SSI2164

FATKEYS™ QUAD VOLTAGE CONTROLLED AMPLIFIER

The SSI2164 provides four independent, high-performance VCA's in a single package. A versatile Mode control allows selection of Class A, Class AB, or in-between using a single resistor to optimize noise versus distortion performance. Current input and output of audio signals provides design flexibility, with ground-referenced -33mV/dB control ports.

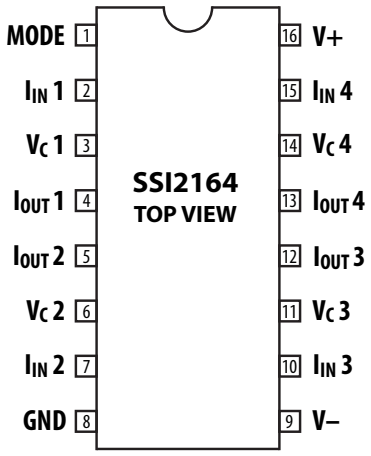
Further flexibility is provided by the SSI2164's four-fold increase of input current handling over the SSM/V2164 which allows reduction of R_{IN}/R_{OUT} values for lower noise at little to no cost in THD.

The SSI2164 will operate on supplies as low as ±4V for battery-powered devices, or up to ±17V in systems where maximum headroom is desired.

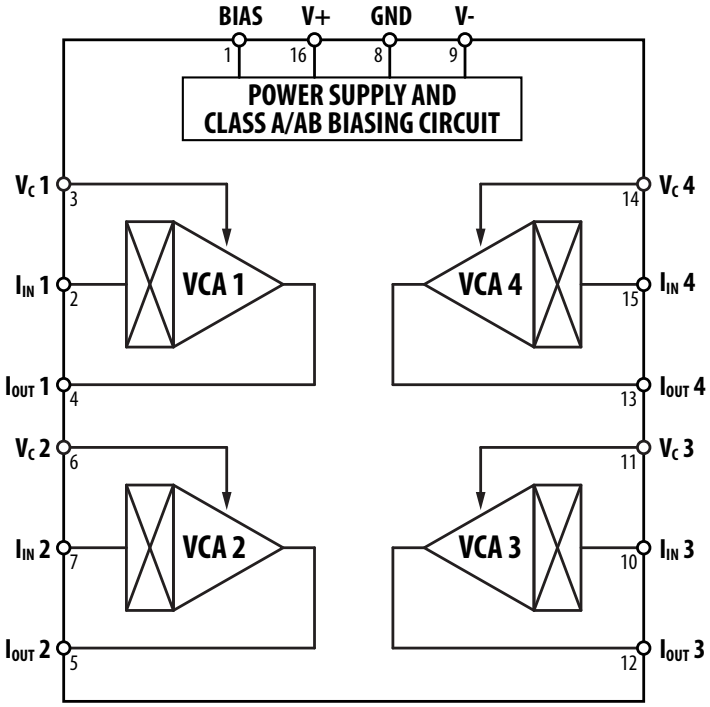
Distortion performance is improved across the board compared to the SSM2164/V2164. Depending on bias mode selection, extremely low noise (-96dBu typical, Class AB) or distortion (0.025%, Class A) can be achieved. The SSI2164 offers low control feedthrough, channel-to-channel gain matching better than 0.25dB, and a wide gain range of 120dB.

FEATURES

- **Improved Direct Replacement for SSM2164/V2164**
- **Input Current Handling Increased 4x to 2mA**
- **Pin-Selectable Class A or AB Operation**
- **118dB Dynamic Range (Class AB)**
- **Low Distortion – Typical 0.025% (Class A)**
- **Large Gain Range: -100dB to +20dB**
- **±4V to ±18V Operation**
- **No External Trimming**
- **Low Control Feedthrough – Typical -60dB**



PIN CONNECTIONS
16-PIN SOP
(JEDEC MS-012-AC)



