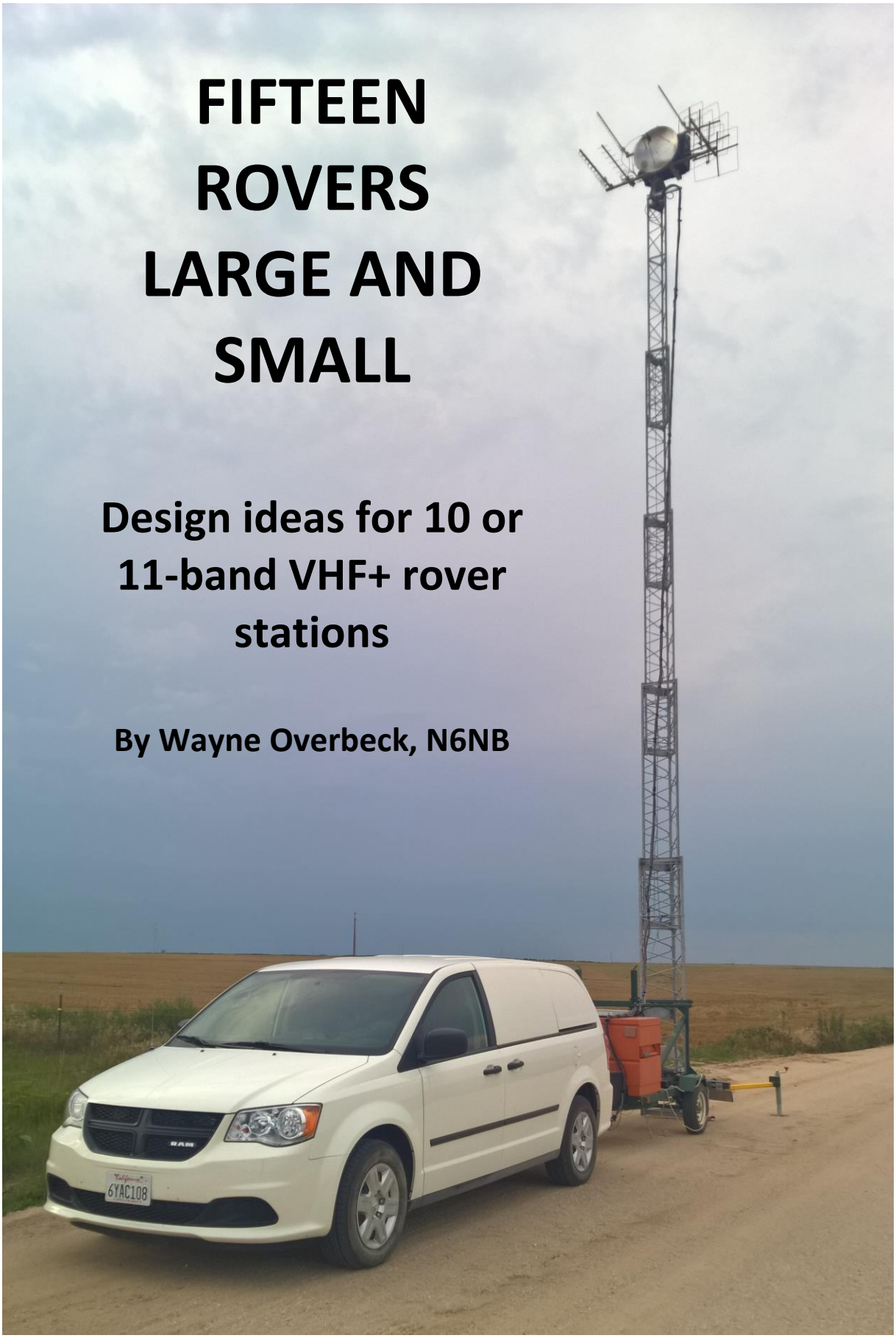
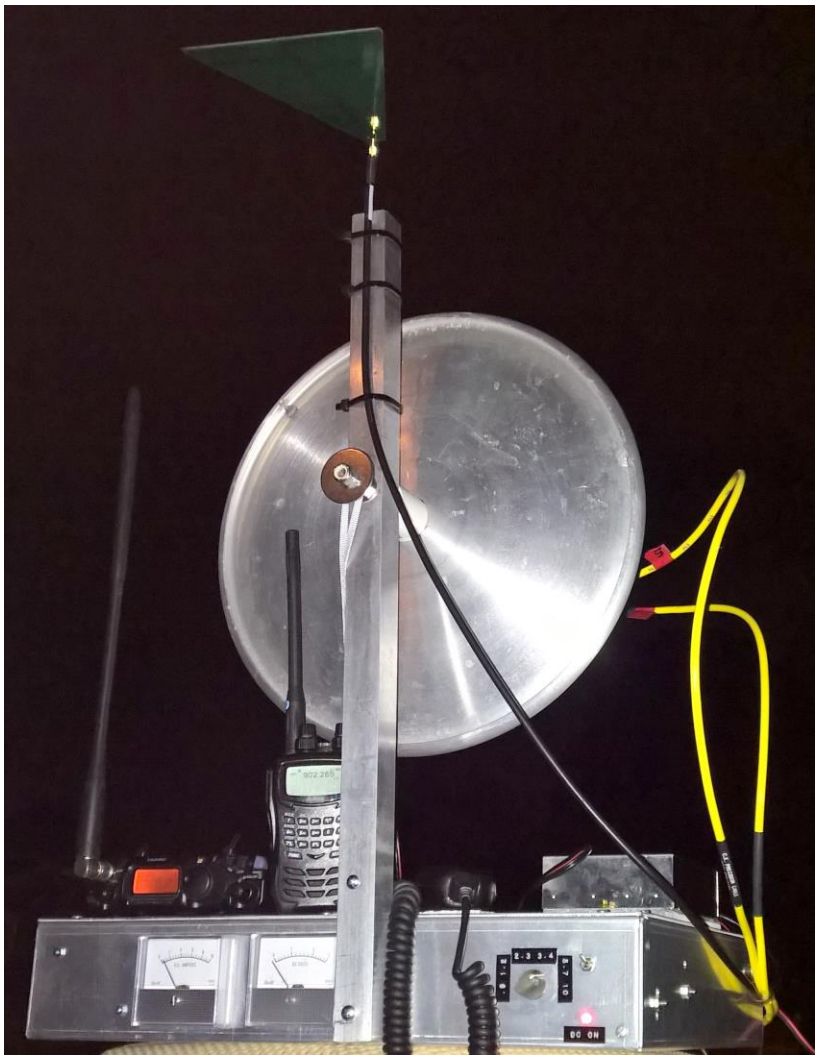
FIFTEEN ROVERS LARGE AND SMALL

