ONE TECHNOLOGY WAY • P.O. BOX 9106 • NORWOOD, MASSACHUSETTS 02062-9106 • 617/329-4700

AGC Amplifier Design with Ajustable Attack and Release Control

The automatic gain control (AGC) amplifier described below and shown in Figure 1, features selectable gain reduction compression ratios and time domain adjustable AGC attack and release. This design employs the SSM-2013 VCA , SSM-2110 precision level detector, two SSM-2134 low noise op amps, and an OP-215 FET input dual op amp.

The design features an inverting or noninverting input buffer amplifier, a voltage controlled amplifier with adjustable attack and recovery characteristics, driven by a true RMS level detector. Additionally, it provides selectable gain reduction compression, adjustable AGC output level, and maximum gain limit controls. Signal-to-noise ratio is better than 100dB and the RMS level detector allows the AGC amplifier to operate transparently throughout the audio spectrum. The gain recovery is linear and time adjustable, and has maximum gain limiting (gating) to preclude input source noise floor rise.

The input circuit includes a line level (−10dBu to 0dBu) buffer amplifier, that accepts inverting or noninverting inputs with greater than 10kΩ loading impedance. The buffer also isolates the input source from the compressor gain reduction ratio selector, and limits step function slewing voltage.

The six-position gain reduction selector that follows the input amplifier provides adjustable compression that smoothes the AGC action. Six GAIN REDUCTION slope ratios of 2 to 22 can be selected, thus reducing the irritating *"hole producing and pumping"* character of most AGC circuits. The SSM-2013 VCA is chosen for its predictable behavior and its high performance. The dynamic range exceeds 94dB over the frequency range 20Hz to 20kHz. Over this frequency range, the amplifier achieves typically less than 0.01% THD + noise, and 0.03% IMD.

The SSM-2110's precision rectifier circuit produces the true RMS output that comprises a level detector. It results in a consistent and precise AGC action that retains good signal dynamics while leveling the input signal. It responds to the audio signal power density in a manner similar to human hearing.

Following the precision RMS rectifier is the VCA control voltage conditioning circuits. Constructed around U_6 (OP-215), the FET-input amplifier forms an integrator while the other amplifier provides the VCA control port buffer. The AGC output level is set by the rectified signal voltage compared to the reference voltage from the OUTPUT LEVEL control.

