

*Adapt the military AT-1011/U vertical antenna for stationary vehicular use at special events and for emergency deployments.*

# Toyota Tacoma “Truck-Tenna”

BY PHILIP A. NEIDLINGER,\* KA4KOE

**T**he basic precepts required for effective radio communications remain constant. If you want to be heard, then a certain set of conditions must exist in terms of equipment and propagation, combined with operator skill and technique. Many technical advances were made during times of war. American hams contributed greatly during those times of crisis. The United States military appreciates the value of communications and its application on the battlefield, on the high seas, in the air, and in space. If a vital message cannot get through when the bullets are flying, then people will die. The military radioman<sup>1</sup> of today is trained to select the proper antenna, frequency of operation, power level, modulation method, and encoding technique in order to maximize the likelihood of successful reception. At the same time, the radioman employs operational methods and highly classified electronics in order to prevent detection and decoding by the enemy. He will also contend with hostile electronic countermeasures. Finally, he must attend to personal hygiene and weapon cleanliness while enjoying a steady diet of MRE's (Meals Ready to Eat) in the field. Indeed, the world of the radio amateur is far removed from that of the military communicator.

Amateurs can learn a lot by reading military radio field manuals (FMs) and other publications. Many FMs are readily available on the internet.

The manuals emphasize one important concept: In order to effectively communicate on the high-frequency bands, one must get as much metal in the air as possible. An electrical-efficient antenna is especially important when one is active in emergency communications. How often have you seen physically short HF antennas in use solely for the convenience they present in terms of deployment? The penalties exacted for the sake of this so-called convenience are severe in terms of radiation efficiency. Utilizing higher output power to compensate for a poor antenna will reduce the operational time of the emergency station with a limited energy source. An antenna that addresses the issues of ease of deployment and excellent efficiency is the military AT-1011/U tactical vertical antenna (photo A and Table I).

### Background of the AT-1011/U Antenna System

The original Shakespeare AT-1011/U was fielded by the U.S. military in 1960 and is still in widespread use today. In sta-

tionary applications, the aerial is erected as a ground-mounted vertical with a total length of 32 feet (fig. 1). Mobile vehicular operations (called “shoot and scoot” by the military) limit the practical length to 16 feet due to overhead impact hazards. The antenna sections are olive drab in color, 4-foot-long hollow fiberglass tubes of varying tapers and diameters that are designed to be screwed together by hand; no special tools are required. Each section has an internal conductor

