

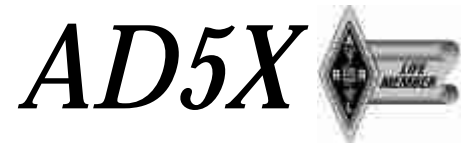
Mobile Operation Hints & Kinks

- ◆ Mobile HF Antenna Efficiency
- ◆ Mobile Mounting & Noise Considerations
- ◆ Mobile Antenna Construction
- ◆ Antenna Accessories/Tools/Hints

Phil Salas – AD5X

ad5x@arrl.net

www.ad5x.com



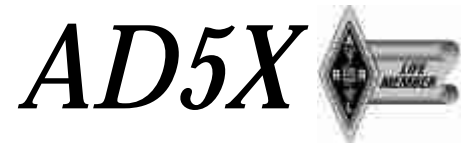
Mobile Antenna Efficiency

Search for the Ideal Mobile Antenna

- ◆ Unobtrusive
- ◆ Very Small
- ◆ Cheap
- ◆ 100% Efficient

TANSTAAFL

- ◆ ***There Ain't No Such Thing As A Free Lunch***
- ◆ Everything is a Tradeoff



Mobile Antenna Trade-offs

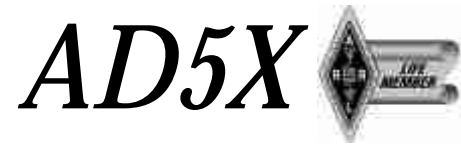
Positive

- ◆ Can be small
- ◆ Can be light
- ◆ Can be very inexpensive
- ◆ Can be Spouse-Friendly

Negative

- ◆ Efficiency

“QRP is alive and well. Just look at the typical mobile antenna set-up.” - K0BG (www.k0bg.com)



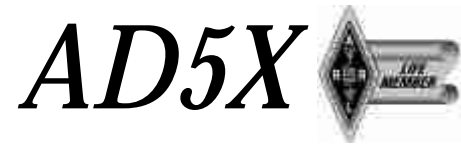
Why an Efficiency Penalty?

Radiation Resistance is what you want to get your power into to get it radiated. However...

- ◆ Radiation Resistance \approx Height²
- ◆ Radiation Resistance \approx Frequency²

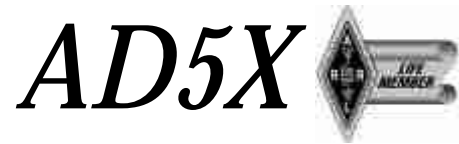
Therefore, as Height and Frequency are reduced, the Radiation Resistance Plummets!

- ◆ So Who Cares – Just match to the lower radiation resistance, right?



Efficiency Loss

- ◆ Theoretically, matching to a low impedance is no problem.
- ◆ But, if there are other losses in low impedance systems, your efficiency will suffer.
- ◆ And there ARE other losses.
 - Coil Losses
 - matching and loading coils
 - Ground Losses
 - Because you won't have a perfect ground system



Simple Antenna Equations

Let's consider some simple equations:

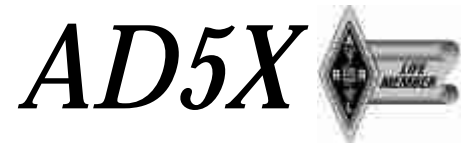
◆ Capacitance of a short antenna

- $C_b = 3.75 \text{ pf/ft}$ (base loading)
- $C_c = 1/2 C_b$ (center loading)

◆ Radiation Resistance of a short antenna ($< 1/8\lambda$)

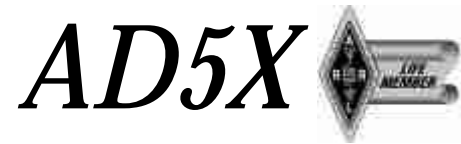
- Base Loading: $R_{Rb} = 2.73 \times 10^{-6} (hf)^2$
- Center Loading: $R_{Rc} = 6.7 \times 10^{-6} (hf)^2$

Where: h = height in inches, f = frequency in MHz



Simple Equations (Cont.)

- ◆ Antenna $Q = 360f_{\text{MHZ}} / (2:1 \text{ VSWR BW}_{\text{KHZ}})$
- ◆ Inductance $L = 1 / [(2\pi f)^2 C]$
 - Not totally accurate for calculating loading coil. But very close.
 - Tends to give a slightly greater inductance value than necessary.
- ◆ Coil $Q = 2\pi f L / R_L$
- ◆ Coil Loss = $R_L = 2\pi f L / Q$



Simple Equations (Cont.)

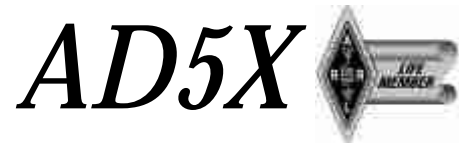
◆ $R_T = \text{Total System Resistance } (R_R + R_L + R_G)$
 $= 2\pi fL / \text{Antenna } Q$

◆ $\text{Ant. Efficiency (\%)} = [R_R / (R_R + R_L + R_G)] \times 100$
 $= [R_R / (\text{Total System Resistance})] \times 100$

◆ $\text{Power Loss (dB)} = 10 \text{ LOG } [R_R / (R_R + R_L + R_G)]$
 $= 10 \text{ LOG } [R_R / (\text{Total System Resistance})]$

8-Foot Base-Loaded 40 Meter Antenna, Coil Q = 300

- ◆ $C_b = 3.75 \text{ pf/ft} \times 8 \text{ ft} = \mathbf{30 \text{ pf}}$
- ◆ $L = 1/[(2\pi f)^2 C] = 1/[(2\pi 7.2 \times 10^6)^2 (30 \times 10^{-12})] = \mathbf{16.3 \text{ uhy}}$
- ◆ $R_L = 2\pi f L / Q = 2\pi (7.2) (16.3) / 300 = \mathbf{2.5 \Omega}$
- ◆ $R_{Rb} = 2.73 \times 10^{-6} (hf)^2 = 2.73 \times 10^{-6} (96 \times 7.2)^2 = \mathbf{1.3 \Omega}$
- ◆ High-Q Coil Loss is Almost TWICE the Radiation Resistance. With a **PERFECT** ground, you still lose 2/3rds of your power do to the coil loss! Your antenna is **34%** efficient!
- ◆ With 10Ω of ground loss, your efficiency is only **9%**!
 - 100 watts transmitted = 9 watts radiated!



Simple Example (Cont.)

What Does Center Loading Buy You?

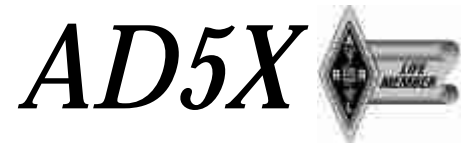
$$\begin{aligned} \blacklozenge R_C &= 6.7 \times 10^{-6} (hf)^2 = 6.7 \times 10^{-6} (96 \times 7.2)^2 \\ &= 3.2 \, \Omega \end{aligned}$$

$$\blacklozenge R_L = 2\pi fL/Q = 2\pi(7.2)(32)/300 = \mathbf{5 \, \Omega}$$

◆ Radiation Resistance increases 2.5 times, but your coil losses double (twice the inductance).

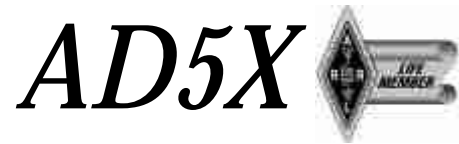
- With no ground losses, your efficiency is now **39%**.
- With 10 Ω ground loss, your efficiency becomes **17.5%**.

◆ In the real world with finite ground losses, center loading generally doubles your antenna efficiency.



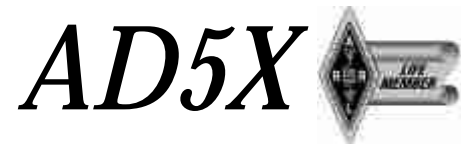
Loss vs Freq. vs Efficiency

- ◆ Losses get worse fast if ground losses and/or coil losses increase due to low antenna radiation resistance.
- ◆ Things get much better as you go higher in frequency because the radiation resistance increases as **frequency²** and so the other losses don't hurt you as much.
- ◆ Conversely, efficiency can get much worse when you go lower in frequency.



Determining Efficiency

- ◆ Measure the antenna 2:1 SWR bandwidth
 - Typically 30-80 kHz for a 7-8 foot long antenna.
- ◆ From the above, determine the antenna Q.
- ◆ Find antenna capacitance (based on length).
 - 3.75 pf/ft for base loading, 1.9 pf/ft for center loading.
- ◆ Calculate resonating inductance needed.
- ◆ Calculate the radiation resistance
 - Base loaded or center loaded.
- ◆ Determine Total System Resistances.
- ◆ Calculate the antenna efficiency.

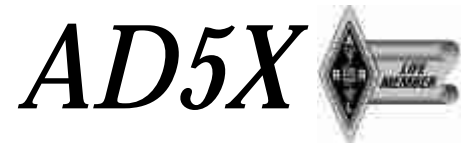


Mobile Antenna Comparisons

Some common mobile antennas

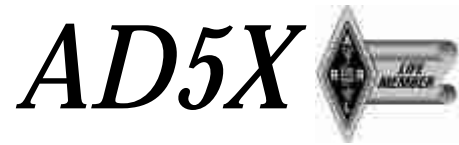
| <u>Type</u> | <u>2:1 SWR BW (40m)</u> |
|---------------------|-------------------------|
| Carolina BugKatcher | 30 kHz |
| Hustler "Standard" | 40-50 kHz* |
| Hamstick | 50 kHz |
| Outbacker | 50 kHz |
| Hustler "Super" | 50-80 kHz* |

* From Data Sheets



Ex: Carolina BugKatcher

- ◆ Measure the 2:1 VSWR bandwidth of your antenna
 - 30 kHz
- ◆ From the above, determine the antenna Q.
 - Antenna $Q = 360f_{\text{MHZ}} / (2:1 \text{ VSWR BW}_{\text{KHZ}}) = 360(7.2)/30 = 86.4$
- ◆ Measure the antenna length and calculate the antenna capacitance using 1.9 pf/ft (antenna is center loaded).
 - $7\text{ft} \times 1.9 \text{ pf} = 13.3 \text{ pf}$
- ◆ Calculate the inductance needed for resonating the antenna.
 - $L = 1 / [(2\pi f)^2 C] = 1 / [(2\pi 7.2 \times 10^6)^2 (13.3 \times 10^{-12})] = 36.74 \mu\text{Hy}$



Carolina BugKatcher (Cont.)

◆ Calculate the radiation resistance (center loaded).

- $R_{RC} = 6.7 \times 10^{-6} (hf)^2 = 6.7 \times 10^{-6} (84 \times 7.2)^2 = 2.45 \text{ } \Omega$

◆ Determine the Total System Resistance.

- $R_T = 2\pi fL / \text{Antenna } Q = 2\pi(7.2)(36.74)/86.4 = 19.24 \text{ } \Omega$

◆ Calculate the antenna efficiency.

- Power Loss (dB) = $10 \text{ LOG } [R_R / (R_R + R_L + R_G)]$
 $= 10 \text{ LOG}(2.45/19.24) = \underline{\underline{-9 \text{ dB}}}$

40m 2:1

| <u>Antenna</u> | <u>VSWR BW/Q</u> | <u>Length</u> | <u>C(pf)</u> | <u>L(uhy)</u> | <u>R_R(O)</u> | <u>Eff.%</u> | <u>Loss</u> |
|----------------|------------------|---------------|--------------|---------------|-------------------------|--------------|-------------|
| CBKatcher | 30 kHz/86 | 7'(84") | 13.3 | 36.74 | 2.45 | 12.7 | -9 dB |
| Hamstick | 50 kHz/52 | 7'(84") | 13.3 | 36.74 | 2.45 | 7.7 | -11 dB |
| Hustler Super | 80 kHz/32 | 7'(84") | 13.3 | 36.74 | 2.45 | 4.7 | -13dB |

What are the actual ground losses?

◆ Carolina BugKatcher Coil Q Measured: 210

$$R_L = 2\pi fL/Q = 2\pi(7.2)(36.7)/210 = 7.9 \text{ O}$$

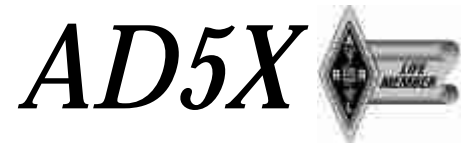
$$R_{RC} = 6.7 \times 10^{-6} (hf)^2 = 6.7 \times 10^{-6} (84 \times 7.2)^2 = 2.45 \text{ O}$$

$$R_T = 2\pi fL/\text{Antenna Q} = 2\pi(7.2)(36.74)/86.4 = 19.24 \text{ O}$$

$$R_G = R_T - R_R - R_L = 19.24 - 2.45 - 7.9 = 8.9 \text{ O (typically 7-15 ohms)}$$

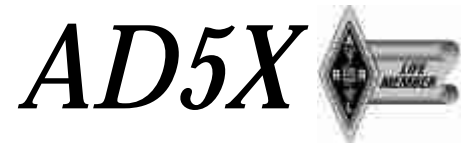
AD5X Auto-Tuners & Short Antennas

- ◆ Auto-tuners provide flexibility
 - You must re-tune an **efficient** antenna every few KHz.
- ◆ Auto-tuner must be located directly at the base of a *non-resonant* antenna for best operation.
 - The auto-tuner is now effectively the loading coil of a base-loaded short antenna.
- ◆ Auto-tuner must be connected to the base of a *non-resonant* antenna with a very short piece of wire – NOT COAX.



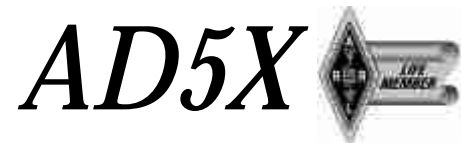
Auto-tuners (Cont.)

- ◆ Unfortunately, most mobile auto-tuners do not have hi-Q inductors.
 - Mobile auto-tuner inductors are typically close-wound inductors with much lower Q than the air-wound loading coil inductors normally used.
 - This base-loaded antenna will be less efficient than normal due to the lower Q inductors in the auto-tuner.
- ◆ So again, TANSTAFFL
 - You are trading off efficiency for QSY convenience.

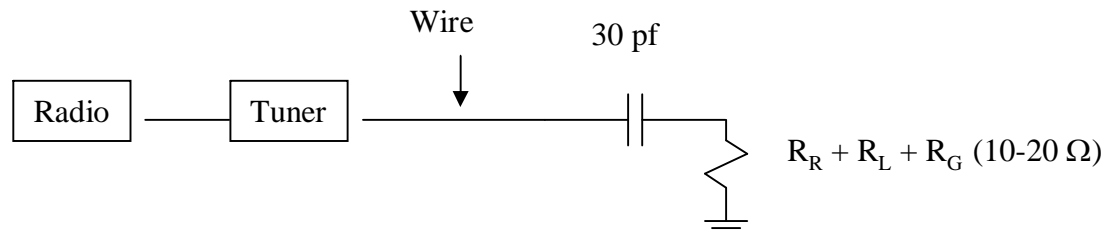


Auto-tuners (Cont.)

