SSI2161

PROCIRCUIT™ VOLTAGE CONTROLLED AMPLIFIER

The SSI2161 is a versatile VCA building block for high-performance audio applications. A single channel provides voltage control of a current-mode input and output for a gain range from +20dB to –100dB, with control provided by a ground-referenced –33mV/dB constant.

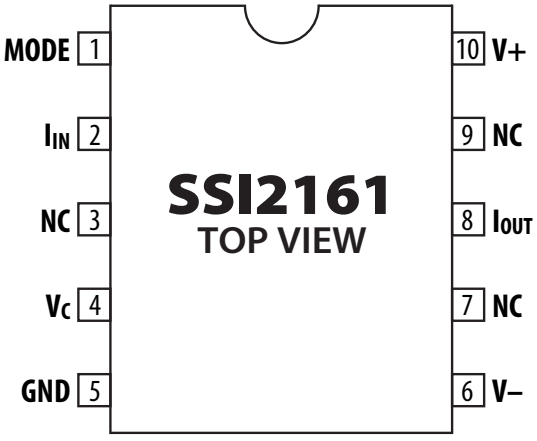
The device offers considerable flexibility for a wide range of design goals and applications. A unique mode control allows selection of Class A, Class AB, or in-between using a single resistor. In addition, improved current handling allows use of lower value input resistors for reduced output noise without loss of headroom. Finally, the VCA can be used as a high-quality OTA building block for a variety of applications such as voltage controlled filters, exponential generators, and antilog converters.

The SSI2161 will operate on supplies as low as +8V for battery-powered devices such as guitar pedals, or up to ±18V in systems where maximum headroom is desired.

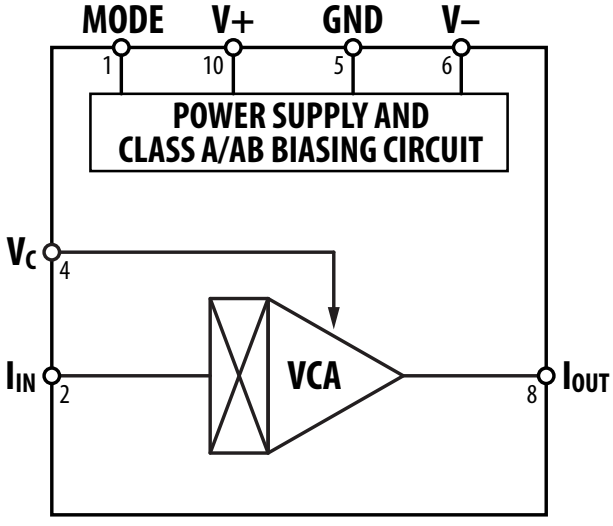
The SSI2161 is part of a family of affordable high-performance VCA's from Sound Semiconductor. The SSI2164 offers four VCA's in a compact SOP package with lowest cost-per VCA, and the SI2162 provides two channels in a small PCB footprint.

FEATURES

- **Our Highest Performance VCA in a Compact Package**
- **Pin-Selectable Class A or AB Operation**
- **6dB Lower Noise than SSI2164**
- **126dB Dynamic Range (Class AB)**
- **Low Distortion – Typical 0.025% (Class A)**
- **Large Gain Range: -100dB to +20dB**
- **Highly-Compact 10-Lead SSOP Package**
- **±4V to ±18V Operation**
- **No External Trimming**
- **Low Control Feedthrough – Typically -60dB**



PIN CONNECTIONS
10-LEAD SSOP



FUNCTIONAL BLOCK DIAGRAM

The SSI2161 is available exclusively from Sound Semiconductor and its authorized resellers
PO Box 1587, Arroyo Grande, CA 93421 USA, www.soundsemiconductor.com
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SPECIFICATIONS (V_S = ±15V, V_{IN} = 0.775V_{RMS}, f = 1kHz, A_V = 0dB, Class AB, T_A = 25°C; using Figure 1 circuit without diode)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
POWER SUPPLY						
Supply Voltage Range	V_S		±4		±18	V
Supply Current	I_S	Class AB, V_C = GND		±6	±8	mA
Supply Current	I_S	Class A, V_C = GND, I_M = 1mA		±8.0		mA
Power Supply Rejection Ratio	PSRR	60Hz		90		dB
CONTROL PORT						
Input Impedance			2.25	2.5	2.75	kΩ
Gain Constant		After 60 seconds of operation		–33		mV/dB
Gain Constant Temp. Coefficient				–3300		ppm/°C
Control Feedthrough		A_V = 0dB to –40dB		–60		dB
Gain Accuracy		A_V = 0dB		±0.30		dB
		A_V = +20dB		±0.55		dB
		A_V = –20dB		±0.55		dB
Maximum Attenuation				–100		dB
Maximum Gain				+20		dB
SIGNAL INPUT						
Input Bias Current	I_B			±10		nA
Input Current Handling				3.4		mA_P
SIGNAL OUTPUT						
Output Offset Current		V_{IN} = GND		±150		nA
Output Compliance				±100		mV
PERFORMANCE						
Output Noise		Class AB *(20Hz -20kHz, unweighted)*				
([1]I_M = 1mA)		$R_{IN/OUT}$ = 7.5kΩ		–99		dBu
		$R_{IN/OUT}$ = 5kΩ		–102		dBu
		$R_{IN/OUT}$ = 3.74kΩ		–105		dBu
		$R_{IN/OUT}$ = 1.8kΩ		–107		dBu
		Class A *(20Hz -20kHz, unweighted)*[1]				
		$R_{IN/OUT}$ = 7.5kΩ		–87		dBu
		$R_{IN/OUT}$ = 5kΩ		–90		dBu
		$R_{IN/OUT}$ = 3.74kΩ		–93		dBu
		$R_{IN/OUT}$ = 1.8kΩ		–99		dBu
Headroom	HR	1% THD		+22		dBu
Total Harmonic Distortion	THD	Class AB (*80kHz BW)*				
([1]I_M = 1mA)		A_V = 0dB		0.05		%
		A_V = 0dB, V_{IN} = –17dBu		0.025		%
		A_V = +20dB		0.20		%
		A_V = –20dB		0.045		%
		Class A (*80kHz BW)*[1]				
		A_V = 0dB		0.025		%
		A_V = 0dB, V_{IN} = –5dBu		0.015		%
		A_V = +20dB		0.17		%
		A_V = –20dB		0.025		%
Unity Gain Bandwidth		C_F = 10pF		500		kHz
Slew Rate	SR	C_F = 10pF		700		µA/µs

