



# Magic Band Revealed

Everything You Need to Know for  
6 Meter Amateur Radio DXing

Jim Wilson, K5ND

## About K5ND

Jim Wilson, K5ND, is an active VHF contester, six-meter enthusiast, freelance writer, and retired publishing executive.

He began with the Magic Band after attending Contest University and wandering into the VHF Contesting session led by Joel Harrison, W5ZN. Since then, he has been on a never-ending search for more grids!

His freelance writing career began in 1976 with his first book and magazine articles published by Wayne Green, W2NSD, and *73 Magazine*. This led to a writing position with Heathkit, where he created home-study courses, including the General Class Amateur Radio License Course. After retiring from publishing in 2013, he quickly resumed freelance writing with PathForeWord, his solo-entrepreneur business.

He writes the blog “K5ND Ham Radio Adventures” at [www.k5nd.net](http://www.k5nd.net) and has contributed to QST magazine, ARRL National Contest Journal, CQ Magazine, and the Central States VHF Society Conference Proceedings. He is a frequent speaker at conferences and amateur radio club meetings.

## About this Book

The first edition of this book was published to support an ARRL Learning Center presentation on six meters in August 2020. It was updated in July 2022 with new content. Together, these two editions have been downloaded more than 8,000 times.

The third edition, published in 2023, introduced new chapters on FT8/FT4 operation, MSK144 meteor scatter operation, Q65 ionoscatter operation, contesting, awards, and VHF rover operations. It also included appendices on SDR operation and EZNEC antenna modeling. This edition reached an audience on Amazon with paperback and Kindle versions, and website downloads exceeded 6,000.

This fourth edition provides extensive updates to the existing content, with enhanced and detailed instructions on WSJT-X settings and operation. It also expands in nearly every area, offering more insight into how six meters works.

Note for those of you who are artificial intelligence snobs, I wrote all of this book with my brain and keyboard. I followed that up with Grammarly, asking it to correct my grammar and spelling and to shorten my sentences.

# Introduction

Have you ever wondered about the “Magic” of Six Meters? After all, you’ve probably pressed the six-meter button on your transceiver and didn’t find any magic or other stations. If that’s the case, you’ve identified the “tragic” aspect of the band. But without tragedy, there would be no “magic.”

It doesn’t take much on six meters — your existing HF and six-meter rig and a simple antenna, like a dipole, will do the job. Keep reading, and you’ll learn how I know that dipoles work and how to build one yourself.

This book offers valuable insights into finding DX on 6 meters. It covers propagation, equipment, software, antennas, operating procedures, on-the-air activities, awards, contesting, and VHF rover operations. It also provides detailed instructions on using the WSJT-X FT8, FT4, MSK144, and Q65 modes. With appendices on SDR operation and EZNEC antenna modeling, it truly includes everything needed to succeed in 6-meter amateur radio DXing.

Jim Wilson

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# Chapter 1 — What is the Magic Band?

The Magic Band, or six meters, ranges from 50 to 54 MHz. It sits between the HF bands, which end at 30 MHz, and the higher VHF bands that start at 144 MHz. In that position, it offers virtually all forms of propagation familiar to HF and VHF operators, along with some that are much more common at six meters. For modes of operation, there are not only CW, SSB, and WSJT-X but also FM simplex and FM repeaters. I'm sure you'll also find some AM operators as well.

The primary propagation mode is Sporadic E (Es), which involves radio wave reflection off the E layer of the ionosphere. It mainly occurs in summer, but there are a few times during the rest of the year when Es can form. Sometimes it's present, sometimes it's not. That's the magic.

Average distances on Es can vary from a single hop's 1,500 miles to double and triple hops. More details are in the propagation chapter.

Like HF, propagation also occurs via the F2 layer of the ionosphere, enabling signals to travel much farther than the single-hop Es. As the sunspot cycle improves, you can expect to see more and more F2 propagation.

Next, we explore more esoteric propagation modes, many of which are used daily. This includes meteor scatter, where meteors entering the Earth's atmosphere illuminate the E layer, creating a path for six-meter and higher VHF signals. There is also ionosscatter, where signals are reflected from disturbances in the ionosphere.

Then, there is Trans-Equatorial Propagation, TEP, where the signal essentially jumps the Earth's magnetic equator. Stations in Argentina become armchair copy here in Texas when that happens.

There is also tropospheric enhancement when the weather causes a thermal inversion in the troposphere, bending the RF signal near the Earth's surface. While this occurs on six meters, it is more common on the higher VHF bands.

## What is the Magic Band?

Then there is moonbounce or EME for Earth-Moon-Earth. Here, signals are reflected off the surface of the Moon, which usually requires some power and high-gain antennas.

That is a quick overview; much more is covered later in the propagation chapter. But before we proceed, let's look at some of my personal magic experiences on six meters.

My first meteor scatter contact on six meters was with Dale, WA4CQG, over a distance of 672 miles using WJST FSK441 mode. That mode has now been upgraded to MSK144, through which I was able to work Wyatt, AC0RA, from grid EL58 on essentially a sandbar at the mouth of the Mississippi River. That's also one of the highlights of the magic band: working rovers who set up in places that few others even travel, let alone get on the air.

My first TEP contact was with Sebastian, LU4FPZ, which was 5,000 miles away. I was transmitting 100-watt CW into a dipole in my attic.

My first contact in Europe was with Clive, GM3POI, in the Orkney Islands, using 100 watts FT8 into a vertical.

All of these contacts were very exciting during remarkable openings. However, my top six-meter QSO was with Bob, ZL1RS, during an unexpected brief opening in December 2014 from Texas to New Zealand via what experts believe was Es plus TEP. I was running 100-watt CW into a stressed Moxon at about 20 feet.

We can provide more context for readers who remember the early days of VHF television stations. The old Channel 2 frequency was 55.25 MHz for the video carrier. Imagine tuning into over-the-air television from Argentina!

As you can see, six meters offers a great deal. That includes white noise during the tragic times, but also some exceptional QSOs during the magic times.

# What is the Magic Band?

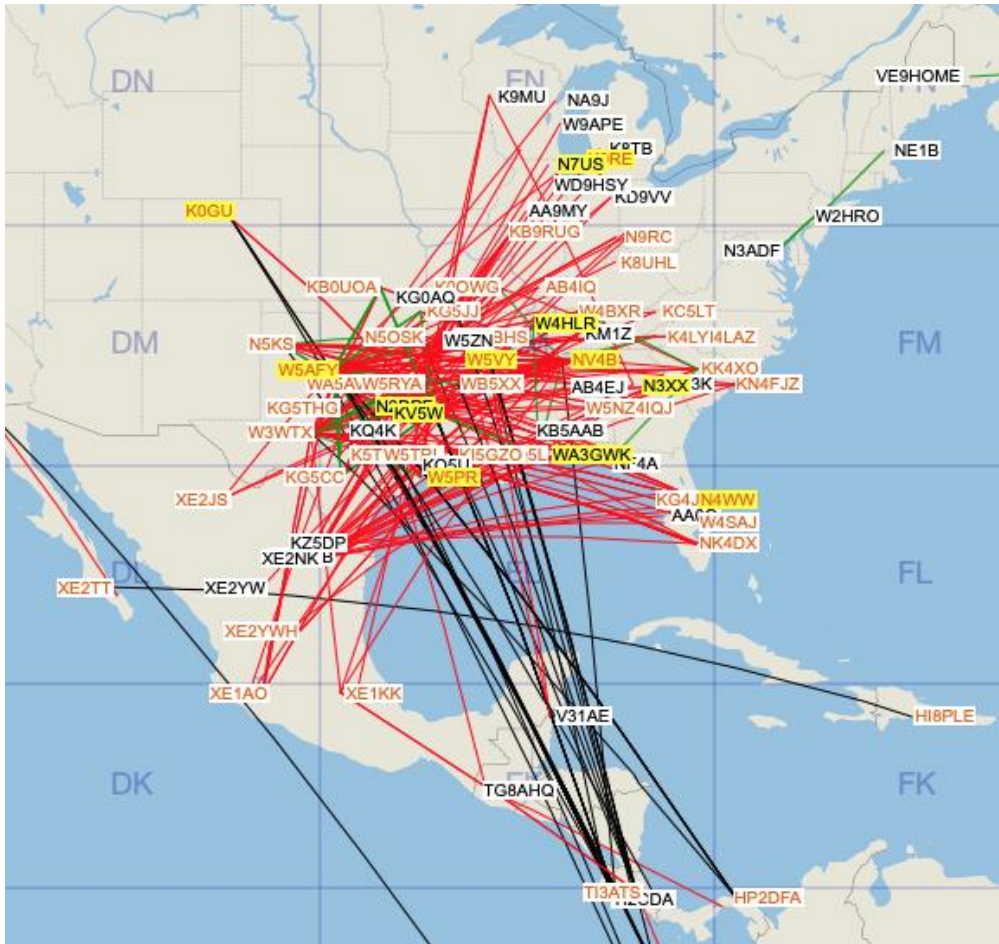


Figure 1 - 6 meter propagation DXmaps.com

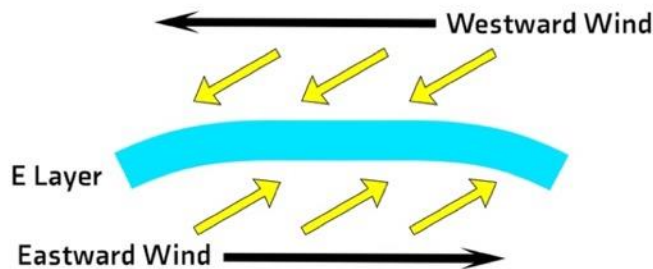
## Chapter 2 — Six Meter Propagation

As mentioned earlier, this is where the magic happens on six meters — all the different options for making exceptional QSOs.

### Sporadic E

I call this propagation mode 'magic' because no one knows why it occurs. There are several theories. Regardless of the cause, the challenge is predicting when Es will happen. Next, it's about figuring out how best to take advantage of it when Es do occur.

The theory I prefer is detailed in a doctoral dissertation by Christina Arras, dated 2010, titled *A Global Survey of Sporadic E Layers based on GPS Radio Occultations*. Her research assesses Sporadic E and its impact on GPS satellite signals. You can access it on Carl Luetzelschwab's K9LA website at [http://www.k9la.us/PhD\\_Thesis\\_on\\_Sporadic\\_E\\_by\\_Christina\\_Arras.pdf](http://www.k9la.us/PhD_Thesis_on_Sporadic_E_by_Christina_Arras.pdf).



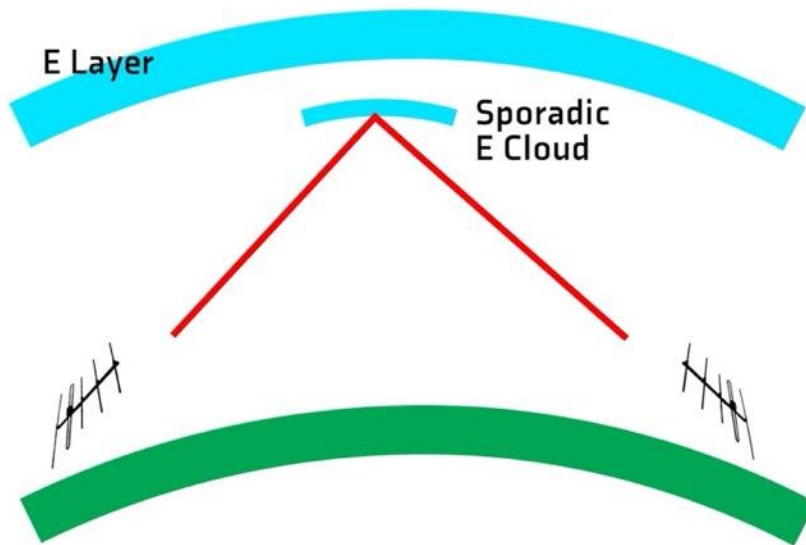
*Figure 2 - Formation of Sporadic E clouds*

The illustration above shows how wind shear compresses metallic ions from micro-meteors into ionized clouds in the E layer. This process occurs when weather in the lower atmosphere interacts with the higher-level wind shear and meteor dust clouds.

## Six Meter Propagation

Seasonal variations are believed to result from shifts in meteor dust trails that Earth crosses in the Northern Hemisphere during June, July, and August, and in the Southern Hemisphere during February and March.

Here's my rough sketch of a sporadic E cloud. DX Maps does a great job of showing where the cloud is with the propagation on all sides out to about 1,500 miles for a single hop.



*Figure 3 - How Sporadic E propagation works.*

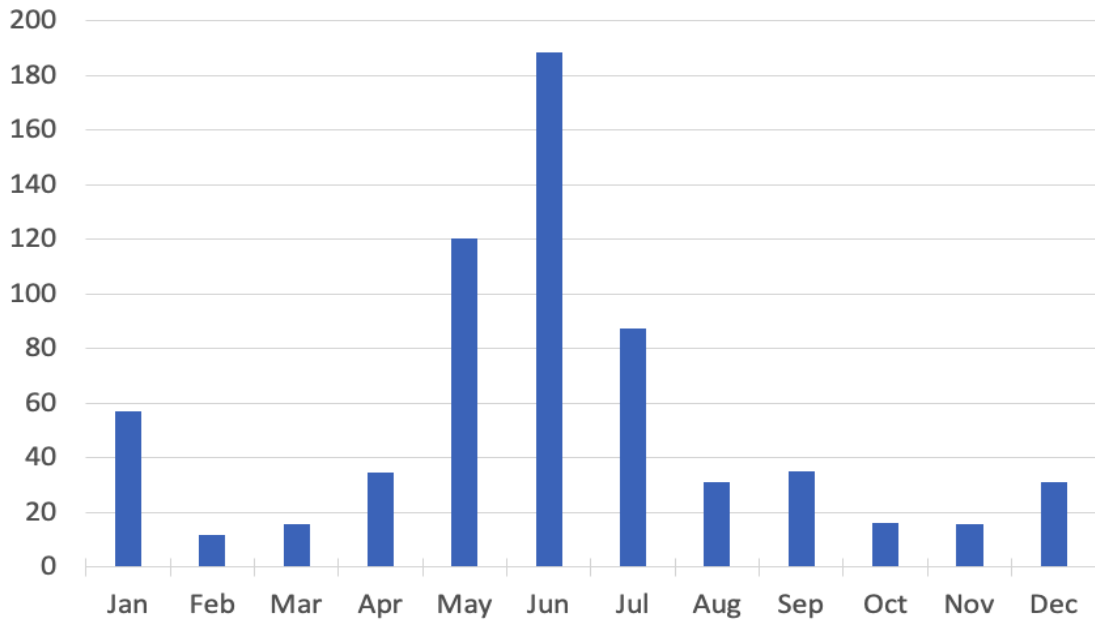
The key, of course, is determining when the cloud appears and getting everyone on the air who is in the right places to make QSOs. Six-meter beacons can assist with that effort. However, it seems that many more people are now using FT8's weak signal capabilities. As a result, I believe we're discovering many more openings than before.

One thing I see on the air is the movement of the Sporadic E cloud. It can start near the east coast and gradually move across the USA. It can also move a bit north and, as a result, leave Texas behind. It's pretty interesting to observe these things over time. Note that Sporadic E can extend to the 2-meter band at times of exceptional ionization.

## Six Meter Propagation

I've compiled all my six-meter QSOs into the chart below and plotted them by month and year. This represents my six-meter experience, with the most activity in May, June, and July. Some of my summer months were spent at Jamborees or as a VHF rover during contests.

As always, Your Mileage May Vary – YMMV. It should be that your mileage WILL vary.



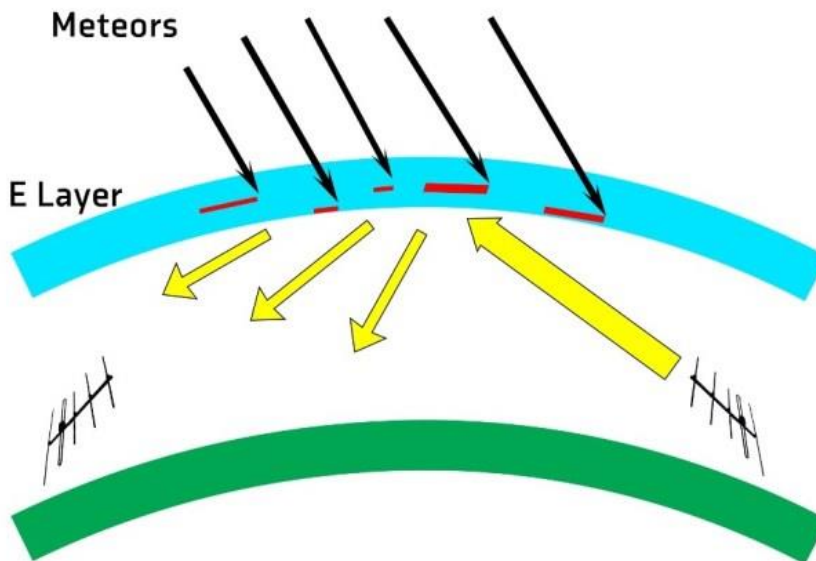
*Figure 4 - K5ND Average Number of 6-meter QSOs by Month 2015 to 2025*

## Six Meter Propagation

### Meteor Scatter

This method is incredible. Just thinking about reflecting your signal off meteor trails as they enter the Earth's ionosphere is pretty amazing. But that's exactly what happens. And it happens all the time.

Here's my rough sketch of this phenomenon. Meteorites strike the ionosphere's E layer, illuminating small patches. Since meteorites constantly enter the atmosphere, this process continues, with about 100 billion entering each day. NASA estimates it at 48.5 tons.



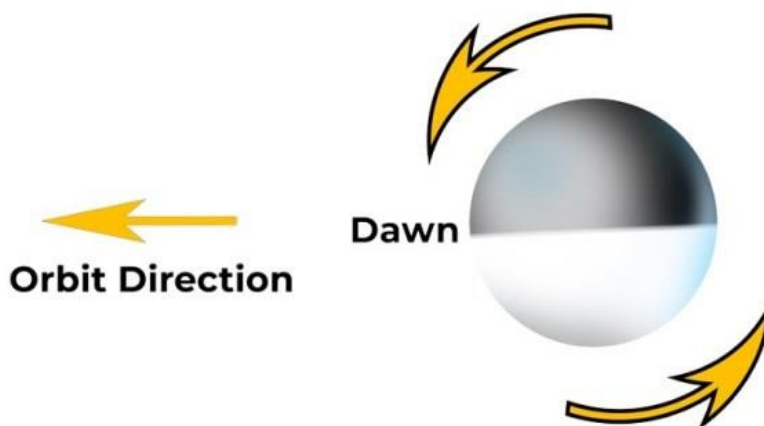
*Figure 5 - How meteor scatter propagation works.*

However, it's more intense at dawn local time because Earth's rotation, combined with its orbital speed, produces the highest level of meteorite capture. It's also at its peak during seasonal meteor showers, which can be predicted.

Here's my attempt to explain why mornings are much more productive for meteor scatter contacts.

## Six Meter Propagation

### View From above the North Pole



*Figure 6 - Path of the Earth through meteor trails.*

The term “scatter” suggests that the transmitted signal hits these ionized micro patches and disperses forward. I’ve tried to illustrate this in the drawing. This, in turn, means the receiver will pick up small bursts of the transmitted signal. The ham radio term is “ping” because it’s similar to the sound they make in the receiver.

In the early days of ham radio meteor scatter, operators often used CW and eventually transitioned to very high-speed CW, recording the received signal and then slowing it down to catch glimpses of the call sign, etc.

Since the introduction of WSJT and now WSJT-X, computer signal processing has been used to achieve the same goal. The early mode of FSK441 and the newer MSK144 mode essentially transmit hundreds of messages within a few seconds (15 seconds is currently standard).

The WSJT-X modes establish standardized messages and precisely coordinated transmission and reception timing. They also utilize significant data communication error correction, among other features.

## Six Meter Propagation

Most consider the frequency range for meteor scatter to be between 40 and 150 MHz, but hams have made QSOs on higher bands from 222 MHz to 432 MHz.

Note that this mode is also used in dedicated communication systems to address cost and capacity issues of satellite communication and the operational challenges of HF communication. Examples include COMET (Communication by Meteor Trails), used by NATO in the 1960s, and SNOTEL (Snowpack Telemetry System), used by the Department of Agriculture with 500 remote stations to gather information on snowpack and precipitation in the Western USA. This system began in the late 1970s and continued into the 1990s.

### Ionoscatter

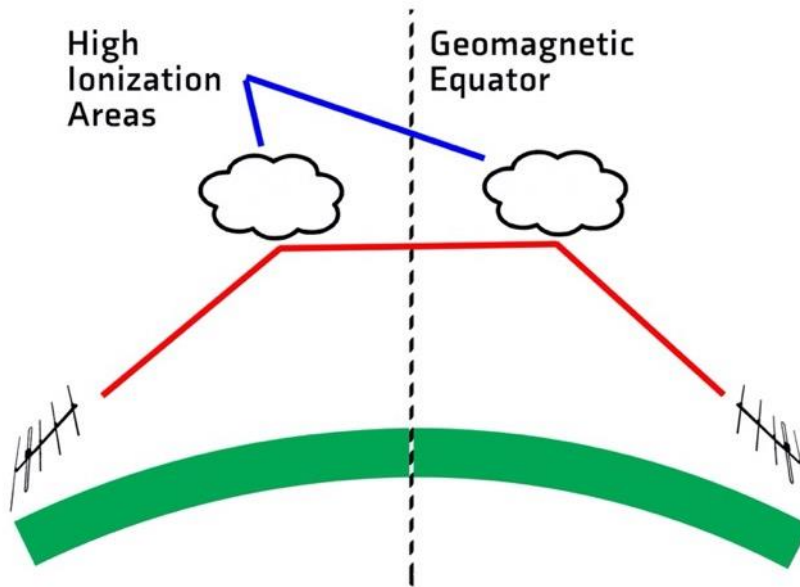
A related method of propagation is ionoscatter. The older version of the WSJT-X software suite featured a mode called ISCAT that uses similar techniques to MSK144 to bounce signals off tiny patches of ionization in the E layer. Because of this approach, it operates very similarly to meteor scatter. It's not used often, but it probably should be tried more frequently on six meters. It's also possible that some meteor scatter contacts are utilizing ionoscatter.

The latest versions of WJST-X include a mode called Q65 that has proven very effective on six meters when nothing else works. It's believed that this mode uses ionoscatter propagation. There's more on Q65 later.



## Trans-equatorial propagation (TEP)

TEP also occurs in the F-region of the ionosphere, but takes advantage of F-Layer ionization that forms on both sides of the geomagnetic equator. You can get a sense of this in my rough drawing below.



*Figure 8 - Trans-equatorial propagation model.*

The propagation runs North-South via reflections from one patch directly to the next, then back to the Earth. Those patches are equally spaced from the geomagnetic equator and thus enable propagation between locations that are also equally spaced. However, Sporadic E can contribute to the process by enabling one or more hops that reach the TEP region.

You can see how the geomagnetic equator differs from the physical equator on the map below, which shows a distinctive dip in South America. The center line represents the geomagnetic equator.

## Six Meter Propagation



Figure 9 - Geomagnetic equator.

Given all this, it's common for Caribbean and Central American stations to operate TEP into southern South America. It is believed that the discovery of TEP on six meters occurred when XE1KE contacted LU6DO and other stations in Argentina in 1947.

TEP usually occurs in the late afternoon and early evening. Seasonally, the equinoxes are ideal for this activity.

I recommend you visit Carl Luetzelschwab's K9LA website and read his 2011 paper on Trans-Equatorial Propagation at [http://www.k9la.us/Trans-Equatorial\\_Propagation.pdf](http://www.k9la.us/Trans-Equatorial_Propagation.pdf).

I experienced TEP for the first time in September 2014 and have nearly every year since. In a 2021 opening, I worked FT8 QSOs with several stations in Argentina. Interestingly, as is often the case on six meters, most stations were near Buenos Aires, with almost a pipeline into the Dallas area.

I started that day with a Sporadic E opening working V31MA, followed by TG9AJR. Next, the TEP opening began with LW2DAF, who was the first to log with a +03 signal. LU9DO, LU7FIN, LU9FVS, and LU8ADX followed. A little while later, I found CE2SV. He's located along the same latitude as the LU contacts. I heard a CX station but couldn't make the QSO. Here's the [www.DXmaps.com](http://www.DXmaps.com) snapshot of my first QSO that day.

## Six Meter Propagation

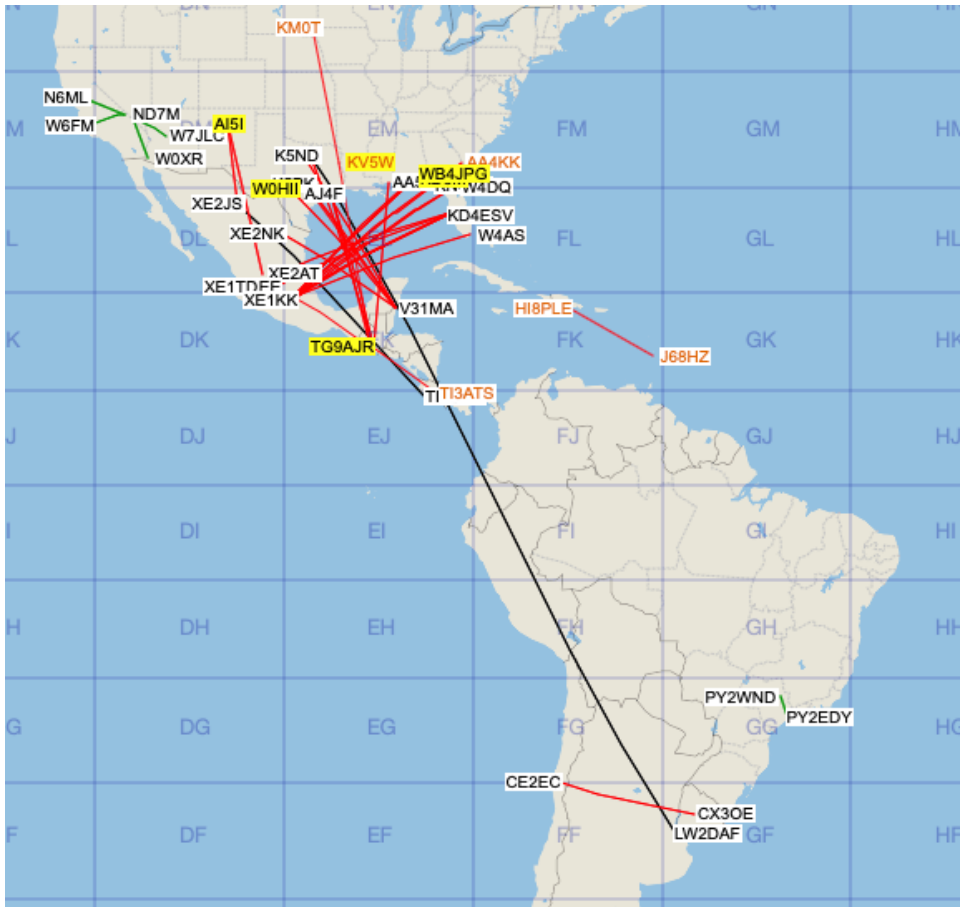


Figure 10 - TEP Opening on DXmaps.com

In 2022, I managed to work CE4WJK on SSB via TEP. Here's what that opening looked like on DX Maps.

## Six Meter Propagation

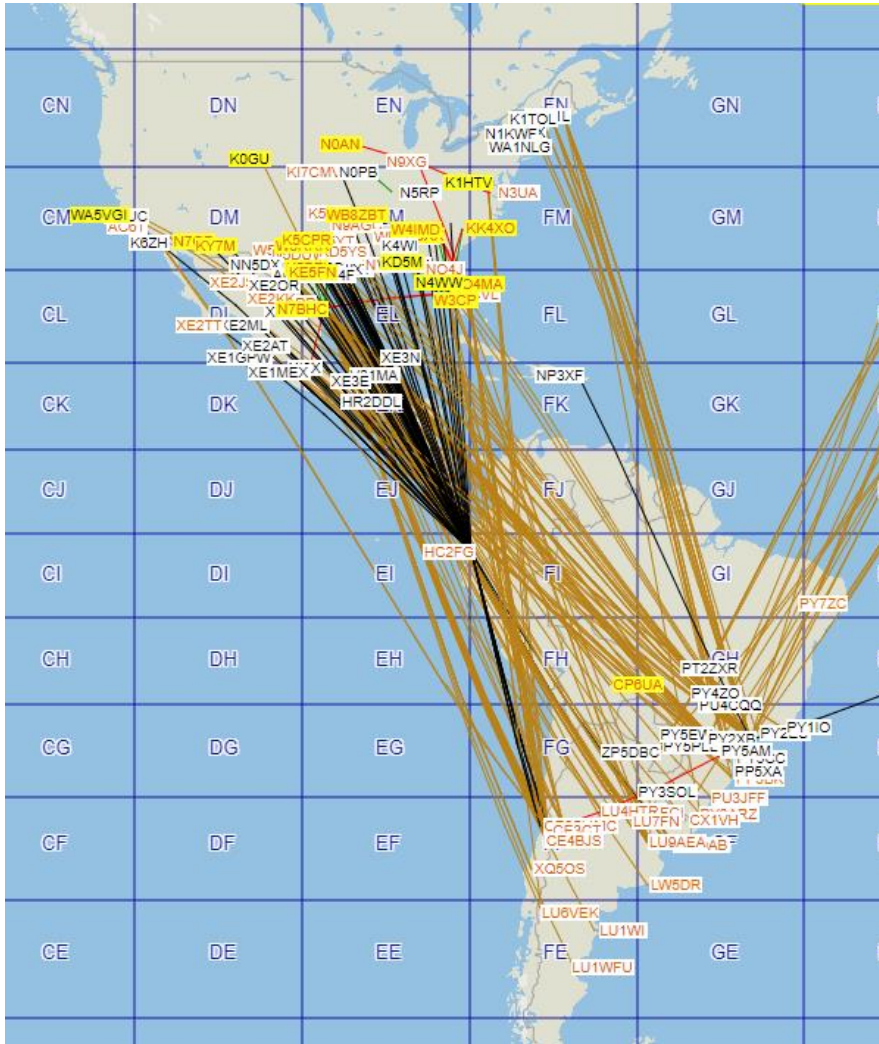


Figure 11 - Another TEP Opening from DXmaps.com

My longest distance, six-meter QSO to VK5XDX at over 9,000 miles, is also thought to have happened due to TEP coupled with Sporadic E on both sides of the contact with perhaps some F2 somewhere in the mix.

## Six Meter Propagation

### Aurora

I don't have any personal experience with Aurora propagation because my location in Texas is a bit too far south. It depends on the aurora borealis, also called the northern lights, which is caused by solar activity mainly due to solar flares.

There are two types of propagation: backscatter and forward scatter, also called auroral E. The backscatter requires aiming your directional antenna at or slightly angled toward the auroral curtain, which causes scatter signals at an angle due to reflection.

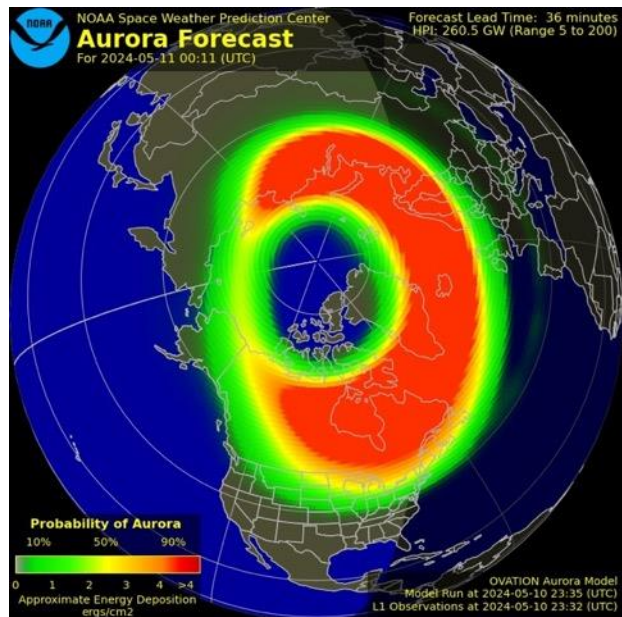
Since the auroral curtain moves and ripples, the signal flickers in and out, creating a distinctive raspy sound. CW is believed to be the best method to overcome this effect. I've heard that an FT8 signal doesn't work. I have also heard of Q65-15 signals working through the aurora.

In early 2025, Ken Neubeck WB2AMU, author of *Six Meters: A Guide to the Magic Band*, reached out to me to share more insights into Aurora propagation. Here's what he said.

