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## Introduction

Back in the day your first station would have been something like a Heathkit CW transmitter and a military surplus receiver. Times have changed and FM repeaters have become the most visible and desirable aspect of the hobby for most beginners. Having said this, we are losing some new hams to frustration as they try to get on the air through FM repeaters. My purpose here is to provide guidance in getting an effective first station on the air.

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## Your First Radio

What should it be? As mentioned above, FM repeaters are a great way to get started. Ham radio clubs are often organized around a repeater. Ham radio was the original social media and FM repeaters are now the primary ham radio social media. Most FM repeater activity is on 2-meters and 70-centimeters. 2-meters is the VHF high band and 70-centimeters is commonly referred to as the UHF band. These bands are so popular that manufacturers make what they call 'dual-band' radios that cover both.

This is what I recommend - your first ham radio should be a good dual-band FM rig.

I realize that cost is an issue for some, but what is the real cost of a purchased radio that does not work? There are several reasons why a radio won't work.

- A. It may be defective
- B. It may be poor quality
- C. It may not be the right type or suitable for the intended use

Let's look at defective. The best place to find a defective radio is at a ham radio swap meet. A swap meet or 'ham fest' is a great way to find gear and a heck of a lot of fun. However, buyer beware. Buy from a reputable seller. Other hams often know who can be trusted and who can't. If at all possible, test the radio before using it - this is often possible at the swap-meet.

Now quality - to be blunt, Japanese radios are good quality and Chinese radios are not. Points B and C above are actually the trigger that prompted me to write this.

Suitability: The radio forms a part of your first station and has several key components that will be discussed in detail. However, if all of the station components fit in your hand, you will be disappointed.

- Buy a dual-band radio from Alinco, Icom, Kenwood, or Yaesu. (given in alphabetical order)
- Buy new if you can or be very cautious when buying used.
- Never buy anything Chinese unless you have money to throw away (I've thrown away 3 Chinese radios).
- Your first radio **should not be a portable**, (a hand held 'walkie-talkie')

Some of you reading this have already bought a Chinese portable for your first radio. It may even marginally work, but this is only true if you live under a repeater. If you think it is working well, you don't understand the capabilities of a good mobile or base FM station.

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## Repeater Operation

Don't be intimidated by repeaters. They are really very simple. A repeater receives on one frequency and simultaneously transmits on another frequency. A repeater is typically located at an advantageous location such as a tower, a mountaintop, a tall building, a water tower, et cetera.

VHF signals do not go very far - they are blocked by trees, hills, and buildings. If a repeater antenna is placed on top of a tower, it can receive weak signals and re-transmit them at a higher power. This would enable two stations that normally could not reach each other to communicate.

My main repeater transmits on 147.38 MHz. It listens on 147.98 MHz. Therefore, if you wish to use my repeater, you would have to transmit on 147.98 and listen on 147.38. The difference between these two frequencies is called offset. For the 2-meter band, the offset is 0.6 MHz or 600 KHz. Your radio would be programmed to 147.38 and the transmit offset would be set to +600 KHz. In the 145 to 146 portion of the band, the offset is negative. Our secondary repeater is 145.40 and so to access it you would need to transmit on 144.80 which is 600 KHz down, a negative offset.

One more thing; tone. Due to the proliferation of repeaters and the possibility of overlapping areas of coverage, a tone is required. My repeater is designated in repeater books as 147.38 + T114.8. This simply means that you would program 147.38 with a positive offset (+) of 600 KHz and a tone of 114.8 on transmit.

Each band is unique on offset. The 70 cm UHF band is always a 5.0 MHz positive offset. In Texas, the VHF band plan is maintained by the Texas VHF-FM Society.

<http://www.txvhffm.org/coordination/bandplan.php>

It is important to remember that when you are using a repeater to communicate, you are never listening to the other station's signal - you are listening to the repeater's signal. If you have a S-meter on your radio, that signal is the repeater's strength and not the other station's strength.

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## What Makes an Effective Station

Before going further, here are some important points.

