Installing HF/VHF/UHF in an SUV

Leo Nikkinen, VE2SI ©

West Island Amateur Radio Club
Presented: January 19, 2026
Revised: January 19, 2026

Mobile Radio Installations

- Why?
  - Extend your radio activities beyond the confines of your home
  - For some, a more capable setup than their base station
  - It travels with you on summer vacations, etc.
- Why not?
  - Expose your radio equipment to theft
  - Expose the radio to temperature extremes
  - Expose the antennas to road salt and other stresses

- Don’t become a victim of distracted driving
- Keep in mind that using handheld electronic devices (operating amateur radio equipment) while driving is illegal in some jurisdictions

How Did This Come About?

- COVID-19 made me do it!
  - COVID'S self-isolation had reduced and eliminated many other possible activities and the excuses were all gone
- Traveling to fleamarkets (NEAR-Fest), we would have a FT-7800R 2m/70cm mobile radio sitting on Nora's knees
- It was inconvenient to use and had to be set up for each trip
- Installing a radio in a car is a significant project
  - Car's interior panels need to be removed
  - Custom brackets/panels will have to fabricated
  - Need to pull cables the length of the car
- There was time to complete the project and we really wanted to finally install the FT-857D and HF antennas in the car

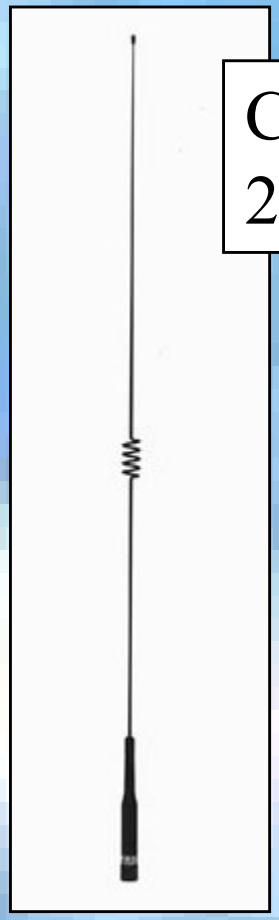
We Had All the Required Equipment: Radio, Antennas and Car

- Radio: Yaesu FT-857D HF/VHF/UHF mobile radio
- Antennas
  - Yaesu ATAS-100 HF to UHF screwdriver antenna (no 220 MHz, 1-1/4m band)
  - 80m mobile (short) vertical antenna
  - 2m / 70cm mobile antenna
- The car is a 2014 Subaru Forester
  - Room for a radio in the back, but a location had to be identified
  - Space on the roof and tailgate for antennas
  - Room for the control head below the ventilation controls
- Some custom cables and brackets would need to be prepared

The Radio: Yaesu FT-857D

- Repackaged FT-897D with no built-in power supply options
- 160m to 2m and 70cm all mode transceiver
- 100W out on HF and 6m, 50W on 2m and 20W on 70cm
- Separate control head and radio using YSK-857 separation kit
- HF and 6m antenna connection, 2m and 70cm antenna connection

Antennas



Comet SBB-5
2m/70cm, 38” high

Comet HA035
80m, 44” high

ATAS-100 40m to 70cm
55” to 63” high (ATAS-120 shown)

These antennas each need a suitable mount

The Car: 2014 Subaru Forester

- All wheel drive SUV
- 12 volt electrical system
- Lots of room in back
- “Styled” modern interior and dashboard
- It really needs at least one HF/VHF/UHF radio and many antennas

Three Important Considerations

- DC Power Supply
  - 50W VHF/UHF: 12 volts, 8.5 amps (FT-7800R)
  - 100W HF: 12 volts, 22 amps (FT-857D)
  - Need to maintain the radio voltage (13.8V +/-15%) at full load current
- Antenna(s)
  - VHF/UHF: magnetic / trunk lip / luggage rack mount
  - HF: Higher wind load, require a much stronger mount
  - Some form of theft-proofing needed
- Bonding (grounding)
  - Crucial for mobile HF installations
  - Possible need for clamp-on ferrite choke cores on control cables
  - Bonding will affect DC return current path

Cars

- **Old, 1960's to 1970's era**
  - 12 volt electrical system and some 6 volt cars
  - Electrically noisy ignition and alternator whine a real problem
  - Steel body and sturdy steel bumpers
  - Simple interiors and front panels, more room for radio installation
- **1970's to 1990's**
  - Quieter ignition systems, alternator whine less of a problem
  - Bumper began to disappear as an antenna support
  - Computers and other noise-producing electronics were added
  - The interior parts styled together, access is difficult
  - Instrument panels left little room for other equipment
- **Modern cars**
  - Ignition systems quiet and no alternator whine
  - Panel includes entertainment system, climate controls, cup holders, GPS display, etc.
  - Styling rules the interior design and space for front-mounting a complete radio is difficult to find
  - Modern dashboards don't leave much room for a control head

Step Zero - Figure it all out FIRST!!!!

- Trunk-mount FT-857D (find a spot)
- Front-mount radio's control head (find space)
- Determine antenna mounting locations
  - ATAS-100 40m to 70cm screwdriver antenna
  - Comet HA035 80m loaded vertical
  - Comet SBB5 2m/7cm
- Yaesu FAS-1-4R remote antenna relay for ATAS-100/HA035 switching
  - FAS-1-4R will be switched automatically in final configuration
- Locate bonding connections (HF antennas, radio and FAS-1-4R)
- Cable routing & treatment
  - DC power cable from battery (engine compartment) to radio
  - Control cable between radio head and radio
  - Microphone cable from front to radio
  - Speaker cable from radio to front
  - Temporary cable for FAS1-4R remote antenna relay
  - CW key cable to trunk

Information on the Car

- Knowing where all the existing cables run and the internal structure of the body will help when performing the first-time installation a radio
- I downloaded a copy of the Subaru Forester service manual (approx. 8000 pages, 380MB pdf) to understand the way that interior panels should be removed
- Disconnecting the battery sends some of the car's system's back into a prenatal state. You have to go through some calibration procedures in order to recover full operation.
- The Web was helpful when difficulty was encountered

Radio Control Head

- Will the control head fit?
- Yes!
- Continue with the planning

Antenna Mount Options

- Must be able to withstand the torque produced by the antenna at highway speeds, plus wind gusts.
- A stronger mount is preferable to one that “should be okay”
- No specifications are available, probably because wind survival depends, to a considerable extent, on the mounting surface or structure
- Single-magnet magnetic mounts for VHF and UHF antennas
- Multi-magnet mounts for larger antennas (ok for HF antennas?)
- Trunk lip & front hood mounts
- Luggage rail mounts
- Bumper mounts (on today’s plastic bumper!)
- Body mounts (drill a big hole into the side of a new car)

