

# An Introduction to VHF Operating and Contesting

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## Abstract

Just getting started with a license? Looking to try some new things on the air, and improve your operating skills for public service? Then this guide is for you. Here we explore tips on setting up a basic station, and on upgrades and ideas to implement as you are able, geared toward general proficiency with VHF communications and operating in both public service and contest environments.

## 1 Introduction

During a public service event, radio operators rely on their knowledge of their radio and its limitations to communicate and get the messages through. In order to be able to do that efficiently and effectively, operators must have practiced with their radio. Outside of the training activities and public service events your local club may offer or be involved with, there's another great place to learn: contests.

Contests offer an interesting perspective on your station, because unlike with public service events where communications are often over a repeater or at very short range, you will be trying to make simplex contacts at great distances (whatever that means). Unlike most repeaters, the other station may not have much power or a high point from which to transmit, so you may need to work harder to make a contact.

With a basic station (handheld, stock rubber-duck antenna), you may be limited to distances of only a few miles or kilometers—and even less if you are inside a building or vehicle. As you make upgrades to your antenna, location, and power, those distances can increase. Contacts of more than 250 km (150 mi) are possible with 5 W FM. Yes, you need a decent antenna, a high location, good propagation, and perhaps a big gun station on the other end, but it can and does happen.

Okay, so contests can be exciting and you can learn about your station's effective range, but how does it all work? How does a new operator get involved? The first step is to figure out what kind of station you have in terms of equipment and location.

## 2 Station Levels

In this section, I'll try to outline some options for participating in a contest. These are non-exhaustive, and distinctions are drawn somewhat arbitrarily on a large spectrum of station

capabilities and operator interests. One theme is shared throughout: HEIGHT IS KEY. If you can get your antenna higher, do it.

**On-the-air** This is the most basic level of station one can have: a radio (probably handheld), and an antenna (probably the stock antenna). From indoors or inside a vehicle, you will likely have a very hard time making contacts on simplex. It's really best if you go outside, and try to *get somewhere fairly high up* or with an expansive view. Fortunately, your handheld radio and its antenna are quite small and portable, so taking them on a walk or a bike ride to somewhere good for operating (top of a hill, high balcony, etc.) is fairly easy. Do not expect much range with a handheld and the stock antenna. You have everything you need to make contacts, it just takes a high location and another station close by—for contests, this means you will need to encourage all your local friends to get on the air.

**Upgraded Antenna (Omnidirectional)** Really the biggest single thing you can do to improve your range is to get a better antenna than the rubber duck—which isn't very difficult. There are several forms this can take. On the commercial side, you can buy a longer, flexible antenna from a variety of manufacturers designed to replace the stock antenna but still leave the radio effectively a handheld. Magnetic mount antennas for a car are quite inexpensive, too, and useful if you don't want to permanently install a radio in your vehicle. Still another option is a J-pole or similar antenna. These can be purchased for under \$40 including shipping, and can be strung from a tree outside (or even a curtain rod inside, though with reduced performance). I have one of these commercial J-poles and really love it, even though I can't move around with the antenna deployed (unrolled it's about 4' long, but it rolls up to fit in a large sandwich baggie).

Making your own antenna is another option. Find a simple design you like online, and see if anyone in your club wants to join you for a building party. It's a fun club activity, and a good Elmering opportunity.

During a contest, you will want to get your antenna as high as possible, and outside. You might use your deck or balcony, or you might go to a nearby park where you can get that portable J-pole up into a tree.

**Mobile FM** You've been doing the ham radio thing long enough to have a mobile rig in your vehicle, along with some form of antenna on the roof. Great! The simplest thing a mobile FM station can do is to drive somewhere fairly high (like a park on a hill), find a place to park, and operate from there. With a driver, you could even go ahead and operate while on the road (make sure the planned route takes you home via an ice cream store, nice restaurant, or beverage purveyor to thank the driver!). However, if you have a mobile station, you might consider being a rover (see below).

**Rover** Rovers are portable or mobile stations which operate from at least two different grid squares. Each time a station enters a new grid, it counts as an entirely new station. So if AEØEE/R (rover) starts in EN34 and works KØBBC, ADØMJ, and WØUC, upon driving north into EN35, AEØEE/R can contact all three of them again. Rovers make the contests more interesting for fixed stations, because rovers can be worked again and again. *Being a*

rover is exciting because you get to drive around and see things as well as operate—and you can work all the stations each time you reach a new grid.

