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What to Look for in Buying a Receiver

A great many radios from cheap portables to expensive communications receivers will allow you to listen to the BCB. How can you determine which is best for you in your price range? First, don't assume that the more you pay, the better the radio will be for BCB DX'ing. The extra money might be going into its memories and scanning abilities, appearance, sound quality, or coverage of bands other than BCB. One way to find out would be to read the reviews in this and other books (extensive receiver reviews occur in the editions of Passport to World Band Radio and the World Radio TV Handbook. Radio Netherlands regularly airs reviews, versions of which appear in the WRTH, and which are available at their Web site at www.rnw.nl/en/pub/rxshop).

Ultimately, the best way to evaluate a receiver is to try it out (especially if it's used), preferably comparing it to a known DX'ing machine, even just a good portable radio. If possible, use the radio at your DX location before buying. Stores are often in poor signal areas with lots of electrical noise from electrical fixtures. Make sure you can get a refund or another radio if you're not satisfied, especially if you are dealing with a mail order outfit. Particularly with the portables, there seems to be some variation in quality from set to set, so don't just use a good review as a reason for buying a radio. Try it out.

Do you want small size and portability, or will you DX from one location, and so can use a larger table model receiver? Make sure the radio's power source is compatible with what you have. Some cannot be run off batteries or from 12 volt DC, others may need an AC adapter to be used on house current. Does a bank of controls and adjustments on a radio present a pleasant challenge to you as you chase DX, or would you rather have something that you merely switch on, tune, and listen to? Don't get carried away by the sight of a lot of controls; make sure they're of some use when BCB DX'ing. Do you DX or listen to bands other than BCB? Some of the expensive multiband radios could be a waste of money if you don't, as their BCB may not be any better than a good AM-FM portable. If you want to listen on headphones or to record from a radio, check that it has appropriate outlets.

Used radios are a possibility, and some of the older tube-type receivers still make fine BCB DX machines. Remember that parts (especially tubes) are getting harder to obtain. On the other hand, an inexpensive used receiver may be an interesting challenge to your technical expertise. Older solid state receivers can be a bit more of a risk, as failures may entail the replacement of modules rather than indivdual parts, and modules must be liberated from similar sets if the manufacturer no longer stocks the item. Test out a used receiver thoroughly before buying if possible, making sure that all controls run smoothly, that there are no "dead spots" on the dial, and that it can hear DX well.

Although a good radio is important to DX'ing success, remember that you won't hear DX unless the radio is switched on. Listening often and intelligently is the secret to hearing the rare ones, no matter what radio you use.

The following are some things to take into consideration once you've decided on the general type of radio that you want:

Sensitivity: This is simply the ability of a radio to receive weak signals. It is usually expressed in microvolts, such that so many microvolts of signal at the antenna terminal will give a "signal" to "signal plus receiver noise" ratio of 10 dB (all receivers have some degree of internal noise). However, the medium wave DXer should not get too excited about receivers which have excellent sensitivity specs in the order of one microvolt or less. For one thing, sensitivity specifications are dependent on the IF bandwidth used for the measurement. If that bandwidth is not specified, it can be difficult to compare two receivers using the sensitivity specifications alone. Much more important to the medium wave DXer is the fact that at BCB frequencies, external noise, not receiver noise, determines whether a DX signal can be heard or not. This external electrical noise is usually man-made, radiating from power lines etc.--just something we have to live with. A DX signal which has less strength than this noise level will be unreadable, no matter how sensitive the receiver, as the signal will be covered by noise.

So what one needs to determine is the useable sensitivity of the receiver. Try to use the receiver in the location from which you intend to DX, using your own antenna. With a receiver which has no internal loop (if the receiver shows virtually no signals, even from locals, without an antenna, it is of this type), use this procedure: During an electrically "quiet" time (daytime in winter--Sunday morning is often quietest), tune the receiver to a part of the

band with no signals, and as far away in frequency as possible from any strong signals. Note the background noise, if any, with the antenna disconnected. Then connect the antenna to the receiver. If the noise level increases, then your receiver is sensitive enough for the band and antenna you are testing--no matter what the specs say. For more detail on this topic, see "Noise Levels and Useable Receiver Sensitivity" in IRCA's A DXer's Technical Guide.