Design ideas for 10 or 11-band VHF+ rover stations

By Wayne Overbeck, N6NB





Above: N6NB/R station #1 in CM94, Gaviota Beach, CA

Left: N6NB/R station #13 sitting on a bar stool nowhere in particular

Previous page: N6NB/R station #12 in DM88, rural Colorado

I began roving even before ARRL created a VHF contest category for it in 1991. By the time I retired in 2003, building rover stations had become my main passion in amateur radio. Eventually I built 15 (fifteen) different 10-band rover stations for my own use and to lend to others to promote activity, especially on the microwave bands. Six of the stations also include equipment for an 11th band, 24 GHz.

I'm writing this article to describe the various kinds of rover stations I've built in the hope that it will encourage others to take on similar projects. Perhaps some of the ideas presented here and the photographs of other rovers will be useful.

Roving had become a popular part of VHF contesting by the early 2000s with as many as 100 rover logs submitted in each contest. However, those logs mostly reported activity on just three bands: 50, 144 and 432 MHz. My first rover station only covered those bands plus 222, 902 and 1296 MHz. I decided in 2003 to expand that first station with Down East Microwave transverters for the 2.3, 3.4, 5.7 and 10 GHz amateur bands, but it soon became obvious that there was no one regularly active on any band above 1296 in Southern California except during the 10 GHz Cumulative Contest. If I wanted to work anyone on the microwave bands during VHF contests, I needed to build more stations and recruit operators to use them. So I added a second station and then a third. Each included VHF transceivers, microwave transverters, plus antennas and a rotator that could be mounted on a vehicle's roof rack. Later I built still more stations as more people became interested.

Those early stations enjoyed a lot of success in the ARRL VHF and UHF contests, thanks in large part to the skilled contest operators who took those stations to as many as 22 grid squares during a single contest. At left is a group of 15 operators who used 10 rover stations during the June, 2010 contest, posing with N6NB/R station #2. It turned out that some very good HF operators were willing to try VHF contesting if someone could outfit them with a turnkey station. As interest in roving grew, we began competing under the banner of the Southern California Contest Club-- and we needed more and more stations. The rover stations came to be known as "toolbox stations" because seven of them were housed in 20" Craftsman tool boxes that could be mounted with antennas and a rotator on almost any car or truck with a roof rack. Let's call the toolboxes rovers #3 through rover #9. Six rovers, including five with toolbox stations, are shown on the next page near Joshua Tree National Park with N6NB/R station #1 in the foreground.

Meanwhile, some of the rover stations became something other than *rovers*. One was mounted atop a 70-foot crankup tower at my home in Orange County, California to provide a 10-band fixed station for the rovers to work (call it "former rover" #10). Another one was mounted on a tower trailer parked in the back yard of a house that I own on a nearby hilltop ("rover" #15). That tower trailer probably isn't going to travel again, but the fact that it's a licensed vehicle freed me from the normal building permit requirements for a "structure". Those two former rover stations are still there in 2019, creating two more 10-band VHF+ fixed stations that sometimes have guest operators to promote activity. Rover #12, the tower trailer shown on the opening page of this article, sometimes is parked in the driveway on the hill, providing another (temporary) fixed station for rovers to work, less than 100 feet from the backyard tower trailer but completely independent from it. Stations #10 and #15 are shown below.