It can be a good idea to scout out potential rover locations *before* a contest. Check a map to find where the grid lines are (the EN34/EN35 boundary is in the northern part of the Twin Cities metro area), then look to see where might be a good location near the line from which to operate. Hilltop parks and tall parking structures are good choices, but open fields will suffice if there's not much else around.

**Beams and Directional Antennas** When trying to contact stations all around you simultaneously, an omnidirectional antenna is ideal. However, sometimes you only need to contact *one* station at a time, but they are on the edge of your range. Enter the bigger, directional antennas. For VHF and above, directional antennas are of a modest size (particularly 2 meters and above). Three elements for 2 meters fit on a boom not much longer than a meter; even more elements fit on the same boom for 70 cm. These antennas are available commercially, or can be built (again, you might consider having an antenna building party with your club) fairly easily and cheaply, especially this popular design from WA5VJB. Because these antennas can be the difference between making the contact and not, it's good to get one when you have the resources to put toward it; for most things, you probably want the omnidirectional antenna upgrade first.

Upgrading your antenna to a directional one has advantages beyond raising your effective power. With a directional antenna, you can reduce noise from other directions, which increases the signal to noise ratio of the station you are trying to hear. Put another way, at the same distance, the beam would give you the ability to hear weaker stations than the omnidirectional antenna (if the beam is pointed the right way).

One disadvantage of beams is that they are directional. When all the stations you want to contact are in one direction, it's great, but if you're in the middle of things, you will need to turn your antenna. This can be accomplished by hand or with some sort of rotor (including turning the car on which the beam is fixed). It does take a little time to turn the beam, too.

When you are putting up your antenna, keep in mind that FM signals are generally vertically polarized. This means that, for FM use, you want the elements of your beam to be oriented vertically. Having a horizontal polarization could mean signal rejection of  $\sim 20$  dB (99%). You can still make contacts with the antennas having different polarizations, it's just not nearly as likely. Work them if you hear them.

**Weak Signal** Although FM equipment is readily available, there are some drawbacks to its use. Chief among them is that FM doesn't have the range that single-sideband voice, Morse code, or other weak-signal modes.

Stepping up to this level requires at minimum a 2 meter all-mode rig, although many operators have all-mode transceivers which work from 160 m to 70 cm (not including 1.25 m). These transceivers are available for  $< \$1000$  and are quite capable. I have had all kinds of adventures with mine, from being a 70 cm rover to nearly completing worked-all-states on 160 m in one weekend (worked lower 48, confirmed 47).

At this level, it is also very likely that your station would be equipped with a beam of some sort—this is not a requirement, though, so don't let your antenna situation keep you

off the air! Unlike with FM, weak signal uses horizontally-polarized signals. If you have an HT or mobile rig, you can set that up for FM with a vertically polarized antenna, then use your all-mode rig and the beam to do weak-signal work.

So what do I mean when I'm talking about range here? My general feeling is that with my FM handheld, I am unlikely to have contacts beyond 10 miles with my magnetic mount on the car under most conditions. Good tropospheric ducting (propagation), a high location, or a big station on the other end may extend that significantly, but most of my action will come from within 10 miles.

Weak signal from a decent location in the Twin Cities with a 3-element beam can probably cover much of Minnesota. Admittedly part of that is because there are some well-equipped weak-signal stations in far-flung corners of the state. It is possible, though, to make contacts with a horizontal dipole even down in the urban canyons of Minneapolis; my furthest under those conditions was a large station 90 km away near Milaca, MN.

If you're taking the time to set up for weak signal, I strongly encourage you to do so in a way where you can get on 6 m. A small (7'×2'), directional Moxon antenna is easy to build and provides great performance. When big sporadic-E openings appear for VHF, they tend to happen for 6 m first. From the Twin Cities it's easy to work from Texas along the coast to Florida, Virginia, and northward into Quebec if the band is open (fairly big 'if').

Feedline loss is a larger concern at VHF and UHF frequencies than in HF. Keep the runs as short as possible, and use only low-loss cable of the largest diameter which you can reasonably afford/accommodate. Low-loss RG-8x size cable (i.e. LMR-240 or its equivalents) should be considered a bare minimum, with most stations using LMR-400, LMR-600, or larger.

There's much more to say about weak signal, but I don't want to get bogged down here. Do some research online, contact me, or ask your local Elmer for more info and advice on setting up a station.

## 3 Operating Technique

In the last section, we covered the basic part of the station equipment, and hopefully you have identified where in that scheme your station fits. Now let's move on to some of the operating techniques.

### 3.1 Frequencies

One of the first things you need to do if you want to make a contact is to be on the same frequency as the other station. Even just within 2 m, there are a lot of frequencies to choose from. Fortunately, the choice is fairly simple.

