Microphone Audio Amplifier Signal Conditioner

The PEAGM-3 is a multi-function audio signal conditioner based on the SSM2166 and SSM2167 microphone audio IC with automatic gain control (AGC) voltage-controlled amplifier (VCA) to provide a consistent audio output level for audio systems. The signal condition ICs have input buffer, automatic VCA gain, adjustable VCA response rate, compression ratio, rotation point, and noise gate to suit most audio applications. The audio output can go to an op-amp (LM258) bandpass filter for voice audio or low-power headphone/speaker driver (LM386) for direct listening. There is an optional op-amp circuit to driver an LED as an audio level indicater and buffer/amplifing transistor for high impedance inputs such as guitar or sensor pickup. An AGC high sensitivity microphone unit is useful for audio applications such as CCTV, online chatting, voice/speech recognition and audio spectrum displays where over-level signals can cause ADC clipping and poor recording. The PEAGM-3 also accepts line-level audio for conditioning (compressor/expander). It is perfect for viewing online video media such as from YouTube. The audio from ads or action scenes maybe very loud and the normal audio/voice maybe quiet. This module is able to amplify whisper quiet speech and attenuate loud shouting to provide a consistent, low-noise audio output. The PEAGM-3 module will save a lot of troubleshooting time in your audio project due to noise and signal level issues.

Features:
- SSM2166/2167 audio signal conditioner IC
- AGC/VCA/AVC/ALC audio signal level
- Use with electret condenser microphone
- High sensitivity for senor/instrumentation inputs (<1mV)
- Adjustable output level
- LM258 op-amp bandpass filter and buffered audio output
- In-circuit fixed voltage regulator.
- Output signal level LED
- LM386 audio driver
- Easy-to-use integrated design
- Multi-function for DIY projects
- Robust design, reliable operation.
- Use standard 0805 SMD components
- 1.80"x0.75" size PCB.
- Robust 1/16” FR4 PCB, ROHS and lead-free.
- Double-sided copper traces, HASL coated holes.
- Easy to read silkscreen labels.

Operation:

The microphone is biased at to provide audio AC signal output. Capacitors provide low-pass and high-pass signal filtering before inputing into the IC1 (SSM2166/67). The microphone audio is signal conditioned and VCA controlled at a pre-set compression ratio with noise gating (minimum sensitivity offset trigger) by the SSM2166/67 to provide a consistent, low noise line-level audio output. The output signal is further conditioned through a bandpass filter by the op-amp. An optional low-power speaker driver can output audio directly to small speakers or headphones. Since audio volume can vary up to 1000 times from quiet to loud sound, AGC is required for audio processing applications.

SSM2166 and SSM2167 Comparison:
Analog Devices SSM216x low voltage microphone preamplifier with variable compression and noise gating.

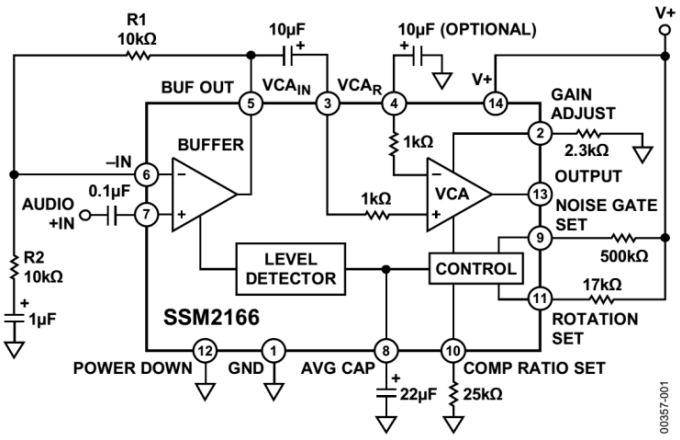


Figure 1. Functional schematic of SSM2166.