FUNCTIONAL BLOCK DIAGRAM

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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 options)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
POWER SUPPLY						
Supply Voltage Range	V_S		±4		±17	V
Supply Current	I_{CC}	Class AB		6	8	mA
Supply Current	I_{EE}	Class A		8		mA
Power Supply Rejection Ratio	PSRR	60Hz		90		dB
CONTROL PORTS						
Input Impedance				10		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
Channel-to-Channel Gain Matching		A_V = 0dB		0.07		dB
		A_V = –40dB		0.24		dB
Maximum Attenuation				–100		dB
Maximum Gain				+20		dB
SIGNAL INPUTS						
Input Bias Current	I_B			±10		nA
Input Current Handling				2		mA
SIGNAL OUTPUTS						
Output Offset Current		V_{IN} = 0		±60		nA
Output Compliance				±100		mV
PERFORMANCE						
Output Noise		Class AB				
		$R_{IN/OUT}$ = 30kΩ		-93		dBu
		$R_{IN/OUT}$ = 20kΩ		-96		dBu
		$R_{IN/OUT}$ = 10kΩ*		-100		dBu
		$R_{IN/OUT}$ = 7.5kΩ*		-101		dBu
		Class A				
		$R_{IN/OUT}$ = 30kΩ		-80.5		dBu
		$R_{IN/OUT}$ = 20kΩ		-84		dBu
		$R_{IN/OUT}$ = 10kΩ*		-90		dBu
		$R_{IN/OUT}$ = 7.5kΩ*		-92		dBu
Headroom	HR			+22		dBu
Total Harmonic Distortion	THD	Class AB (*80kHz BW, f=1kHz*)				
		A_V = 0dB		0.058		%
		A_V = 0dB, V_{IN} = –15dBu		0.037		%
		A_V = +20dB, V_{IN} = –15dBu		0.17		%
		A_V = –20dB, V_{IN} = +10dBu		0.15		%
		Class A (*80kHz BW, f=1kHz*)				
		A_V = 0dB		0.03		%
		A_V = 0dB, V_{IN} = –7dBu		0.025		%
		A_V = +20dB, V_{IN} = –15dBu		0.045		%
Channel Separation		A_V = –20dB, V_{IN} = +10dBu		0.118		%
Unity Gain Bandwidth				-110		dB
Slew Rate	SR	C_F = 10pF		500		kHz
		C_F = 10pF		700		µA/µs

*Requires changes to input RC compensation network which will be advised in a future data sheet update.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	±18V
Storage Temperature Range	-65°C to +150°C
Operating Temperature Range	-40°C to +85°C
Lead Temperature Range (Soldering, 10 sec)	260°C

ORDERING INFORMATION

Part Number	Package Type	Quantity
SSI2164S-TU	16-Lead SOP* - Tube	50
SSI2164S-RT	16-Lead SOP* - Tape and Reel	4000

*Compliant to JEDEC MS-012-AC. Please order in full container multiples.

NOTES:
*15kΩ for Class A; Open for Class AB
[1]Optional - for improved control feedthrough
[2]Optional - as needed for asymmetrical power-up protection in modular systems. 1N4001-style.

