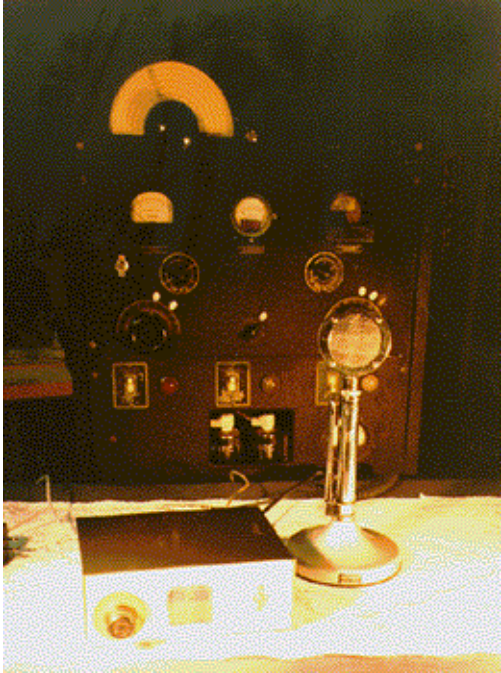


## Audio Preamp with AGC and Feedback to Improve AM Fidelity

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Is your shack warmed by the glow of vintage AM gear? If so, here's a little circuit to optimize your mike gain.

By John Robert Burger, WB6VMI



**The AGC preamp is the box next to the microphone. The author's 1938-vintage AM rig glows warmly in the background.**

This preamp circuit uses only three op amps and a JFET. Simple as it is, it functions as though you had an engineer with his hand on the mike gain to maintain the clarity of each phrase. With this service, operators and guests are free to move to slightly different positions around a mike without fear of losing modulation.

When you speak loudly, the preamp gain decreases. Consequently, your modulation level stays closer to optimum as you move about a given mike position. Preamp automatic gain control (AGC) works as well as AVC (automatic volume control) in any receiver. Preamp AGC is similar to the automatic level control (ALC) in a modern transmitter; it helps avoid overdrive. Preamp AGC is also known as audio compression. It differs slightly from ALC, however, because AGC not only reduces the amplitude of loud sounds; it actively amplifies soft sounds.

Audio compressors (and AGC) differ from audio processors, which increase audio power by using very short time constants to reduce voice peaks. Speech "processing" affects audio fidelity, whereas AGC acts slowly in an attempt to improve intelligibility while preserving fidelity.

### Preamp Circuit Description

The audio-feedback path is from the output of the modulator back to the input of the preamplifier. Feedback ensures, as much as possible, that the modulation envelope very closely resembles the mike signal. Feedback can correct distortion in the audio circuits, so it effectively expands the bandwidth of the electronics. Low distortion greatly enhances the pleasure of hearing the human voice. In my station, an amplified D-104 mike sets the transmitted audio bandwidth of the transmitter.

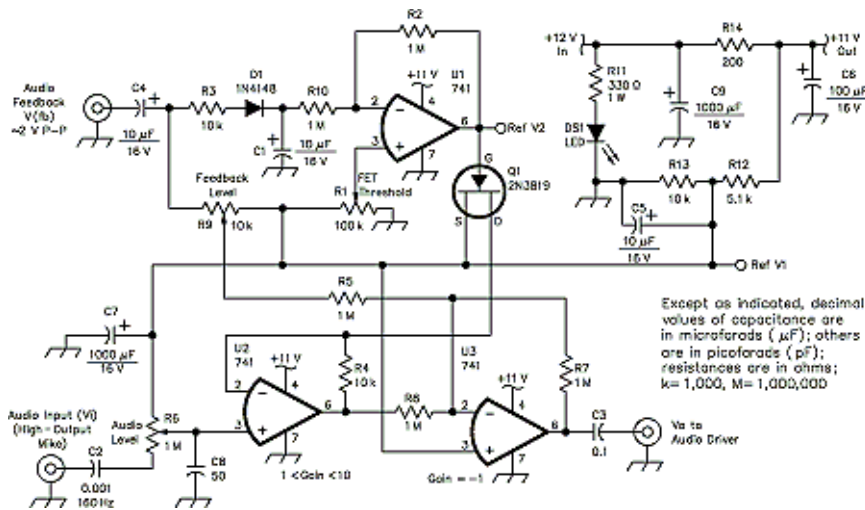
The preamplifier uses audio feedback for two purposes: to improve the linearity of the audio amplifiers and to generate an AGC voltage. Unlike broadcast-quality compressors, this preamp is inexpensive if you build it yourself. One word of caution: You may

need an audio generator and an oscilloscope to debug this circuit.