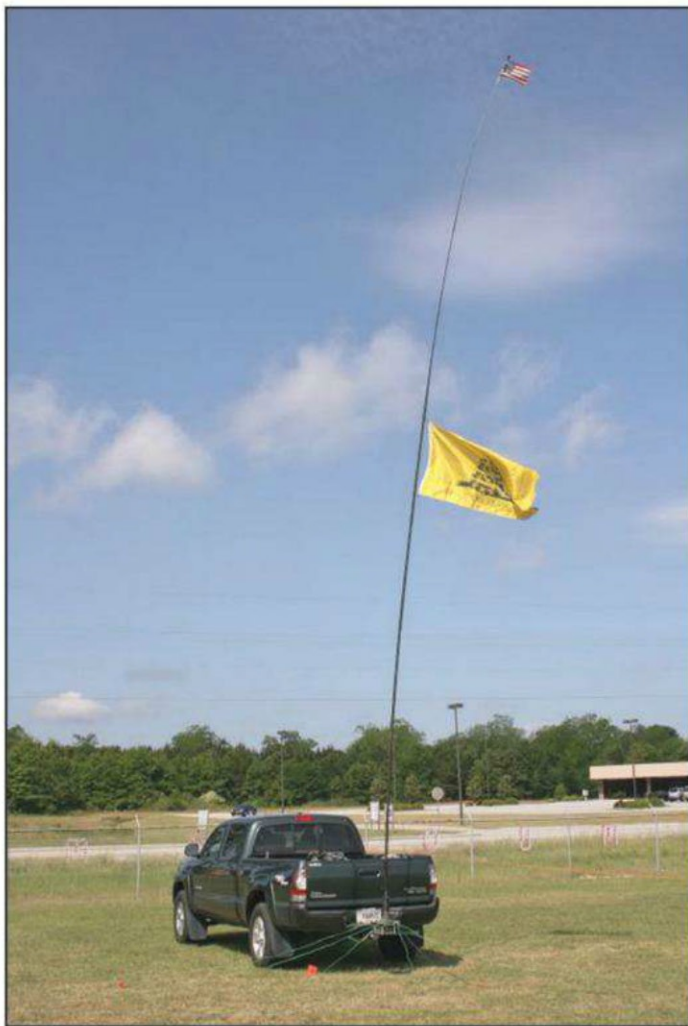


Photo A— AT-1011/U on Toyota Tacoma, 100th Anniversary Scouting Jamborama, Kiwanis Fairgrounds, Statesboro, Georgia, April 30, 2010. (All photos by the author)

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serving as the radiating element. The only tool required for erection of the ground-mounted vertical is a rubber mallet for driving guy stakes.

The aerial is very flexible and designed to take abuse. Vehicular tests during development were conducted to simulate impacts with overhead obstacles (a horizontal oak beam) while in motion. Stationary testing was even more demanding: A ground-mounted AT-1011/U was subjected to, and survived, shock wave over-pressures from a nearby nuclear explosion. Needless to say, the antenna is extremely rugged and well-suited to the rigors of communications in the field. The basic kit rolls up into a duck cotton canvas bag (photos B and C) and is designed to be dropped from a low-hovering helicopter without damage. The antenna is essentially a very long and flexible radiating fishing pole that works well for hams trying to "hook" that rare DX station.

## Amateur Radio Applications

I am active as a Radio Merit Badge advisor for the Boy Scouts of America. After organizing and hosting several Jamborees on the Air (JOTAs) and other events, it was clear that the usual methods for erecting wire antennas

Antenna Part Number Table**			
Antenna Item	NSN Number	Nomenclature	Model
Tip Element	5985-00-733-6042	AT-1039/U	120-20
Second Element	5985-00-733-6043	AT-1040/U	120-2
Third Element	5985-00-733-6044	AT-1041/U	120-34
Fourth Element	5985-00-733-6045	AT-1042/U	120-8
Extension Element (4 required for 32')	5985-00-733-6046	AT-1043/U	120-14
Flange Base (Witch's Hat)	5985-00-733-6047	SC-C160410	120-28
Canvas Carry Bag	5985-01-475-2367	---	120-58
Ground Radial Kit	5985-01-397-6971	---	120-47
Guy Rope Kit	---	---	120-59
Heavy Duty 1 KW Spring Base	5985-00-267-2752	AB-1335/G	4245
NVIS TWA Adapter	5985-01-422-8525	NVIS Tilt Whip	4282
Complete Portable AT-1011/U Kit	5985-01-453-4775	32'	120-60
Complete Stationary AT-1011/U Kit	5985-00-846-6442	AT-1011/U	120-55

Table I— Antenna parts numbers.

were time-consuming. This task was particularly difficult if trees or other supports were unavailable. I needed an antenna that was efficient, quickly and easily erected, and did not rely on external supports.

I obtained a mostly complete AT-1011/U antenna kit from a friend who was cleaning out his garage. The kit was missing several of its vertical sections, flange base, ground radial kit, and