Pick The Right Mount

- The various mounts are described as “heavy duty” or intended for VHF/UHF antennas or “medium size” HF antennas. Some mention a maximum antenna height.
- The ATAS-100 requires a strong, so-called heavy duty, mount
  - Drilling a hole into a body panel was undesirable
  - Unsure about multiple-magnet mounts.
  - Heavy-duty Diamond (K-400 and TE-5M) and Comet (RS-840 and RS-720) trunk lip mounts have been used successfully to install mobile HF antennas
- The HA035 is small for an 80m antenna but there’s no problem using a heavy duty mount
- The Comet SBB-5 2m / 70cm antenna could be roof-mounted using a good magnetic mount

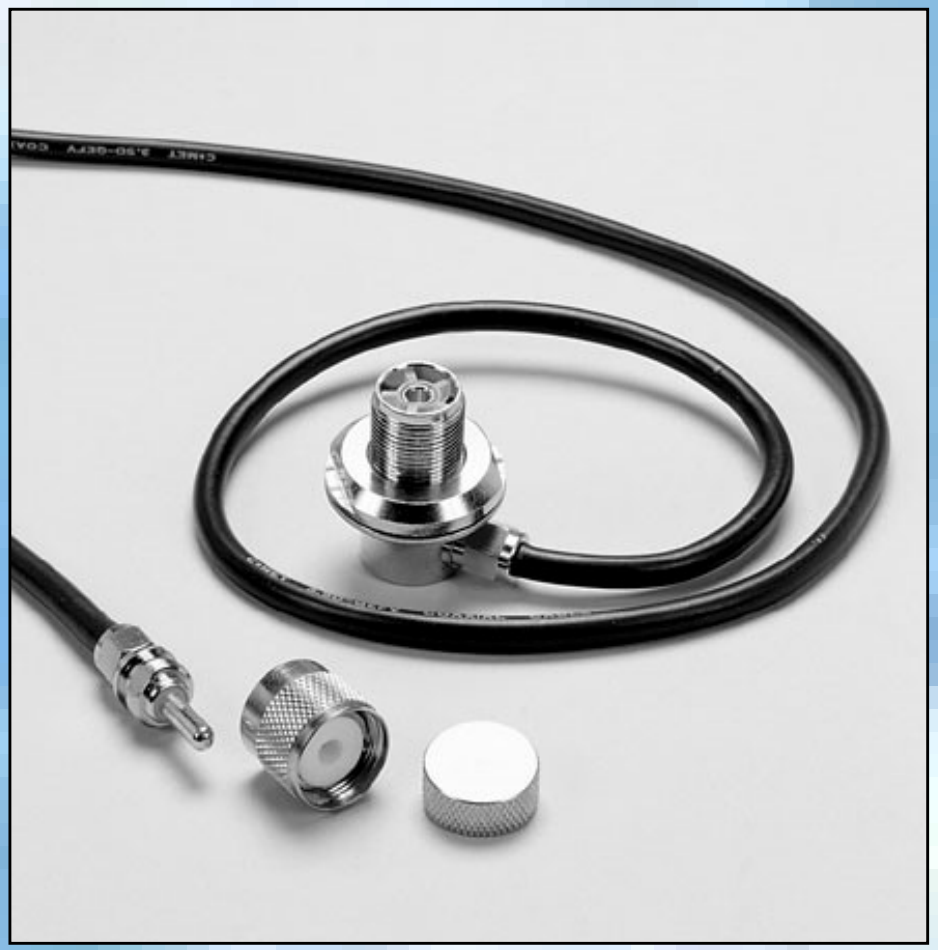
Antenna Mounts / Bases

Comet RS-840, top and bottom views, 2 axis adjustments

Diamond SPM-35, for antennas up to 45” high

Details: Antennas and Mounts

- Most trunk lip and similar mounts are adjustable along two different axes and allow the antenna to be oriented vertically
- Some antennas can be folded down for low ceilings
  - The fold-down feature isn't always easy to operate
  - Some antennas pop back up, maybe only part way, if shaken
- Trunk lip and other clamp/bolt-on bases don't always include the actual antenna connector and cable



Cable Assembly (ATAS-100 and HA035)

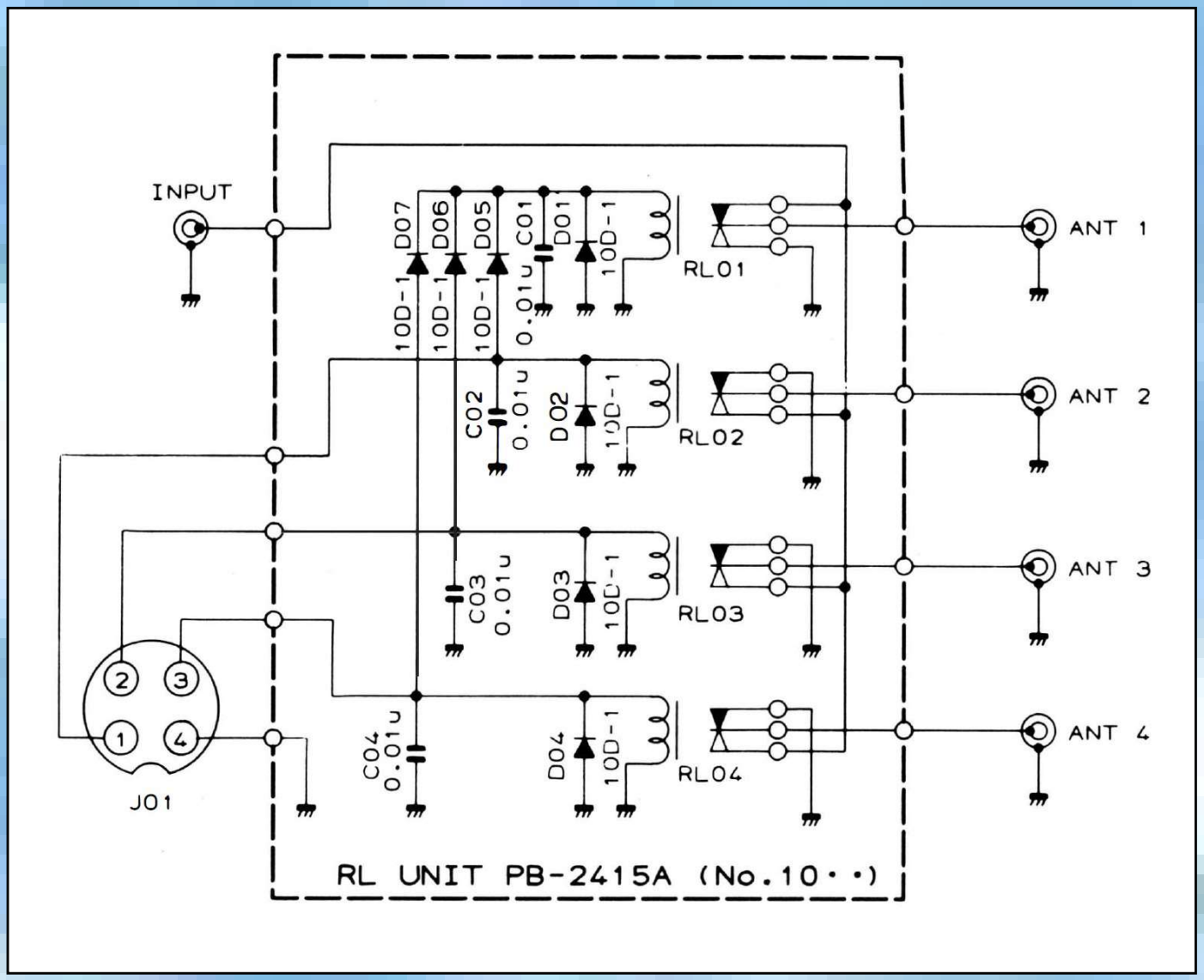
- Comet 3D4MC cable assembly
- Metric SO-239 antenna connector
- PL-259 radio connector