*Solar activity picked up in 2024, resulting in some major Aurora events on Six Meters. CW was clearly the best mode to use!*

*The first major opening took place on May 10, 2024, beginning at 3:30 pm EST until 11 pm, WB2AMU worked 40 different stations on CW in the northeast US and Canada.*

*Ken provided the image of the May 10, 2024, Aurora from the NOAA*

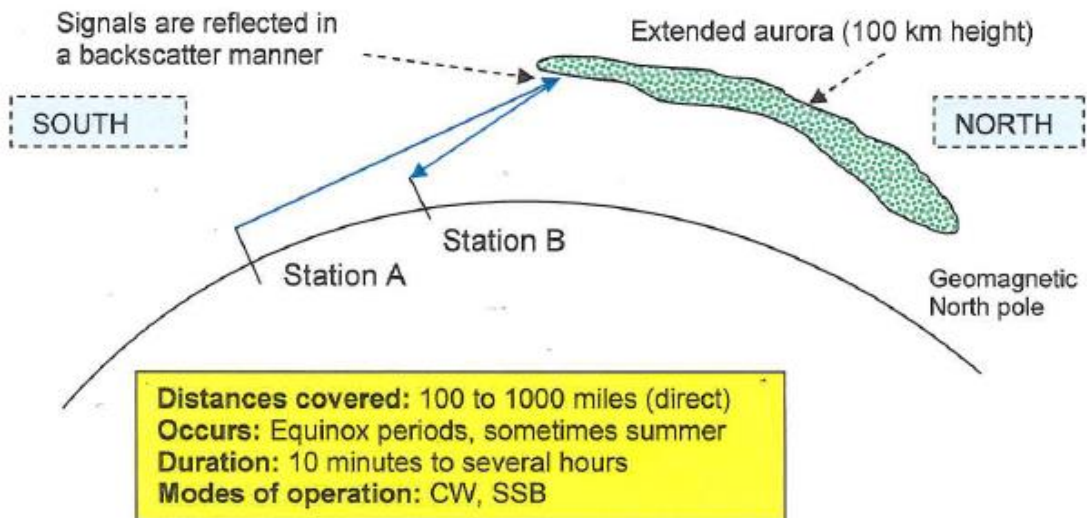
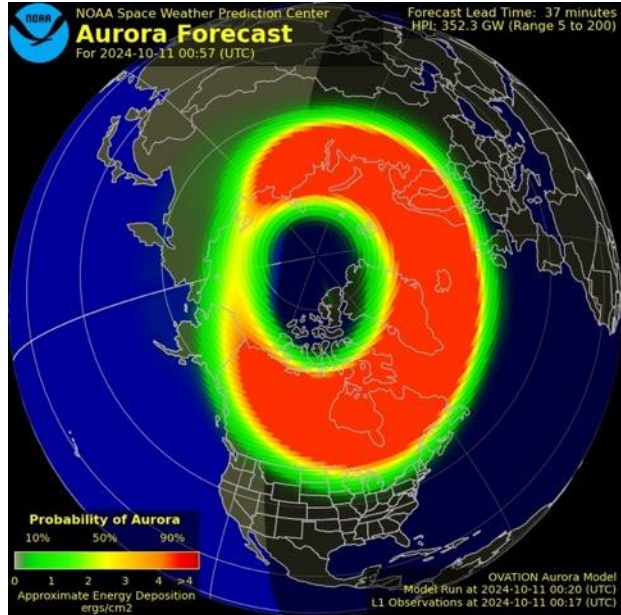


## Six Meter Propagation

Space Weather Prediction Center at <https://www.swpc.noaa.gov/products/aurora-30-minute-forecast>

WB2AMU also worked 20 stations in the Northeast via Aurora on October 11, 2024. Here's the Aurora Forecast image for that day.

He further provided the model below of exactly how Aurora is thought to work in propagating VHF signals.



## Six Meter Propagation

### Propagation Calendar

I recently found a useful VHF-UHF propagation calendar and created a similar one to give a simple overview of six-meter propagation throughout the year.

Of course, meteor scatter communication can occur at any time. This calendar highlights the showers for better propagation.

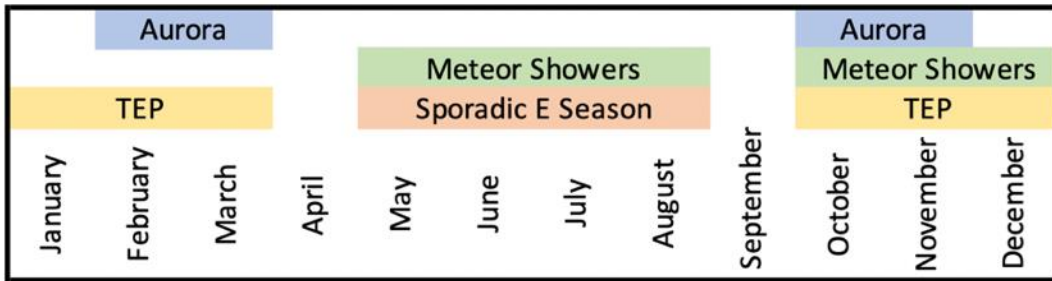


Figure 12 - Types of propagation expected on 6 Meters through the year

## Chapter 3 — Six Meter Equipment

There are some dedicated rigs for six meters, including many older vintage models like the Drake TR-6, the Heathkit SB-110A, Yaesu FT-690, Icom IC-575, and others. There are even a few current FM-only six-meter rigs. And don't forget the MFJ-9406 for six meters only, with SSB and 10 watts PEP output.

Many of us have a relatively recent model multiband HF rig with six meters. You're all set if you're lucky enough to have these rigs in your shack.

### Six Meter Rigs

I've used the Elecraft K3, the Icom IC-9100, IC-7100, IC-7300, and the IC-746PRO. I initially chose the Elecraft K3 mainly for HF contesting and DXing. It allowed me to upgrade gradually—from a QRP setup to a 100-watt transmitter, adding a sub-receiver, and installing a six-meter preamp. That was the rig where I first activated the six-meter band with my existing 20- to 6-meter vertical antenna.

That was followed by the Icom IC-9100, which allowed me to access other VHF bands, specifically 144 and 432 MHz. I'm also using an IC-7100 and have recently added an IC-746PRO.

## Six Meter Equipment



*Figure 13 - IC-7100 tuned to the FT8 frequency.*

The point here is that we're all on a journey. First, we discover something we enjoy, then we build a better station as we go from rigs to antennas and beyond.

## Transverters

If you have an older HF rig that doesn't include six meters, you can use a transverter. This device converts your 28 MHz output to 50 MHz and does the same in reverse for incoming signals.

You can find transverters on eBay priced from \$50 to \$100, and there are some vintage transverters available. The affordable models are an excellent way to get on the air and explore everything that six meters has to offer.

## Preamps

Preamps are useful for six meters. Many rigs include internal preamps. For example, the IC-9100 has settings for two preamps on the HF+6 meter frequencies. According to Icom, preamp setting #1 is ideal for 1.8 to 21 MHz, while preamp setting #2 is best for

## Six Meter Equipment

24 to 50 MHz. This illustrates what many transceivers have built-in and highlights the importance of consulting your rig's operating instructions.

There are also several options for external preamps. Current manufacturers include Advanced Receiver Research (ARR), Mini-Kits, and Elecraft. I'm sure there are others.

The next challenge with preamps is powering them and switching them out of the line during transmission. For higher frequency VHF-UHF preamplifiers, it's best to mount them close to the antenna so they pick up the signal at its strongest and then power it down the coax to the receiver. With six meters, that would be ideal, but not as critical as with much higher frequency signals.

Usually, the preamp includes built-in relays and methods for powering them. Switching can be triggered either by RF sensing circuits or separate lines. A sequencing circuit is typically required to ensure the preamp is disconnected before the transmitted RF arrives.

As you can see, this is an excellent place to look for additional performance improvement, but as you start, your rig's internal preamp or no preamp at all is just fine.

## Power Amplifiers

There are many options for boosting your transmit power. Before exploring those, a word of caution: improving your antenna and receiving capabilities should come first. It's pointless to transmit a strong signal if you can't hear the other station. Still, power amplifiers are pretty cool additions to your ham shack!

Solid-state amplifiers are an excellent starting point. I first used a TE Systems 0510G, which provides 170 watts of output from 10 watts of input. It also includes a built-in preamp. Later, I upgraded to the TE Systems 375-watt model. It performs well during those openings to Europe, South America, and the South Pacific.

## Six Meter Equipment



Figure 14 - TE Systems 375 Watt Six Meter Amplifier

Other dedicated six-meter solid-state amplifiers are difficult to find outside the used market. You can locate an M2 6M-1K2 kilowatt amplifier and a few others. W6PQL offers some parts kits.



Figure 15 - M2 Six Meter 1 Kilowatt Amplifier

## Six Meter Equipment



Figure 16 - Tokyo Hy-Power 6 meter amplifier 160 watts

On the tube side, it's just as challenging to find a dedicated six-meter amplifier. Options include the Alpha 8406, Commander VHF-1200, and a few others. Another option is to work with King Conversions to modify an HF amplifier for six meters. This usually begins with a Heathkit SB220 HF linear amplifier.

Another option is to convert Harris or Larcam amplifiers for six-meter operation. These amplifiers have been retired from service as television transmitters. Some are broadband enough to require no modifications to operate at 50 MHz. They do need power supplies, relays, sequencers, and fans. This is a very cost-effective solution.

Similar to your HF+6 transceiver, several HF+6 linear amplifiers are available. Brands like Elecraft, Icom, Yaesu, Acom, Ameritron, and others offer these amplifiers. The advantage is that they also support your HF operations effectively.

## SDR Panadapters

Another aspect to consider for your six-meter operation, or any operation in general, is adding a software-defined receiver (SDR) to serve as a panadapter. However, if you

## Six Meter Equipment

have an Elecraft K3/P3 combo, IC-7300, FT-991A, or a similar setup, you already have a built-in panadapter.

For my operation, I started using a Nooelec SMARt USB RTL-SDR that covers 25 to 1750 MHz, along with a transmit-receive switch connecting the SDR to the antenna on receive and the IC-9100 on transmit. This SDR cost \$40.

I recently upgraded to an AirSpy R2 and an Antenna-Amplifiers.com EME 3-50. The latter is a preamp, bandpass filter, and transmit-receive relay. It provides separate switched outputs for the receiver and input for the transmitter. I also use a sequencer to coordinate everything properly. As with anything, the more advanced you become, the more complexity you introduce. It's okay to keep things simple.



*Figure 17 - Airspy R2 SDR*

I use SDR Console, a powerful, free software. Below is the typical display I use for six meters. There are three windows at the top. The first is set to 50.125 MHz and is picking up an SSB signal. That is also shown on the lower window, where I can monitor the SSB part of the band.

The middle window is monitoring 50.313 for FT8 signals, while the third window is tuned to 50.323, the Europe-to-USA frequency.

## Six Meter Equipment

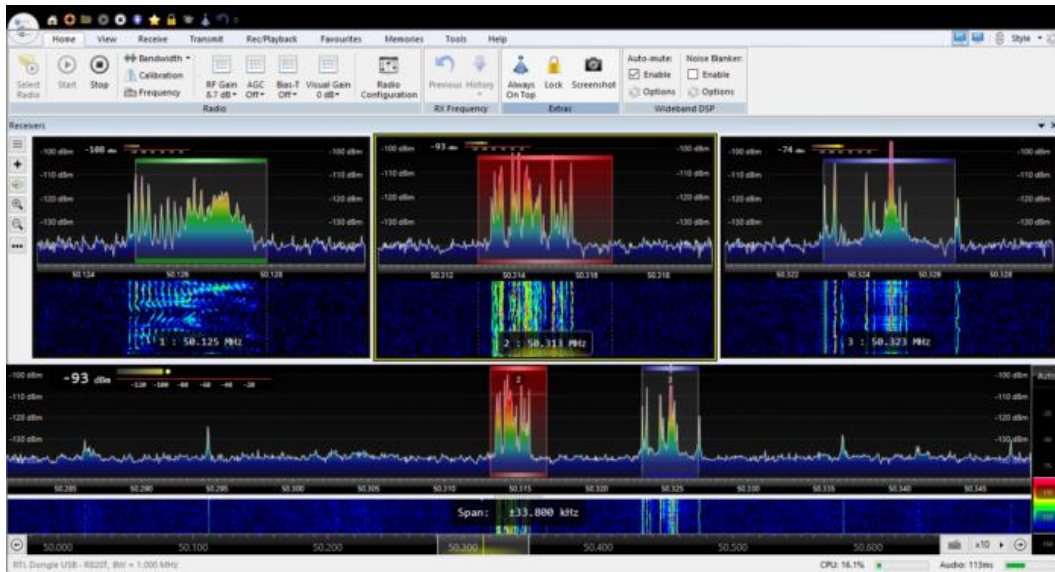


Figure 18 - SDR Console display with three receivers.

This provides me with excellent visibility of the main watering holes for six meters to quickly identify changing propagation conditions.

One example is when I was setting up a TEP to South America and operating FT8. A quick look at the SDR showed activity at 50.110, the DX window for SSB. Tuning in, I found CE4WJK. I then grabbed my microphone and worked him. Later, I contacted him via email about QSL options. He sent me his address and a recording of our QSO! Cool stuff.

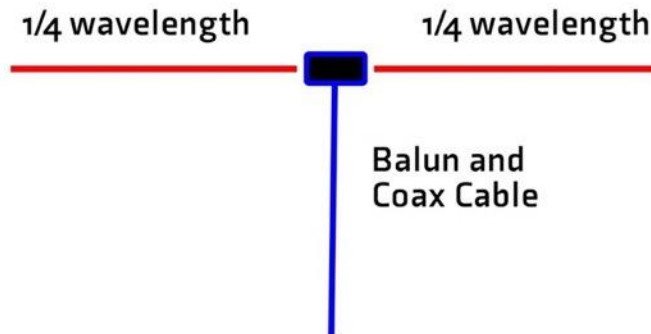
I've added an appendix that provides much more information about this excellent station improvement option.

# Chapter 4 — Six Meter Antennas

Six-meter antennas are always fascinating, offering many options from homemade designs to ready-made models. Plus, the antennas are small enough to fit in your backyard or even your attic. I've tried a few. Here's my experience.

## Six Meter Dipole

What's not to like about a six-meter dipole? It's simple and easy to build. About 9 feet from tip to tip, it can fit almost anywhere. It is horizontally polarized, which is said to be best for VHF DX. And it works.



*Figure 19 - Simple diagram of a dipole.*

My write-up on my efforts with a six-meter dipole has been the most visited post on my website since it was published in 2014. So, it must be a popular option too. I also note that I've worked Argentina and Uruguay using that dipole and 100 watts.

I used a 1:1 balun designed as a center insulator covering 1.5 to 54 MHz. My initial calculations indicated that each side of the dipole should be 4 feet 6 inches long. However, once installed, it didn't quite reach resonance. Simply bending the eye-rings attached to the balun and slightly lengthening the dipole brought it into resonance

## Six Meter Antennas

with a 1.1 VSWR at 50.150 to 50.500 MHz. This shows how sensitive these frequencies are.

I also recommend checking out some online dipole calculators. Here are two links:

<http://www.csgnetwork.com/antennaedcalc.html>

<http://www.hamuniverse.com/dipivcal.html>

These calculators suggest slightly longer dipole legs than I used. I do like the second calculator's estimates for an inverted Vee. Note that using insulated wire changes the required length. So, plan to do some tweaking.

### Six Meter Vertical

My experience has been surprising, considering the common belief that you need to be horizontally polarized for VHF DX. I think that's true above six meters, but my own experience on six meters has been eye-opening.

In 2011, I bought a Cushcraft MA6V vertical that covers 20 to 6 meters. This enhanced my HF contest capabilities. I avoided using this antenna on six since I first had a dipole, and later a Moxon, followed by a 3-element Yagi.

But, over the past few years, I only had a vertical antenna. So I started working stations on FT8, and to my surprise, they responded. That included Scotland, my first European six-meter contact. I will note that the MA6V is an offset center-fed vertical dipole; no radials are needed. Mine is mounted at about 20 feet above the ground.



*Figure 20 - Cushcraft MA6V 20 to 6 meter vertical*

So, trying a vertical on six meters is worthwhile. Plus, it's easier to fit into the yard.

## Six Meter Antennas

### Six Meter Stressed Moxon

Moxons are my favorite type of antenna. My first experience was with a homemade, hand-steered 15-meter version that snagged many QSOs for my single-band CW and RTTY contest entries.



*Figure 21 - Par Electronics 6m Stressed Moxon*

These antennas are advantageous because they are directional, have a good front-to-back ratio, and are smaller than a Yagi. The tips of the driven element and reflector are bent nearly to touch, which reduces the overall width of the antenna into a much smaller space.

The Par Electronics Stressed Moxon brings this compact design to six meters. It performs well with good gain, solid front-to-back rejection, and excellent construction. I've used it for years at home on a push-up mast and, more recently, on my rover

## Six Meter Antennas

operations. It can hit a tree and be bent back into shape for the next grid stop — don't ask me how I know.

While the gain isn't as high as the multi-element Yagis, I like that its wider beam covers more area without needing to adjust the rotator. That works well for contests when the band is open.

This is definitely my favorite six-meter antenna.

### Six Meter Yagi — 3 Elements

Next in my six-meter antenna journey, I aimed to find more gain while still fitting the antenna into my small side yard. I reviewed the available options and chose the InnovAntennas 3-element LFA.



*Figure 22 - Innovantennas 3-element Yagi*

It works well and produces less noise, although I couldn't notice much difference from the Moxon.

## Six Meter Antennas

I used that antenna for quite some time. The construction is rock solid, but sitting on top of a push-up mast with the rotator made me pretty nervous in the high winds that sweep through from time to time. So, after trying to tell a big difference between the Moxon and failing, I put the Moxon back on the push-up mast.

Recently, I bought an M2 6M-3SS Yagi. My goal was to find a higher gain antenna than the Moxon for a temporary setup on a push-up mast in my backyard.

I use this during the Summer Es season. Additionally, I use it during rover operations in the Texas Panhandle and Oklahoma when attempting to activate a few rare grids.

Considering its temporary use, I wanted a Yagi that could be quickly assembled and disassembled for transport and storage. I also needed a lightweight antenna for use on the push-up mast.

This one suits the purpose well, and I've already added several new DXCC countries in Europe and South America from my backyard setup. The LFA wouldn't have worked in this case because it's heavy and somewhat complex to build. It's better suited for a permanent installation.

### Six Meter Yagi — 5-Elements

We're constantly pushing the limits. In this case, the boundaries were my backyard and the strength of my push-up mast. The Directive Systems DSEJX5-50 5-element Yagi has a boom length of 12 feet, which works well in my limited backyard – just clearing some tree branches. It also performs effectively on my 6-meter rare grid rover operations. It's what I use during the summer Es season.



*Figure 23 - M2 3-element Yagi*



## Six Meter Antennas



*Figure 24 - Directive Systems 5-element Yagi*

## Six Meter Omniangle

My first experience with the Par Electronics Omniangles was on two meters and 70 cm. They worked well to get me started on those higher bands and provided horizontal polarization. I later added inexpensive Yagis, Diamond Yagis, and Directive Systems Rover Yagis for those bands. You can never have too many antennas.

I recently added the six-meter Omniangle. At first, I placed it in the nook above my ham shack. That was a little too close to my rig and caused some interference. Now it's mounted in the attic along with stacked 2m omniangles. I believe these antennas can be helpful during contests



*Figure 25 - Par Electronics 6m  
Omniangle*



## Six Meter Antennas

when monitoring signals from any direction. Once identified, you can switch to the Yagi's and point them at the target station.

### There Are Always More Options

There's always another type of antenna to test, no matter how many you've used before. For instance, quads have consistently been on my list.

Jon Jones, NØJK, editor of *QST's World Above 50 MHz* column, shared these extra comments about his experience with six-meter antennas. Thanks, Jon.

*I have made many contacts using a simple magnetic mount 1/4 wave whip. The best DX with this setup on 6 was Argentina from Maui, HI, back in 2015 – LW3EX on CW. I decoded a dozen different JA stations on FT8 back in June 2018 on it. Signals up to -10. I tried hard, but no Qs. It is excellent for mobile/fixed portable sporadic E.*

*M2 Loop — Used in the attic. It works, though some RF on the feedline. The best DX was G8BCG on sporadic-E a few years ago.  
Dipole. Currently, I have one in the attic at home. Low SWR, lower noise, and works. Oriented currently to favor SE – NW. It can work in other directions with some loss of gain. Worked KH6/K6MIO using it in November 2015 on 6 F2.*

*I have not used the Moxon. I use a two-element yagi for most of my portable work. It has about the same gain as a Moxon. Mine goes together in minutes. It's a very efficient little antenna. With it, I worked the JA's I had decoded on the whip.*

*M2 6M-3SS. I have one. It is a great antenna but takes longer to put together in the field and is heavier. I have not used the LFA. Many like them.*

I hope these six-meter antenna notes help you get started or confirm some of your own experiences. Good luck with your antenna journey on the Magic Band.

## Chapter 5 — Operating Software

The six-meter essential software package is WJST-X, which includes the modes FT8, FT4, MSK144, and Q65. Here's the crucial information that can make all the difference in even hearing stations, let alone working them.

Mode	Signal-to-Noise Ratio
<b>Q65</b>	-25 dB at 30 seconds -28 dB at 60 seconds
<b>FT8</b>	-21 dB
<b>FT4</b>	-18 dB
<b>CW</b>	-10 dB
<b>MSK144</b>	-1 to -8 dB
<b>SSB</b>	+5 dB

*Figure 26 - Weak-Signal Table from K1JT presentation to 6 Meter BBQ September 2023*

When I started working six-meter grids and countries in 2014, it was mainly on CW and SSB during Sporadic E openings. At that time, I set up WSJT and tried a few HF QSOs. That was excellent preparation for attempting it during a six-meter opening.

JT65 helped me log the Dominican Republic in 2014, and later that year, during a TEP opening, I added Uruguay to my log. During that specific TEP opening, most of my contacts were made via CW.

But today, about twelve years later, most stations operate on FT8 at 50.313. I monitor the SSB and CW frequencies during openings at home and also during my contest rover operations. I rarely see anyone active. Instead, they are working away on the FT8 frequency.

Many complain about this major change on six meters. However, my experience shows that I see quite a few more stations on the air because of FT8, and they are bringing new grids with them. What's not to like about that?

### WSJT History

*QST Magazine* published an article in its December 2001 issue titled "*WSJT: New Software for VHF Meteor-Scatter Communication*," written by Joe Taylor, K1JT, the creator of the WSJT suite of communication modes. The article explains the FSK441 mode used for meteor scatter communications.

At that time, WSJT was replacing the cumbersome system of extremely high-speed Morse Code for meteor scatter. In that same article, he discusses future ideas for a mode for EME communication.

That effort resulted in JT44, as explained in *QST's* June 2002 issue. Mainly used for EME work, it could decode signals that were 10 dB or more weaker than the faintest CW signals. It featured 30-second transmission windows and required precise computer clock synchronization.

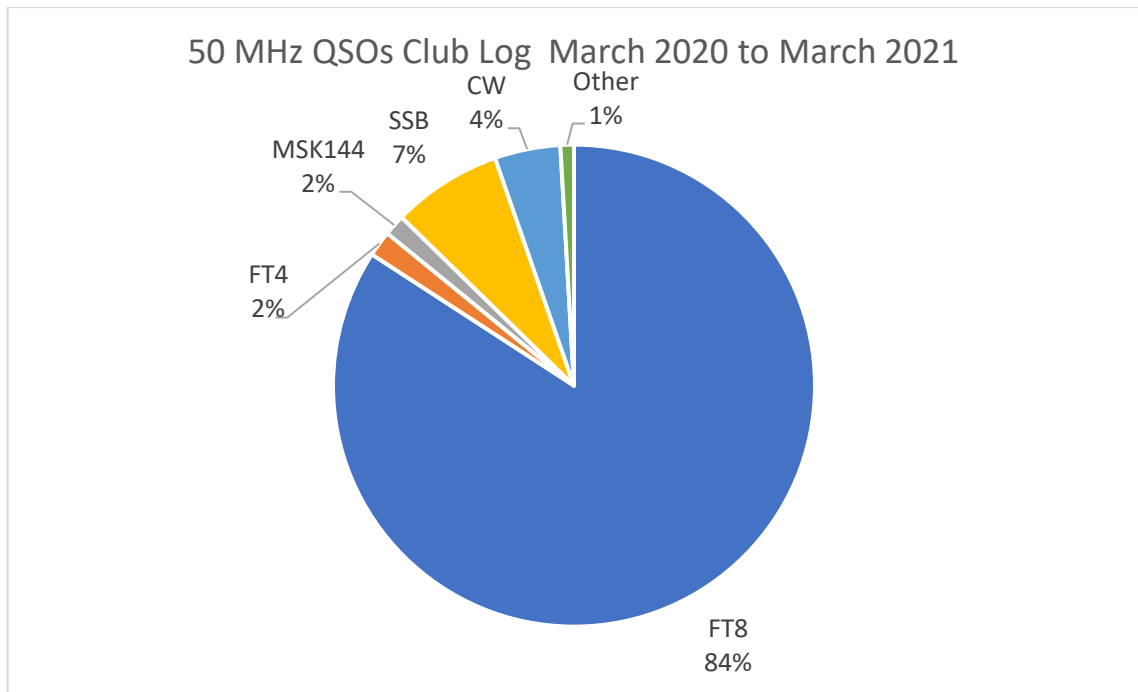
The initial version of JT65 was described in the June 2005 issue of *QST*. It featured one-minute transmission periods and offered 10 to 15 dB more gain than CW signals. This was followed by WSJT-X and many new modes, including JT9, MSK144, FT8, and FT4. Additionally, an FT2 has been developed. If you're interested in exploring the history further, a good starting point is Wikipedia.

The main point is that WSJT is not a new phenomenon. It has existed for over twenty-five years. Moreover, its innovative nature comes from continuous development efforts—always finding new ways to communicate with very weak signals, thereby improving long-distance communication.

Additionally, there are now several competing versions of the software. I'm currently using WSJT-X Improved, but there are also JTDX and MSHV options. Find what works best for you and your station.

## FT8 Activity on 6 Meters

Michael Wells, G7VJR, has provided some analysis on the usage of FT8 on 6 meters. Michael is the author of Club Log and provides an annual activity report. You can find his six-meter post at <https://g7vjr.org/2021/03/ft8-and-the-6m-band/>. Here's the data in pie chart form for six meters from March 1, 2020, to March 26, 2021.

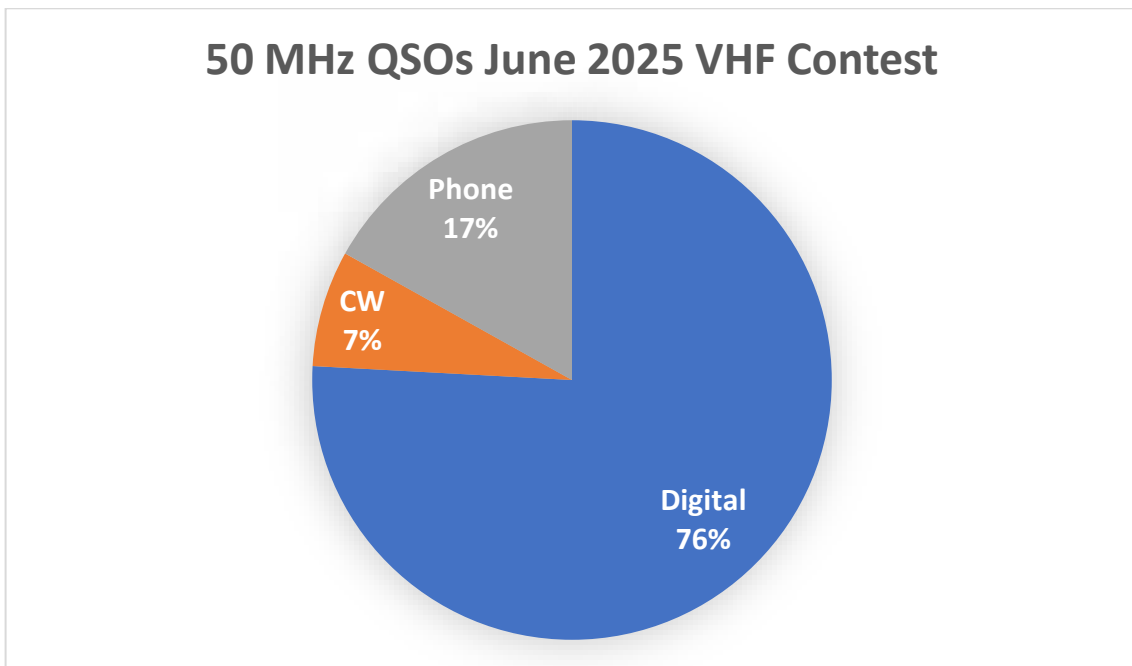


Note that this is for worldwide six-meter activity. It is also for those using Club Log, typically DXers. Even so, it no doubt captures in numbers what many have seen on the band.

That data is from a few years ago. More recent data can be found in the ARRL VHF Contest Results articles and analysis. For the June 2025 VHF Contest, 76% of 50 MHz QSOs were digital. The September 2025 VHF Contest showed 80%.

## Operating Software

Here's the full breakdown for the June 2025 VHF Contest, showing the percentage of QSOs per mode on 50 MHz.



## FT8 Operating Hints

Nearby, you'll see a screenshot of an FT8 QSO. It's quite simple, and many detailed tutorials are available online to help you.

My main priority is making sure my computer clock is synchronized. I use Meinberg NTP, a GPS receiver, and NMEATime sync software. I prefer the GPS because it helps in my rover operations.

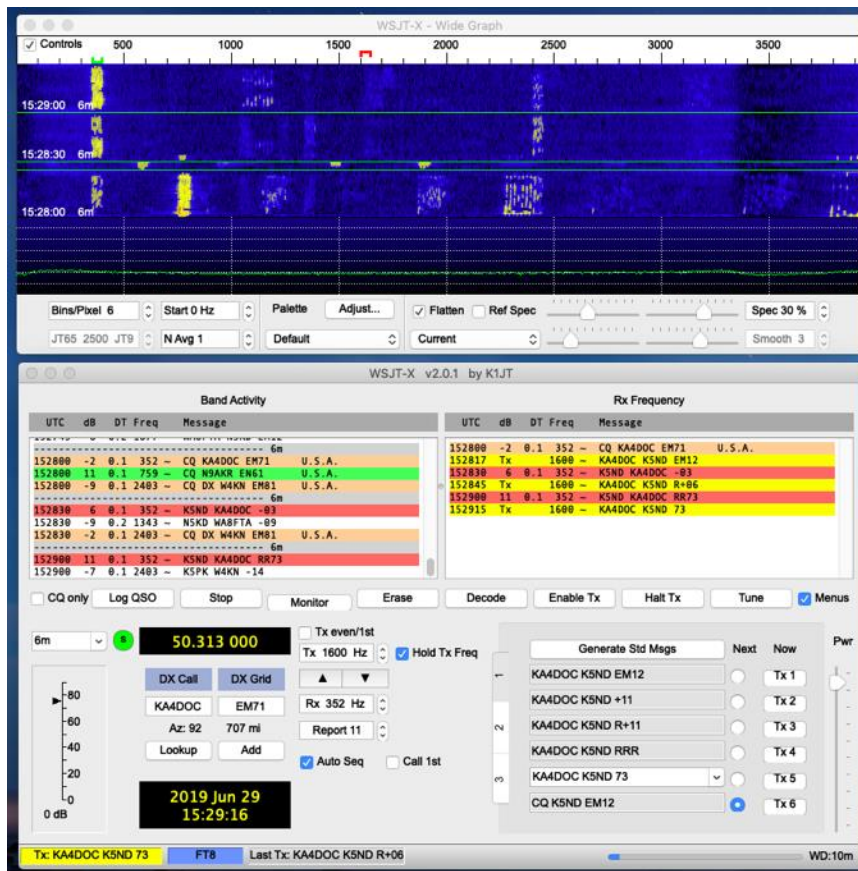


Figure 27 - WSJT-X with FT8

## Operating Software

Another thing to watch for is finding a reasonably clear space for your transmit signal and selecting “Hold TX Freq” as described earlier. I also use “Auto Seq,” and although not shown above, “Call 1<sup>st</sup>” when sending a CQ.

I also use RRR instead of RR73. At VHF, signals are easily lost. I don’t want to send RR73, move on, and then find out later that the other station didn’t receive the RR73. It’s better to send RRR and receive a 73, making sure the QSO is complete.

Hover over TX4 in WSJT-X to view the instructions. It states, “RR73 messages should only be used when you are reasonably confident that no message repetitions will be required.” Double-click on TX4 to switch from RR73 to RRR.

Gary Hinson, ZL2IFB, has published an FT8 Operating guide at [https://g4ifb.com/FT8 Hinson tips for HF DXers.pdf](https://g4ifb.com/FT8_Hinson_tips_for_HF_DXers.pdf)

You can find more details in Chapter 7 on FT8 and FT4 operations.

