Solid State Micro Technology for Music

SSM 2013

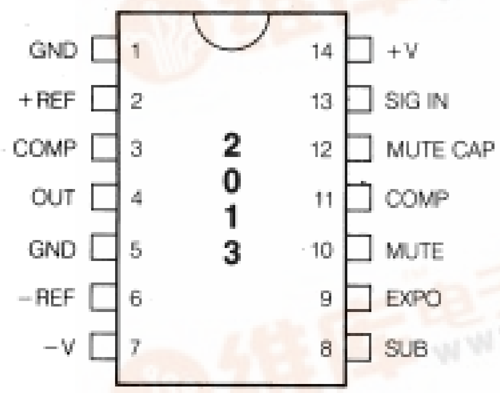
VOLTAGE CONTROLLED AMPLIFIER*

DESCRIPTION

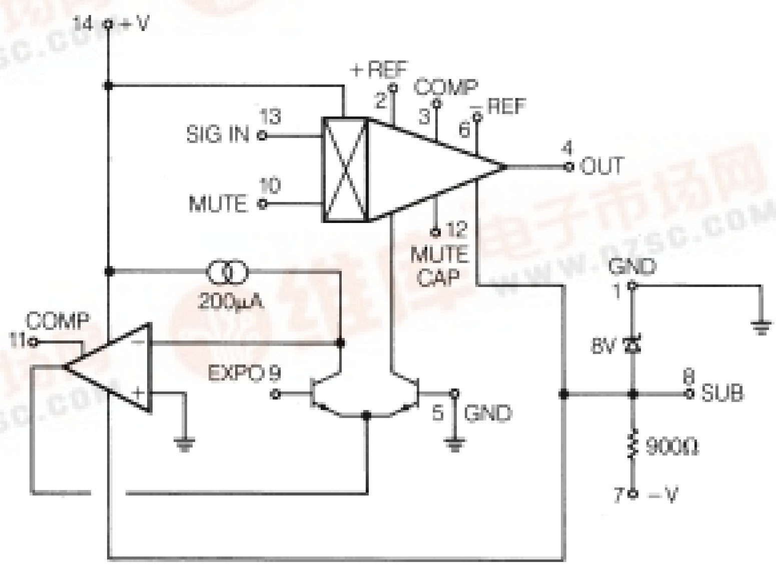
The SSM 2013 is a low cost, high performance antilog voltage controlled amplifier with full class A performance. The device has a 94dB signal to noise figure at 0.01% THD. The current inputs and outputs make possible wide bandwidth, easy signal summing, and minimum external component count. Inherently low control feedthrough and 2nd harmonic distortion make trimming unnecessary for most applications.* In addition, the 2013 has more than 12dB of headroom at the rated specifications and can be configured to give up to 40dB of gain.

FEATURES

- 94dB Signal/Noise (20Hz-20kHz)
- 0.01% THD
- 0.03% IMD
- 12dB of Headroom (at rated specs.)
- 800kHz Bandwidth
- Mute and Exponential Control Inputs
- 40dB Gain Capability
- Low Cost
- Full Class A Performance
- Minimum External Component Count
- Current Input, Current Output
- 106dB Dynamic Range (17.5 BITS)
- −40dB Control Feedthrough (untrimmed, RE 0 dBV)
- No Trimming Required for Most Applications



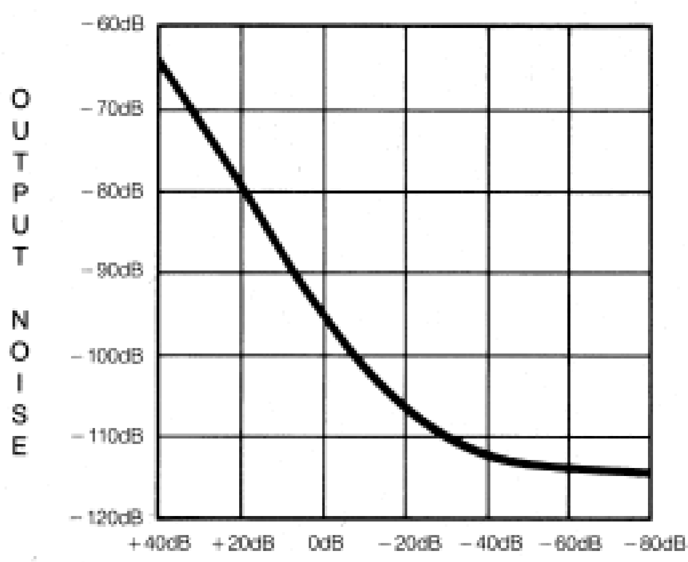
PIN OUT (TOP VIEW)