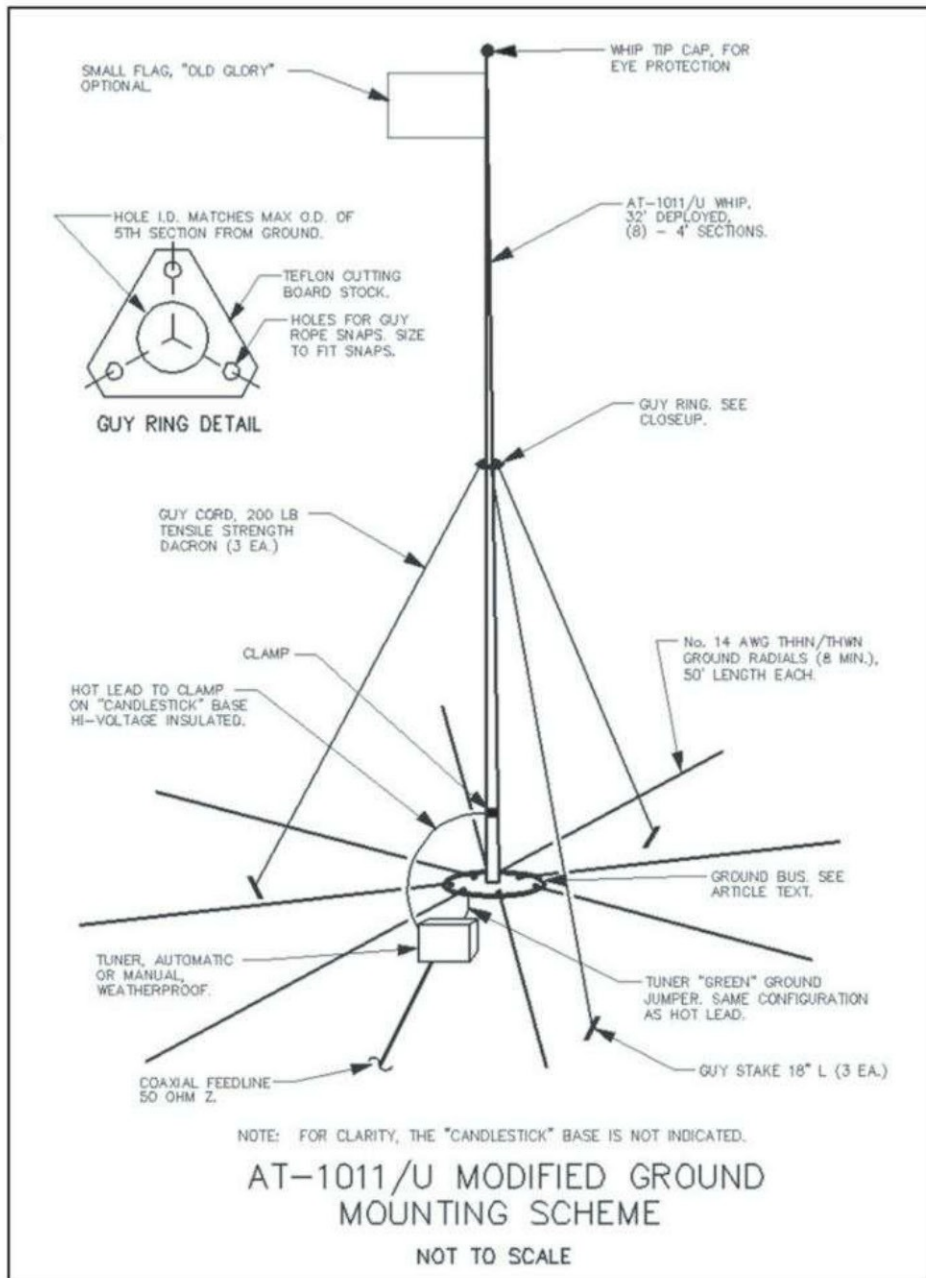
guys. The missing components, with the exception of the ground radials and guys, were obtained from the original manufacturer, eBay, and other sources. Pricing new radials and guys made fabrication of homebrew replacements desirable.

In due course, I constructed a set of radials using a 300-foot roll of green No. 14 AWG THWN/THHN copper stranded wire from a "big box" hardware store

Fig. 1— AT-1011/U ground-mounting scheme (detail by the author). The figure is drawn from a Shakespeare catalog detail. Information used for reference with permission of the manufacturer. →

as well as a dozen heavy-duty ring terminals. The radial anchor ring (photo D) was assembled from six copper-coated steel pipe hangers, soldered together in a hexagonal “circle.” The ring was then drilled to make room for stainless-steel bolts, washers, and wing nuts. The anchor ring guaranteed low-resistance radial connections rather than rely on the questionable conductivity of the flange base (“witch’s hat”). The guy kit was assembled using olive-drab 550-pound test para/military cord (“paracord”) and “carabiner” snap hooks from a nearby sporting-goods store. A 1/4-inch thick, white Teflon® kitchen cutting board was saw cut and drilled to form the guy anchor ring.