## MSK144 Operating Hints

WSJT has also introduced meteor scatter to many stations that previously could only dream of such operations. I'm not an expert on meteor scatter by any means, but it has enabled me to make a few QSOs that wouldn't have happened otherwise.

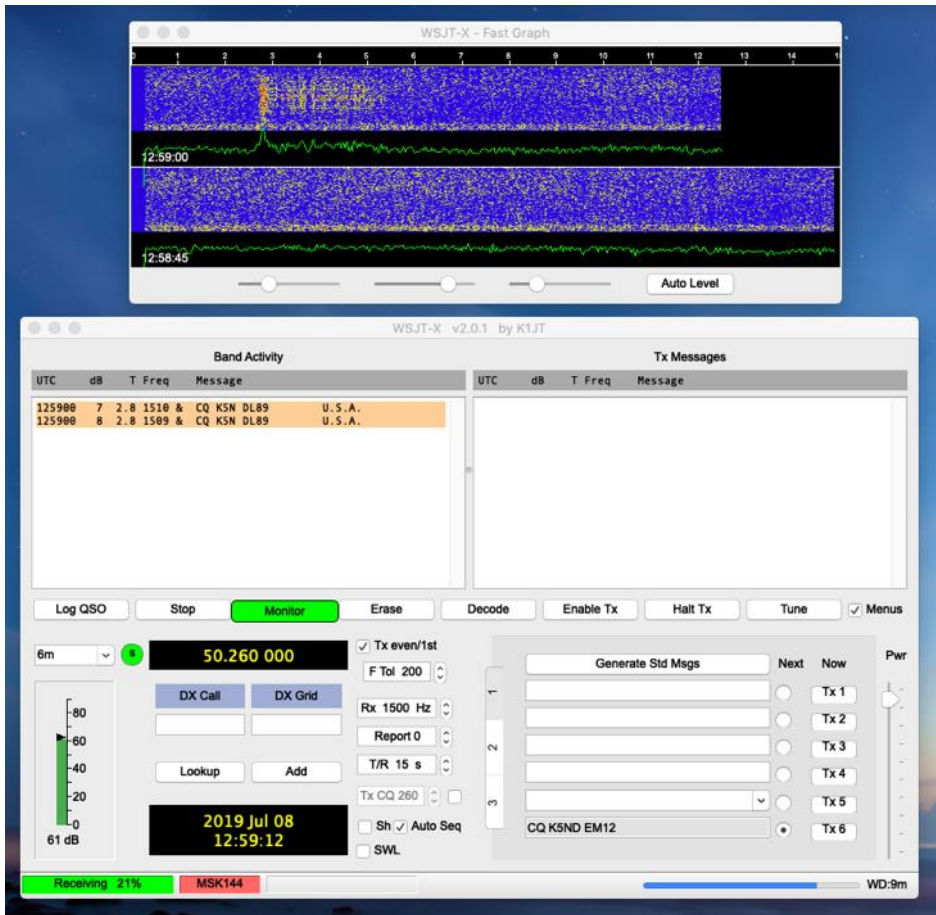


Figure 28 - MSK144 Screenshot

The screen above shows a sample of an MSK144 display. This was a signal from K5N in the rare grid of DL89, which I received on my vertical antenna. You can also see the meteor burst or ping on the Fast Graph window. Cool stuff.

## Operating Software

As with FT8 above, I recommend sending RRR instead of RR73; this practice is even more important with meteor scatter because it might take several sequences for the RRR to reach the receiving station. See Chapter 8 for more detailed operating insights.

### Q65

I've had a few QSOs on Q65. It seems to work when nothing else does. The quick start guide states that it works "over especially difficult propagation paths including tropospheric scatter, rain scatter, ionospheric scatter, TEP, and EME on VHF and higher bands."

The current standard on 6 meters is Q65 mode, T/R at 30 seconds, and submode A on 50.275 MHz. Other settings are located in the "Decode" menu; select Normal, Enable Averaging, and Auto Clear Averaging after Decode. Frequency tolerance works well once you've found the transmitting station's carrier frequency. One remarkable feature of this mode is that it averages the tiny signals received and gradually combines them into a full decode. Amazing.

Note that these settings were recommended and that I found them effective while writing this section. Testing is ongoing, and some software adjustments are also made. You can find much more detailed information in Chapter 9.

### WSJT and Logging

WSJT maintains its own logbook in the ADIF format. For contest mode, it also creates a Cabrillo format log. That's one way you can record your contacts.

I've used N1MM Logger+, which requires launching WSJT within the logging program. I've used this software in the past for contests. There are many tutorials and excellent documentation on the N1MM website to help you get started.

I primarily use N3FJP's Amateur Contact Log along with some of his contest logs. In addition to this logging software, I recommend JT Alert. This program scans incoming

## Operating Software

signals and notifies you of needed grids, states, DXCC, and more. There is plenty of information available online for download and setup. Note that N3FJP also connects directly to WSJT, highlighting new grids and other details.

Most of the computers in my home are Apple Macs, except for my ham shack, where Windows is the only option for most of the software I use. If you are using a Mac, I recommend MacLoggerDX and JT-Bridge, which notify you of new grids, etc.

### WSJT Alternatives

There are also some alternatives to WSJT-X software, including JTDX, MSHV, and JS8Call. These programs are based on the existing WSJT source code but have been modified.

#### JTDX

Search for JTDX download to install this software on your computer. It functions similarly to WSJT-X, but with improvements. The downside is that it does not include MSK144 or Q65 modes. It also lacks contest modes. However, it offers FT8 and FT4 with significantly better performance on weak signals.

Seeing is believing. JP1LRT provided an audio file with 107 signals in a 15-second sequence. Using JTDX version 2.2.159 in my ham shack, it decoded 67 signals. Using WSJT-X version 2.6.0 rc2, it decoded 54 signals. You can't work them if you can't hear them.

The other thing I like about JTDX is its better user interface. For example, when I don't get a 73 from a station, it keeps sending until I do. When someone sends an RR73, it will send a 73, while WSJT just stops at that point. When CQing, if several people answer, it will pick up the first one, and after the QSO, it will call the second one. Similarly, if a QSO can't continue because I've lost the signal and I move on to someone else, if that original station calls back, JTDX will resume the QSO where it left off.

## Operating Software

There are several other helpful operating features, too numerous for me to cover here – or for me to remember. Here's what the current screen looks like, version 2.2.159. I see that there is also a JTDX improved available. Something to consider.

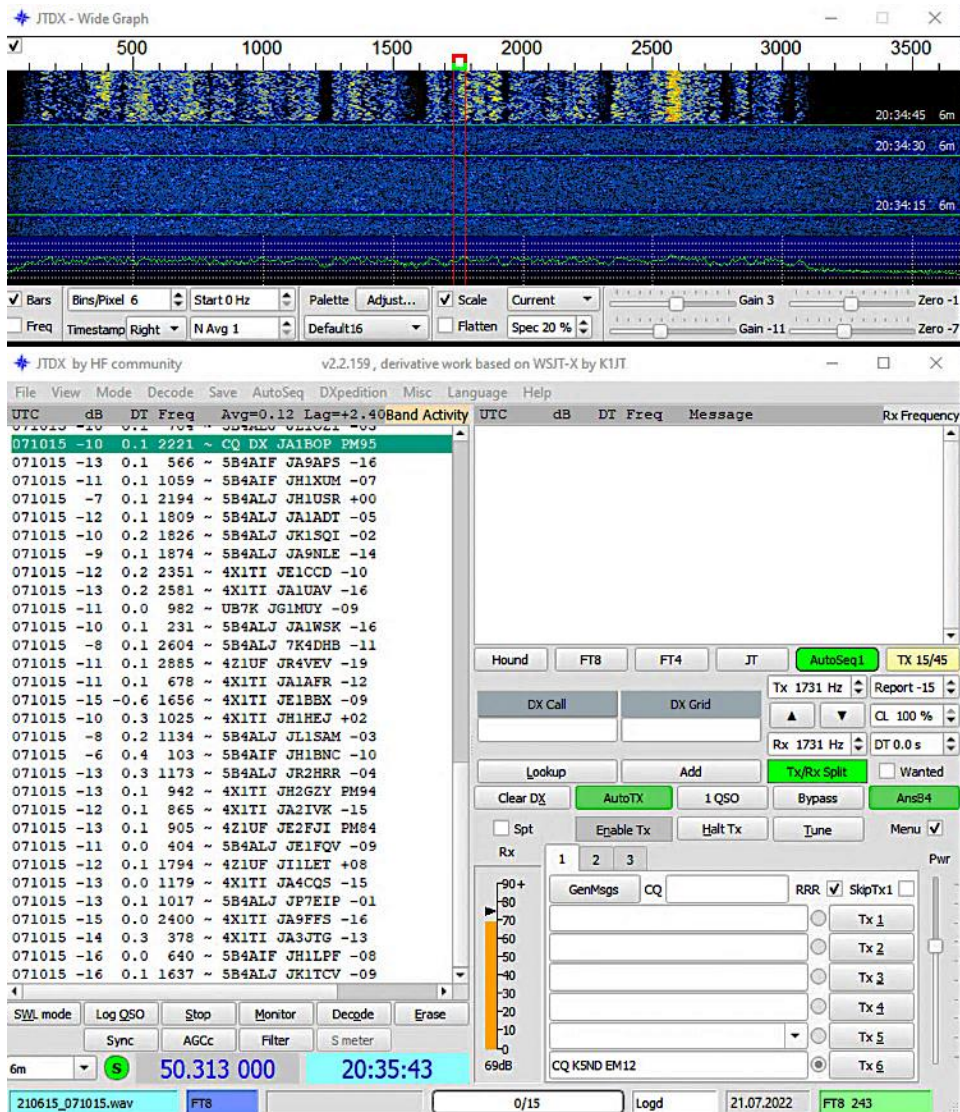


Figure 29 - JTDX Display

## Operating Software

### WSJT-X Improved

I've recently started using WSJT-X Improved. I like that it adds many of the operating features of JTDX while keeping all the operating modes from FT8 to MSK144 to Q65 and the contest messages.

The chapter on FT8 and FT4 operation provides more details on this WSJT-X alternative.

# Chapter 6 — Six Meter On-the-Air Operations

We've discussed propagation, equipment, antennas, and software. Now, it's time to cover some operating protocols for six meters.

## Six Meter Frequencies

Here are the major frequencies for six meters.

Frequency	50.125 SSB Calling
	50.100 CW
	50.1 to 50.125 DX Window
	50.313 for WSJT-X FT8
	50.323 for FT8 to Europe
	50.318 for FT4
	50.260 for MSK144 Meteor Scatter
	50.275 for Q65 in 30A mode
	50.080 and down Beacons

The primary calling frequency for SSB is 50.125 MHz. It's a good frequency to monitor to see band conditions. If you hear someone, the band is probably opening. Sound advice is to call on this frequency and then move to a higher one for the QSO. When the band opens, people will work stations every three to five kilohertz above 50.125.

The DX window is from 50.100 to 50.125. Here, you'll find DX stations calling CQ. It's verboten for USA stations to call CQ in this area. That must be why they call it the DX window.

## Six Meter On-the-Air Operations

You can also monitor the CW beacons on the air from 50.080 MHz and below. An Internet search for the “six-meter beacons list” will help you find the frequencies and locations. Of course, the beacon will transmit call signs and usually the grid.

### Digital Mode Operations

Today, most six-meter operating takes place on digital modes, mainly FT8. The go-to frequency is 50.313 MHz. Most stations are compressed into about 4 kHz.

There are pros and cons, of course. The benefit is that you can see almost all the stations currently on the air and usually work them all. The downside is that they are squeezed into a small space when the band is open. Not only that but there’s no way to have a conversation. If that’s your goal, then it’s time to move to the SSB frequencies.

There is also a special frequency for working FT8 across the Atlantic, 50.323 MHz. The protocol on that frequency is for North American and Caribbean stations to operate on second or odd sequence (0:15 and 0:45 seconds) and for European stations to operate on first or even sequence (0:00 and 0:30 seconds).

Meteor Scatter occurs on 50.260 and 50.265 MHz. This type of contact is usually coordinated online in one of the chat rooms. This helps determine the frequency, sequence, direction for pointing the antenna, etc. The standard protocol is that the westernmost station operates on the first sequence, while the eastern station operates on the second sequence.

FT4 is another option; I’ve worked a few on six meters when the band is open with a great deal of activity. FT2 is available, but I haven’t found it to be of much use on 6 meters.

Q65 is at 50.275 MHz in the 30-second T/R sequence and submode A. There are separate chapters devoted to these modes.

## Six Meter On-the-Air Operations



*Figure 30 - K5ND Ham Shack September 2023*

### Contest and Rare Grid Roving

I've mentioned roving a few times in this book, and there's a later chapter with much more detail. Rovers are a distinctive part of VHF contesting, and they have become essential for those pursuing grid-based awards like the Fred Fish Memorial Award (FFMA).

Stations set up their transceivers and antennas in their car or van, then drive out to a remote location. After setting up the station, they hope for good propagation on 6 meters.

I've participated in contests around the Dallas-Fort Worth area. I've also done some rare grid roving in the Texas Panhandle.

## Six Meter On-the-Air Operations

The photos below show the backseat operating position, the rooftop rotator system I usually use in VHF contests (note the six-meter Moxon), and the push-up mast I've used in the Texas Panhandle.

This can be an enjoyable activity for the rover and satisfying for those hunting these rare grids.



*Figure 31 - K5ND/R back seat operating position*

## Six Meter On-the-Air Operations



*Figure 32 - K5ND/R with 50, 144, 220, 432 antennas*

### Finding Openings

My favorite resource for finding and tracking six-meter openings is [DXmaps.com](http://DXmaps.com). This website displays all the spotted stations and plots them on a map. You've seen a few examples earlier in the document.

## Six Meter On-the-Air Operations

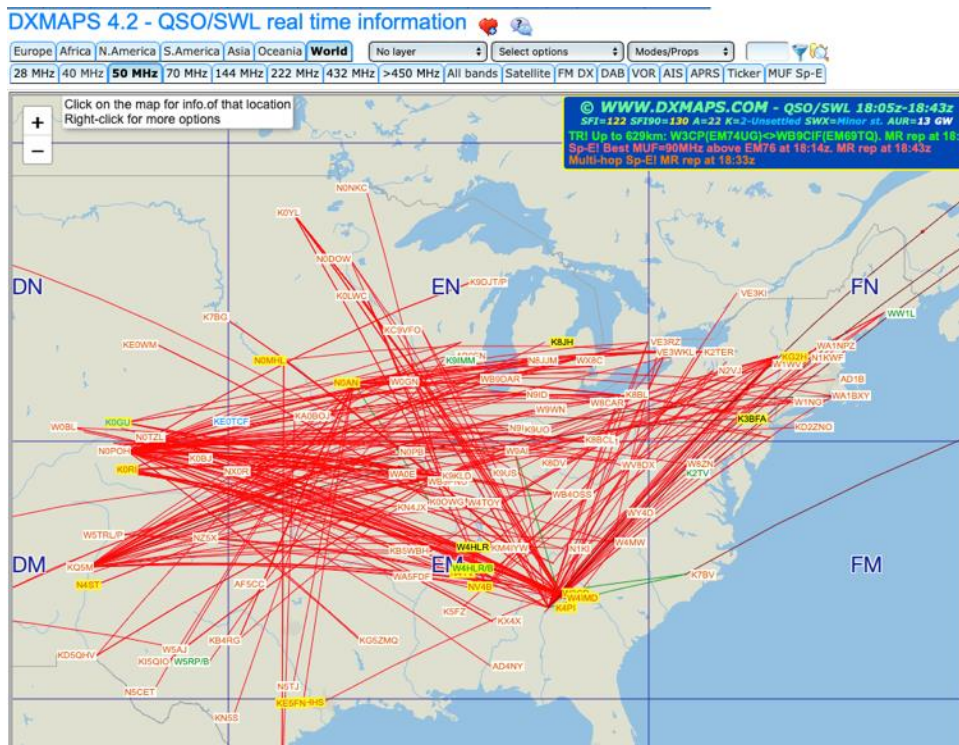


Figure 33 - DXmaps.com display of a 6-meter opening

I use this to help me aim my antenna and listen for signals. It's useful to see these maps, but if you're not hearing anything, at least it keeps you hopeful that something might happen on this mysterious and tragic band.

It's also helpful to monitor various online chat rooms, including Slack VHF-Chat, ON4KST Chat, and PingJockey. An online search can help you find and log in to these chat systems.

Many of the conversations focus on setting up lengthy meteor scatter contacts. They are also immensely helpful for tracking any rovers activating rare grids. Pointing your antenna at them and monitoring what's happening on the air and in the chat system can help you snag one of those grids when the conditions are just right.

## Six Meter On-the-Air Operations

I mentioned CW beacons earlier. These have traditionally been great resources for providing an early indication of openings. It can be beneficial to have a panadapter that offers a wide display of the entire range of CW beacons.

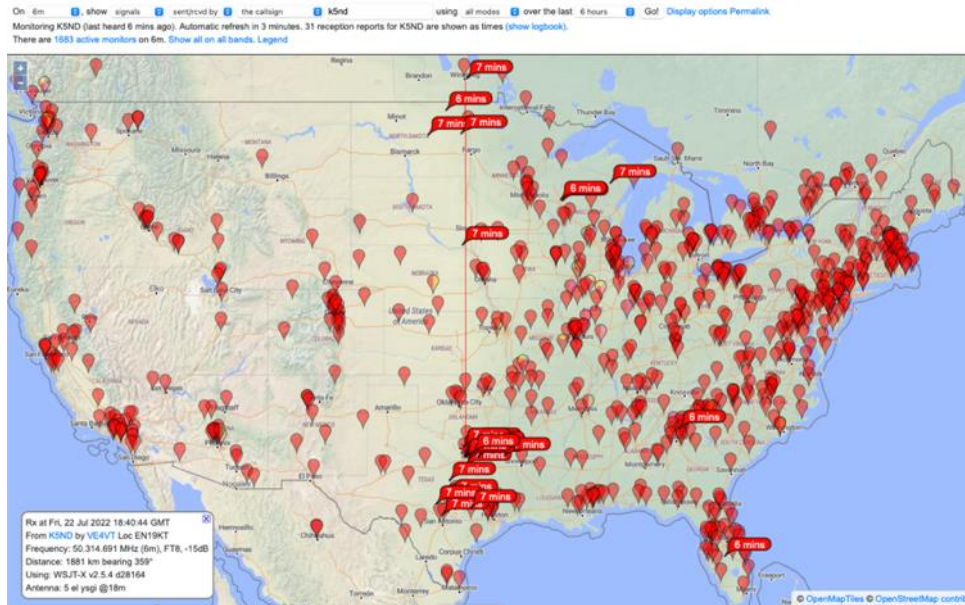


Figure 34 - PSK Reporter showing my FT8 signals

The PSK Reporter system consists of many stations around the world with receivers on the ham bands, all tied into an extensive database that collects and displays all this information.

They report all digital-mode contacts. You can select the band and mode to monitor. I have started using this resource more frequently to pick up my signal and see how I'm getting out. It can be particularly helpful for meteor scatter—pretty cool stuff.

# Chapter 7 — WSJT-X Operations: FT8 - FT4

Chapter 5, Operating Software, provides a broad overview of the software available for 6-meter operations. Of course, the big one is WSJT-X. This chapter delves into FT8 and FT4 operations, while the following two chapters address MSK144 and Q65, respectively.

There are many online resources to help you set up your rig for WSJT-X operations, including operating guides. I won't match their level of detail or insight, but I will share my setup, operating practices, and experiences.

## How FT8 and FT4 Work

FT8 and FT4 operate through the normal ionospheric propagation modes of the F2 layer, sporadic E, and tropospheric scatter.

As noted earlier, FT8 and, to a lesser degree, FT4 offer substantial improvements in decoding weak signals. In comparison, CW can be expected to be decoded by a good operator at a -10 dB signal-to-noise ratio. SSB works at about +5 dB signal-to-noise. But FT8 operates at an astounding -21 dB signal-to-noise ratio.

It does this by using a 2.5 kHz bandwidth while decoding individual signals at a 6.25 Hz bandwidth for FT8. It is, in essence, bringing the magic of digital decoding to the magic band and every other band.

## WSJT-X Overview

Using a computer soundcard, either built into the rig or an external USB device, audio frequencies spanning roughly 0 to 3.5 or 4 kHz are used to transmit and receive multiple FT8 or FT4 signals.

Likewise, there is a rig-to-computer connection for Computer-Aided Transceiver (CAT) control to key the rig and make frequency changes.

You can find the WSJT-X User Guide at <https://wsjt.sourceforge.io/wsjt-x-doc/wsjt-x-main-3.0.0.html>. Note that the software changes frequently. Always look for the current version.

The guide provides detailed information on connecting your rig for audio and CAT control.

## Computer Time Alignment

One of the ways that WSJT-X achieves its incredible signal-to-noise ratio is through time alignment between the transmitting and receiving stations.

Typically, your computer is reasonably well synchronized. You can check on the website [time.gov](http://time.gov). If it's close, you may be able to get by without particular time-synchronizing software. Yet, we are ham radio geeks. So, there must be more.

UTC	dB	DI	Freq	Message
214400	-10	0.0	774	~ W1IXQ JA1NVF 73
214400	9	0.0	1412	~ 3D2USU VE3SS 73
214400	-10	0.0	845	~ A1SOS JR8AMF QN03
214400	-14	0.1	962	~ CS8ABF N2WMF FN31
214400	-15	0.1	702	~ KE1VT N7JQQ 73
214400	-14	0.0	146	~ YV4KWI JF2KOZ PM84
214400	-9	0.8	1760	~ CQ KY2T FN21
214400	-14	-0.0	1295	~ KQ4LLM AI7AD RRR
214400	-7	1.8	1595	~ 3D2USU VE3FNT FN03
214400	-21	0.0	1165	~ CX5ABM KK7HPF CN87
214400	-15	0.1	524	~ VP8WA WQ9N CM87
214400	-16	0.0	1520	~ HK2N JE1NVD -17
214400	-11	0.0	1829	~ KN4WOJ VA7JC -23
214400	2	0.0	1442	~ VP8WA WB8SIG EN91
214400	-1	-0.6	1889	~ KF7ZN VE7BGD CN89
214400	-14	-0.1	437	~ OA4DFE JA0EVI R-04
214400	-13	0.1	1474	~ XT2AW PY2AMP GG66
214400	-24	0.0	1180	~ KF7ZN JA8GJH RR73

Figure 35 - Band Activity window

There are several options for installing software that will sync your computer clock. Try Dimension 4 at <http://www.thinkman.com/dimension4/> There is also Meinberg NTP available at <https://www.meinbergglobal.com/english/sw/ntp.htm>

## WSJT-X Operations: FT8 - FT4

You can also use a GPS antenna and the NMEATime2 time software at <https://www.visualgps.net/#nmeatime2-content> This is the setup I'm currently using.

You can view the difference between your computer's time and others' on the air by observing the Band Activity window and the DT column. It will typically show 0.1 or 0.2, and sometimes a minus sign. If it's consistently showing 1.0 or greater, your clock may be off by that amount. See the nearby sample with one transmission at 1.8 seconds out, highlighted in red.

### Settings Considerations

The WSJT-X User Guide includes screenshots and additional background for each setting. I've included some of my settings windows below. Please note that this is from WSJT-X Improved, found at <https://sourceforge.net/projects/wsjt-x-improved/>. This is a slightly improved version of WSJT-X. Undoubtedly, some of the features added to this version will eventually appear in the public versions of WSJT-X.

## WSJT-X Operations: FT8 - FT4

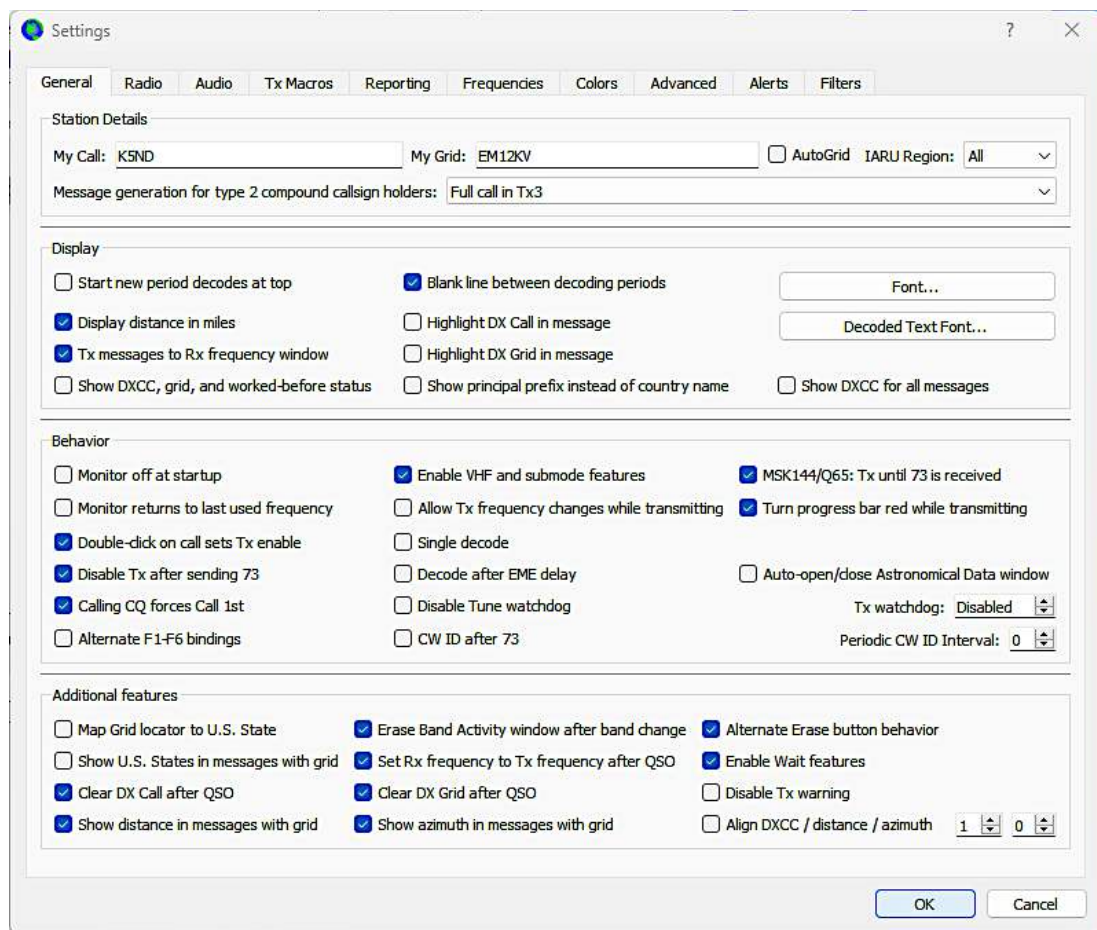
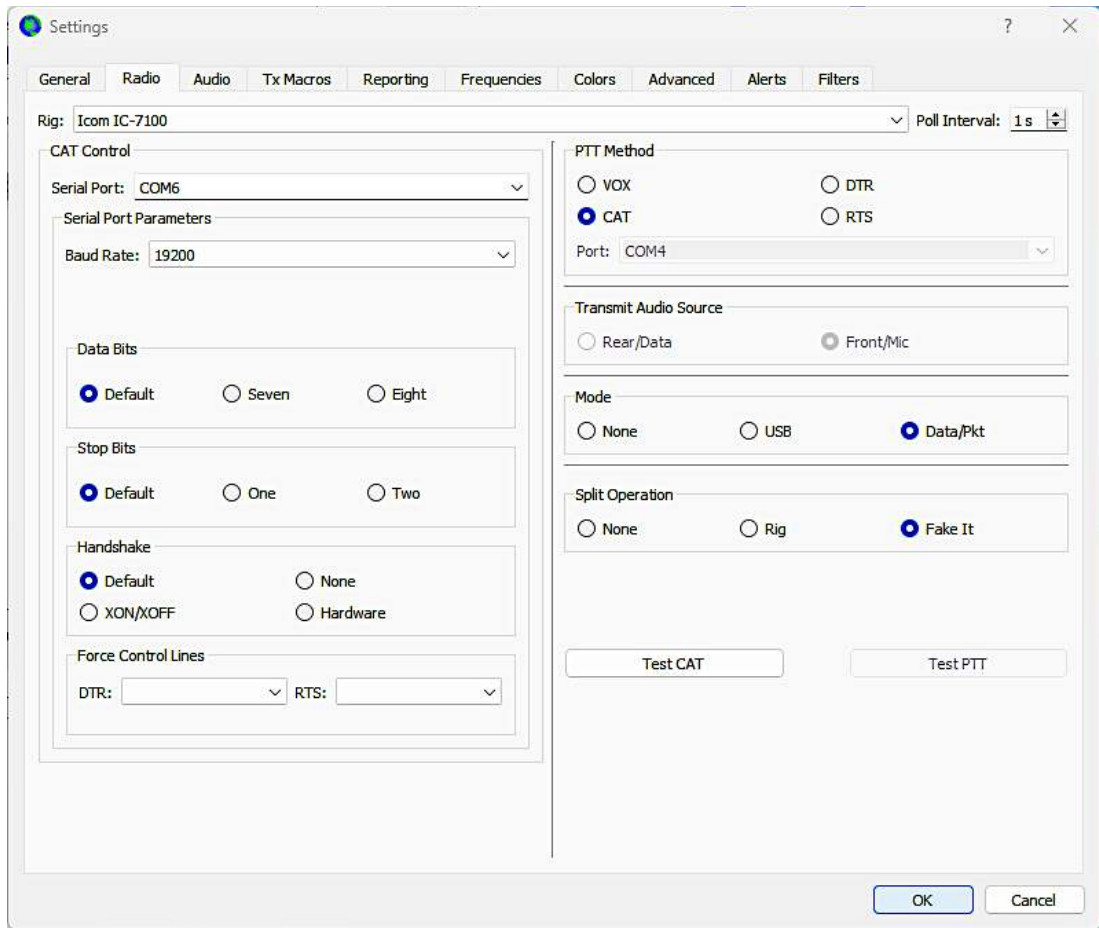


Figure 36 - WSJT-X Improved Settings General Tab

In the general tab, I've ticked off the usual stuff, including Enable VHF and submode features. Note the setting for MSK144 to transmit until 73 is received—more on this in the MSK144 chapter.

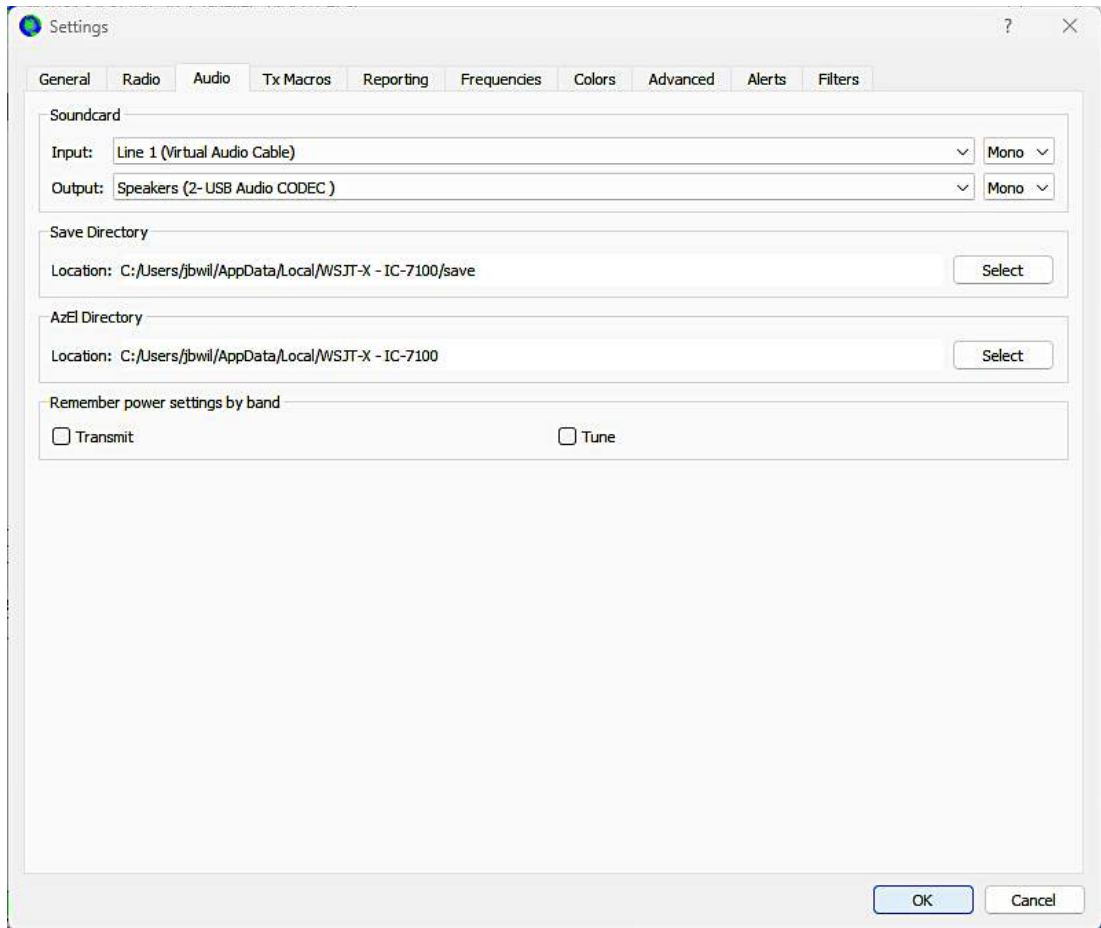
## WSJT-X Operations: FT8 - FT4



*Figure 37 - WSJT-X Improved Settings Radio Tab*

In the radio settings tab, I've set up my rig and the serial port for CAT control. Note the Split Operation setting for Fake It. This ensures that the transmitter operates in a spot in the audio bandpass, ensuring no harmonics are transmitted.