- Use Yaesu FAS-1-4R antenna relay to switch between antennas

- There are imperial (ϕ 5/8”-24 tpi) and metric (M connectors, ϕ 16mm-1mm pitch = ϕ 0.630”-25.4 tpi) versions of the “standard” PL-259 & SO-239 connectors
- An antenna such as the Yaesu ATAS-100/120 and HA035 **must** be provided with the correct, metric, UHF cable assembly in order to achieve a mechanically secure connection

Yaesu FAS-1-4R Antenna Switch

- 1 input
- 4 outputs
- 12 volt operation



DC Power Cable Requirements

- The current carrying capacity of a wire is referred to as its ampacity (a bit of Electrician's jargon)
- The suitability of a particular gauge of conductor depends on the conductor length, current being drawn, acceptable voltage drop, ampacity, ambient temperature, insulation type and installation details
- Ampacity ratings can be found in tables
- Resistance and conductor voltage drop need to be calculated, or tables are available

DC Power Cable: What Size?

- Yaesu recommends 12 AWG
- Larger diameter wire (lower resistance) would be better

Wire Size AWG	Resistance (Ohms/1000 feet)	Diameter (inches)	Max. Current (amps)
8	0.6282	0.12849	46
* 10 *	0.9989	0.10189	32
12	1.588	0.0808	23
14	2.525	0.06408	16
16	4.016	0.05082	11

- AWG 12 would satisfy the ampacity requirement, but # 10 wire will provide a higher voltage during transmit
- Max. Current varies according to insulation type (table is for 75°C insul.) and installation (single conductor or bundled wires)

How Will #10 Wire Perform?

- Assume a fully charged car battery or the engine is running (14 volts)
- Freshly charged battery: 6 cells x 2.3 volts/cell = 13.8 volts
- Yaesu's specs: 13.8 volts +/- 15% at 22 amps or 11.73 volts minimum at radio (2.07 V drop)
- Installation requires 12 feet of two-conductor stranded cable
  = 24 feet of conductor

- R (AWG 10) = 24 feet x 0.9989 Ohms/1000 feet
  = 0.024 ohms
- Battery internal resistance = 0.003 Ohms, approx.
- Voltage drop = I x R = 22 x (0.024 + 0.003) = 0.59 volts
- Voltage at radio = 13.8 V – 0.59 V = **13.21** V (11.73 V required)
- I had a comfortable safety margin as various contact resistances will further reduce the voltage, slightly

AWG 10 Power cable: Worst Case

- A “resting” (charged) 12 volt battery will have a terminal voltage of about 12.45 (75% charge) to 12.6 volts (100% charge)
- A car battery should usually be close to fully charged
- During full key-down transmit (22 amps) and the car engine turned off, the radio would still receive:

  12.45 – 0.59 = 11.86 volts (11.73 V required)
- #10 wire will provide an adequate safety margin with the car engine turned off and it isn’t too difficult to route through the car or bend around corners

The Planning Is Over

Time To Start The Installation

Step One: Route The DC Power Cable

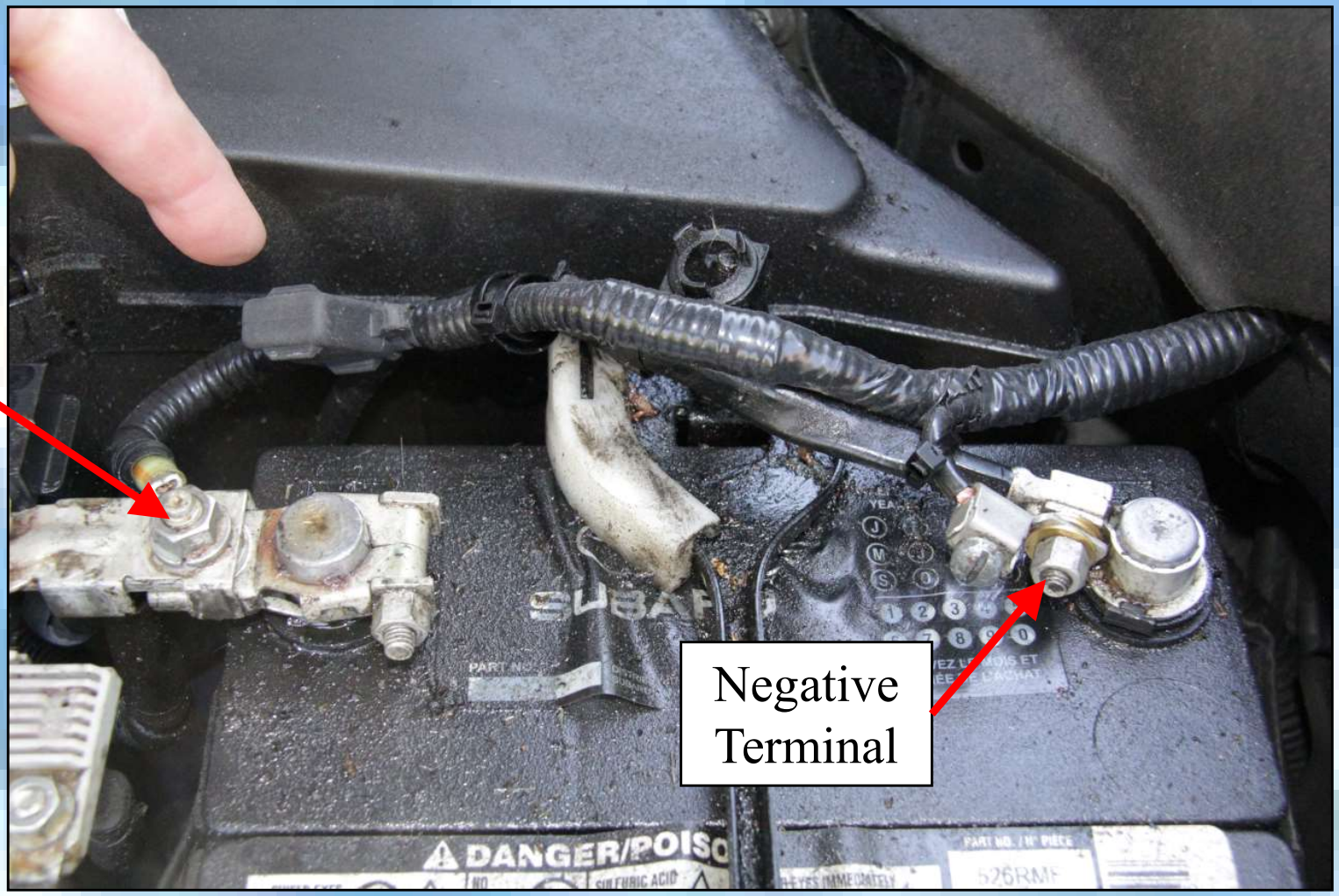
- I had all the major components and the RS-840 mounts had been ordered
- There were no major problems left to figure out
- It was time to find an acceptable path from the battery (engine compartment) through to the back of the car
  - Going through the firewall was an option, but access was difficult and I didn't want to make another opening in the **"firewall"**
  - Subaru had routed cable bundles through the front left fender and some driver-side body panels
  - The Service Manual and Body Repair Manual were very helpful
  - After one whole day, twisted up like a pretzel under the steering wheel and working with a mirror and flashlight, I managed to pull a fish wire from the passenger compartment, through two grommets, an internal hidden body stiffener panel, into the upper driver-side fender. That was the hardest part of the project.

