OPTIMAL USES OF ORION RECEIVER FOR WEAK SIGNAL DXING AND CONTESTING:

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There has been some confusion over how to optimally set up the Orion for its full capabilities for weak signal DXing vs. contesting vs. general-purpose operating.
We are not covering general purpose operating as essentially this is covered by the operation manual of the transceiver.

With this document, we will briefly discuss how crystal roofing filters, DSP bandpass filters, the two AGC systems in the Orion, and the DSP noise reduction interact, and how they should be set for weak signal DXing vs. contesting.

You can skip the entire document if you're merely looking for optimum initial settings for maximizing receiver performance.
If you'd like a more detailed explanation of how these all work and interact, read on.

Set AGC to programmable and use these settings for prog AGC, NR, and Xtal Filter:

Use	Hang	Decay	Threshold	NR(optional)	XTAL
Weak signal CW	0.00	40-60 dB/s	0.5 uV	3 or OFF	1 kHz
Contesting	0.00	20 dB/s	1.0 uV	OFF	AUTO

DEFINITIONS:

AGC: The AGC system in the Orion consists of two parts: digital AGC and analog AGC.
Digital AGC is used for compression of signals up to S9+30 dB – stronger than that point analog AGC also comes into play. AGC is for uniform output of a wide range of signal strengths.
If no signal appears at greater than S9+30, only digital AGC is used.

ROOFING FILTERS: Crystal roofing filters are used in the Orion for one purpose only – to prevent signals from outside the target passband from compromising the high dynamic range and third order intercept point of the receiver. They are **not** for setting the final passband.
Traditionally, transceivers have used a 15 to 20 kHz roofing filter at the front end of the receiver chain – and any signal appearing inside that roofing filter would allow compromise of close-in receiver performance
even if that signal did not appear in the receiver's passband of 2.4 kHz, or 500 Hz, or whatever the operator was using for a bandpass filter. Here is a key point:
if there is no offending signal, narrower roofing filters gain nothing for RX performance over the wider values – and in the case of the 250 Hz crystal roofing filter, could slightly inhibit readability on the very weakest signals.

DSP NR: DSP noise reduction in the Orion is an adaptive filter, using DSP algorithms, that can be used to identify desired signals in noise. The higher the value set in Orion, the faster the filters adapt, and past that point **no change** will be noted for a specific set of circumstances. More on how this is important for weak signal work below.

DSP bandpass filters:
The available 590 IF-DSP filters built into the radio, to be used together with the crystal roofing filters.

Setting up the Orion for weak signal low band DXing ("single signal DXing"):

With recent transceivers, a operator typically would set CW for a low or comfortable offset, select a narrow bandwidth filter (like 250 Hz), turn AGC to either "fast" or "off", use some setting for DSP noise reduction and start listening for weak signals. Which is fine – **except that 'typical' settings like this used for other radios simply won't use Orion to its maximum capabilities.**

An important point to ponder: There is **no one setting for RX combination (defined as roofing filter, DSP bandwidth filter, DSP NR, and AGC together) that is the correct one for Orion**.
There are good places to start – and by understanding how the operation of the high dynamic range receiver in Orion is different from other transceivers will set you on the correct path toward optimum use.

Let's think this through logically. Band conditions always vary, noise always varies, signals always vary. If you set a transceiver for one optimal setting to use it for variable conditions, would it seem logical that the operator would be using the transceiver to its optimum capability each and every time? No.

Refer back to the above definition of the use of a crystal roofing filter.
The roofing filter is used for keeping strong closeby signals from compromising receiver performance. Listening to a weak signal on a quiet band does not meet the definition of need for a tight roofing filter.
On a band where few signals are present other than a desired target weak signal, only a wide roofing filter would be necessary.
Putting in the 250 Hz roofing filter when listening to a single weak signal on the low bands gains nothing additional. In fact, it could hurt your ability to hear a noise floor level weak signal. Why?
Among other reasons, all narrow bandwidth filters suffer from insertion loss – and in the Orion, like other transceivers have for many years, we use an amplifier to compensate for crystal filter loss.
A 250-Hz filter is going to have slightly more loss than a 500-Hz filter.
Both of these narrow filters have more loss than the 1 kHz roofing filter.
The loss, after preamp compensation, is about 2 dB. **No loud signals nearby = no need for a tight roofing filter**.
Regardless of **DSP bandpass filter setting**, we'd recommend using a wider roofing filter as acceptable for weak signal DXing. The DSP bandpass filtering does not vary in gain down to the minimum setting of 100 Hz. Therefore, if there is no offending signal within 1 kHz, setting the roofing filter at 1 kHz and narrowing the DSP bandwidth to any desired value is by far the best setup for Orion for single signal DXing.

Of course, if you have a pileup 1 kHz away, perhaps a tighter roofing filter is warranted to keep those loud callers from compromising close-in performance. That's fine – but make sure that the **crystal roofing filters are centered** (see bottom of page).