- 146.550 MHz FM
- 144.200 MHz  $\pm$ 50 kHz SSB
- 50.125 MHz (SSB calling) up to 50.200 MHz SSB
- 52.525 MHz FM
- 446.000 MHz FM [see note below]

- 432.100 MHz  $\pm$ 20 kHz SSB/CW

Leave 146.520 MHz alone if you are participating in a contest, as well as 146.505 MHz and 156.535 MHz. Do not contest on the calling frequency, and leave space above and below for non-contest activity. Similarly, do not contest on repeaters, and do not solicit contacts on repeaters—it can make the people monitoring grouchy. That said, before the contest starts, announcing that a contest will be going on and giving suggested times/frequencies is fair game and can help drum up activity.

If there is a lot of activity on 146.550 MHz FM, you can move up to 146.580 MHz. Under extremely busy conditions, you could also try 146.460 MHz (often used as the weak signal liaison frequency), or start consulting your bandplan for simplex frequencies. It is unlikely you will need to do this; 146.550 MHz will probably suffice for the entire contest.

On six meters, the SSB DX window is between 50.110–50.125 MHz. Do not contact US or Canadian stations within that range (50.125 MHz is fair game, though). During a contest, or a band opening when things are busy, do not ragchew on the calling frequency. If you start to have some stations to work, move up. When the band really opens, or there are lots of stations on, people will be spinning the dial up and down. During slow periods, give some space (few minutes) between paired calls so that other stations can call too.

For 70 cm, the frequencies used are fairly tightly grouped. Use 446.000 MHz for FM (check your state’s bandplan before using any other frequency for 70 cm FM simplex; MN recommends 446.025 as well, but the frequency may be shared with repeater links or digital simplex). You probably don’t need to monitor here, because most action will start on 2 m and move up after a successful contact. The case is similar with 432.100 MHz SSB/CW: generally there is a small offset from that frequency, coordinated on a lower band.

If you are looking to move away from those suggested frequencies for whatever reason, check the bandplan for your state to see where your type of operation is recommended. Do not use FM in the SSB portion of the bands (and vice versa).

## 3.2 Logging

Logging for a VHF contest is fairly easy, and unless there’s a big six meter opening, you can probably do as well on paper as with a computer. If you have <25 QSOs, figuring out the score by hand isn’t too hard either. There are forms online which can, for a few contests including the ARRL VHF contests, convert your paper log to the proper format and calculate the score for submission to the contest organizers. However, as you start adding more bands, modes, and contacts, it can be very handy to use computer logging.

For a relatively simple logging program, I would recommend N3FJP’s logger. It does what it needs to do. Personally, I prefer the more contest-oriented N1MM+; I’m not sure that my preference comes to much more than familiarity, but there seem to be more developers and a larger contest userbase with N1MM+. Both of these programs are available free (or at least free to try, for N3FJP).

For most VHF and above contests, the required exchange is quite simple: callsign and 4-digit grid square, although the ARRL 222 MHz-and-Up Distance Contest and most microwave contests require a 6-digit grid square. You can look up your grid square online or in most logging programs. Sometimes a name or state is required, too, but for the ARRL VHF

contests (January, June, and September), it's just callsign and grid square. Thus for any contact, you need to log the following information:

- Date and time (UTC)
- Frequency (in kHz is fairly standard. The VHF contest allows simply 50, 144, 440, etc., but I prefer to log the whole frequency used; it's good practice.)
- Mode (FM, SSB, CW, or some flavor of digital)
- Call copied
- Grid copied

For a small operation on one day (watch out for UTC day change!), from one location, doing 2 meter FM-only on 146.550 MHz, that simplifies the info you *need* to record to simply UTC time, call, and grid.

### 3.3 Calling CQ

Turn your radio on, find an appropriate frequency (e.g. 146.550 MHz FM), and listen for a few seconds. If you hear voices, this is not an appropriate frequency to call CQ on; you can either wait to make a search-and-pounce contact, or choose another frequency (e.g. 146.580 MHz FM). You'll probably be able to use 146.550 MHz.

Just to be sure, ask if the frequency is in use, and give your callsign phonetically at the end of the transmission.

Is this frequency in use? This is alpha echo zero echo echo.

The most likely response is that nothing will happen. Otherwise, someone will tell you that yes, the frequency is in use—and you will need to find a different frequency on which to call.

Now that you have a clear frequency, calling CQ is fairly straightforward. Use two to four repetitions of CQ at the beginning, give your callsign phonetically (generally twice), and your grid locator (phonetically) once. Then pause for a few seconds to allow another station to respond.