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	±20V
Storage Temperature Range	-65°C to +150°C
Operating Temperature Range	-40°C to +85°C
Lead Temperature (Soldering, 10 sec)	260°C
Mode Current (I_M; Pin 1 to Pin 10 via R_M)	2.0mA
Control Pin Voltage (Pin 4)	V- to V+

ORDERING INFORMATION

Part Number	Package Type/Container	Quantity
SSI2161SS-TU	10-Lead SSOP* - Tube	100
SSI2161SS-RT	10-Lead SSOP* - Tape and Reel	4000

*SSI Package ID "**PSSL10**"
Mechanical drawing available at www.soundsemiconductor.com

PIN DESCRIPTIONS

Pin(s)	Name	Description
1	MODE	Current into this pin sets VCA core to operate as Class A (lowest THD), AB (lowest noise), or inbetween, set by external resistor. Leave open for Class AB operation.
2	I_{IN}	Ground-referenced current inputs; each requires RC network.
3	NC	Leave this pin unconnected.
4	V_C	Ground-referenced control port with a –33mV-per-dB constant.
5	GND	Connect to analog signal ground with short, low inductance trace.
6	V–	Negative supply. Recommend 100nF local decoupling capacitor placed as close to package as possible with a low inductance trace to ground.
7	NC	Leave this pin unconnected.
8	I_{OUT}	Ground-referenced current ouput.
9	NC	Leave this pin unconnected.
10	V+	Positive supply. Recommend 100nF local decoupling capacitor placed as close to package as possible with a low inductance trace to ground.

USING THE SSI2161

The SSI2161 is a single-channel voltage controlled amplifier with a control range from +20dB to –100dB. The VCA is a current-in, current-out device with an exponential voltage control port. Basic operation is described below; see the "Principles of Operation" section for further details on inner workings of the device and an application section that follows.

Signal Input

Figure 1 shows the basic application circuit. A resistor converts the input voltage to an input current, and a 56Ω resistor in series with a 4700pF capacitor connected to ground ensures stable operation. The SSI2161 is quite tolerant of RC network selection, but 56Ω/4700pF has been proven to work well over a wide range of R_{IN} values.

A 3.74kΩ value for R_{IN} is recommended for most applications, but can range from 1.82kΩ to 25kΩ – lower values will produce the best noise performance at some cost in distortion.

Maximum input current handling is approximately 4mA peak. This input current "headroom" is only likely to be a consideration when using R_{IN} values of 2.5kΩ and below with supplies of ±12V and higher. In such cases, one may want to design the signal chain for a maximum input current of 3.6mA to allow adequate headroom.

An optional series-connected 47µF capacitor is recommended for improved control feedthrough.

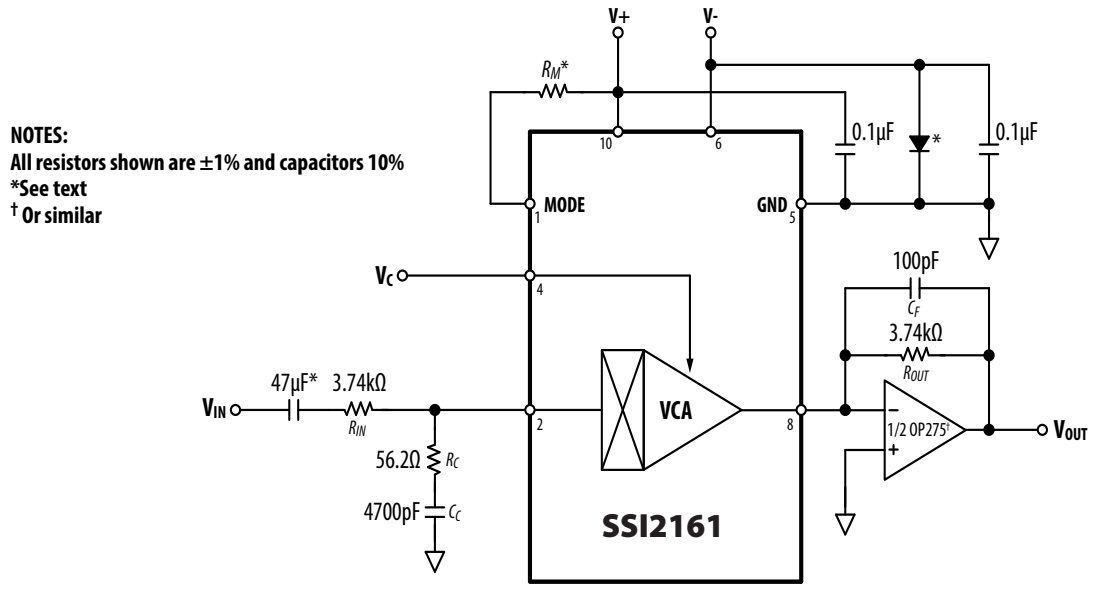

Figure 1: Typical Application Circuit