Earlier I had outfitted larger rover stations in a Ford E350 van (station #2) and in a Ford F150 truck (station #1). The most-traveled rover is #12, the one I towed as far as Cape Cod, MA and used in East Texas and Colorado at various times. All of these include every band through 10 GHz with add-on 24 GHz equipment available.

However, as time passed it became obvious that lifting the tool box stations and their antennas, rotators and platforms onto a car roof was becoming more difficult for me. So in 2012 I built a complete station in a black Pelican-type case with transceivers on a board atop the case for use on a car seat (rover #11). That came to be known as an "antenna-free" station because it used one of Kent Britain's small PC-board log periodic Yagis for the bands at .9, 1.2, 2.3, 3.4 and 5.7 GHz with a slotted waveguide antenna for 10 GHz, both inside a vehicle but

aimed out a window. That station was so convenient that I built two more very compact "antenna-free" stations (stations #13 and #14).

Later I built still another 10-band station to use on rental cars in Hawaii. It certainly roved, but it didn't get assigned a rover number. Maybe if we take away the rover number of the station that's now mounted on a 70-foot tower, that one could be designated as the new rover #10.

If you tally up all of them, there really are 15 different rover stations, 14 of which could rove in any given contest if enough people with a pulse and a call sign were available. That opened the way for larger groups to rove. By 2018, *13 different people* who used one of these 10-band stations had won first place nationally in one of the rover categories in at least one ARRL VHF+ contest and our club, SCCC, had won 14 club gavels in VHF+ contests. As far as we can determine, no West Coast club had ever won a gavel in a VHF contest until SCCC first won in 2009. Between 2003 and 2018 I won 23 contests nationally as a rover and seven in the QRP portable category with rovers providing the critical mass for a good score. Now we're seeing a new generation of talented young men and women winning the rover categories, often using the strategy of roving together or meeting for a "rover lunch" near a four-grid convergence. The contest wrap-up articles are starting to routinely describe this phenomenon. This paper also includes photos of some of their well-equipped rover stations.

"Antenna-Free" Rover Stations

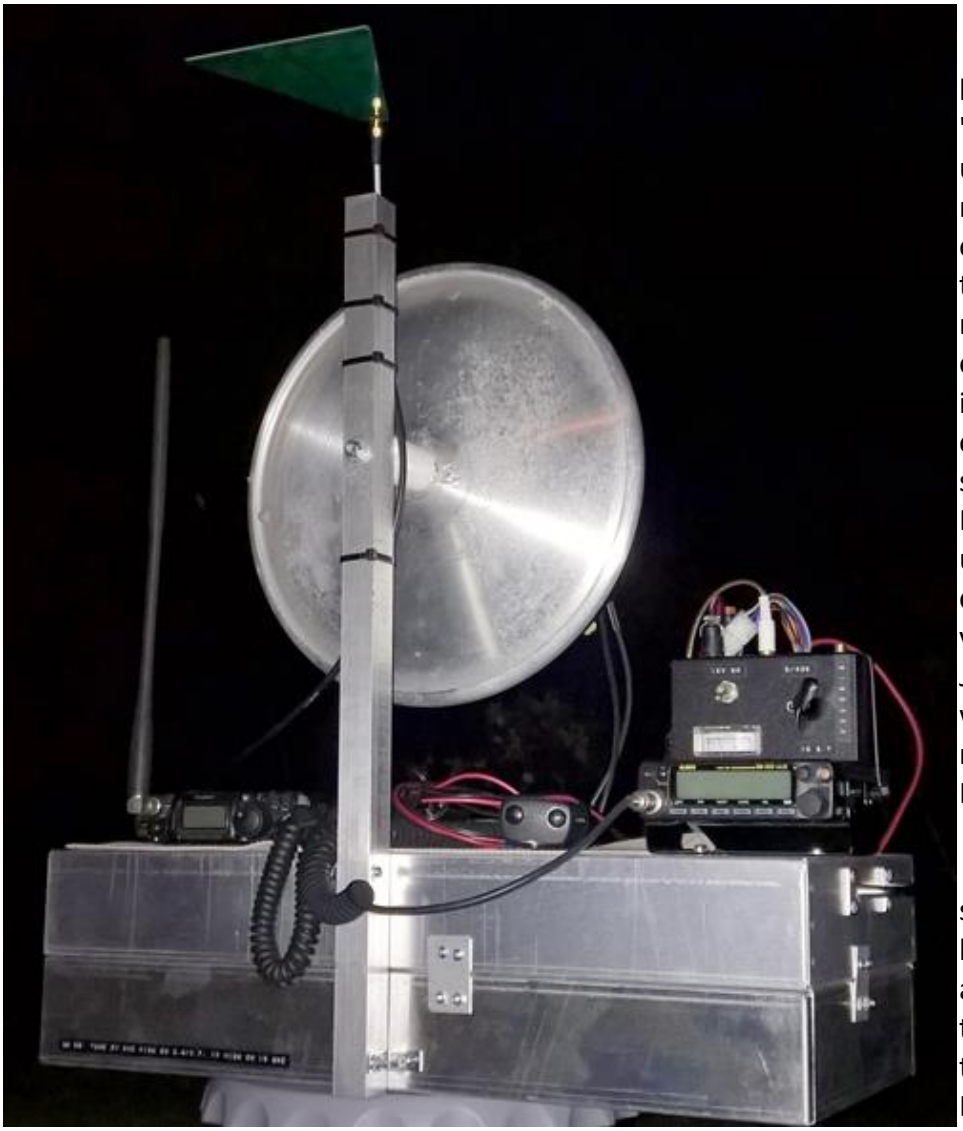
The so-called "antenna-free" rover stations began as a response to my mobility and agility issues in the 2010s—nearly 60 years after I was first licensed. Frankly, I needed more stations that I could install without doing any heavy lifting while standing on a ladder.

