Newcomers and Elmers Net: Tuning In To Shortwave Radio
Oct 27, 2013 By Robert Gulley, AK3Q

Folks my age often wax nostalgic over fond memories of listening to shortwave radio as a kid, perhaps with the family gathered around the radio, or perhaps by the memory of building their first radio.

A Cultural Bonanza and a Last Line of Defense

When was the last time you turned on a shortwave radio and listened for the news from exotic lands and the music of places far away? If you are anything like me you grew up glued to a radio of one kind or another. AM radio was its own kind of magic, but broadcasts from the BBC or the Netherlands or Deutsche Welle were absolutely spellbinding! Some of these stations were as well-known among Americans as any AM station. As the world healed from its wars and we entered the space age, shortwave radio served to keep us connected with the world at large. Shortwave radio was special, not just for the education we received as we learned about distant lands and their cultures, but also because it represented a unique kind of freedom found nowhere else. It still does.

Shortwave radio has long provided its own form of governmental checks and balances; while it can certainly be a propaganda tool for some, it can be the voice of freedom for others. To this day freedom fighters in oppressed regimes rely on mobile shortwave transmitters to let the world know what governments and tyrannical leaders are doing. Information is power, and repressive governments guard the flow of information in any way they can.

Not that long ago China imposed restrictions during the Olympics as to what information could be sent or received over the Internet, presumably to protect their image. Other forms of media control are common around the world, and without shortwave radio many citizens would know nothing of the world outside their own culture. Amateur Radio and Shortwave radio really are the last line of defense in the war for information—they are the only form of communication that cannot be controlled by an out of control government. They truly are there "when all else fails."

A Little History, a Little Theory

Shortwave radio has been around a long, long time. Almost since the invention of radio folks have sought to span the globe with radio communications. What once took days or months (written messages), and then hours (Morse Code) eventually became almost instantaneous. By the 1920s shortwave radio was growing rapidly, and replacing expensive transoceanic cable (much to the chagrin of the cable companies!).

The rise of shortwave communications was due to the ever-expanding range of knowledge amateur radio operators and others were gaining as they experimented with various frequencies. Shortwave radio works on the principle that radio waves are refracted (or bounced) off of the "E" and "F" layers of the atmosphere, allowing long distances to be covered around the world. Add to this refraction the ability of radio signals to reflect off the earth back up to these same layers (known as a "hop"), and suddenly the world is literally within reach of almost any transmitter. Shortwave stations generally operate using 50,000-100,000 watts of power, enough to overcome signal losses (or *attenuation*) between multiple hops. Knowing what I can regularly achieve with a mere 100 watts of power with my amateur station, sometimes it is amazing when I *can't* hear a shortwave station!

Seasonal variations occur, of course, as do differences between daylight hours and nighttime hours. The higher ionization of the atmosphere during the day means stations operating on 120 meters down to approximately 49 meters are either difficult or almost impossible to hear well. Conversely, stations operating below 31 meters are heard much better during the day, particularly when solar cycles are best.

Because most shortwave broadcasts use AM (or *Amplitude Modulation*), the separation between stations is 5 kHz. While it is not uncommon for stations to bleed over one another, more often than not when this happens it is the result of multiple stations on a given frequency coming in to your location from various directions at the same time. Since the signals are AM transmissions, they are more prone to atmospheric noise, such as lightning and electrical/man-made noise. Fading is not uncommon, while sometimes signals will sound hollow or slightly distorted. These conditions are the result of various wave interruptions and multi-path phase shifts. While this bothers some folks, those of us fascinated by shortwave listening barely notice these slight interruptions.

Listening Opportunities

Many folks do not even try to listen to shortwave broadcasts during the day, particularly because of the interference mentioned above, but this means they are missing out on a lot of great stations! One of my favorite broadcasts to listen to during the day is Radio Australia, usually found at 9590 kHz, 9710 kHz, or 11660 kHz. Radio China International has daytime stations from 9000 kHz to 17000 kHz daily in English, as well as other languages. So too Voice of Russia broadcasts, Cuba, and of course American stations broadcast around the clock.

