A Simple, Adaptable AGC Circuit for the Simple High-Frequency Communications Receiver

This circuit is also useful with other home-built receivers.

James Forkin, WA3TFS

My simple high-frequency communications receiver (see the lead photo), which was featured in the May 2020 issue of *QST*, has manual gain controls that must be adjusted when the signal levels are of varying signal strength. An automatic gain control (AGC) circuit would keep the audio output at a more consistent level on weak signals and attenuate the audio when the incoming signal is at a much higher level, thereby eliminating the need to readjust gain manually. This simple AGC circuit meets that need.

The circuit retains the manual gain control function, and also provides an output to drive an S-meter. Two different AGC outputs are provided. One increases level when a loud signal is received, and a second one decreases level on a loud signal. The second output is used with my simple high-frequency communications receiver.

The Circuit

The design (see Figure 1) uses a handful of readily available and inexpensive through-hole parts. A 1.35 × 2.45 inch PCB is available at **www.wa3tfs.com**. You could also wire it on perf board; my board layout is on the *QST* in Depth web page at **arrl.org/qst-in-depth**. Provide a good ground plane for best performance.

Three potentiometers allow full adjustment of AGC action. One is used to set the point at which AGC action is desired. A second provides adjustment to calibrate an optional S-meter, and a third sets the level of attenuation when a strong signal is present.

The input to the AGC circuit connects to the top of the existing receiver volume control, which is the output from the audio pre-amp. Potentiometer R8 sets the threshold point where AGC action begins. The signal is amplified by Q1 and rectified by D1 and D2. The rectified signal charges C6. The dc voltage level stored on C6 varies with the incoming audio level. It is then amplified by Q2 and, if desired, optionally drives the positive input of a 1 mA full-scale S-meter. The negative S-meter lead connects to ground. Potentiometer R9 adjusts the level to calibrate the meter.

The amplified signal also passes to Q3, which is connected to the receiver board at R8 of Figure 2. As signal level increases, Q3 begins to turn on. As input signal level increases, the AGC board draws more current. Less current flows through D2 of Figure 2 on the

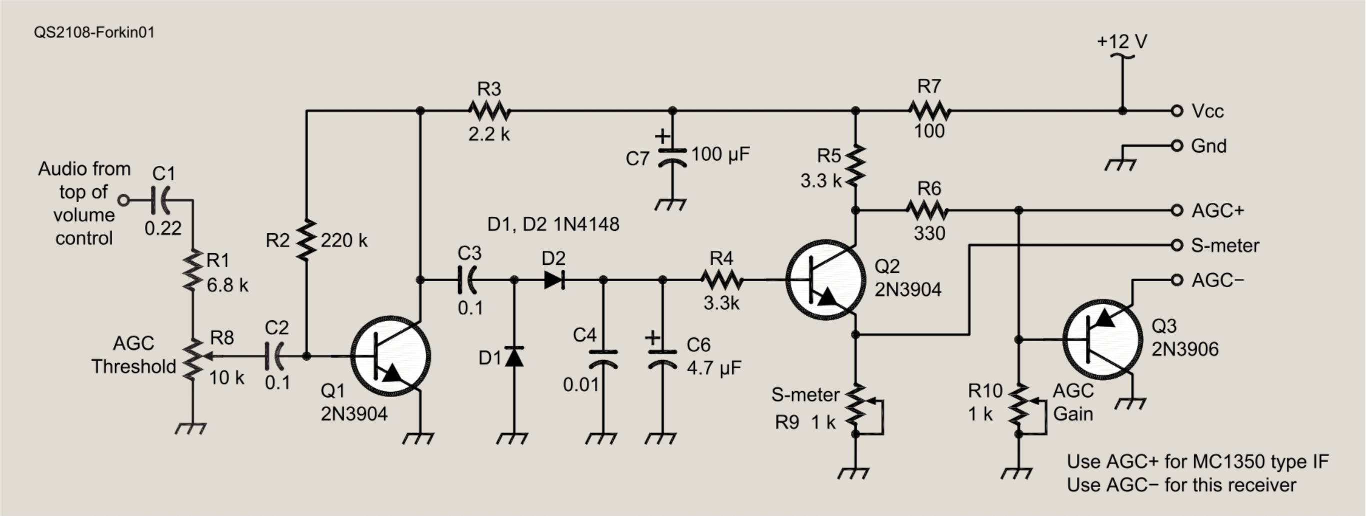
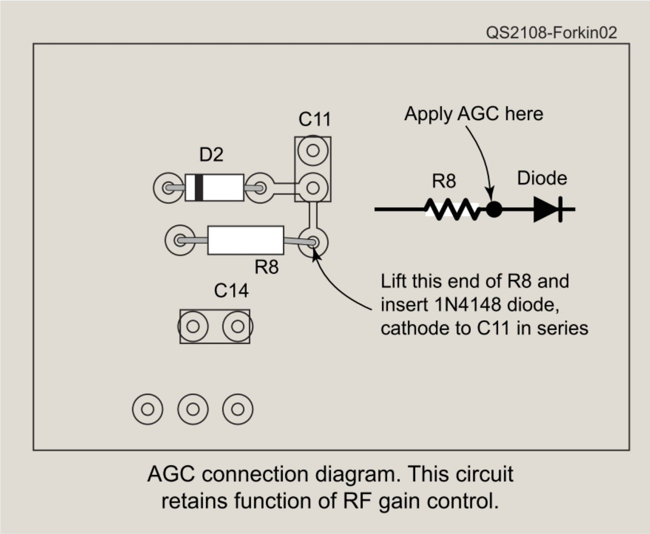