The result was senior-friendly "antenna-free" 10-band rover stations like the one shown at right and the one on the next page. By 2016 I had built three of this type. Let's call them #11, #13 and #14 because of the order in which they were built. The one at right (#13) needs no exterior antennas at all and can be quickly "installed" on the passenger seat of almost any car. If the unit rests on a large box such as a shoe box, both microwave antennas are high enough to be aimed out the passenger window. This entire station is housed in and on a 12" x 17" x 3" chassis. Five compact DB6NT transverters (for 1.2 GHz, 2.3 GHz, 3.4 GHz, 5.7 GHz and 10 GHz) are mounted inside the box along with many SMA relays for the necessary bandswitching. An FT-817 provides 50, 144 and 432 MHz plus the I.F.

for the higher bands. An Alinco DJ-G29 HT is often used for 222 and 902 MHz.

"Antenna-free" station #13 is fully wired for DEMI transverters in lieu of the HT for 222 and 902, but that adds to the unit's weight and has not been needed yet when this station has been used during VHF contests. The on-board antennas are typical "rubber ducks" on the lower bands, with the WA5VJB log periodic for 902, 1.2, 2.3 and 3.4 GHz. That antenna also will work well on 5.7 GHz, but the dual-band 5.7 and 10 GHz 30 cm. dish is used for higher gain on those bands. The system has a Rubidium standard to assure frequency accuracy on the microwave bands. The two panel meters monitor DC current flow and relative power output. The bandswitch is on the right.

This is not the place for a full-blown construction article, but this system has certainly played well. Best of all, this package is something that a septuagenarian can carry with one hand and install quickly. I spent two weeks building it in 2015. That was time well spent.



The people who have used these "antenna-free" stations usually did have external mobile whip antennas on 6, 2, 222 and 432, but these stations perform remarkably well with only the antennas shown in the photos. The original "antenna-free" station in a black Pelican-type case was used in several earlier contests, including a venture in East Texas in January, 2012, where it was used by an all-YL roving team, K5FAY and KJ6CNO.

The 10-band station shown at left (#14) is larger and heavier but also runs more power than the one pictured on the last page. It uses Down East Microwave transverters instead of the smaller DB6NT transverters. It is built on two 10" x 23" x 3" chassis with handles on each end to make the unit easier to carry. Yes, it does fit on a normal car seat. Most cars have more than 23" of clearance from the seat back to the dashboard to provide adequate knee room for

tall passengers.

Instead of an HT for 222 and 902, this larger station uses a 25-watt Alinco mobile transceiver for 222 and a DEMI transverter for 902. Other transverters inside the box are for 1.2, 2.3, 3.4, 5.7 and 10 GHz. As shown, it uses an FT-817 for 50, 144 and 432 plus the microwave I.F. However, a Yaesu FT-857 can be quickly substituted for the 817, providing 100 watts on six and 20 watts on 432. The two meter power has to be limited to 5 watts even with the FT-857 to avoid overdriving the transverters. Recipe for disaster #1 is to turn up the 857 to full power on two (50 watts), assuming that the operator will always remember to cut the power back to 5 watts every time the station is switched to a microwave band! If an operator needs more power on two meters, a Mirage amplifier can be added to the system with an extra relay to switch the 857 from the amp to the microwave I.F. line. In this higher power configuration, the station must always use external antennas on 6, 2, 222 and 432 (typically mag-mount whips on the car roof). The FT-817's "rubber duck" antenna will not handle more than about 10 watts.

The larger “antenna-free” station has a separate bandswitch box mounted on the Alinco 222 transceiver. There is only a current meter, not a relative output meter. This larger unit also differs from the smaller one in that it has no Rubidium standard. The operator must tune the I.F. as much as 25 kHz on some bands to be on the same frequency as the other (Rubidium-stabilized) 10-band stations. But aside from those differences, this station works exactly like the smaller one and even the larger toolbox stations. In each case, the operator uses transceivers straight through on 50, 144, 222 and 432 MHz, then turns a bandswitch to rapidly run through the higher bands. Instant bandswitching has been a key feature of all of the 10-band stations. Without it, the large groups shown in earlier photos would never have been able to operate at the fast pace necessary for successful 10-band roving.

