

POWERSDR™/OPENHPSDR USER NOTES

This document is intended to describe the operation of certain PowerSDR™ features that are unique to HPSDR or have been modified / improved and operate differently on HPSDR hardware than on other hardware platforms.

Table of Contents

POWERSDR™/OPENHPSDR USER NOTES	1
AGC – Automatic Gain Control (NR0V, 2012-11-23).....	2
The Basics.....	2
AGC Presets.....	2
Panadapter Controls	3
Custom Settings	3
Gain Details / Example	3
AM/SAM – Demodulation (NR0V, 2012-10-30).....	4
AM – Modulation (NR0V, 2012-10-23)	5
Automatic Noise Reduction (NR0V, 2012-10-07)	5
Automatic Notch Filter (NR0V, 2012-10-07).....	6
Transmit ALC (NR0V, 2012-10-23)	6

AGC – Automatic Gain Control (NR0V, 2012-11-23)

The Basics

Received signals may vary in strength by several orders of magnitude. The AGC automatically adjusts the gain applied to signals such that the audio volume is relatively constant independent of the of the received signal strength. To maintain excellent audio quality, gain changes are not instantaneous; gain changes follow exponential curves defined by time constants. Gain changes LEAD changes in received signal strength—this ensures that the audio output never overshoots or undershoots the appropriate levels.

This is a single-attack, dual-decay system meaning that a single time constant is used to decrease the gain and two different time constants are available to increase the gain. The attack time constant and the normal-decay time constant are user selectable while the fast-decay time constant is set as an internal parameter. The fast-decay time constant is employed following a fast impulse, i.e., a noise “spike”, so as to prevent the AGC from blocking a weak signal during the time-span of a normal-decay from the transient.

“Hang” functionality is incorporated to delay an increase in gain in certain situations, for example during a brief pause in speech of a strong SSB station. This maintains quieting during the pause by holding the gain constant during the hang-time.

Gain Slope functionality allows a user-selectable amount of gain above the “knee” or “threshold” at which the AGC begins to limit gain. This allows, for example, a very strong signal to sound somewhat louder than a strong signal.

AGC Presets

Several presets are found under the AGC pull-down on the radio front-panel.

- Fixed: AGC is turned OFF. The gain is fixed rather than the AGC automatically adjusting it. The Fixed Gain adjustment appears in place of AGC Gain on the front-panel. Use care when switching to this mode! With no gain reduction applied by the AGC, very high volumes can result depending upon the Fixed Gain Setting.
- Long: The attack time-constant is 2ms; the normal decay time-constant is 2000ms, hang is enabled with a hang time of 2000ms. Note that the “time-constants” are really that, i.e., it takes several time constants for complete gain adjustment. The hang-time is NOT a time-constant, it is a fixed time.
- Slow: Attack $\tau = 2\text{ms}$; Normal Decay $\tau = 500\text{ms}$; Hang Time $t = 1000\text{ms}$.
- Medium: Attack $\tau = 2\text{ms}$; Normal Decay $\tau = 250\text{ms}$; Hang is DISABLED.
- Fast: Attack $\tau = 2\text{ms}$; Normal Decay $\tau = 50\text{ms}$; Hang is DISABLED.
- Custom: Uses the “custom” settings on Setup Form -> DSP -> AGC/ALC.

Panadapter Controls

There are two controls that can be enabled to appear directly on the panadapter—AGC Max Gain and Hang Threshold. The controls can be enabled in “Setup Form -> DSP -> AGC/ALC”. Note, however, that the HANG is permanently disabled and will not appear in certain of the AGC Presets.

The AGC Max Gain is the maximum gain that the AGC will apply to increase the strength of a signal. This operates somewhat like the RF Gain of an analog radio. By grabbing the box at the left-end of the “G” line, one would normally set this level a bit above the noise floor on the panadapter.

The “H” line is to set the hang threshold. If a signal has sufficient strength to cross the H line, a hang will be invoked. Moving this line to the top of the screen effectively disables Hang.

Custom Settings

Under “Setup Form -> DSP -> AGC/ALC”, the attack and normal-decay time-constants, hang-time, hang-threshold (also on the panadapter), Maximum AGC Gain (also on the panadapter and front-panel), and slope can be independently adjusted.