Figure 1 — Schematic diagram of the AGC circuit. Digi-Key part numbers are shown below:

C1 — 0.22 μF, ceramic capacitor, 50 V, 399-13990-2-ND
C2, C3 — 0.1 μF, ceramic capacitor, 50 V, 20%, 478-12590-ND
C4 — 0.01 μF, ceramic capacitor, 50 V, 10%, 399-9865-1-ND
C6 — 4.7 μF, electrolytic capacitor, 50 V, 20%, 493-11017-1-ND
C7 — 100 μF, electrolytic capacitor, 35V, 35YXJ100M6.3X11
D1, D2 — 1N4148, switching diode, 1N4148FS-ND
Q1, Q2 — 2N3904, NPN general-purpose transistor, 2368-2N3904-ND
Q3 — 2N3906, PNP general-purpose transistor, 2368-2N3906-ND
R1 — 6.8 kΩ, ¼ W resistor, 5% axial, CF14JT6K80CT-ND
R2 — 220 kΩ, ¼ W resistor, 5% axial, CFM14JT220K
R3 — 2.2 kΩ, ¼ W resistor, 5% axial, CF14JT2K20CT-ND
R4, R5 — 3.3 kΩ, ¼ W resistor, 5% axial, CF14JT3K30CT-ND
R6 — 330, ¼ W resistor, 5% axial, CF14JT330RCT-ND
R7 — 100, ¼ W resistor, 5% axial, CF14JT100RCT-ND
R8 — 10 kΩ, miniature trimmer resistor, CT6EP103-ND
R9, R10 — 1 kΩ, miniature trimmer resistor, CT6EP102-ND
PCB — Printed circuit board, available at **www.wa3tfs.com**



AGC connection diagram. This circuit retains function of RF gain control.

Figure 2 — High-frequency communications receiver modifications to accommodate the AGC.

receiver board, so gain decreases in the second IF amplifier stage and that, in turn, lessens the detected audio level. You must modify the receiver, as shown in Figure 2. Lift one end of the R8 resistor and insert a 1N4148 diode in series to provide a connection point (see Figure 2). AGC output level to the receiver is also adjustable by R10, so you can set the attenuation required.

The Circuit Board

The circuit board is configured to closely match the layout of the schematic diagram. See the board layout and details at **arrl.org/qst-in-depth**.

Setup

Start with the receiver RF gain control set to maximum, and the AF gain control to a comfortable level. Then, on the AGC board:

1 Set R8, R9, and R10 potentiometers approximately to mid-point.

2 If you have connected an S-meter, tune in a strong signal that you would consider S-9 level, and adjust R9 to show S-9 on the meter. If the meter will not reach that high, adjust R8 until the level is reached.

3 Adjust the AGC (R10) for a comfortable audio level from the receiver.

4 Now, tune in a weak signal of about S-5, and adjust the threshold to the point where the audio level from the receiver just starts to lower. There will be no AGC applied at or below this point, but AGC begins on signals above this level. No AGC is necessary on signals of this level.

5 Initially, adjust settings as necessary to meet your own requirements. There is interaction between the R8, R9, and R10.

6 Once you set the controls to your preferences, no further adjustments are necessary.

If no S-meter is attached, leave the connection open. Also, leave open the unused AGC output. AGC hold time is controlled by the value of C6. I designed it for fast AGC, but you can change this by increasing C6 up to 10 µF or so. As designed, the AGC action works well on CW, SSB, and AM signals. If you increase C6, and you hear a popping sound when a strong signal is detected, the value of C6 is too high; it is slowing initial AGC response, as well as increasing hold time. Decrease the value of C6.