CQ CQ CQ this is alpha echo zero echo echo, alpha echo zero echo echo in echo november three four.

This call serves two purposes: to give other stations a chance to find you (via scanner on FM, or tune up on weak signal), and to identify who you are and what you're about. It should be long enough to meet those goals, but not too long—under 15–20 seconds is best. You want to give the other station a chance to reply to you fairly quickly.

To protect my voice when doing this on VHF FM, I would give the call above then wait 5 seconds or so, then repeat it, which takes a total of ~30 seconds. After the second repetition of the call, I would wait 2–3 minutes and repeat the paired-call procedure. Calling for most of

the 30 seconds will give scanners a chance to find you, but if nobody is on frequency, there's no point running down your voice or power source. It also gives other stations a chance to call CQ, if several of you happen to have worked each other already.

When you get a response, log the callsign, then repeat their callsign (phonetically) and give your grid square. They will acknowledge receipt (or ask for a repeat) and give their grid square. In a fast-paced contest (or if you can barely hear each other), acknowledge receipt with a simple thank you, your callsign phonetically, and QRZ (the Z is pronounced as zed).

During most VHF contests, you will have some time to chat if you want to. In doing so, be sure to allow pauses between transmissions, and mention that you are in a contest and are willing to have other stations break in. Identify more often than the FCC-mandated 10 minute intervals (2–3 minutes is about right). You might want to get the nearest town/city (and state) of the other station, so that you will know more precisely the distance for that contact.

If you have capability for another band, at the end of the QSO but before giving your callsign and QRZ, ask if they have capability for that band (e.g. 446.000 MHz). Propose a frequency, and move there quickly to contact them. Give your callsign before moving.

### 3.4 Search and Pounce

With search and pounce, you simply find a station calling CQ (search) and answer them (pounce). For VHF FM, that probably means leaving your radio tuned to 146.550 MHz, and answering any stations which call. Note that if all of the stations on the frequency are adopting this strategy, none will make any contacts. Call CQ periodically if there's a clear frequency to be had, especially if you are just turning on your radio or are in motion.

Answering a CQ is as simple as giving your callsign (phonetically). In a contest, it is usually given just once. For SSB or CW, when there may be ambiguity in which station you are responding to, you might first give the calling station's callsign first, then your own.

Kilo zero bravo bravo charlie, this is alpha echo zero echo echo.

This technique reduces the confusion on the calling end, and can alert the calling stations that they do not have a clear frequency; with weak signal it is quite easy to have two stations be calling on one frequency, neither hearing the other.

When the calling station responds, log their grid square (you already wrote down their callsign, right?). They will either acknowledge receipt of your info or ask for a repeat. Be prepared for them to ask if you want to change bands, and write down the time of the contact.

### 3.5 Sample Contact

A VHF contest contact may look something like this.

AEØEE (146.550 MHz FM): CQ CQ CQ this is alpha echo zero echo echo, alpha echo zero echo echo, in echo november three four.

KØBBC: Kilo zero bravo bravo charlie.

AEØEE: Kilo zero bravo bravo charlie, echo november three four.

KØBBC: Roger roger, echo november three four.  
AEØEE: Roger, do you have 70 cm?  
KØBBC: Yes, how about 446.000 MHz?  
AEØEE: Okay, alpha echo zero echo echo to 446.000 MHz.  
KØBBC: Kilo zero bravo bravo charlie to 446.000 MHz.  
AEØEE (446.000 MHz FM): Kilo zero bravo bravo charlie, kilo zero bravo bravo charlie, this is alpha echo zero echo echo.  
KØBBC: Alpha echo zero echo echo, echo november three four.  
AEØEE: Roger roger, echo november three four.  
KØBBC: Thanks, is there anyone else on frequency?  
[Silence]  
AEØEE: Alpha echo zero echo echo back to 146.550 MHz.  
KØBBC: Seventy three, this is kilo zero bravo bravo charlie.

### 3.6 Timing

**When to Key Up** If you are operating search-and-pounce (contest rule-of-thumb: call CQ if you can), time your transmission to follow closely after the other station finishes calling CQ. Hesitating for 2–4 seconds will put you right on top of that station calling again. Your transmission should come at a natural pace, as though you were in conversation with someone and they asked a question (i.e. “what is your callsign?”).

**When to Participate** When first starting out in contests, you will not want to participate for the whole thing. Instead, aim to spend one or more 15–30 minute periods on the air. Once you’re to that point, you need to figure out *which* 30 minute period(s) to target. Your schedule may constrain that already, but if you have an open schedule, there are a few considerations. First, your local club may have organized a focus time, which solves your problem immediately—get on during the focus time.