V(fb) brings in roughly 2 V (P-P) of audio feedback to the Feedback Level control, R9. D1 allows C1 to charge quickly for a 0.1 s fast attack, but slows its discharge for at least 10 s of hold for the AGC. The output of U1 controls the resistance of Q1, while the FET Threshold control adjusts U1's action.

The mike audio (Vi) enters the circuit through the Audio Level control, R6. The 1 MΩ input resistance permits use of this circuit with high impedance (crystal) micro-phones although I use an amplified D-104 that does not require a high-resistance load. Carefully shield this part of the circuit to minimize 60 Hz and RF pickup. In fact, there should be no 60 Hz power, and very little RF, anywhere inside the grounded metal box.

U2's gain is variable, from 1 to more than 10. U3 sums the (negative) feedback with the mike signal. U3's output goes to the transmitter's audio-driver stage. The preamplifier needs a power supply of from +12 to +16 V at roughly 35 mA, with less than 1% ripple.



**Figure 1—Schematic of WB6VMI's preamp with high-level audio feedback and AGC. Equivalent parts may be substituted. Unless otherwise shown, use 1/4 W, 5% tolerance carbon-composition or metal-film resistors and 20% tolerance disc ceramic capacitors. RS indicates Radio Shack part numbers.**

- D1—1N4148 silicon diode (RS 276-1122)**
- DS1—LED, builder's choice (such as RS 276-022)**
- Q1—2N3819 N-channel JFET, or equivalent (RS 276-2035)**
- R1—100 kW pot (RS 271-092)**
- R6—1 MW pot (RS 271-211)**
- R9—10 kW pot (RS 271-1715)**
- U1-U3—741 op amp (RS 276-007)**

**Adjustment**

For testing, set R9 for no output. Set the FET Threshold control, R1, for minimum voltage at test point Ref V2, that is, the output of U1. This cuts off Q1, giving a gain of 1 from the preamplifier. Then adjust R1 for a gain of roughly 5. If you are testing with an oscilloscope, apply 2 V (P-P) to V(fb) and to Vi. Adjust R6 so that a perfect sine waveform emerges from the output.

For low mike input levels, amplification is about 10. As the input increases, the JFET begins to cut off, which reduces U2's audio amplification. In its active range—with sine wave input—doubling the input level yields little change in the output level. Attempts to overmodulate with a sine wave causes additional output reduction until Q1 stops conducting, and amplification in U2 drops to unity.

When the preamplifier is functional, integrate it with the transmitter. In AM, the feedback comes from the output of the modulation transformer, via a voltage divider. [1, 2]

Watch the modulated envelope during this phase of the adjustment. The feedback polarity must be negative, or severe audio oscillation occurs. Perform a brief test for oscillation. If severe oscillation occurs, reverse the polarity of the audio, for example, by reversing the plate caps of push-pull modulator tubes. Assuming correct polarity, there will be a definite drop in percentage of modulation for a given audio level, as feedback increases. Modulation might drop by a factor of 3, which is equivalent to about 10 dB of feedback. Excessive feedback normally results in small amplitude oscillations, so the operating point must be safely below this limit.

## Conclusion

The lead photo shows my 1938 amateur transmitter, originally built by Ed Eggebrecht, W6OEE. This transmitter uses a pair of 805 triodes operating push-pull Class B to modulate a 250TH triode operating Class C, putting out about 300 W. The preamplifier adjusts the audio for this old rig. If you're into vintage AM, this preamp should be on your list of future projects.

## Notes

<sup>1</sup>AM is simply an abbreviation for amplitude modulation. Hams actually use several forms of AM. Single sideband (SSB, short for single-sideband suppressed-carrier amplitude modulation) is the most common ham AM mode, but there are others, such as fax and ATV.

<sup>2</sup>Refer to articles about improving audio in old gear, for example, "Measuring Distortion in AM Transmitters," *Electric Radio*, Oct '95, *Electric Radio*, 14643 County Road G, Cortez, CO 81321; e-mail [er@frontier.net](mailto:er@frontier.net).

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