The transmitter moves power to the antenna. To do this effectively, the antenna must be:

- matched to the transmitter
- in a proper location
- and hopefully provide some gain

Power is transferred to the antenna via coaxial cable. At VHF and UHF frequencies, coaxial cable selection is important.

This can get a bit complicated but the easiest explanation is to remember the first rule of engineering:

*“Some of it, plus the rest of it, equals all of it.”*

Radio output power minus loss due to mismatch, minus loss in coax cable, minus loss due to ineffective antenna position, plus antenna gain is equal to what comes out of your station.

It is very important to understand that these factors are critical. This is not plug & play CB stuff - you are an Amateur Radio Operator now. Think of a radio amateur as an olympic athlete - we are the best but we don't get paid. It is all about learning and advancing the hobby and the art of radio.

Antenna theory is an advanced topic - I just want you to know that this is not plug & play - it has to be done right or the results can be disappointing. The difference between a usable station and an effective station can be significant. How is one to know what is effective compared to mediocre when you are starting out? You really can't know without good advice.

## Your First Station

The radio I have recommended may be used as a mobile or a base station. It operates on a nominal 12-Volts and so if used as a base, it requires a good 12-Volt supply. Mobile is the easiest and cheapest since you don't require a power supply, longer cable, and other accessories.

Mobile first then - your mobile installation has several components:

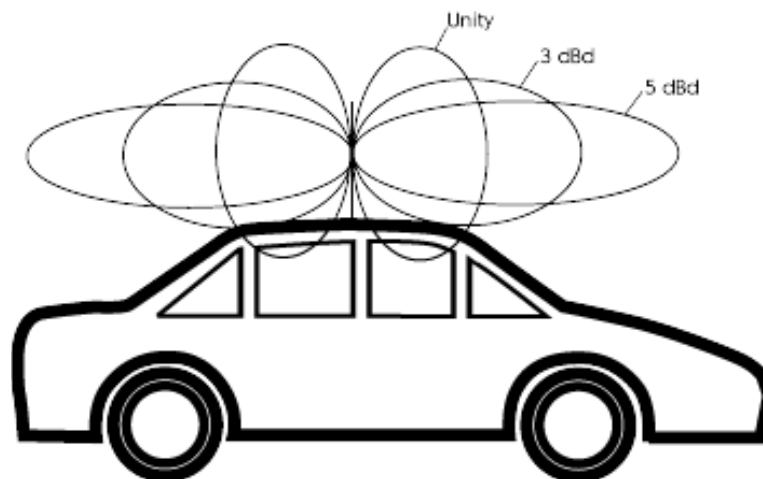
- Power connection to the vehicle.
- Radio ground connection to the vehicle
- Antenna mounting
- Coaxial cable
- Antenna type

Let's look at these components in turn.