## WSJT-X Operations: FT8 - FT4



*Figure 38 - WSJT-X Improved Settings Audio Tab*

The audio tab is pretty straightforward. Here, it shows that the input for receive is from a virtual audio cable from the Airspy SDR I'm using on receive. You can learn more about that setup in the Appendix.

The output is direct to the USB Audio Codec in the IC-7100.

## WSJT-X Operations: FT8 - FT4

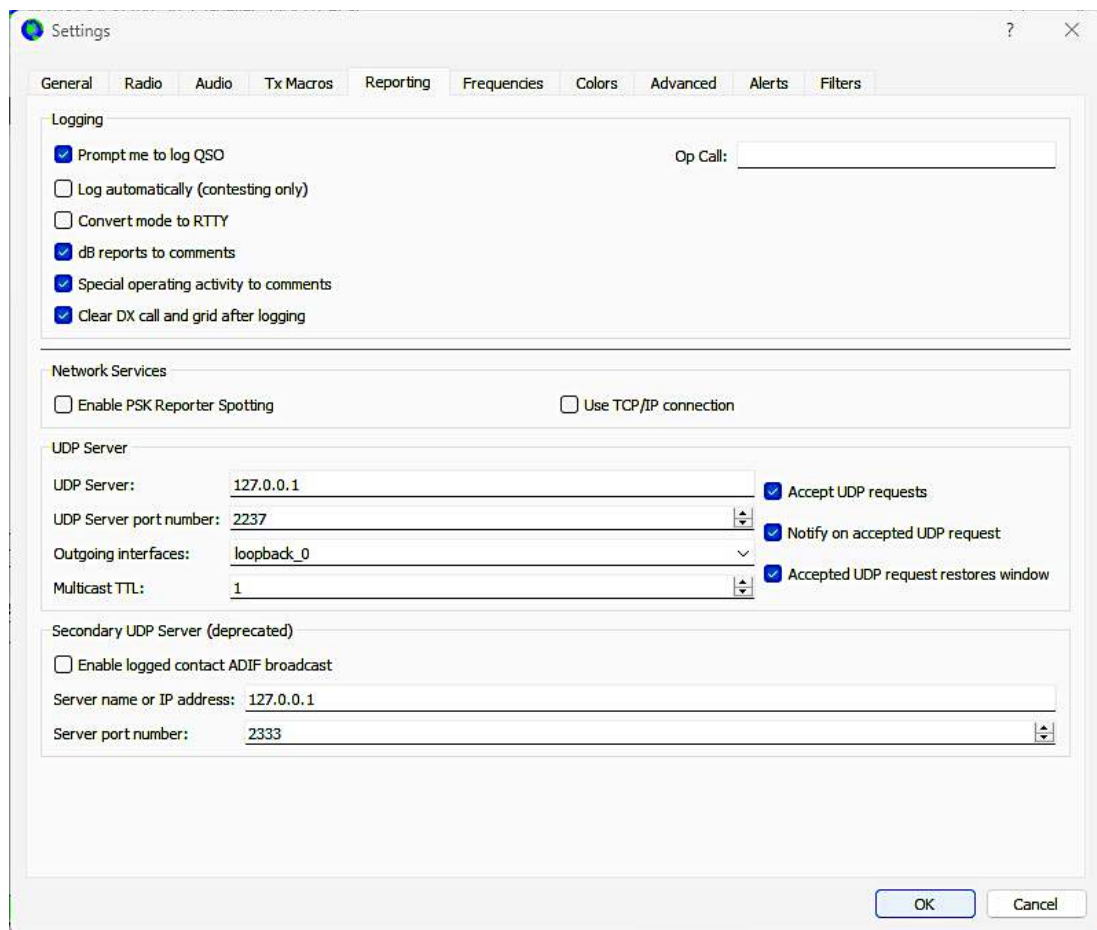


Figure 39 - WSJT-X Improved Settings Reporting Tab

The Reporting tab displays the various prompts and logging comments. The network server settings depend on the logging program you're using. I'm using N3FJP's AC Logger with JT-Alert.

## WSJT-X Operations: FT8 - FT4

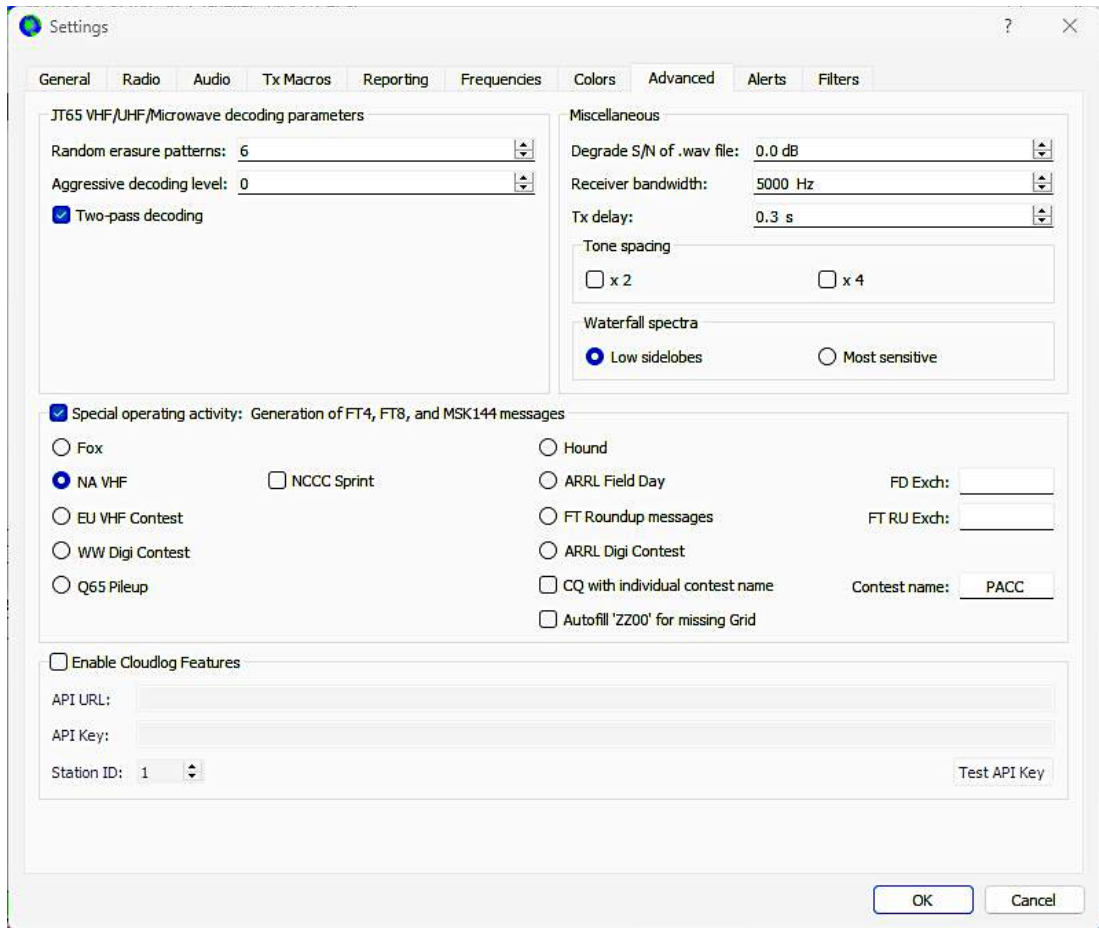


Figure 40 - WSJT-X Improved Settings Advanced Tab

Here's the Advanced Tab. There is not much to select here other than the Special Operating Activity. I've chosen the NA VHF contest mode. Which I use in contests or when using MSK144 to minimize the number of transmissions required for a valid QSO. There are many other contest settings, as you can see.

## WSJT-X Operational Insight

I'm not sure I have a great deal of insight to offer when operating FT8 and FT4 on six meters. As with operation on all bands, it's wise to ensure you're transmitting on an open frequency. When calling someone, ensure your transmit frequency is clear from interference, at least as far as you can make out at your station.

It is generally accepted practice to not transmit on the other station's frequency. If you are transmitting on the other station's frequency when that station responds to someone else, WSJT-X will close your transmission.

You'll find that one of the frustrations is someone transmitting over the top of that rare DX station you're trying to work. Often, that's simply because they can't hear the DX station. You may also find that when you pause your call to the DX station, someone else has started transmitting on the same sequence and frequency you're using. That's the time to change frequency.

Most of the activity is on FT8 and 50.313 MHz. There is also, from time to time, FT4 activity on 50.318 MHz. FT4 uses 7.5-second sequences. This allows for making more QSOs in a shorter time. That can be helpful during contests. Unfortunately, only a few people are taking advantage of this capability.

Recently, I managed to work E51WL on FT4, and a year or so before that, VP8LP. Both stations announced on FT8 that they were moving. That's when it's wise to get there fast to work them before everyone else shows up.

One final bit of operating insight is that I prefer to set the Wide Graph display for N Avg 1. That spreads out the decoded signals as shown nearby. I like to see as much of the received signal as possible, hoping it will decode if I keep an eye on it!

## WSJT-X Operations: FT8 - FT4

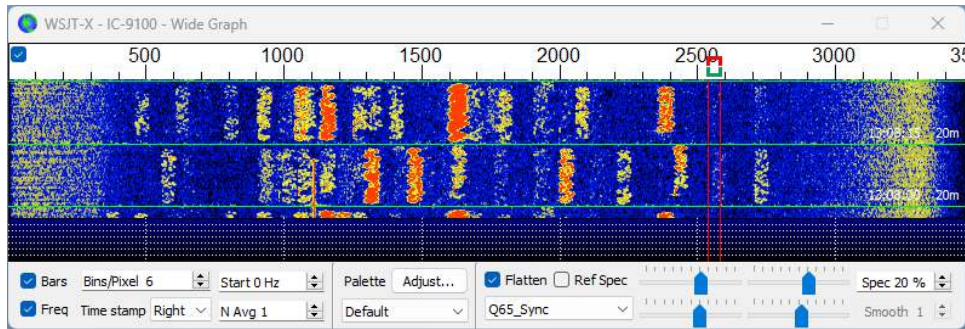


Figure 41 - Wide Graph Display with N Avg 1

I adopted this operating preference when initially working JT65 on six meters. I wanted to see every pulse received over the 60-second transmission. I just carried that over to the FT8 15-second and F4 7.5-second transmissions.

## WSJT-X Variations

Currently, there is a standard version of WSJT-X, and a beta version is often posted for testing. Then, there is the WSJT-X Improved version that I mentioned above.

There are also two significantly different versions: MSHV and JTDX. You can find MSHV at <http://lz2hv.org/mshv> It offers a substantially different interface and more modes, such as FSK441, which has been discontinued in WSJT-X. It's something worth investigating.

JTDX can be found at <https://sourceforge.net/projects/jtdx/> It offers a different user interface and some operating conveniences. It also purports to provide decodes of weaker signals than the regular version of WSJT-X. I've generally found that to be true. But it does not offer contest modes or MSK144 or Q65.

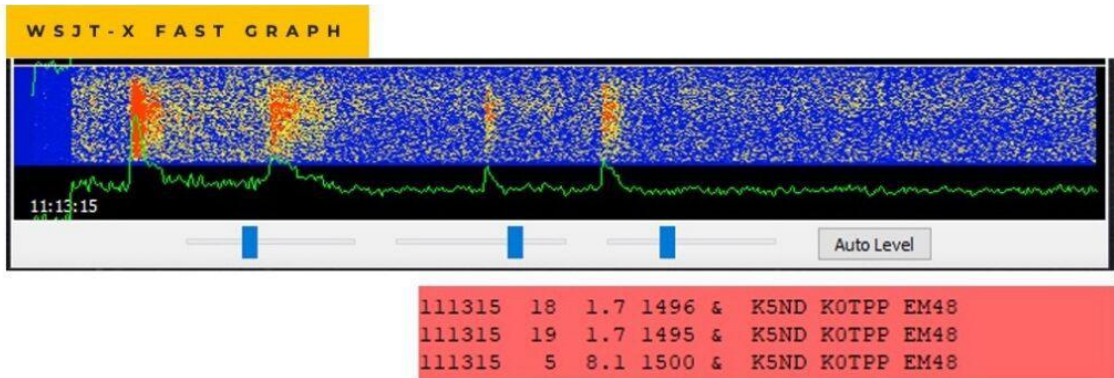
# Chapter 8 — WSJT-X Operations: MSK144

This chapter provides step-by-step instructions for using WSJT-X MSK144 to make meteor scatter contacts. It also provides an in-depth look into the principles of meteor scatter propagation. All of this is intended to give you the insight you need to get on the air and make QSOs using meteor scatter.

First, let's cover a typical MSK144 meteor scatter contact.

## Meteor Scatter QSO Snapshot

The nearby screenshot shows the WSJT-X Fast Graph display when the mode is set to MSK144. You can see meteor "pings" at 1.7, 3.5, 6.1, and 8.1 along the full 15-second window. The brighter the ping appears, the stronger the signal. For example, the pings at 1.7 seconds are +18 and +19 dB, while the one at 8.1 seconds is +5 dB. These are the only pings that have been decoded, which are displayed in the red box.



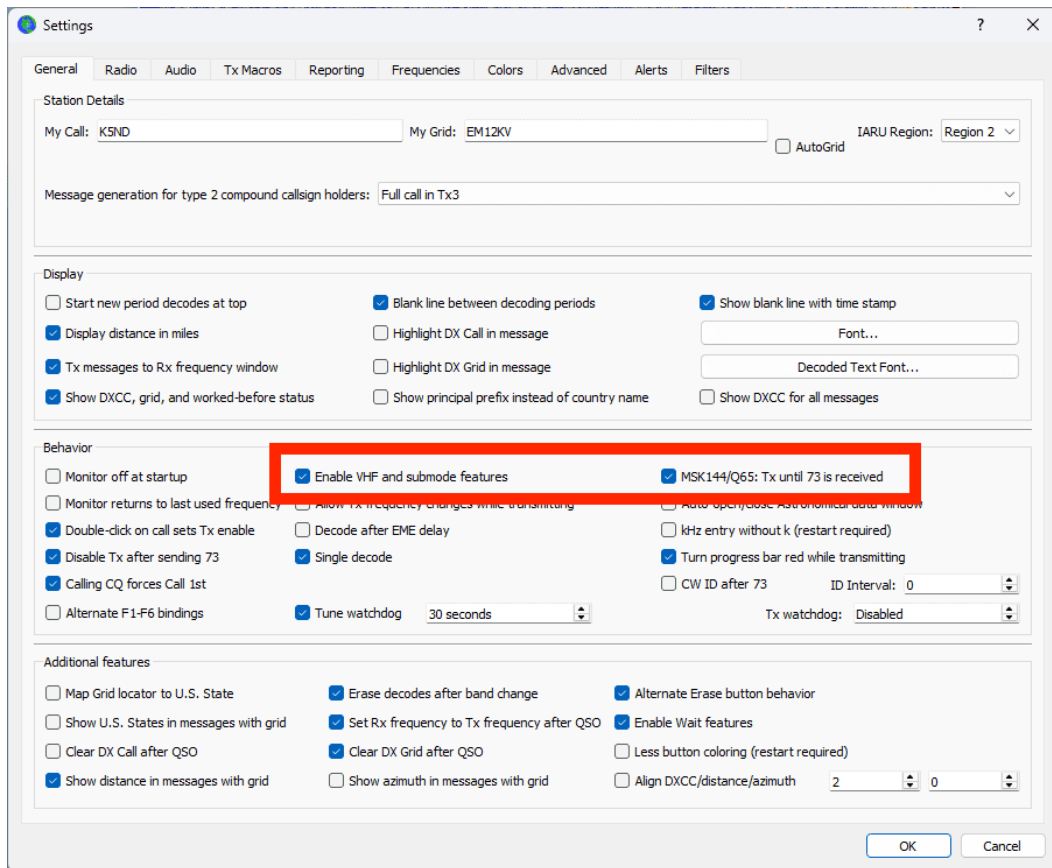
You can find a video about meteor scatter and how to work MSK144 on my blog at <https://k5nd.net/2022/08/harnessing-meteors-for-vhf-qsos/>

## WSJT-X Operations: MSK144

Note that MSK144 pings are decoded in real time. It's not like FT8, where you wait for the full 15-second transmission before seeing the decode. In fact, the messages are sent repeatedly at 250 characters per second. That's how a small ping can result in a decoded message.

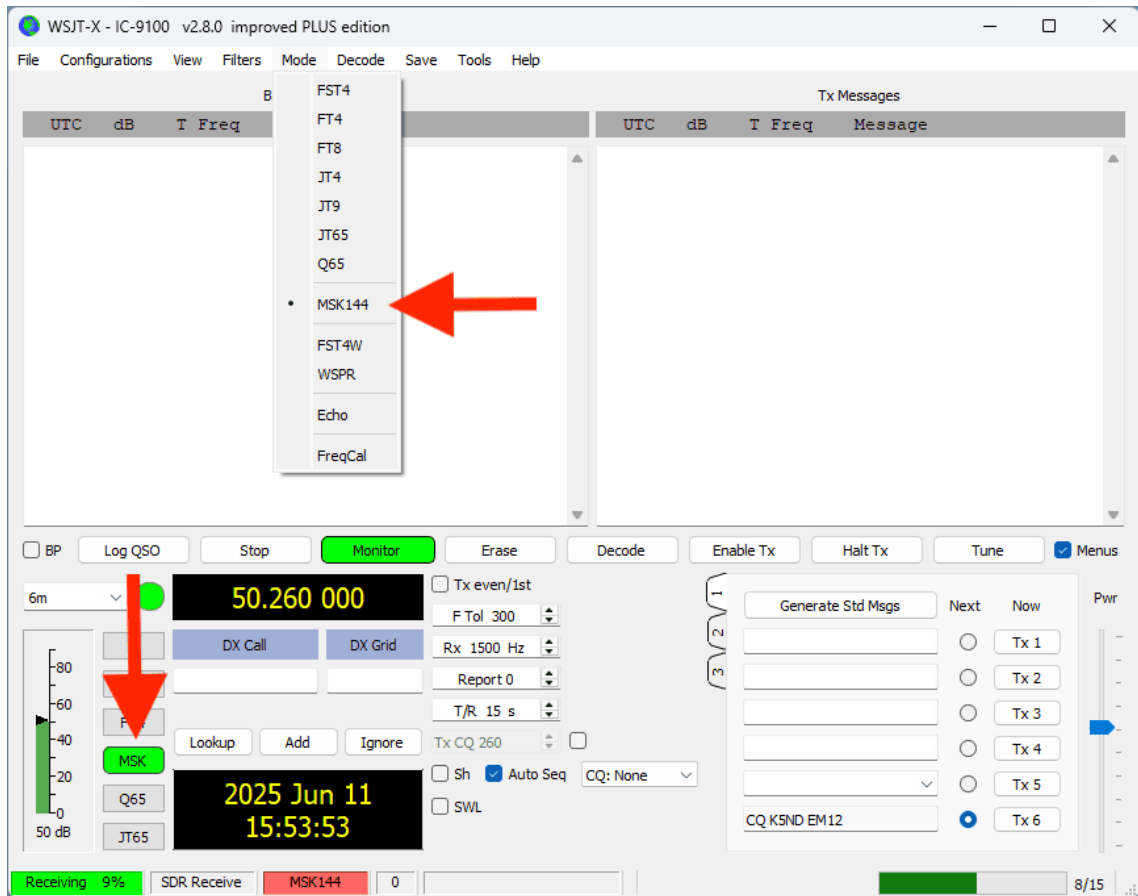
### MSK144 Detailed Settings

The settings for MSK144 in WSJT-X will generally match those used for FT8, including rig control, audio, and other parameters. Here are the exceptions for meteor scatter operation. Note that my screenshots show WSJT-X Improved. They should be similar to the General Availability version of WSJT-X.



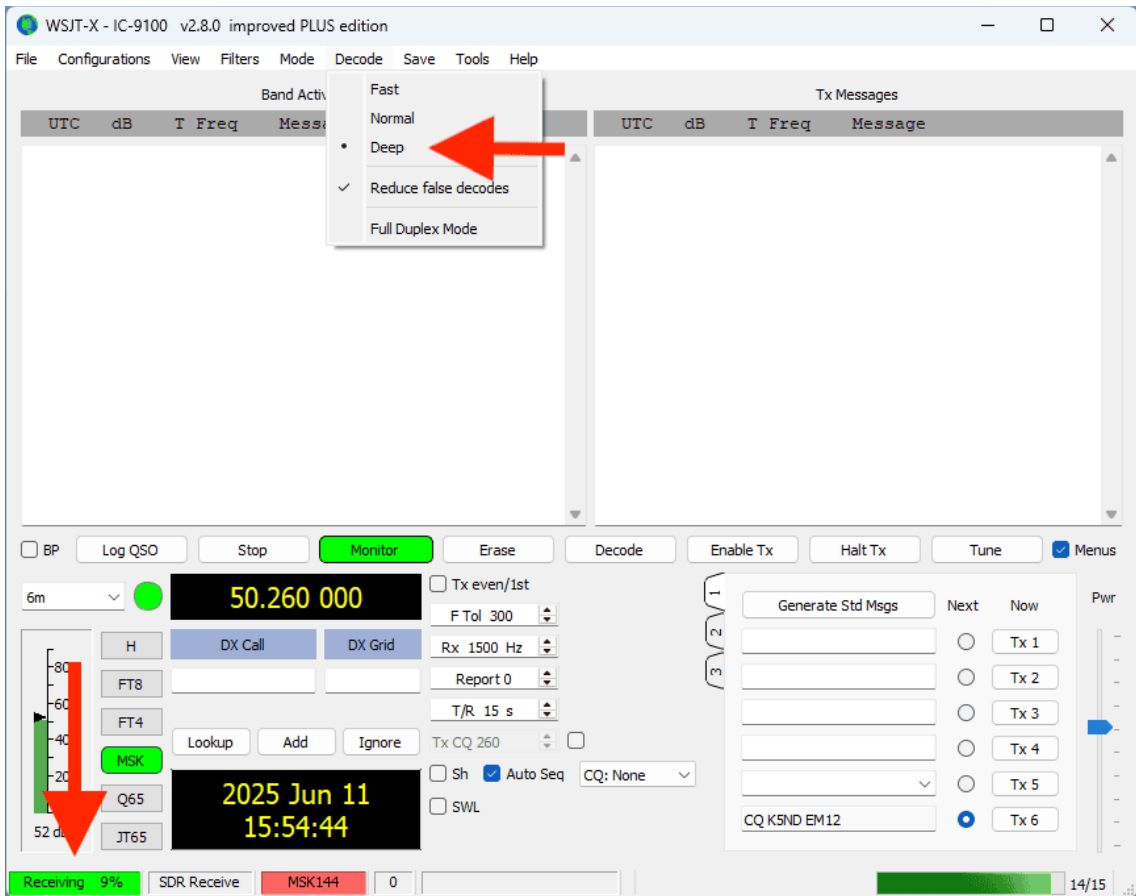
## WSJT-X Operations: MSK144

Under the Settings General Tab, make sure you've selected "Enable VHF and submode features" along with "MSK144/Q65: Tx until 73 is received." More on sending 73 later. Next comes mode select, which can be selected via the MSK button or from the pulldown Mode menu.



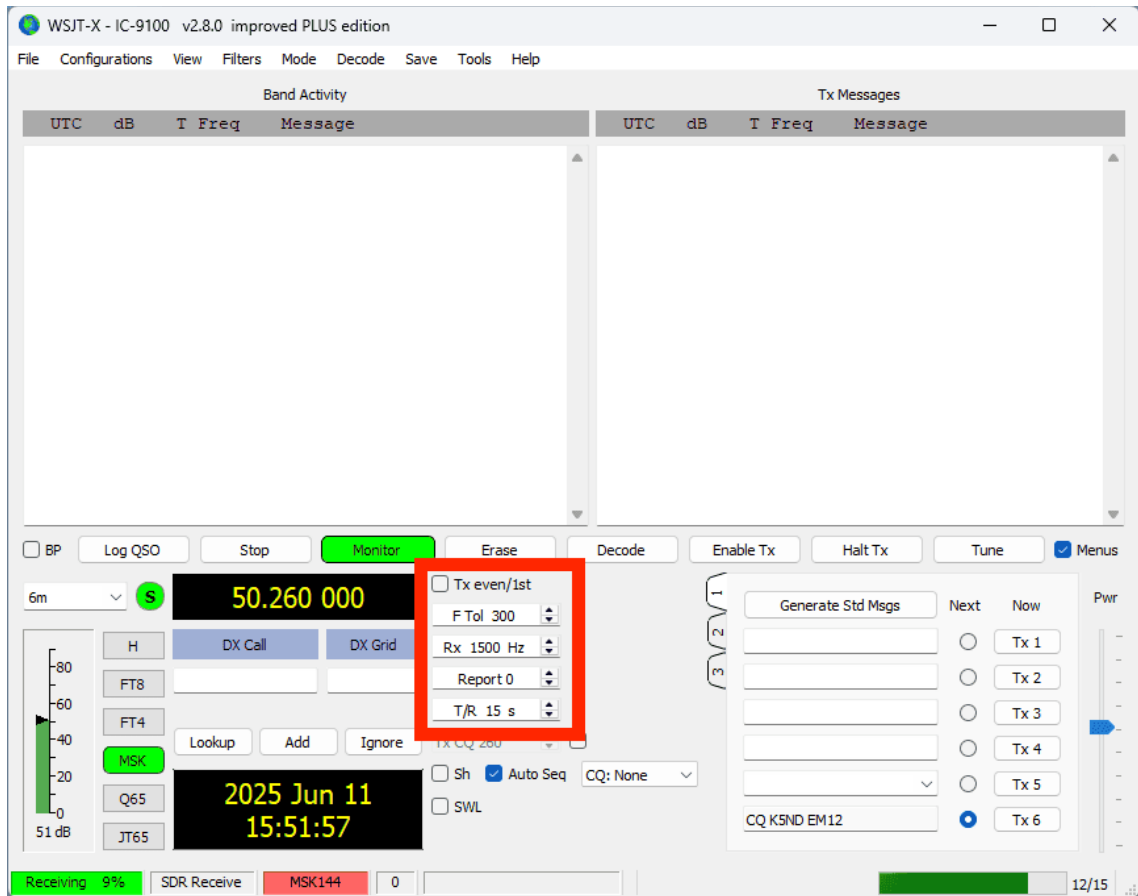
The Decode menu follows. It is a drop-down menu for selecting Fast, Normal, or Deep. K1JT suggests choosing the option that best suits your computer; monitor the CPU usage percentage at the bottom of the screen, and select the option that doesn't overload the CPU. Some suggest that Normal provides the best decodes.

## WSJT-X Operations: MSK144



The other settings are F Tol set to 300 Hz, Rx set to 1500 Hz, and T/R set to 15 seconds. I prefer the 300 Hz tolerance, but you can choose whatever works best for your CPU. According to K1JT, it makes no difference in the decodes. You need to ensure that you're covering the frequency of the station you're trying to work with, in case they are not quite calibrated and transmitting above or below 1500 Hz.

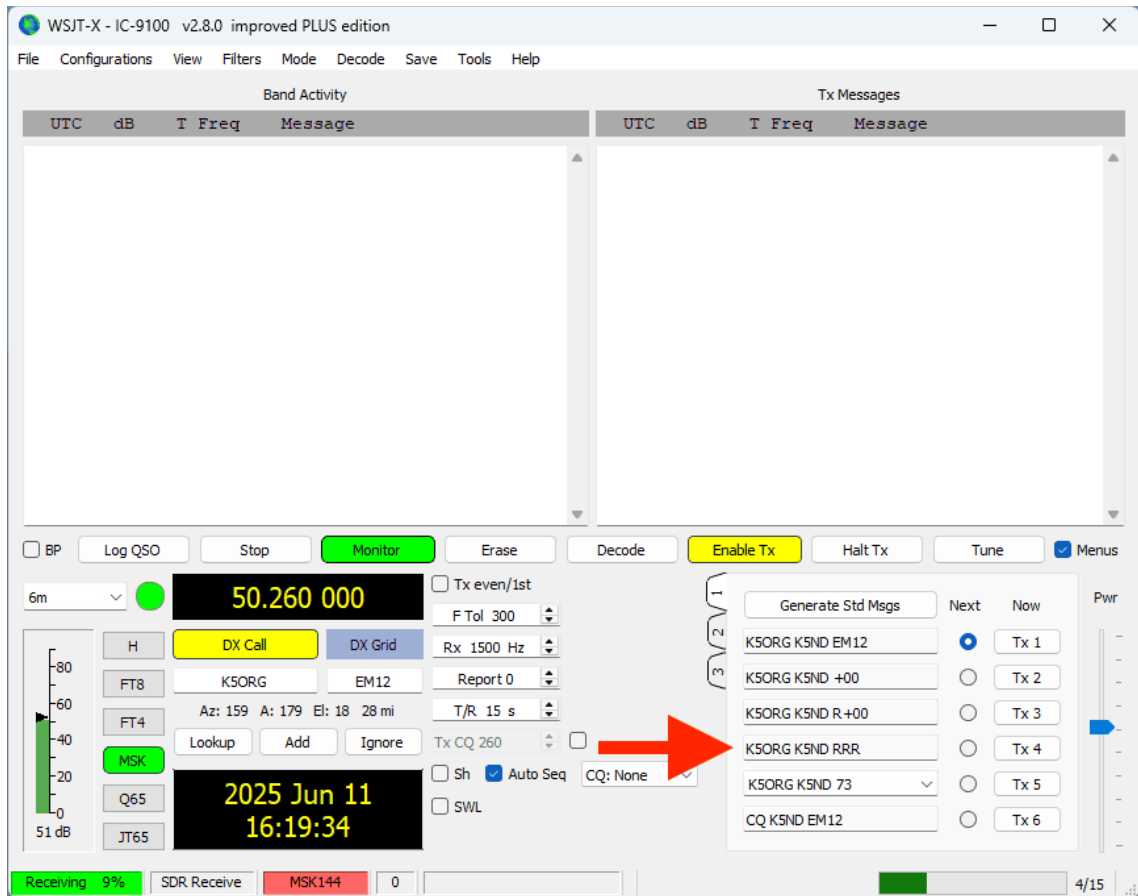
## WSJT-X Operations: MSK144



Note the “TX even/1st” checkbox. Check the box to transmit first, uncheck it for second. The protocol states that if you're pointing east, you transmit even/first; if west, you transmit odd/second. This also emphasizes the importance of coordinating your meteor scatter QSO through one of the chat pages. It's not ideal for both stations to transmit at the same time! Additionally, be aware that 15-second transmit/receive periods are standard for meteor scatter.

I also strongly recommend using RRR in your sequence instead of RR73. With WSJT, after you send RR73, it logs the QSO. However, with meteor scatter, it's unlikely that a single transmission of RR73 will actually get through. Therefore, you can use RRR as often as necessary to receive confirmation from the other station that the QSO is complete.

