Receiver Dynamic Range (DR)

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There are three main reasons we hear splatter off-frequency:

1. The Receiver is not up to the job, but it could be.
2. The Transmitter is not up to the job, but it could be.
3. The Signal is just too close in frequency, and reasonable use of technology won't cure the problem.

The most useful specification for receivers is called **Dynamic Range (DR)**. Dynamic range (DR) tells us the ratio in decibels (dB) of the weakest signal that can be heard to the level where problems start. **Anything described in decibels is a ratio**.

Receivers

Third Order Intermodulation Distortion Dynamic Range (IM3 DR) would be the ratio of two equal level signals (creating a third-order product by unwanted mixing) to the noise floor of the receiver.

Imagine we have two strong CW signals spaced 1kHz apart, one at 1840kHz and another at 1839 kHz. As the level is increased, the receiving system has an increasingly non-linear response. The 2nd harmonic of 1840 can mix with the fundamental of 1839, and the result would be a new signal at 2*1840-1839=1841kHz. Another signal, if the two original signals are equal strength, appears at 2*1839-1840=1838kHz. (There are also sums, but they fall outside the filters and tuned circuits. We normally can't hear them, so we generally just ignore them.)

The response of this product is non-linear. The level of the mixing product increases faster than the level of either individual "real" signal.

When we can hear that "phantom signal" above the noise floor of the receiver, it adds interference to other weak signals we might be trying to hear. We reference the main signal level this occurs at to the noise floor, because that is the level where it would start to be noticeable.

Always remember actual overload is the result of the vector sum of signals in the passband of the system at that point. One way to look at it is that overload is an accumulated power problem, not an absolute level problem with one signal. This means a great number of weaker signals can cause the same problem as a few strong ones.

Higher Order Intermodulation (IM)

We can have higher order IM products, but they are always odd sums or differences. For example the 2nd harmonic of one signal can mix with the third harmonic of another, and we have 5th order products (2*F1 minus 3*F2 called fifth order because 2+3=5).

Although they can affect CW receivers, higher order products create most of our SSB receiver problems. This occurs because higher-order products fall well outside the filter passband of a typical SSB receiver or transmitter.

Blocking

Blocking is the point where we can detect a change in sensitivity or gain from a single strong unwanted signal. Blocking "pumps" the receiver gain and can actually make false clicks. We always have to be sure any click reports are given with signal levels well below the blocking point!

Blocking again is a ratio referenced to noise floor, since loss of sensitivity (either through increased noise or decreased gain) can affect readability of weak signals.

Receiver N**oise** F**loor (**NF**) also called [**M**inimum** D**iscernable** S**ignal (**MDS**)] is a measure of Sensitivity**. -135dBm is 10dB more sensitive than -125dBm. This number doesn't matter very much in what you actually hear. **The real test is if you hear a very noticeable noise increase when you connect an antenna to the receiver. If you hear an obvious noise increase when you connect an Active Antenna instead of a Dummy Load, your receiver is sensitive enough! You should check Sensitivity at the quietest time with the narrowest selectivity you use on every antenna you use.**

Contrary to folklore and hyperbole, there isn't a receiver sold today that can dig into noise more than others on CW, based on sensitivity or the use of a Digital Signal Processing (DSP) or multiple DSP systems. The exceptions are:

1. Increased selectivity will reduce noise.
2. Poor Automatic Gain Control (AGC) design or detector problems can cause mixing of signals and noise.

If you read a review that claims a receiver made weak signals appear from nowhere, you better keep a wary eye on the rest of the review. It is possible for a receiver to be abnormally bad, but it is not possible for a receiver to work better than other properly working receivers based on sensitivity.

Blocking Dynamic Range (BDR) is the point where a strong signal either 2 or 10kHz just starts to make your receiver lose sensitivity. **Bigger the BDR number the better, ESPECIALLY at 2kHz spacing. The BDR number you want here is probably around 80dB or more if you live in a reasonably quiet location and work weak signals on crowded bands.** If you run two transmitters on the same band or have a neighbor who operates near your frequency, you almost certainly need more dynamic range

Intermodulation Dynamic Range (IMDR). **This is the single most important number when comparing receivers.** This is where two or more strong close-frequency signals mix and generate a new phantom signal or multiple tones in an adjacent frequency SSB signal mix with themselves and make what sounds like splatter. The measurement is made just at the point where the phantom signal level is high enough to interfere with the weakest signal your receiver can detect. **IMDR is a measure of how badly your own receiver causes problems you** might blame on other people. Bigger IMDR numbers mean better receivers. It is most important the 2kHz number be good. The 10kHz test number doesn't mean nearly as much, because almost any radio is good enough at 10kHz or wider. Some number above 80dB is enough to stay out of trouble 99% of the time. If you are in a noisy location, you obviously need less performance. 85dB keeps most receivers at the point where poor quality external signals cause nearly all off-frequency problems. With 85dB IM3DR only a few of the strongest stations cause a receiver to make its own internal problems.