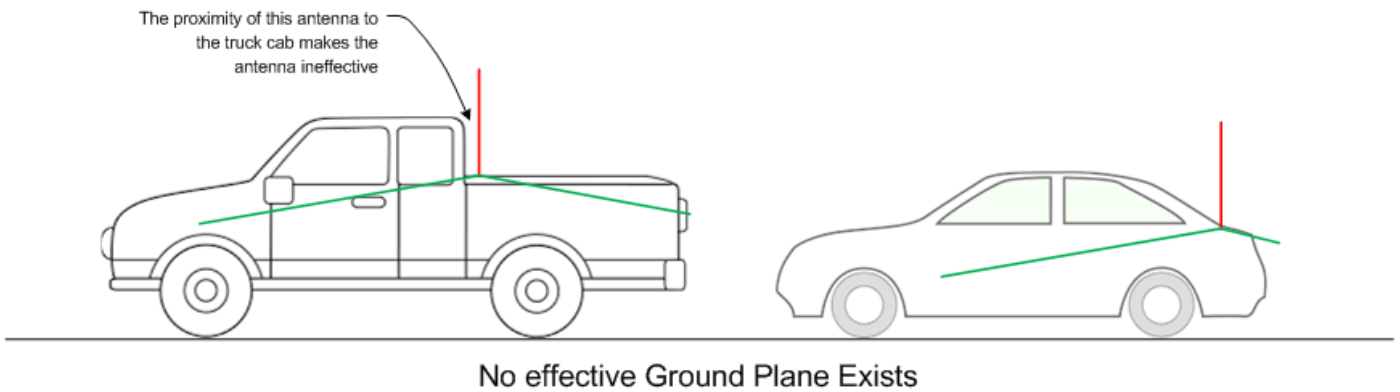
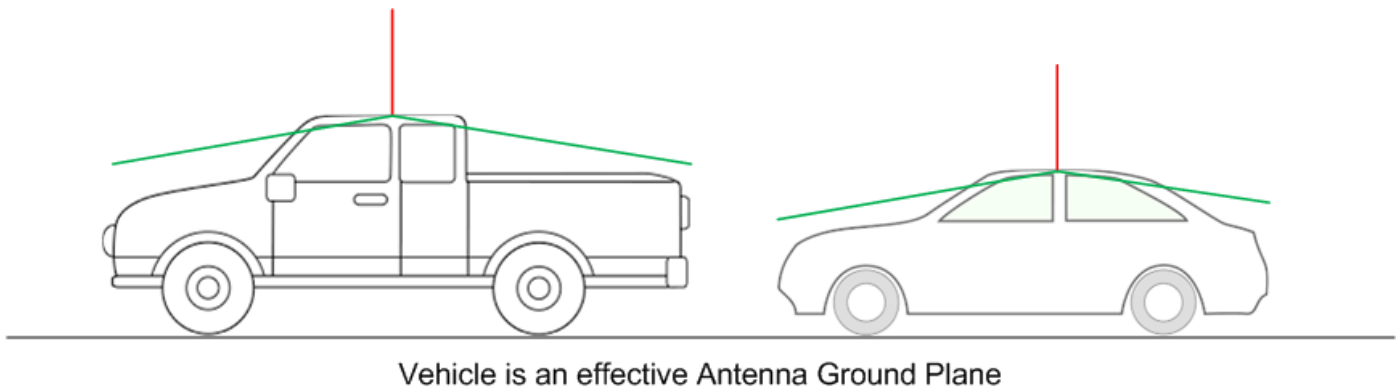
**Power:** If you have to use the 'cigarette lighter' power outlet, consider this temporary. It is best to connect directly to the battery or to the fuse block under the hood. Use either the cable provided with the radio (assuming you have the original) or a wire gage sufficient to prevent excessive voltage drop. If your display light dims when you transmit, the wire is not big enough or the connection to power is not good.

**Radio Ground:** Most radios are well grounded internally to the DC negative wire which is in turn grounded to the vehicle frame. Some radios have a screw at the back for grounding. If it is there, use it.

**Antenna Mounting:** The antenna is best located where it is free and clear all the way around. In other words, the best location possible is the center of the highest point on your vehicle. This provides what is called 'a good RF ground plane'. This means that the vehicle becomes an effective part of the antenna system.



To a true Ham, an effective antenna is more important than a hole in the vehicle. I have an effective antenna on my pick-up truck and I have an ineffective antenna on my wife's vehicle.



**Coaxial Cable:** RG-58 coaxial cable is not recommended. For example, your transmitter is running 25W on UHF and you have 15 feet of RG-58 coax to your antenna. Coax losses alone are almost 8 Watts. Many pre-made antenna mounts come with coaxial cable installed and it is often RG-58. No problem but understand you are not getting all that power to the antenna. Also understand that it affects received signals as well. dB losses and gains are another subject but the RG-58 loss I reference here is 1.6 dB for only 15 feet of cable. Learn about coax cable and use only good cable. Low loss RG-213 should be considered a minimum for a permanent installation.