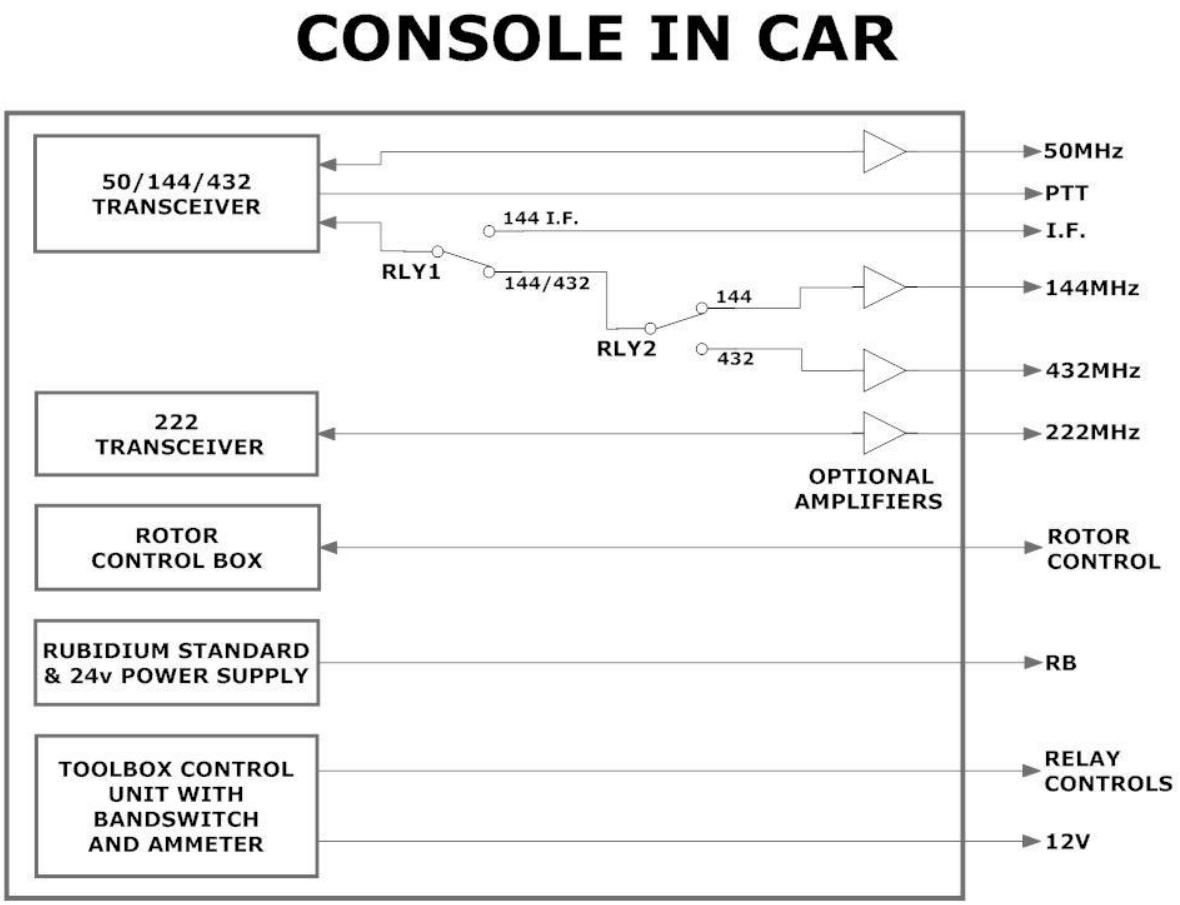
The photo at right shows W6TE’s well-equipped “red rover”, which was operated alongside the “antenna-free” stations in several contests. It is definitely not “antenna free” and it consistently outperformed the small stations that are described here, proving that there is no free lunch in roving! However, those using the small rovers were able to work the same distant stations on every band in every grid square as W6TE. That included a multiop station about 100 miles away from our main four-grid-corner site. The WA5VJB PC-board log periodics are very small and are rated at about 4 dBd average gain, but they perform surprisingly well, even mounted inside a car looking out a window.

The “antenna-free” stations were designed for use in VHF contests where rapid, easy station deployment is the crucial consideration. However, after the small stations were built it turned out they’re useful for other things such as demonstrations at club meetings and other places where a small station that covers the VHF, UHF and the microwave bands is needed.