If no focus time is given, you will need to get on at the same time as the other stations. Some times are better than others. In the late afternoon, more stations are on (e.g. 4:00–4:30 PM local). In the late evening and early morning, there is more likely to be tropospheric ducting, which can increase the range of your station. For that, try getting on around 9:00–9:30 PM or 8:30–9:00 AM. There is very little activity between midnight and 6:00 AM, so you can be away from your radio guilt-free during that time. Weekend contests tend to have a little more activity on Sunday than Saturday.

Finally, if you see any indication of good propagation: ground clutter on weather radar, hearing multiple FM broadcast stations on the same frequency, or distant APRS packets (directly or on the internet), turn on your radio. Those are the times you can make more distant contacts, which are more exciting and can be worth more points.

**Using the Internet or Cell Phones** *For ARRL VHF+ contests only*, it is allowed to use a cell phone or the internet to coordinate contacts (e.g. “I’m on 146.580 MHz and located on Buck Hill, would you please try a contact with me?”). This takes a bit of the fun out of calling CQ, but can be essential for VHF/UHF stations with beam antennas.

## 4 After the Contest

**Convert to Computer Format, Score** After a contest, there is a bit of paperwork to do. First and foremost, you must convert your log into a computer format if it is on paper. That will probably take care of calculating your score at the same time—most computer programs will do that automatically. Once this is done, you will need to create a Cabrillo file. This is a text document which conforms to certain formatting standards and allows the log to be machine-readable for easy cross-checking. Any good computer logging program will have a simple export function for this, and there are web forms for a few contests, including the ARRL VHF contests, which will take your paper log and format it correctly.

**Submit Your Log** Once your log is computerized and you’ve created the Cabrillo file, you will need to submit it. The web form linked above will do this automatically, but if you use a logging program on your computer, you will need to check the rules about how and where to submit your log. For the ARRL contests, you will usually submit via email (e.g. [septembervhf@arrl.org](mailto:septembervhf@arrl.org)). The email subject is your callsign (e.g. AE0EE, K0BBC/R, etc.), and you will need to attach your Cabrillo log.

**Announce Your Unofficial Score** This is optional but recommended. After submitting your log, go to [3830scores.com](http://3830scores.com) and use the submission link at left to enter your score. These unofficial results are useful in gauging participation, establishing a record of your contest achievements, and in seeing how your efforts stacked up against other participants. Recording a few comments about your antenna and radio system, contest highlights, or other stories can be fun too. Check the box which sends a copy to your email, then forward it to your club email reflector.

**QSL** It is strongly encouraged that you QSL following contacts you make on simplex—especially if they are long-distance or you are in a relatively rare place (grid, state, island, summit). Logbook of the World makes this very easy, is pretty widely used, and is free (until you apply for an award). Getting it set up is a little tricky, so start here and don’t hesitate to ask an Elmer for help getting it going. Once you have your account made and your key issued, things get very simple and easy. Logbook of the World will also track your progress toward the Worked All States awards, DXCC, and the VHF/UHF Century Club (100 grid squares on a given band). Of course, you are welcome to do printed QSL cards, but they can get expensive pretty quickly both in time and money.

## 5 Summary and Further Reading

The most important part of contesting is to get your station on the air. You will not make contacts without doing that. Look at your station, figure out what improvements can be made easily, and make those. Convince some of your friends in your local club to get on the air at the same time—it's more fun if there are stations out there to work even if propagation is poor.

Log your contacts carefully, and submit your log after the contest or activity. Better yet, QSL afterward too, even if it's just Logbook of the World.

You might be surprised what your station can (or can't) do. For instance, there's a repeater within 10 miles of my house which I can only open if I use my 3-element Yagi. It's only through getting out and trying things that you can really discover the capabilities—and limitations—of your station. Contests provide a great opportunity to do this, because there tend to be more stations on at once.

Before participating in each contest, be sure to read through the contest rules. If you're interested in pursuing VHF contesting further, I strongly recommend reading through KC9BQA's VHF contest guide. I have also written a few tips about HF contesting, for hams with some HF experience. Here in the Minnesota, we have a local VHF/UHF/microwave club, the Northern Lights Radio Society, which is full of good information and helpful Elmers.

Contests are also more fun if you have a friend or club to share them with. Talk about your plans beforehand, perhaps work each other a few times during the contest, and discuss what did and didn't work afterward. Share the stories of big DX you logged and the ones that got away. Think about what improvements you might make for next time, and get input on those ideas. Most importantly, though, get on the air and have fun.