Metre Band	Frequency Range	Remarks
120 m	2300–2495 kHz	tropic band
90 m	3200 – 3400 kHz	tropic band
75 m	3900 – 4000 kHz	shared with the North American amateur radio 80m band
60 m	4750 – 5060 kHz	tropic band
49 m	5900 – 6200 kHz	
41 m	7200 – 7600 kHz	shared with the amateur radio 40m band
31 m	9400 – 9900 kHz	currently the most heavily-used band
25 m	11,600 - 12,200 kHz	
22 m	13,570 - 13,870 kHz	substantially used only in Eurasia
19 m	15,100 - 15,800 kHz	
16 m	17,480 - 17,900 kHz	
15 m	18,900 - 19,020 kHz	almost unused, could become a DRM band
13 m	21,450 - 21,850 kHz	
11 m	25,600 - 26,100 kHz	may be used for local DRM broadcasting

There are a number of useful shortwave listening guides (or SWL Guides) available in print form or on the Internet, and many, many sites dedicated to SWL. There is no shortage of useful information, neither is there a shortage of shortwave equipment available to enhance your listening pleasure! While daytime listening is fun, nighttime is when the bands will be so busy you will have a hard time choosing between stations, styles, and countries of origin.

Often I find myself listening first to known favorites, then going on a search for something new. I also use SWL guides to find stations and countries I have not heard before. And of course, bagging an elusive DX station is almost as fun in shortwave as it is in amateur radio. There's no question about it: for me, radio is in the blood!

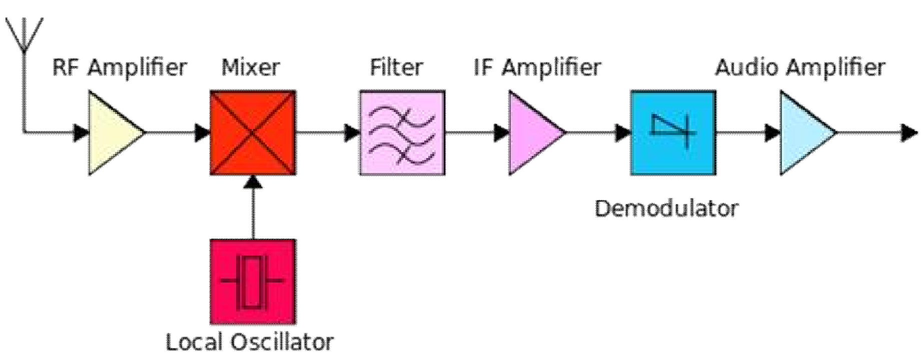
A Typical Shortwave Radio
A typical shortwave radio is one which covers from about 2.3 to 26 MHz (2300-26000 kHz), and usually includes the AM broadcast band, along with LF starting at .300 MHz. The shortwave bands are often broken up into 2 or more ranges on the radio, and sometimes as many as 5-7 shortwave bands are available. The Kaito 1103 pictured below has 10 shortwave bands plus AM and FM. (Radios mentioned in this article are for example only—no endorsements are being made!)

Most stations transmitting in the HF portion of the band are AM or *amplitude modulation*, with a few broadcast stations using SSB (*Single Side-Band*). This means almost all of the shortwave broadcasts are as easy to tune as your regular AM radio. This also means the signal is susceptible to atmospheric noise, static crashes, and some man-made interference. I will talk more about signal reception a bit later on in the article, but for now, my emphasis is on the relative simplicity of design needed for shortwave tuning.

Many radios, like the Kaito, offer multiple modes so that one radio does almost everything. Standard AM and FM broadcast stations are usually included, and many radios offer some form of tuning for amateur radio and SSB. (If you are not familiar with SSB transmissions, they represent a narrow portion of an AM signal which requires separate circuitry to tune properly.) More advanced radios offer several other options for receiving frequencies in the VHF range and/or separate modes to receive Morse Code (CW), as well as RTTY, FM transmissions in the upper bands, and possibly a digital mode for digital communications.

