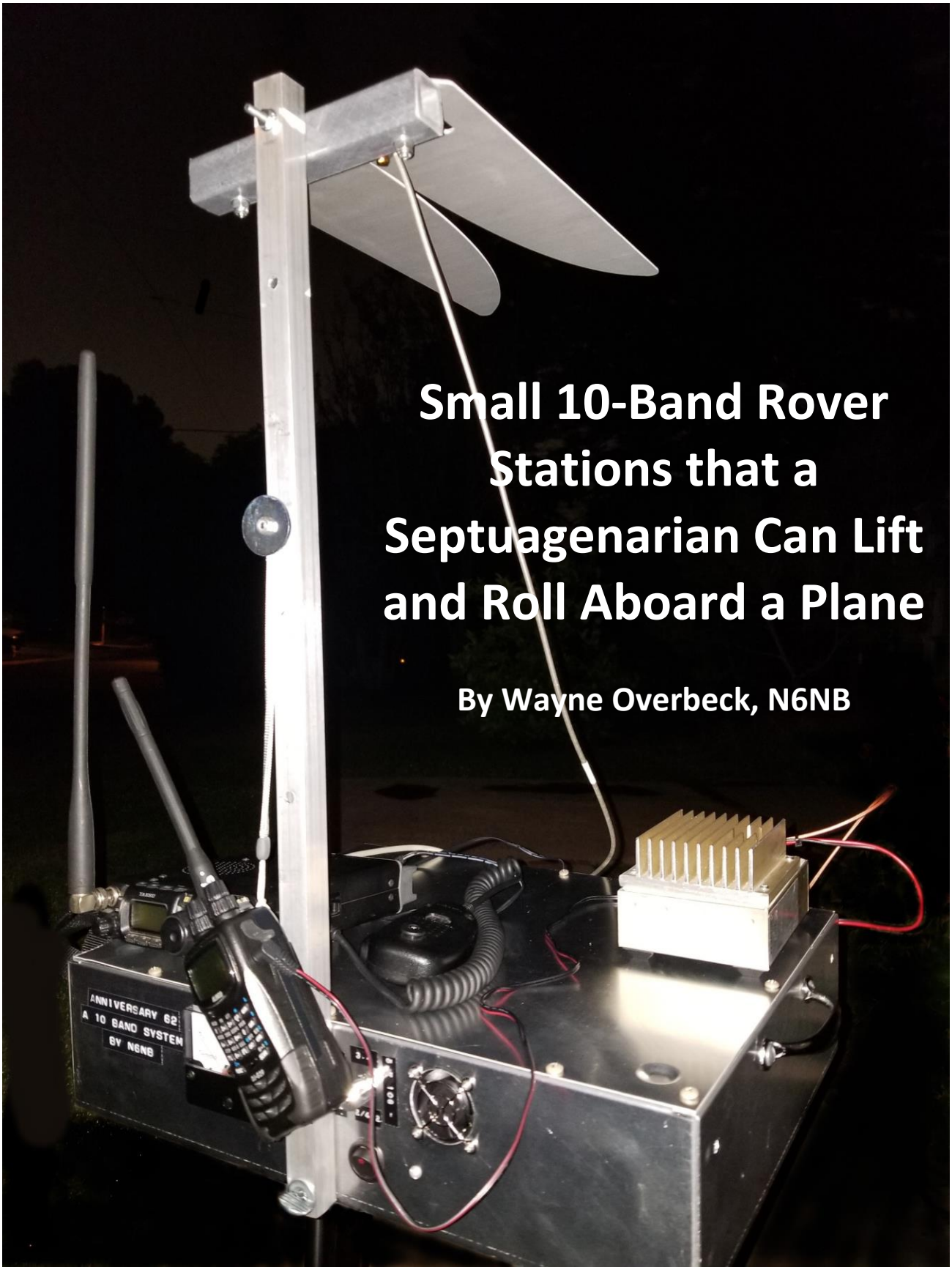


# Small 10-Band Rover Stations that a Septuagenarian Can Lift and Roll Aboard a Plane

By Wayne Overbeck, N6NB

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This article is about the quest for small but complete 10-band rover stations that someone closer to age 80 than age 70 can still lift and install in a car (or roll aboard an airplane, as packaged in the photo at right below). The photos in this article show four different stations I've built with the goal of making them senior-friendly. All four work surprisingly well without any exterior antennas. The most recent one, built in May of 2019, has transverters for five bands and amplifiers for the highest four bands (2.3, 3.4, 5.7 and 10 GHz) housed in a 13x17x4 inch chassis box. It has the cabling and connectors in place to plug in transverters for two more bands, 222 MHz and 902 MHz.