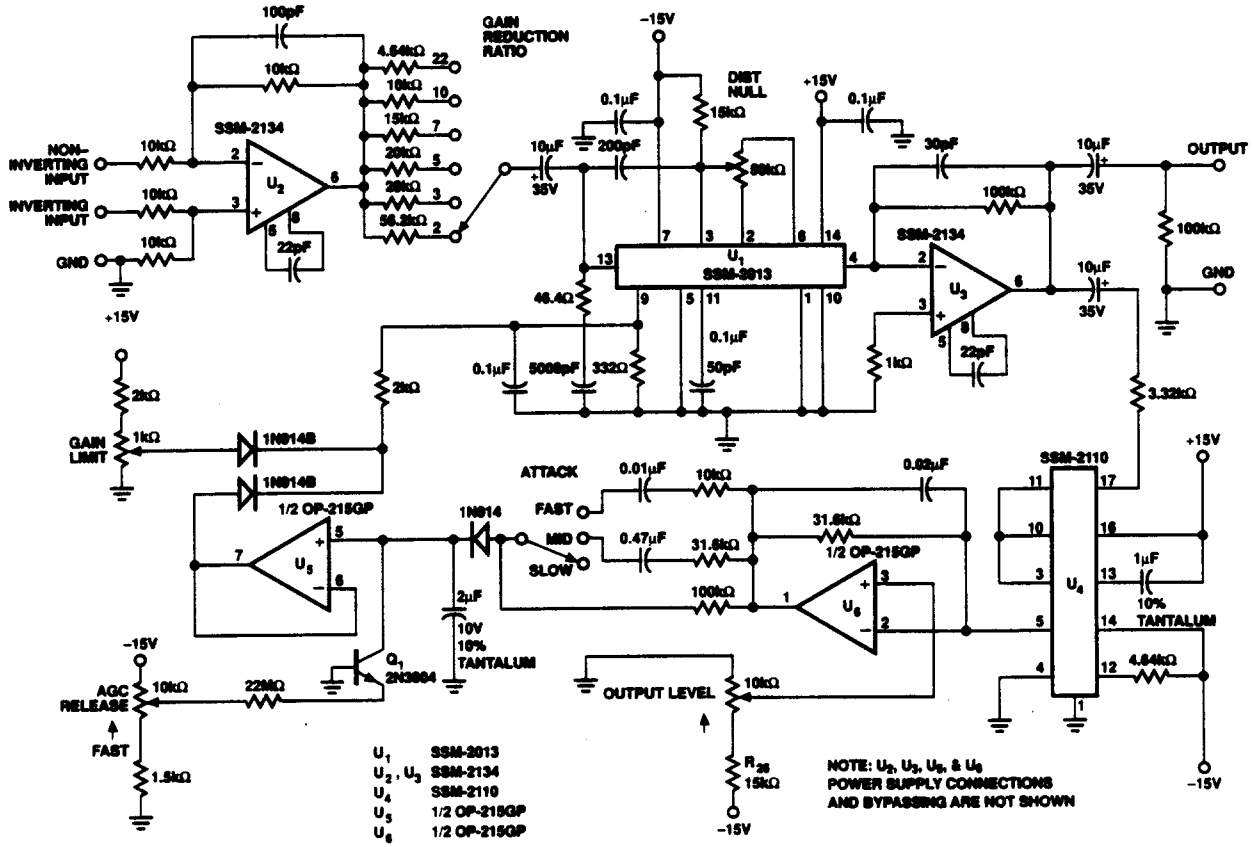

FIGURE 1

The AGC attack and compression response is altered by adjusting the integrator charging time constant or integrator wave shape current. The three-position ATTACK switch allows selection of fast, medium, and slow compression and AGC response. When the slow position is selected, an insignificant amount of compression will take place, while fast and medium combine compression with the AGC action. The AGC release rate is controlled by a constant current discharge of the integrator capacitor. The recovery time constant is linear and adjusted by changing the integrator discharge current supplied by Q_1 and regulated by the RELEASE rate control.

The SSM-2134 has been selected for its low noise and high performance characteristics. The AGC circuit described is of the feedback class, that is, the level detecting rectifier follows the voltage controlled amplifier stage. This class of AGC circuit combined with the complementary gain reduction compression, driven by RMS level detection, and adjustable attack and release AGC action, allows this circuit to be as unobtrusive or as conspicuous as desired.

The flexibility and high performance of this design, along with the simplicity and cost effectiveness, allows this design to be suitable for incorporating in mixing console designs, or in stand-alone products.

TABLE 1: Circuit Performance Specifications

Input Voltage Range (Nominal for 0dBu Out)	−26dBu to +10dBu (6mV to 2.45V_{RMS})
Rectifier Type	RMS
AGC Amplifier Class	Feedback
Attack Time	20 to 200ms
Recovery Time (6dB)	3 to 32 SEC
VCA Feedthrough (Trimmed)	−100dB
Gain Limit Range (Gain Reduction 22)	−26dBu to −12dBu
Frequency Response (20Hz to 20kHz)	±0.2dB
S/N Ratio (@ ±10dB Gain)	106dB
THD + Noise (@ +23dBu, 20Hz to 20kHz)	0.01%
IMD (@ + 23dBu, SMPTE 60Hz & 4kHz, 4:1)	0.02%
Output Voltage Slew Rate	6V/µs
Output Voltage (2kΩ Load)	+22dBu or 10V_{RMS}