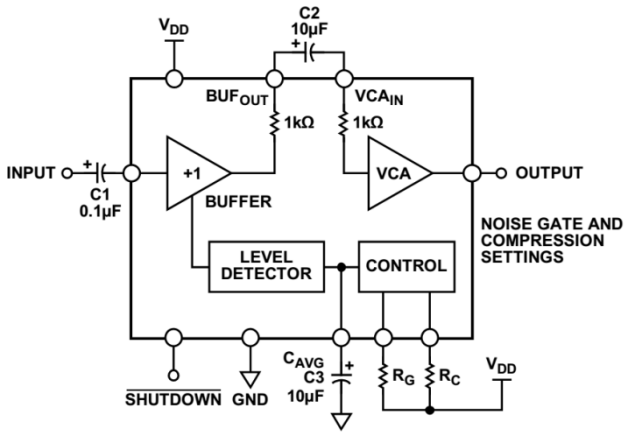


Figure 2. Functional schematic of SSM2167.

Table 1. Comparison of audio signal conditioner IC specifications.

	SSM2166	SSM2167
Operating Voltage	4.5-5.5V	2.5-5.5V
Package	14-lead SOIC	10-Lead MSOP
Input Buffer Gain	0 dB to 20 dB	0 dB
Input Buffer Impedance	180kΩ	100kΩ
Output Impedance	75Ω	145Ω
VCA Range	60dB	40dB
VCA Fixed Gain	0 dB to 20 dB	18dB
Compression Ratio, Minimum	1:1	1:1
Compression Ratio, Maximum	15:1	10:1
Rotation Point	100mV RMS	63mV RMS
Noise Gate Range (nominal)	-34 dBV to -70 dBV	−40 dBV to −55 dBV
Shutdown	GND=ON	+V=ON

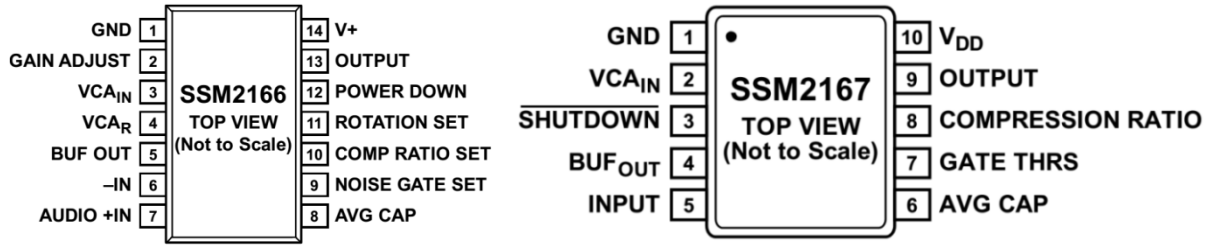


Figure 3. Pinout of SSM2166 and SSM2167.

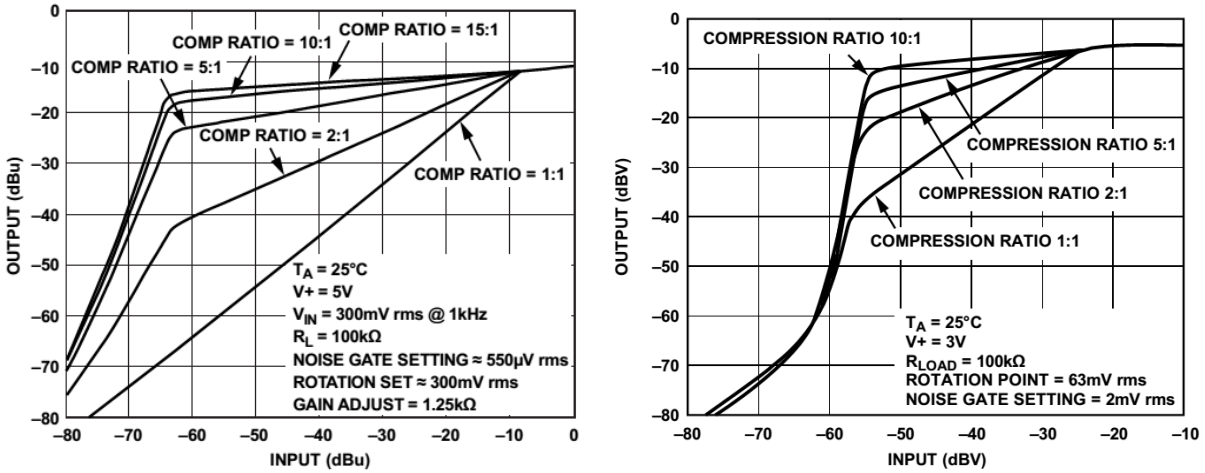


Figure 4. SSM2166 (left) and SSM2167 (right) output-input level at various compression ratios.

