

FEATURES

- Complete microphone conditioner in a 14-lead SOIC package
- Single 5 V operation
- Adjustable noise gate threshold
- Compression ratio set by external resistor
- Automatic limiting feature—prevents ADC overload
- Adjustable release time
- Low noise and distortion
- Power-down feature
- 20 kHz bandwidth (± 1 dB)

APPLICATIONS

- Microphone preamplifiers/processors
- Computer sound cards
- Public address/paging systems
- Communication headsets
- Telephone conferencing
- Guitar sustain effects generators
- Computerized voice recognition
- Surveillance systems
- Karaoke and DJ mixers

GENERAL DESCRIPTION

The SSM2166 integrates a complete and flexible solution for conditioning microphone inputs in computer audio systems. It is also excellent for improving vocal clarity in communications and public address systems. A low noise, voltage-controlled amplifier (VCA) provides a gain that is dynamically adjusted by a control loop to maintain a set compression characteristic. The compression ratio is set by a single resistor and can be varied from 1:1 to over 15:1 relative to a user-defined rotation point; signals above the rotation point are limited to prevent overload and to eliminate popping. In the 1:1 compression setting, the

SSM2166 can be programmed with a fixed gain of up to 20 dB; this gain is in addition to the variable gain in other compression settings. The input buffer can also be configured for front-end gains of 0 dB to 20 dB. A downward expander (noise gate) prevents amplification of noise or hum. This results in optimized signal levels prior to digitization, thereby eliminating the need for additional gain or attenuation in the digital domain that may add noise or impair accuracy of speech recognition algorithms. The compression ratio and time constants are set externally. A high degree of flexibility is provided by the VCA gain, rotation point, and noise gate adjustment pins.

The SSM2166 is an ideal companion product for audio codecs used in computer systems, such as the AD1845. The SSM2166 is available in a 14-lead SOIC package and is guaranteed for operation over the extended industrial temperature range of -40°C to $+85^{\circ}\text{C}$.

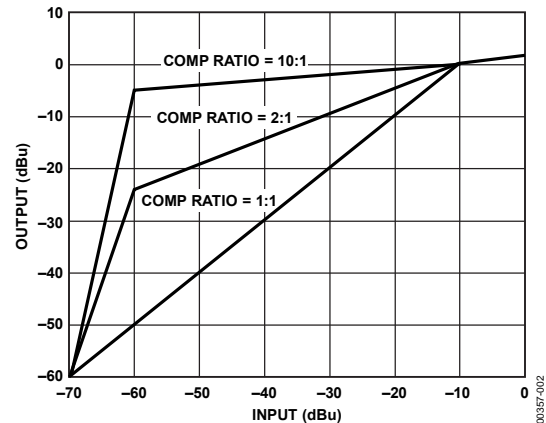


Figure 1. Compression and Gating Characteristics with 10 dB of Fixed Gain (The Gain Adjust Pin Can Be Used to Vary This Fixed Gain Amount)

FUNCTIONAL BLOCK DIAGRAM AND TYPICAL SPEECH APPLICATION

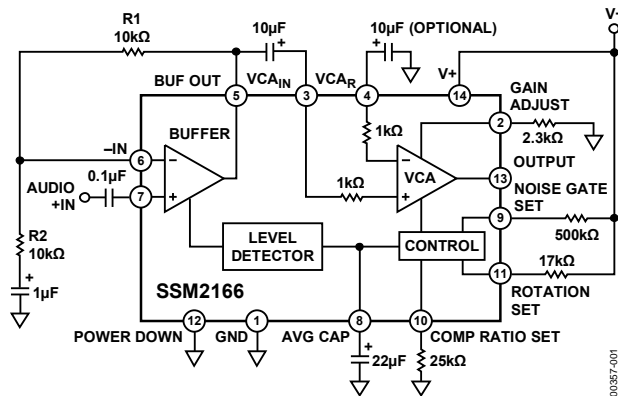


Figure 2.