Install Cable Bundle & Place Equipment

- Having secured a route to the car's battery, Nora and I bundled the DC power, control, microphone and speaker cables into split loom and taped the full length of split loom shut with Scotch 33+ electrical tape
- The cables must be protected against crushing, abrasion and cuts. Automotive split loom (corrugated plastic tubing) provides good protection.
- I had found a spot for the radio, with bonding locations easily accessible and a nearby storage nook that would accommodate the FAS-1-4R antenna relay
- With the Service Manual as a guide, I removed some interior trim panels and installed the cable bundle.

DC Power Connection

- #10 wire in split loom
- Positive and negative wires from radio to battery
- 25 amp ATO style fuse, close to the battery
- Cable-tie the wires so they don't move



Step Two: Mounting Brackets For Radio and Control Head

- The radio's control head, microphone connection and remote speaker would be installed in a storage bin. The control head mounting shell needed a bracket.
- The storage bin and some front trim panels were removed.
- A test bracket was fabricated using cheap galvanized steel sheet
  - A test installation of the control head and mounting shell worked
  - The final bracket was made using sheet aluminum and painted

Control Console Disassembly

Remove storage bin & trim

Storage bin

Hole in bin for control, microphone and speaker cables

Control Head Mounting

Control head mounting shell on bracket

Control head mounting bracket

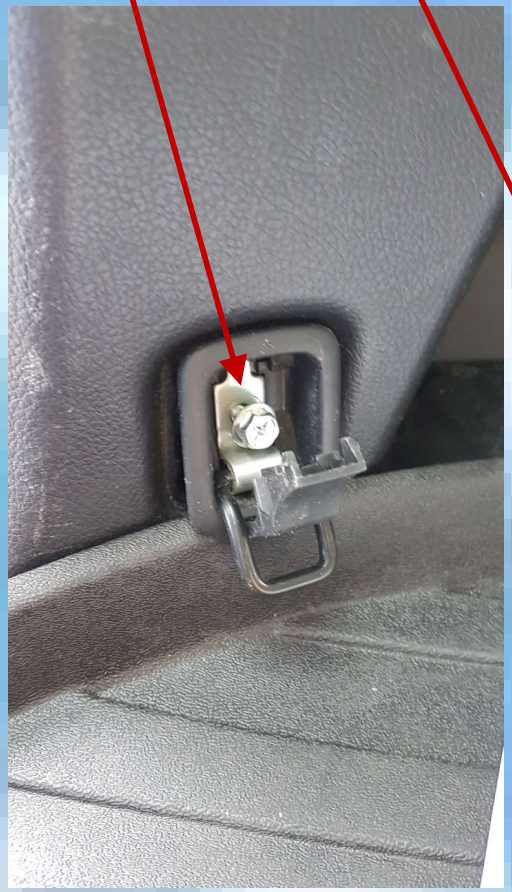
The bracket was made out of aluminum sheet and bolted to console trim panels on either side of the centre console

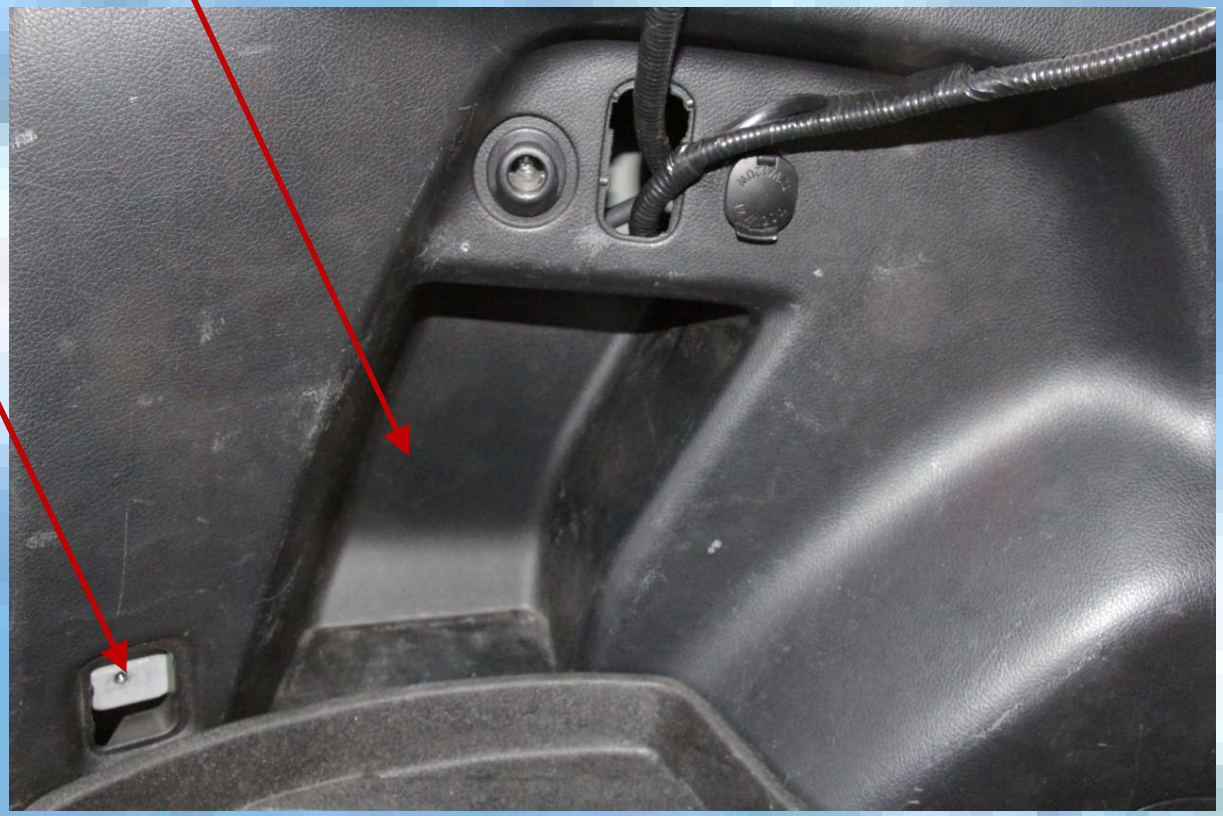
Cargo Compartment:
Radio Mounting Location