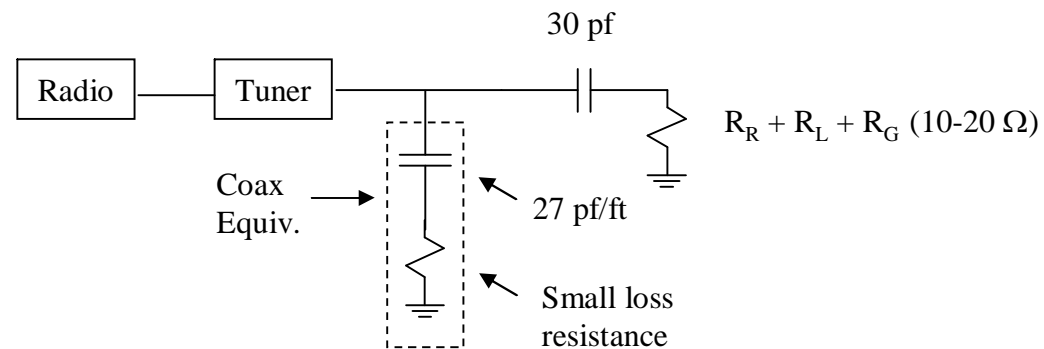
- ◆ Coax interconnects from an antenna tuner to a non-resonant antenna leads to very poor efficiency.
- ◆ A short antenna capacitance ~ 30 pf (depends on length).
 - A one-foot length of coax cable has about the same capacitance.
 - So you will shunt the antenna capacitive reactance with a similar amount of coax capacitive reactance.
- ◆ You could lose half of your power just by putting a 1-foot section of coax between the tuner and non-resonant antenna!



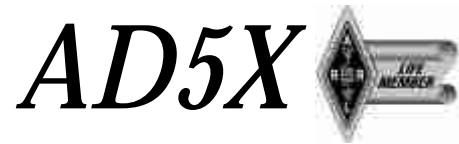
Auto-tuners (Cont.)



Tuner with short wire interconnect

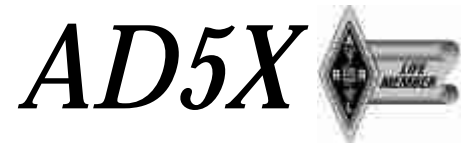


Tuner with 1-ft coax interconnect



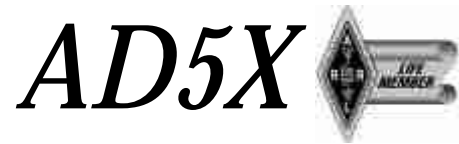
Efficiency Summary

- ◆ Use center loading
 - Typically doubles the efficiency of base loading
 - 3 dB or ½ S-Unit improvement
- ◆ Use high-Q coils
 - Large wire (with at least 1-turn wire separation)
 - Air wound
- ◆ High-Q means reduced operating bandwidth!
 - But more power is radiated
- ◆ Use the highest frequency HF band available
 - Doubling the frequency (7→14 Mhz) **quadruples** the radiation resistance.
- ◆ Make your antenna as long as possible.
 - Increases radiation resistance as ratio of length².



Efficiency Summary (Cont.)

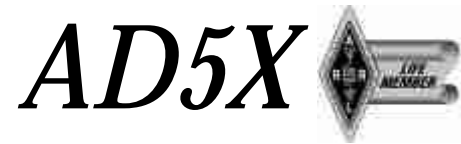
- ◆ Mount the antenna as high as possible.
 - Reduces Ground losses.
- ◆ Keep capacitive hats well-above loading coil.
 - Hat-to-coil capacitance reduces coil Q.
- ◆ If you don't need some sort of base matching to achieve a good VSWR with a short antenna, you probably have high coil and/or ground losses.
 - The better the antenna/ground is, the worse the VSWR at resonance becomes for a short efficient antenna.



Efficiency Summary (Cont.)

- ◆ It is BEST to use a resonant antenna.
- ◆ If you use an auto-tuner with a *non-resonant* antenna, use a short wire interconnect to the base of the antenna.
 - For reasonable VSWR conditions ($< 5:1$ VSWR) coax losses will be minimal if the antenna tuner is located away from the antenna.
 - Coax losses are not too bad at these VSWR levels if the coax run is reasonably short.

“It’s not what you don’t know, but what you know that ain’t so!” – Will Rogers



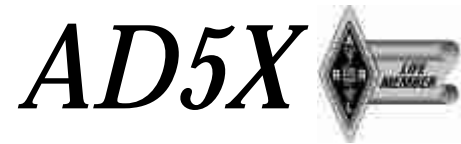
HF Mobile Considerations

◆ Compact radios designed to put into cars

- Alinco DX-70T/TH
- Icom IC-706MKIIG/7000
- Kenwood TS-50S/480S
- Yaesu FT-100D/857ND

◆ We'll look at:

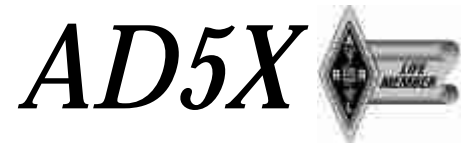
- Transceiver mounting
- Powering
- Noise reduction
- Antenna location



Safety First!!!

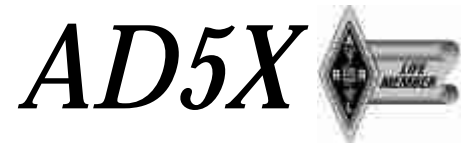
- ◆ **Remember - Driving is your first priority!**
- ◆ Mount your transceiver firmly for safety
- ◆ Radio must be readily visible and not interfere with car operation and safety equipment
- ◆ Mag-mount antennas can be hazardous in an accident
- ◆ Don't let radio operation distract you!

Radios will never be a success in cars because
“...people cannot drive and listen to the radio at the same time.” *Electronics* magazine - 1922



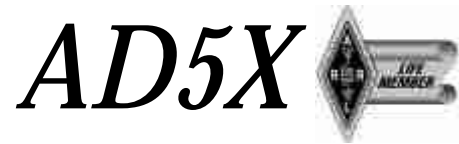
Mobile Mounting Basics

- ◆ Always provide a SHORT ground connection at the radio.
 - Braid from radio to car chassis
- ◆ Use a permanent mount, but provide for easy removal of the radio if possible
 - Thumbscrews vs standard mounting screws
 - Typically 4mm x 20mm
 - www.mortonmachine.com
- ◆ Use your automotive sound system for transceiver audio for great sound
 - Cassette adapters work great



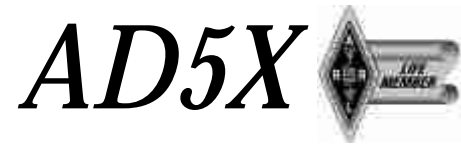
Powering

- ◆ Power directly from the battery or high current accessory connector if available
 - Use 12-gauge wire or larger
- ◆ Fuse positive & negative power leads when connected directly to the battery
 - Positive lead fusing OK if connected to high current accessory connector
 - Use blade-type fuses and fuse holders
- ◆ Use 30-amp PowerPole connectors
 - Self-cleaning contacts
 - Very low resistance contacts



Antenna Connections

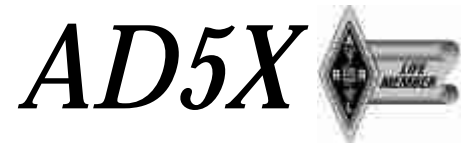
- ◆ Use a *high-quality* ball-mount on left side of car
 - Less prone to hitting overhead tree branches
 - Doesn't un-screw
- ◆ Use Home Depot “appliance” paint on ball-mount to match car
- ◆ Use trunk-lip, mag-mount, hatch-back mounts only as last resort.
 - Measured 20 ohms higher ground loss on hatch-back vs ball mount on Ford Explorer
- ◆ Use LMR-200 or LMR-240 (RG-58/8X size) coax.
 - Both are 100% shielded



Noise Reduction

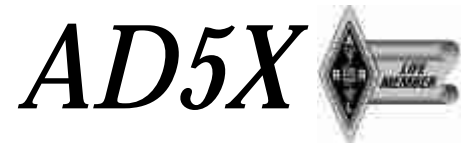
- ◆ Noise problems are normally your greatest challenge!
- ◆ Test noise level with & without 20 meter antenna, with & without car engine running.
 - Determines whether noise is radiated or conducted
- ◆ Conducted power line noise:
 - Make sure radio is well grounded
 - Short braid from transceiver to car chassis
 - Add 12-volt in-line filters

But – Radiated Noise is normally the main problem



Radiated Noise Solutions

- ◆ Connect copper braid from hood to body
- ◆ Connect copper braid from trunk or hatchback to body
- ◆ Connect copper braid from engine to body
- ◆ Connect copper braid from exhaust pipe to body at engine end, **and tail pipe end.**
 - Tail pipe looks like $\lambda/4$ on 20 meters!
- ◆ Put bypass capacitors on all fan and air conditioning leads



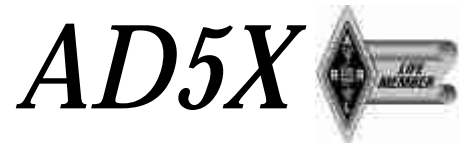
Mobile Antenna “Tricks”

◆ Hamsticks

- Replace two #6 setscrews with one #6 thumbscrew
- Use each on two bands with 1/8” shorter brass rod
 - 40/30m, 20/17m, 15/12m
- Use capacitive base matching
 - 560 pf for 40m, 150 pf for 20 & 17m

◆ Carolina BugKatcher

- Replace two #6 setscrews with one #6 thumbscrew
- Use capacitive base matching
 - 680 pf/40m, 220 pf/20m, 150 pf/17m, 52 pf/15m, 24 pf/12m



Mobile Antenna “Tricks” (cont.)

◆ Outbacker

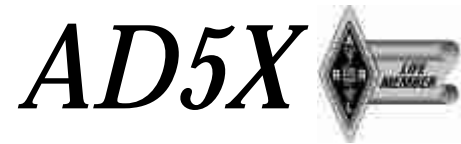
- Screw 7/16” SS nut over normal thumb bushing
 - Makes tightening and adjusting whip easier

◆ Bug Catchers

- Capacity hats should be well above loading coil
- Want to increase capacitance to ground, not capacitance to loading coil!

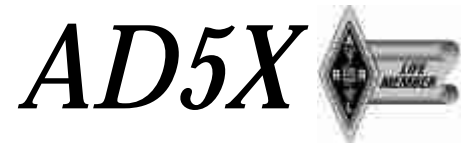
◆ All Antennas

- Keep loading coil ABOVE car roof if possible
- Keep loading coil as far from car as possible
- Mark stingers with permanent markers for desired frequencies



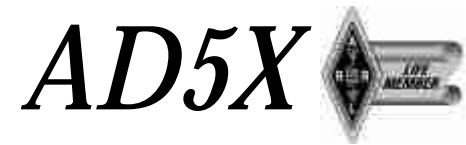
General “Tricks”

- ◆ Always use stainless steel hardware
- ◆ 1/8 NPT brass plumbing pieces are tapered 3/8X24 threads.
 - Can be chased with 3/8X24 tap.
- ◆ You can screw a single-hole SO-239 into a 3/8 NPT brass adapter.



General “Tricks” (Cont.)

- ◆ A “UHF-T” with capacitors soldered into PL-259 connectors makes simple base matching device
- ◆ Or build capacitive, inductive or transformer matching units (info later)
 - Appropriate capacitors for 100 watts
 - 300V minimum
 - Silver Mica preferred
- ◆ Consider making your own antenna!