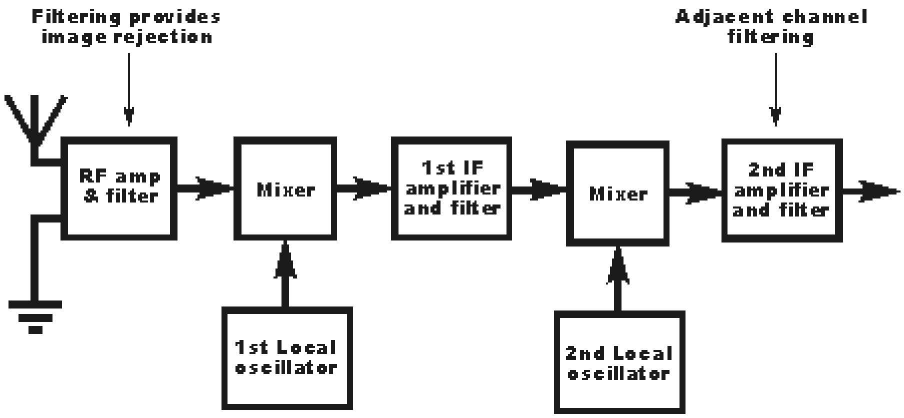
Cost
Of course the more options a radio has the more these options generally add to the cost of a radio. An inexpensive shortwave radio may sell for under $50, while advanced radios may sell for $500, $1000, or even $5000! While new radios can be quite expensive, there are hundreds, if not thousands of used radios looking to find a good home. Auction sides, mailing lists, Goodwill stores and yard sales will all turn up all levels of shortwave radios. Often the folks selling them do not know anything about how the radios work, especially if they need an external antenna, and they will turn it on but hear nothing. Sometimes you will see something like "I could tune in some AM radio stations, but everything else was just static." This usually means the radio will be sold cheap, and you may have just found yourself a real bargain!

Some Technical Jargon
Shortwave radios are usually described as single, double, or triple conversion radios, and you may also see the terms heterodyne or super-heterodyne bandied about. I'll start with the second set of terms first. A heterodyne circuit is one in which two or more frequencies are mixed, or combined, to produce a third frequency. This third frequency is allowed to pass through the radio out to the speaker, while the other elements are not.



A superheterodyne (or *superhet*) receiver shifts all incoming signals down to an intermediate frequency (or *IF*), which is then filtered and modified to produce the audio.

A *single-conversion* receiver shifts the signal (heterodyne) to one intermediate frequency, whereas a *double-conversion* receiver creates a second intermediate frequency, first high and then low, allowing optimal filtering to be accomplished at each end of the intermediate frequency.



What are the real-world implications between the two designs? In older radios before computer chip/software processing of signals, a dual conversion radio had less problems with *images* (duplicate signals received on a different frequency), and audio was generally cleaner. The additional circuitry added to the expense of the receiver, but the results were generally worth the difference in cost. With modern receivers using digital signal processing chips, even single-conversion radios can produce good sound, but dual conversion radios will have the edge in quality. Still, the cost savings may be enough to warrant buying a modern single-conversion radio if it has DSP.

Features

As one might expect, tabletop radios generally have more features and higher quality than a portable radio, but the gap is closing as newer radios incorporate a lot of technical wizardry to enhance a signal. Tabletop radios have larger speakers and therefore better audio, and their antenna options are usually greater as well. Tabletop radios often feature several modes such as CW, SSB, AM, and FM, as well as filters (sometimes optional) for widening or narrowing bandwidth as needed.

Other refinements often include the ability to shift the intermediate frequency to battle near frequency interference; noise filters to reduce or eliminate electronic hums; an attenuator circuit to keep strong signals from being distorted; pre-amps to boost weak signals; and many feature controls to monitor SSB amateur radio bands. Tabletop rigs also offer several methods for tuning, including manual dialing, automatic search ranges, and direct entry keyboards. Of course some portables have these search options as well, and in general, the more tuning options you have the better.