I was eager to test out the new vertical antenna for our next JOTA at the Mighty Eighth Air Force Museum, located at Pooler, Georgia. A moderate breeze was blowing that morning. I quickly realized it was nearly impossible to set up the antenna without a helper holding the vertical sections

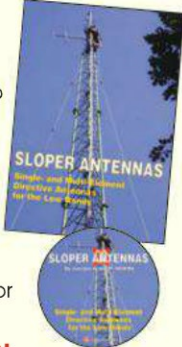


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Photo B— AT-1011/U roll-up kit and “witches hat” flange base.

steady for guy placement, even with two anchored guys. A friend showed up and helped with setup. The homebrew radials, tuner, and coaxial cable were then attached to the flange base. I powered up my trusty 20-watt Philips-MEL PRC-2000 HF manpack radio (photo E) and began making contacts for the scouts. The entire set-up process, from unloading my truck to turning on the radio, took over an hour.

The antenna performed spectacularly! Contacts were easily made on 17 and 20 meters, even though the bands were crowded with other scout stations. As a demonstration, I poured water on the waterproof military radio. The scouts loved it! Volunteer soldiers from the 3rd Infantry Division, Ft. Stewart, had the scouts run foot races while wearing 50 pounds of body armor. Finally, the day's activities wound down and propagation began to suffer. All in all, it was a very successful JOTA with 70 scouts, 20+ amateur radio volunteers, and five soldiers in attendance.

### Hitch-Mounted AT-1011/U

After a couple of events, I concluded that the ground-mounted AT-1011/U still took too long to set up and break down. The proverbial "light bulb" began to glow above my head. The solution was to use my 2009 Toyota Tacoma in place of the flange base and guys. I essentially "reinvented the wheel," as our military has been using this particular aerial on tactical vehicles for decades. My version required fabrication of a custom bracket to mount the large mobile spring and an SGC SG-237 autotuner.

A prototype ball-hitch-mount aluminum bracket was fabricated. I attached the new custom bracket, spring, and autotuner to a standard 2-inch square, 4-inch rise trailer-hitch ball mount. The bracket incorporates four screw lugs for attachment of eight ground radials, as well as an SO-239 female connector. All critical hardware is stainless steel. The metal parts of the bracket are painted black. (See fig. 2 and photo F.)

The +12-VDC operating voltage for the SG-237 is supplied via a standard female, seven-pin trailer plug soldered to the tuner's power cord. For my project, I replaced the autotuner's coax and power pigtails. Be aware that opening the autotuner may void the warranty; consult with the manufacturer prior to proceeding.

The vehicle ignition key is set to "ACCESSORY" to supply power to the



Photo C— AT-1011/U roll-up kit unrolled. Note that the ground rod is not part of the standard kit.

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autotuner. Be absolutely sure that your vehicle does not draw excessive current in this mode or you may end up with a dead battery. I learned this lesson the hard way: One does not leave the emergency brake engaged when energizing the autotuner, as the vehicle brake lights will be illuminated. I wrapped up one Boy Scout event via a jump start from my friend Ralph Quinn, W4REQ. If you are unsure of the current

draw on your battery, then start the vehicle periodically as a precautionary measure.

### “Mobile” Operating Notes

The reader is *strongly* warned to refrain from driving a vehicle with an attached AT-1011/U. Many states set a maximum height above the road surface in the 12- to 13-foot range for any items attached to a motor vehicle. The primary danger is contact with high-voltage overhead power lines. This warning bears repeating: **Using the AT-1011/U while in motion can result in death by electrocution!**

My system will allow an amateur radio operator to travel to an event or emergency location and field deploy a very effective fixed station antenna system in short order. In practice, I was able to erect the full 32-foot vertical and eight radials in approximately 15 minutes. Contacts are easy to make even at the 20-watt power level of my manpack radio. The truck-mounted antenna and integral autotuner loads up easily and performs well on all bands from 160 to 10 meters.

