

Use An ALC Meter To Avoid Distortion & Interference

Advice From Two Ham Radio Experts

An Automatic Level Control (ALC) circuit governs the signal strength going into the power amplifier in a ham radio transmitter. It keeps the amplifier input in the designed range for linear operation.

Depending on the ALC circuit design and how hard it is driven (by the microphone output level and mic gain setting), the ALC circuit can distort the signal and cause interference.

This article is about how to operate a transmitter at the optimum point—where the average signal level is as high as possible without noticeable distortion or interference. The key is knowing how to use the ALC meter.

Choosing an optimum amount of ALC activity is easy if the radio manufacturer tells you the ideal ALC meter reading. The Elecraft K3, Flex Radios, and Yaesu FT DX-3000D are good examples.

It's not as easy when the recommended range on the ALC meter is wide. You might be tempted to operate at the top of the range for a more powerful signal, but the signal quality may suffer.

This article summarizes practical advice about using an ALC meter from two experts on amateur radio signal quality.

The final section summarizes access to ALC meters for blind and vision-impaired hams.

The article does not apply to digital modes, such as PSK31, that are more sensitive to nonlinearity from ALC action than are voice modes.

The Experts

Julius Jones, W2IHY, and his company W2IHY Technologies (<http://www.w2ihy.com>), produce high quality audio equipment designed to work with ham radios. He has listened to the signals of hundreds of hams while helping them set up their radios and his products. He also has hands-on experience with Icom 756PRO-series radios of his own, and he was kind enough to answer my questions about ALC.

Martin Ehrenfried, G8JNJ, is an electrical engineer who has written many excellent articles on ham radio topics. The article, (<http://g8jnj.webs.com/FTALC.pdf>) Audio Processing and ALC in the FT-897D (pdf), describes his research and gives advice on optimum microphone gain and processor settings. His study was prompted in part by low transmitted average power levels.

Average Power Of SSB Signals

The average power of a typical single sideband signal is much lower than the peak power. For uncompressed speech a typical SSB peak to average power ratio is 14 dB. Audio processing can improve this ratio, but depending on the radio and on voice characteristics, a typical signal peaking at 100 watts might have an average power of only 4 - 10 watts.

A High ALC Reading Is Tempting

G8JNJ found that "with modest ALC action" the average output power from his FT-897D for a single sideband phone signal was 10 dB below a single tone at maximum peak power. By amplifying the audio input and pushing the ALC reading to the top of the scale, he could increase the average power by 3 dB.

Which raises the question, what is the optimum ALC level for your radio?

Signal Distortion

The clarity of your signal depends in part on the particular ALC circuit in the transmitter and how hard it is driven (as indicated by the ALC meter reading).

For radios with a wide recommended range on the ALC meter, W2IHY advises keeping the ALC reading in the lower part of the range to avoid distortion. For example, he reports that Icom 746/756 PRO-series radios can produce noticeable distortion when the ALC reading is in the upper part of the bracketed range on the meter scale.

His warning is borne out by my tests with an IC-746PRO. In Monitor mode I recorded the audio signal from the earphone jack using Audacity software. With the mic gain high enough to drive the ALC reading into the upper third of the range, speech is muffled—noticeably less clear and crisp.

This result matches guidance in the Icom user manual. With the stock Icom HM-36 microphone, the recommended mic gain control setting is between 10 and 12 o'clock. That corresponds to ALC readings in the bottom half of the range bracketed on the meter.

Interference

Interference on adjacent frequencies is another problem with high ALC levels. Your contact will not hear this splatter, but hams operating on nearby frequencies might, and it can show up on a bandscope.

The transceiver testing authority, Rob Sherwood, NC0B, describes in his Dayton Contest University 2008 video (<http://www.sherweng.com/index.html>) the ALC-caused splatter from his mobile rig at the default settings.

In one test G8JNJ turned up the audio input to his FT-897D so the ALC meter reached the top of the scale. A spectrum analyzer connected to a second radio showed a 20 dB increase in his signal 10 kHz from the carrier. His article (<http://g8jnj.webs.com/FTALC.pdf>) includes a photo of the broadened signal spectrum.

Additional Speech Compression

Ideally, compression increases the perceived volume of speech and the average power. However, when G8JNJ fed compressed audio into the FT-897D, phase distortion in the radio triggered the ALC circuit, resulting in minimal improvement in the average power.

By contrast, some hams report their average signal power is 30 watts or more at 100 watts peak power, and they get good signal reports. This demonstrates a wide variation in the performance of

speech processors and ALC circuits.

On my Icom 746PRO, mid-range COMP settings (corresponding to low COMP level readings on the multi-meter) cause noticeable distortion of the audio.

Signal Intelligibility

Single sideband audio components in the 1600 - 3200 Hz range have a big effect on signal intelligibility (<http://g8jnj.webs.com/speechintelligibility.htm>). Some microphones enhance these frequencies, and some radios have built-in equalizer functions. External audio-quality speech enhancers, such as the W2IHY 8 Band Audio Equalizer (<http://www.w2ihy.com/equalizers/8-band-audio-equalizer.html>), are also available.

Access To ALC Meter Readings

For blind and vision-impaired hams, spoken ALC meter readings are available from some radios:

- (1) Precise multi-meter measurements can be read using the HamPod K3 Reader (</hampod-k3-reader/>), Icom Reader (</hampod-icom-reader/>), and Kenwood Reader (</hampod-kenwood-reader/>). The K3 Texter (</elecraft-k3-texter-program/>) program works with K3's.
- (2) The Kenwood VGS-1 (</ts-590-swr-power-announcements/>)

Voice Guide accessory can announce multi-meter readings from the TS-590S.

(3) The Kenwood TS-990S has a standard voice guide feature ([/kenwood-ts-990s-voice-guides/](#)) that announces multi-meter measurements.

A number of programs can display a multi-meter graphically on a computer screen, where it can be magnified. In the [HamRadioAndVision Table of Contents \(/home/\)](#) there are two groups of articles with details—the Rig Monitoring section and the Transceiver Multi-Meter section.

Conclusions

- The ALC meter is an important tool for finding the best mic gain. Check the operating manual for recommendations. Many, but not all, radios are designed to work best when the ALC meter indicates only minimal activity.

- Both experts advise keeping ALC activity low—setting the mic gain so the meter just shows ALC activity on your voice peaks (eg, 3 - 4 bars on the FT-897D).

- Alternatively, use a wattmeter to find the point where the peak power stops increasing as you turn up the mic gain, and operate just below that gain setting. Note that the average power continues

to increase with mic gain, well past the onset of ALC activity. Use the ALC meter, and avoid the temptation to maximize average power.

- Speech compression circuits (sometimes called speech processors) can cause distortion that decreases the intelligibility of your signal. G8JNJ advises turning off compression in the FT-897D unless your signal to noise level is low because of band conditions.
- If possible, use a second radio or the monitor function on your transceiver to listen to recordings of your audio.
- Collect on-air signal reports in a variety of band conditions.

For More Information

Audio Processing and ALC in the FT-897D

(<http://g8jnj.webs.com/FTALC.pdf>) by G8JNJ

Improving the Intelligibility of SSB Transmissions

(<http://g8jnj.webs.com/speechintelligibility.htm>) by G8JNJ

The Abominable ALC (<http://www.sm5bsz.com/dynrange/alc.htm>)
by SM5BSZ

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