## WSJT-X Operations: MSK144

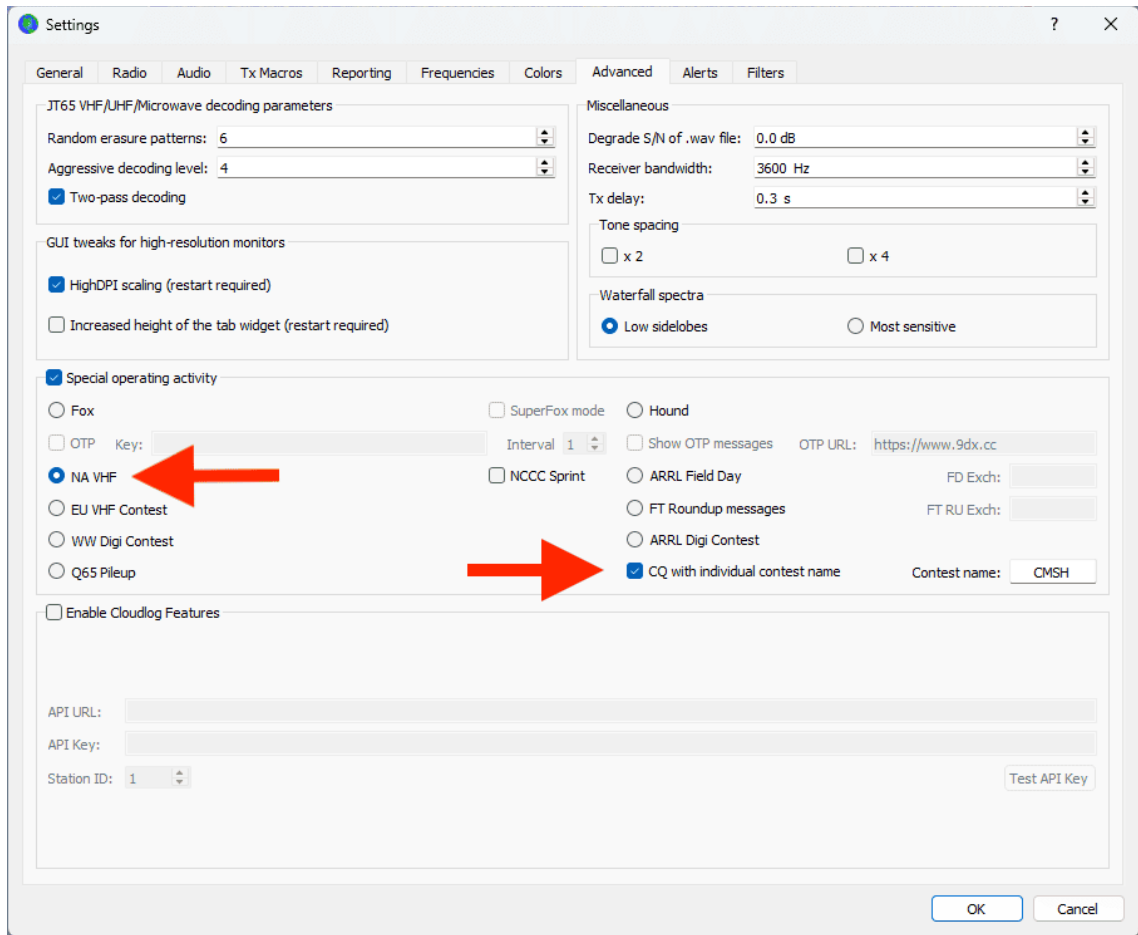


You can select RRR or RR73 by double-clicking the Tx4 button. Alternatively, you can use your keyboard by pressing Alt+R for RR73 and Ctrl+R for RRR.

Often, in meteor scatter QSOs coordinated through an online chat, when a station receives the RRR, they can declare the QSO complete by letting the other operator know and logging it. Learn more at <https://k5nd.net/2021/10/valid-qsos-and-online-chat/>

For 2 meters and above, MSK144 QSOs use NA Contest Mode to minimize the number of sequences needed for a complete QSO. However, it's not uncommon to utilize contest mode on 6 meters and, of course, during contests. Here are the settings.

## WSJT-X Operations: MSK144



Select the checkbox “special operating activity” and then NA VHF. You can also check the “CQ with individual contest name.” Here, I’ve used CMSH, which indicates that I’m sending a CQ with Contest Mode and SH activated—more on SH below in the sample 2-meter QSO.

### Sample 6-Meter MSK144 QSO

Here's the screen display for an actual 6-meter MSK144 QSO. I provide this to illustrate that meteor pings can be few and far between. This QSO lasted 16 minutes and included plenty of silence throughout. Patience and, ideally, coordination between stations are necessary to help both parties continue when it seems like all is lost.

## WSJT-X Operations: MSK144

Please note that this QSO contradicts my recommendation to use contest mode and RRR.

Band Activity					Tx Messages				
UTC	dB	T	Freq	Message	UTC	dB	T	Freq	Message
125530	-2	11.8	1466	WSAJ KASYEU +03	125530	-2	11.8	1466	WSAJ KASYEU +03
130300	9	14.3	1461	K5ND KASYEU +02	125615	Tx	1500		KASYEU K5ND EM12
130500	2	1.9	1465	K5ND KASYEU +02	125845	Tx	1500		KASYEU K5ND EM12
130500	7	3.4	1464	K5ND KASYEU +02	125915	Tx	1500		KASYEU K5ND EM12
131300	-7	9.0	1468	K5ND KASYEU RR73	125945	Tx	1500		KASYEU K5ND EM12
131300	-3	9.1	1468	K5ND KASYEU RR73	130015	Tx	1500		KASYEU K5ND EM12
131300	-1	9.8	1469	K5ND KASYEU RR73	130045	Tx	1500		KASYEU K5ND EM12
131930	6	4.0	1469	CQ KASYEU ELO7 U.S.A.	130115	Tx	1500		KASYEU K5ND EM12
132130	17	13.9	1490	W5LDA N5DUW EM11	130145	Tx	1500		KASYEU K5ND EM12
132130	20	14.2	1489	W5LDA N5DUW EM11	130215	Tx	1500		KASYEU K5ND EM12
132145	20	0.4	1489	W5LDA N5DUW EM11	130245	Tx	1500		KASYEU K5ND EM12
					130300	9	14.3	1461	K5ND KASYEU +02
					130315	Tx	1500		KASYEU K5ND R+09
					130345	Tx	1500		KASYEU K5ND R+09
					130415	Tx	1500		KASYEU K5ND R+09
					130445	Tx	1500		KASYEU K5ND R+09
					130500	2	1.9	1465	K5ND KASYEU +02
					130500	7	3.4	1464	K5ND KASYEU +02
					130515	Tx	1500		KASYEU K5ND R+09
					130545	Tx	1500		KASYEU K5ND R+09
					130615	Tx	1500		KASYEU K5ND R+09
					130645	Tx	1500		KASYEU K5ND R+09
					130715	Tx	1500		KASYEU K5ND R+09
					130745	Tx	1500		KASYEU K5ND R+09
					130815	Tx	1500		KASYEU K5ND R+09
					130845	Tx	1500		KASYEU K5ND R+09
					130915	Tx	1500		KASYEU K5ND R+09
					130945	Tx	1500		KASYEU K5ND R+09
					131015	Tx	1500		KASYEU K5ND R+09
					131045	Tx	1500		KASYEU K5ND R+09
					131115	Tx	1500		KASYEU K5ND R+09
					131145	Tx	1500		KASYEU K5ND R+09
					131215	Tx	1500		KASYEU K5ND R+09
					131245	Tx	1500		KASYEU K5ND R+09
					131300	-7	9.0	1468	K5ND KASYEU RR73
					131300	-3	9.1	1468	K5ND KASYEU RR73
					131300	-1	9.8	1469	K5ND KASYEU RR73
					131315	Tx	1500		KASYEU K5ND 73
					131351	Tx	1500		KASYEU K5ND 73
					131415	Tx	1500		KASYEU K5ND 73

Log QSO Stop Monitor Erase Decode Enable Tx Halt Tx Tune  Menu

6m S 50.260 000  Tx even/1st F Tol 200 Generate Std Msgs Next Now Pwr

## Sample 2-Meter MSK144 QSO

For two meters, even more patience is required. Jim, W7OUU, typically dedicates a full hour to a meteor scatter QSO on 2 meters.

## WSJT-X Operations: MSK144

It's also recommended to use the SH setting. This generally stands for Short Hand, which significantly simplifies the transmitted messages, reducing them to 20 ms compared to the standard 72 ms message. This means that during the 15-second transmission, either the 72-ms or the 20-ms message is repeatedly sent. That's how a meteor ping can be translated into a decode—just one message received in those few milliseconds, and you've started the QSO.

The setting is displayed below with the Sh checkbox; the blue highlighted messages are the only ones sent using the 20 ms coding. This mode is often referred to as CMSH, which stands for Contest Mode Short Hand. SH is typically used on 2 meters and above. It is not standard practice to use it on 6 meters.

The screenshot shows the WSJT-X software interface. The top window title is "WSJT-X - IC-9100 v2.8.0 improved PLUS edition". The interface is divided into several sections:

- Band Activity:** A table with columns for UTC, dB, T, Freq, and Message.
- Tx Messages:** A table with columns for UTC, dB, T, Freq, and Message. The messages listed are:
  - WB0JPN K5ND EM12 (Tx 1)
  - WB0JPN K5ND EM12 (Tx 2)
  - WB0JPN K5ND R EM12 (Tx 3)
  - <WB0JPN K5ND> RRR (Tx 4) - highlighted in blue
  - <WB0JPN K5ND> 73 (Tx 5) - highlighted in blue
  - CQ CSMH K5ND EM12 (Tx 6)
- Control Panel:** Includes buttons for BP, Log QSO, Stop, Monitor, Erase, Decode, Enable Tx, Halt Tx, Tune, and Menus. It also shows the current frequency (144.150 000) and various settings like F Tol, Rx, Report, and T/R.
- Message Queue:** A list of messages to be transmitted, with a red box highlighting the "Sh" checkbox and the "CQ CSMH K5ND EM12" message.

## WSJT-X Operations: MSK144

Below is a sample QSO on 2 meters. I'm responding to a CQ. It took a long ten minutes to see the response, followed by a relatively quick completion with the SH messages shown in brackets.

The screenshot displays the WSJT-X software interface, divided into several sections:

- Band Activity Log:**

UTC	dB	T Freq	Message
173130	-1	8.9 1454	CQ CSMH KO9A EN52
173130	0	9.6 1454	CQ CSMH KO9A EN52
173615	-6	8.8 1487	KO9A AASAM EM13
173615	-5	8.8 1486	KO9A AASAM EM13
173615	-2	9.9 1487	KO9A AASAM EM13
174200	0	5.5 1493	CQ TEST W0VB DN74
174200	1	5.5 1495	CQ TEST W0VB DN74
174330	-2	3.4 1495	CQ TEST W0VB DN74
174330	0	3.9 1502	CQ TEST W0VB DN74
175400	-3	14.9 1501	K5ND W0VB DN74
175600	1	0.9 1508	<K5ND W0VB> RRR
- Tx Messages Log:**

UTC	dB	T Freq	Message
174330	0	3.9 1502	CQ TEST W0VB DN74
174449	Tx	1500	W0VB K5ND EM12
174515	Tx	1500	W0VB K5ND EM12
174545	Tx	1500	W0VB K5ND EM12
174615	Tx	1500	W0VB K5ND EM12
174645	Tx	1500	W0VB K5ND EM12
174715	Tx	1500	W0VB K5ND EM12
174745	Tx	1500	W0VB K5ND EM12
174815	Tx	1500	W0VB K5ND EM12
174845	Tx	1500	W0VB K5ND EM12
174915	Tx	1500	W0VB K5ND EM12
174945	Tx	1500	W0VB K5ND EM12
175015	Tx	1500	W0VB K5ND EM12
175045	Tx	1500	W0VB K5ND EM12
175115	Tx	1500	W0VB K5ND EM12
175145	Tx	1500	W0VB K5ND EM12
175215	Tx	1500	W0VB K5ND EM12
175245	Tx	1500	W0VB K5ND EM12
175315	Tx	1500	W0VB K5ND EM12
175345	Tx	1500	W0VB K5ND EM12
175400	-3	14.9 1501	K5ND W0VB DN74
175415	Tx	1500	W0VB K5ND R EM12
175445	Tx	1500	W0VB K5ND R EM12
175515	Tx	1500	W0VB K5ND R EM12
175545	Tx	1500	W0VB K5ND R EM12
175600	1	0.9 1508	<K5ND W0VB> RRR
175615	Tx	1500	<W0VB K5ND> 73
- Main Control Panel:**
  - Frequency: 144.150 000
  - Mode: MSK
  - Date/Time: 2022 Aug 13 17:59:25
  - Buttons: Log QSO, Stop, Monitor, Erase, Decode, Enable Tx, Halt Tx, Tune
  - Settings: Tx every 1st, F Tol 200, Rx 1500 Hz, Report 0, T/R 15 s, Tx CQ 250, Sh, Auto Seq, NA V-F, SWL
  - Generate Std Msgs: Tx 1-6 (Tx 6 selected)
  - Status: Receiving 8%, HF 9100 Rcvr, MSK144, Last Tx: <W0VB K5ND> 73

## Sample MSK144 QSY QSO

Another type of MSK144 operation that's available is a QSY QSO. With this approach, the station calls CQ on the calling frequency and listens on a different frequency, known as a QSY frequency. When they hear another station, the QSO is completed on the QSY frequency. This is typically only used during contests or other very active times. Here's an example.

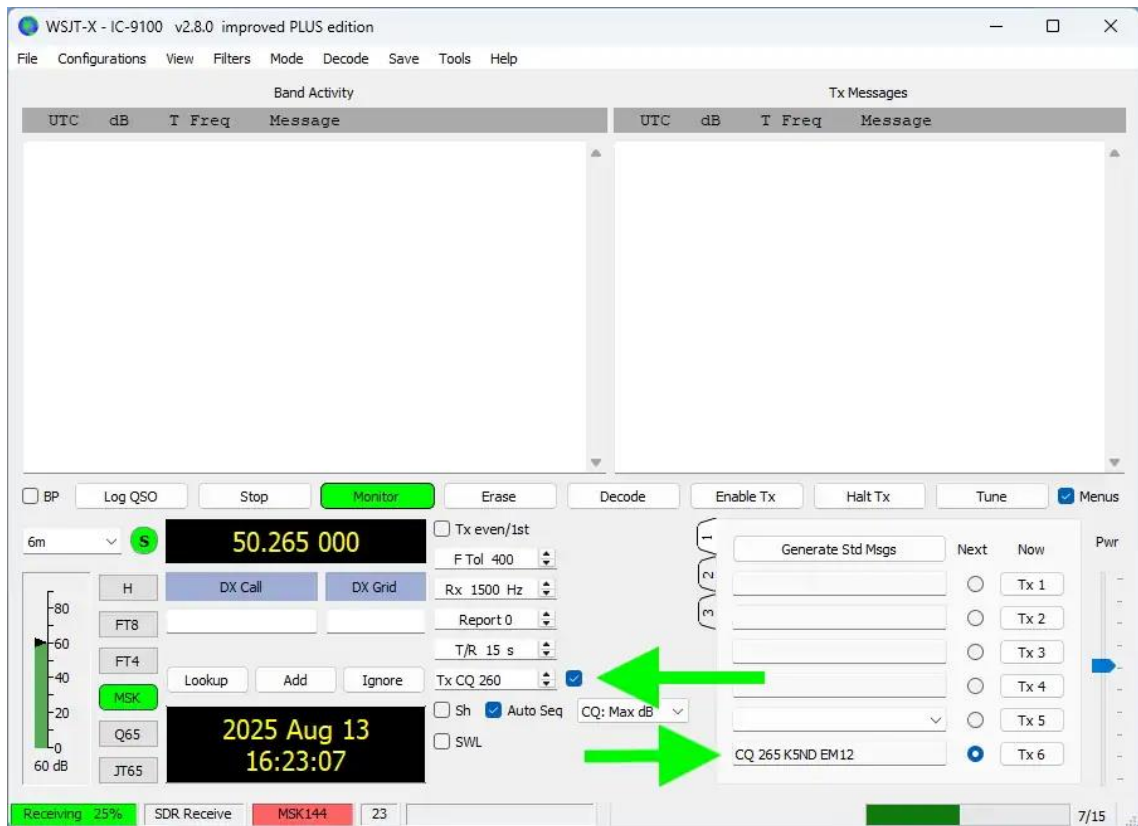
The screenshot displays the WSJT-X software interface. The 'Band Activity' window shows a list of stations and their messages. A call from KG5CCI on 50.260 MHz is highlighted in green, with a green arrow pointing to the 'Tx Messages' window. The 'Tx Messages' window shows a response from K5ND on 50.250 MHz with the message 'QSY 50.250'. The main interface shows the current frequency is 50.250 MHz and the call sign is MSK144.

Band Activity				Tx Messages			
UTC	dB	T Freq	Message	UTC	dB	T Freq	Message
103300	-1	8.9 1523	W5SUM NOLL/P RRR	103300	-2	8.2 1521	W5SUM NOLL/P RRR
103300	0	12.3 1521	W5SUM NOLL/P RRR	103315	Tx	1500	NOLL/P K5ND EM12
103300	0	12.3 1520	W5SUM NOLL/P RRR	103345	Tx	1500	NOLL/P K5ND EM12
103330	2	0.8 1525	W5SUM NOLL/P RRR	103400	4	0.7 1525	K5ND NOLL/P +00
103330	4	0.9 1523	W5SUM NOLL/P RRR	103415	Tx	1500	NOLL/P K5ND R EM12
103330	5	8.5 1524	W5SUM NOLL/P RRR	103430	-4	5.5 1525	K5ND NOLL/P RRR
103330	6	9.3 1486	CQ 250 KG5CCI EM07 U.S.A.	103430	2	14.2 1515	K5ND NOLL/P RRR
103330	6	9.3 1486	CQ 250 KG5CCI EM07 U.S.A.	103445	Tx	1500	NOLL/P K5ND 73
103400	4	0.7 1525	K5ND NOLL/P +00	103515	Tx	1500	NOLL/P K5ND 73
103430	-4	5.5 1525	K5ND NOLL/P RRR	103835			QSY 50.250
103430	2	14.2 1515	K5ND NOLL/P RRR	103500	0	2.5 1493	CQ 250 KG5CCI EM07 U.S.A.
103500	0	2.5 1493	CQ 250 KG5CCI EM07 U.S.A.	103900	1	8.5 1494	W5SN KG5CCI 73
103545	14	1.3 1488	NOLL/P WASTKU R+06	103916	Tx	1500	KG5CCI K5ND EM12
103600	14	0.5 1487	NOLL/P WASTKU R+06	103945	Tx	1500	KG5CCI K5ND EM12
103615	13	1.4 1487	NOLL/P WASTKU 73	104000	2	10.2 1475	K5ND KG5CCI -03
103630	13	0.4 1489	NOLL/P WASTKU 73	104015	Tx	1500	KG5CCI K5ND R EM12
103715	12	1.2 1487	NOLL/P WASTKU 73	104030	0	6.4 1492	K5ND KG5CCI -03
				104030	1	6.4 1493	K5ND KG5CCI -03

You can see that KG5CCI was calling CQ 250 while transmitting on 50.260, the six-meter meteor scatter calling frequency. When I clicked on his CQ, my transmission moved to 50.250 MHz. This was indicated by the QSY message in pink, followed by the rest of the QSO, which was completed on 50.250.

## WSJT-X Operations: MSK144

Here's how the transmit side works.



The top arrow above shows the checkbox for setting up a QSY CQ. You enter the QSY transmit frequency in the box near the checkbox. Once you hit "enable TX" you'll transmit on the Tx CQ setting 260. Your messages will be CQ 265 in this case, since WSJT-X is set to 50.265. Your receiver will monitor 50.265. When someone responds, you select them, and the rest of the QSO happens on 50.265. Try it out during those very busy days or during a contest. Note that the settings in the "radio" tab of WSJT-X for "split operation" need to be "rig" or "fake it" for this option to work.

## Meteor Scatter Operating Protocol

That's the process for setting up WSJT-X for meteor scatter. But there's more! Yes, there is a meteor scatter operating protocol that began long before WSJT was introduced and has since been expanded.

- **Operating Frequencies:** 50.260 and 50.265 as well as 144.150 MHz.
- **Operating Times:** Early Mornings are the Best.
- **Transmission Sequence:** Pointing East, Transmit First Sequence. Pointing West, Transmit Second Sequence. Another way to think of it is that the easternmost station uses odd; westernmost even.
- **Contest Mode:** Often used on 6 meters, CM+SH is used on 2 meters.
- **Coordinate Contacts:** [Ping Jockey](#), VHF-Chat-Slack, [ON4KST](#). Random contacts are rare.

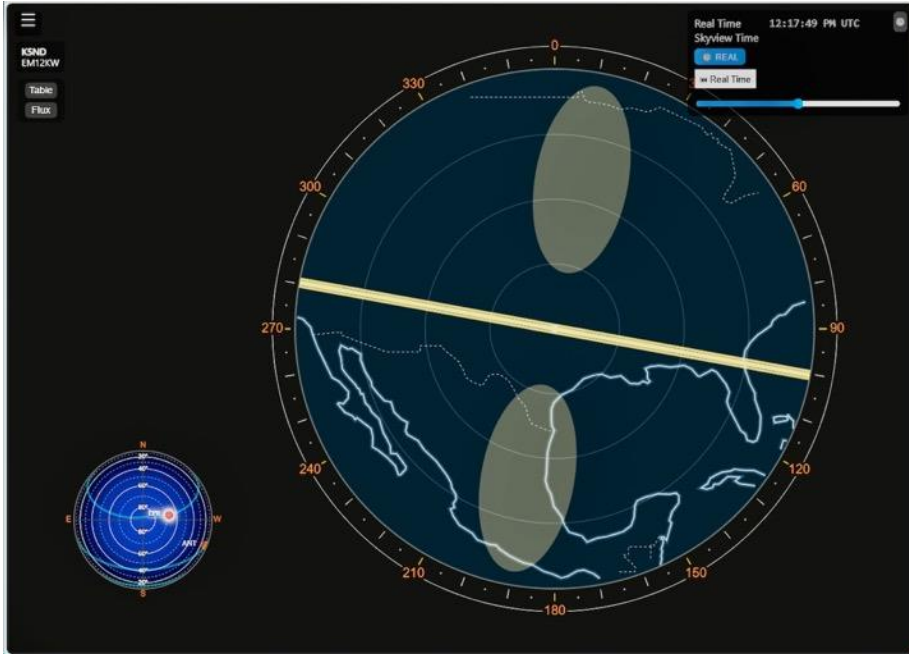
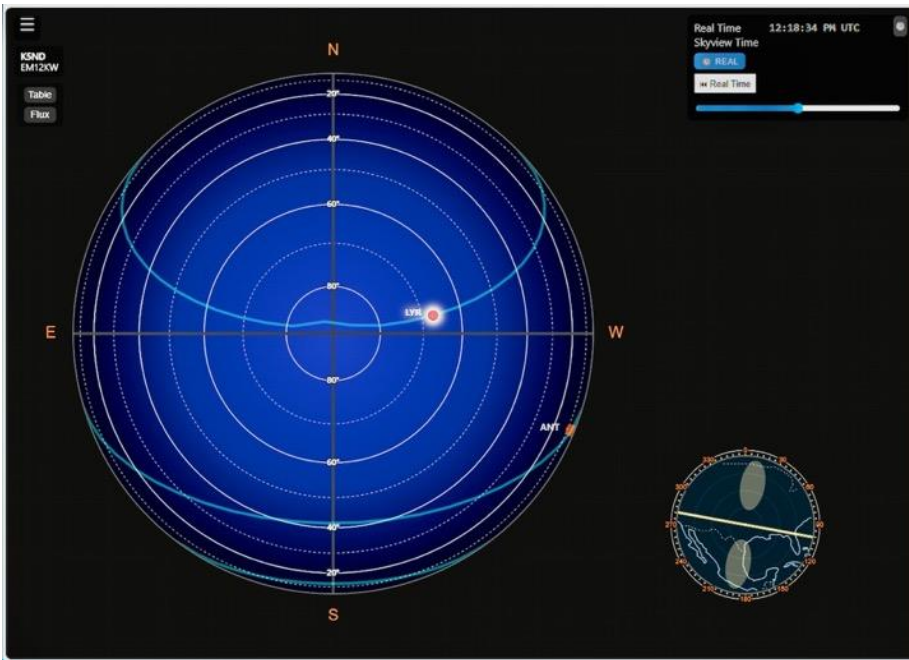
## Useful Meteor Scatter Tools

When you're transmitting CQs and not hearing anything at all, [PSK Reporter](#) can be very helpful. Simply enter your call sign, select the band, and it will show the stations receiving your signal. You can also find valuable information about your signal level and frequency. It is not limited to MSK144, as all digital signals can be decoded and displayed. Give it a try if you haven't used it already.

Another helpful meteor scatter tool is the Swan app at <https://swan.ms/>. Sabine, DL1DBC, created this app to support meteor scatter contacts. It uses your location and data from the International Meteor Organization to provide real-time information on meteor shower radiants, helping you determine the best direction to point your antenna.

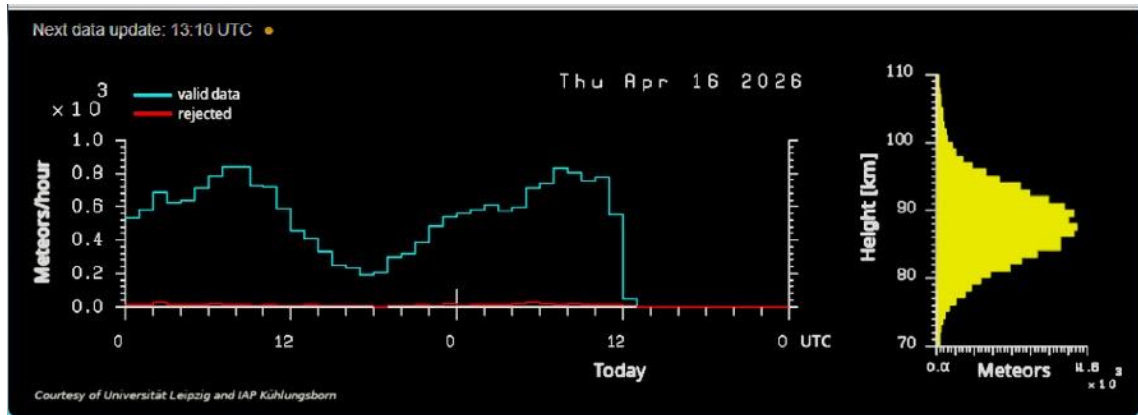
You can see the displays below.

# WSJT-X Operations: MSK144



## WSJT-X Operations: MSK144

The top display is a sky map showing the meteor shower. The bottom display is an Earth map centered on your location, highlighting the best zones for meteor scatter QSOs based on the current shower pattern.



Here's another display showing the measured meteors per hour along with their height. The data for this display is provided by the Collm Meteor Radar in Germany at a frequency of 36.2 MHz. So, for North America and amateur radio frequencies, it's not precise, but it does provide an excellent representation of current meteor shower behavior.

The Help tab provides plenty of information about using the app. Here's my favorite quote:

- **Please note:** *Swan is not JPL Horizons and this is not rocket science. The meteor trail and the two corridors ("searchlights") are intended as practical guidance for planning forward scatter QSOs, not as exact physical models.*
- *The antenna does not have to be aligned exactly perpendicular to the meteor trail. In practice, the radiant's elevation often has a stronger influence on detection probability than the precise geometric angle. Point the antenna toward your intended target area and optimize empirically.*

It clearly states that we're working with "scatter," with no precise pointing.

## Meteor Scatter Gear

You've probably realized that a dipole and 5-watt rig won't work with this mode. Instead, you'll need a directional antenna and at least 100 watts on 6 meters, and more on 2 meters. High power can be beneficial, and a preamp is usually required on 2 meters.

Interestingly, you can have too much antenna directivity for meteor scatter. K1JT recommends a 16-degree beamwidth for long paths and a 32-degree beamwidth for shorter ones. You can find more information at

[https://wsjt.sourceforge.io/AntBk22\\_Meteor\\_Scatter.pdf](https://wsjt.sourceforge.io/AntBk22_Meteor_Scatter.pdf)

There are also offset azimuth settings to capture the meteor path accurately.

For example, the WSJT window below displays a direct "Az" of 24 degrees, compared with a "B" offset heading of 13 degrees when pointing from my grid, EM12, to the station's grid, EN42. It also shows a recommended elevation. At times, there can be an "A" offset heading for your station. The other station will always have the opposite offset. I've seen a table listing the offset, with shorter distances between stations having the greatest offset.

Here's a further bit of information regarding the A and B headings.

*Where should you point your antenna to optimize the probability of usable meteor scatter reflections with a station at a distance of, say, 1000 miles? For random (as opposed to shower) meteors, the optimum direction is offset from the great circle path by 10 to 15 degrees -- to higher or lower azimuth, depending on time of day. In effect this creates "hot spots" A and B on either side of the direct path, slightly elevated above the horizon. -- 73, Joe, K1JT*

Bottom line, the offset toward a specific station/location can vary based on the time of day. At one time it can be an A offset and later it can be a B offset heading.



## Logging Meteor Scatter QSOs on Logbook of the World

I've noticed several questions regarding logging meteor scatter contacts in various online forums. The main issue is that QSOs can take a considerable amount of time to complete. Here are my insights on what works and why.

Logbook of the World requires "both QSO descriptions specify start times within 30 minutes of each other." Here's the link <https://lotw.arrl.org/lotw-help/frequently-asked-questions/?lang=en#datamatch>

That further means that LoTW only records the QSO start time for their records. The next issue is what your logging program submits to LoTW.

I use N3FJP's AC Log. Since WSJT-X sends the QSO record to N3FJP upon completion, it captures both the start and stop times within less than a minute of each other. Essentially, it only records the actual stop time. Generally, that's acceptable since the QSO likely lasts under 30 minutes. When it exceeds 30 minutes, operators will often coordinate the time they log the QSO, usually focusing on the stop time.

If you're using logging software that accurately tracks both start and stop times, it's wise to ensure your start time falls within the 30-minute window. If it's not, adjust your start time accordingly.

## WSJT-X Operations: MSK144

When you find yourself without a match in LoTW, contact the other operator to determine when they logged the QSO and resubmit your updated QSO information. I hope that helps.

**MSK144 Update January 2024.** The FCC has updated amateur radio regulations to permit 2.8 kHz bandwidth digital modes on the bands below 30 MHz. This allows MSK144 and Q65A to be operated on 10 meters and lower. I notice that the current MSK144 calling frequency is 28.145 MHz.

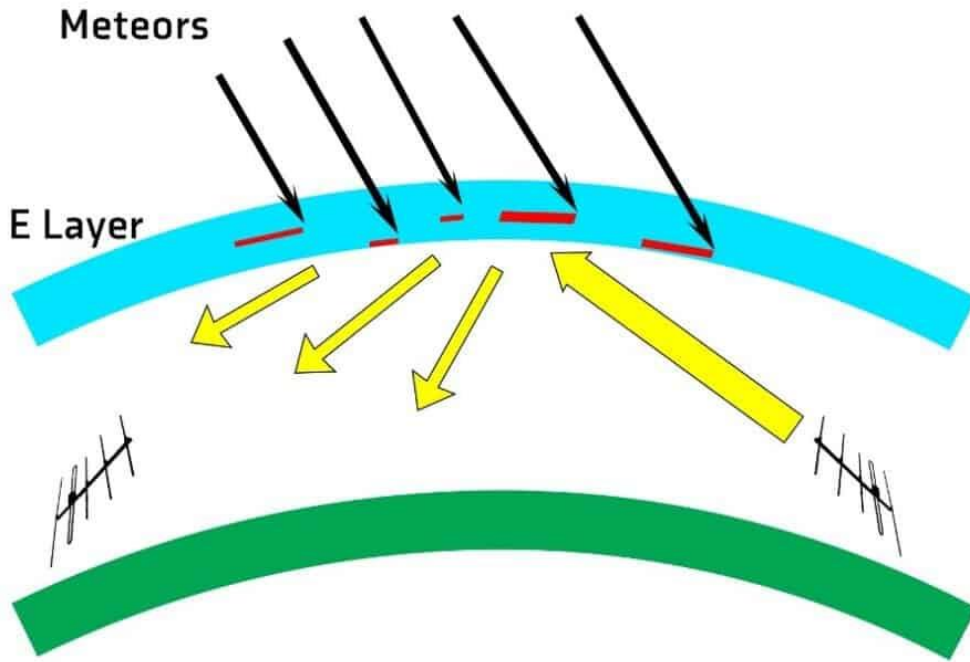
### How Meteor Scatter Works

At this point, I hope you've already tried and logged a few meteor scatter QSOs. Now, you're probably wondering how this whole process works. Hopefully, with that enhanced understanding, you can refine your operating techniques and timing to work even more meteor scatter QSOs at greater distances.

There are tons of meteors entering the Earth's atmosphere every single day. Meteors are dust trails left by comets and are tiny, no larger than a grain of sand. Upon entry, those grains of sand burn up and consequently ionize the E-Layer.

### Meteor Scatter Diagram

You can get some idea of the process in the image below. The red lines represent ionization, with some meteors being more effective than others, either due to their size, entry speed, or perhaps both. The yellow lines indicate the transmitted signal, with some reflecting off the ionized meteor trails. Hopefully, it reflects enough RF toward the desired receiving location for a decode or two.



For those interested in statistics, it's estimated that approximately 100,000 meteors enter the atmosphere each day. About half of these are large enough and travel fast enough to create ionized trails. The peak meteor rate occurs between midnight and sunrise, with the lowest rate happening in the late afternoon and evening.

In a further dive into the numbers, NASA estimates that 48.5 tons of meteorites enter the Earth's atmosphere every day. If we map that out over the Earth's surface area, 197 million square miles, that's roughly 0.008 ounces of meteorites per square mile. It's a wonder that it works at all.

