

Add AGC to the uBITX

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Who Needs AGC?

Commercial rigs generally have automatic gain control (AGC) that seeks to maintain a constant volume for signals of any strength, except for perhaps the weakest signals. It is a creature comfort many of us are used to. The uBITX receives just fine without AGC. But you will notice that when receiving weak signals you may have the volume control turned up to 70% full volume or more, while the largest signals have you using the volume at 5% or less. I find this behavior most annoying when tuning across the band or suddenly when a huge signal stomps on the small signal I am copying. I don't mind using the volume control to copy smaller signals, but I added this AGC to address the loudest signals. Even this 'soft AGC' is a nice improvement, and may be all you need.

Typical AGC Practice

In classic analog technology receivers AGC is implemented often at the first IF, just passed a narrow filter. The reason to have it after the filter is so it only gets exercised based upon the narrow band of frequencies near the signal being received. Doing this up front means that circuitry after this is less taxed by the burden of addressing large signals. To cover the full range of possible signal strengths a good AGC system needs to operate over 70 dB or more dynamic range. In many new rigs part of the AGC action may take place in digital signal processing.

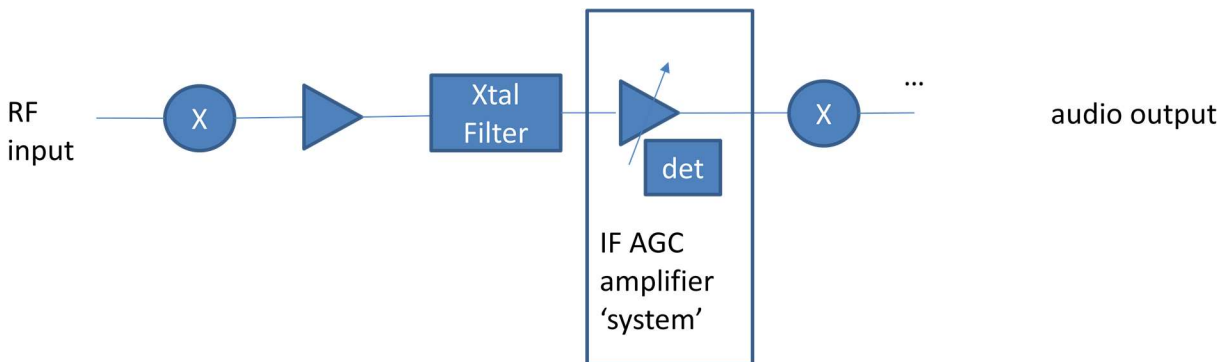


Figure 1. **A typical rig contains a sophisticated AGC circuit typically located soon after a narrow IF filter.**

AGC circuits may use an integrated circuit (IC) but they are not very common at typical IF's used in ham gear. A classic IF AGC amplifier the MC1350 is getting scarce except maybe in ham junk boxes. Usually 2 chips are required to get the sought after AGC dynamic range. A few years ago W7ZOI designed a very nice circuit known as the hybrid cascode amplifier (or HYCAS) using discrete transistors. I built one of these for use in a homebrew receiver, still in progress. It is nearly as complex as the entire uBITX receiver!

The uBITX design does not easily lend itself to inserting a conventional IF AGC circuit (nor a CW bandwidth crystal filter either). This is because the unique design of the uBITX employs bidirectional amplifiers (also described in the past by W7ZOI). These 'bidi' amplifiers allow key functions like mixers and crystal filters to be shared between transmit and receive without needing RF switches, greatly simplifying the uBITX. However, integrating an AGC amplifier in place of the receive portion of the 'bidi' amplifier is a difficult design project on its own. As a result the most common AGC solutions for the uBITX use an audio amplifier technique.

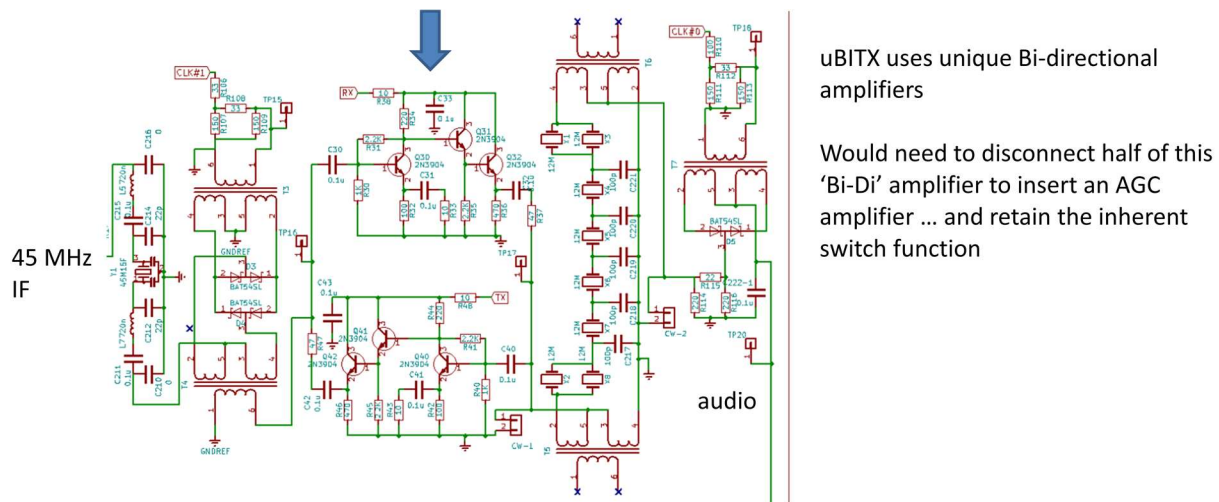


Figure 2. Unique bidirectional amplifiers make integrating a typical IF AGC circuit not so easy.

