Solid State
Micro
Technology
for Music

SSM 2012

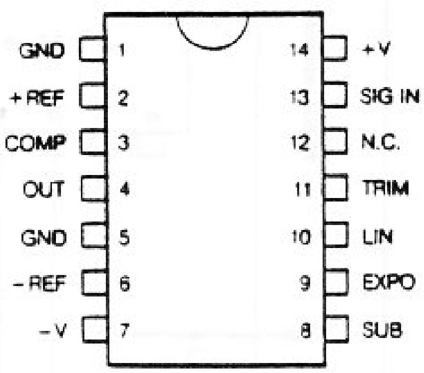
VOLTAGE CONTROLLED AMPLIFIER*

DESCRIPTION

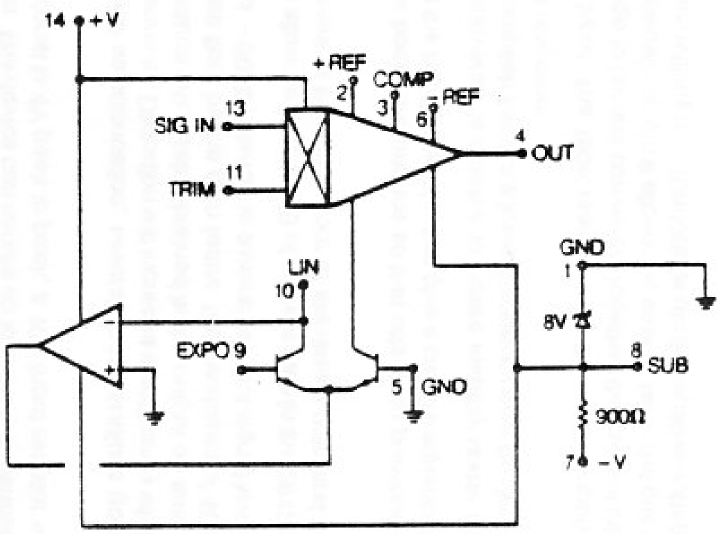
The SSM 2012 is a low cost, high performance linear-antilog voltage controlled amplifier with full class A performance. The device has a 100 dB signal to noise figure at 0.01% THD. The current inputs and outputs make possible wide bandwidth, easy signal summing, and minimum external component count. Inherently low control feedthrough and 2nd harmonic distortion make trimming unnecessary for most applications.* In addition, the 2012 has more than 12dB of headroom at the rated specifications and can be configured to give up to 40dB of gain.

FEATURES

- 100dB Signal/Noise (20Hz-20KHz)
- 0.01% THD
- 0.025% IMD
- 12dB of Headroom (at rated specs.)
- 100KHz Bandwidth
- Linear and Exponential Control Inputs
- 40dB Gain Capability
- Low Cost
- Full Class A Performance
- Minimum External Component Count
- Current Input
- Current Output
- −40dB Control Feedthrough (untrimmed)
- No Trimming Required for Most Applications



PIN OUT (TOP VIEW)



BLOCK DIAGRAM

SPECIFICATIONS*

OPERATING TEMPERATURE
−10°C to +55°C

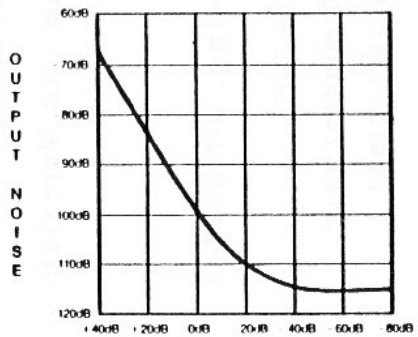
STORAGE TEMPERATURE
−55°C to +125°C

Specification* @ V_s = ±15V and T_A = 25°C

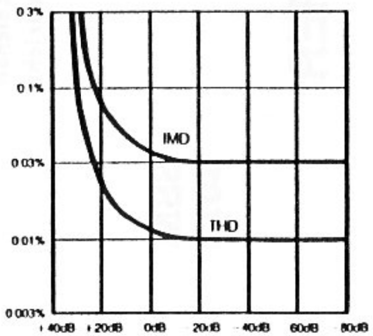
PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS
Positive Supply Voltage	+12	+15	+18	V	
Negative Supply Voltage[1]	−7.6	−8.2	−8.7	V	
Positive Supply Current	6.5	8.7	11.5	mA	
Negative Supply Current	6.5	8.7	11.5	mA	
Negative Supply Bias Resistor (pin 7 to pin 8)	675	900	1170	Ω	
Expo Input Bias	0.25	0.5	1.3	μA	V_c = GND, I_i = +100μA
Expo Control Sensitivity		−10		mV/dB	at pin 9
Linear Input Bias	0.25	0.5	1.3	μA	V_c = 300mV, I_i = 0
Linear Control Sensitivity	0.98	1	1.02	%/μA	
Trim Input Resistance to GND	9	12	15.6	Ω	
Current Gain	0.95	1.0	1.05		V_c = GND, I_i = +100μA
Current Output Offset (untrimmed)	−5	0	+5	μA	V_c = GND, I_i = +100μA
Output Leakage	−10	0	+10	nA	V_c = +600mV, I_i = +100μA
Max Available Output Current	−800	0	+800	μA	V_c = GND, I_i = +100μA
Current Bandwidth (3dB)		300		KHz	V_c = GND, I_i = +100μA
Signal Feedthrough		−105		dB	I_i = 0
Signal to Noise (20Hz-20KHz)		−98		dB	V_c = GND, I_i = 100μA
THD (untrimmed)		0.025		%	V_c = GND, I_i = 100μA
THD (trimmed)		0.01		%	V_c = GND, I_i = 100μA
IMD (untrimmed)		0.075		%	V_c = GND, I_i = 100μA
IMD (trimmed)		0.03		%	V_c = GND, I_i = 100μA