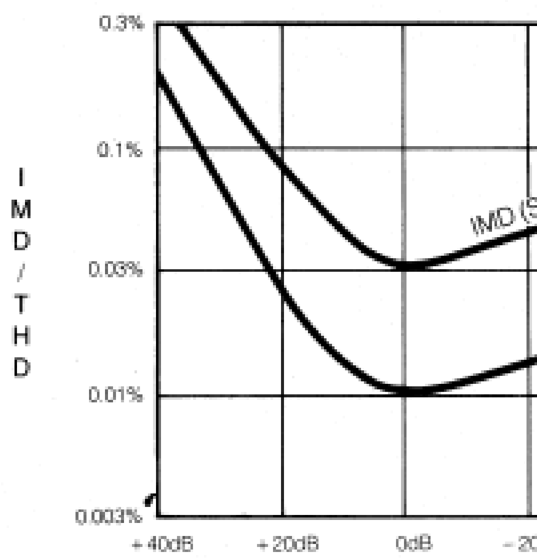


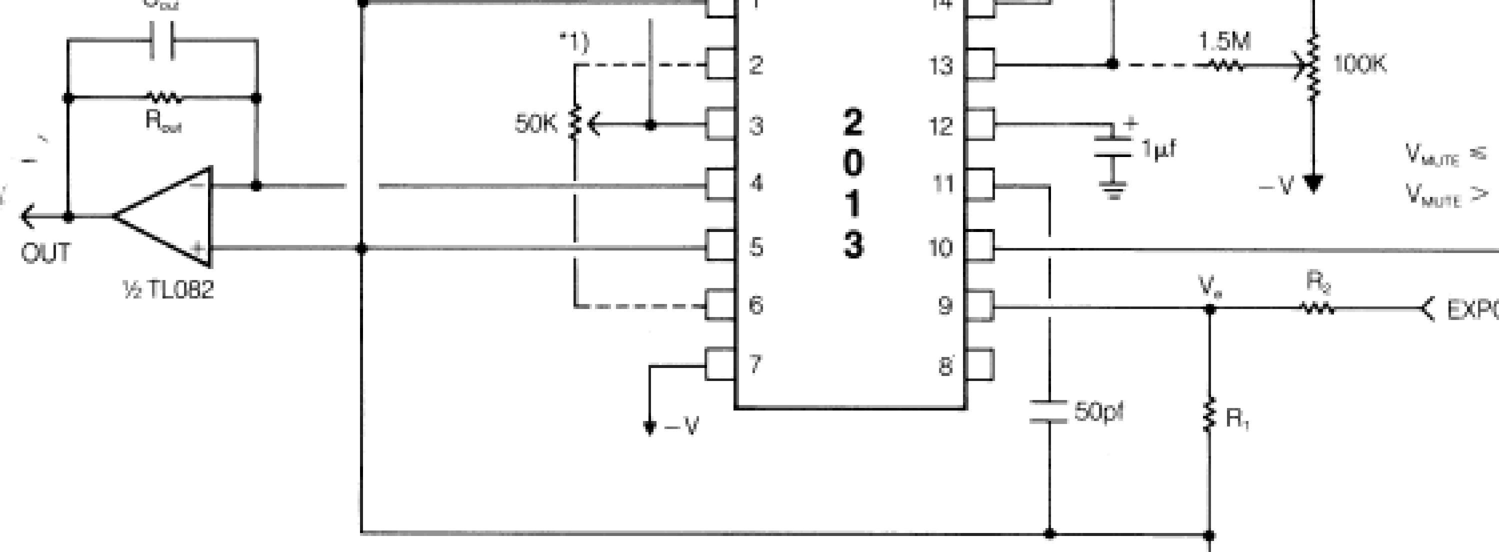
BLOCK DIAGRAM

PARAMETER	MIN	TYP	MAX	UNITS	CONDITION
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		1.0	2.5	μA	V_e[2] = GND
Expo Control Sensitivity		−10		mV/dB	at pin 9
Mute Off (logic low)	0.0V	—	1.0	V	
Mute On (logic high)	3.0V	5	15	V	
Mute Attenuation		−96		dB	@ 1kHz, $V_{PIN\,10}$ = +
Current Gain	0.95	1.0	1.05		V_e = GND
Current Output Offset	−7.5	0	+7.5	μA	V_e = GND
Output Leakage	−10	0	+10	nA	V_e = +600mV
Max Available Output Current	±1.2			mA	V_e = GND, 15K (pi
Current Bandwidth (3dB)		800		kHz	V_e = GND
Signal Feedthrough		−100		dB	V_e = +1.2V
Signal to Noise (20Hz-20kHz)[3,4]		−94	92.5	dB	V_e = GND, No Sign
THD (untrimmed)[4]		0.01	0.04	%	V_e = GND, I_{IN} = 40
THD (trimmed)		0.004		%	V_e = GND, I_{IN} = 40
IMD (untrimmed)[4] SMPTE		0.03	0.12	%	V_e = GND, I_{IN} = 40
IMD (trimmed) SMPTE		0.012		%	V_e = GND, I_{IN} = 40

1) Measured at pin 8, pin 7 = −15V.
2) V_e is voltage on pin 9.
3) Referred to a 400μA$_{pp}$ input level.
4) Parameter is sample tested to max limit (0.4% AQL).







*1) Optional adjustments, 2nd harmonic trim (for high current gain applications).
*2) Optional control feedthrough trim.

TYPICAL CONNECTION

General

The circuit above shows the typical connection of the 2013 as a precision voltage controlled amplifier. Wh on pin 9 is ground, the device will be operating at unity current gain.

Signal Input (Pin 13)

Since the 2013 is a current input, current output device, the input and output resistor values can be se optimum performance for any given signal processing environment. A peak to peak input signal of ±300µ rated specifications and allow for 12dB of headroom. The device can handle more than ±1.2mA without cl radical increases in distortion. If the average peak input signal is 7V peak to peak and the supplies are ±15 resistor will yield the proper input current and headroom.