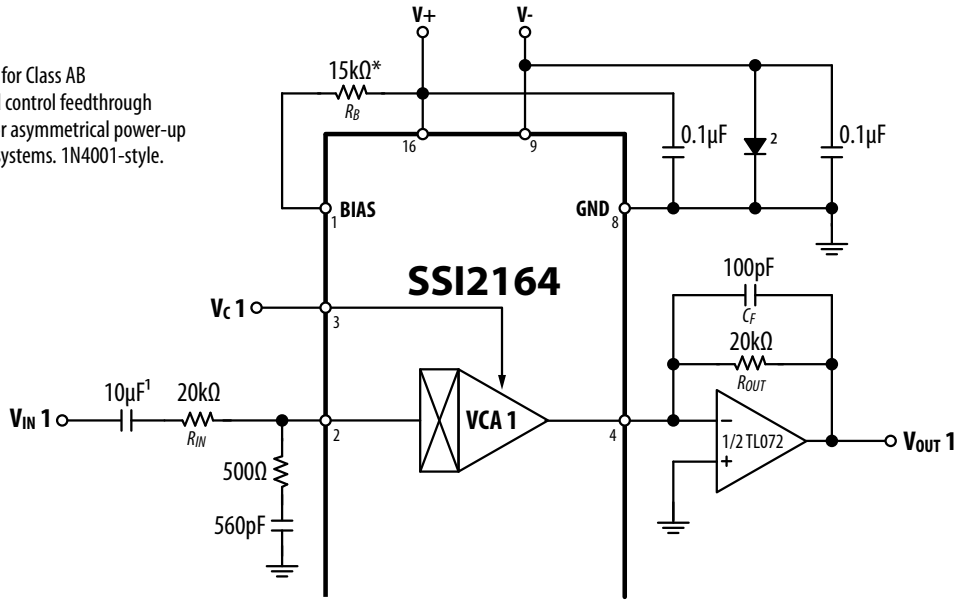


Figure 1: Typical Application Circuit

GENERAL DESCRIPTION

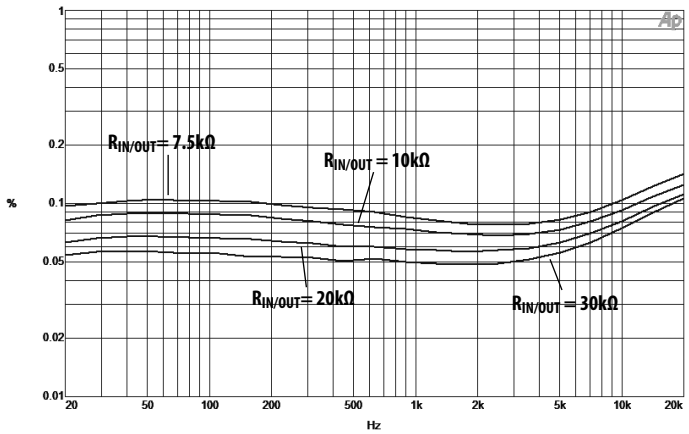
The SSI2164 is a versatile VCA building block for high performance audio applications. Four independent channels provide voltage control of current-mode inputs and outputs for a gain range of +20dB to -100dB. Among improvements over the SSM/V2164 is a four-fold increase in input current handling. As a result, one can trade a minor increase in distortion for substantial improvement in output noise by reducing the input and output resistor values. For example, changing Rin/out from 30kΩ to 20kΩ increases THD+N marginally from 0.05% to 0.058% while lowering output noise from -93dB to -96dB. Further flexibility is provided by the Mode Control (Pin 1) that biases gain cores as class A (lowest THD but higher noise) or AB (lowest noise but higher THD). Finally, improvements in the VCA core have the result of lower distortion across the board compared to the SSM/V2164.

Each channel has a dedicated control port with a -33mV/dB gain constant. For the full gain range -660mV results in 20dB of gain, and 3.3V provides 100dB of attenuation. If only attenuation is desired, the control port can be driven directly from a 5V DAC.

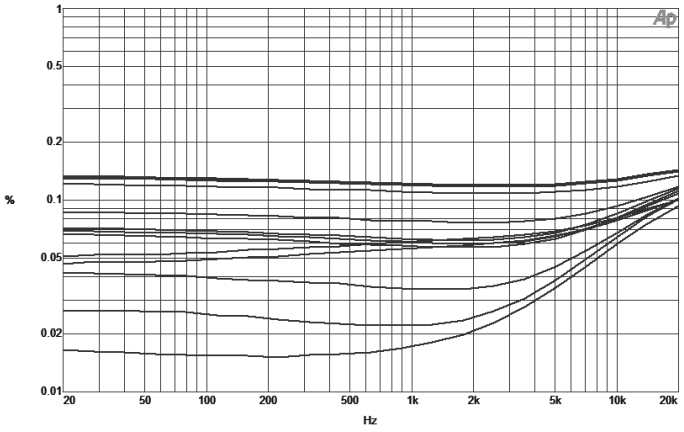
The SSI2164 retrofits SSM2164 and V2164 application circuits, using the standard 30kΩ input and output resistors and 500 ohm/560pF input compensation network. For best overall performance 20kΩ is recommend, with no changes necessary to compensation network. However, the same network results in oscillation at high signal levels with Rin/out values below 20kΩ and therefore requires changes in RC values. Watch for future data sheet updates with further information on RC network values when using Rin/out resistors below 20kΩ. *(continued next page)*