DSP noise reduction in the Orion interacts somewhat with the digital AGC system. Here is why:
when turning on the noise reduction, without changing digital AGC, the receiver will get very quiet, very quickly. This is **not the desired effect** of noise reduction!
The desired effect is to identify what is signal and what is noise and improve the ratio between the two, rather than making the whole receiver quieter, signals and noise.
When DSP NR is selected, digital AGC artificially reduces the threshold setting of the digital AGC – and you will notice that the overall noise level can **increase –** but **signal-to-noise ratio improves** and that is the ultimate goal of the NR system.

In practical terms, how does it work? There are 9 different settings, and each of the 9 are used to determine only **how aggressively (quickly) the NR adapts and identifies what is signal and what is noise.** Here is the rub (and it's logical): with weak signals, it is harder for the DSP NR to determine what is noise and what is signal.
When turning DSP NR on with a setting of "1" with a signal that is very weak, it's going to take a **very long time** for the algorithm to figure out what is signal and what is noise.
For a somewhat louder signal (20 dB or more above the ambient noise level, still fairly weak) – a setting of "1" will adapt very fast! What is needed for weak signals is **more aggression**.
By starting the NR at "3" or "4", the NR will more quickly adapt to what is signal and what is noise for a weak signal. **Once the NR has adapted, for the same signal, no change in NR will be made when adjusting the value!** If you turn the DSP NR on, and just cycle through the values looking for 'best' – nothing will happen.
Because the DSP NR builds a bandpass filter to automatically reduce noise, it produces the same effect as manually selecting a very narrow DSP passband filter.

Perhaps nothing is more important than AGC setting, and
for single signal weak signal DXing purposes the programmable AGC value is probably the only setting that the operator should consider using. Put the AGC hang at 0.00 – turn it off. Why?
Because with AGC hang, the AGC will grab onto the most recent noise peak and will adjust gain to it for the hang period, then decay will begin – this is **not good**
if you're trying to listen to a signal at the noise floor and band noise is varying on top of the signal! The **threshold** value in the AGC system acts like an IF gain control for the receiver chain – turn the value low (like to .37 uV) and the receiver gain comes up, as do the signal levels. The crucial part is adjusting **decay** and **threshold**. **Decay**
is used to determine how fast the IF gain increases in the absence of a signal above the **threshold** value. For a conventional setting like 'fast' or 'off', **either on Orion or any other transceiver**, the AGC can actually clip both a weak signal and the noise! Want an example? Tune to a point on the band where there is no signal, only band noise. Set AGC hang at 0.00, threshold at .37 uV, and then start decay rate at 5 dB/s. Turn it up to 1000 dB/s (fastest setting).
Hear the background noise change? That's AGC clipping the noise at the fast decay setting.
If there's a weak signal in there at that level – you guessed it, the signal gets clipped too.

How to use the programmable AGC for optimum performance for weak signal DXing: There are two possibilities. For each, set hang value at 0.00. The first example we'll call "quick decay, variable gain" Set the **decay** to 60 dB/s (which is still fairly fast) and the **threshold** at .37 uV while listening to a weak signal. As you increase the **threshold** to higher values, it is possible that the weak signal will come out of the noise as the system gain decreases and the AGC no longer clips the weak signal and the noise! The other method is "low threshold, varied decay" to set **threshold** at a low or the lowest value for maximum IF gain, and then use the **decay**
control to adjust, starting from the slowest setting of 5 dB/s and working upward.
As decay goes faster, it introduces clipping. When listening to a weak signal with **threshold** low, advance the **decay** until the point clipping starts (audible change in the noise component and/or loss of copy of chopping of the weak signal) – ideally, you want to adjust this to just before the clipping point for maximum copy of the weak signal.

So, all that being said, how about a "set-it-once-and-leave-it" value for programmable AGC for weak signal DXing?

As noted in the graph at the top, set AGC hang at 0.00, decay at 40-60 dB/s, and the threshold at .5 uV. This ought to provide a good enough combination of settings to allow just about anything that can be audible to be detected by the radio (and likely copied as well) and allow for plenty of gain.
If you need 'just a little more', you can go in and change the AGC parameters for a given situation as described above.

While you can have an optimal starting point for programmable AGC – every signal and every noise situation is unique! This is precisely what makes this system so advantageous over traditional settings of 'fast' and 'off'.

Consider the settings we have suggested for single signal DXing: wider roofing filter, NR (if desired) at a start value of "3" or higher, use of programmable AGC, DSP bandpass filter set at any value desired.
Now consider what we started with above: conventional settings on a past transceiver of 250 Hz crystal filter, AGC fast or off, DSP NR on.
Let's say on Orion, you've put in the 250 Hz roofing filter, put the DSP BW at 100 Hz, turned the AGC to fast or off, put the DSP NR on "1", and then went to copy a single weak CW signal on the low bands.
Knowing what you now know, what is the likely result?
No chance that desired signal is going to be as copyable (or copyable at all!) as it would be with setting the transceiver to take it to its full capabilities.