HF Installation in Geo



Richardson, Texas



Phil Salas – AD5X

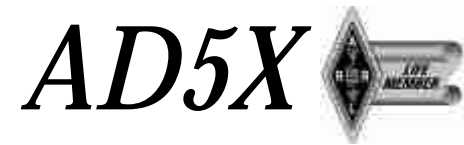
AD5X 

IC-706 in Geo



Richardson, Texas

Phil Salas – AD5X



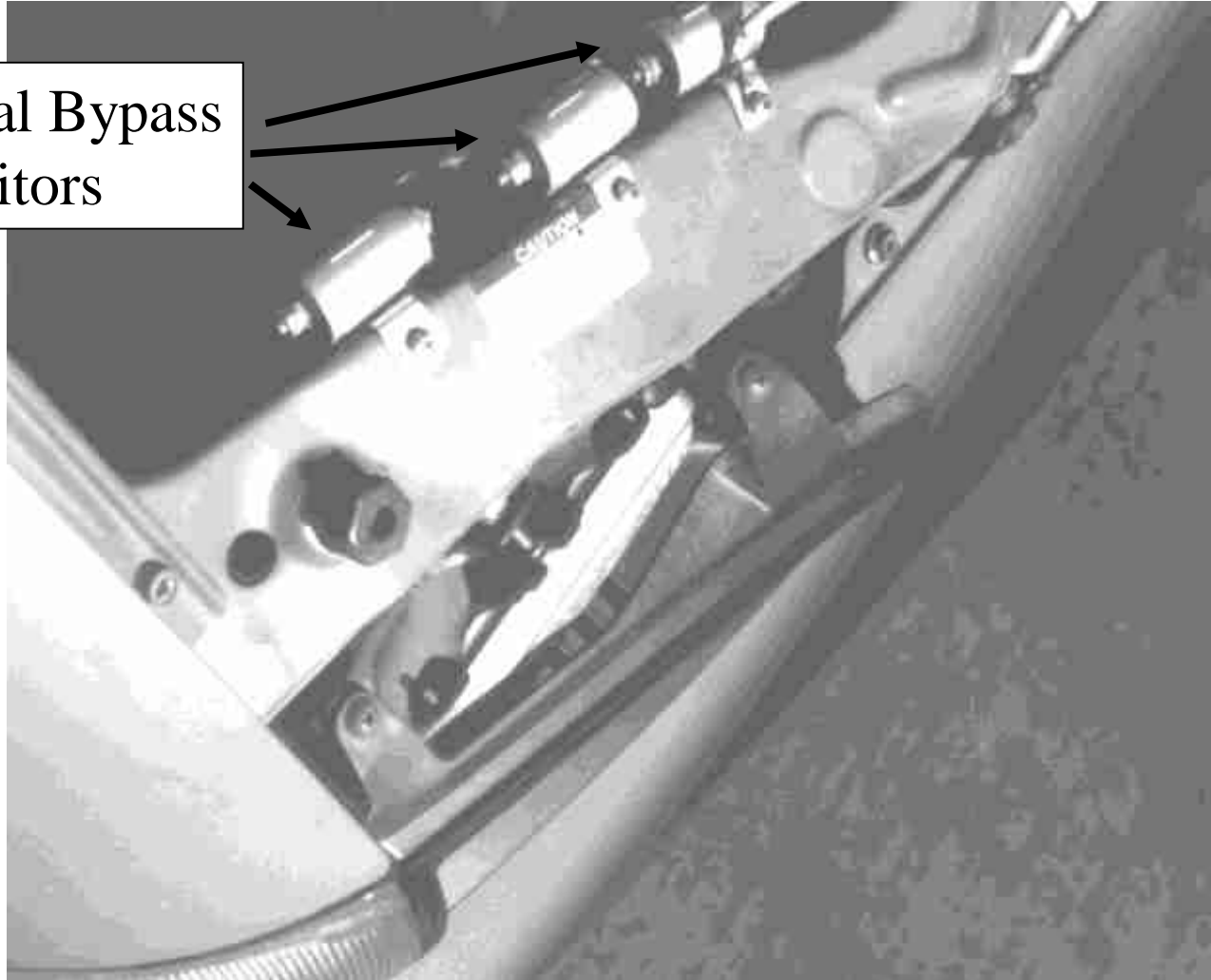
IC-706 & IC-3200 in Explorer

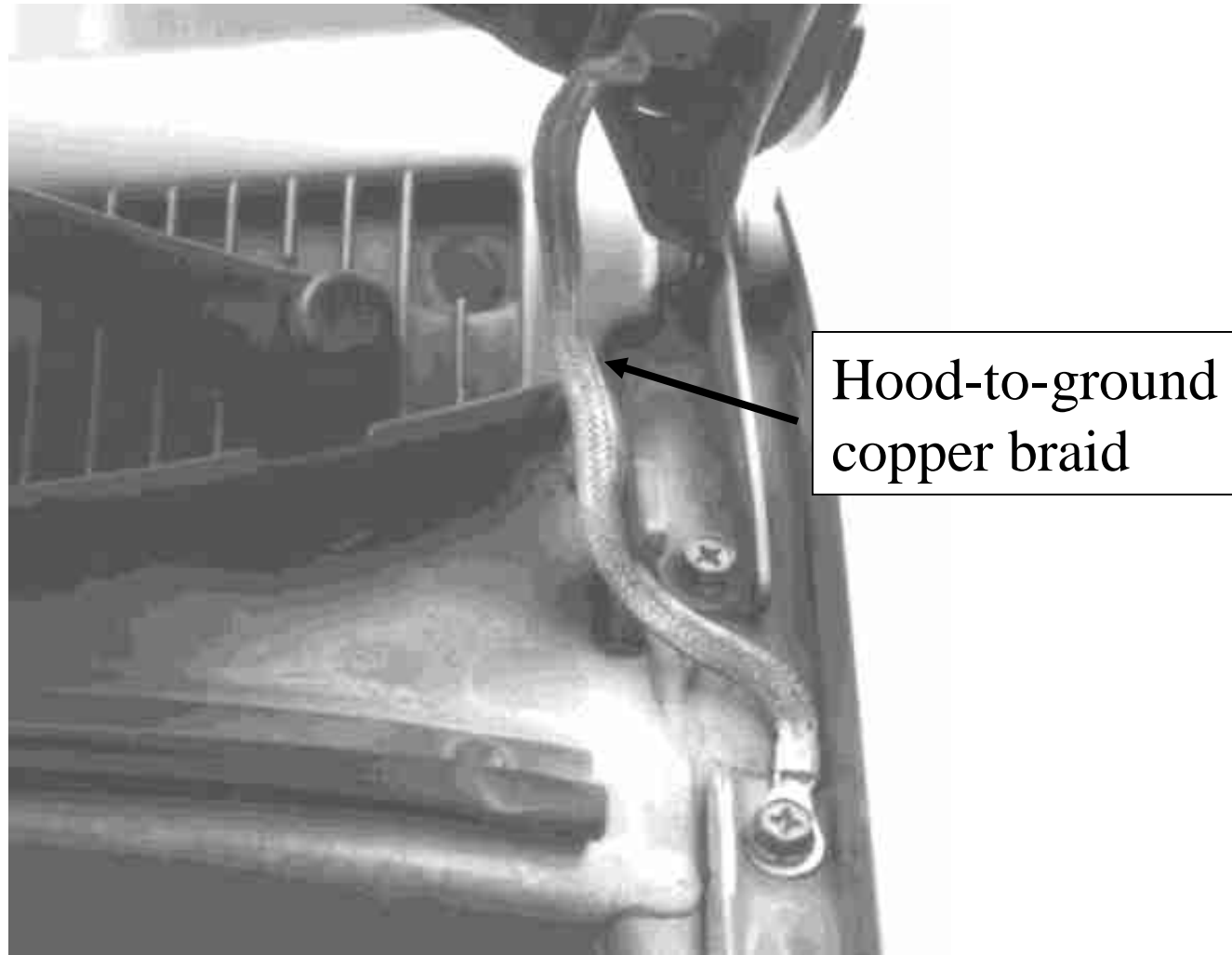


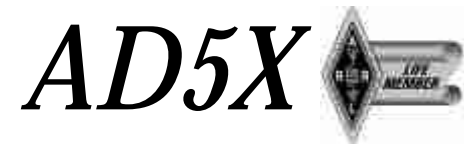
Richardson, Texas

Phil Salas – AD5X

Coaxial Bypass
Capacitors





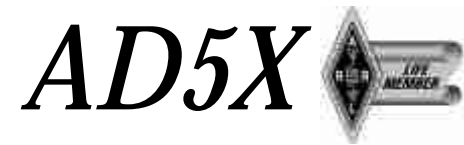


Outbacker on Geo

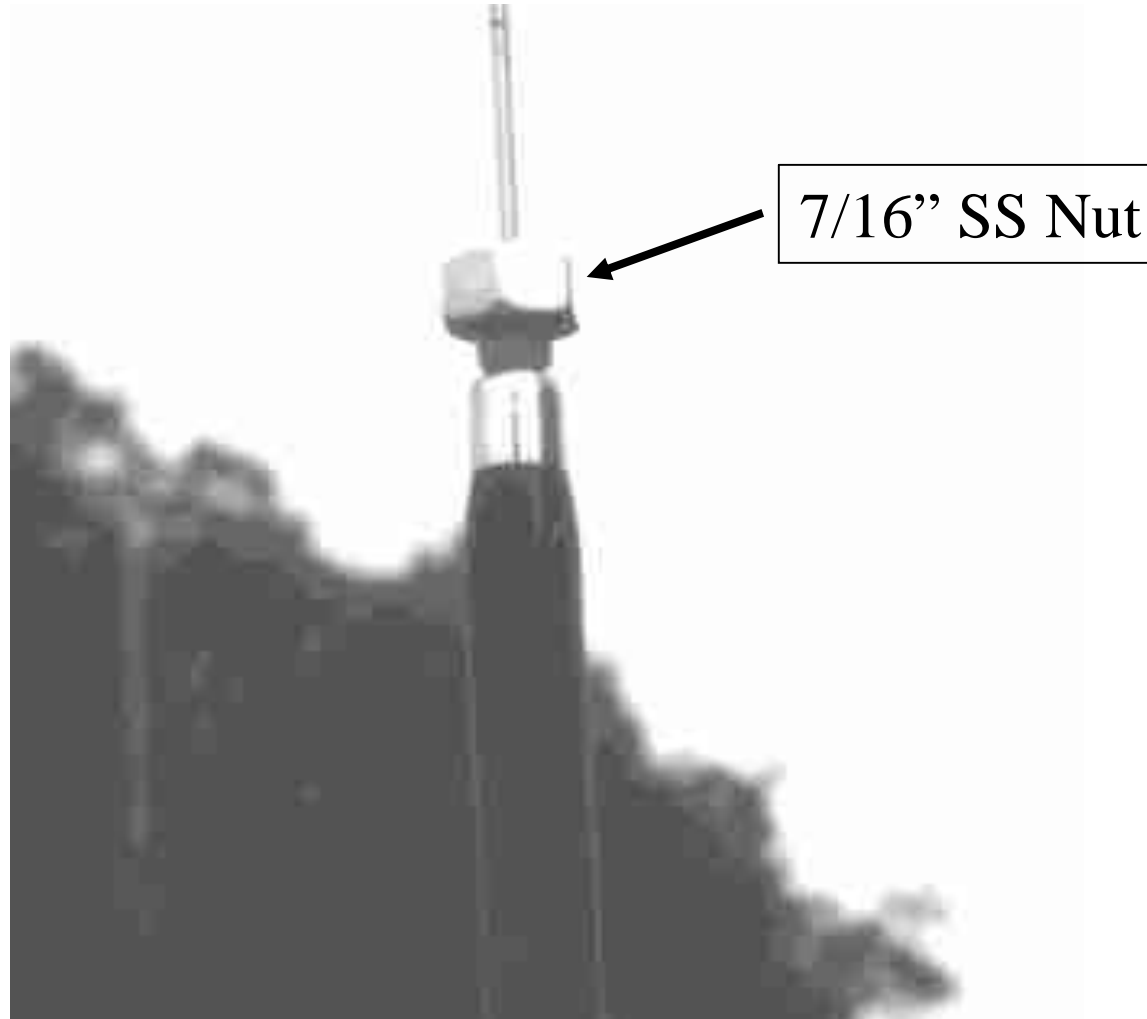


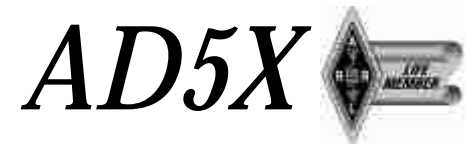
Richardson, Texas

Phil Salas – AD5X



Easy Adjust for Outbacker



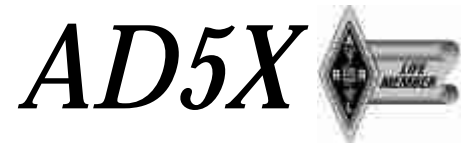


Screwdriver on Geo



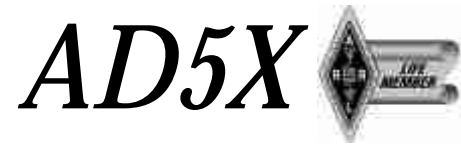
Richardson, Texas

Phil Salas – AD5X



References

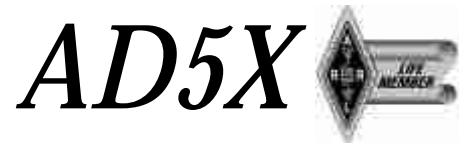
- ◆ Don Johnson, "40+5 Years Of HF Mobileering", World Radio.
- ◆ Dave Ingram, "The Modern Amateur's Mobile Handbook", MFJ Enterprises, Inc.
- ◆ Walt Maxwell, "Reflections", ARRL.
- ◆ "The ARRL Antenna Book", 16th Edition, Chapter 16.
- ◆ Bruce Brown, "Optimum Design Of Short Coil-Loaded High Frequency Mobile Antennas", The ARRL Antenna Compendium Volume 1.
- ◆ J.S. Belrose, "Short Antennas For Mobile Operation", QST September 1953.
- ◆ Don Johnson, "Everything you forgot to ask about HF Mobileering", World Radio.
- ◆ K0BG web site – www.k0bg.com



Antenna Construction Hints & Kinks

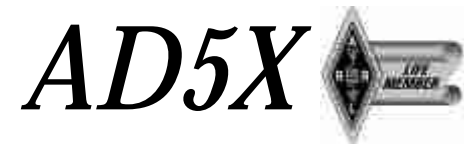
- ◆ Mobile/Portable Antenna Construction
- ◆ Antenna Accessories/Tools/Hints

"To invent, you need a good imagination and a pile of junk." - Thomas A. Edison

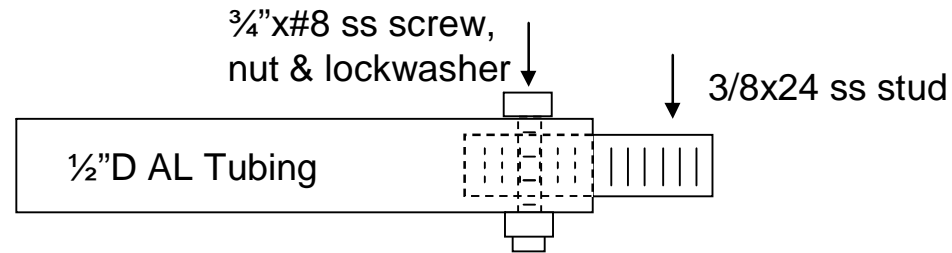


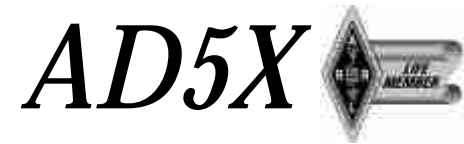
Build Efficient Short Antennas

- ◆ Use 3/8" diameter brass rods from local hardware store.
- ◆ Or 3/8" or 1/2" diameter aluminum tubing from Texas Towers or your local hardware store.
 - You can solder to aluminum with aluminum solder paste from www.solder-it.com.
- ◆ Make brass coupling interconnects for rods and coils.
 - Use 1/8 NPT brass nipples and couplings.
 - Thread 3/8" wood/fiberglass rods to screw into 1/8NPT couplings.
 - Non-preferred: Ream out couplings (use 3/8" drill bit) to fit over 3/8" diameter brass rods and wood/fiberglass insulators.

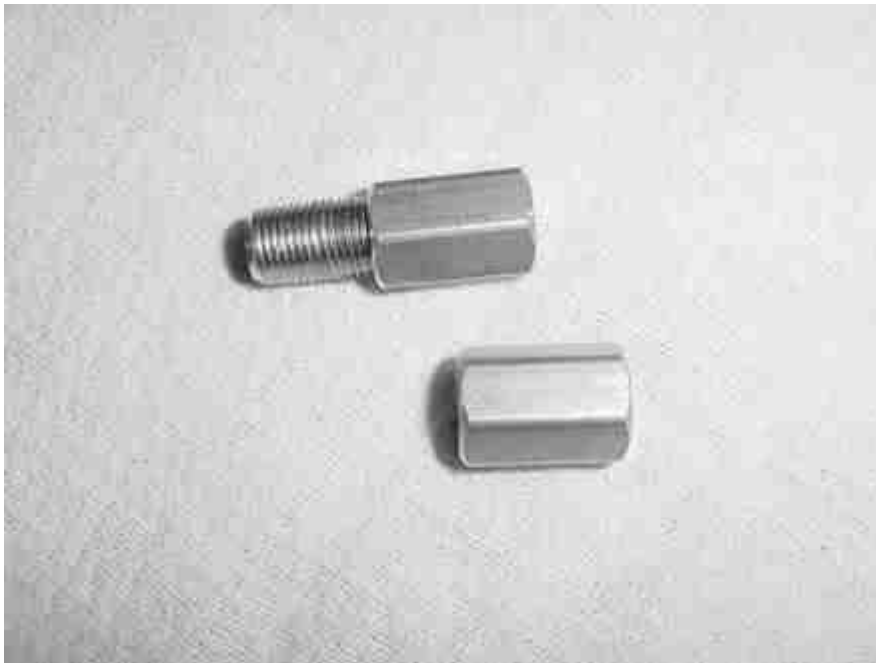


$\frac{1}{2}$ "D Mast with $\frac{3}{8}$ x24 Thread





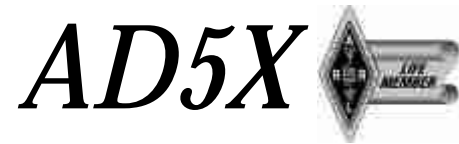
1/8NPT Nipple & Coupling



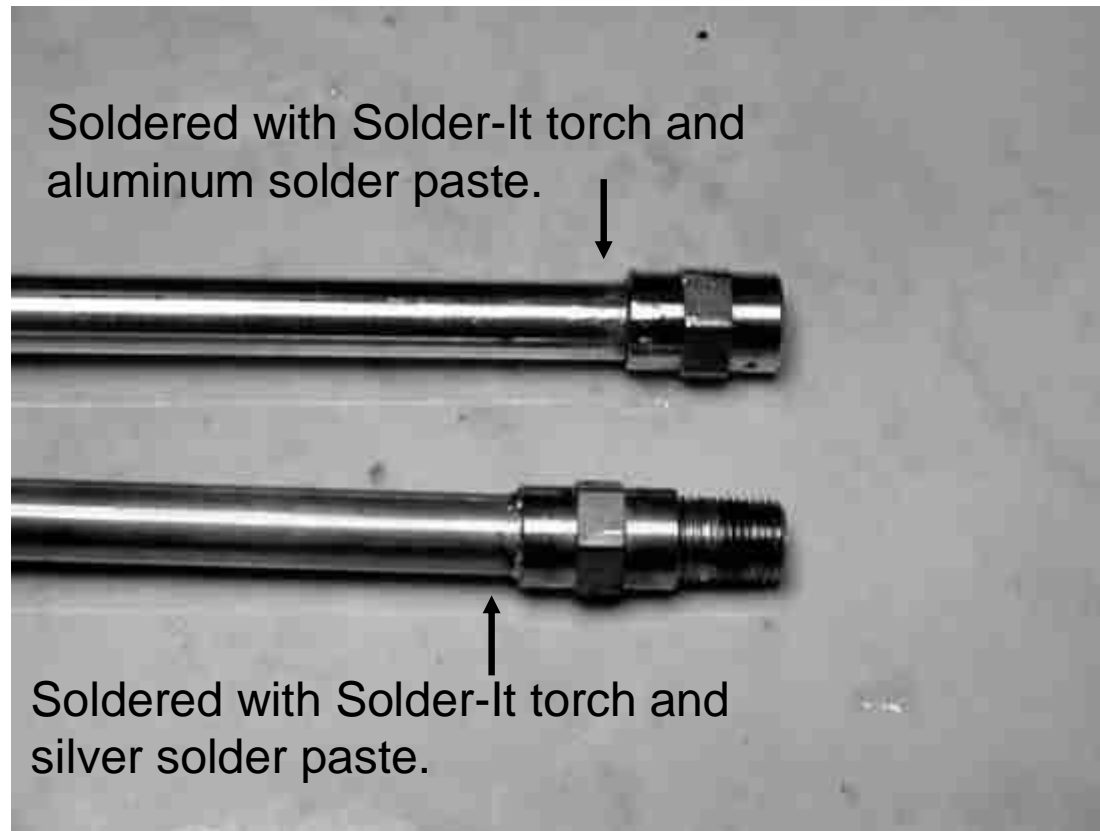
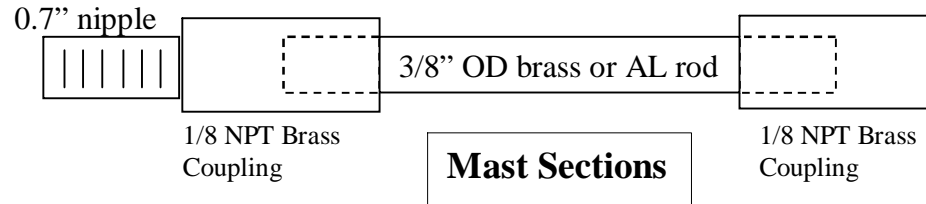
Male/Female 1/8NPT Assemblies

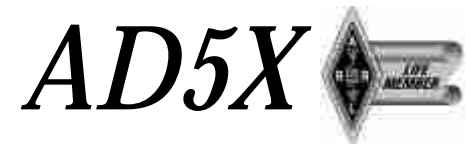


Reaming: Non-preferred
Be Careful!!