The reason for specifying that the above test be carried out away from strong signals is that local oscillator (LO) noise sidebands can limit a receiver's dynamic range. In some PLL designs particularly, the LO can produce a weak range of signals on either side of the frequency that it's supposed to be generating. These weak signals mix with the incoming signals the same as does the desired LO signal; this is known as "reciprocal mixing". A strong signal near the desired incoming signal can mix with these LO sidebands to produce mixing products within the radio's IF passband which will increase the apparent noise level the receiver hears. This in turn reduces the radio's useable sensitivity. In effect, it also reduces the receiver's apparent selectivity ("dynamic selectivity") because the receiver is responding to signals outside the passband of the IF filters, no matter how good the ultimate rejection of the filters.

Though accurate tests for phase noise involve lab grade test equipment, one can get a feel for its effect by choosing two similarly weak but steady signals, one as far removed in frequency from any strong signals, and one as close in frequency to a strong signal as possible without suffering from sideband splatter. If the weak signal next to the strong signal shows a superimposed hiss compared with the isolated weak signal, then there is probably some degree of phase noise on the LO. (refer to an article by Steve Ratzlaff (T-086), or QST of March and April 1988 or The ARRL Handbook 1989 and following years for further details on the measurement of receiver phase noise)

With a receiver that has an internal loop for BCB, useable sensitivity is harder to determine. Many receivers with such a loop can use more sensitivity. At night, tune to a clear channel with no apparent signal on it. Wrap a couple of turns of wire around the radio body and connect a random wire antenna to one end and a ground to the other. If a signal appears, make sure it is a station assigned to that channel and not one of your locals making a spurious appearance. If it is a legitimate signal that can't be heard with the radio alone, you may need some help for weak signal DX'ing. Try comparing such a radio with a known DX'ing portable like a GE Superadio, so you will get an idea of its relative sensitivity.

Selectivity: This is the ability of a receiver to separate signals which are close to each other in frequency. The specifications of a radio usually give an IF bandwidth in kilohertz between the two points on either side of the center of the passband where the signal is -6 dB down from its maximum strength. A receiver with good selectivity will usually specify the IF bandwidth at -60 dB as well. Those which only specify a -40 dB or -50 dB bandwidth generally are not as sharp in their tuning. For reasonable DX listening on domestic channels, you will want a -6 dB bandwidth of at most 6 kHz (or ±3 kHz). Smaller bandwidths of down to 2 kHz can be used, although the audio that the radio delivers will be more bassy and muddy sounding the smaller the bandwidth. But with smaller bandwidths you should be able to hear split frequencies near domestic channels. You need to know more than just the -6 dB bandwidth to know whether you can hear a split close to a domestic channel however; the shape of the selectivity curve is important. For serious DX'ing of splits, the ratio of the -60 dB to the -6dB bandwidth shouldn't be more than 3:1. 2:1 or less will allow you to tune within less than a kilohertz of an interfering signal without hearing a heterodyne; this is done by tuning to one sideband of the desired signal

However, sharp selectivity will not solve all your problems with interference from domestic channels. If you have a strong local which plays rock music and overmodulates, you may not be able to hear weak stations 10 kHz away due to the immense amounts of sideband splatter which is actually being broadcast on top of the desired channel. Sideband splash from quite distant domestics can be a problem if you're trying to ID a weak split a few kilohertz away. So don't think a receiver "isn't selective enough" if you still hear sideband splatter with it. Again, the best thing is to try the radio out (particularly if no specs are given). If you are only interested in domestics, see that semi-locals separate cleanly channel by channel as you tune past them. If you are interested in DX'ing difficult splits, you will want something which leaves substantial gaps between channels--you may hear splatter in these gaps, but no readable audio unless it is a split. As you tune past a signal on a good selective receiver, it will suddenly become readable, then suddenly unreadable again--none of the slow rising to a peak that we are used to in tuning household radios.