Slope has a range of 0dB to 20dB. At 0dB, there is no slope and all signals will be limited to the same output level. At 20dB of slope, an extremely strong signal could produce 20dB higher output volume than a signal just meeting the AGC threshold. Settings of 6dB to 10dB may be preferable.

Gain Details / Example

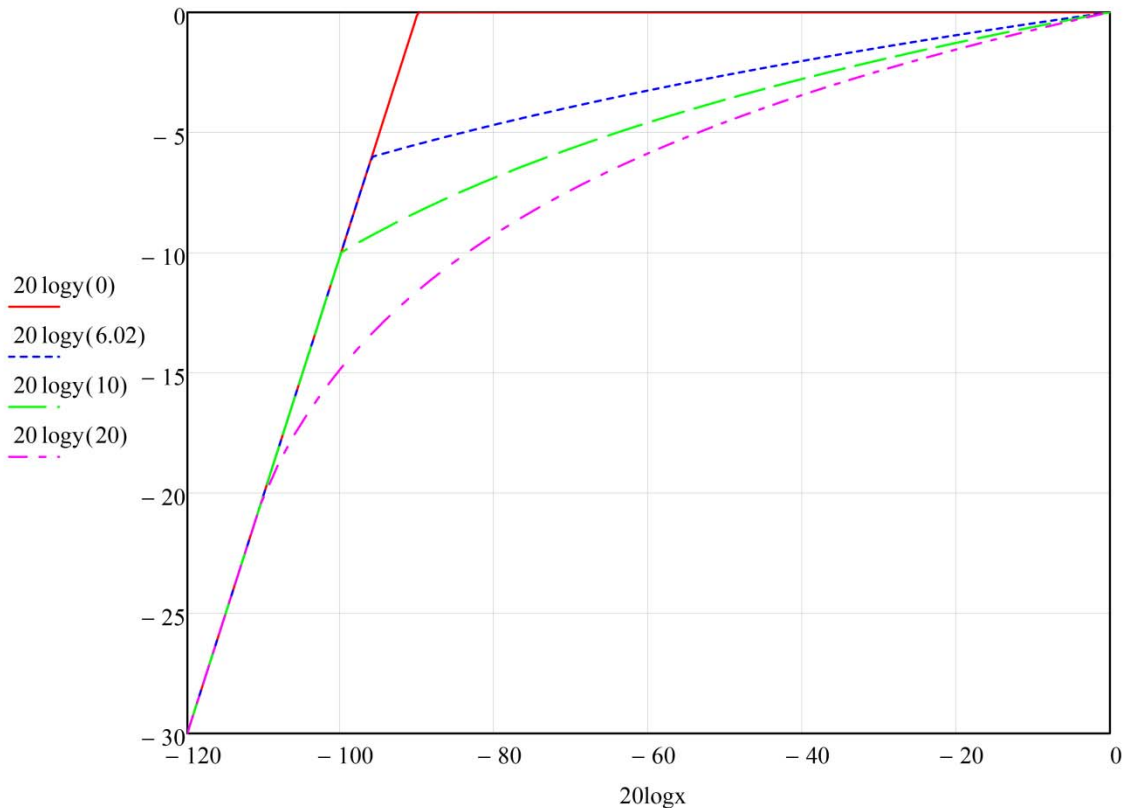
For those who really want to understand how the AGC controls gain, the following example is provided.

Shown below is the gain response (output versus input) for this system with an AGC Gain setting of 90dB. Four different potential output responses are shown corresponding to four different Slope settings. The Slope settings are the values in parenthesis for each output curve.

Note that, in each case, the Slope setting is the amount of available gain between the knee of the curve and the maximum output level. All curves converge at the maximum output level at the upper right corner of the graph.

As noted above, in this example, AGC Max Gain is set to 90dB. This value represents the gain below the respective knee of each curve. The 0dB-slope curve clearly displays that, at an input of -90dB, the output is 0dB, i.e., there’s 90dB gain.

AGCT := max_gaindB = 90



Note that if, while listening to a signal, you increase the slope setting, the volume of that signal will reduce. This is to “make room” for higher volumes of stronger signals. This effect is reflected in the above graph but may be a surprise to operators until understood.

