AN-583
APPLICATION NOTE

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Evaluating the SSM2167 Low Voltage Microphone Preamplifier with Variable Compression and Noise Gating

by Shawn Scarlett

THE SSM2167 EVALUATION BOARD

The SSM2167 evaluation board is a convenient means to evaluate and understand the operation of the SSM2167. This application note provides a basic explanation of how the board is set up, and how to use it to evaluate the SSM2167. This document is only a supplement and refers to figures contained in the SSM2167 data sheet.

This application note also contains the schematics and layout for the SSM2167 evaluation board to allow easy modification and experimentation. Applications support is available from Analog Devices, Inc., online at www.analog.com or in the United States at 1-800-ANALOGD or 1-800-262-5643.

BASIC CONNECTIONS AND SETUP

The SSM2167 board features simple, easy-to-use connections that allow for a broad range of experimentation. The evaluation board is available only with the SSM2167-1.

Power and Ground

The SSM2167 is optimized for operation at 3 V; however, it can operate from a wide range of supplies. Refer to the SSM2167 data sheet for the maximum limits. The SSM2167 evaluation board can be connected to a bench power supply or two AA batteries. Power leads must be soldered into place at JP3. Alternatively, a header jack can be soldered to the SSM2167 board to allow easy disconnection. The power and ground connections are critical to the performance of the SSM2167 board; therefore, ensure proper connection.

Shutdown Connection

The low current shutdown current connection is located at the lower part of the SSM2167 evaluation board along with the power and ground. The SSM2167 board has a pull-up resistor installed so that if no connection is made at that point, the device operates in active mode. To enable the shutdown feature, connect $\overline{SD}$ to ground. To perform an in-depth analysis on the shutdown current, remove the pull-up resistor (R5). Do not leave the shutdown pin floating. When R5 is removed, connect $\overline{SD}$ directly to the supply or ground.

Signal Connections, Input, and Output

Signal sources can be connected to the SSM2167 evaluation board with standard 3.5 mm jacks or leads, which can be soldered directly to the SSM2167 evaluation board at JP1 and JP2. The SSM2167 evaluation board uses 3.5 mm stereo sockets with the signal on the tip and the sleeve connected to the board ground; the ring is left floating. At both jumper connections, a ground point is available to prevent noise.

The input jack is configured for maximum versatility. By default, it is designed for use with an electret microphone or input source. It can be changed easily to accommodate dynamic microphones.

ELECTRET MICROPHONES

The SSM2167 evaluation board is configured with a 2.2 kΩ resistor (R4) to the supply for use as a biasing resistor. It connects directly to the signal path so that both the jack and the jumper (JP2) can be used as input connections. Standard computer electret microphones can be used without modification because the ring and tip are connected internally in the microphone. The input jack and JP2 are decoupled from the input pin via a 0.1 µF capacitor (C1).

DYNAMIC MICROPHONES

When the SSM2167 evaluation board is used with a dynamic or self-powered microphone, remove R4.

OUTPUT SIGNAL

The output jack is decoupled from the circuit via a 10 µF capacitor (C2). The connection can be made at either JP1 or the standard 3.5 mm jack, with the signal connection to the tip of the plug. For listening tests, the output signal can be connected directly from the 3.5 mm jack to an RCA input on a normal audio amplifier using a standard stereo adapter cable. In this case, use the left (white or black) RCA connection because it corresponds with the tip of the 3.5 mm jack. The output of the SSM2167 is not sufficient to drive headphones or other output transducers without external amplification.

TEST EQUIPMENT SETUP

The recommended equipment and configuration is shown in Figure 1. A low noise audio generator with a smooth output adjustment range of 50 µV to 50 mV is a suitable signal source. A 40 dB pad is useful to reduce the level of most generators by 100′ to simulate microphone levels. The input voltmeter can be connected before the pad and only needs to go down to 10 mV. The output voltmeter must go up to 2 V. The oscilloscope is used to verify that the output is sinusoidal, that no clipping occurs in the buffer, and that the noise gating threshold is set.

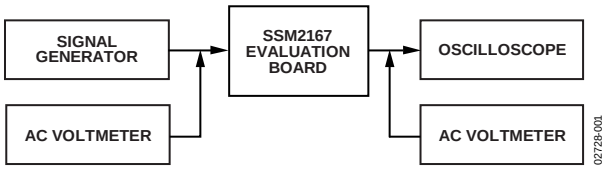

Figure 1. Test Equipment Setup

CONNECTIONS

Connect power, ground, input, and output as described in the Basic Connections and Setup section.