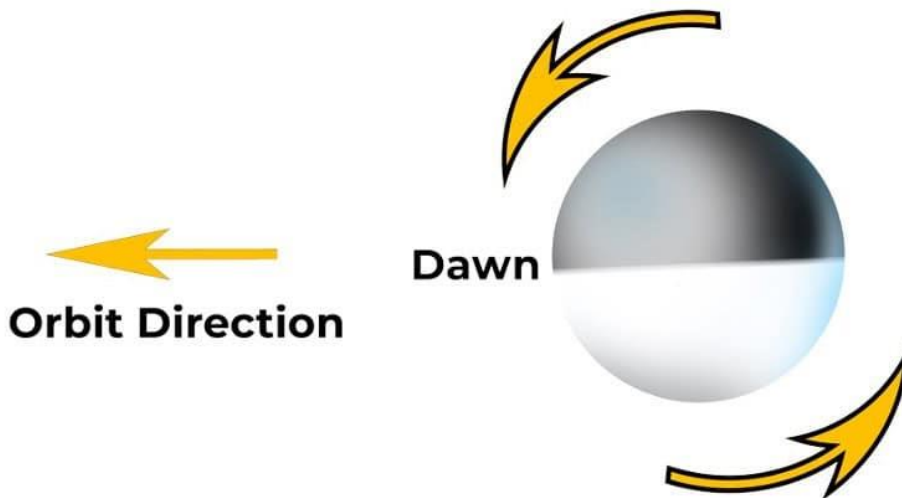
## Optimal Times for Meteor Scatter QSOs

Based on this, the optimal time for meteor scatter propagation is early morning. There is roughly three times more propagation at 6 AM than at 6 PM local time. The reason for this can be observed in the image below. This happens because the Earth's orbit around the sun drives it into the meteor stream, with the Earth's rotation aiding that

velocity near dawn, rather than reducing it later in the day when meteors are essentially chasing the Earth.

The relevant statistics indicate that meteors entering the Earth's rotation and orbit in the morning can travel at speeds of up to 72 kilometers per second. Those entering in the same direction as the Earth's movement can only achieve speeds of up to 12.5 kilometers per second. The higher the meteor's velocity, the greater the ionization will be. Some might think that the Doppler effect would be applicable. However, radio signals bounce off the relatively stable ionized trails, rather than the meteors themselves, minimizing the Doppler effect.

### **View From above the North Pole**



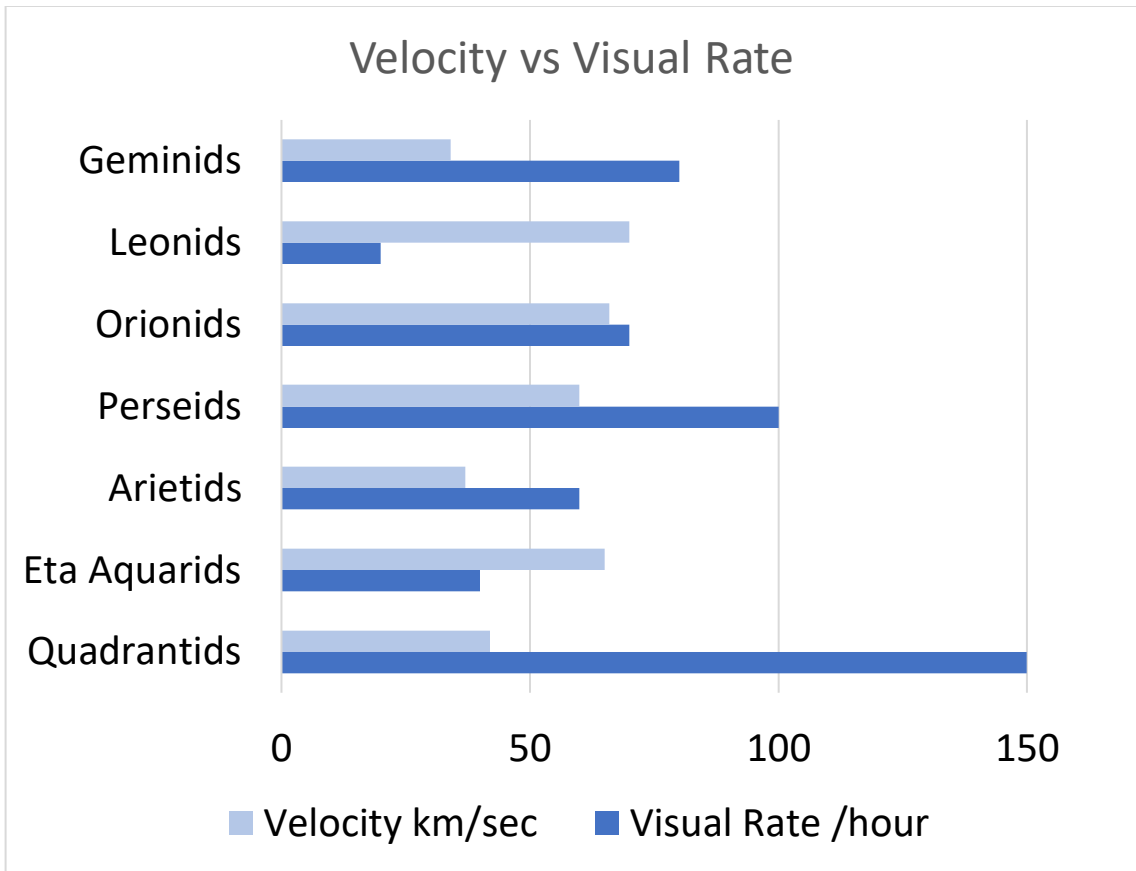
The height of the ionized trails also plays a role. The data I've seen suggests an altitude of 80 to 120 kilometers (50 to 75 miles). This, in turn, affects the maximum distance that can be achieved, which is generally accepted to be 1,400 to 1,500 miles.

## Annual Meteor Showers

All of this happens every day. However, there is a bonus during meteor showers. These predictable comet trails feature a high concentration of meteors and occur annually at specific times of the year. Below is the list of major showers.

Major Showers	Date Range	Peak Date	Time Max
<b>Quadrantids</b>	January 1 to 6	January 3-4	14 hours
<b>Eta Aquarids</b>	April 21 to May 12	May 4-5	3 days
<b>Arietids</b>	May 29 to June 19	June 7	?
<b>Perseids</b>	July 23 to August 20	August 12	4 to 6 days
<b>Orionids</b>	October 2 to November 7	October 20	2 days
<b>Leonids</b>	November 14 to 20	November 17	4 days
<b>Geminids</b>	December 4 to 16	December 13	2.6 days

All of these major meteor showers have an ionization height of about 100 kilometers, except for the Leonids, which have a height of 150 kilometers. Although its visual rate per hour is the lowest on this chart, it offers better prospects for longer-range QSOs due to its altitude.



## Meteor Scatter Seasons

In addition to the annual showers, there is a seasonal rate for random meteors. The lowest frequency of meteors occurs from February to April, increasing in May, peaking from June to August, and gradually declining into January.

You may also hear about a “fireball season” that runs during the vernal (spring) equinox, which happens in March. With this, astronomers speculate that Earth passes through areas with a higher density of larger interplanetary debris during this time of year. The source is said to be sporadic meteors from the anthelion source, which is

located opposite the sun. In early spring, this source reaches a high position in the sky during the night, leading to a higher rate of visible fireballs. In addition, the meteoroids from this source tend to be slower relative to Earth, which can make them last longer and appear brighter, often creating a better visual show. One would think that slower meteorites would generate less E-layer ionization. Something to consider as you're working with meteor scatter.

## Pointing Your Antenna for Optimum Propagation

I mentioned earlier the recommendations from WJST-X regarding the A or B heading versus the direct heading. These headings create a slight offset that allows for optimal meteor pickup between two stations. Of course, if you're using a relatively wide beamwidth antenna, it may not make much difference whether you're pointing directly or towards the A or B azimuth. As mentioned above, one station will have an A offset while the other station will have the B offset. Plus, the lower the distance between the stations, the greater the offset.

Another antenna pointing phenomenon is that its optimal meteor scatter direction is 90 degrees to the path of the meteor shower. We touched on this earlier when discussing the Virgo app, which can display either the shower path or the best antenna direction. Of course, the station you're communicating with needs to be along that path; otherwise, it doesn't really matter. Additionally, there are enough random meteors around that most directions should work. It's just that the shower path can indicate the best direction for meteor scatter QSOs.

## Meteor Scatter Summary

I've thoroughly researched the information on meteor scatter available online and condensed the specific WSJT MSK144 settings and operating protocol. Additionally, I've provided further background on what is causing these pings to arrive at your receiver. I hope all of this helps you get on the air with this exciting mode.

Good luck.

## Meteor Scatter References

Here are a few of the references I consulted in compiling this article.

WSJT-X Operating Manual [https://wsjt.sourceforge.io/wsjt-x-doc/wsjt-x-main-3.0.0.html#\\_msk144](https://wsjt.sourceforge.io/wsjt-x-doc/wsjt-x-main-3.0.0.html#_msk144)

VHF Meteor Scatter—An Astronomical Perspective  
By Michael Owen, W9IP/2, QST June 1986

Working DX on a Dead 50 MHz band using Meteor Scatter  
<http://www.uksmg.org/content/deadband.htm>

“Meteor scatter communication with very short pings,” by Mike Hasselbeck, WB2FKO, comparing FSK144 and MSK144 [http://www.sportsclique.com/wb2fko/pings\\_rev.pdf](http://www.sportsclique.com/wb2fko/pings_rev.pdf)

MSK144 vs FSK441 Meteor Scatter Modes. <https://k5nd.net/2020/10/msk144-vs-fsk441-meteor-scatter-modes-my-scattered-compilation-of-data-points/>

## Chapter 9 — WSJT-X Operations: Q65

I've been amazed by the Q65 mode in the WSJT-X software suite. It works over long distances when nothing else is happening. It's said to operate via ionospheric scatter for terrestrial contacts and is becoming the go-to mode for moon bounce. This chapter provides a brief introduction along with current operating recommendations. The goal is to help you make QSOs when nothing else is working.

### What is Q65?

Q65 uses a 65-tone frequency-shift keying modulation mode. It has a sync tone for both time and frequency synchronization. Q65 is particularly effective for tropospheric scatter, rain scatter, ionospheric scatter, TEP, and EME on VHF and higher bands, as well as other fast-fading signals.

Joe Taylor, K1JT, states: *"Q65 will enable stations with a modest Yagi and 100 W or more to work one another on 6 meters at distances up to ~2000 km on most days of the year, in dead band conditions. Ionospheric scatter is best near mid-day and in summer months but is present at all times."*

That's how it has worked for me. Moving to Q65 has made it happen from home or as a rover when nothing else is working. It, of course, helps to coordinate between the two stations, just as is done with meteor scatter contacts.

## How Does Q65 Work?

Q65 offers selectable transmit/receive sequences and sub-modes. On 6 meters, the standard is 30-A, meaning a 30-second t/r sequence and sub-mode A. On 2 meters, it's 60-C, meaning a 60-second t/r sequence and sub-mode C. The [K1JT Quick Start Guide to Q65](#) recommends the following t/r sequences and sub-modes.

- Trans-Equatorial Propagation (TEP) on 50 MHz: **15C, 30C**
- Ionospheric scatter on 50 MHz: **30A**
- QRP ionospheric scatter on 50 MHz: **120E**
- Ionospheric scatter on 144 MHz: **60C**
- Troposcatter and rain scatter at 10 GHz: **60D**
- Small-dish EME, 10 and 24 GHz: **120E**
- Other EME: 50, 144 MHz **60A**; 432 MHz **60B**; 1296 MHz: **60C**; 10 GHz: **60D**

The sub-modes provide different tone spacings. The available t/r sequences are 15, 30, 60, 120, and 300 seconds. Here's how those t/r sequences come into play with signal-to-noise ratios.

- 15 seconds, -22.2 dB SNR, with *a priori* (AP) decoding -23.7 dB SNR.
- 30 seconds, -24.8 dB SNR, with AP decoding -26.6 dB.
- 60 seconds, -27.6 dB SNR, with AP decoding -30.2 dB.
- 120 seconds, -30.8 dB SNR, with AP decoding -32.5 dB.
- 300 seconds, -33.8 dB SNR, with AP decoding -37.4 dB.

*A priori* or AP decodes messages using heuristics and available information, thereby increasing the SNR by several dB.

## WSJT-X Operations: Q65

A big part of the magic of Q65 is that it averages the signals received. It keeps track of the sequences received and pieces the information together to achieve a decode. You can see this as the QSO develops. Decodes are tagged with “q” followed by one or two numbers. The first number shows the type of AP information used. The second number indicates the total number of received sequences averaged to produce the decode. Here are some examples.

- **Q0** — This is a decode obtained without using any AP information.
- **Q1** — This usually means that AP has decoded the message as a CQ call, with the DX Call and Grid unknown to AP.
- **Q2** — This usually means that AP has used your call as AP knowledge but has assumed nothing about the DX Call or Grid.
- **Q3** — This usually means that AP has used AP knowledge of your Call and the DX Call in the decode. It then looks for a grid, a report, 73, etc.
- **Q32** — This means that a Q3 decode has been obtained after averaging 2 transmissions.

## Q65 Operation and WSJT-X Settings

Here are the settings I’ve compiled from various websites and found helpful for my Q65 operations on 6 and 2 meters. The full list of references appears at the end of this chapter.

The standard operating frequencies I’ve used are 50.275 MHz with Q65-30-A and 144.170 MHz with Q65-60C. However, many variations are currently in use. For example, 50.235 MHz is in use with Q65-15B.

## WSJT-X Operations: Q65

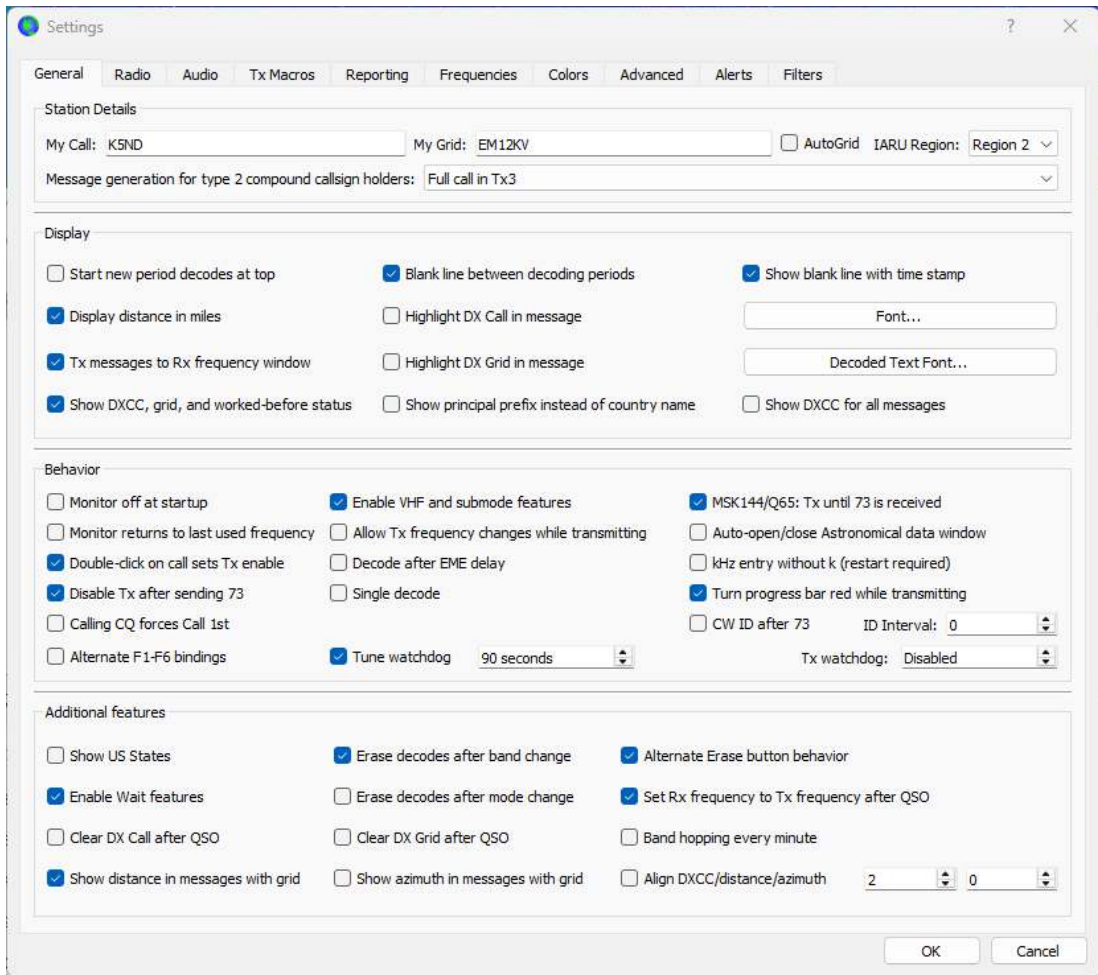


Figure 42 - WSJT-X Q65 General Settings

On the File/Settings screen shown above, remember to choose Enable VHF and submode features. Do NOT check Disable Tx after sending 73 since you may need to send it multiple times. It is also recommended that you do NOT check the Single Decode, although I've used it both ways for a successful Q65 contact.

## WSJT-X Operations: Q65

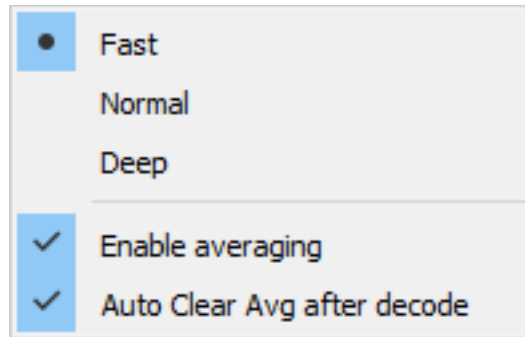


Figure 43 - Q65 Decode Settings

Under the Decode menu, select Fast, Enable Averaging, and Autoclear AVG after decoding.

Selecting "Q65\_Sync" on the Wide Graph will display an orange line with peaks that suggest potentially decodable Q65 signals in the most recently received sequence. When the accumulated average includes two or more reception intervals in the appropriate odd or even sequence, a red curve similarly shows potentially decodable signals.

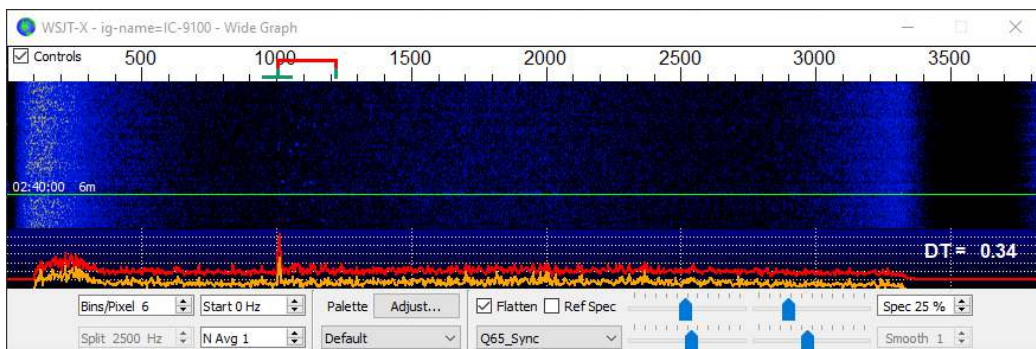


Figure 44 - Select Q65 Sync on the Fast Graph

Set F Tol to 20 Hz for the best decodes on a known audio frequency within the wide graph. In this image, the audio frequency is set to 1500 Hz. If you don't know the frequency, you can set the F Tol wider to capture whatever's there and decode it.

## WSJT-X Operations: Q65

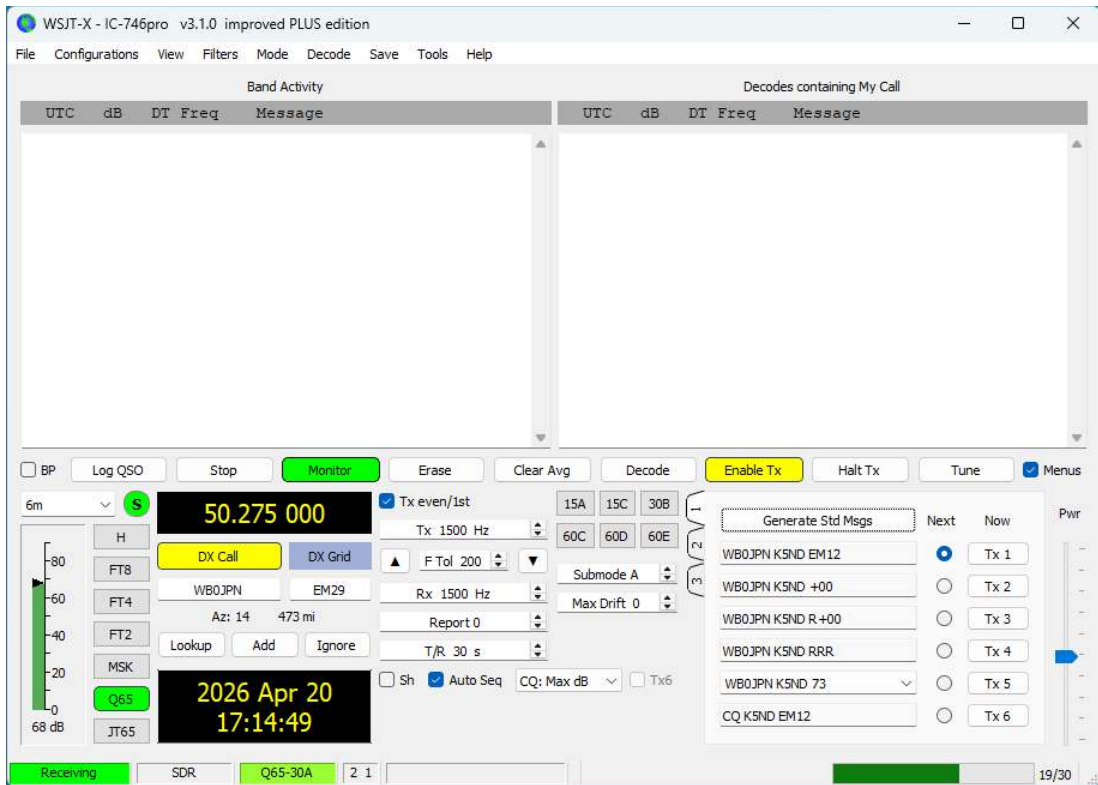


Figure 45 - Tolerance Settings

If you're working a schedule or a coordinated QSO, not only will you enter the expected audio offset frequency, but you'll also enter the DX call sign and grid before the QSO begins. This helps the AP with its decoding tasks. It knows exactly what it's seeking in the received signal and noise.

Select the T/R sequence. Here, it is set to 30 seconds. Select the sub-mode. Here, it is set to A. Leave the Max Drift at the default value of 0.

SH is not usually checked. This allows sending single tones during a coordinated QSO. It's mainly used at microwave frequencies.

Press the Generate Std Msgs bar to enter the messages to be transmitted. Check the Auto Sequence box. In a typical operation, you want to start with Tx1. However, in NA VHF contest mode, Tx1 starts calling with Tx2.

## WSJT-X Operations: Q65

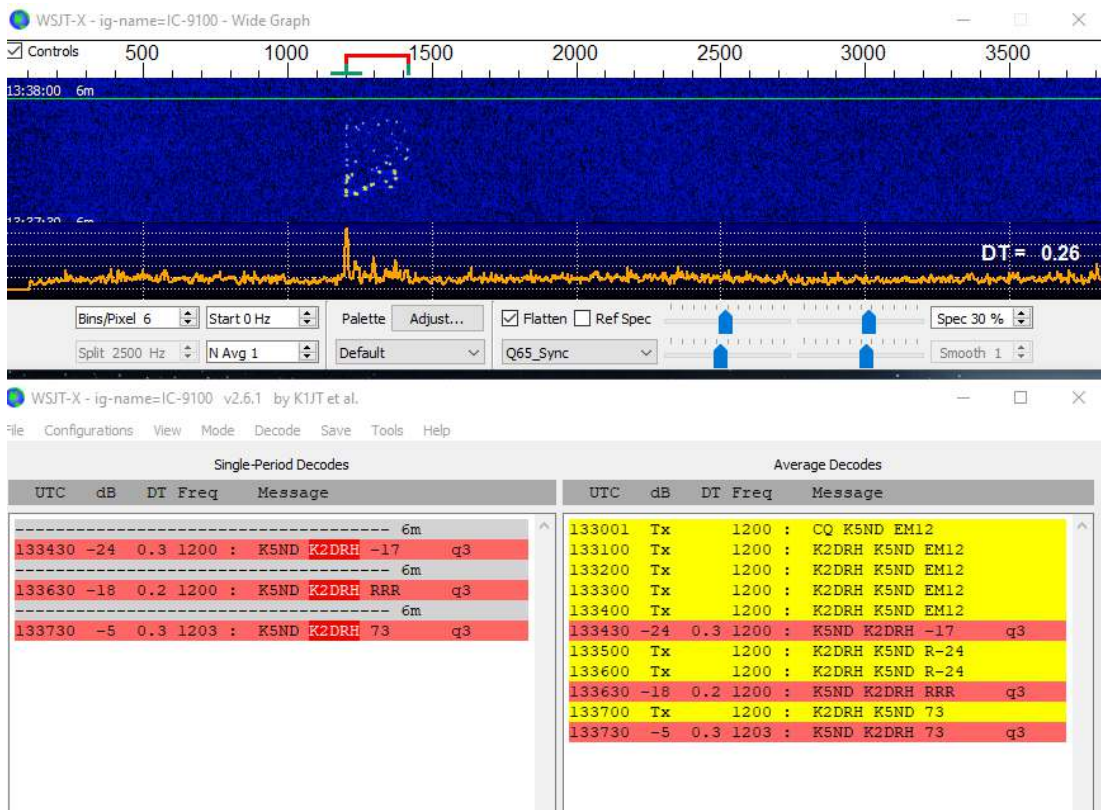


Figure 46 - Q65 QSO with Wide Graph Display

The setting here is 20 Hz F Tol, as shown by the green bar at the top of the wide graph. TX frequency is 1200 Hz. RX frequency is 1200 Hz. You can also see the orange curve showing the Q65 sync signal. Note the sprinkles in the wide graph. Each decode shows q3, indicating that the AP used both the DX Call and Your Call as entered, then looked for the signal report and messages.

## WSJT-X Operations: Q65

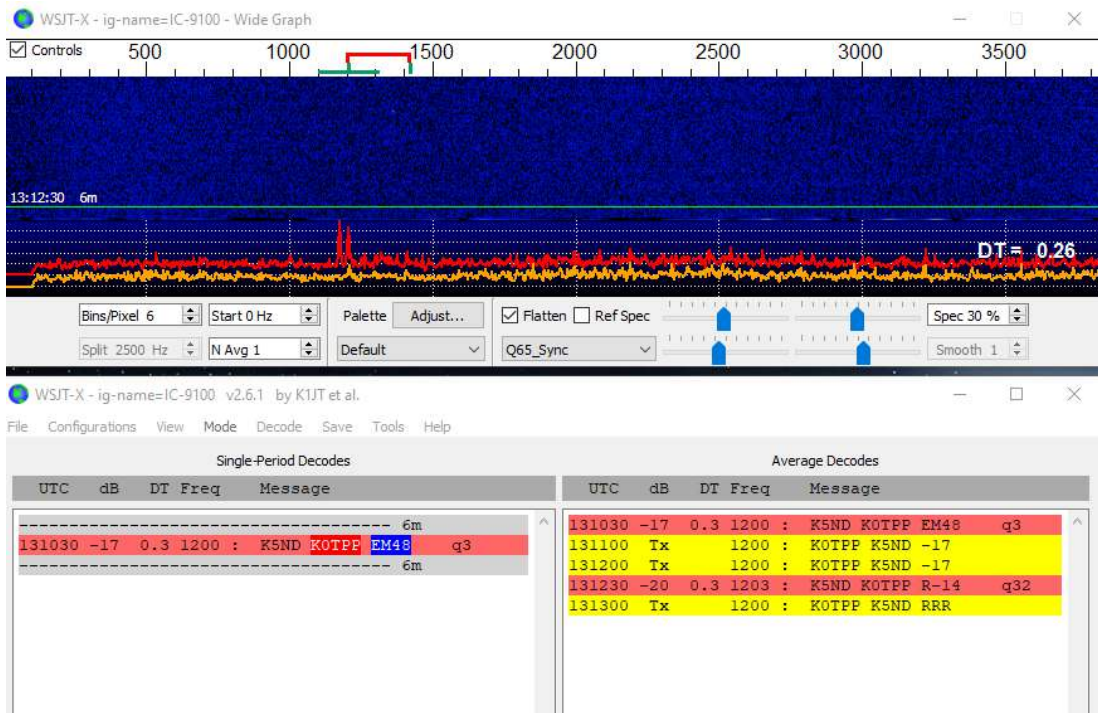


Figure 47 - Q65 QSO with q32 decode

This screenshot shows an initial q3 decode followed by a q32 decode. The last one required two averages to display the decode. I'm advised that the red line in the wide graph display represents the accumulated decodes over time, and the orange line represents the current decode. Let me know if I've got that wrong.

## Q65 Averaging versus Period Length

As with most things, there are tradeoffs in the Q65 settings. Longer t/r sequences increase sensitivity, as shown in the bullet list above. That should mean fewer decodes are required before averaging is needed to help with the full decode. But shorter t/r sequences and more averages may help the QSO complete faster—something to consider when working with someone under very tough conditions.

## WSJT-X Operations: Q65

I sincerely hope this has helped you get started with Q65. As always, your mileage may vary. Consult the references for additional background and details. Good luck and have fun.

### Q65 References:

[https://wsjt.sourceforge.io/Q65\\_Quick\\_Start.pdf](https://wsjt.sourceforge.io/Q65_Quick_Start.pdf)

<http://www.bigskyspaces.com/w7gj/Q65SETUP.pdf>

[http://www.bobatkins.com/radio/Q65-average%20or\\_longer\\_period.html](http://www.bobatkins.com/radio/Q65-average%20or_longer_period.html)

[http://www.bobatkins.com/radio/Q65\\_1296\\_setup.html](http://www.bobatkins.com/radio/Q65_1296_setup.html)

### Q65 Update January 2024

The FCC has updated amateur radio regulations to allow 2.8 kHz-bandwidth digital modes on bands below 30 MHz. This means MSK144 and Q65A can be used on 10 meters and lower. I'm seeing that the current Q65 mode A calling frequency is 28.140 MHz.

# Chapter 10 — Six Meter Award Chasing

I'm a paper chaser. I enjoy pursuing awards from HF to VHF. Many HF awards apply to 6 meters, and one in particular applies only to that band.

## VUCC

This is the VHF/UHF Century Club (VUCC) award. It requires working and confirming QSOs with stations in 100 grids. There are no mode endorsements (CW, Phone, etc.), but you can continue to add grids in 25-grid increments to earn additional stickers for your certificate.

VUCC operates on a band-by-band basis. There are awards for six meters, separate awards for higher VHF/UHF and microwave bands, and satellite QSOs.

In addition, ARRL publishes lists of stations, showing the number of confirmed official grids. As of this writing, the leader is K1TOL with an astounding 1802 grids!

## WAS

The Worked All States (WAS) award is offered on a band-by-band basis for all amateur radio bands, including six meters. The challenge in earning this award on six meters is working Hawaii and Alaska, along with a few small states that have few operators on the air.

## DXCC

The DX Century Club (DXCC) award is granted for confirming contact with 100 DX entities. It is awarded by band and mode, so a six-meter award is available. This, too, is a tough award to earn, particularly if you're in the center of the USA and have a hard time reaching Europe and Asia on six meters.

### CS-VHF States Above 50 MHz

The Central States VHF Society offers the States Above 50 MHz Award to stations that work 30 or more states on bands above 50 MHz each year. The year begins on June 1. This fun award encourages you to work stations every year.

### UK 6 Metre Group

This group offers several awards for six-meter operations focused on working continents, countries, and grids. It's an excellent place to look if you're into certificates. The organization also helps keep you up to date on what's happening on six meters around the world.

### The Fred Fish Memorial Award (FFMA)

The Fred Fish Memorial Award was established by the ARRL in 2008 to honor Fred Fish, W5FF, who worked and confirmed all 488 grid squares in the 48 contiguous United States on 6 meters. For more, read the QST announcement and ARRL's online FFMA information. Here's an important quote from that announcement:

*The FFMA is an “all-or-nothing” award. You must submit confirmation of 2-way contact with all 488 grid squares on 50 MHz to qualify. There are no endorsements and no recognized tiers of progression. Any mode may be used. The rules for the award will strictly follow the rules of the ARRL VUCC program.*

It's an extension of the ARRL VUCC award program, but one that is exceedingly difficult to earn. How tough is it, you might ask? Ten years after the award was introduced in 2018, only seven had earned FFMA. The class of 2019 saw two earn the award. The class of 2020 added four to the list. In 2021, a bumper crop of 12 earned the award. As of April 2026, the total is 62 all-time. For more information, see the appendix.