Signal handling ability: If you live in an urban area, this quality is probably the most important in a receiver as well as the hardest to find. There is no sense in having good sensitivity and selectivity in a radio if all you can hear is your local stations all over the band. The easiest way to check a radio for its signal handling ability is to tune across the band (again preferably using your own antenna and location) and listen for birdies (whistles that go from a high to low to high pitch as you tune past; make sure the BFO is not on). And listen for your local stations showing up on channels other than their own (spurious signals or "spurs"). If you can find out the radio's IF frequencies, use the arithmetic from "Spurious Responses and How To Recognize Them", (T-010), and calculate expected second and third order products likely to be generated by pairs of your stronger local stations. Then go to those channels, and using your favorite antenna, look for signals from those locals. Keep another radio nearby tuned to locals so that you don't have to wait for ID's on each channel. Also, check particularly the channels near to locals for any sign of the local's audio (cross-modulation). If possible, check during the day for these spurious responses, as those channels prone to overload should be clear so one can spot unwanted signals.

Don't think that a radio chock full of signals is supersensitive until you make sure the signals are not spurs. It is an uncomfortable fact that many radios, particularly multi-band ones, will show any number of these spurious responses, depending upon how many BCB transmitters are nearby. Your decision regarding a certain radio will have to be personal--how many DX channels are you willing to write off due to poor signal handling ability? Or would you rather save up your money and get a receiver with more available DX channels? Incidentally, some of the older AM portables with tuned RF amplifiers (e.g. Realistic TRF's, and the earlier GE Superadios) have strong signal handling ability far in excess of the more costly multi-band radios, so expense is not everything. On some receivers, turning down the RF gain control (if it has one) or switching in antenna attenuation will improve the situation, but make sure the radio does not lose all sensitivity as a result. A trade-off between sensitivity and signal handling ability often appears to be the only solution with some receivers.

Sometimes, external mixing products confuse the search for spurious responses. These products occur when signals from local stations are mixed and re-transmitted at some point outside the receiver (perhaps an electrically imperfect join between two pieces of metal), and even the best receiver will not eliminate them; it's as if there is actually a transmitter on this frequency. If the same "spurious response" shows up on different higher quality receivers, it is possibly an external mixing product.

On some receivers, birdies may be generated inside the receiver. This is not a signal handling problem, but can sound like it. Disconnect the antenna (if it doesn't have an internal loop), turn on the BFO and tune across the band. Whistles will indicate receiver-generated carriers. If these are strong, they may cover up DX. If a radio with an internal loop shows a number of spurs with no external antenna connected, you might be wise to reject it, as only internal modification can solve the problem. If spurs appear only with an external antenna connected, you may find an antenna tuner or use of a good loop antenna will help. For further information on this topic see "Spurious Responses and How to Recognize Them" (T-010) and "Strong Signal Handling" (T-050).

Image Rejection: An "image" is a spurious signal heard at twice the receiver's IF frequency below the actual transmitting frequency. Although many receivers use upconversion to a high first IF to control images, there can still be image rejection problems similar to those found in simple single conversion receivers, due to the broadbanded nature of some first IF filters. If the final IF is 455 kHz, search for a spurious signals 910 kHz below a strong station's frequency. Check 910 kHz above as well, though 910 kHz below is much more common. For other IF frequencies look for signals at twice the final IF above and below the strong station's frequency.

Readout: It is necessary for the DXer to know the frequency to which he is tuned, and to be able to tune slowly so that he does not skip over channels inadvertently. "Thumb wheel" type direct drive tuning found on some portables is virtually impossible to use for DX'ing and should be avoided. An arrangement where a pointer is moved across a dial by a cord and pulley set-up between the tuning knob and variable capacitor is better, as it spreads the band out. Usually these dials do not have particularly accurate markings, although an experienced DXer can usually find his way about using regular stations as markers and counting off channels as he tunes by. You can sometimes upgrade the dial yourself by putting a strip of masking tape along the top and marking off divisions of 10 or 20 kHz. High quality older radios have gear arrangements which move a dial past a pointer. On the best radios with such a dial, readout is possible to less than one kHz, provided the radio is properly aligned.