To summarize for weak signal, single-signal DXing:
Use the programmable AGC settings in the table above, adjusting if needed for each situation to enhance weak signal copy.
Use the narrow roofing filters only if a loud signal is close enough to warrant it.
Gain does not vary for DSP bandpass filters – use any value down to 100 Hz you feel comfortable with. For weak CW signals, either leave NR off or start NR at a setting of "3" or "4" for quicker adaptation.
Make sure the narrow roofing filters, if you choose to use them, are centered using the C.F. controls in the menu**. Make sure the signal you are listening to is zero beat at the CW offset you have selected.**

Setting up the Orion for contest operation:

Generally, contesters are not going to want to be fiddling with controls during the course of the contest like DSP NR, AGC, etc. unless it's to quickly adjust some parameter for a given situation.
The needs of the contester are somewhat different from the single signal DXer.
The contester needs the radio to be set for a somewhat optimum set of values to meet these criterion: 1) the ability to copy both weak signals and loud signals with AGC good enough to minimize the output variability between the two. 2) The minimization of loud nearby signals having an effect on overall receiver performance and 3) having an reasonably optimum 'start' setting that will keep the operator from having to constantly adjust controls on the radio.

Now, these goals are not common to single signal DXing.
At first thought, it would seem that what would be good for single signal weak signal DXing would also hold true for contesting – and perhaps for previous transceivers there was an element of truth to that.
Actually, though, what would be good for copying a varying ratio of signal strengths under crowded band conditions is not at all the same as copying one weak signal with a Beverage receive antenna under quiet (non-contest) conditions.

Recommended start settings for CW contesting: In the menus, set "Xtal Filter" to AUTO.
This will bring in the desired roofing filter automatically as you adjust the DSP BW filter settings across the value of the roofing filter.
Likely loud signals are going to be present nearby, and minimizing them as a factor in overall receiver performance is paramount. This is where **every other radio fails** under contest conditions.
That S9+30 dB CQer 3 kHz up the band from you? It's **killing**
the receiver performance of other radios, even though the operator doesn't hear the signal through the **bandwidth** filter.
With the narrow roofing filter, the **Orion has no negative reaction to the same signal**
– preserving receiver performance down to the smallest bandwidths needed for optimal contest operation.

Programmable AGC can also be of tremendous value as it gives the operator the ability to determine **in his head** what large signal strengths can be accommodated.
It also will prevent fast AGC action from chopping up weak signals present in the passband, which can happen with conventional AGC settings.

Setting programmable AGC value is a little more tricky for contest operation.
Obviously, you want a good amount of gain through the system, but limit the ability of strong signals to 'blast the operator' in between listening to the weak ones.
Setting the AGC hang value again to 0.00, a good starting point for threshold value would be approximately 1 uV with decay at a somewhat slow value to prevent signal clipping of the weak ones as noted in the 'weak signal DXing' adjustments for prog AGC.
This will allow good copy of the weaker signals but allow the AGC system to compress loud signals and give uniform signal output for both the weak and loud signals.
Of course, there are times when digging out the weak ones is part of contesting as well, and the prog AGC settings for weak signal DXing may be of use, but setting the most optimal AGC setting for any one signal is not always the most practical during a contest. **Setting prog AGC at 0.00 hang, 20 dB/s decay and 1 uV threshold is a good starting point** but individual operators will want to vary them according to taste and to account for what band you're operating at the moment.

Where do I set the DSP NR?
Obviously, with signals coming in and out, if you choose to use NR it should be at a higher setting like "3" or "4" to allow very quick adaptation of each appearing signal. Setting it very high to start could result in signal distortion (particularly on SSB), but setting the value too low may not allow it to act quickly enough on the weaker signals. There is another choice, of course, and that is to simply leave it off – and with the Orion's RX capabilities individual operators may find this to be the best choice of all.
Remember, like all adaptive DSP noise reduction, sometimes it helps, sometimes does nothing, sometimes hinders. It all depends on signal and noise at that particular moment. Each operator will use or not use to taste.

The Orion is different, for a lot of reasons, than transceivers that have come before it.
Please don't hesitate to contact us via telephone or email if we can help you make the most of this innovative new

transceiver.

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additional note:
Proper centering of roofing filters: DSP filters are all the ‘same’ but crystal filters can vary somewhat in tolerance. To center them is easy. Set your CW offset to desired value. Tune in a carrier of reasonable strength (S7 is good), at your CW offset. Go into the menu and turn the appropriate filter on with the “Xtal Filter” control. Adjust MULTI knob for signal peak.

You will not have to re-adjust these unless you do a subsequent master reset of the radio.