*Final Specifications may be subject to change

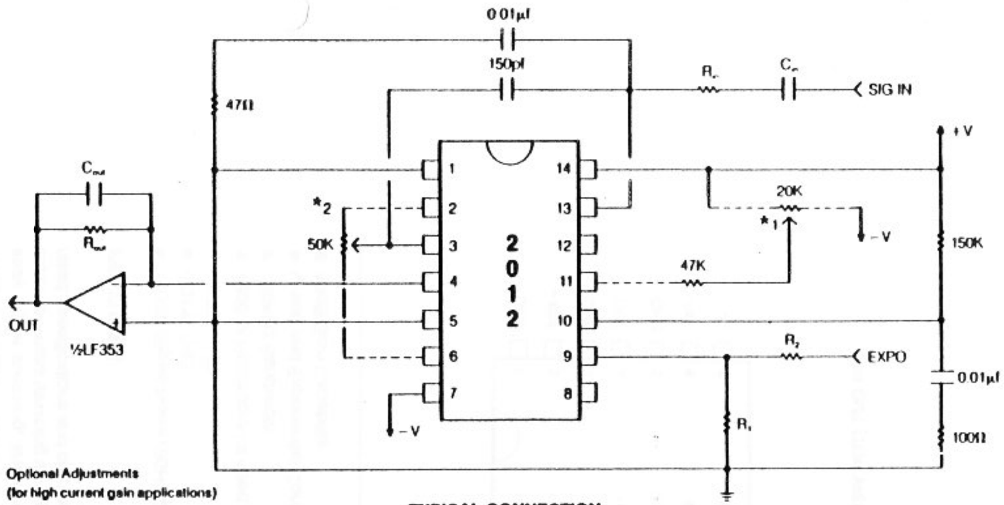
1) Measured at pin 8, pin 7 = −15V



CURRENT GAIN/ATTENUATION
NOISE BANDWIDTH (20Hz - 20KHz)
(Referred to 300μA rms Output)



CURRENT GAIN/ATTENUATION
1KHz (BANDWIDTH 20KHz)



Optional Adjustments
(for high current gain applications)
*1 Offset trim
*2 2nd harmonic trim

TYPICAL CONNECTION

The circuit above shows the typical connection of the 2012 as a precision voltage controlled amplifier. When the voltage on pin 9 is ground, the device will be operating at unity current gain.

Since the 2012 is a current input, current output device, the input and output resistor values can be selected to give optimum performance for any given signal processing environment. A peak to peak input signal of ±200μA will give the rated specifications and allow for 12db of headroom. The device can handle up to ±800μA without clipping or other radical increases in distortion. If the average peak input signal is 4V peak to peak, a 10K input resistor will yield the proper input current.

Since the 2012 is capable of current gain as well as attenuation, several considerations go into the selection of the feedback resistor in the output current to voltage convertor. Distortion will increase significantly when the device is operated above 20 to 30dB of current gain. (See graph at bottom left.) Gain obtained in the output op amp by ratioing the output to input resistors is at the expense of raising the noise floor by the gain factor. If a maximum of 40dB of gain is desired the noise floor would be raised from around −100dB to −60dB referred to a useable input signal level.

A workable compromise in this case would be to allow for 20 to 30dB of current gain in the 2012 and get the rest from the op amp. This will result in a several dB improvement in the noise floor at maximum gain and a significant reduction in distortion.

The input D.C. blocking capacitor is required for best performance so that offsets in previous stages do not upset the balance of the device. C_{in} should be chosen so that the R_{in}, C_{in} combination give a cutoff frequency below the audio band.

The capacitor in the output current to voltage convertor is needed to insure stability under all signal and output load conditions. A corner frequency of 300KHz will accomplish this but a lower frequency may be desired to limit noise outside the audio band at the expense of a slower transient response.

Pin 10 is a virtual ground, linear current control input. The 150K resistor from the +15V supply establishes a +100μA reference current for the internal exponential voltage to current convertor. Together the current into pin 10 and the voltage on pin 9 control the gain of the VCA. The R_1, R_2 attenuator to pin 9 allows the user to tailor the gain sensitivity of the device to the available control voltage range. (The control sensitivity is −10mV/dB at pin 9. Negative voltages give current gain and positive voltages give attenuation.)

The 2012 has been designed for minimum distortion, offset and control feedthrough at unity current gain. In order to get optimum performance in applications requiring more than 10 to 20dB of gain, two trim points have been provided. Trim 1 is helpful because offset and control feedthrough are amplified by the gain of the device. The small offset one obtains at unity current gain may not be acceptable at +30 or +40dB. Since distortion in the 2012 is more variable from device to device at high current gain, trim 2 allows one to get the best overall distortion figures vs. gain on a repeatable basis. The procedure is to apply a control voltage to pin 9 corresponding to the maximum desired current gain and set the input level so that the output is just below clipping. Trim 2 is then adjusted to give minimum distortion.