dowel rod to continue to insert the motor assembly into the bottom section tube. Push it almost all the way through the tube, until the shaft connector is fully visible out the top of the tube.

3. Locate the upper antenna assembly (coil and upper part of the lower mast) and carefully reattach the threaded drive screw to the shaft connector. Be sure to match the 'flats' ground into both the motor drive shaft and the threaded drive screw with the Allen set screws, then tighten all set screws securely.

4. Carefully pull the threaded drive screw down, forcing the coil wiper to the bottom of the coil. This will give you some 'working room' while positioning the motor inside the base section tube.

5. Grasp the threaded drive screw and carefully press the motor back into the bottom section tube, watching through one of the motor mounting screw holes to see the dark horizontal line on the body of the motor cover which will indicate that the motor is aligned vertically. Once you find this line, carefully rotate the base section tube in an effort to also locate one of the previously-made indentations from the mounting screws. If you can find these dents, installation of the motor mounting screws will be a bit easier than if you have to make new indentations.

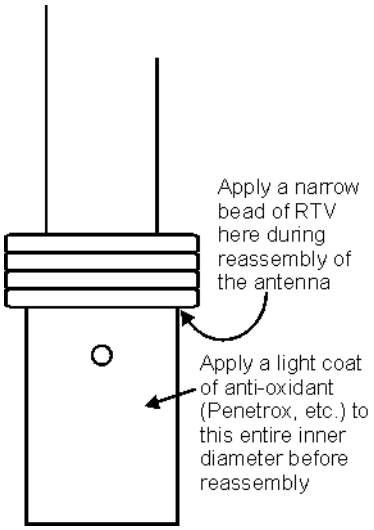
   Install the four (4) motor mounting screws in the middle of the base section tube.

6. Apply a thin **bead** of black RTV (silicone sealer, see **note** regarding the use of RTV sealers at end of document) completely around the circumference of the upper plug, at the point indicated at right. DO NOT use excessive RTV. This is only required to prevent moisture entering the antenna at this joint and should ONLY be applied around the plug, right AT the point shown.

7. Apply a ***light*** coating of anti-oxidant (Penetrox, No-Al-Ox, etc.) to the entire inner surface of the bottom half of the upper plug. See illustration at right.

8. Carefully slip the top section of the antenna into the bottom section tube, align the screw holes and reinstall the three (3) screws. Tighten securely.

9. In a manner similar to step 7 above, apply a light coating of anti-oxidant to the entire inner surface of the base plug. ***DO NOT apply RTV*** to this plug, it must remain open to allow for drainage of possible accumulated moisture.



9. Gather together the (now) two pairs of wire which exit the bottom of the base section tube.

   Locate the base plug and install it, allowing both of the wire pairs to exit via the channel machined into the plug.

   Match up the mounting holes and install the three (3) Allen-head bolts. Tighten securely.

Done! Some pictures of completed modification are included on the following page.

REASSEMBLY OF THE HiQ 5-80 RT and 5-160 RT ANTENNA

1. Lay the coil, with the threaded drive shaft and the motor connected, on a table. Lay beside this section the base section with the mark on top and just turn the threaded drive in or out the coil just until the mark on the motor is at the same place as the screw holes in the base section. (the contactor must be at, or very near, the top of the coil).

2. Carefully insert the motor assembly into the base section tube (mark on the base section must match the mark on the coil housing). ***Ensure*** that the two reed switch signal wires are properly formed into their channel in the motor cover, and that they will allow the motor assembly to be slipped inside the base section tube ***without*** stripping the insulation from the wires.

3. The motor should now be exactly at the screw places in the lower section. Install the four (4) motor mounting screws in the lower section tube.

4. Install the three Phillips-head screws to secure the lower section to the coil housing (be sure the mark on the coil housing is match with the mark on the base section, see illustration at right)

5. Apply a ***light*** coating of anti-oxidant (Penetrox, No-Al-Ox, etc.) to the entire inner surface of the base plug. ***DO NOT apply RTV*** to this plug, it must remain open to allow for drainage of possible accumulated moisture.

6. Gather together the (now) two pairs of wire which exit the bottom of the base section tube.

   Locate the base plug and install it, allowing both of the wire pairs to exit via the channel machined into the plug.

   Match up the mounting holes and install the three (3) Allen-head bolts. Tighten securely.

Done! Some pictures of completed modification are included on the following page.

Picture of the completed reed switch mounting bracket, with the reed switch installed.

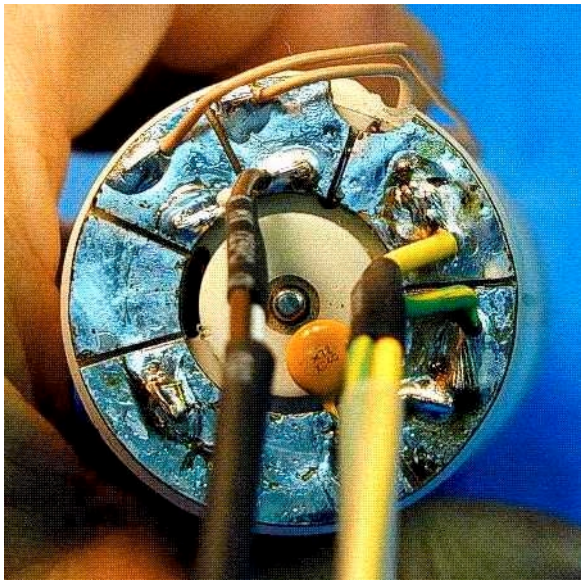
NOTE THE FOLLOWING:

1. The reed switch is recessed into the cutout slot, to permit it to be positioned as far from the button magnet as possible.

2. This picture does not show the piece of heatshrink tubing which was placed over the vertical reed switch mount to prevent the copper-covered back side of the mount from touching the body of the antenna itself.

3. Neither the top ring (this picture) nor the bottom ring (shown below) must be allowed to extend out past the width of the motor cover. To do so would cause a short between the motor and the inner wall of the antenna itself.

Picture of the PC board ring which attaches to the back (bottom) side of the gear-head drive motor and permits secure attachment of all wires which will exit the bottom of the antenna once it is reassembled.



73,

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REGARDING THE USE OF SILICONE SEALERS WITH ELECTRONICS AND OTHER DEVICES

Often, the silicone sealers we use to weatherproof out antenna (and other) connections contain acetic acid (vinegar) as one of the curing agents for the sealant. Acetic acid can be corrosive and may not be fully suitable for the intended use. For this project, I used Permatex #82180 Ultra Black OEM Hi-Temp "Sensor Safe" RVT Silicone (available at most auto parts stores) which does NOT contain acetic acid and therefore will not promote corrosion. Most (though possibly not all) RTVs do not contain acetic acid and should be more appropriate electronics-type work. You can easily tell if the sealant you plan to use contains acetic acid... it will have the distinctive odor of vinegar. Others will not.