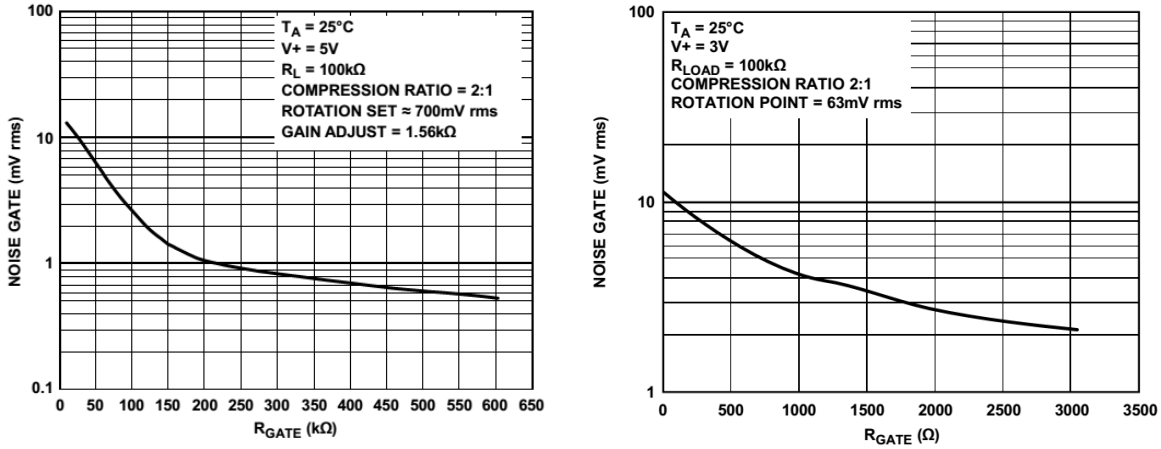


Figure 5. Noise gate (sensitivity) level at R_{GATE} resistance for SSM2166 (left) and SSM2167 (right).

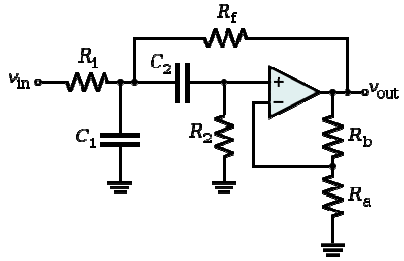
COMPRESSION RATIO / ROTATION POINT	1:1	2:1	5:1	10:1	15:1
100mV rms	0.1	8.7	19.4	45	395
300mV rms	0.1	8.7	19.4	45	N/A
1V rms	0.1	8.7	19.4	45	N/A

TYPICAL R_{COMP} VALUES IN kΩ.

Compression Ratio	Value of R_{COMP}
1:1	0 Ω (short to V+)
2:1	15 kΩ
3:1	35 kΩ
5:1	75 kΩ
10:1	175 kΩ

Figure 6. Comp. Ratio at R_{COMP} resistance for SSM2166 (left) and SSM2167 (right).

Sallen-Key bandpass filter frequency calculation. Fill values in formula list.



$$f_0 = \frac{1}{2\pi}\sqrt{\frac{R_f + R_1}{C_1 C_2 R_1 R_2 R_f}}$$

$$Q = \frac{\sqrt{(R_1 + R_f) R_1 R_f R_2 C_1 C_2}}{R_1 R_f (C_1 + C_2) + R_2 C_2 (R_f - \frac{R_b}{R_a} R_1)}$$

Gain=1+R_b/R_a A too high gain will cause oscillation. G<3.
R_1=R7, R_f=R8, R_2=R10, R_b=R11, R_a=R9, C_1=C9, C_2=C8
Q=Quality factor($f_o/\Delta F$)
f_o= center frequency