TYPICAL PERFORMANCE GRAPHS

Figure 1 Application Circuit at V_S = ±15V, A_V = 0dB, f = 1kHz; w/o options unless otherwise noted



THD+N vs. Frequency vs. $R_{IN/OUT}$
Class AB, V_{IN} = 0dBu, 22Hz - 80kHz Filter

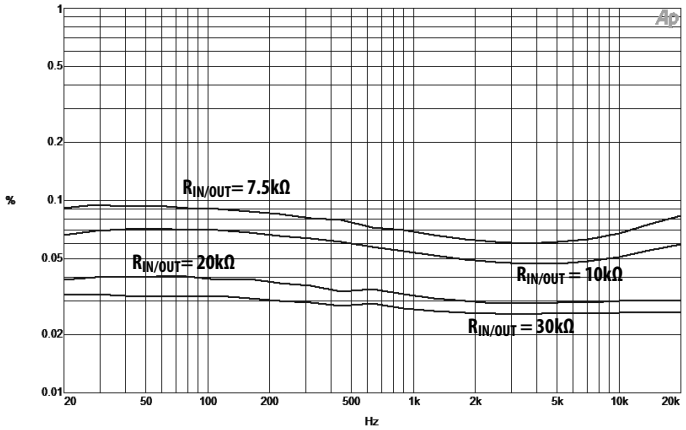


THD+N vs. Frequency Distribution - 12 Channels
Class AB, V_{IN} = 0dBu, 22Hz - 80kHz Filter

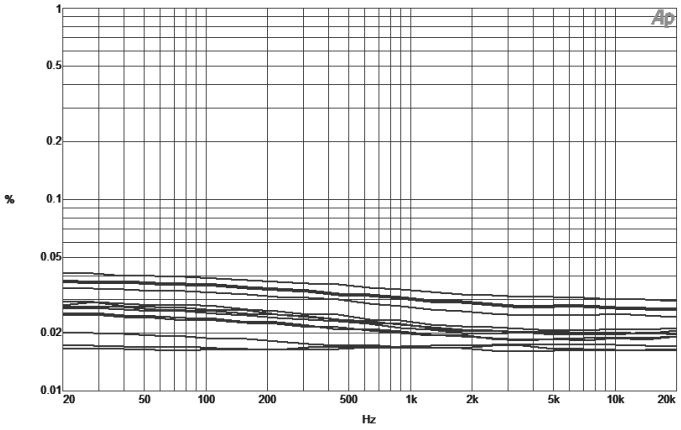
Internal protection has been added to prevent catastrophic failure during asymmetrical power-up, which may occur in modular synthesizers. For most applications, no external components for protection are necessary but modular system designers may want to include the standard diode shown in Figure 1 as an extra measure of protection.

If any channels of the SSI2164 are unused, outputs should grounded. Inputs can be left open, but the input compensation RC network should remain in place. Control pins can be left open or grounded.

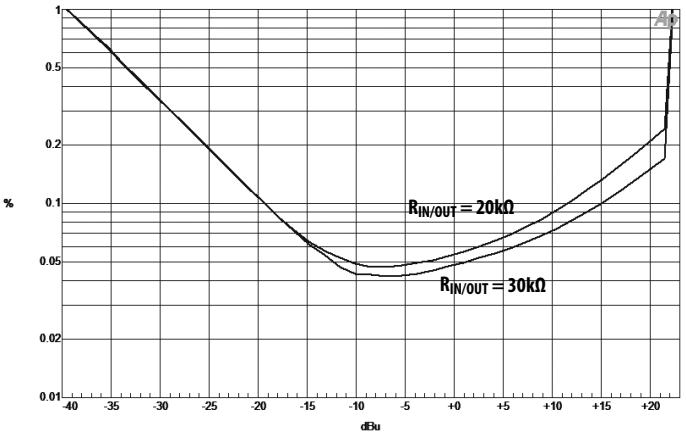
Figure 1 shows the typical application circuit with recommended 20kΩ $R_{IN/OUT}$ values. An optional input coupling capacitor provides improved control feedthrough.