Conclusion

You will find that listening becomes more comfortable. You can now set the RF gain on the receiver to maximum and the audio to a comfortable level. However, the RF gain still functions normally and may be decreased for extremely strong signals if necessary. The circuit works well with several receivers I've built, and the small size allows inclusion into small enclosures. Although simple in design, it enhances listening pleasure under varying signal conditions.

James Forkin, WA3TFS, learned code as a Boy Scout while working on his Eagle rank, and was licensed in 1971 while in the US Army stationed in Hawaii. He made his first contact with Alaska from there, using a homebrew 5 W transmitter and vertical antenna on 15 meters. Jim retired as an electronics design engineer after 35 years of developing analog and digital products. He specialized in electromechanical design and EMI suppression techniques. Jim has been designing and building amateur radio devices since he was first licensed. You can find some of his projects at **www.wa3tfs.com**. He has published articles in *QST* and *Ham Radio Magazine*. He is active on 40- and 20-meter SSB, using homebrew transceivers. You can contact Jim at **jforkin@verizon.net**.

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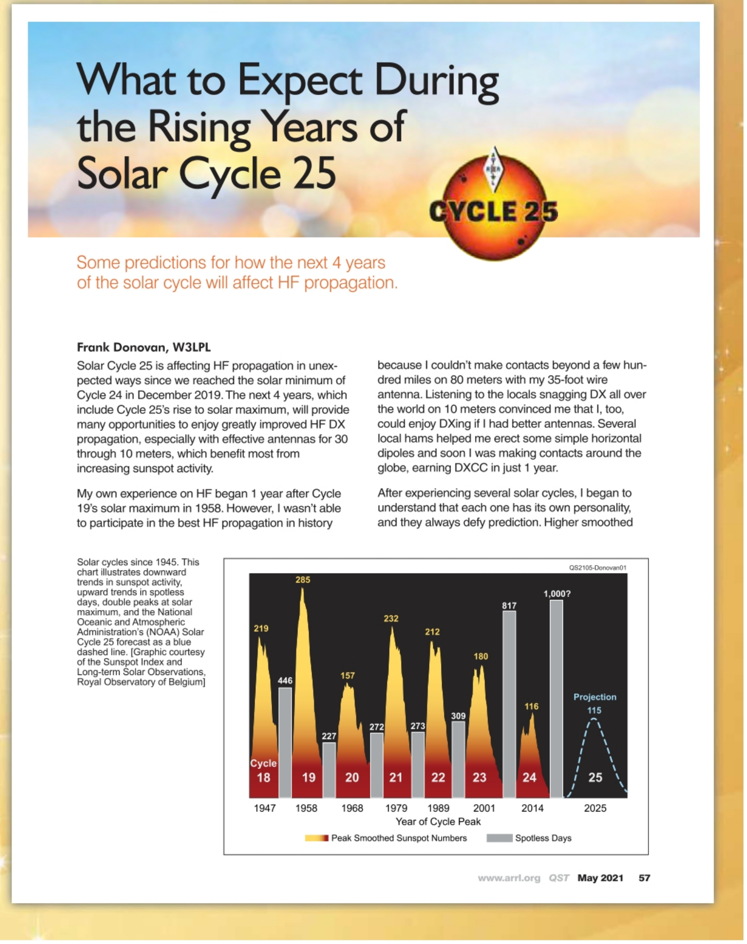

What to Expect During the Rising Years of Solar Cycle 25

Some predictions for how the next 4 years of the solar cycle will affect HF propagation.

Frank Donovan, W3LPL

Solar Cycle 25 is affecting HF propagation in unexpected ways since we reached the solar minimum of Cycle 24 in December 2019. The next 4 years, which include Cycle 25's rise to solar maximum, will provide many opportunities to enjoy greatly improved HF DX propagation, especially with effective antennas for 30 through 10 meters, which benefit most from increasing sunspot activity.

My own experience on HF began 1 year after Cycle 19's solar maximum in 1958. However, I wasn't able to participate in the best HF propagation in history because I couldn't make contacts beyond a few hundred miles on 80 meters with my 35-foot wire antenna. Listening to the locals snagging DX all over the world on 10 meters convinced me that I, too, could enjoy DXing if I had better antennas. Several local hams helped me erect some simple horizontal dipoles and soon I was making contacts around the globe, earning DXCC in just 1 year.

After experiencing several solar cycles, I began to understand that each one has its own personality, and they always defy prediction. Higher smoothed

Solar cycles since 1945. This chart illustrates downward trends in sunspot activity, upward trends in spotless days, double peaks at solar maximum, and the National Oceanic and Atmospheric Administration's (NOAA) Solar Cycle 25 forecast as a blue dashed line. [Graphic courtesy of the Sunspot Index and Long-term Solar Observations, Royal Observatory of Belgium]

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