AM/SAM – Demodulation (NR0V, 2012-10-30)

- For AM Demodulation & SAM Demodulation, the “Fade Leveler” function will often reduce fading and improve the audio for AM. It operates by removing the fading carrier and replacing it with a much more stable carrier. Note that if this function is used with the Automatic Notch Filter, you may wish to select the “Post-AGC” option for the ANF. Otherwise, the ANF will notch out the carrier before the AGC and therefore the carrier will not have the intended quieting and stabilizing effect.
- For SAM Demodulation, Sideband Selection (LSB+USB, LSB, or USB) is available. If interference exists on one side of the AM signal, the alternate sideband may be selected to avoid the interference. Selecting a single sideband also sometimes eliminates the “flutter” occasionally heard on AM signals.

AM – Modulation (NR0V, 2012-10-23)

- As with all other modes, it is strongly recommended that for AM operation the transmit ALC be enabled.
- The carrier level control on the Transmit setup tab adjusts the ratio of carrier to audio.
 - The normal setting is 100.0. At this level, assuming sufficient mic gain, you will achieve 100% modulation. The ALC limits the audio such that you will not exceed 100% modulation. At this setting, with no modulation, the ALC meter should show -6dB.
 - When another station is receiving you with a synchronous detector, you may be able to reduce the carrier level and, assuming sufficient signal strength, the synchronous detector may still be able to lock on the signal and demodulate it correctly. Note that this reduction in carrier will produce distortion on a normal AM detector. At a carrier level of 0, you have no carrier, i.e., you are transmitting DSB.
 - If you wish to modulate at less than 100%, increase the carrier level above 100. The ALC will reduce the audio accordingly such that the total signal remains within the limits required by the HPSDR transmitter card.
- Note that the modulation algorithm prevents “carrier shift.” This means that the carrier level will NOT vary based upon the level of the modulation.

Automatic Noise Reduction (NR0V, 2012-10-07)

- Expectations:
 - LMS Noise Reduction algorithms work best when the signals already have a good signal-to-noise ratio; they can be very effective in providing a quiet background under these circumstances. This is really their purpose.
 - It is unlikely that you will be able to pull an otherwise unreadable signal out of the noise with this type algorithm.
 - This algorithm is CPU intensive. The CPU load increases with the number of taps and with sample rate.
- Use:
 - Set the AGC Gain line just above the noise floor for best operation. (So AGC doesn't undo what the ANR is trying to do.)
 - Baseline values to try FOR 192K SAMPLE RATE:
 - Taps = 256 (increase to expand frequency range, generally reduces noise)
 - Delay = 64 (generally increase to reduce noise)
 - Gain = 100* (decrease to reduce noise)
 - Leak = 100 (Increase to reduce noise)
 - *Lower values of gain may work very well on CW signals.
 - The Pre-AGC position in the processing pipeline should generally be used. Post-AGC may work better in certain situations, for example, fast QSB.

Automatic Notch Filter (NR0V, 2012-10-07)

- Expectations:
 - This algorithm is CPU intensive. The CPU load increases with the number of taps and with sample rate.
 - Increasing gain allows the algorithm to more effectively lock onto and notch carriers. HOWEVER, at higher gains the algorithm will begin to generate distortion on speech. I.e., there is a tradeoff between notching effectiveness and speech distortion.
- Use:
 - Baseline values to try FOR 192K SAMPLE RATE:
 - Taps = 256 (increase to expand effective frequency range)
 - Delay = 64 (lower to increase maximum effective frequency)
 - Gain = 200 (increase to more effectively lock onto carriers)
 - Leak = 100
 - The Pre-AGC position in the processing pipeline should generally be used. Post-AGC may work better in certain situations, for example, fast QSB, or when listening to AM with the Fade Leveler enabled.

Transmit ALC (NR0V, 2012-10-23)

- ***IT IS STRONGLY RECOMMENDED THAT TRANSMIT ALC ALWAYS BE ENABLED.***
- With HPSDR, it is necessary to limit the signal transferred to the transmitter hardware to below a particular level; otherwise, very broadband splatter can result. The transmit ALC does this limiting.
- Proper operation of the ALC is indicated by the fact that the ALC Meter will not exceed 0dB.
- Normal settings for ALC parameters are:
 - Attack = 2ms
 - Decay = 10ms
 - Hang = 500ms