Like the earlier rover stations that don't require outside antennas, this one uses a transceiver such as a Yaesu FT-817 or FT-857 both for the microwave IF and for primary coverage of 50, 144 and 432 MHz. This and one of my earlier small stations use Alinco DJ-G29 hand-held transceivers for 222 and 902 MHz, but it's easy to add transverters for those bands, at the price of added weight. This newest station has only one antenna besides the "rubber ducks" on the hand-held radios: a Vivaldi UWB3 "ultra wide band" antenna that covers 900 MHz through 10 GHz with about 11 dBi gain on six amateur bands. The earlier ones all use WA5VJB's surprisingly effective but very small PC board log periodics. All of these stations can be upgraded with higher power and rooftop antennas by someone who is feeling especially frisky: these stations have sometimes been used with magnet-mount whips or even directional antennas on a platform with a rotator for 50, 144, 222 and 432 MHz.

Both the Vivaldi antenna used in my 2019 rover (see below) and the WA5VJB LPs don't seem to mind being aimed out a window while the unit rests on the passenger seat of a car. They don't even mind a *closed* window. This particular Vivaldi design has not been well-known in amateur radio until recently. Made by RFSpace and sold by Amazon.com (among other vendors), this 13" long aluminum antenna exists because there is now a large non-amateur market for directional antennas in the microwave region. This antenna is intended for wi-fi, drone flying and many other uses in addition to amateur radio. For our purposes, this made it feasible to cover 902 through 10 GHz with just one antenna no larger than the equipment box on which it is mounted. Granted, it seems a little weird to plop a 10-band station on a car's passenger seat and then work distant stations all the way up to 10 GHz with good signals using only one antenna aimed out a closed car window.

What originally inspired the entire idea of building senior-friendly stations with no external antennas was WA5VJB's PC board log periodic design that covers the spectrum from 850 MHz to 6.5 GHz. A small (30 cm.) dish or slotted waveguide omni was added for 10 GHz in the earlier stations. If a single antenna smaller than some cellphones can perform so well on 902, 1296, 2304, 3456 and 5760 MHz, the idea of building an entire 10-band station that fits on a car seat (including antennas) seemed irresistible.

However, one problem became evident with the earlier designs. The antenna "stack" of a small LP and a 10 GHz dish only works well when both antennas can "see" out the passenger window. That isn't a problem in a larger truck or van, but most cars have windows small enough that the station works much better if the passenger side *door* is open. If the door is closed, either the LP or dish looks partly into the car body. That means a mobility-challenged senior has to jump out of the car (or maybe "hobble out" is a better term for it) and go around to open and close the passenger door at every stop to run through the microwave bands.

The newest small microwave station solves the car door problem by using just one antenna, but the tradeoff is lower gain on 10 GHz with only the Vivaldi and no dish.