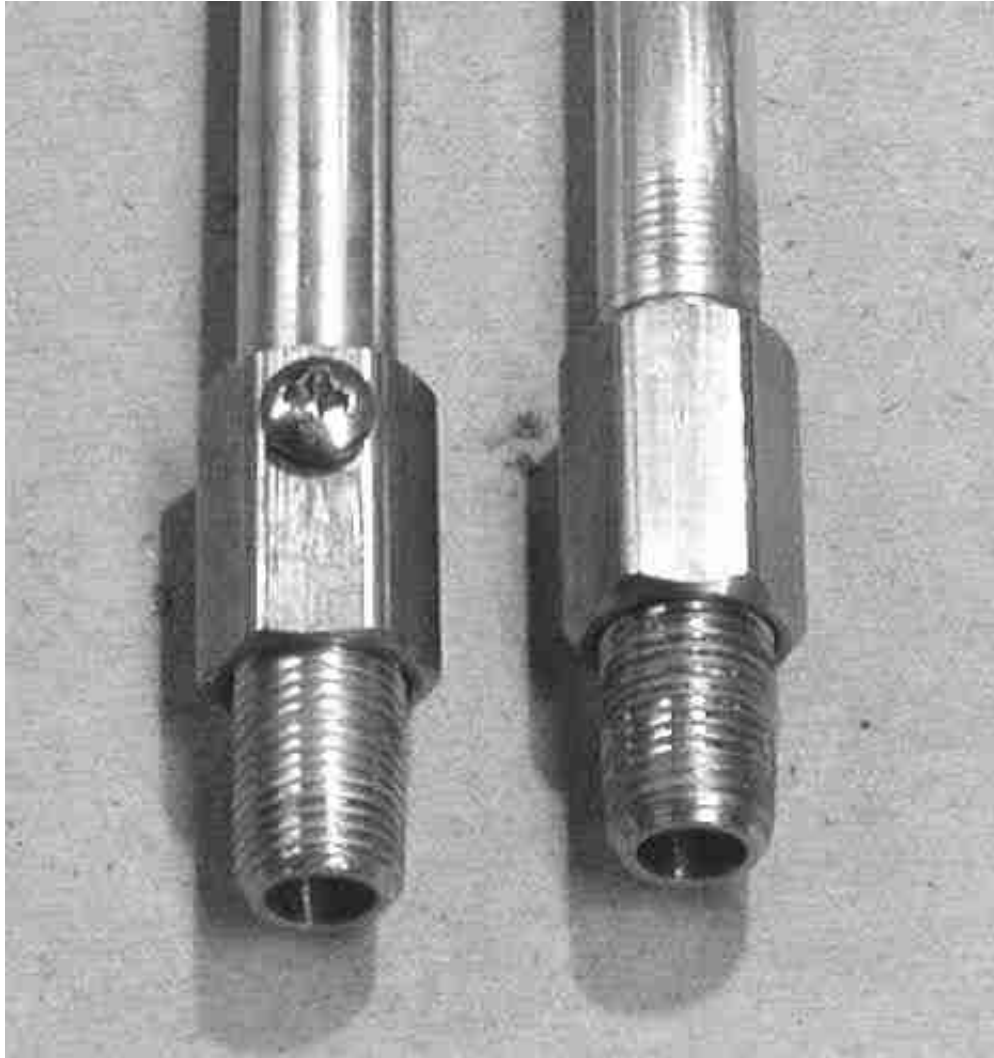


3/8" Diameter Mast Details



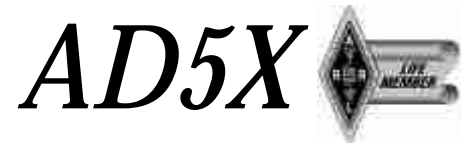


Alternative Attachments



Richardson, Texas

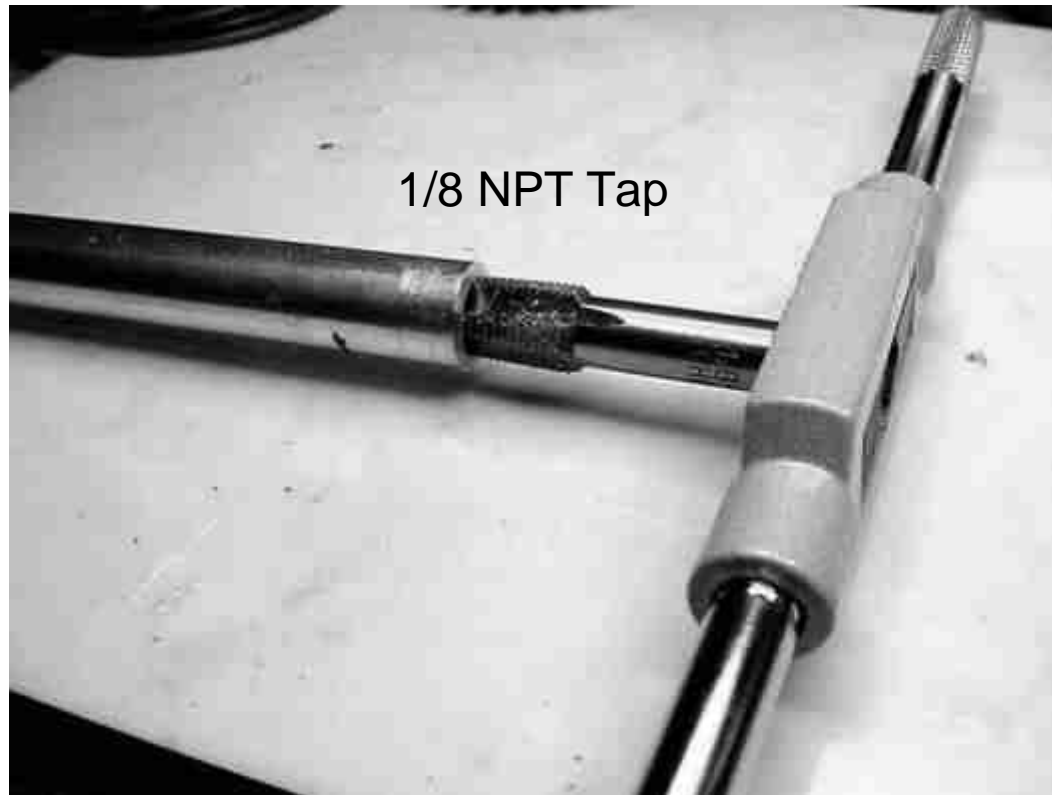
Phil Salas – AD5X

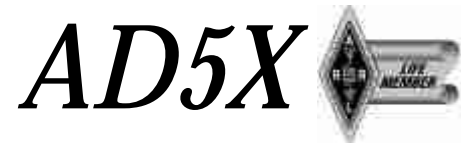


Better 1/2"D Mast Construction

Harbor Freight 39391-0VGA Tap & Die Kit @ \$12.99

Sizes: 4-40, 6-32, 8-32, 10-32, 10-24, 12-24, 1/4-20, 1/4-28, 5/16-18, 5/16-24, 3/8-16, 3/8-24, 7/16-14, 7/16-20, 1/2-13, 1/2-20, 1/8" NPT pipe tap.