Rev. D

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SPECIFICATIONS

$V_+ = 5\text{ V}$, $f = 1\text{ kHz}$, $R_L = 100\text{ k}\Omega$, $R_{\text{GATE}} = 600\text{ k}\Omega$, $R_{\text{ROT PT}} = 3\text{ k}\Omega$, $R_{\text{COMP}} = 0\text{ }\Omega$, $R_1 = 0\text{ }\Omega$, $R_2 = \infty\text{ }\Omega$, $T_A = 25^\circ\text{C}$, unless otherwise noted;
 $V_{\text{IN}} = 300\text{ mV rms}$.

Table 1.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
AUDIO SIGNAL PATH						
Voltage Noise Density	e_n	15:1 Compression		17		$\text{nV}/\sqrt{\text{Hz}}$
Noise		20 kHz bandwidth, $V_{\text{IN}} = \text{GND}$		-109		dBu^1
Total Harmonic Distortion and Noise	THD + N	Second and third harmonics, $V_{\text{IN}} = -20\text{ dBu}$, 22 kHz low-pass filter		0.25	0.5	%
Input Impedance	Z_{IN}			180		$\text{k}\Omega$
Output Impedance	Z_{OUT}			75		Ω
Load Drive		Resistive	5			$\text{k}\Omega$
		Capacitive			2	nF
Buffer						
Input Voltage Range		1% THD		1		V rms
Output Voltage Range		1% THD		1		V rms
VCA						
Input Voltage Range		1% THD		1		V rms
Output Voltage Range		1% THD		1.4		V rms
Gain Bandwidth Product		1:1 compression, VCA gain = 60 dB		30		MHz
CONTROL SECTION						
VCA Dynamic Gain Range				60		dB
VCA Fixed Gain Range				-60 to +19		dB
Compression Ratio, Minimum				1:1		
Compression Ratio, Maximum		See Figure 19 for $R_{\text{COMP}}/R_{\text{ROT PT}}$, rotation point = 100 mV rms		15:1		
Control Feedthrough		15:1 compression, rotation point = -10 dBu, $R_2 = 1.5\text{ k}\Omega$		± 5		mV
POWER SUPPLY						
Supply Voltage Range	V_+		4.5		5.5	V
Supply Current	I_{SY}			7.5	10	mA
Quiescent Output Voltage Level				2.2		V
Power Supply Rejection Ratio	PSRR			50		dB
POWER DOWN						
Supply Current		Pin 12 = V_+^2		10	100	μA

¹ 0 dBu = 0.775 V rms.

² Normal operation for Pin 12 is 0 V.

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Supply Voltage	10 V
Audio Input Voltage	Supply voltage
Operating Temperature Range	-40°C to +85°C
Storage Temperature Range	-65°C to +150°C
Junction Temperature (T _j)	150°C
Lead Temperature (Soldering, 60 sec)	300°C

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

THERMAL RESISTANCE

Table 3.

Package Type	θ_{JA}	θ_{JC}	Unit
14-Lead SOIC	120	36	°C/W

ESD CAUTION



ESD (electrostatic discharge) sensitive device.

Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

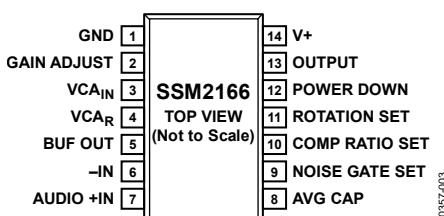
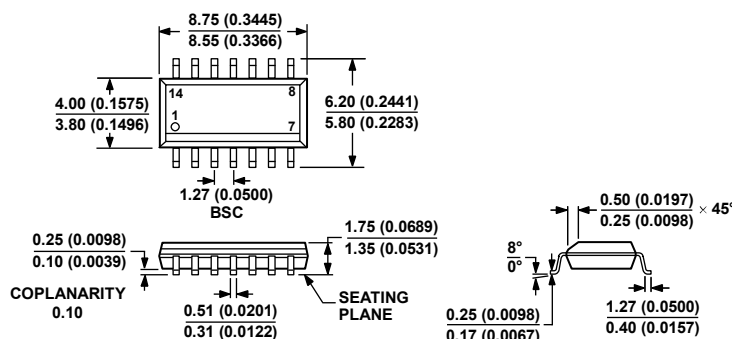