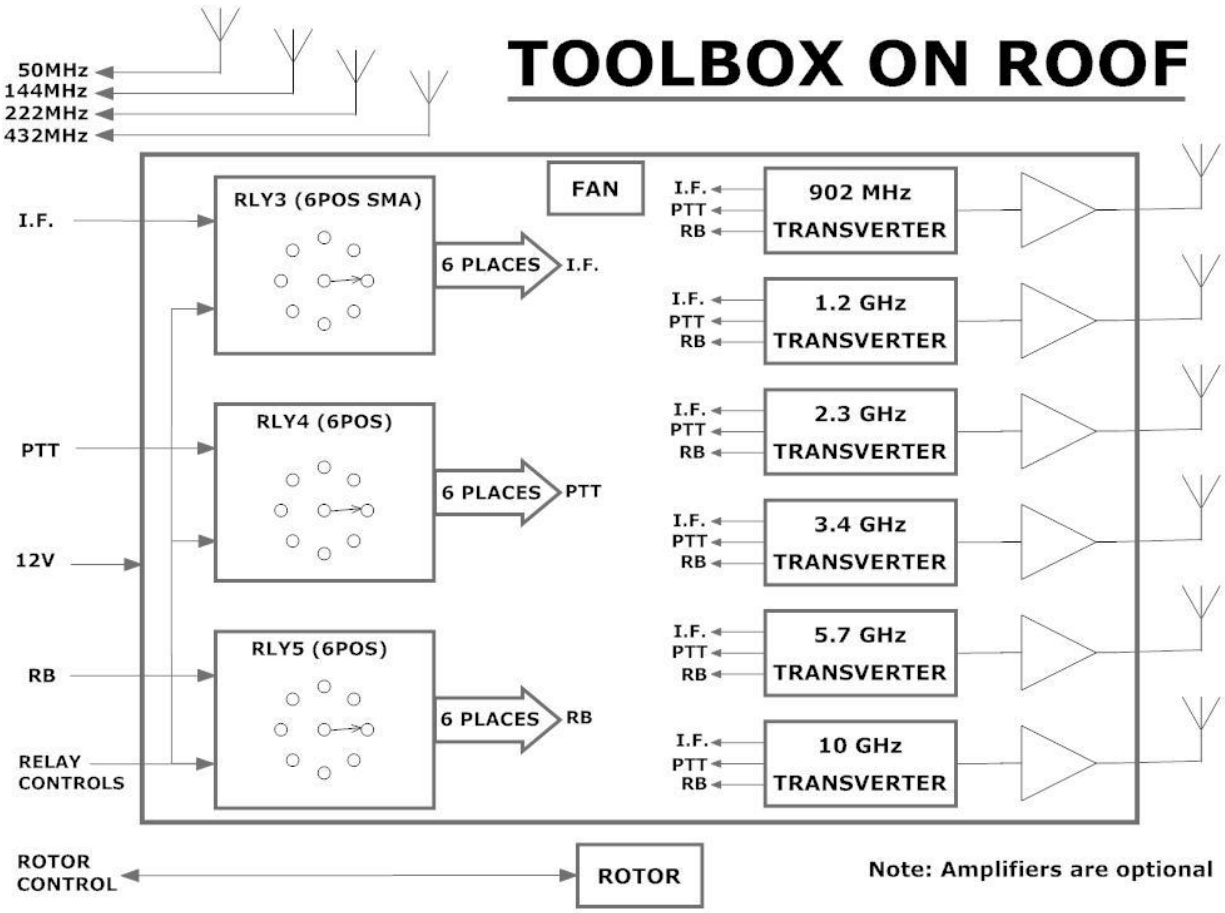
They have also been used to check out other newly assembled VHF+ rovers and fixed stations before contests. If a station has a problem, it's preferable to discover it beforehand.

What's Inside the Boxes

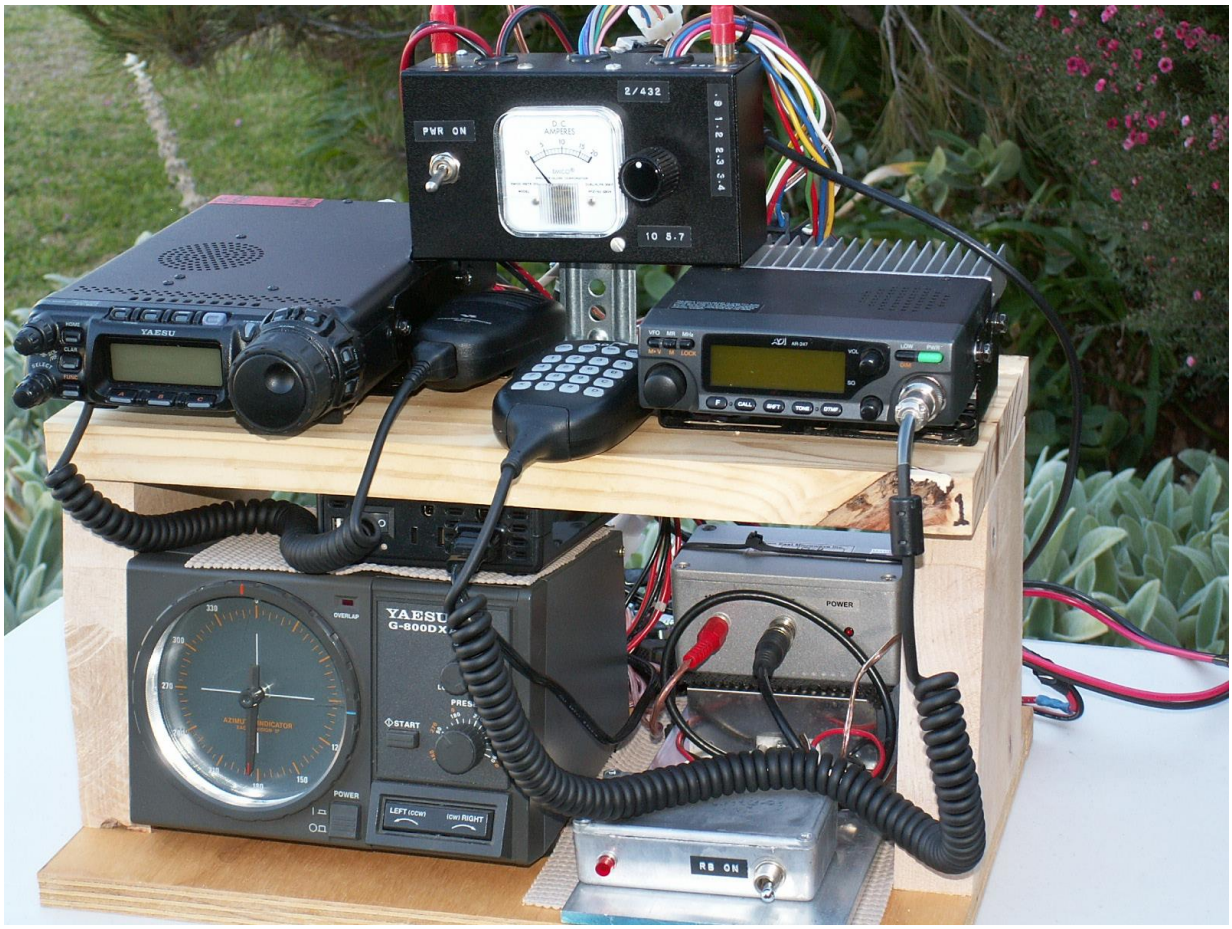
All of the 10-band rover stations follow the same basic design and have interchangeable control cabling and control boxes except for the small stations with built-in switching (instead of a separate bandswitching box). The diagrams on the next pages show the arrangement of the consoles and microwave equipment.