Electronic digital frequency displays are now virtually universal on all but the cheapest radios. The domestic DXer may be happy with the 10 kHz digital readouts on car radios and some portables, but others will prefer resolution of 1 kHz or better. These can give the impression of great accuracy, but check that the display is not giving readings of say, 1293 for a station on 1290 kHz. Some digital displays generate a lot of RF noise at medium wave (MW) frequencies. This noise could destroy any weak signal reception on MW, particularly if a loop antenna is used near to the receiver, so is definitely something to be checked out.

The "feel" and movement of a tuning knob are often a matter of individual taste, but the more selective receivers should allow you to tune easily yet slowly through a signal. Watch out for dial backlash--you tune in a signal, take your hand off the knob and find that the radio detunes slightly. This can be frustrating in tight tuning situations, and should really only appear as a problem with cheaper radios.

Audio quality: Hi-fi frequency response is not needed in a DX'ing radio; a DXer is usual y just interested in voice frequencies, approximately 250-3000 Hz, so response beyond this range usually just introduces unwanted noise. It is, however, important for a radio to have a good audio amplifier--when you're listening to a signal already distorted by the distance it's travelled, you don't need an amplifier that adds further distortion. Listen to speech on a semi-local--it should not sound distorted or "flatted-out" on voice peaks. If the receiver has narrow IF selectivity, audio will sound bassy or slightly muffled but should still be quite readable. This bassiness is not the fault of the audio amplifier. Tone controls or audio filters can help if the radio is so equipped. You can often make a voice sound more snappy and pleasant to listen to by using these controls, so try them out.

Stability: Does the receiver drift away from a frequency once it has been set? This is not usually a problem for a program listener; few receivers drift very far or very quickly except for just after they've been switched on (a matter of a couple of kilohertz at most). The older tube-type receivers had more problems with frequency drift than more recent receivers due to the heat generated internally. With selective receivers the problem is more acute. If you set a timer and a tape machine for a few hours later, the receiver may have drifted enough to make the desired signal unreadable by then.

In general, stability is much more important if you're interested in single sideband listening on the shortwave bands, or in ECSS techniques for MW listening. A good test for stability is to set up the receiver in ECSS mode (see above), then see if the pitch of the demodulated signal changes with time.

S-meter: An indicator of relative signal strength. It is mainly useful to the BCB DXer when he is trying to watch for a null when using a loop or phasing unit, or for peaking a loop or tuner. For best results the meter should have a wide range, i.e. it should not "pin" on every signal that is not actually down at the noise level. That way it will be easier to find peaks and nulls; it will also give you a more accurate idea of comparative strengths of signals, though on most radios such comparison must be limited to "weaker than" or "stronger than". Some feel that digital S-meters, using LED or LCD indicators, are still not as quick in their response or as easy to read as an analog meter.

BFO: The beat frequency oscillator. The BFO simply injects a signal at the IF frequency of the receiver which in turn creates a heterodyne or "beat" with the carrier of the incoming signal. It's necessary for BCB DX'ing if you use ECSS, but even if you don't, it is useful for spotting weak carriers which would otherwise be buried in noise. If your receiver has good enough readout, a BFO can help determine a signal's frequency more accurately. On some earlier receivers, switchable upper/lower sideband type BFO's showed an offset on the frequency display when the signal was zero-beat which meant that accurate frequency display was a problem. If the receiver is well designed, the upper sideband / lower sideband (USB/LSB) type BFO can allow you to switch between sidebands during ECSS without retuning..

ANL: The automatic noise limiter or noise blanker. Limiters are found mainly on vacuum tube communications receivers. Most are designed to suppress the spikes of pulse type ignition noise which is rarely a problem on BCB; if the limiter works well (some don't), it is most useful on the higher shortwave bands. Noise blankers detect a noise pulse and actually cut out the receiver during its duration. Obviously this will only work well for noise pulses of short duration, but if adjusted correctly can be quite effective on impulse noise.

Limiters and blankers are not often useful on the sideband splatter and atmospheric noise of the BCB, but try them out, just in case.

Notch Filter: This is sometimes found on the more expensive receivers, and is usually located in the IF stages. It can be used to null out an interfering carrier within the IF passband. Such receivers usually have good selectivity, so the notch filter is only needed if there are two interfering signals, one on either side of the desired carrier. One is tuned down off the IF passband, the other is eliminated with the notch filter. These filters usually require some practice to get them working well. Audio frequency notch filters are used on some receivers; these can be quite effective, but, in principle, it is better to knock down a strong interfering carrier before it reaches the detector (i.e. at the IF), where it might cause distortion in the recovered audio.