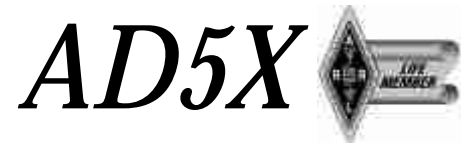
1/2" Diameter Mast Interfaces



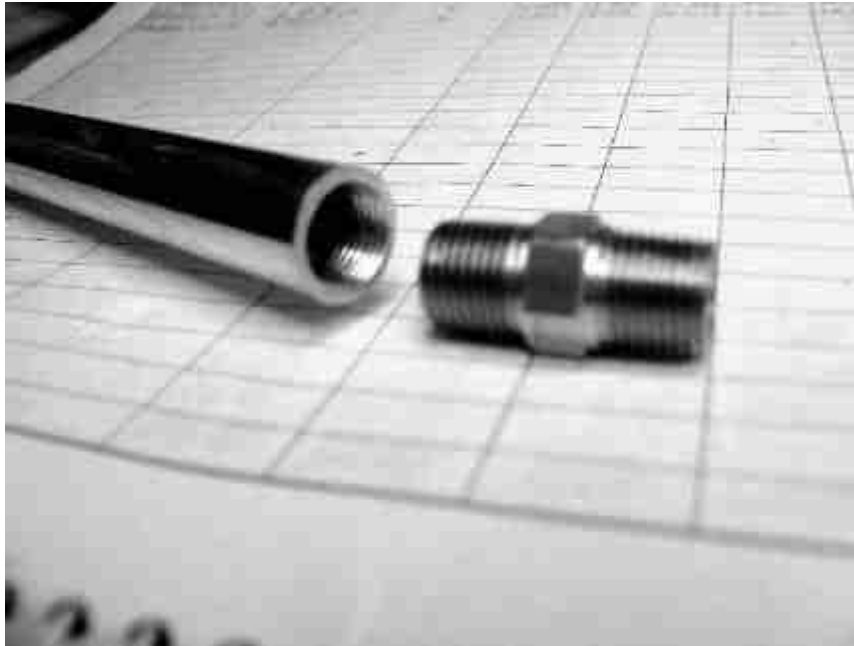
Parts for Female End



Assembled – With & Without
Heat-Shrink Tubing



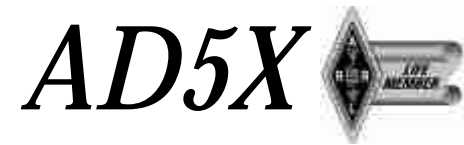
1/2" Diameter Mast Interfaces



Parts for Male End



Assembled – With & Without
Heat-Shrink Tubing

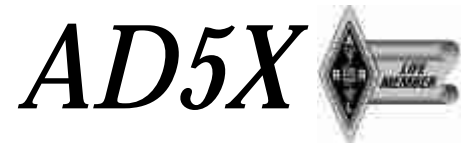


Nipples, Couplings, 3/8x24 Studs

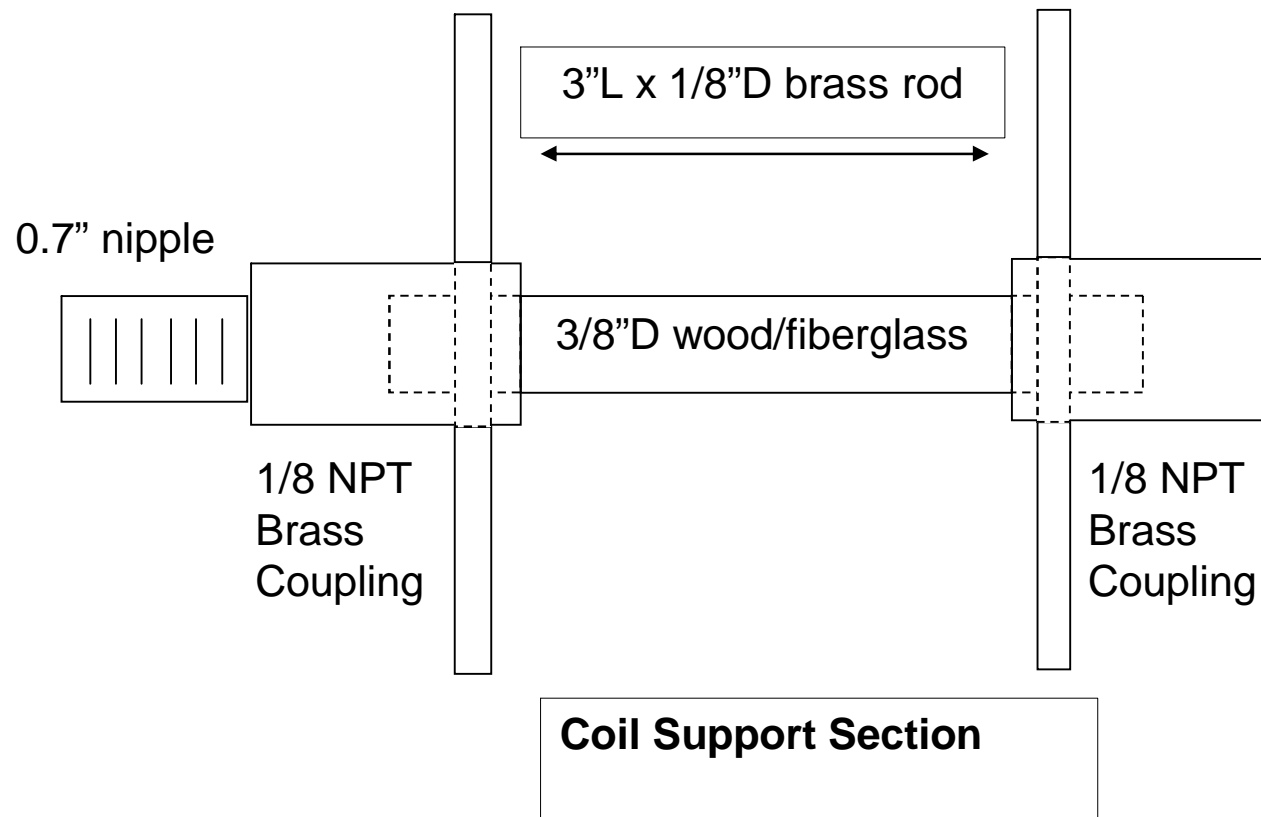


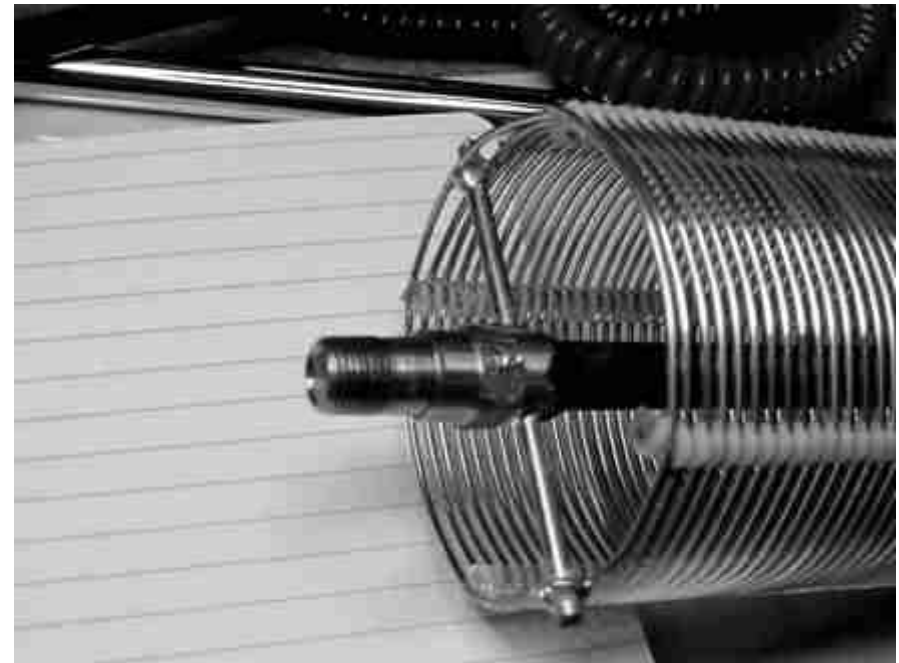
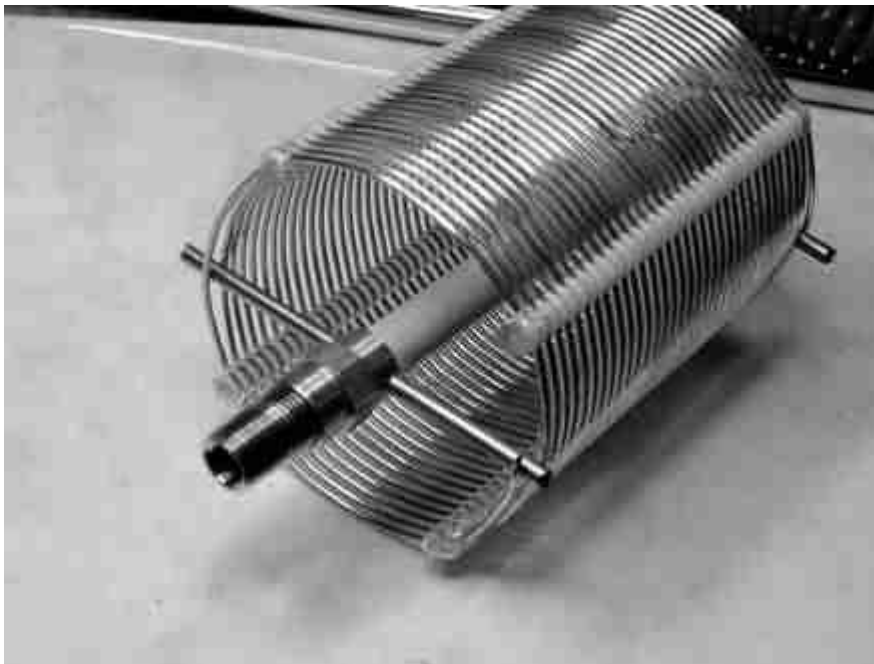
- ◆ Use 3/8" diameter wood dowel or fiberglass rod for the coil support.
- ◆ 1/4"D fiberglass Bicycle Flags also make good supports.
 - Use 1/4" compression-to-1/8 NPT Male/Female brass adapters
 - ***Be careful when working with fiberglass!***
- ◆ B&W 3027 Coil (~60 uHy)
 - 2"D x 10"L
 - Surplus Sales of Nebraska (www.surplussales.com)
 - \$15 ea
- ◆ MFJ-404-008 (~60 uHy)
 - 2.5"D x 5"L
 - \$15 ea.

Note: Reinforce ends of coils with Home Depot 2-part quick setting clear epoxy.