Bonding connection (car body)

FAS-1-4R Location

Cables exiting at radio mounting location





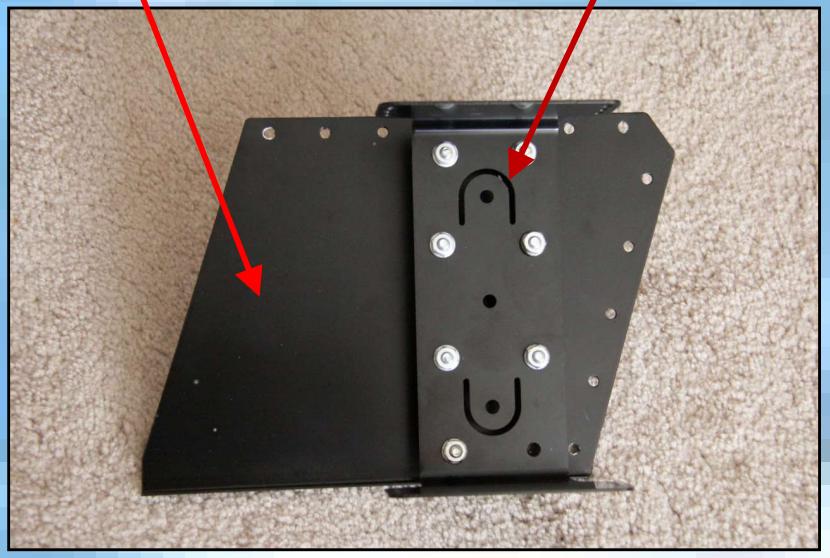
Radio Mounting

- A plate to adapt the radio bracket to an interior rear panel was fabricated out of aluminum
- The cables exit from behind the panel close to the radio
- The FAS-1-4R remote antenna relay fits nicely into a small rear storage bin set into the bottom section of the panel

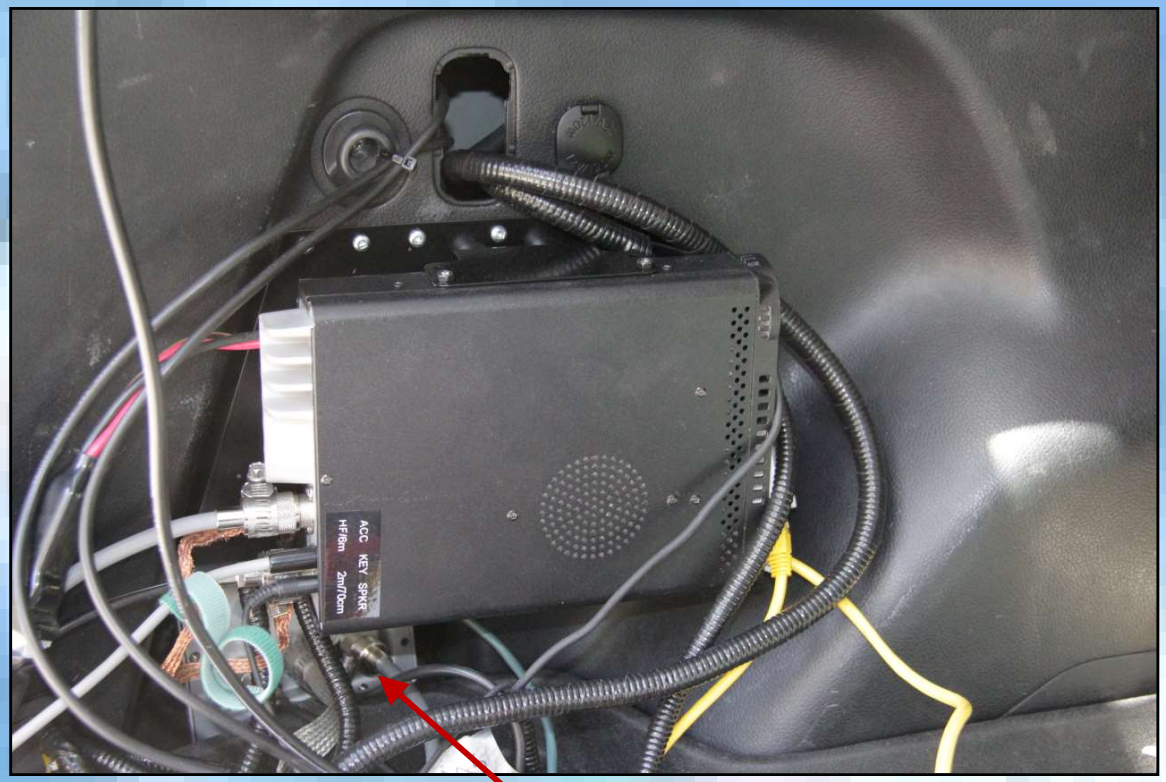
Radio: Mounted

Plate

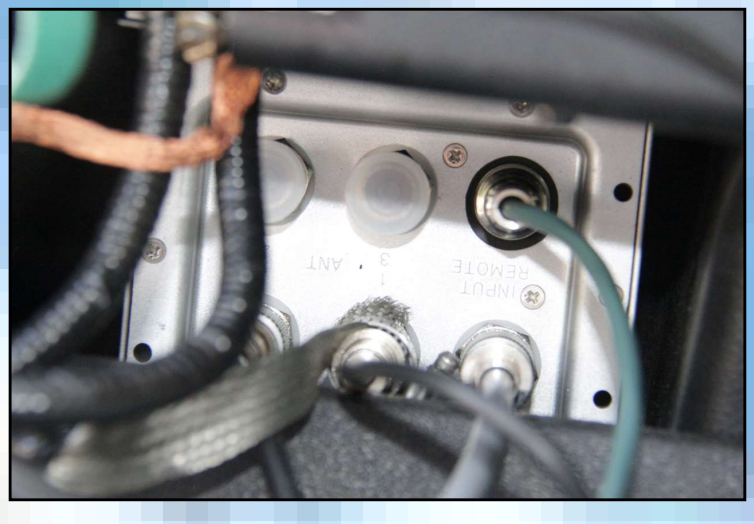
Yaesu Mounting Bracket



Radio screwed to Yaesu bracket
Bracket screwed to plate
Plate screwed to interior panel