AGC: Automatic gain control, or automatic volume control (AVC). All receivers have this facility. If nothing else, it helps to keep IF amplifiers from overloading. A receiver should not take a discernible time to recover full gain after tuning through a strong signal. Some AGC systems can't handle a strong sub-audible heterodyne or flutter, and make a real mess of the resulting audio. Being able to choose a fast or slow decay in AGC time is useful, as is the ability to switch the AGC off.

Passband tuning (PBT): This can be found on more expensive receivers. The IF passband is shifted across a signal, and interference is shifted out. The width of the IF passband and the frequency indicated on the receiver's digital display do not change when PBT is used. When listening to AM, the same effect can be obtained by detuning the receiver, though with resultant change in displayed frequency. PBT is of more use in SSB demodulation, as the receiver BFO continues to track the signal's suppressed carrier during passband tuning, which it wouldn't during simple detuning.

Variable Bandwidth Tuning: This tunes the passband of one IF filter across the passband of another IF filter. Variable bandwidth tuning gives the effect of a continually adjustable width passband as the passband common between the two filters changes.. On the ICOM receivers, it was called passband tuning, which shouldn't be confused with the system described above.

Receiver Incremental Tuning (RIT) (also known as Δf, clarifier, fine tuning etc.): Found on receivers using synthesized local oscillators tuning in steps of 10 Hz or more, rather than continuously. These discrete steps can make tuning of SSB signals and ECSS quite difficult, so a RIT control should be provided for tuning between the steps. In receivers without a synthesized local oscillator, a clarifier control is simply a bandspread.

Memory: Most receivers using a synthesized local oscillator, even the simplest ones, feature memory, which allows one to call up other channels at the flick of a control. It can be very useful for checking parallel channels, as one can go from a DX channel to a stronger parallel and back again, thus eliminating the need for a second receiver for parallel DXing. Unfortunately, use of memory assumes a receiver with a broadbanded front end, and a wideband antenna (such as a random wire). If one is re-adjusting an antenna preselector or loop tuning capacitor every time a memory channel is recalled, then much of the advantage of memory is lost. In urban areas, it is not possible to use most broadband receivers on MW using a wideband antenna due to overloading problems. Shortwave (SW) parallels could be used if one had an antenna switching unit--a random wire for the SW signal, and a loop for the MW one. Where memory-equipped receivers really shine is in areas away from strong local transmitters, and DXers in such locations have developed listening techniques which take full advantage of the ability to check many channels nearly simultaneously. Check whether the memories store mode as well as frequency information; it is pretty standard in modern receivers. It is also helpful if the memory can be tuned and its mode changed once it is accessed.

Computer Interface: Many of the better communications receivers feature RS-232 interfaces which allow a personal computer to control a receiver and to log simple data from it. For many listeners, this is a needless frill, as the radio controls do a fine job unassisted, and there is not a lot of control software available. Also, the use of a computer close to any sort of antenna is asking for electrical interference problems. However, if one is has programming skills and is interested in propagation studies, or in receiving notification of

when signals are coming in on certain frequencies, the ability to monitor signal strengths automatically may be of considerable interest.

Receivers with Internal Loop Antennas: If the receiver you're looking at has an internal loop antenna for BCB, some points must be considered. Is the receiver sensitive enough with its internal antenna or will it require boosting? Can the receiver be used for nulling a signal by rotating it? Most should; there have been models that has a loop antenna which rotates separately from the body of the radio. How deep are the nulls? How easily can the receiver be rotated to take advantage of this nulling ability? Some are rather unwieldy; rotating them on one of the plastic "turntables" such as Rubbermaid makes may well make this chore easier. Is there an external antenna connector that is useable on BCB? And if it is, is there a problem with strong signal overload when it is used, and does it bypass the internal antenna (so an external loop antenna will not be affected by the response of the internal one)? Radios with internal loops can make reasonable DX receivers, but it is sometimes difficult to couple in longwires or external loop antennas for more flexibility.