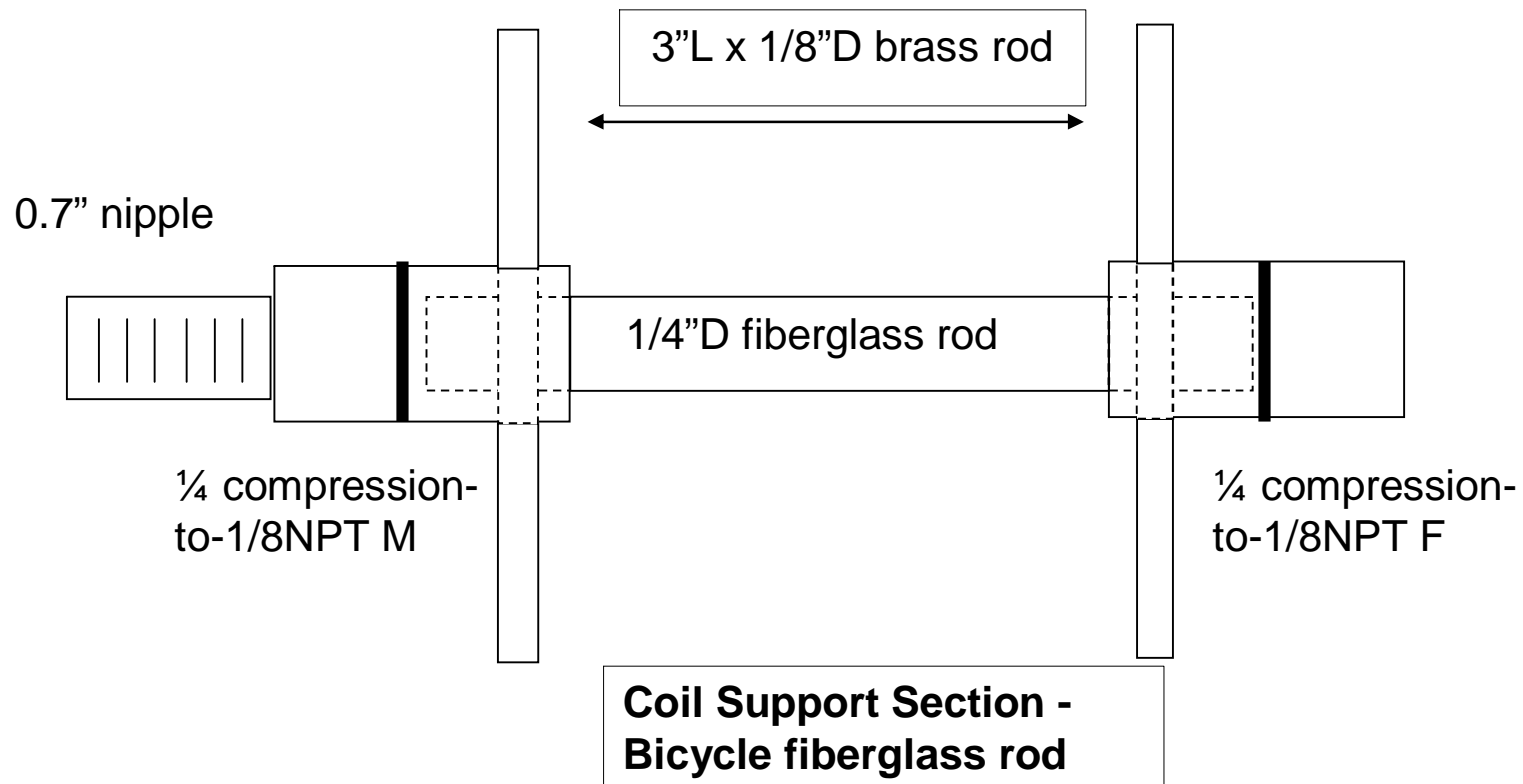
3/8" Dia. Rod Coil Support

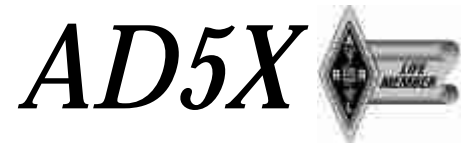




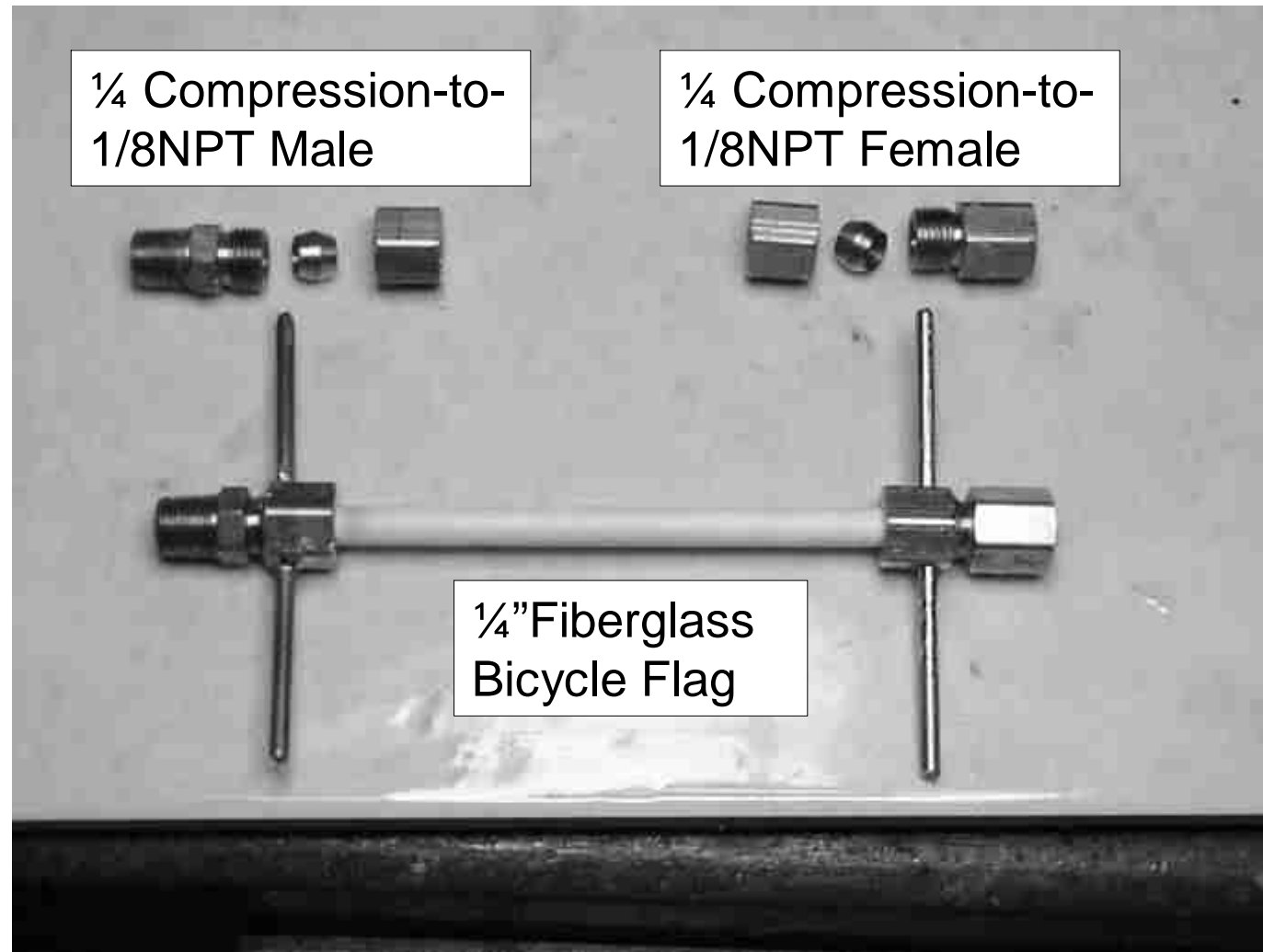
Coil: MFJ-404-008 @ \$14.95
2.5"D x 5"L

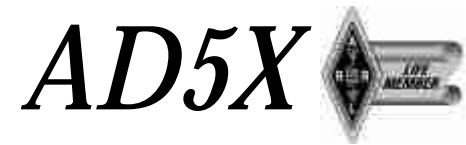
AD5X 1/4" Fiberglass Rod Coil Support



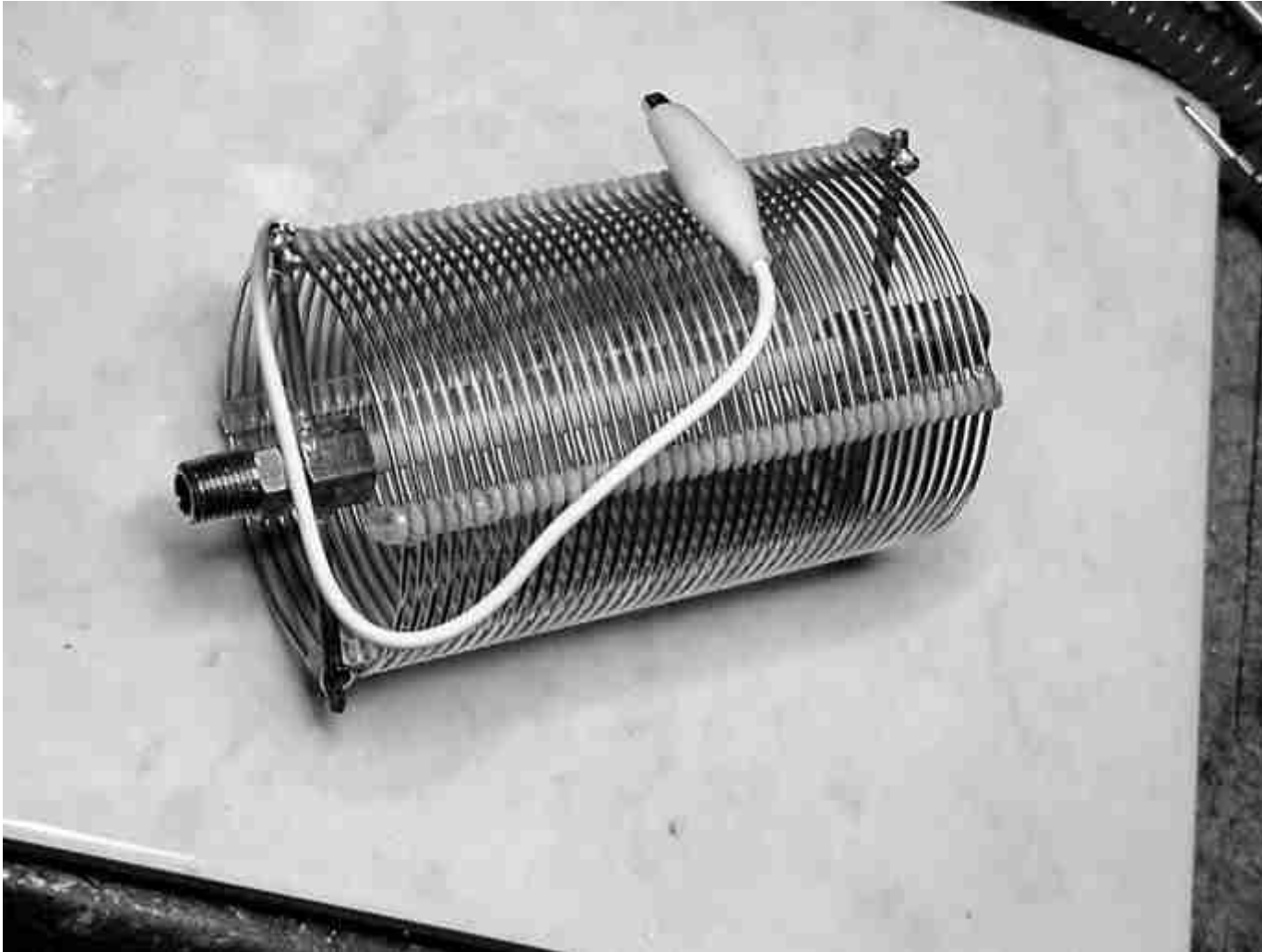


1/4" Fiberglass Coil Support





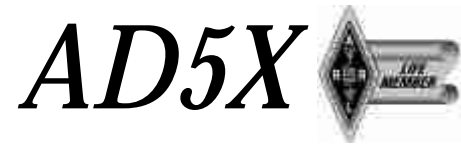
1/4" Fiberglass Support Coil



Richardson, Texas

Phil Salas – AD5X

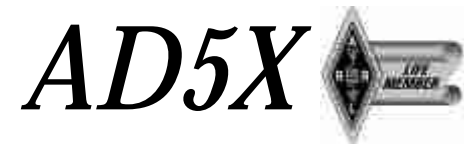




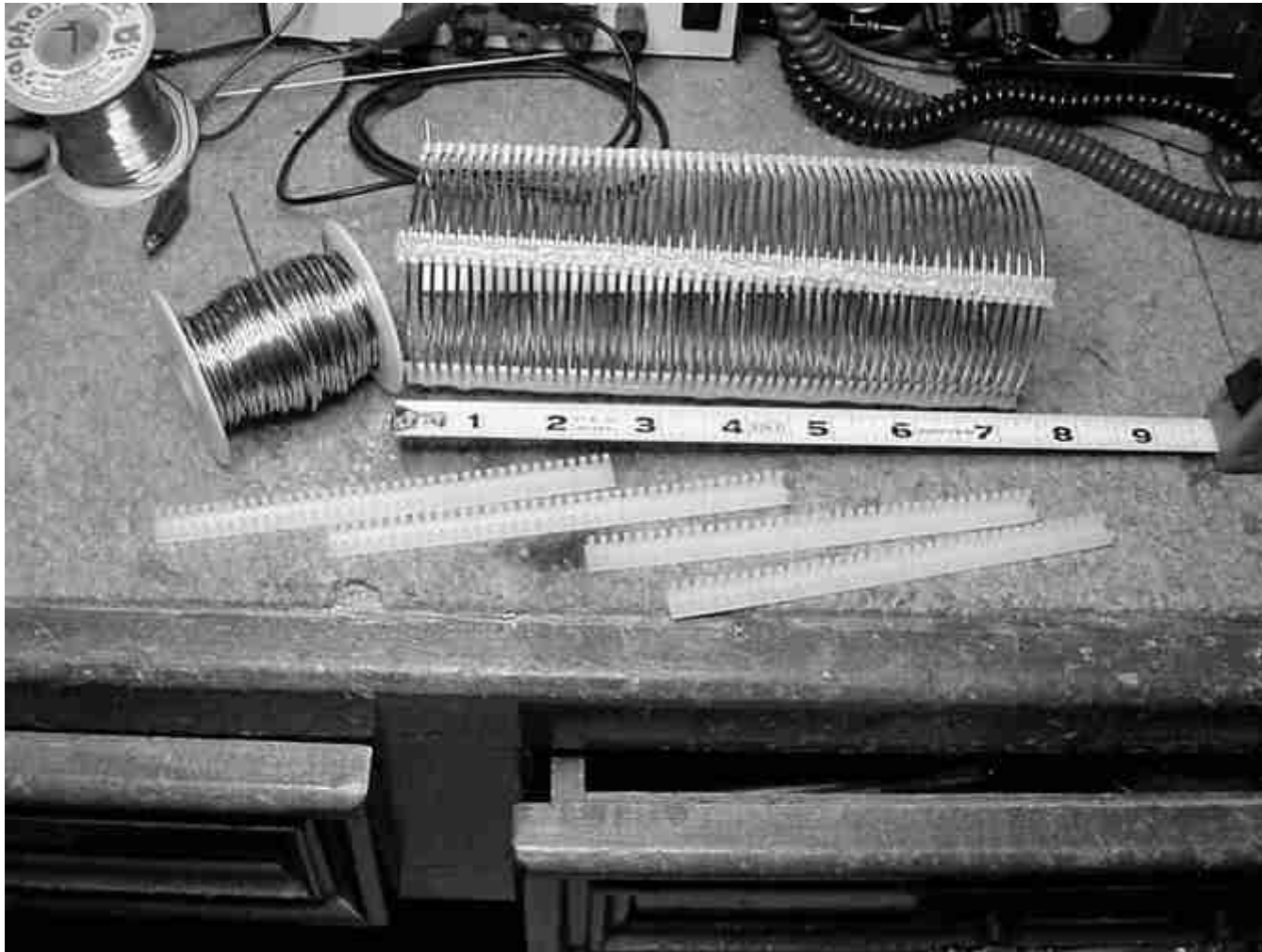
Build your Own Coil

◆ Items needed:

- Desired PVC pipe form (OD and length)
- Nylon Edge Trim (8-TPI)
 - McMaster-Carr 85085K8, \$10.29 for 25x12-3/4" strips
- 14 Gauge bare copper wire
 - McMaster-Carr 8873K51, \$10.20 for 80-feet
- Tie Wraps
 - To hold ends of Nylon Edge Trim to PVC pipe
- Hot Glue



Build Your Own Coil



Richardson, Texas

Phil Salas – AD5X



Build Your Own Coil



Richardson, Texas

$$L(uhy) = d^2n^2/(18d + 14l)$$

where:

d = diameter (wire center to
wire center in inches)

n = number of turns

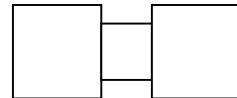
l = length of coil (inches)

AD5X Top Whips or Dipole Elements

- ◆ 1/8 NPT Nipple has a 1/4" ID
 - Will take a 1/4" OD fiberglass bicycle flag pole
 - Or a Pacific Antennas 72" telescoping whip
 - May need to ream nipple with 9/32" drill bit
- ◆ 1/8 NPT Nipple will screw solidly into a 0.5" OD aluminum tube.
 - Thread the 1/2" diameter tube for 1/8NPT.
- ◆ To make a 3/8X24 stud, screw a 3/8X24 stainless steel bolt firmly into a 1/8 NPT coupling. Then cut off the head of the SS bolt.

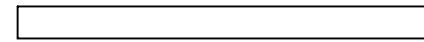
AD5X Top Whips or Dipole Elements

3/8 x 24 Stud



1/8 NPT Brass
Coupling

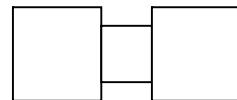
1/8 NPT x 3" Nipple



6' Bicycle Fiberglass Rod
or
Pacific Antenna 72" whip

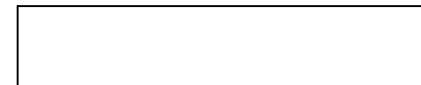
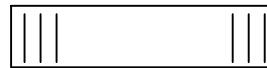
OR

3/8 x 24 Stud

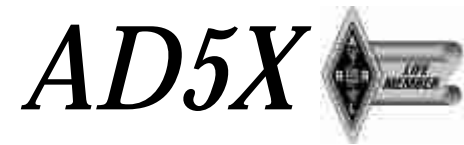


1/8 NPT Brass
Coupling

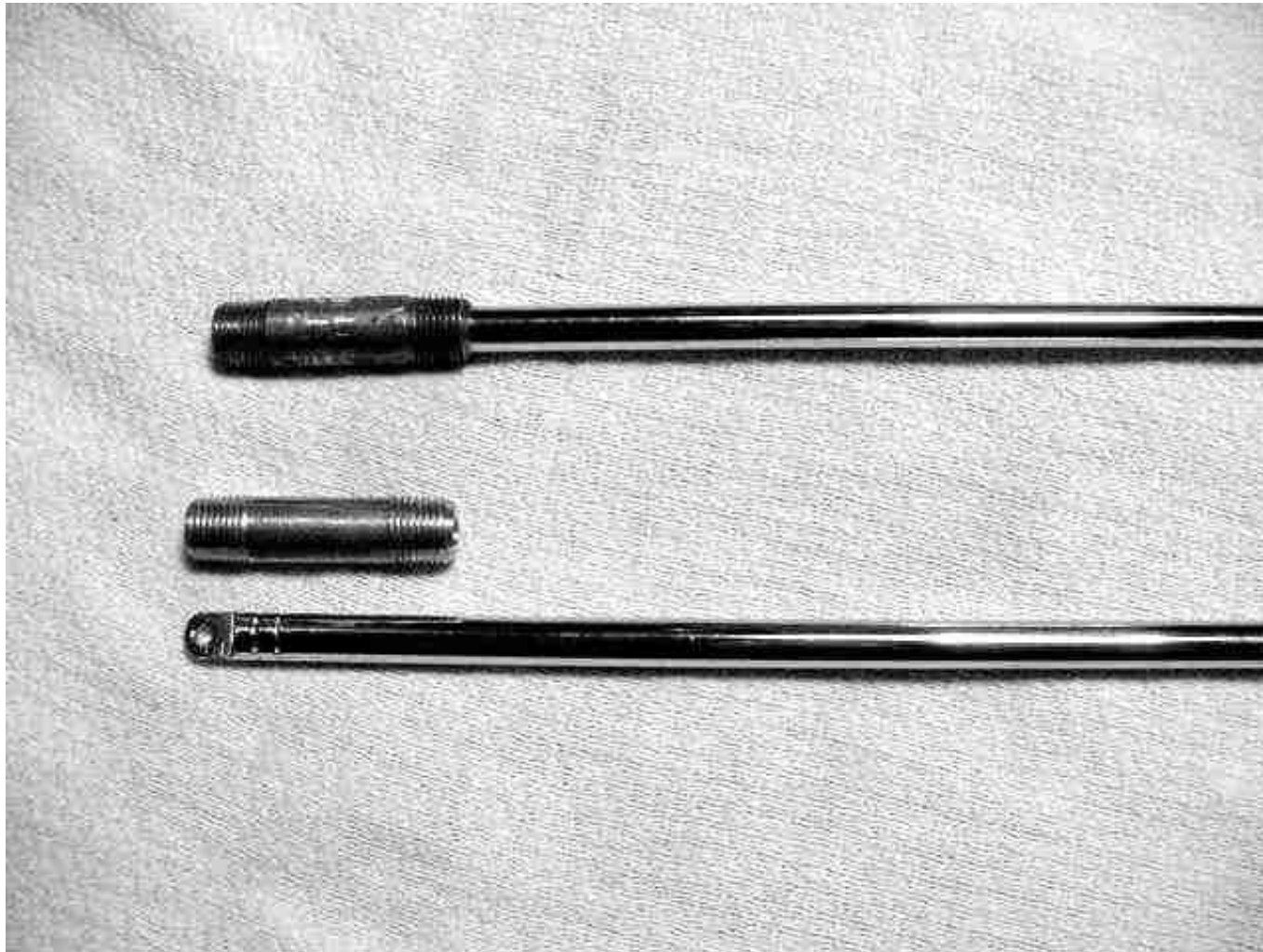
1/8 NPT x 3" Nipple



0.5" OD Aluminum Tube

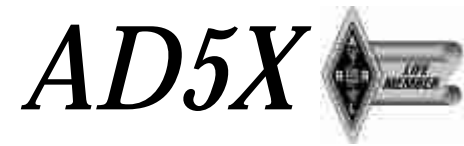


72" Whip Interface



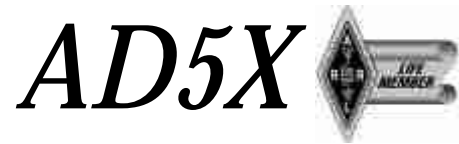
Richardson, Texas

Phil Salas – AD5X



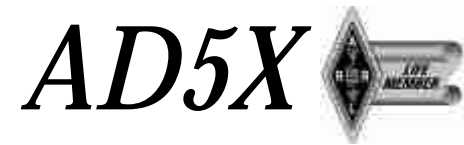
72" whip with 3/8 x 24 thread





Fixed and Sliding Whips

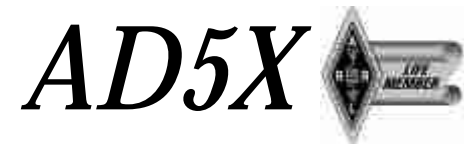
- ◆ Top whips can be made with 1/8" rods
 - 3-feet brass rod @ Home Depot for \$2.29 each
 - 4-feet steel rod @ Home Depot for \$1.19 each
 - 12-feet stainless steel rod from Jacob Schmidt
 - www.jschmidtstainless.com
 - 12-feet for \$2, but shipping ~\$10.
- ◆ Couplers made with 1/8 Compression-to-1/8NPT Male brass adapter
 - Drill out center hole to 1/8" diameter
 - Use compression collar for fixed whip
 - Throw away compression collar for sliding whip
 - Drill and tap brass adapter for #6 thumbscrew
 - And/or solder on #6 nut over tapped hole for extra support



1/8" Steel or Brass Whip Intfc

1/8 Compression-to-1/8NPT Male Adapter





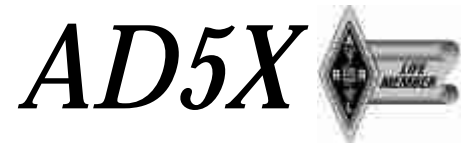
Sliding Whip Adapter

1/8 Compression-to-1/8NPT Adapter
Drilled & tapped for #6 thumb screw

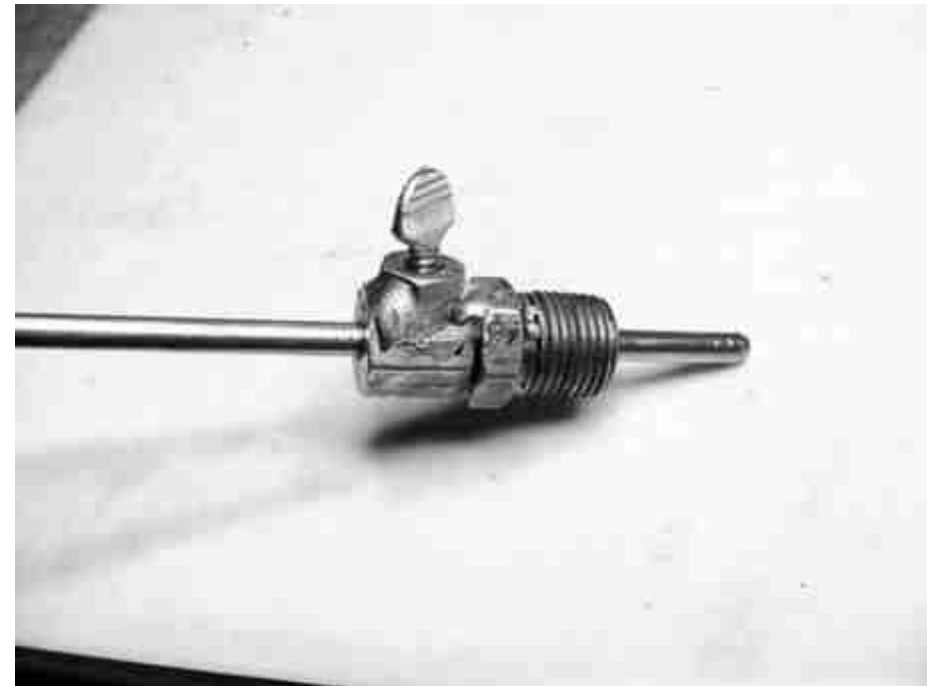
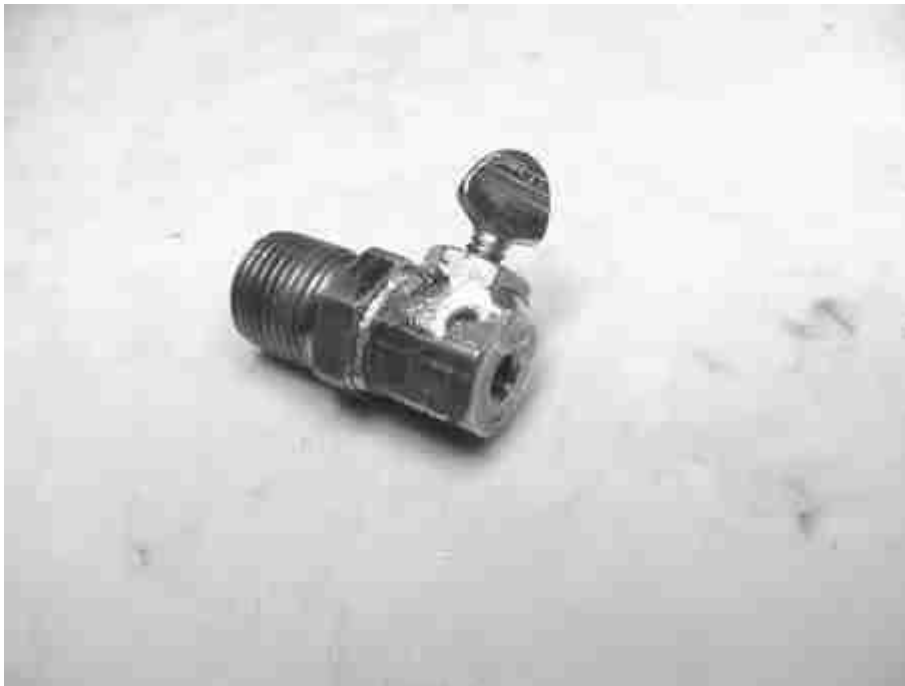