FAS-1-4R Antenna Relay



FAS-1-4R

Step Three: Antennas, Bonding & Route Antenna Cables

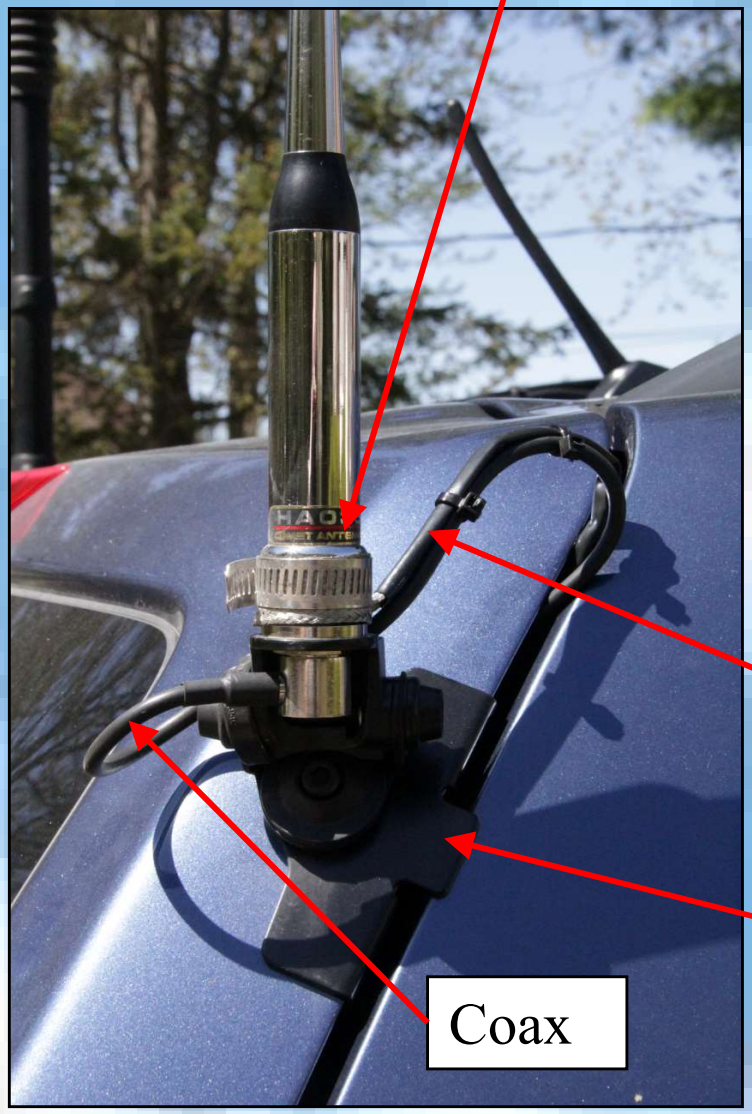
- Install antenna mounts and cable assemblies
- Route antenna cables
- Install antennas
- Install bonding conductors

HF Antenna Bonding

- A portion of the antenna's electric field terminates on the car body
- It is crucial that each HF antenna base and the ground side of the feedline have a low inductance path to the car body, including the tailgate
- The tailgate and car body must be bonded together by a low inductance connection if antennas are mounted on or near the tailgate
- Braid (3/8" or 1/2") provides a good low inductance connection
- An alternative would be to remove the paint from a small section of the car body, drill a hole in the body and connect a braid directly between the antenna base/mount and the car body. This approach will likely be unattractive to most people.
- The magnetic base used with a VHF or UHF antenna is sufficiently well capacitively coupled to the car body that a separate bonding conductor is not necessary for RF purposes

Mounting & Bonding (HA035)