### Operating Suggestions

1. Verify that you have plenty of room for laying down the radials. The usual warnings about overhead power lines and other possible hazards apply should the antenna accidentally fall over. Always practice situational awareness and enlist the aid of a helper. Radials will dramatically improve your signal! Do not rely solely on the antenna bracket vehicle-chassis bonding jumper.



Photo D— Homebrew ground radial anchor ring and eight guys on AT-1011/U flange base. SGC SG-237 tuner is also attached to the base.

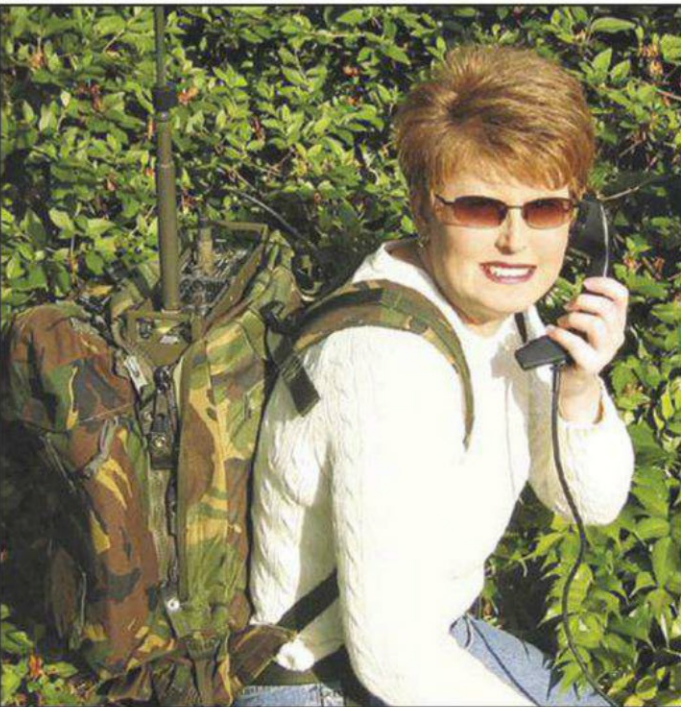


Photo E— The author’s 20-watt Philips-MEL PRC-2000 HF manpack (or in this case, womanpack) radio, demonstrated by his wife, Sheri, K4SMN.



Photo F— Custom AT-1011/U mounting trailer hitch bracket assembly. Additional photos are available online at <http://photobucket.com/at1011> and <http://photobucket.com/at1011-bonus>.



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2. Mark the radial wires at regular intervals with orange construction warning flags to alert others of the potential trip hazard. I also suggest surrounding the entire radial field with orange construction marking tape elevated with wooden stakes. The stakes, flags, and tape are inexpensive and available from most hardware stores. Do not secure the radial ends to the ground. In the event a person trips on a radial, the wire will "give" and may avert an accident.

3. The usual cautions with respect to RF exposure apply. I use a 100-foot-long coaxial feeder to put plenty of distance between the antenna and operators. The metal spring will cause RF burns if touched during transmissions. I have a nice scar on my left hand to prove this very point: I was hauling down a flag attached to the vertical element and inadvertently touched the spring while a friend was transmitting. OUCH!!

4. In practice, the SGC SG-237 tuner "likes" to see some mismatch while in use. The 32-foot AT-1011/U is resonant as a quarter-wavelength radiator near the 40-meter amateur band (the original designer must have been a ham!). Remove a single 4-foot vertical section to shift the antenna's resonant point. Trial runs with the tuner indicated that it would not stay tuned and would randomly "hunt" for a match. Also consider using the SGC "Smart Lock" accessory if tweaking the radiator length is unsuccessful.