# Chapter 11 — Six Meters and VHF Contesting

I really like how Joel Harrison, W5ZN, describes VHF contesting:

*Magic Bands with Super Results from Average Stations*

VHF contesting is the niche that fits my current operating restrictions and offers a fun, competitive outlet, even for my small station. Plus, it gets a lot of stations on the air, often from grids you might need.

## Low Number of Entries and Multiple Categories

For example, while the CQ WW SSB Contest has 8,000 to 9,000 entries, the CQ WW VHF Contest typically has 500 entries. Plus, a few categories might match your station and operating preferences perfectly. These include six- and 2-meter single-band entries, hilltopper, QRP, and my favorite category – rover. It's held over two weekends in July, with one dedicated to digital operations and the other to analog operations.

The ARRL VHF contests are held in January, June, and September. While all offer six meters, the June contest is by far the best positioned for sporadic E openings. Entry categories include single-operator low and high power, portable for QRP entries, FM only, 3-band only (6 m, 2 m, and 70 cm), multi-operator, and rover. There are also analog-only entry categories for those interested only in SSB and CW operation.

### Wide Open Assistance Rules

The ARRL contests have very permissive assistance rules. This includes sharing information on chat rooms, social media, texting, phone calls, and APRS. You can also self-spot on DX clusters, including DX Maps. You cannot confirm QSOs or request repeats once a QSO is underway. The watering holes include PingJockey, VHF-Chat Slack, ON4KST Chat, etc.

### Adding Grids and Countries to Your Log

Contests are always the perfect way to add DX to your logbook. While VHF isn't the best for increasing your DXCC totals, it is a great way to add grids to your VUCC totals.

In addition to finding new grids for your pursuit of VUCC or FFMA, the fun part is that everyone starts with zero grids at the beginning of the contest. Plus, it gives you a great window into how your station is performing compared to others in your area and how you're doing against yourself with year-over-year improvements.

### Average Stations for VHF Contesting

Another thing about VHF contests is that they don't typically require a massive station with an antenna farm. Here's some general guidance.

- **50 MHz.** HF-6 meter rig at 100 watts with a 3-element Yagi at 30 feet.
- **144 MHz.** 50 watts or more with a Yagi at 50 feet.
- **222 and 432 MHz.** 50 watts or more with Yagis at 50 feet with more elements.
- **Preamps.** Helpful at 50 and 144 MHz, needed on higher bands.

My home setup has always been a push-up mast at about 25 feet. I've had reasonable results, so don't feel that a tower is essential.

### Best Contest Operating Practices

There are several best practices. Here's an opening list.

- **Pick the Category that Fits.** If you've got a 2-meter FM HT, choose FM only. You'll not only face less competition, but you might even win your section or division.
- **More Bands and Modes.** The more bands you operate on, the more QSOs you'll make. That means more points. The more modes you have, the more stations you'll be able to work.
- **Move Stations to Other Bands.** As you work a station, ask whether they have other bands. Then move there for another QSO and point. This is easy on SSB and CW but more challenging on the digital modes.
- **WSJT-X is a Must-Have.** While the analog-only entry categories are helpful, the broader contest community will use WSJT-X modes from FT8 to MSK144. You'll need to be there to work them.
- **Sunday Morning Tropo and Meteor Scatter.** VHF contests usually start Saturday afternoon and end Sunday evening. That means Sunday morning is the time to work tropo or meteor scatter contacts.
- **Butt-in-Chair.** It's a rule for all contests that you must be in the chair in front of your radio to work any contacts. The more time you're in the chair, the higher your contest score.

Contesting is a great way to have even more fun on 6 meters and the higher bands. Good luck!

### Online Score Reporting

While this may not be a best practice, it is a fun way to spice up the long time you're sitting in front of your rig. Online score reporting lets you track your progress and, as a result, keeps you in your chair searching for more contacts and multipliers.

I like the Contest Online Scoreboard at <https://contestonlinescore.com>, but others are available, including one operated by N3FJP using his logging software.

## Six Meters and VHF Contesting

Nearby is the online score display for my QSOs and multipliers in the June 2023 VHF Contest.

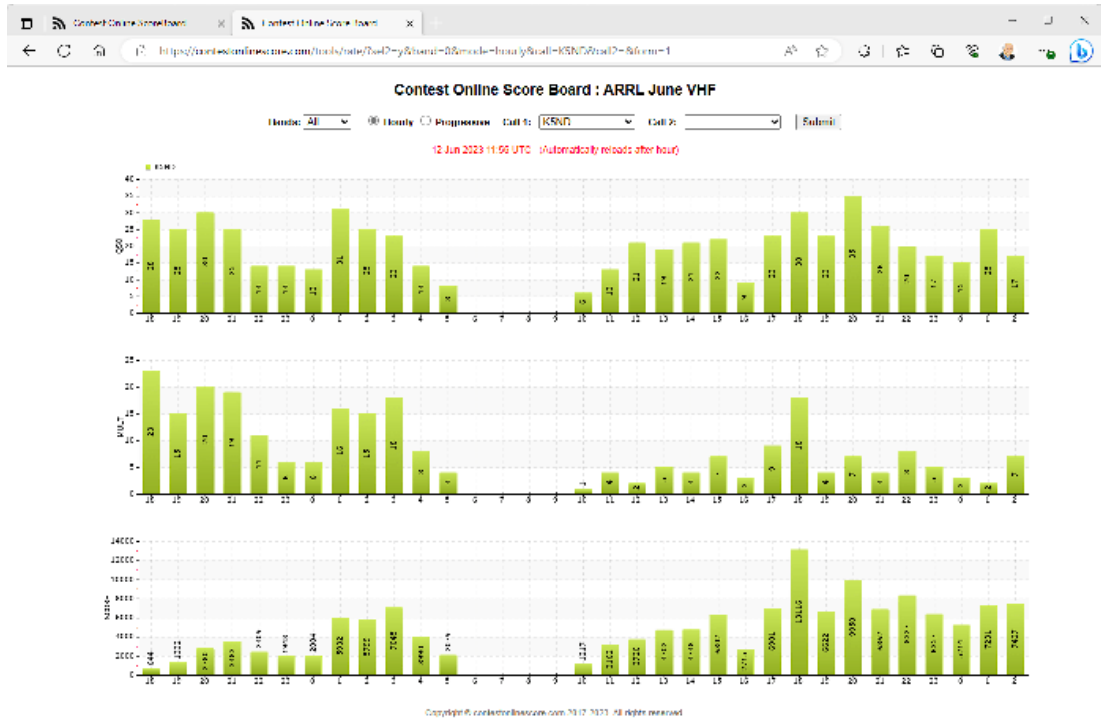


Figure 48 - Contest Online Scoreboard displays my activity level throughout the contest.

The standard display is a leaderboard sorted by contest entry category and by ranking within each category. It's updated about every minute, so you can see who's leading and by how much. That has proven very helpful in keeping me in the chair.

# Chapter 12 — VHF Rover Operations

In my VHF contesting journey, I first discovered the fun of working local stations and those not-so-local, particularly during 6-meter Sporadic E openings. But I also discovered lots of downtime, with no one to be heard at all. Then I started picking up a few rovers that would come into view, moving from one grid to the next and adding valuable QSOs and multipliers to my log. Finally, I determined that I should try my hand as a VHF contest rover.

I started my K5ND/R activations in 2017 and over the years added masts, antennas, bands, amps, DC power systems, etc. By 2022, at 72 years old, I decided to simplify things by operating from home at times and then using a portable setup, where I activated only one grid during the contest. You can find more details at <https://k5nd.net/k5nd-rover/> and at <https://k5nd.net/hilltopper-and-single-op-portable/>

In this chapter, I cover the highlights and insights I've learned and attempt to focus mostly on six meters.

## What is VHF Roving?

In the ARRL National Contest Journal, Greg, K5GJ, defines VHF roving as:

*The fine art of stuffing every piece of VHF and microwave gear you own into and onto your vehicle and then driving hundreds or thousands of miles, all the while contacting the same people over and over again.*

That pretty much sums it up. But it also turns your contest into something very, very active and really helps the scores of home stations.

### My Journey with VHF Roving

I started simple because that's my nature — in more ways than one. I grabbed my Icom IC-910H, a painter's pole, and Diamond Yagis for 2 m and 70 cm. A laptop for logging completed my station. That was the September 2017 VHF contest. At that time, there was little need for WSJT on those bands. It was all SSB and a bit of CW. I activated eight grids and learned a lot about operating and the stations I could work.



*Figure 49 - K5ND/R September 2017, my first rover contest entry*

I liked getting outdoors, finding the best locations (which I did before the contest on scouting trips), and working some new stations. I also liked that when I'd finished working everyone at one stop, I packed up and moved to the next grid. I didn't need to listen to white noise for any length of time.

## VHF Rover Operations

Of course, I needed to pursue making improvements. Here's how my station developed over the years.

- Phase 1 - Painter pole and IC-910H on 2 m and 70 m with simple Yagis.
- Phase 2 - Improved push-up mast, added 6 meters with an IC-9100, stand-up outside operating position, and Armstrong rotator.
- Phase 3 - Roof-top rotator. Added 222 MHz.

Nearby, you can see Phase 2 with three bands and the stand-up operating position. I liked that position because I could easily twist the mast to point the antennas at the station I was trying to work. But standing outside left me exposed to the weather. One contest, it was raining, and I had to use a tarpaulin to cover the position. Another time, it was 110 degrees, and I nearly cooked myself.

At Phase 3, the rooftop rotator system eliminated setup at each stop, and the operating location in the back seat of my SUV kept me out of the weather.

Adding 222 MHz to my rover setup helped me in the contest category I chose — Limited Rover. This category uses the lower four VHF/UHF bands at low power, which was perfect for my goal of keeping things simple.



*Figure 50 - K5ND/R June 2018 Contest*

## VHF Rover Operations



*Figure 51 - K5ND/R September 2020 Contest with roof-top rotator.*

### My Rover Goals

You undoubtedly get the gist of my goals from the journey described above. My most fundamental goal is to keep things simple. However, I sometimes run right past this goal in my enthusiasm for one technical marvel or another. That goal also helps maintain a reasonable budget, allowing investment to develop the station over time.

Summed up: develop your station to fit your interests, skills, and budget. All that is measured by how it optimizes your contest results while at the same time determining how the effort maximizes your fun.

What I like about VHF roving is that it lets me set up a top-level station on the road in the best locations, rather than a suboptimal home station that yields limited results.

## VHF Rover Operations

And it certainly doesn't require the same investment as setting up towers with stacked Yagis, power amplifiers, etc., for a top VHF contest station.

While offering that general investment difference, I'll note that many rovers invest a great deal in their stations and operations. Plus, all rovers have a gasoline bill at the end of a contest weekend.

I must add that I greatly appreciate the big VHF contest stations. Those are the ones I rely on from one grid to the next to be there for QSOs and points. Thank you.

### Main Rover Strategies

There are three main strategies for VHF roving:

- **Stop-n-Plop** — Drive to a location to set up your mast and station. It is good in hilly terrain, and when you can make the setup time pay off with many nearby operators.
- **Run-n-Gun** — Omnidirectional antennas covering lots of grids while in motion. Best for flat terrain. It can include small directional antennas on a rotator.
- **Shoot-n-Scoot** — Fixed directional antennas mounted on the vehicle roof. It is sturdy but requires moving the car to point the antennas. It can also be combined with omnidirectional antennas for operation while in motion.

Running through those options, you can see from my journey that I've moved from Stop-n-Plop to what I call Stop-n-Shoot. I stop, get in the back seat, and point the antennas for QSOs. This approach eliminates the setup time and opens up a few more options for location or even quick stops to meet new contacts.

While this approach is related to Scoot-n-Shoot, I don't like the fixed antennas. They offer the advantage of a solid mounting to the vehicle, although my rooftop mount isn't likely to fly off the car at speed. The fixed antennas work well when you have a location with lots of VHF stations to point at once you've stopped. Our few stations in North Texas are generally located around the compass at most of my stops.

I've yet to move to omnidirectional antennas because I don't presently plan to operate while in motion. But that is an excellent option for generating QSOs while moving from

## VHF Rover Operations

one grid to the next. It's also a winning option. It's a must-have for the two-person rover team.

There is at least one more approach. I call it Tow-Stop-Crank-n-Shoot. Wayne Overbeek, N6NB, has implemented this on a grand scale using a trailer equipped with a generator and a sizeable crank-up tower. I recommend his website, [n6nb.com](http://n6nb.com), for those interested in exploring different approaches to setting up a VHF rover.

### Insight into Power Systems

My first rover power systems used a sealed lead-acid battery and my IC-910H. I started by making satellite contacts. That worked for those short contacts, but a VHF rover operation requires power for a much longer period.

My approach was to connect the car's power system in parallel with my battery. I also used a small DC-to-AC power inverter to charge my laptop and cell phone. That worked for my first few rover operations, with each grid operation lasting an hour or two, recharging the battery between operations and at night. I'll note that I continue to use the power inverter to power my laptop, cell phone, and antenna rotator.

As I contemplated routing large-gauge cables from the battery to the back of the car, I realized the car audio guys do this all the time. I found a suitable vendor, made my simple request, and they got everything set up. Using their cable, I added a RigRunner 8012 to handle up to 80 amps and distribute it to all my devices. The PowerPole connectors work great.

For the really high-power stuff, I've also used a portable suitcase-sized generator. When I activated DM85/DM86 for an FFMA chaser, I brought a 375 watt 6 meter amplifier and the generator to power everything. I had a 60 amp 12 VDC power supply plugged into the generator. It worked great and the conditions were perfect to put the chaser in the log and quite a few others.

I recommend Alan Applegate, K0BG, and his website, [k0bg.com](http://k0bg.com), for higher-power efforts. He covers all aspects of mobile amateur radio operations, including upgrading car batteries and alternators, as well as several other topics.

## VHF Rover Operations

Greg, K5GJ, addressed safety concerns about all this power running around your car in his National Contest Journal article. My wake-up call came during a contest on a late Saturday night, when I arrived home to rest before heading out early the next morning for the next grid. I pulled my portable battery out of the car to charge it overnight. While doing that in the dark back seat, my makeshift battery cable shorted the terminals. Sparks, noise, and fire soon followed. First lesson: be careful, as this is powerful stuff. Second lesson: bring a fire extinguisher with you on the road.

### Insight into Antenna Systems

I mentioned above using fixed-mount antennas mounted above the roof of your car. This uses a PVC framework that holds the antennas. It has the advantage of providing plenty of room for many antennas. The disadvantage is that you must move your car to point the antennas in the needed direction.

I've used pushup masts and Armstrong rotators in many of my setups. I like this approach's height and the ability to quickly point the antennas in the right direction, even faster than rotators. The disadvantage is the time needed for setup and teardown at each stop. That not only consumes time but also your energy.

The decision to move on to another approach came when the mast fell over as I was setting up at my last grid for a contest. There was no personal injury, other than pride, but it bent the antennas and made it clear I needed to try something different. Of course, it would work much better in a two-person operation or with a trailer-hitch mount.

With the rooftop rotator system, the platform is built from 2×4 rails, cross members, and a plywood deck. The rotator cage mimics a three-legged tower structure using Steel-Tek pipes and flanges. On top of that is a DX Engineering DXE-AS455G tower shelf and a DXE-TB-300 thrust bearing. The mast uses a six-foot, 2"-diameter aluminum tube.

## VHF Rover Operations

It uses straps to secure the whole thing to the roof rack. I've tested it at speeds of 75 to 80 mph with the antennas. Of course, wind gusts from passing trucks will increase that force. All in all, it's pretty sturdy. For example, I can grab the structure and haul myself up onto the deck to work on the antennas.

For cables, I use LMR-400. Short cables in a rover minimize losses. Even so, I also use preamps for 2 m and 70 cm. I don't bother mounting them at the antennas. The cables are routed through the window, with an insulating tube over the cranked-up window edge to keep out wind and rain. Routing them to the antennas uses cable ties up the rotator cage and mast, including a rotator loop.



*Figure 52 - Rooftop mounting system*

My antennas are Directive Systems rover Yagis with 8-foot booms for 2 m (6 elements), 1.25 m (10 elements), and 70 cm (15 elements). I use a Par Electronics Stressed Moxon for six meters, which works well for contesting and has a reasonably wide beam width. Plus, its size fits nicely on the top of the rover.

Antenna separation is always part of the discussion. In this system, the antennas are about 12 inches apart. At low power, that works well, and isolation isn't a problem. I've read papers that specify the required distance between antennas, but at least one says, "work with the space you have." I agree.

Most experienced rovers advise placing the six-meter antenna at the top of the mast. That makes sense, though I'd like to keep the 2 m beam as high as possible, since it's the go-to band for local QSOs, followed by QSYing to other bands. Of course, there are always trade-offs with any rover setup.

## VHF Rover Operations

I've also found that placing the 2 m antenna at the bottom of the stack puts it too close to the car's roof, causing SWR problems when pointing the antenna. In one direction, crossways with the roof, it may work well, while lining up with the roof sends the SWR through the roof, so to speak.

### Insight into Radios

My rover operations began with an Icom IC-910H operating on 2 m and 70 cm. I then upgraded to an Icom IC-9100 to add six meters. I also have 23 cm on that rig, but for now I prefer to focus on the four low bands for Limited Rover entries. However, 23 cm may come in handy for the UHF contest.

For 1.25 m, I added a Q5 Signal / DEMI transverter. This is the 25-watt version used to drive an amplifier to reach the 100-watt level for the contest category.

What I like about the IC-9100 is that it has two HF outputs. I can use one for six meters and the other for the 28 MHz transverter IF. It also has separate outputs for 2 m and 70 cm.

My overall approach is to set the rig to 10 watts output to drive the 1.25 m transverter and the 6, 2, and 70 cm amplifiers, with all amplifiers running at power levels up to the contest category limits of 200 watts on the lower two bands and 100 watts on the upper two bands.

Other options for rovers include antenna switches that route the rig's input/output to different transverter setups. Bottom line, use what you've got and get out and start learning more about roving.

### Insight into Computers and Software

In today's ham radio, computers and their software systems make up a significant part of any station. That includes rig control, logging, sequencing amplifiers/preamps, running WSJT-X, and chat room software. Rovers have a few other details to track, including changing grids – some systems can do that automatically using GPS signals.

## VHF Rover Operations

My system is pretty simple. I've used MacLoggerDX in contest mode on my Apple laptop and JT-Alert with WSJT-X. I have to update the grid manually as I travel. I now use a Windows laptop with N3FJP's VHF Contest Log. Again, I need to update the grid manually. The only downside is that it doesn't show the extra multipliers that rovers earn for each activated grid.

### Insight into VHF Rover Modulation Modes

A significant aspect of rover operation is finding another station, usually on 2 meters, and then moving them to other bands for more points. That usually happens on SSB, where you can easily direct stations to other bands and frequencies.

WSJT-X disrupts this operating practice while revolutionizing weak-signal work. JT65 was excellent but slow. FT8 is fantastic. MSK144 works when other modes won't. But there's still no solution for sending messages about band changes. A messaging system has been added to the latest versions, but few are using it, and most are unaware it exists.

FT4 should have made a difference in speeding up QSOs. But I've found that few use it, and often the sensitivity isn't sufficient to complete the QSO.

### Insight into Rover Routes

Rover routes are all about grids – maximizing the number of grids activated while minimizing the miles driven. For me, with my Stop-and-Shoot approach, miles driven mean I'm not on the air.

## VHF Rover Operations

Since a grid in the USA measures roughly 70 miles north to south by 100 miles east to west, I plan my routes to run north and south where possible. This reduces the distance required to get from one grid to the next.

I also try to set up my routes around grid corners – where four grids merge. That allows quick drives across four different grid boundaries. My June 2019 VHF rover routes in the Texas Panhandle really took advantage of this type of driving.

Some rovers head out with only a general idea of their route. I always scout out my route and find the best locations for setting up my rover. First, I work with one of the grid mapping applications. There are also online topographic maps and summit information that can prove very helpful. That helps me set up the best route for limiting travel time.

Second, I get out on the road well before the contest to find exactly where I can park the car and point the antennas. I look for clear horizons and higher spots without

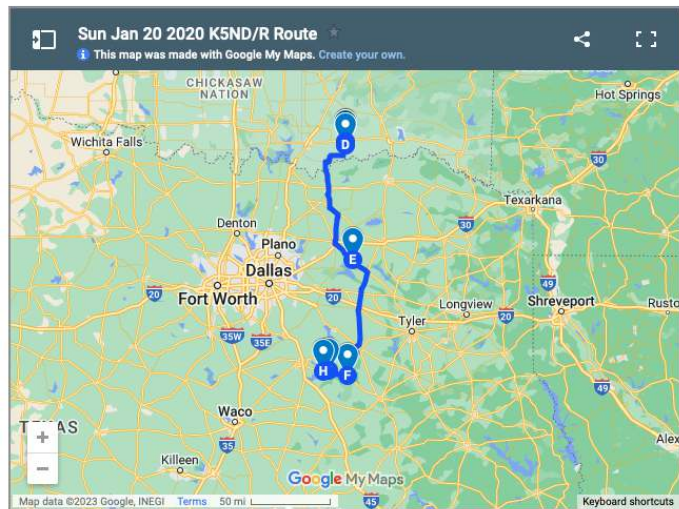
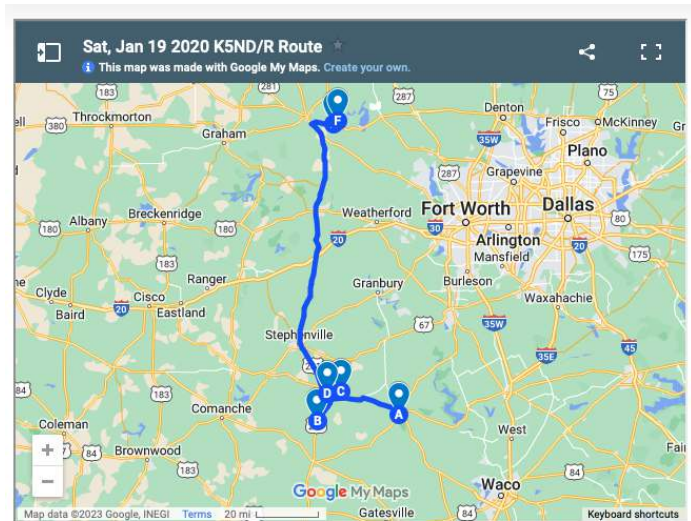


Figure 53 - Rover Route Plans for January 2020 Contest

## VHF Rover Operations

trees. That's easier in Texas than in many other places. Then I take GPS snapshots of the location to help me map and verify that I'm in that grid.

I also pay particular attention to overhead tree branches on my routes. While my rover is only 12 feet high, trees can reach out and snag your antennas. That adds yet another challenge for contest weekends and can bring your efforts to a sudden, disappointing halt.

### Communicating Your Plans

A big part of any rover contest effort is letting people know you're out on the road so they watch for you and point their antennas your way. Here's what I'm doing before each contest:

- Build a Google Map with the exact routing. Add it to a blog post listing expected times at each grid and your station details, including bands, antennas, and power. [I use the same map when driving the route.]
- Announce this same information, including a link to the blog post, to online VHF and Contesting Groups. This includes national and local groups.
- Build your email list from those you've worked in previous contests, particularly the local big contest stations. Route this same information to them.

Randy Wing, NOLD, does an incredible job in his communications. He does all the above and reaches out throughout the year to speak at hamfests and club meetings about roving and how to work VHF contests. He works hard to prepare local FM-only stations, picking up QSOs as he drives by.

### Communicating During the Contest

Since the new VHF contest rules were introduced a few years ago, there are now many communication options during the contest. The chat groups are extremely helpful. These include PingJockey, VHF Slack, and ON4KST chat. There is also APRS spotting to help stations follow your route.

I also use text messages and even phone calls. Sometimes I'll text a station to let them know I've arrived in a new grid. I also receive messages from some stations, including other rovers, asking about my current location. Phone calls: I usually call a few big contest stations right before I leave a grid if we haven't worked each other yet.

There is a caveat here: you can arrange schedules and initiate contact efforts, but you can't reveal QSO details through any of these communication channels. So, make sure you restrict your efforts to setting up QSOs. See the information in the appendix about online chat and valid QSOs.

### Rare Grid Roving

Rare grid roving happens when operators visit rare grids, often those with few existing amateur radio operators, and get them on the air for grid chasers. It's a major part of the chase for the FFMA award. It also applies to those chasing grids or states on any VHF band. The principles are, by and large, similar to those described above.

The real key is identifying the rare grids. For six meters and FFMA, it's part of the online FFMA Leaderboard and gridzilla.us. This is where those with 400 or more grids, working toward 488, identify their needed grids. Then, the trick is figuring out how to get there and operate with power and a good antenna. Plus, it helps if you can stay there for several days to catch the openings. That also means most FFMA rare grid activations happen during the summer Es season.

## VHF Rover Operations



*Figure 54 - K5ND/R at DM86-DM85 Grid Line*

## YMMV – Your Mileage May Vary – Literally

This is your rover journey — do what works best for you, your goals, and your local area. For example, I prefer solo radio sport, but many enjoy working as a team in a rover or as part of an extended effort with several rovers.

That's the fun of amateur radio - finding what works for now and then finding the next thing. But the first step is always to get started and get on the air. I hope to add you to my log in future contests.

# Chapter 13 — VHF Contest Portable Operations

There are many opportunities to get on the air with portable operations, including Summits on the Air and other similar programs. I got my start by activating a few grids on satellites, earning the AMSAT Rover Award in the process. From there, I moved into VHF Contest Rover operations, as described in the previous chapter.

However, VHF contest portable operation felt like a road too far because it limits power to 10 watts across all bands. Here's how I overcame that concern, opening up an entirely new approach to contesting.

## QRP Operation — It Works on VHF

I'm no stranger to QRP operation. I've worked QRP DXCC on HF and entered a number of HF contests in the QRP category, winning a few. But my first take on VHF contests was that it was probably a bit much to think others could hear my signal, and I was concerned that beating my head against a wall wasn't what I wanted to do on a contest weekend.

But I was missing my VHF rover days, and operating from home wasn't all that satisfying. So I looked long and hard at the CQ VHF World Wide Contest's Hilltopper category. At the time, it required 10 watts, a remote location, and only six hours of operation. So if I ended up banging my head against a wall, at least it would only be for six hours!

The other nice thing about the CQ VHF is that it is in July, with a good chance of finding 6-meter signals through Sporadic E.

### QRP VHF — Location is Everything

It's not specific to QRP, but the location on VHF is important. Height is helpful, as is a clear horizon in all directions. That's one reason I like roving and portable operation, you can pick out the best location if only for a few hours during the contest.

For my first and subsequent entries into VHF portable operation, I selected a favorite rover location in EM01. The benefits of this location, as noted above, include good height and excellent horizons. Another benefit is that it is midway between Austin/San Antonio and Dallas-Fort Worth, where other ham radio operators reside. It's also within a reasonable distance from Houston. And the only other ones on the air from the grid during contests are rovers. This also means rovers come through the area to light up my portable station. That nearly-rare grid is also advantageous on 6 meters, where it is highlighted in the WSJT-X window with a new grid color.

### VHF Portable Antennas

For my first effort in the portable category, I actually went back to a painter pole, a three-element 6-meter Yagi, and a 2-meter rover Yagi. It worked great for the CQ WW VHF Contest, which is only for 6 and 2 meters.

Since that effort went so well, I looked for several improvements for the next contest. For antennas, I added an Antennas Amplifiers dual-band antenna that covered both 144 and 432 MHz. It also has a single coax connector, which fit perfectly with my Icom IC-7100, which has a single connector for those two bands and a separate connector for HF/6. Plus, I put my fiberglass push-up mast to use.



*Figure 55 - VHF Portable in EM01*

## VHF Contest Portable Operations

### VHF Portable Radios

There are a number of excellent radios available. I mentioned the IC-7100 above. I have also used both the IC-7100 and the IC-9100 in my contest portable operation. This allows simultaneous monitoring of two bands, which I selected as 6 and 2 meters. I then switch to 70 cm from time to time.



*Figure 56 - Portable Setup with IC-7100 and IC-9100*

The IC-7100 also remembers power settings from one band to the next. Although the power output is limited to 10 watts, the radio still requires the power level to be set for each band. I also use wattmeters to monitor the power so I don't exceed it during the contest. The IC-9100 does not have this capability. You set the power knob on the front panel, but the actual power output varies across bands. The IC-7100 remembers what you set for each band.

## VHF Contest Portable Operations

### VHF Portable DC Power

As noted in the VHF Rover chapter above, I have a high-capacity cable that supplies DC power to the radios. I still have that capability, but I've started using LiPO batteries for my portable operations. That saves a lot of gasoline, and the DC power is much more stable. I monitor the voltage and current and charge the battery overnight. I haven't tried solar panels yet.

### K5ND VHF Portable Results

I've had pretty good results over the last several VHF contests. In fact, I won the portable category in September 2024, January 2025, June 2025, and September 2025. The CQ WW VHF Contest changed the Hilltopper category to 100 watts in 2025. But I did enter the digital weekend as QRP from home and won. For the January 2026 contest, I was only able to get on the air on Saturday and finished third.

The reasons behind these wins are finding a good location and staying on the air throughout the contest. And it helps that there are only 15 to 20 other entries across the country, so the field is small.

This is something for you to consider. I do it because I have a great deal of fun, and it's a very nice break from roving, with a far better location than my home.

# Good Luck with the MAGIC BAND

That's my brief guide to working six meters. It is a Magic Band but can also be very quiet. You never know when it will take off and provide contacts into Europe, South America, Africa, or the Pacific. Yet if you start collecting grids, a new one just a few hundred miles away can be pretty exciting.

Of course, it pays to be patient, and there is always something in your station to tweak, install, upgrade, or whatever to improve your results.

It's a never-ending journey that has as its reward new call signs in the logbook, new grids, new friends, and pure magic working stations that shouldn't be possible at six meters.

Have fun.

73 + 55 (best success)

Jim Wilson, K5ND

# Appendix A — SDR Operations

One of the significant advances over the past several years has been the implementation of digital receivers. This began with DSP (digital signal processing) in various receivers and transceivers. There are now SDR (software-defined receivers) ranging from the Icom IC-7300 and IC-7610 to many others.

A related advance has been the implementation of low-cost SDR dongles in the receiver chains, alongside an existing transceiver used primarily for the transmit side of the operation.

In this appendix, I've documented my early work with a very low-cost SDR dongle, running around \$30, and later with a more elaborate setup with an AirSpy R2 SDR.

## NESDR SMARt RTL-SDR

In May 2020, I added a \$30 SDR covering 25 to 1750 MHz. Paul, N2EME, introduced the device during an online presentation to the Front Range 6-meter Group.



*Figure 57 - RTL-SDR Dongle Receiver*

## SDR Operations

Interestingly, I've previously considered similar SDR devices for satellite work, but I couldn't pull the trigger. However, with Paul highlighting its use on 6 meters, I immediately sprang for it. Not that I'm a 6-meter addict, no, not at all.

### SDR Console Software

This is Paul's recommendation for use with this device, and it's free. So that's what I tried in mid-May with weather satellites, etc.

Paul believes in this software so much that he took time with me later that month to walk me through his setup in his ham shack. Then, he used AnyDesk to take over my computer and set up several things to optimize my view.

Paul notes that he only knows some of the software's features, even though he's been using it for years. The documentation is limited but free and works like a charm. The capabilities are staggering — you just need to find them.

### SDR Switch

The rest of the system uses a relay box to connect your antenna to your transmitter and SDR receiver. It adds a dummy load for terminating the receiver when you're transmitting. This way, you can use the SDR as a receiver and your standard rig as the transmitter.

You can learn more at <https://sdrswitch.com/>

### SDR Use on Six Meters

It can be complex or straightforward. I've taken the simple route in my startup efforts. With SDR Console, you can create up to 24 receiver screens. I've chosen three for now.

The first monitors 50.125 for SSB signals. The second monitors 50.313 for FT8. The third monitors 50.323 for intercontinental FT8. Other options include monitoring CW frequencies, beacons, FT4, and MSK144.

## SDR Operations

I'm only using the SDR to monitor activity across the band. I have used a virtual audio cable to connect 50.313 FT8 to WSJT-X. It works well in that application. Likewise, you could use separate instances of WSJT-X to decode 50.260 for meteor scatter, FT4, and more simultaneously.

In the screenshot below, you can see how it worked during a recent opening. Receiver #1 was on SSB, monitoring a signal near 50.140; #2 was on FT8 313; and #3 was on FT8 323. Those are displayed across the top of the screen. The bottom of the screen covers the broader SSB band and highlights additional signals to the one you're monitoring, such as the one shown at about 50.128.