TEST SETUP

To confirm the operation of the board and test setup, first put JP4 in the 1:1 position and JP5 in the −55 dB position. With power on, adjust the generator for an input level of 15 mV, 1 kHz. The output meter should indicate approximately 100 mV. If it does not, check the setup.

LISTENING

Connect a microphone to the SSM2167 and listen to the results. Ensure proper power for the microphone by following instructions in the Basic Connections and Setup section. Experiment with the settings to hear how the results change. The compression ratio keeps the output steady over a range of source to microphone distances, and the noise gate keeps the background sounds subdued.

SETTING THE NOISE GATE THRESHOLD

The SSM2167 evaluation board provides three different preset values of noise gate threshold. Experiment with these values by varying the gate. The SSM2167 evaluation board also provides landing pads for a custom value that can be extrapolated from the specifications table in the SSM2167 data sheet, or the noise gate vs. R_{GATE} figure the SSM2167 data sheet. Using more than 5 kΩ is not recommended because extremely low noise gate thresholds may approach the noise floor of the system.

The highest setting (−48 dB) is recommended to start an evaluation. If the input signal is not sufficient to surpass the threshold, lower the setting. In most applications, the input signal easily overcomes this setting. If the gate is set too low, the background noise is amplified well into the audible range. By examining the function (see the general input/output characteristics figure in the SSM2167 data sheet), the maximum gain of the device can be determined when the input signal is at the noise gate threshold. The dashed line on the transfer function represents unity gain; the distance between the dashed line and the solid line represents the VCA gain.

ADJUSTING THE COMPRESSION RATIO

The SSM2167 evaluation board provides three different settings for the compression ratio in the same manner as the noise gate threshold. Experiment with different compression ratios to determine what sounds best in a given system; starting with a 2:1 ratio is recommended. High compression ratios exaggerate the effect of the noise gate because the compression ratio determines the gain at the noise gate, as shown in the output vs. input characteristics figure in the SSM2167 data sheet. Use compression of 10:1 only in systems where the noise floor is well below the noise gate. Most systems require between 2:1 and 5:1 compression for best results.

LISTENING TEST

The final step in evaluating the SSM2167 is a listening test. The improvement in vocal clarity can be heard by recording the SSM2167 output or listening to it live. Ideally, connect the SSM2167 evaluation board to an existing system. The impact of the compression is demonstrated by shorting out RCOMP (R9 through R12). When the RCOMP resistor is shorted, the VCA reverts to the audible 1:1 compression setting, which does not affect the noise gate or limiting settings. The effect of turning off the compression is most noticeable when the input signal is between −50 dBV and −40 dBV. Evaluating the SSM2167 within the end application also gives the best indication of how high the noise gate threshold should be set. The noise level of the system is greatly influenced by the design of the system, including cooling fans, hard drives, handling, and other sources of acoustic noise.

Listening tests are the most critical part of an evaluation. Because test equipment and signal generators do not represent audio signals well, listening is the best way to evaluate the benefits of the SSM2167. The SSM2167 evaluation board makes it easy to implement the SSM2167 and to pick appropriate application settings. The end result is a noticeable improvement in signal clarity and a system that is easy for customers to use.

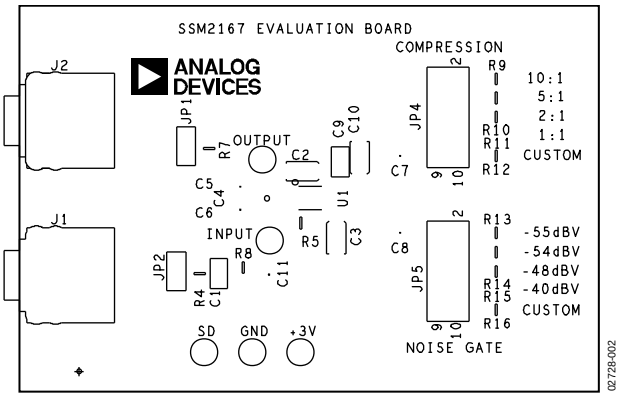

Figure 2. SSM2167 Evaluation Board; Top Layer Including Component Identification and Placement