HA035 with bonding braid hose-clamped to antenna



Coax & Braid

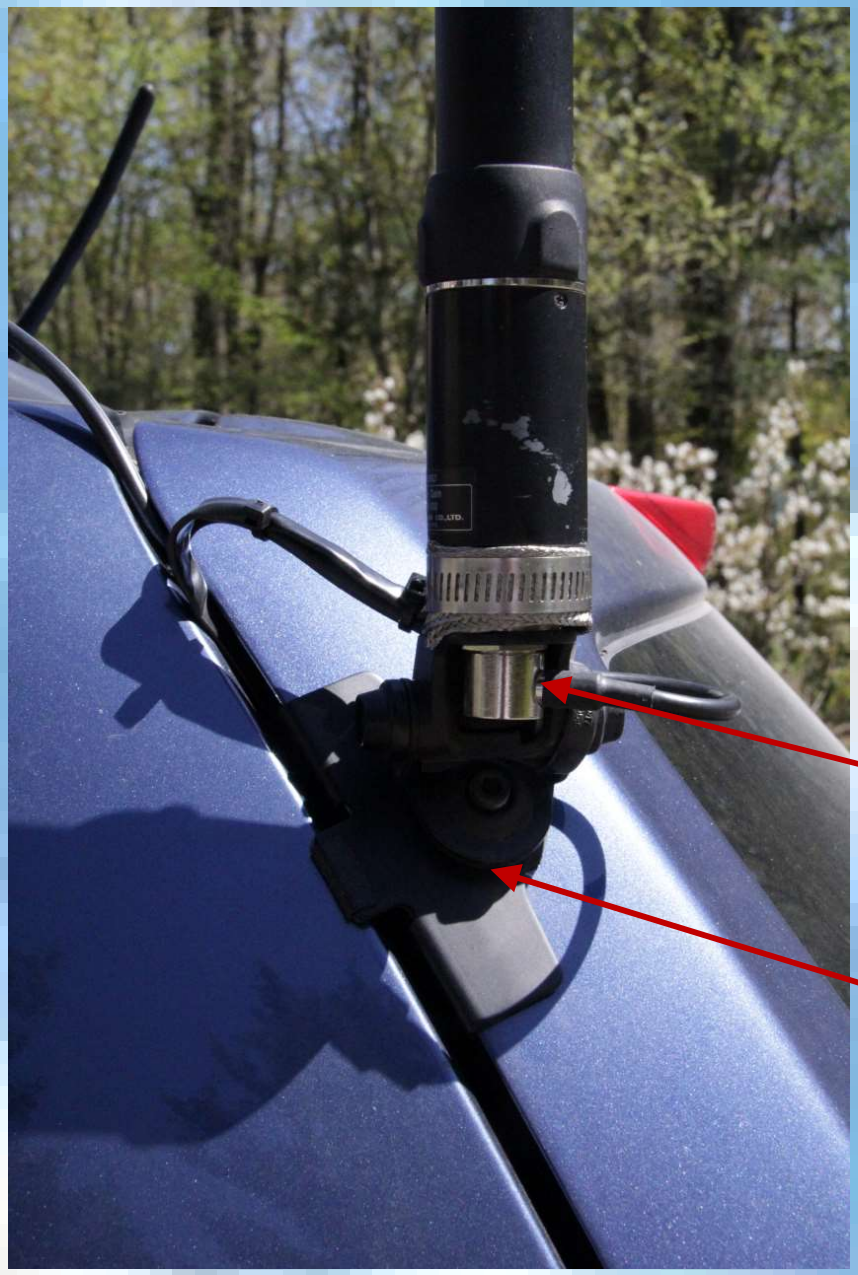
RS-840 Mount

Coax

Antenna bonding braid is covered with heat shrink, soldered to a lug and bolted to tailgate bracket screw

Bonding braid between tailgate and car body

ATAS-100 Mount and Bonding

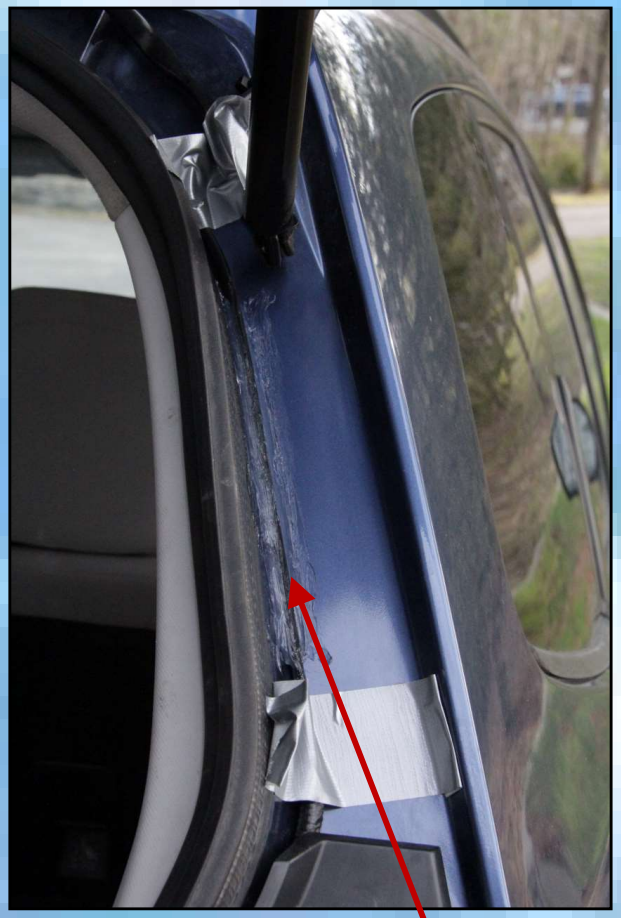


- Hose clamp on antenna makes it difficult to remove the antenna by unscrewing it from the base
- All bonding braids covered with heat shrink
- Same bonding method as used for HA035

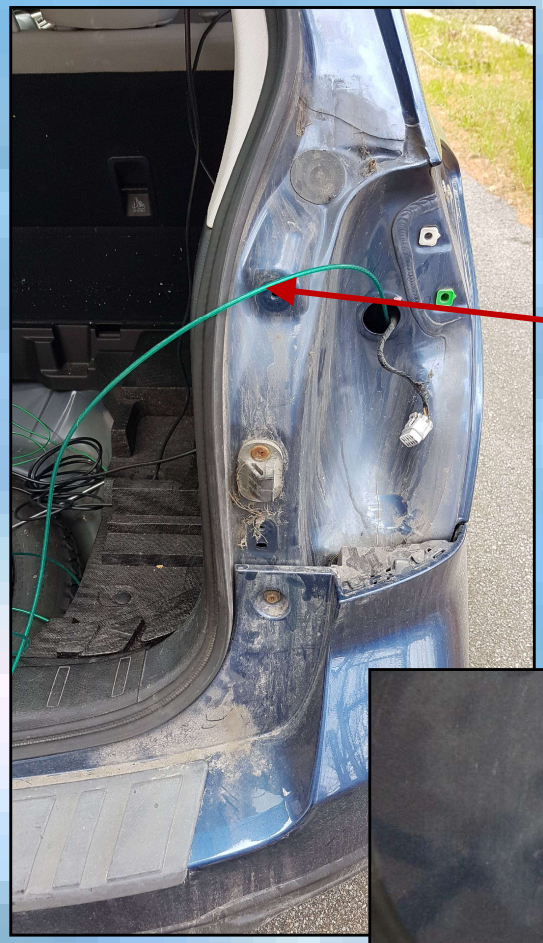
Comet 3D4MC Cable Assembly with metric (SO-239) antenna connector

Comet RS-840 mount

Getting The Coax Inside The car



HA035 coax silicone glued to car body (tape removed when silicone cured)



Tail light removed to gain access to feedthrough grommet, green fish wire used to pull cable through

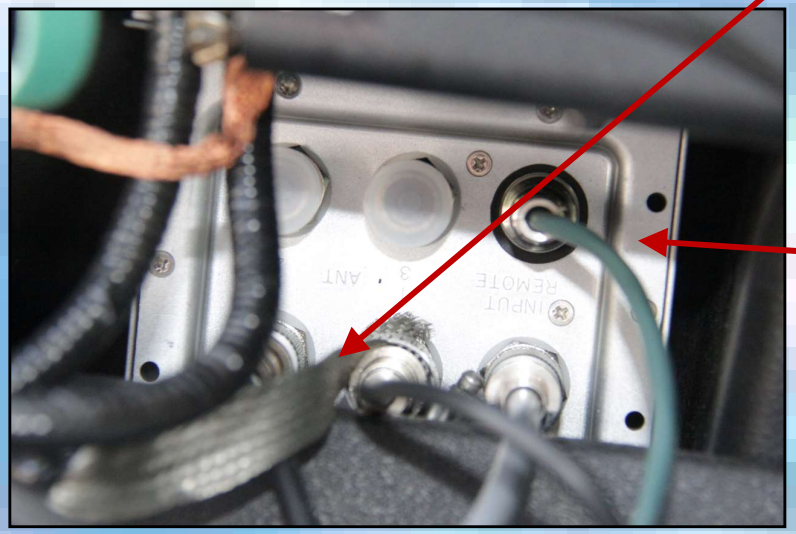
HA035 coax fed through tail light grommet