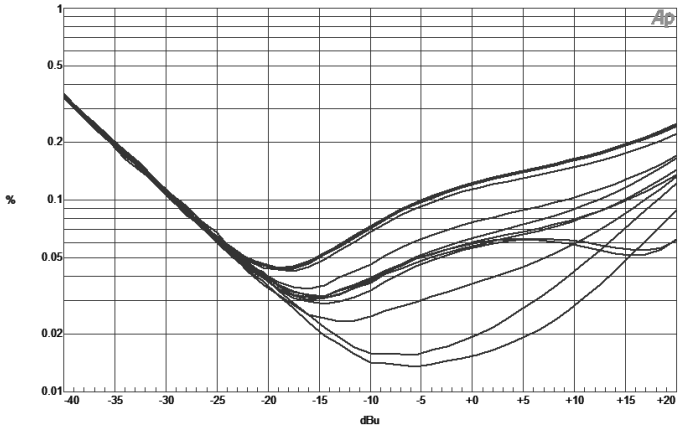
THD+N vs. Frequency vs. $R_{IN/OUT}$
Class A, V_{IN} = 0dBu, 22Hz - 80kHz Filter



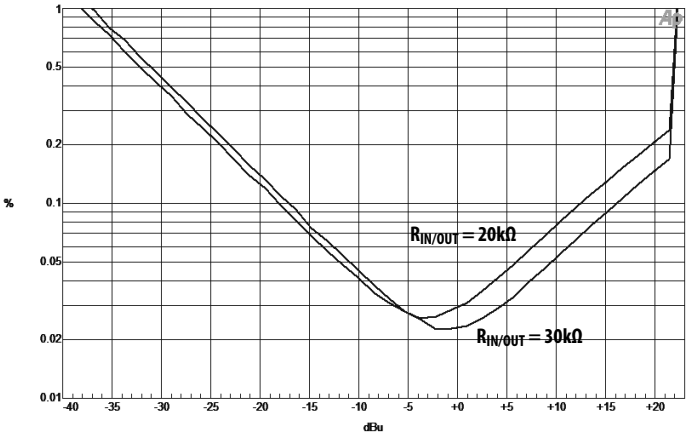
THD+N vs. Frequency Distribution - 12 Channels
Class A, V_{IN} = 0dBu, 22Hz - 80kHz Filter



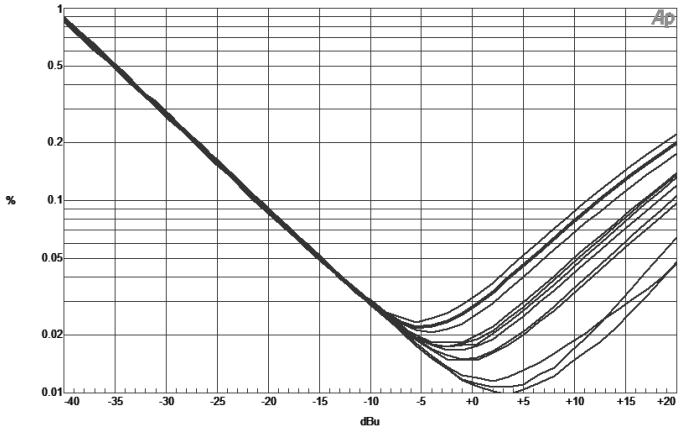
THD+N vs. Amplitude vs. $R_{IN/OUT}$
Class AB, <10Hz - 22kHz Filter



THD+N vs. Amplitude Distribution - 12 Channels
Class AB, <10Hz - 22kHz Filter



THD+N vs. Amplitude vs. $R_{IN/OUT}$
Class A, <10Hz - 22kHz Filter



THD+N vs. Amplitude Distribution - 12 Channels
Class A, <10Hz - 22kHz Filter