The box at right goes inside the toolbox or other equipment box. It switches the I.F., PTT line and Rubidium reference from 902 to 10 GHz..



All 15 rover stations use this basic design. The “antenna-free” stations have an additional SMA relay to transfer the various transverters to a single WA5VJB log periodic antenna. That relay is wired in parallel with the I.F. transfer relay so a single bandswitch still controls everything. A typical bandswitch and control box is shown below.



The console above is typical of the ones used with toolbox stations. The antenna rotator is powered by a 110-volt inverter (not visible). The Rubidium reference oscillator, its 24-volt power supply and a 4-port Down East Microwave buffer are on the lower right. Some of the stations have an additional I.F. transceiver and a DEMI 222 MHz transverter in place of the 222 FM transceiver. Some of them also have "brick" amplifiers for 50, 144, 222 and 432 as well as amplifiers in the 10-30-watt range for the bands above 902. All of the control boxes use the same connectors and are fully interchangeable. Each bandswitch sends 24 volts for the appropriate band up to the toolbox to key the various relays that transfer the I.F., PTT control line and Rubidium reference from band to band.

Toolbox Stations and Big Box Stations

Here is a photo of seven toolbox stations together (rovers #3 through #9), followed by photos of two toolbox stations mounted on vehicles during a contest and photos of what might be called big box stations with larger antennas and higher power.

These photos show the best-equipped N6NB rovers. At left is rover #1, with vacuum-tube kilowatts on 6 and 2 meters and amps in the 20-watt range on all bands 902 through 10 GHz and 3 watts on 24 GHz (on the tripod).

Below at left is the suitcase rover used to set world DX records on 902, 2.3 and 3.4 GHz in Hawaii. It has amps capable of up to 28 watts out on the microwave bands. In this photo it is shown mounted on a rental car in the volcanic terrain of Mauna Loa.

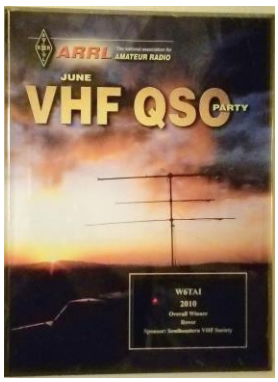
Shown below is the tower trailer that has been towed from California as far east as Cape Cod, MA (rover #12).

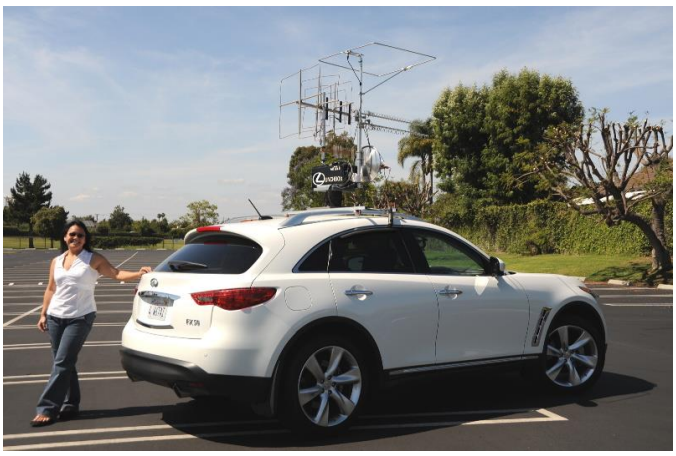
A Small Gallery of Rovers

At left is the “intergalactic rover battle jitney” of W3IY (sk) and his fellow rover ON4IY. Probably no rover ever achieved more success or helped more aspiring rovers than Bill before his untimely passing in 2005 at age 54…

At right is “not your average grandma's car,” as suggested online by Andrea, K2EZ, after she became a grandmother. She finished #1 nationally in the limited rover category in June, 2018 with her roving partner Ria, N2RJ, now ARRL’s Hudson Division Director.