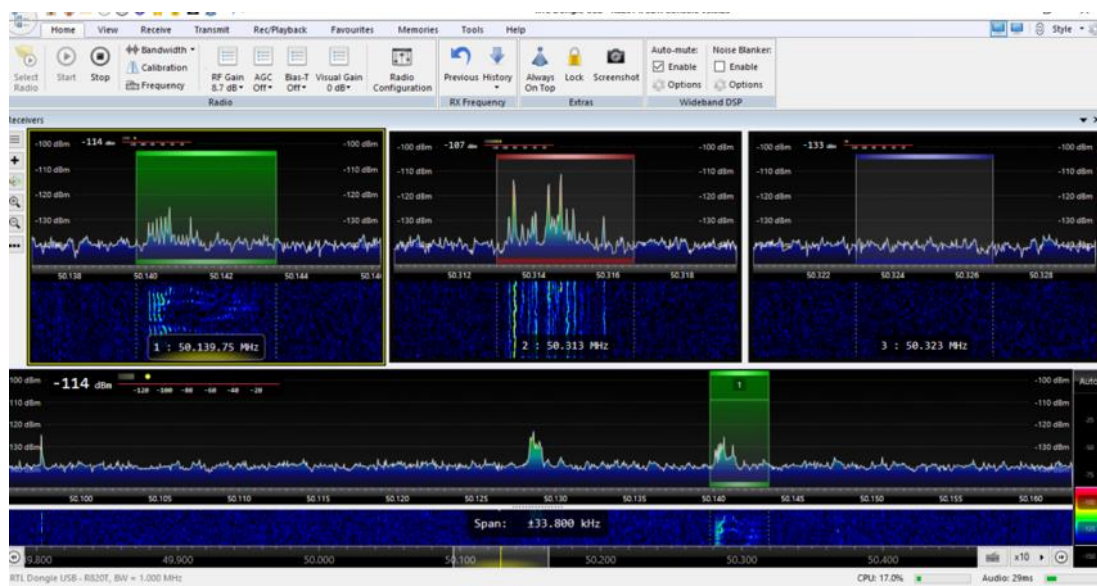


Figure 58 - SDR Console with three receivers

It worked well, highlighting activity levels in each area. For example, at times, there was a great deal of activity at 50.323. But each time I checked, I found only USA stations calling Japan. An improvement would be to add Receiver #4 to monitor CW.

Here's another shot showing activity across all three receivers, with the bottom strip monitoring the 50.300 range. I prefer monitoring the SSB segment.

## SDR Operations



Figure 59 - Receivers covering 50.125 SSB, 50.313 FT8, and 50.323 FT8 to Europe

## AirSpy R2 Setup for 6 meters

Following my earlier work with the RTL-SDR dongle, I implemented an Antennas-Amplifiers Preamp, Bandpass Filter, and TR Relay for 6 meters. It provides a separate receiver output, allowing direct connection of an SDR receiver. Also, since the transmit input is separate, it will enable the use of an attenuator that only affects transmit power and not the received signal. This will allow me to protect the input of my 6-meter amp.

## SDR Operations



Figure 60 - Antennas-Amplifiers 6 meter PTT, Preamp, and Bandpass Filter

You can see the preamp unit in the photo above. It has a very sturdy package.

I use a Down East Microwave LTRS Sequencer to turn off the preamp and close the PTT relay before applying RF to the antenna through the unit.

I also switched from the RTL-SDR dongle to an AirSpy R2. It's further connected to a Leo Bodnar Mini GPS-disciplined oscillator set to 10 MHz to ensure the SDR operates at the correct frequency.

I've used Digi-Key's Scheme-it to draw diagrams of my setup. They are simple and should remind me what I've built and help track changes. They might also give you some ideas for your setup.

## SDR Operations

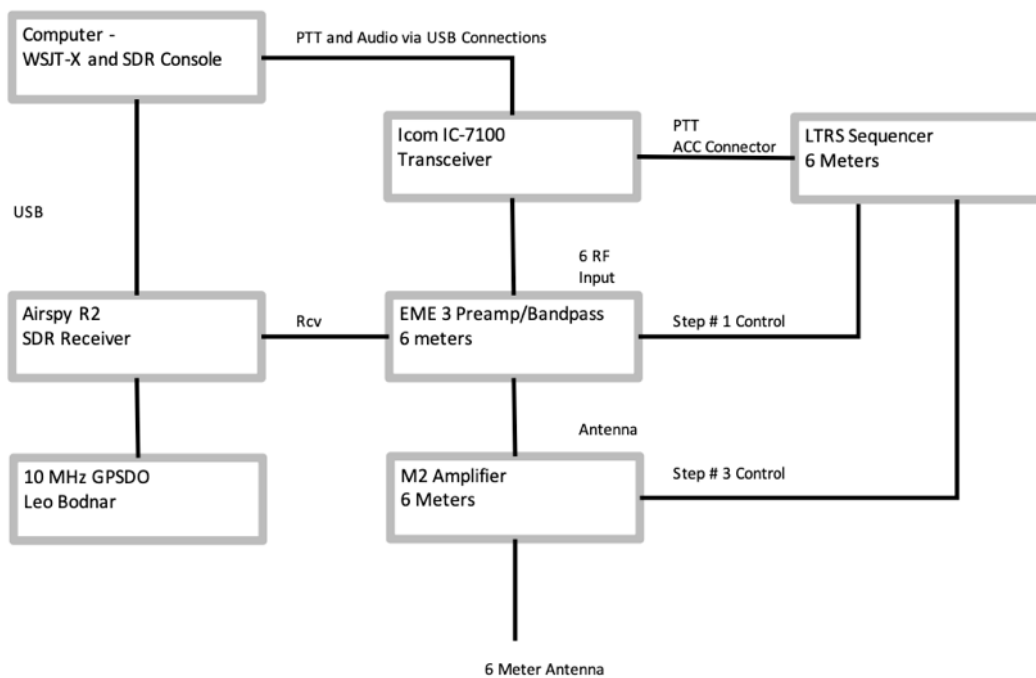


Figure 61 - SDR Setup for 6 Meters

# Appendix B — FFMA Award Detailed Information

The Awards chapter touched on the FFMA, but since it is exclusively for six meters, I thought it would be helpful to provide more detail for those who are considering or actively pursuing the award.

## What's the FFMA?

The Fred Fish Memorial Award was established by the ARRL in 2008 to honor Fred Fish, W5FF, who worked and confirmed all 488 grid squares in the 48 contiguous United States on 6 meters. For more, see the QST announcement at [http://www.arrl.org/files/file/FFMA/FFMA\\_Announcement.pdf](http://www.arrl.org/files/file/FFMA/FFMA_Announcement.pdf) and the ARRL FFMA information at <http://www.arrl.org/ffma> Here's an important quote from that announcement:

*The FFMA is an “all-or-nothing” award. You must submit confirmation of 2-way contact with all 488 grid squares on 50 MHz in order to qualify. There are no endorsements and no recognized tiers of progression. Any mode may be used. The rules for the award will strictly follow the rules of the ARRL VUCC program.*

It's an extension of the ARRL VUCC award program, but one that is exceedingly difficult to earn. How tough is it, you might ask? Ten years after the award was introduced in 2018, only seven had earned FFMA. The class of 2019 saw two earn the award. The class of 2020 added four to the list. In 2021, a bumper crop of 12 earned the award. As of April 2026, the total is 62.

## It's Tough But We're 6 meter Grid Chasers

OK. So it might be tough, but that shouldn't deter general all-around grid chasers, particularly those like me who are addicted to chasing grids. It forms one more goal along the way to adding stickers to your VUCC certificate. Although it is a very, very challenging goal.

## FFMA Award Detailed Information

The good news is that there are several hundred other hams chasing the award, and they are all highly motivated. That means they urge or pester, as the case may be, other ham radio operators to get on the air from rare grids. Or, in grids where nearly no one has gone before, they encourage rovers to make it happen for the needy.

That's where a great deal of excitement can come into play. There are several legendary rovers that operate in extremely remote locations, using four-wheel drive or boats and lightweight equipment, or they travel thousands of miles, activating multiple rare grids along the way. They usually bring big antennas and large amounts of power. There are often photos and even videos of the places and the incredible rover operations.



*Figure 62 - K5ND operating from DM85 for FFMA grid chasers*

**Sign Me Up**

## FFMA Award Detailed Information

So how do you get started? First, work all the six-meter grids you can. All grids in the U.S.A. count, so start with the ones you hear.

Second, start monitoring DX Maps and other online resources to catch Sporadic E openings as they occur. If you're alert and available, you can really add to your list of grids when the band opens.

Third, become familiar with making meteor scatter contacts using WSJT-X MSK144. This mode can be relied on at any time of year, particularly during seasonal meteor showers. It can be very important when trying to work rovers within 1,000 to 1,200 miles.

Another mode that is gaining popularity is WSJT-X Q65. It's achieving excellent results when no other modes are working at all. So get up to speed so you're ready when that mode is needed.

Finally, start a ham shack continuous improvement program. You can do great things on six meters with a vertical or dipole, but you probably won't achieve FFMA with that setup. So look at your antenna first. How can it be improved? Then look at your receiver. For example, many people use a separate SDR receiver and software to optimize their station. And finally, consider more power, which should be the last item on a long list of possible improvements.

## FFMA Resources

Here's an opening listing of FFMA resources, all of which also apply to chasing six-meter VUCC grids.

### General Information

- DX Maps — This is my personal favorite. You can see the openings and gain some understanding of where to point your antenna.
- [FFMA@Groups.io](mailto:FFMA@Groups.io) — This is a mailing list that highlights upcoming grid activations and general chatter on six meters. It also has archives on FFMA history and more. There's a Wiki for further information along with information

## FFMA Award Detailed Information

on adding your efforts to the FFMA Leaderboard, which is used to determine the most needed grids.

- [FrontRange6meter@groups.io](mailto:FrontRange6meter@groups.io) — This group does a good job of keeping up with techniques and what's happening in general for six meters. They also provide online Zoom technical and how-to presentations with top-level speakers.
- [VHF Slack](#) — This is a channel on Slack dedicated to VHF. It covers rover activations, often in real time including "you're in the log" type of information. It's extremely valuable. You'll probably need to request an invitation to join.
- [PingJockey](#) — This online chat system can be helpful in coordinating meteor scatter contacts. There's also a growing channel called splat-65 (JT-65 Terrestrial in the pull down menu) that's used to coordinate Q65 contacts.

## Helpful Software

- [GridTracker](#) — This bit of software can help you not only keep up with your own grids but monitor DX spotting systems to find grids that are currently on the air.
- [JTAlert](#) — This software will monitor your decodes from WSJT-X and alert you for any needed grids that it finds.
- VE7CC — This is a DX cluster with spots on all the ham bands. There are others you can monitor. Usually your logging program will help with this type of monitoring for new grids.
- [DX Lab Suite Spot Collector](#) and [DX Lab Suite](#) — Another helpful bit of software to keep on top of grids that are on the air.
- [JTDX](#) — This is an FT4, FT8, JT65, and JT9 decoding and transmitting software. It's been found to catch many more weak signals than WSJT-X. Your mileage may vary. But it's worth investigating.
- [WSJT-X Improved](#) — This software package provides a number of features before they debut in the regular versions of WSJT-X. It's well worth downloading.

## Rover Information

- <https://www.coilgun.info/rover-us/home.htm> — Documented rover locations by K7BWH that can be helpful in guiding other rovers.

## FFMA Award Detailed Information

- [So you wanna to be a 6 m Rover eh?](#) — This is a well written article by Dave, KG5CCI, one of those legendary rovers on six meters.
- You can find a bit of information on this website about [VHF roving](#) as well. Start with the articles I've written for the National Contest Journal.

## FFMA Leaderboard

This has become the go-to resource for tracking your progress toward the FFMA and for determining the most needed grids within the 488. This is extremely valuable for rovers to determine which grids to visit and also who needs those grids.

The most needed list is developed from the information provided by those who have 400 or more grids confirmed for the FFMA. They are on the downhill side (or is it uphill?) in chasing the last needed grids. So rovers naturally want to help them work those last few grids.

Bill, NDOB, started this effort and generally kept it updated once a year. After he earned FFMA #10, he found Francis, KV5W, to run the system. Since Francis earned FFMA #47, Ed, N7PHY maintains the listing. It's now updated in real time as soon as anyone updates their grid list.

I recommend starting at the [FFMA Groups.io Wiki](#). It provides links to the leaderboard, the grid activation calendar, grid activation resources, and a listing of grid activators. There's also a link on how to submit your data for the leaderboard. Also, sign up for the list while you're there.

Another helpful online tool is <https://gridzilla.us/> This tool went live in early 2026 and is meant to eventually replace the FFMA leaderboard. It also has the added feature of tracking all bands, 50 MHz and above.

You can find several video recordings on YouTube: [FFMA Getting Started by Francis KV5W](#), plus, [Jay N1AV FFMA under 1500 days](#) and, [FFMA Leaderboard Intro by Ed, N7PHY](#).

## You Can Do This

## FFMA Award Detailed Information

Well, maybe you can do this. I'm at 486 FFMA grids and it will be some time before my last two grids are activated and when I work them. Even so, we're reminded that it's all about the journey.

This is a fun journey. Join us in getting on the air.

# Appendix C — EZNEC Antenna Modeling

Most of the traffic to my amateur radio blog focuses on antennas. From that, you can readily imagine that I like experimenting with antennas in the never-ending pursuit of station improvement and working more DX.

In turn, that led me to explore using EZNEC to model antennas, both those I might build and those I might buy off the shelf.

## EZNEC Antenna Modeling Software — K5ND Trial and Error

Some time ago, I'd investigated using EZNEC through a chapter in the ARRL Antenna Handbook and the book Antenna Modeling for Beginners. After a few forays, I wasn't motivated enough to learn and use the software.

You can find the software at <https://www.eznec.com/>

All versions are now free, including Pro/2+ v. 7.0. The creator, W7EL, is now retired, so the software is readily available. There's also an excellent help file. He does not provide support, which is to be expected after retirement. But you can also find information online.

My approach this time was to grab a sample and modify it to match the exact measures. A great deal of trial and a ton of error followed. But I did finally manage to sort through most of the errors. At least, I hope so.

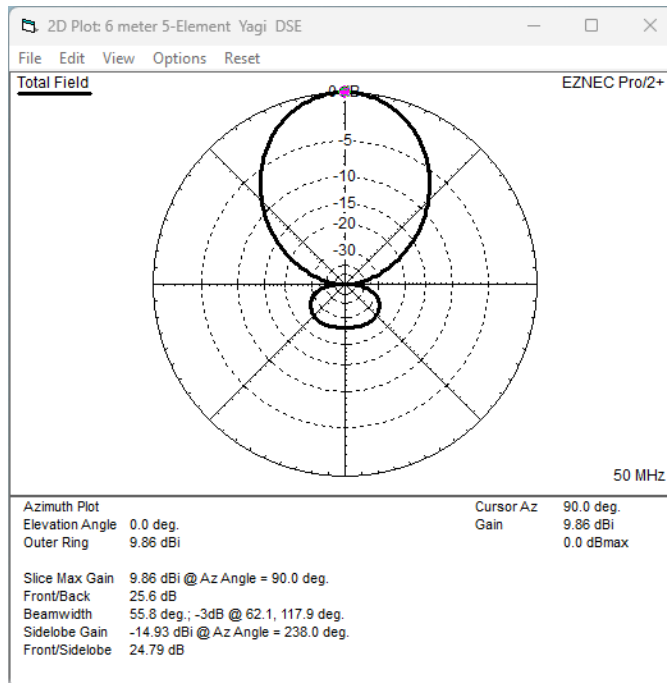
That involved picking up a sample file for a 6-meter Yagi and then modifying it for the Yagis of interest.

I started with the Directive Systems DXEJX5-50. I have this 6-meter, 5-element Yagi on my push-up mast in the backyard. My modeling efforts yielded a 9.86 dBi gain versus

## EZNEC Antenna Modeling

the 10.1 in the datasheet. Front-to-back weighed in at 25.6 dB modeling versus 25 dB. The azimuth pattern looked identical.

Figure 63 - Directive Systems 5-element 6 meter Yagi



## Looking at the M2 6 Meter Yagis

In my original exercise, available on my blog, I delved into 2-meter Yagi alternatives. I've chosen to include a few 6-meter Yagi models for this book.

## EZNEC Antenna Modeling

### M2 6M3SS

I use this antenna for my rover operations. It's lightweight and assembles easily in the field. Here's the azimuth plot from my modeling. It shows a forward gain of 8.48 dBi, compared with the specifications of 8.1 dBi.

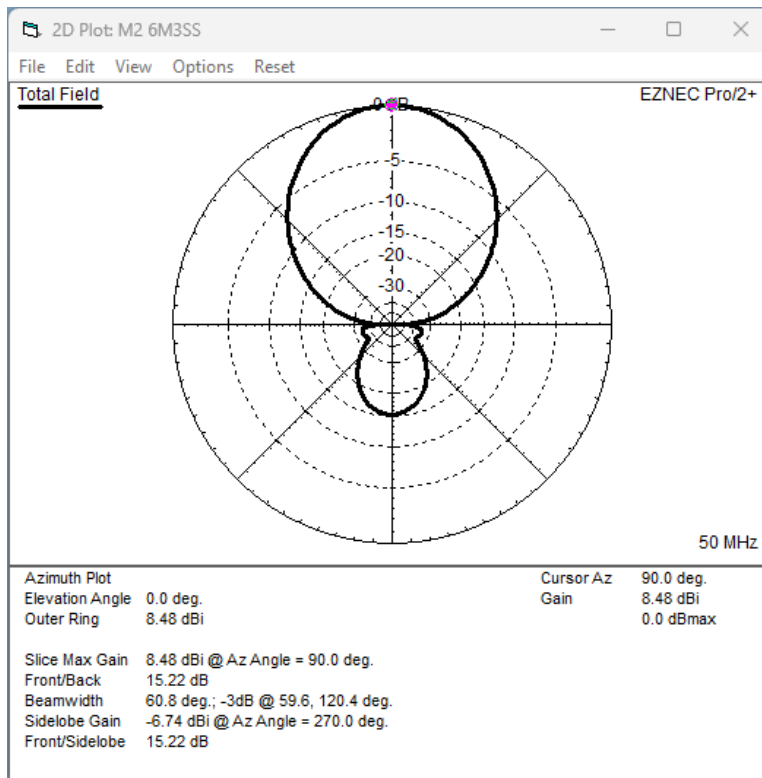


Figure 64 – M2 6M3SS 3-element 6 meter Yagi

## EZNEC Antenna Modeling

### M2 6M5XHP

This is a 5-element Yagi with a longer boom (18 feet) than the Directive Systems 5-element Yagi I use (12 feet). The model shows 11.45 dBi gain versus the specified 11.54 dBi.

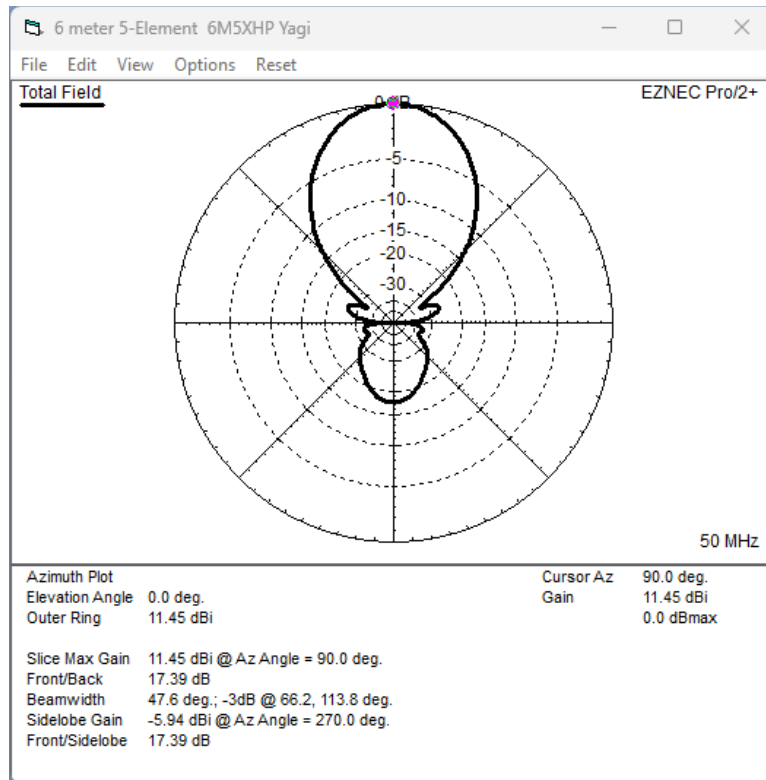


Figure 65 - M2 6M5XHP 5-element Yagi

## EZNEC Antenna Modeling

### M2 6M5XHG

Here's another model. This one is also a 5-element Yagi, but with a 20.25-foot boom. The specified gain is 12 dBi, and the modeled gain is 12.01 dBi. I guess we used the same model!

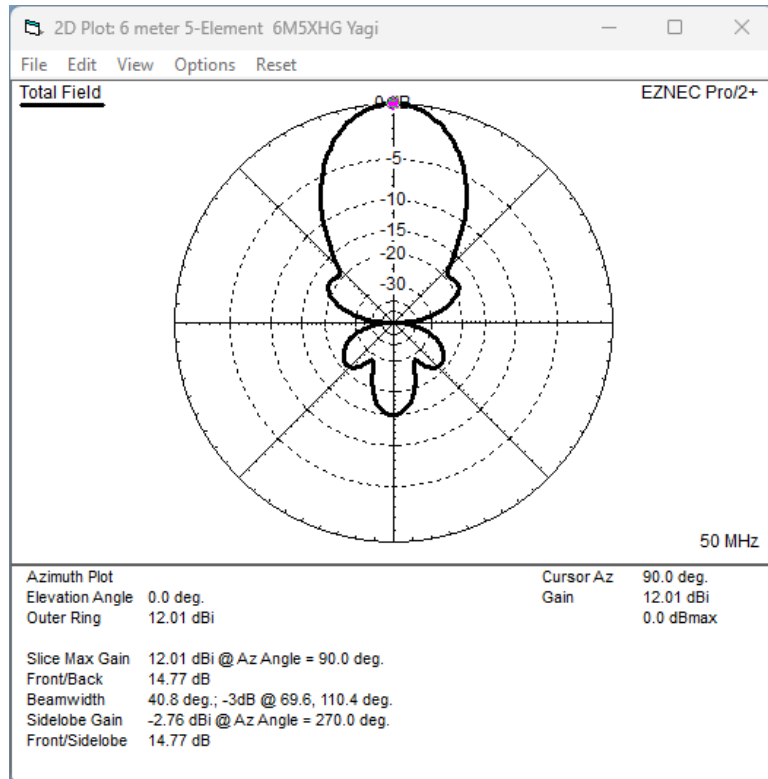


Figure 66 - M2 6M5XHG 5-element 6 meter Yagi

## Antennas Amplifiers Dual Band 6m2m14DX-2C

My latest antenna at home is from Antennas Amplifiers, with both 6 and 2 meters on the same boom. It's still on my push-up mast and only about 20 feet high. But it works well and keeps the visual appearance and is a bit smaller than running two Yagis.

Here's the EZNEC plot for the 5-element 6-meter segment of the antenna.

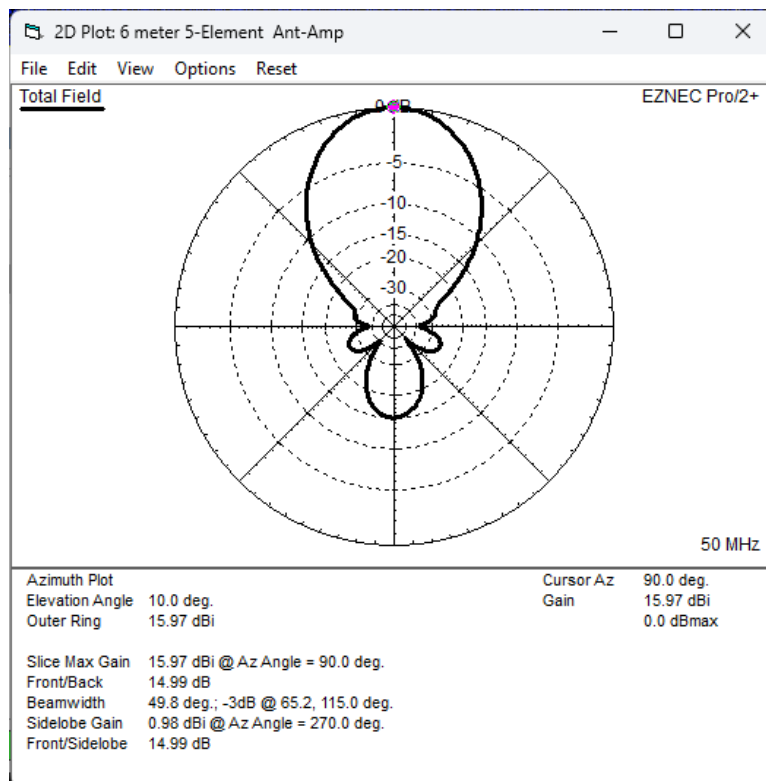


Figure 67 - Antennas Amplifiers 5-element 6 meter Yagi

## Modeling in Free Space versus Ground

Not content to examine only the free space results, I started adding ground to the model.

The results from the M2 6M5XHG 5-element Yagi are shown below. It provides a 3D pattern along with an elevation segment. This look offers insight into the take-off angle, in this case, at 36 feet above ground. I'm sure this can be useful when setting up towers, etc.

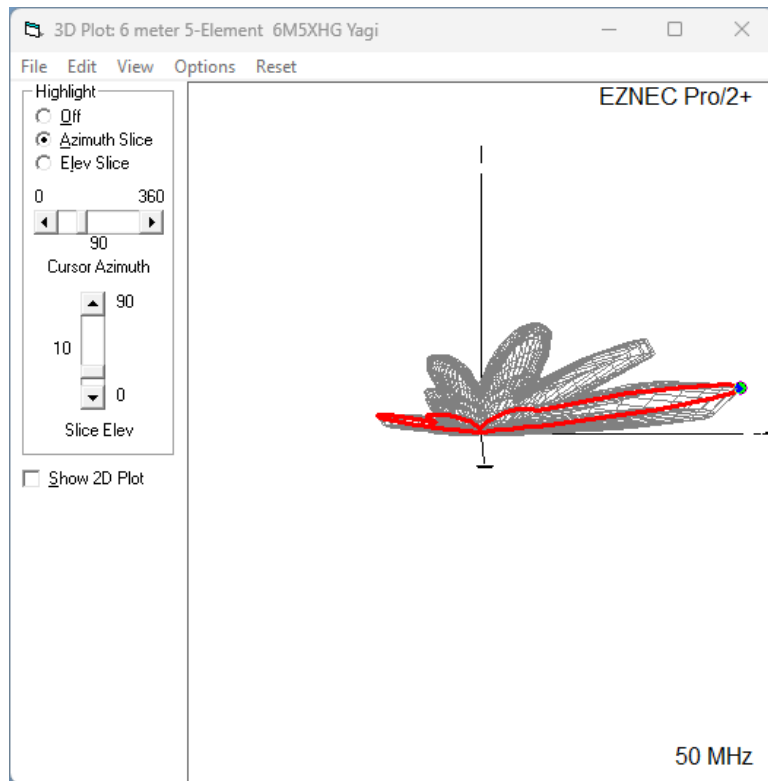


Figure 68 - M2 6M5XHG elevation angle view

# Appendix D — Valid QSOs and Online Chat

I've written about Valid QSOs and Online Chat on my blog and in the World Above 50 MHz column in QST magazine. I also presented on this topic at the 2023 Central States VHF Conference. The question of what constitutes a valid QSO seems to arise from time to time, with some general agreement, though it often ends with an agreement to disagree.

The additional issue of what may and may not be communicated via online chat to facilitate the QSO has also been debated at length.

On both of these questions, the contest rules are quite specific. For general operating and collecting awards, the rules are either less straightforward or not expressed at all.

As with most questions like this, I started by looking up information online. Here's what I've found.

## Valid QSOs

When we dig back into the historical archives, we often find that others have addressed these issues before. Here are the historical definitions.

### **QST March 1957. The World Above 50 Mc. "What is a Contact?"**

*Edward P. Tilton, W1HDQ*

*The minimum exchange for two-way work to be considered a contact has been fairly well standardized on a two-stage procedure: positive identification of calls at both ends, and the completed exchange of signal reports.*

Later in the article, when discussing meteor scatter QSOs, he says: If he gets the signal report, he then sends one to you. If you get it, you send "R." If he gets the single letter, he also sends "R," and the QSO is over, as far as the claim for a contact is concerned.

**QST March 2006. The World Above 50 MHz. “What is a Contact?”**

*Eugene Zimmerman, W3ZZ*

W3ZZ cites the original article above and adds:

*To this day we still follow the same general outline but with a few changes. **Exchange of “signal reports” has come to mean exchange of at least one specific piece of information beyond the other station’s call sign.** This can be an actual signal report in one of several formats, an abbreviation for a signal report like 000, which means full copy but at a very weak signal level, a grid locator or whatever. In addition once the contact sequence has begun, there can be no communication between the participants by some other means like the telephone, the Internet or some other amateur frequency, HF or VHF+.*

He goes on to state: As Ed [W1HDQ] stated, there is no need for the final “73” or “SK” because when the other stations hears/sees the series of Rogers, that confirms that you have both his call and the report.

From 50+ years ago to today, the definition of a valid QSO has remained largely the same, regardless of the mode of communication.

## Online Chat — What’s Allowed, What’s Not

I’m in no position to define this myself, but I can and have done a bit of research. Here’s what I’ve found.

**QST March 2006. The World Above 50 MHz. “What is a Contact?”**

*Eugene Zimmerman, W3ZZ*

*All of our awards and standings depend on how vigorously we maintain our standards. As a group VHF operators have always had high standards in the past. Thus I have been dismayed at the reports I have received and in fact the postings I have seen on the Internet reflectors that are used to make schedules for both meteor scatter and EME contacts where stations are talking to one another on the Internet while a contact is being made on VHF. Worse yet, other well-meaning stations with perhaps bigger antennas or better conditions will tell the participants what they have heard. “Keep going, W1XYZ is sending you 27.” So the participants are getting information about the contact even if all they are doing is watching the Reflector and not sending anything themselves.*

## Valid QSOs and Online Chat

He goes on to state: Setting up schedules and exchanging information *prior* to the contact is perfectly reasonable. Once the contact begins, however, exchanging *any* details about the contact while it is ongoing is unacceptable. Information about the contact from third parties is likewise forbidden.

I personally like the warning posted on the Ping Jockey online chat webpage:

**EXCHANGING ANY CONTACT DETAILS ON HERE BEFORE YOU'RE COMPLETE, INVALIDATES THE CONTACT.**

The ARRL Contest Rules are pretty specific, too.

OPRG.8.4. Such assistance may not be used to facilitate the completion of any contact once the contact has commenced. This means such assistance may not be used to convey receipt or non-receipt of any required element of a contact or to request a repeat of any required element of a contact.

## Valid QSOs and Online Chat — Summary Thoughts

We have some amazing technology at our disposal, including our ham shack computers, incredible rigs, and modulation modes in WSJT-X that really dig out weak signals. Yet we still face the same issues that plagued operators in 1957 and earlier. They are human issues.

We are so eager to earn awards, secure rare grids, and help one another do the same that we'll use any tool at our disposal to make it happen.

I wouldn't propose that a tribunal be established to determine the validity of QSOs. This is, by and large, a self-regulated radio service, along with all the awards and contests.

But there does need to be some earnest reflection on how we coach one another and how we behave when we're placed in circumstances that would violate the principles outlined above.

## Valid QSOs and Online Chat

I feel that elements of the Scout Law can apply here: Trustworthy, Helpful, Courteous, Kind, Obedient. Maybe we should try them on for size.

Good luck with your QSOs, awards, and contests. I hope this history lesson and information compilation has helped you on that journey in some small way.

# Appendix E — Further Information

Here are a few starting points for further reading on six-meter operation.

- **Central States VHF Society** [www.csvhfs.org](http://www.csvhfs.org)
- **UK Six Metre Group** [www.uksmg.org](http://www.uksmg.org)
- **SMIRK Six Meter International Radio Club** <http://www.smirk.info>
- **Magic Band Antennas for Ham Radio, 6 Meter Antennas You Can Build** by Bruce Walker, N3JO. Published by ARRL.
- **Six & Four, The Complete Guide to 50 and 70 MHz Amateur Radio** by Don Field, G3XTT. Published by Radio Society of Great Britain.
- **Six Meters, A Guide to the Magic Band** by Ken Neubeck, WB2AMU. Published by Worldradio Books.
- **Contest University** – W5ZN Presentations on VHF Contesting <https://www.contestuniversity.com/files/>
- **World Wide Radio Operators Foundation Webinars Archive** - <https://wwrof.org/category/webinar-archive/page/2/>