**Antenna Type:** The only way to make up for these losses is in antenna gain (or squeezing the donut). This is what gain looks like. The 3 dBd and the 5 dBd gain shown here is typical of a 5/8 wave dual band antenna. Unity gain is zero or negative in actuality. It is important to understand the difference between dBi and dBd. The 'i' in dBi is for imaginary - it only exists in the minds of some manufacturers and is used to impress you. Rule of thumb: Subtract 3 from any dBi figure for actual gain. If an antenna states 3 dBi gain, it has no gain.

My current favorite mobile antenna is the MFJ-1412. MFJ claims 3 dB for VHF and 5.5 dB for UHF. MFJ is giving actual dBd figures - MFJ is being honest with us.

In summary for your first mobile station, mount your radio and ground it. Connect the power to the battery or fuse block. Run good coaxial cable to a good antenna located properly. If you simply do all this, your mobile station will out perform most other mobile stations.

## **Base Station**

Everything stated above for the mobile station would apply to your base installation. The only difference would be the type of antenna and the length of the coaxial cable.

Get a good dual-band base antenna. Diamond, Comet, and Tram are typical manufacturers. Something in the \$70 price range gets you the same gain figures as the mobile antenna I reference and is adequate to start with. Put the antenna as high as practical and clear of your roof, trees, and anything else, (especially power lines).

Consider the use of a push up telescoping pole or alternatively, several 10 foot sections of rigid conduit can work well.

Coaxial cable becomes even more important now due to increased length. Going back to my RG-58 example but now using 100 feet, that 25 Watts of power is now down to 10.6 Watts. Use good coaxial cable to avoid excessive losses.

Grounding is now more important - lightning strikes are now a possibility. The coaxial cable should be grounded before it enters your ham shack (house). The easiest way to get coax cable into the house is through a window using a feedthrough panel. This panel provides a grounding lug that can be connected to a ground rod just outside the building. Do this for your safety and for the protection of your equipment.

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Pricing (what it will take for good FM dual-band Station)

Radio (used)	\$100
Radio (new)	\$200

**Mobile:**

Mobile Antenna	\$30
Magnet Mount (with coax cable)	\$50

**Base:**

Window Feed Through Panel	\$55
Power, Supply, switching type, 30 Amp	\$150
Base Antenna	\$70
Coax Cable (100ft RG-213 with connectors)	\$120
Push-up Mast (28 ft)	\$85

You can do it right mobile for between \$130 and \$250. For a good base installation, \$580 to \$680.

You are looking at a range of between \$230 and \$780 to do it right. Don't spend \$100 doing it wrong only to have to come back and do it again.

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## Summary

If you follow these guidelines you will have an effective mobile and/or base station for FM repeaters in the 2-meter and 70-centimeter bands. In my estimation, you will be doing better than 85% of hams on these bands. There are definitely ways to improve your station with more power, a better antenna, a tower, and low-loss coaxial cable. Depending upon the repeater and terrain of course, you can expect 15 to 30 miles mobile range and 20 to 60 miles with your base station. Repeaters are great but try 146.52 and talk simplex without a repeater. Your range will surprise you. Later you can try SSB on VHF and HF. There are many other facets to this hobby. I give you these instructions for FM repeaters because it seems to fit the needs and desires of a majority of new ham radio operators.

Now for that Chinese junk portable you may have already purchased - but first let's define junk.

# junk<sup>2</sup>

jəNGk/

*noun*

noun: **junk**; plural noun: **junks**

- 1 a flat-bottomed sailing vessel typical in China, with a prominent stem, a high stern, and lugsails.

See, junk comes from China. I submit that the Anglo use of the word stems from the way these boats are designed and are maintained.

**Bonus:** Do your homework and purchase a good dual-band radio that does cross-band repeat. Place the radio in this mode and use then your portable radio to access your station and talk out to a distant repeater.

There is a use for that portable radio but never as your first or only radio station.

And finally, there is a lot of advice out there and so it is difficult to know what is right or wrong. Be suspicious of "you don't really need to do that" type of advice. What I have presented here is fundamental and basic and should be considered a minimum for starters. If someone disagrees with what I've said here, ~~they are wrong~~ question them - ask why.