5. Referencing Item 4, similar advice applies to the 20-meter band. The SG-237 is matching a 32-foot-long end-fed half-wave vertical, thereby presenting a high-voltage point at the tuner's hot terminal. Some tuners can be damaged by these high voltages. Exercise caution and read your manual prior to use.

6. Be sure all tuner connections and hardware are tight prior to applying RF each time the antenna system is assem-

bled. Loose connections can cause arcing and may damage the tuner's internal RF sense diodes.

7. Verify that your vehicle's emergency brake is not engaged when the ignition key is set to "ACCESSORY" to prevent illumination of the tail lights. A dead car battery can strand you at a remote location if you do not have a friend nearby with a set of jumper cables.

8. Stow the fiberglass antenna elements in their protective canvas bag when not in use. The elements will deteriorate if exposed to the sun's ultraviolet rays for extended periods. Applying RF-transparent paint (i.e., contains no metal or carbon ingredients) may benefit if long-term outside use is contemplated. Consult with the manufacturer prior to applying paint.

9. The antenna can serve double-duty as a flag standard and help draw attention to your ham radio operation. I typically hoist up several flags from the radiating "flagpole" for special events.

### Where to Find an AT-1011/U

Those wishing to obtain an AT-1011/U have several options. The antenna system and accessories are available new from the following companies:

Shakespeare Military Antenna Products: <<http://www.shakespearemilitary.com>>.

Harris Corporation, <<http://rf.harris.com>>. Harris' version of the AT-1011/U is the Model SB-V35F.

Valcom Manufacturing Group, <<http://valcomguelp.com>>. Valcom's version of the AT-1011/U is the Model VAS-1011.

One may also find surplus AT-1011/U kits or replacement parts on eBay. The various items are listed from time to time