Radio & FAS-1-4R Bonding To Car Frame

Bonding
PL-259s on radio

Bonding cables
to car body

Hose clamps were used
to securely fasten the
braid to the PL-259s



FAS-1-4R
antenna relay

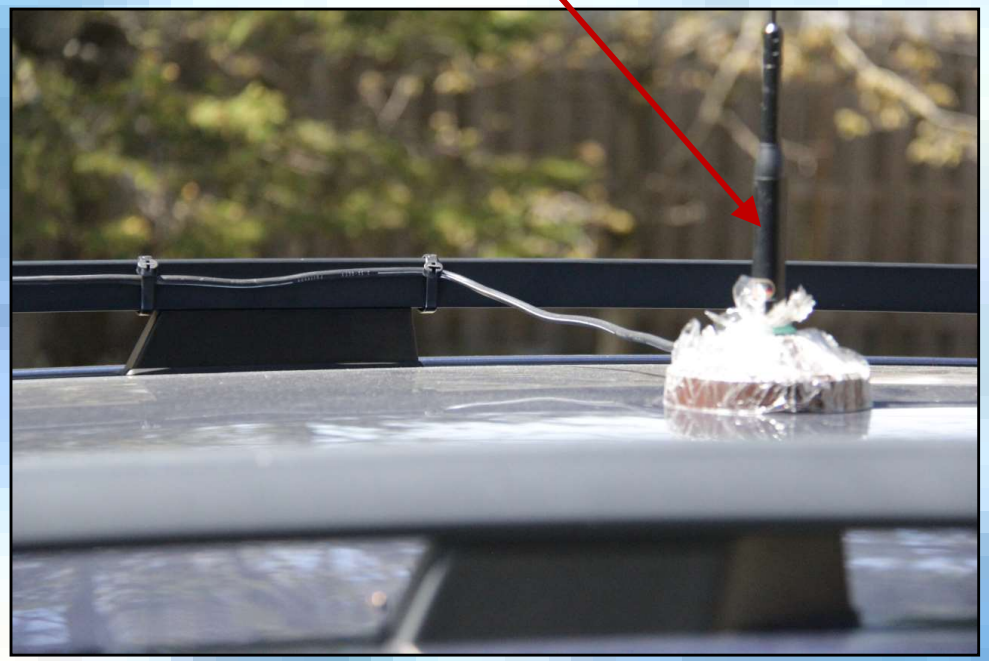
Three Antennas Installed

2m/70cm antenna coax cable-tied to roof rack rails

ATAS-100

HA035

2m/70cm antenna on mag mount base



With Cables Tied Up

2m / 70cm coax

Clamp-On Ferrite on microphone cable (Just in case)

Measured Voltages During Transmit

- Use the radio's voltmeter to measure transmit voltage drop
- Yaesu's specified minimum operating voltage = 11.73 V
- Engine ON: 14.3 V
  - 2m (50W): 13.8V
  - 20m (100W) 13.2 V
  - Measured voltage drop = 1.1 V
- Engine OFF: 12.8 V
  - 20m (100W): 11.8 V
  - Measured voltage drop = 1 V
- Calculated drop at 22 amps = 0.59 V
- Additional 0.4 to 0.5 V drop probably due to other connection resistances in the DC power cable

Additional Feature & Notes

- FT-857D audio is connected to the entertainment system's AUX input, which allow the cars speakers to be used
- If the car is turned off, a de-energized relay routes the audio to an MFJ Clear Tone speaker. Turning on the car energizes the accessory power socket (cigarette lighter socket) which powers a 5 volt relay and routes the audio to the AUX audio input.
- There has been no indication of any RF pickup in microphone or control cables.
- As a backup precaution, a clamp-on RF choke was installed on the microphone line.
- The 80m HA035 has a 2:1 SWR bandwidth of approx. 30kHz
- The HA035 antenna's resonant frequency can be tuned down approximately 20kHz by the addition of a 6 inch long section of foam centre insulation from RG-8/U onto the upper whip section of the antenna.

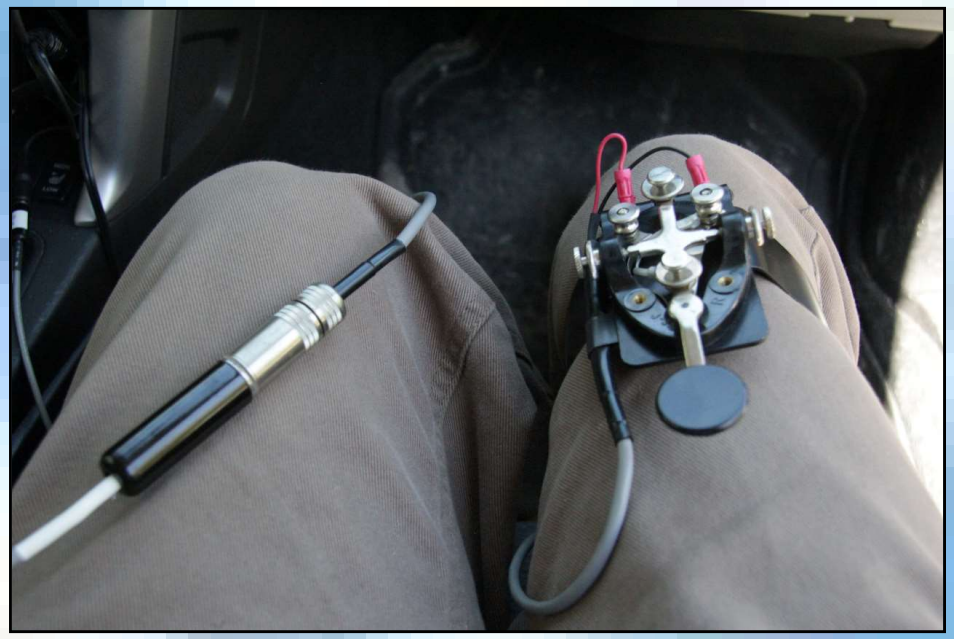
The Final Result

- We've made contacts on a number of HF bands, including into Europe and the States on 20m.
- Not shown is a toggle switch that's used to energize the FAS-1-4R antenna relay for 80m operation

It all works

Speaker

Mobile CW, but not while driving



Work Remaining

- Mount the microphone extension cable's connector onto one of the nearby dashboard trim pieces.
- Build an automatic bandswitching circuit for the FAS-1-4R
- Add a switch to the MFJ speaker to allow it to be used even if the car is on. (We would be able to listen to the FT-857D and the car radio at the same time.)
- Add a 160m antenna to allow the FT-857D to operate on all its bands. (hmmm…)

Stay Alert

- Don't become a victim of distracted driving
- Keep in mind that using handheld electronic devices (operating amateur radio equipment) while driving is illegal in some jurisdictions

Thank you

Environmental Impact Statement:

No Subarus were injured during the installation of the FT-857D or the preparation of this presentation

Any questions?