Sliding whip & shaft

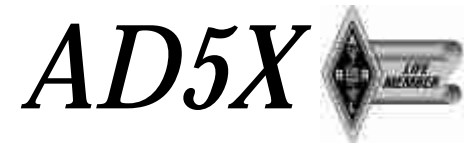




More Robust Whip Adjust



#6 brass nut soldered on brass adapter
for additional thread length

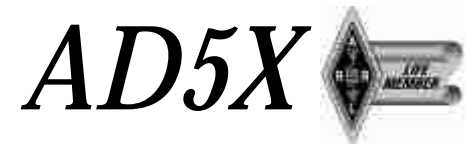


More Robust Adjust & Shaft



Whip/Adapter/Tube Assembly

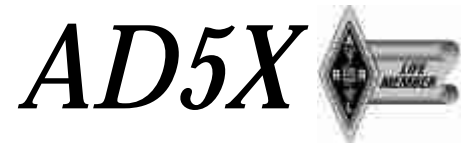
- ◆ Corona Discharge effectively gives you a varying antenna length, with a varying VSWR.
- ◆ To eliminate corona discharge, you need to eliminate any sharp points at the antenna end.
 - Also keeps you from poking your eye!!
- ◆ Taper the end of the 1/8" rod with a file.
- ◆ Screw on a #6 nut just enough so that it is firm on the end of the whip.
- ◆ Solder it in place.



Corona Ball

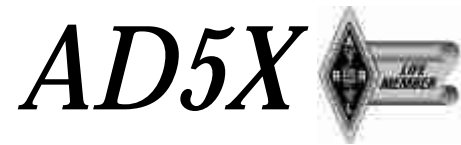


Stainless Steel and Brass “Corona Ball”

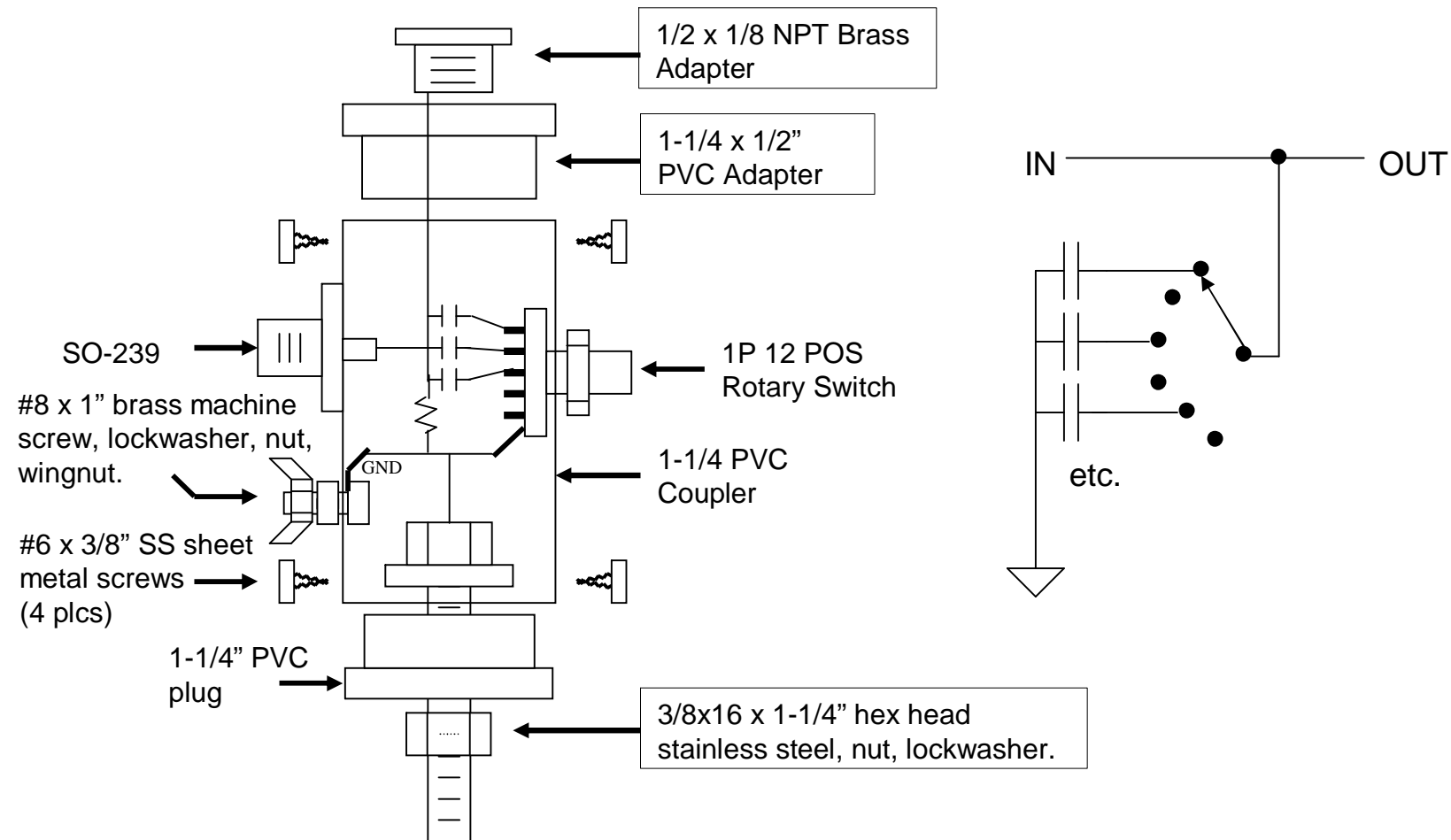


Short Antenna Matching

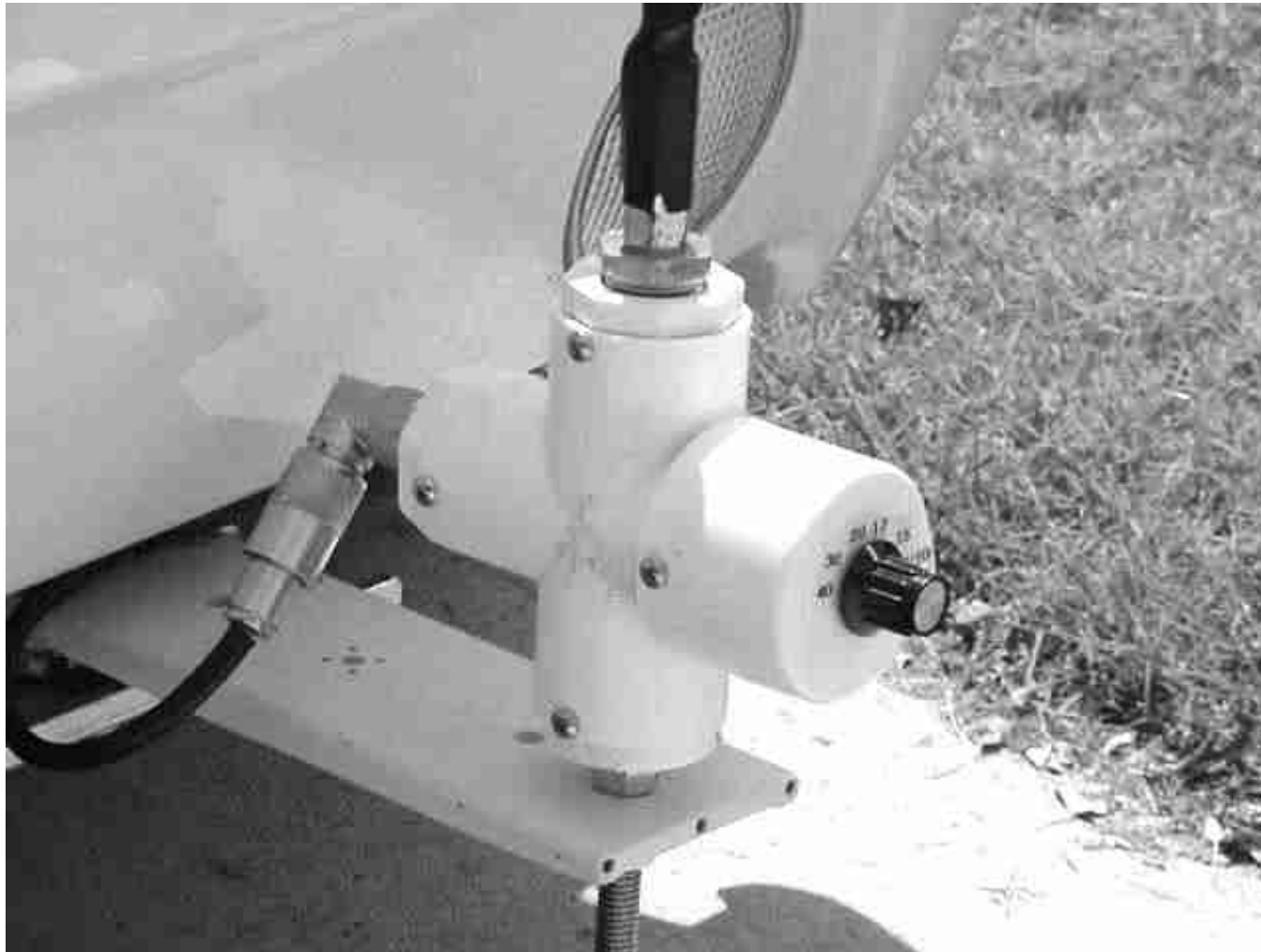
- ◆ Short antennas have low radiation resistance.
- ◆ Sum of radiation resistance, coil loss and ground loss typically less than 25 ohms.
- ◆ Inductive, capacitive, or transformer matching will give you a good VSWR.
- ◆ ***If you don't need base matching on your short antenna, you probably have excessive losses!***