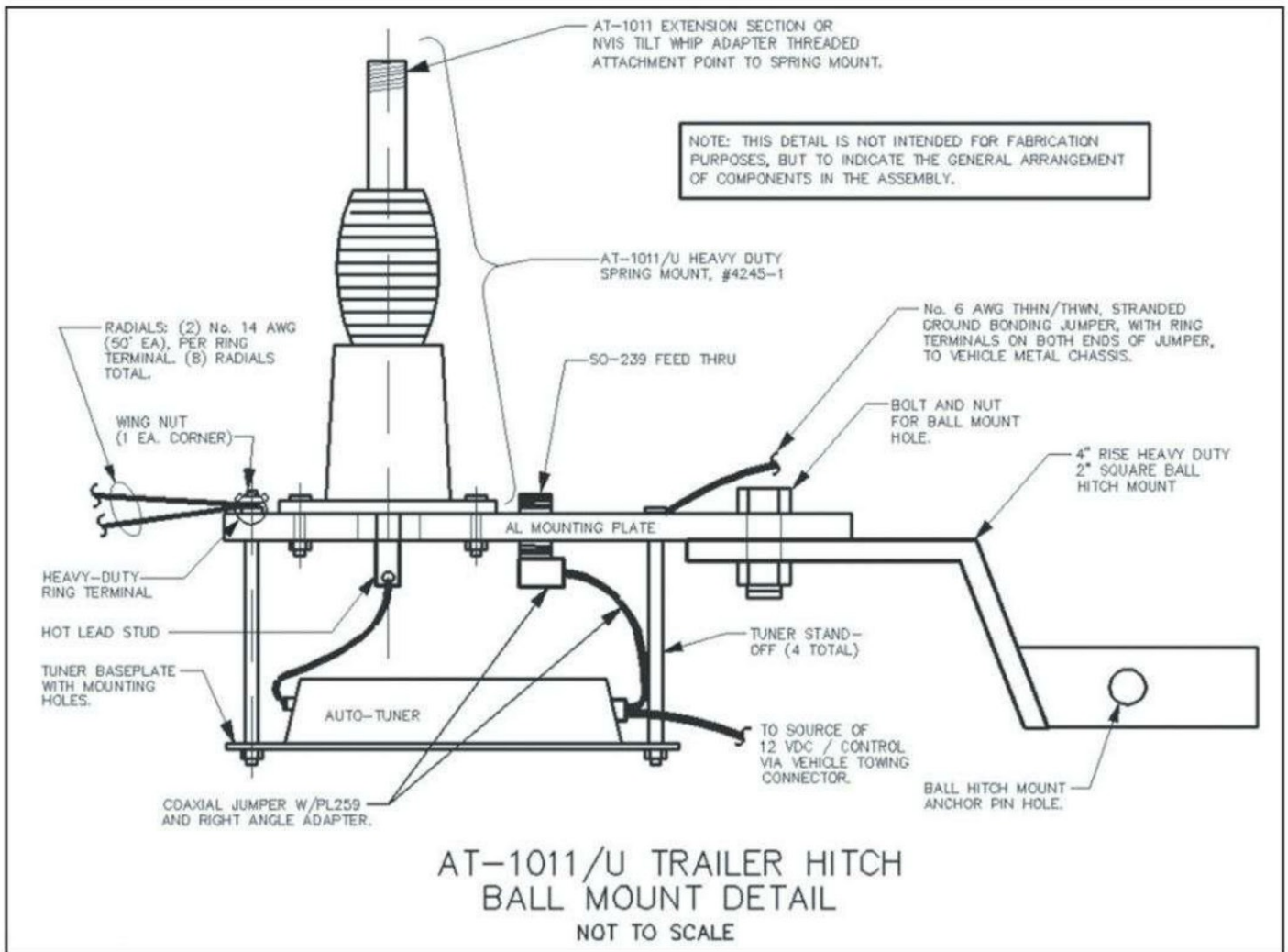


Fig. 2— Hitch antenna mounting bracket design drawing. (Detail by the author)

at a considerable cost savings. I have seen complete kits sell for less than \$200 on eBay. See the References list for additional resources.

## Conclusion

To date, I've deployed my antenna at nearly a dozen radio special events. The system is effective at putting out a strong signal on the HF amateur bands. The only drawback is that one cannot run errands while participating at an event. True mobile operation is strongly discouraged, even with the whip shortened to 16 feet. Other hams express disbelief when I

tell them, with tongue "planted firmly in cheek," that I am operating "mobile."

In the author's opinion, the "Truck-Tenna" is an effective special-event/ EmComm antenna system that will radiate a signal rivaling that of many fixed stations.

As always, be safe, and have fun!

## Notes

1. Radioman as utilized in the context of this article is non-gender and non-service specific, i.e. a man or woman performing his or her assigned duties in any branch of the United States Armed Forces.

## References and Useful Internet Links

eBay (AT-1011/U parts): <<http://www.ebay.com>>  
 Brook Clarke, N6GCE Internet Military Reference: <<http://www.prc68.com//AT1011.shtml>>  
 Yahoo Army Radios Site, <<http://groups.yahoo.com/group/armyradios/>>  
 Yahoo Milpack Site, <<http://groups.yahoo.com/group/milpack/>>  
 Murphy's Surplus (AT-1011/U parts), <<http://www.murphyjunk.bizland.com>>  
*US Marine Corps Field Antenna Handbook*, MCRP 6-22D, available on the internet.  
*US Marine Corps Radio Operators Handbook*, MCRP 3-40.3B, available on the internet.  
*Tactical Single Channel Radio Communications Techniques*, US Army Field Manual FM 24-18, <<http://www.fas.org/irp/doddir/army/fm24-18.pdf>>  
 Fiedler, LTC David; *High Frequency Radio Returns to Transformation Army in Brigade Combat Teams*, Army Communicator Magazine, Winter 2001: <<http://www.signal.army.mil/ocos/ac/Edition,%20Winter/Winter%2001/HFIBCT.htm>>  
 Patricia Gibbons (SK) WA6UBE, NVIS, <[http://www.tactical-link.com/field\\_deployed\\_nvिस.htm](http://www.tactical-link.com/field_deployed_nvिस.htm)>  
 Neidlinger, Philip; "Green Radio Roundup," *QST Magazine*, April 2006.  
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