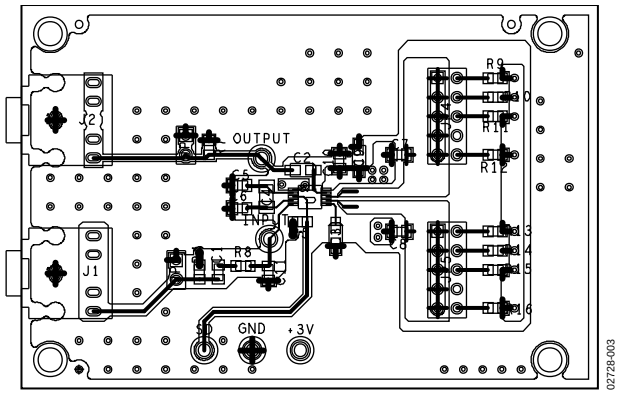

Figure 3. SSM2167 Evaluation Board; Top Layer

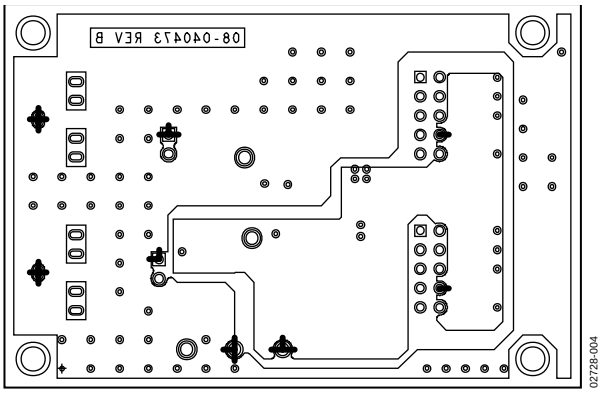

Figure 4. SSM2167 Evaluation Board; Bottom Layer

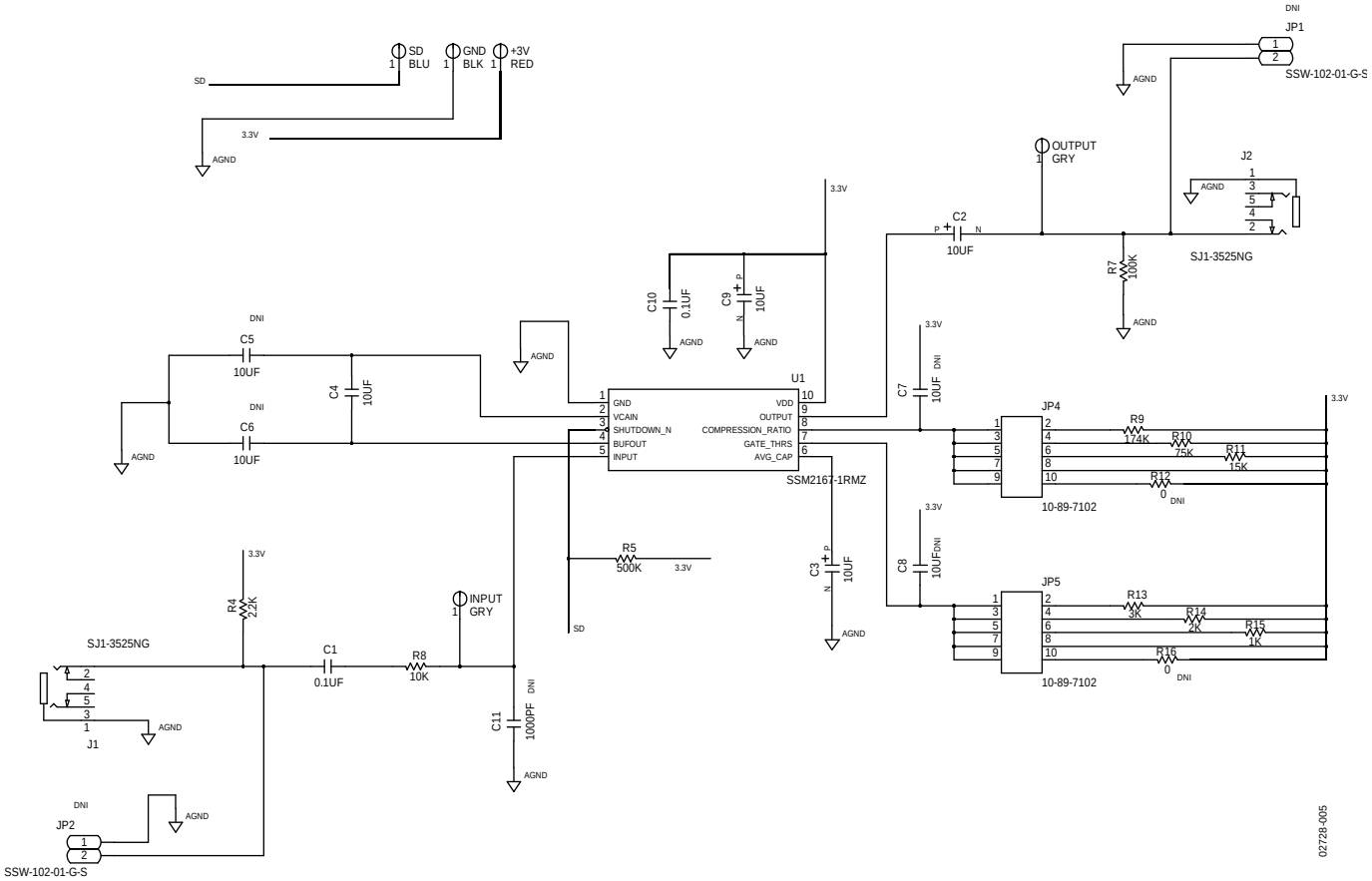

Figure 5. SSM2167 Evaluation Board Circuit Schematic

Table 1. Parts List for SSM2167 Evaluation Board

Reference	Description	Part Number	Value	Tolerance (%)
U1	Low voltage microphone pre-amp	SSM2167-1RMZ	SSM2167-1RMZ	Not applicable
C1, C10	Chip capacitors, X7R, 0805	GRM21BR71H104KA01L	0.1 µF	10
C2, C3, C9	Tantalum capacitors	TAJA106K010RNJ	10 µF	10
C4	Capacitor, ceramic monolithic, X5R	GRM31CR61E106KA12L	10 µF	10
C11	Capacitor, ceramic, C0G	GRM2165C1H102JA01D	Do not install	5
C5 to C8	Capacitors, ceramic, X7R	GRM21BR71A106ME51	Do not install	20
J1, J2	3.5 mm stereo jacks	SJ1-3525NG	SJ1-3525NG	Not applicable
JP4, JP5	Headers	10-89-7102	10-89-7102	Not applicable
JP4, JP5	Shunt connector	SNT-100-BK-G	SNT-100-BK-G	Not applicable
JP1, JP2	Headers	SSW-102-01-G-S	Do not install	Not applicable
R10	Resistor, precision thick film chip, R0805	ERJ-6ENF7502V	75 kΩ	1
R11	Resistor film, SMD, 0805	MC 0.1W 0805 1% 15K.	15 kΩ	1