SO-239 Capacitive Base Match



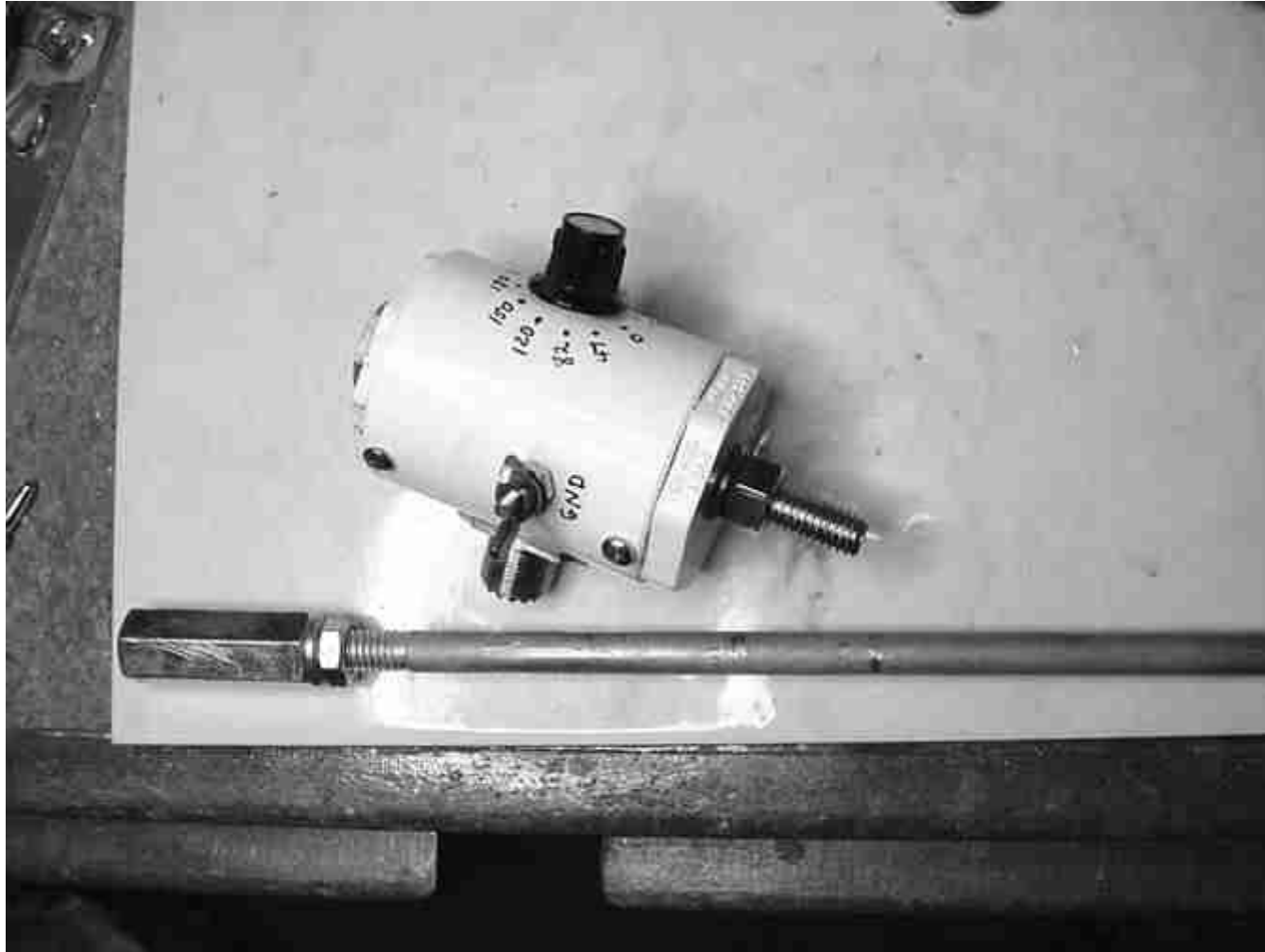
AD5X SO-239 Capacitive Base Match

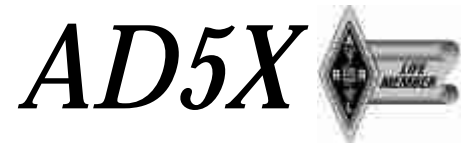


Richardson, Texas

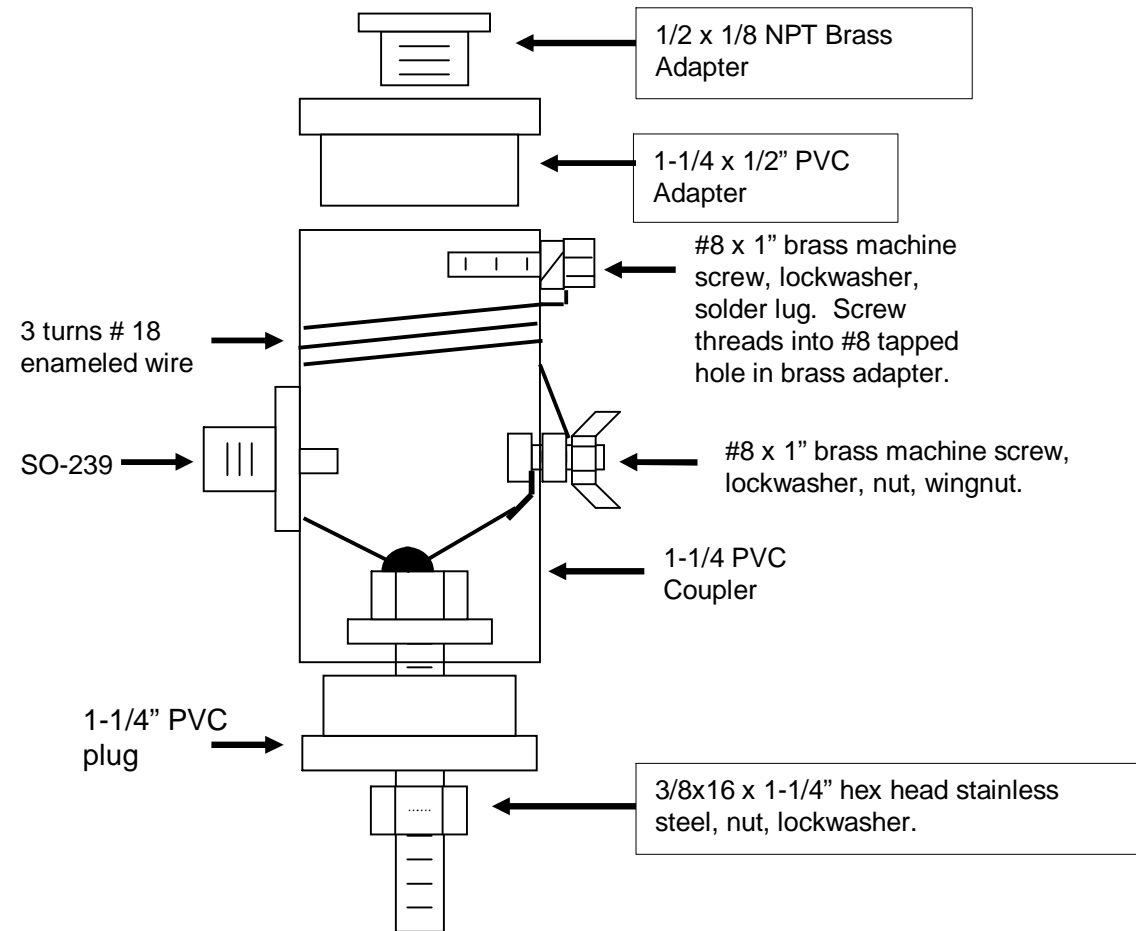
Phil Salas – AD5X

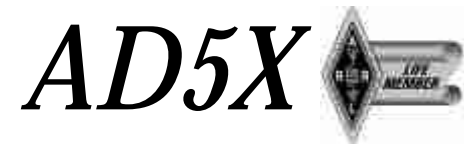
AD5X SO-239 Capacitive Base Match





Inductive Base Mount





Inductive Base Mount

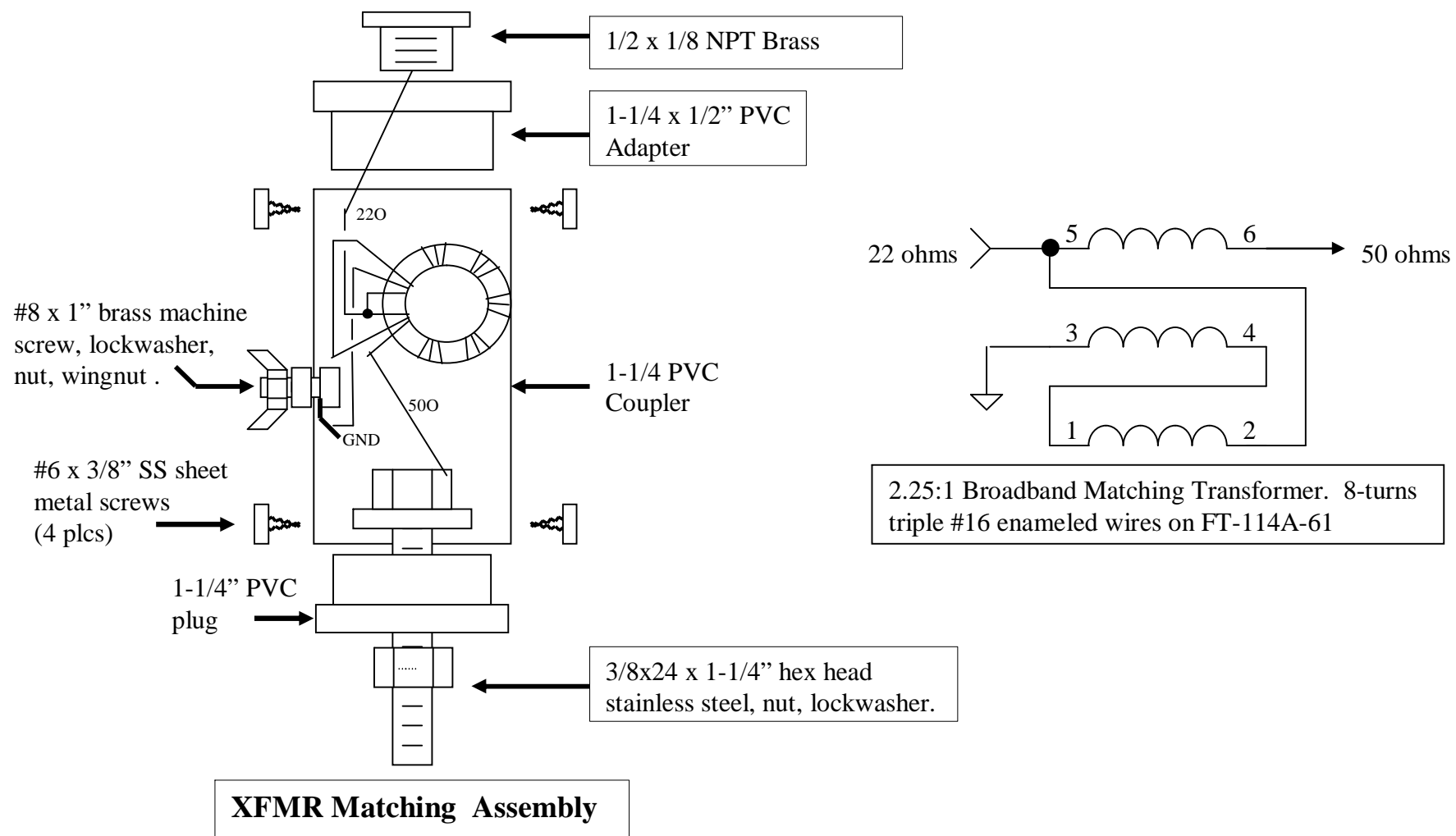


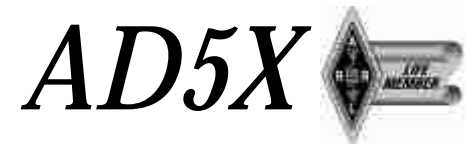
Richardson, Texas



Phil Salas – AD5X

XFMR Base Matching





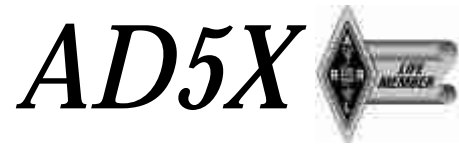
XFMR Base Matching



Richardson, Texas

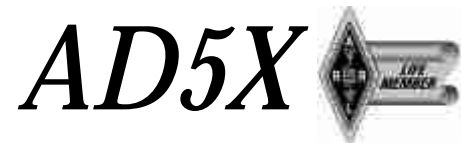


Phil Salas – AD5X

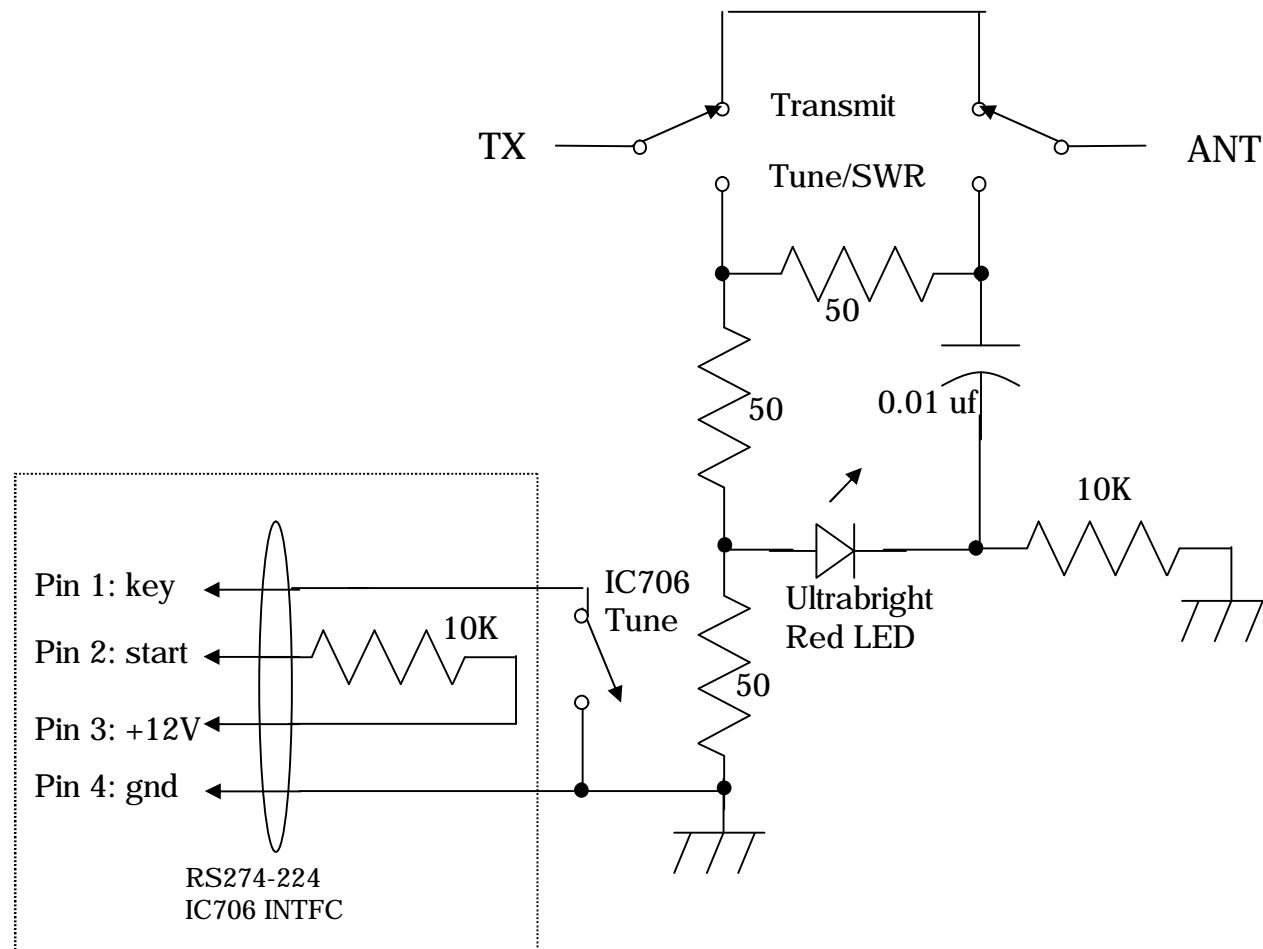


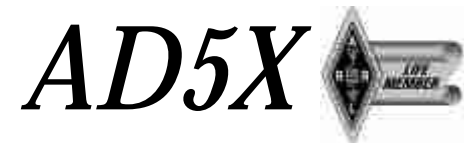
Tuning The Antenna

- ◆ Most radios have internal SWR metering.
- ◆ I prefer a simple external SWR meter that also protects the radio during tune-up.
- ◆ A resistive SWR bridge using an LED indicator works great.
- ◆ Limits worst case SWR to 2:1 during tuning
 - Use Caddock power resistors
 - MP915-50: 15-watt, 50 ohm, TO-126
 - \$2.78 each – Mouser Electronics 684-MP915-50
 - MP930-50: 30-watt, 50 ohm, TO-220
 - \$3.58 each – Mouser Electronics 684-MP930-50



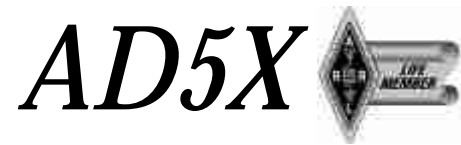
The Tenna-Tune



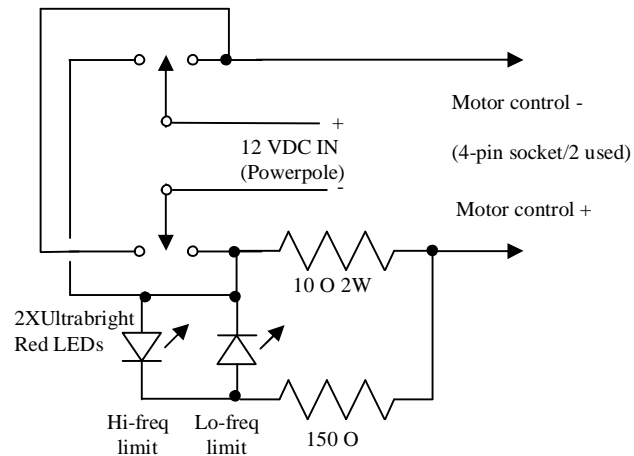


The Tenna-Tune (Cont.)

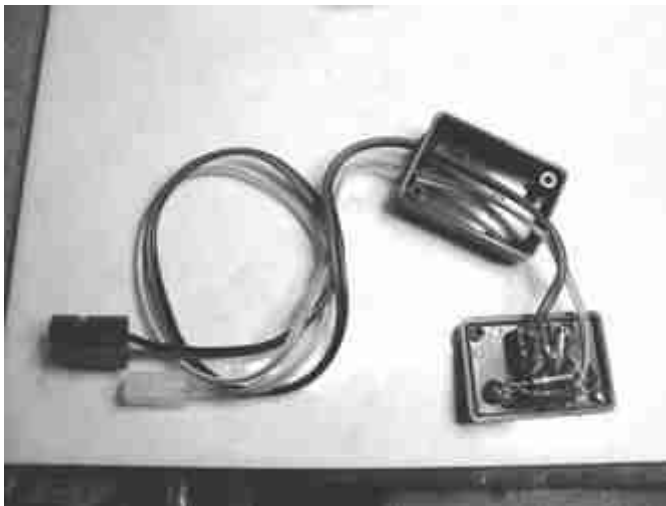




Screwdriver Control/Indicator



Schematic - Direction control and limit indicator



| QTY | Description | Price |
|-----|---|------------|
| 1 | Rocker Switch (Mouser 629-GRS4023C13) | \$1.41 |
| 1 | 4-pin Receptacle (Mouser 538-03-06-1044) | \$0.77 |
| 2 | Female sockets (Mouser 538-02-06-1103) | \$0.19 ea. |
| 1 | 1.97x1.38x .67 box (Mouser 546-1551GB) | \$1.03 |
| 1 | 10-Ω 3-watt resistor (Mouser 71-CW2B-10) | \$0.40 |
| 1 | 150- Ω ¼-watt resistor (Mouser 71-CCF07-J-150/R) | \$0.02 |
| 2 | Ultra-bright red 5mm LED (All Electronics LED-94) | \$0.75 ea |

Covered

- ◆ Mobile Antenna Efficiency
- ◆ Transceiver Mounting & Noise Reduction
- ◆ Mobile Antenna Building Ideas
- ◆ Mobile Antenna Tuning Accessories

It's fun to design antennas while standing in the plumbing area of your local hardware store.

- Though you may confuse the store employees!