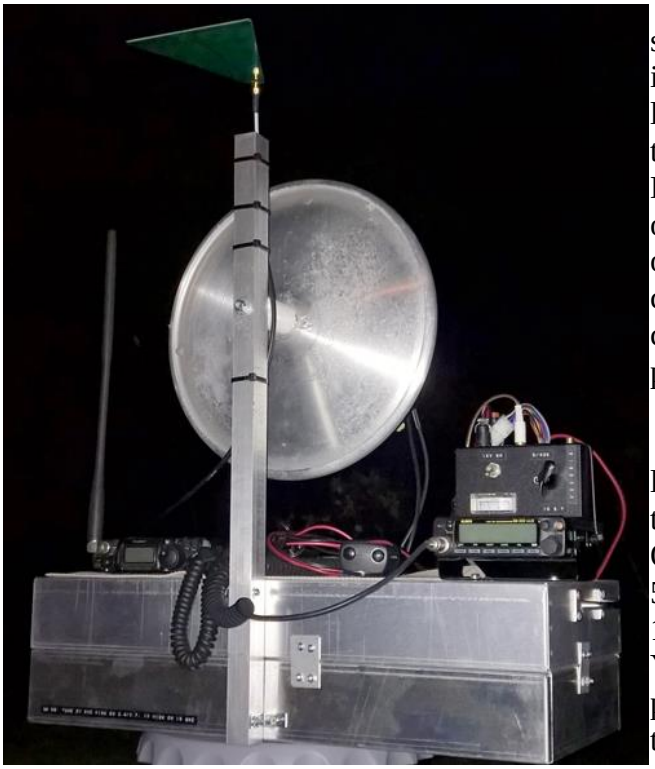
The design of these senior-friendly stations without exterior microwave antennas has been an evolutionary process. The original "antenna-free" station was in a black Pelican-type case and it was used in several VHF contests, including a venture to East Texas in January, 2012, where it was used by an all-YL roving team, K5FAY and KJ6CNO. Compared to the newest stations, it's bulky and heavy.


Setting up this station (shown at left) involves placing the black case, which houses the transverters, on a car seat, then putting the main transceiver, a 222 transceiver, a bandswitch box and a Rubidium standard (all mounted on a plywood board) on top of the black box. Next, five interconnecting cables are attached. Finally, the antenna "stack" is mounted and feedlines are connected. This station is normally used with magnet-mount mobile antennas for 6, 2, 222 and 432. Setting it up is less trouble than installing a toolbox station, but only a little less trouble. The toolbox system involves mounting a platform and rotator on a car roof, adding a toolbox and antenna stack, then placing an operating console on a car seat and hooking up many cables. The photo at left shows the station in the Pelican-type case after a 2019 redesign with a single antenna for 902 through 10 GHz.

After three years of use, the original station without external antennas was joined by two new and less bulky inside-the-car stations. In 2015 I built a complete station in and on a 12" x 17" x 3" chassis as shown at right. That station differs from the newest one mainly in that there are only transverters, not amplifiers. 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 and T/R antenna switching. An FT-817 provides 50, 144 and 432 MHz coverage plus the IF for the higher bands. An Alinco DJ-G29 HT is often used for 222 and 902 MHz in this station.

Like the 2019 station, this station is fully wired for 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 a dual-band 5.7 and 10 GHz 30 cm. dish is used for higher gain on those bands. Like the newest system, this one has a Rubidium standard to assure frequency accuracy on the microwave bands. Two panel meters monitor DC current flow and relative power output. With everything in a single box, there is far less cabling to deal with. The bandswitch transfers the PTT line from band to band, switches the Rubidium signal from one transverter to the next and controls the two six-position SMA relays. All of these small stations have two six-position SMA relays, one to transfer the IF from band to band and another to transfer the transverters to a shared multiband antenna.



Like the 10-band unit just described and shown on the previous page, a third system was built in and on aluminum chassis boxes in 2015 (shown at left). Because it uses Down East Microwave transverters, which are larger and heavier than DB6NT transverters (but also deliver more power output), this system uses two 10x23x3 chassis boxes, one mounted atop the other. It does fit on a normal car seat, but barely. 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 IF 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 is sometimes added to the system with an extra relay to switch the 857 from the amp to the microwave IF line. In this higher power configuration, the station must always use external antennas on 6, 2, 222 and 432. The FT-817's "rubber duck" antenna will not handle more than about 10 watts.

How well do these 10-band stations perform with no external microwave antennas?