R13	Resistor chip, 0805	MC0805S8F3001T5E	3 kΩ	1
R14	Resistor, precision thick film chip, R0805	ERJ-6ENF2001V	2 kΩ	1
R15	Resistor, precision thick film chip, R0805	ERJ-6ENF1001V	1 kΩ	1
R12, R16	Resistors, thick film chip	ERJ-6GEY0R00V	Do not install	Not applicable
R4	Resistor film, SMD, 0805	MC 0.1W 0805 1% 2K2.	2.2 kΩ	1
R5	Resistor, high precision thick film chip	PHT0805Y5003BGT200	500 kΩ	0.1
R7	Resistor, precision thick film chip, R0805	ERJ-6ENF1003V	100 kΩ	1
R8	Resistor, precision thick film chip, R0805	ERJ-6ENF1002V	10 kΩ	1
R9	Resistor, precision thick film chip	ERJ-6ENF1743V	174 kΩ	1
+3V	Test point	TP-104-01-02	RED	Not applicable
SD	Test point	TP104-01-06	BLU	Not applicable
GND	Test point	TP-104-01-00	BLK	Not applicable
INPUT, OUTPUT	Test point	TP104-01-08	GRY	Not applicable

REVISION HISTORY

10/15—Rev. C to Rev. D

Changes to Title, Shutdown Connection Section, and Signal Connections, Input, and Output Section 1
Changes to Figure 2 2
Changes to Figure 3, Figure 4, and Figure 5 3
Changes to Table 1 4

2/13—Rev. B to Rev. C

Changes to Figure 5 3
Changes to Table 1 4

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