A Simple But Effective AGC

I confess I was a bit skeptical when I was introduced to this circuit via YouTube video, and moreso when my first attempts did not work very well. I laid the board aside and moved to other things, including trying the ND6T AGC that I was also disappointed with. A little research on who had succeeded with this circuit led me to email exchange with G4AQB and W0PWE. My mistake was about not knowing how to integrate it into the uBITX. The proper approach is to not change anything in the uBITX, but attach this circuit direct to the volume control. When attached to the uBITX I am impressed with the result. I still need to adjust the volume control to receive weaker signals, but tuning and operating are much more enjoyable amidst large signals.



Figure 3. **The AGC circuit is assembled on a small board and wired directly to the volume control.**

The circuit works by adjusting a light dependent resistor (LDR) that is in parallel with the volume control. The LDR needs to provide a much lower resistance than the volume control pot – something that is a few hundred ohms when well illuminated. The first LEDs I tried were not bright enough, then I spotted a small LED with a clear cover from some discarded consumer item – it is much brighter and has a red illumination. It is placed very close to the LDR. The signal level is sampled by an attachment to the center of the volume control, representing the level presented to the operator. This signal is amplified to drive the LED. Very important in my tweaking is the series resistor (27k) from the sampling point back to the amplifier circuit. The original value in the circuit described by VK3YE had too much interaction between the volume control and the resulting AGC action. The larger value I used provides a nice response. Possibly you may need to experiment with this value some for your selected LED and LDR. I redrew this circuit from the original to better illustrate its integration with the volume control.

While I was tuning the uBITX with minimum volume when wearing headphones, now it is set around 25% - much better for also hearing weaker signals. The response time is driven by the persistence of the LDR and seems rather nice.

I am not aware of anyone currently selling a board for it. This circuit can be home constructed any number of ways – using a vector board with preexisting pads, making pads with a dremel tool on an un-etched board, manhattan style that involves super gluing little pads on un-etched board, or classic ugly dead bug style. All these techniques are suitable and described on line.

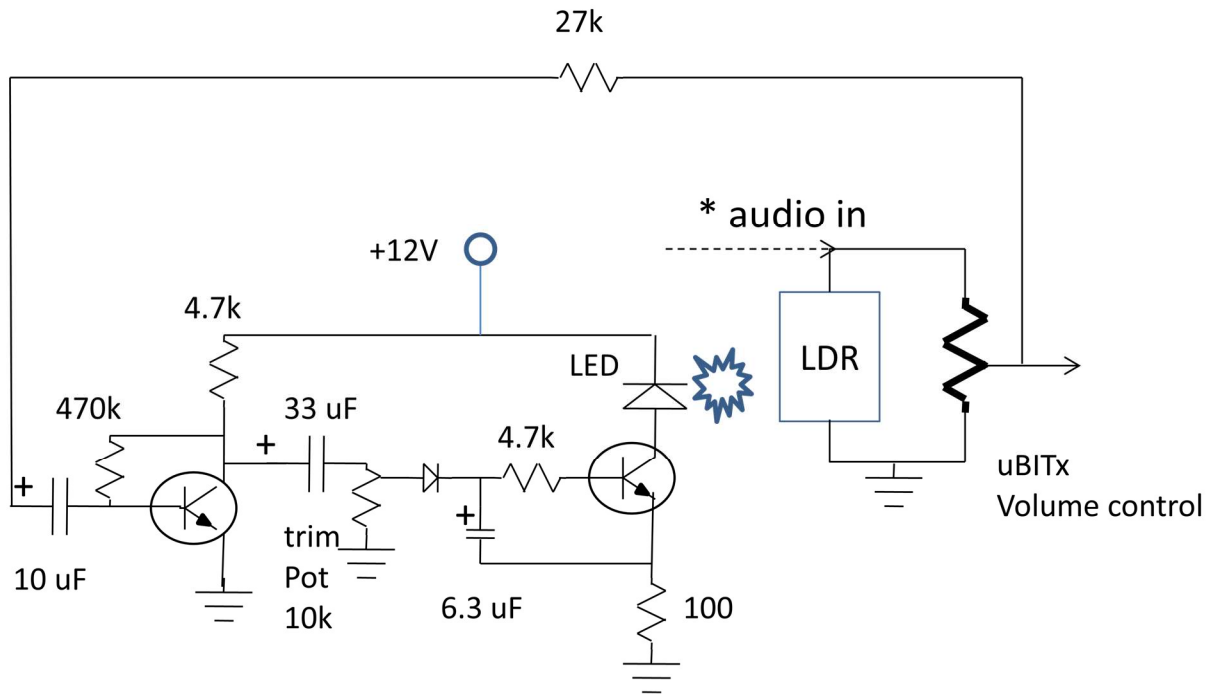


Figure 4. **This unique AGC circuit works remarkably well. There are only 4 connections to the uBITx, 3 to the volume control and a connection to 12 volt bias.**

The transistors can be any common NPN such as 2N3904 or 2N2222, likewise the diode can be any silicon device. Any electrolytic caps at 10 or more volts should work and these exact values may not be required. The one adjustment a trimmer potentiometer sets the sensitivity of AGC onset. Some experimenting with LEDs to obtain a very bright one may be necessary along with trying whatever LDRs that can be found, my version may be yet be fully optimized.

References

1. See Peter Parker (VK3YE) videos that demonstrate this nifty circuit on youtube.
2. The hybrid cascade AGC amplifier by W7ZOI is quite complex, the opposite paradigm, described in December 2007 QST.