Figure 3. Pin Configuration

Table 4. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	GND	Ground.
2	GAIN ADJUST	VCA Gain Adjust Pin. A resistor from this pin to ground sets the fixed gain of the VCA. To check the setting of this pin, make sure the compression ratio set pin (Pin 10) is grounded for no compression. The gain can be varied from 0 dB to 20 dB. For 20 dB, leave the pin open. For 0 dB of fixed gain, a typical resistor value is approximately 1 k Ω . For 10 dB of fixed gain, the resistor value is approximately 2 k Ω to 3 k Ω . For resistor values <1 k Ω , the VCA can attenuate or mute (see Figure 6).
3	VCA _{IN}	VCA Input Pin. A typical connection is a 10 μ F capacitor from the buffer output pin (Pin 5) to this pin.
4	VCA _R	Inverting Input to the VCA. This input can be used as a nonground reference for the audio input signal (see the Applications Information section).
5	BUF OUT	Input Buffer Amplifier Output Pin. This pin must not be loaded by capacitance to ground.
6	-IN	Inverting Input to the Buffer. A 10 k Ω feedback resistor, R1, from the buffer output (Pin 5) to this input pin and a resistor, R2, from this pin through a 1 μ F capacitor to ground give gains of 6 dB to 20 dB for R2 = 10 k Ω to 1.1 k Ω .
7	AUDIO +IN	Input Audio Signal. The input signal should be ac-coupled (0.1 μ F typical) into this pin.
8	AVG CAP	Detector Averaging Capacitor. A capacitor, 1 μ F to 22 μ F, to ground from this pin is the averaging capacitor for the detector circuit.
9	NOISE GATE SET	Noise Gate Threshold Set Point. A resistor to V+ sets the level below which input signals are downward expanded. For a 0.7 mV threshold, the resistor value is approximately 380 k Ω . Increasing the resistor value reduces the threshold (see Figure 5).
10	COMP RATIO SET	Compression Ratio Set Pin. A resistor to ground from this pin sets the compression ratio, as shown in Figure 2. Figure 19 gives resistor values for various rotation points.
11	ROTATION SET	Rotation Point Set Pin. This pin is set by adding a resistor to the positive supply. This resistor together with the gain adjust pin determines the onset of limiting. A typical value for this resistor is 17 k Ω for a 100 mV rotation point. Increasing the resistor value reduces the level at which limiting occurs (see Figure 9).
12	POWER DOWN	Power-Down Pin. Connect this pin to ground for normal operation. Connect this pin to the positive supply for power-down mode.
13	OUTPUT	Output Signal.
14	V+	Positive Supply, 5 V Nominal.

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MS-012-AB
CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS
(IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR
REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN.

Figure 32. 14-Lead Standard Small Outline Package [SOIC_N]
Narrow Body
(R-14)

Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
SSM2166S	-40°C to +85°C	14-Lead SOIC_N	R-14
SSM2166S-REEL	-40°C to +85°C	14-Lead SOIC_N	R-14
SSM2166S-REEL7	-40°C to +85°C	14-Lead SOIC_N	R-14
SSM2166SZ ¹	-40°C to +85°C	14-Lead SOIC_N	R-14
SSM2166SZ-REEL ¹	-40°C to +85°C	14-Lead SOIC_N	R-14
SSM2166SZ-REEL7 ¹	-40°C to +85°C	14-Lead SOIC_N	R-14

¹ Z = RoHS Compliant Part.

Top Branding Revision Reflecting Die Replacement

Version	Original Die Revision (Prior to Rev. C of Data Sheet)	New Die Revision (Rev. C to Current Revision of Data Sheet)
Pb-Free (RoHS) Version	Top Line 1: SSM Top Line 2: 2166 Top Line 3: # XXXX ²	Top Line 1: SSM Top Line 2: 2166A ¹ Top Line 3: # XXXX ²
SnPb Lead Finish Version	Top Line 1: SSM Top Line 2: 2166 Top Line 3: XXXX	Top Line 1: SSM Top Line 2: 2166A ¹ Top Line 3: XXXX

¹ Letter A designates new die revision; refer to revised external component values in Figure 5, Figure 6, Figure 9, and Figure 19.

² # designates RoHS version.