Another YL who was #1 nationally in a June VHF Contest was Carrie, W6TAI, in the rover category in 2010. She drove and operated solo but with a rover group of 14 men in nine other vehicles--and outscored all of them. Carrie put a Lexus logo on her toolbox as a joke (the car is an Infiniti).



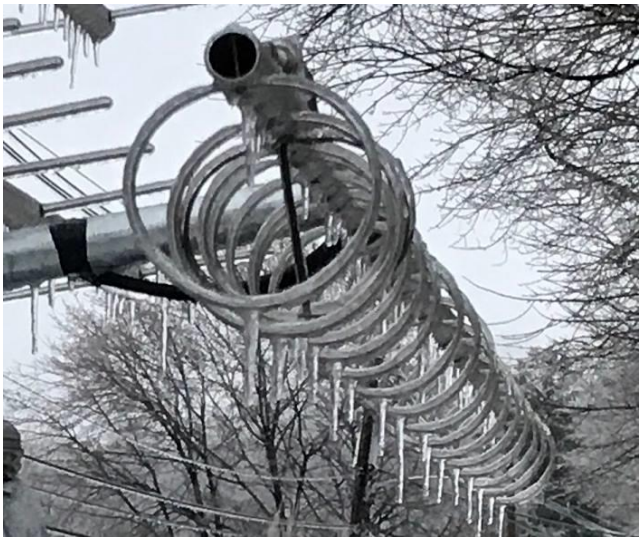


Despite heavy snow, KF2MR (above left) handily won the rover category nationally in January, 2019. KF8QL (above right) has a new rover in the popular H-frame design. A rover owned by K5QE and operated mainly by AE5P (below left) is also an H-frame design. At right below is an H-frame owned by N0LD. This design originated with rovers in the wide open spaces of the Midwest in the 1990s and remains very popular. Its main advantage is that it allows a large stack of antennas on a wood or PVC support structure. Its main disadvantage is that the operator needs maneuvering room to aim highly directional antennas by turning the vehicle. In the bottom left photo, KK6MC demonstrates a unique way to adjust his antennas.

K6YNB's "cabover kilowatt," 1974

Eight rovers in a row, 2009

AA2UK (left) and K1DS, both in 2002



K2EZ (left) and W3DHJ

K5SRT (above), W0JT (right), W9FZ in 2004 (below) and N6MU with K2MM (sk) in 2005 (below, right)

Postscript: A Few FAQs

Several questions have often been asked during presentations about the "antenna-free" and "toolbox" stations.

How long does it take to set up a toolbox station?

Able-bodied workers can usually install a complete toolbox station in an hour or two, depending on the complexity of the job. These are some of the variables:

A) If an existing platform fits a given car's roof rails, that can save major time up front. If a platform has to be redrilled for its u-bolts to fit, it will take longer. If there are no roof rails, rope things down through the windows and get the owner to sign a liability waiver.

B) If a pre-built console fits on a car's passenger seat, that can save some time. If nothing fits, add hours! If there's no passenger seat, suggest that the owner try a DX contest.

C) If there's an existing high-current 12-volt cable in a car's passenger compartment, it will save some time. If not, route fused #10 cables from the car battery under the hood's rubber seal, up the windshield frame to the roof and in a rear window to provide power. Secure everything with low-residue tape. (Thanks to N6VI for this idea.) This step could take an extra hour if it has to be done.

D) If the side windows don't open, find another way to route all the cables from the roof into the car or tell the owner about the next HF contest (see above).

How long does it take to set up an "antenna-free" station?

Maybe five minutes, plus whatever time it takes to get power into the passenger compartment (see above). A cigarette lighter outlet often doesn't have sufficient current capacity, but getting power there is worth a try. Next find a box to put under the unit so the antennas can "see" out a window. Then spend another five minutes telling the car owner about the importance of getting far away from trees, houses and other microwave-eating obstructions. HF operators often don't understand this.

Why do you still do this at your age? And what's grid circling?

We're not really here to talk about religion or politics. Next question.

Wayne Overbeck holds a Ph.D. from UCLA and a J.D. from Loyola Law School. He was first licensed in 1957 and was a professor at California State University, Fullerton from 1968 until 1973 and from 1980 until he retired in 2003. He authored 20 editions of a college textbook, Major Principles of Media Law, and also served four terms as an elected vice director of the American Radio Relay League. See http://n6nb.com