How do these various features enhance your shortwave listening? Since shortwave signals come from all over the world, no two signals are going to sound the same. Some stations will sound like they are right down the street from you, while others will sound like they are down in a hole somewhere with marbles in the announcer’s mouth. Sometimes nothing can help a weak or distorted signal, but modern radios offer a lot of options to help pull the weak signals out of the noise and make them more intelligible.

By having the option to move the intermediate frequency (IF) around you may be able to move a weak signal away from a stronger one, giving you a better chance of hearing them more clearly. Another use for an IF adjust option is to move away from “birdies” (whistle-like noises often the product of electrical interference or internally produced harmonics). No radio can be completely clear of birdies across a band, much less across such a wide spectrum as the HF spectrum. Good radios are designed to minimize this type of interference, but they will show up, and sometimes they show up right where you don’t want them. Moving the intermediate frequency can sometimes allow you to get far enough away that the signal you want comes through. Likewise the noise filters on a radio can help reduce interference to the point where a weak signal is copyable, such as when atmospheric noise is high.

Amateur Radio Monitoring
If listening to amateur radio signals is of interest to you (and I hope it is!), you will want to make sure your shortwave radio has the ability to receive Single Sideband transmissions. Without getting into the technical aspects of this mode, SSB signals are either Upper Sideband (USB) or Lower Sideband (LSB). Better radios will have filters for each, but some use one dial to tune between the modes.

Older radios used something called a variable BFO adjustment, or *beat frequency oscillator* to tune in SSB signals, and these work fine. Newer radios usually have a mode switch to place the radio in SSB mode, with a selector to chose the upper or lower portion of the band.

In general, amateur radio frequencies above 7.3 MHz use upper sideband, while frequencies below 7.3 MHz use lower sideband. It will make a difference in tuning if your radio has options for both.

Another difference is related to the SSB issue, and that is amateur radio signals are usually about half the frequency width of shortwave broadcasts, so the audio sounds more clipped. There are some amateurs who transmit using the AM mode, and these will sound similar to broadcast stations. In case you are wondering why hams use SSB, it is because SSB signals will go further than AM stations at the same power, and the decreased bandwidth requirements of SSB allow more users to fit in the bands, something which can be a real issue on a busy amateur contest weekend!

Listening Tip: By placing the radio in SSB mode while listening to a standard shortwave radio broadcast, you may improve weak signal reception. This is sometimes referred to as ECSS or ECR, *Exalted Carrier Single Sideband* or *Exalted Carrier Reception*. By eliminating one side of the AM signal you can reduce the fading effect common to weak signals, thereby effectively increasing the signal quality.

Antennas

While there are far more antenna options than can be covered here, don't neglect the telescopic whip of your portable radio, or the usefulness of a random wire attached to either your portable or your tabletop radio. A random wire is just that—a length of wire (speaker wire works great) strung across the room, or better yet, running out a window into the back yard, attached with an insulator to a tree or other convenient support. Attach the radio end to a screw terminal if available, or if using a portable, clipped or wrapped around the telescopic whip. While some cheaper portable radios will overload with a random wire, most will not, and can benefit greatly by a 25' or longer wire. (If your radio comes with a retractable wire use that for a start—often they will pull in more signals that just the telescopic whip.)

Another inexpensive antenna design is to use two equal lengths of wire (again speaker wire works great, and when you cut it to length both pieces are already the same length!) running in opposite directions, with the two ends closest to one another connected to a piece of 300 or 450 Ohm ladder line, available at your local radio or hardware store. The other end of the ladder line is then attached to the radio at the screw terminals. If your radio has a coax connector, use a balun (a **bal**anced/**un**balanced transformer available at any amateur radio store) to convert the ladder line to coax and connect the coax to your radio.

Resources

World Radio Handbook (also available Amazon)
http://www.wrth.com/

http://www.primetimeshortwave.com/

Popular Communications Magazine
http://www.popular-communications.com/

http://wiki.radioreference.com/index.php/SWL_Broadcast

http://www.short-wave.info/

http://ac6v.com/swl.htm

http://www.worldofradio.com/dxpgms.html

http://www.radiobanter.com/showthread.php?t=47361

New Magazine replacing Monitoring Times
http://www.thespectrummonitor.com/