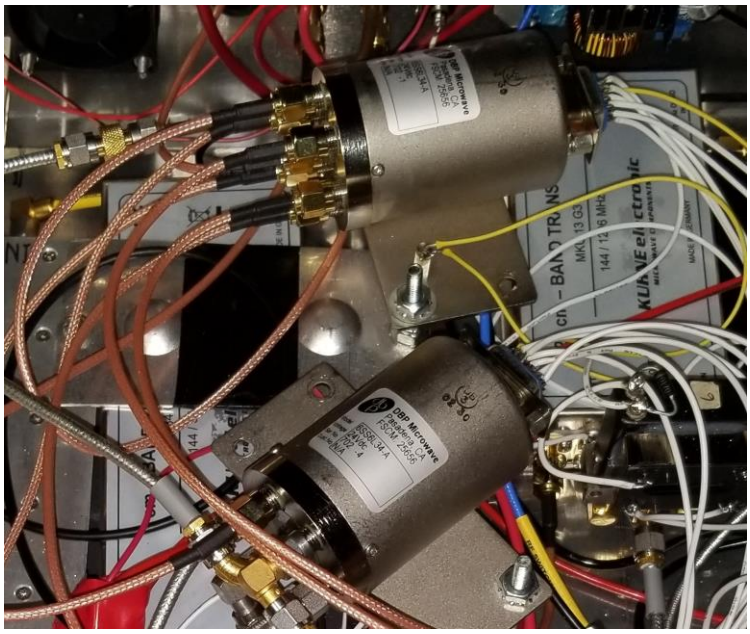
There is no free lunch in VHF+ weak-signal operating. The toolbox stations with three-foot-long loop Yagis on 902, 1296, 2304 and 3456 do hear better and get out better than the smallest stations—but only a little better. In contest operating, the people using the small stations have almost always been able to work all of the same DX as the operators of the larger stations.

Often W6TE's well-equipped "red rover" (with large external microwave antennas, shown at right) and my own full-size rover (also with loop Yagis for the microwave bands plus rover-size Yagis, Moxons, or cubical quads for 6-432, shown below), have been used alongside the small stations, providing opportunities for comparison tests. The small stations have worked amazingly well in these side-by-side tests.


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 events where a small station that covers the VHF, UHF and 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.

Although this is not the place for a detailed construction article, these four 10-band systems have certainly performed well enough for their small size to justify including some technical details. Probably their most important feature, aside from compactness, is rapid bandswitching. The key to that is a single-knob switch that controls all of the necessary functions: keying SMA relays to transfer the IF and antenna(s) from one band to the next, transferring the PTT line from band to band and even transferring the Rubidium reference signal to various bands.

New SMA relays tend to be expensive (*really* expensive). However, on the surplus market good quality six position SMA relays can often be found for prices as low as $20, especially if they run on 28 volts instead of 12 volts. Any system that uses a Rubidium reference oscillator probably already has a 12 to 24 D.C. voltage doubler that can also provide power for the input and output SMA relays (see the example below from the 2019 system, which works but will win no awards for tidy lead dress).



Eventually, after weeks or months of work, a project like this is finished. Then the builder applies power and nervously looks for smoke. If there isn't any smoke (or blown fuses), the builder probably has a working microwave station. It may perform surprisingly well, but there's one final test. Is the finished product still small enough to be lifted and handled by a septuagenarian--or did it gradually grow too heavy to lift?

My 2019 "Anniversary 62" station (so named because I built it just after my 62nd anniversary in amateur radio) meets the septuagenarian lift test. Even with built-in amplifiers on four microwave bands and output powers of 29 watts on 2304, 23 watts on 3456, 6 watts on 5760 and 5 watts on 10 GHz (measured at the antenna), it's still lift-able--for now.

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The photos that follow show earlier roving equipment and some of the operators who used it. There's a 2010 photo of 15 operators gathered in the desert beside one rover van. That group was running ten (10) different rover stations. Below that is a 2011 photo of six rovers (five using rooftop toolbox stations). Those mega-rover operations were gradually scaled back over the years for reasons gerontologists can best explain. I've often said that the huge rover expeditions were a lot of fun, but we knew we couldn't continue them indefinitely.

Another venture that couldn't continue indefinitely was trips to Hawaii to work the famous trans-Pacific tropo duct. I made six trips to the big island of Hawaii in 2014-2016 with a complete station for all bands through 10 GHz in two large suitcases. On each trip I assembled the station in a hotel room, then dragged it out to a rental car and solicited help hoisting it onto the roof. It was cumbersome, but the station performed well enough that I worked the mainland on three of the six trips, setting world distance records on 2.3 and 3.4 GHz in 2015 and on 902 MHz in 2016. The last photo shows this setup on the Mauna Loa volcano, with Mauna Kea, Hawaii's other 13,000-foot mountain, in the background.


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