Frequently 16 to 24dB of headroom is required to handle high crest factor material such as percussive i $\pm 120\mu A_{pp}$ input signal level will allow for 20dB of headroom and yield an 86dB signal to noise ratio at unity and IMD characteristics, given in the graph at the bottom right of page 2, will improve (decrease) by a factor o

The input D.C. blocking capacitor is required for best performance so that offsets in previous stages do balance of the device. C_{in} should be chosen so that the R_{in}, C_{in} combination gives a cutoff frequency below th

Signal Output (Pin 4)

Since the 2013 is capable of current gain as well as attenuation, several considerations go into the se feedback resistor in the output current to voltage convertor. Distortion will increase significantly when the devi above 20 to 30dB of current gain. (See graph at bottom left.) Gain obtained in the output op amp by ratioing input resistors is the expense of raising the noise floor by the gain factor. If a maximum of 40dB of gain is des floor would be raised from around −94dB to −54dB referred to a usable input signal level.

A workable compromise in this case would be to allow for 20 to 30dB of current gain in the 2013 and get th op amp. This will result in a several dB improvement in the noise floor at maximum gain and a significar distortion.

Noise Measurement

Audio noise in the 2013 cannot be correctly calculated from a broadband noise measurement. This is 5000pF–47Ω network at the input form a zero in the compensation network at 600kHz. The noise floor will ro of +6dB per octave from about 45kHz to 600kHz where it will again roll off. When measuring audio noise ir should limit the bandwidth to 20kHz or 30kHz.

The capacitor in the output current to voltage convertor is needed to insure stability under all signal an supplies including TTL and CMOS. The mute cap on pin 12 determines the turn on/turn off rate. This cap ar 10K impedance gives a time constant of 10mS with the 1 µf cap shown. With this value a transition will be quick without being too abrupt or "poppy." The impedance at the mute input is nearly infinite below +2V and lo 10K above +3V.

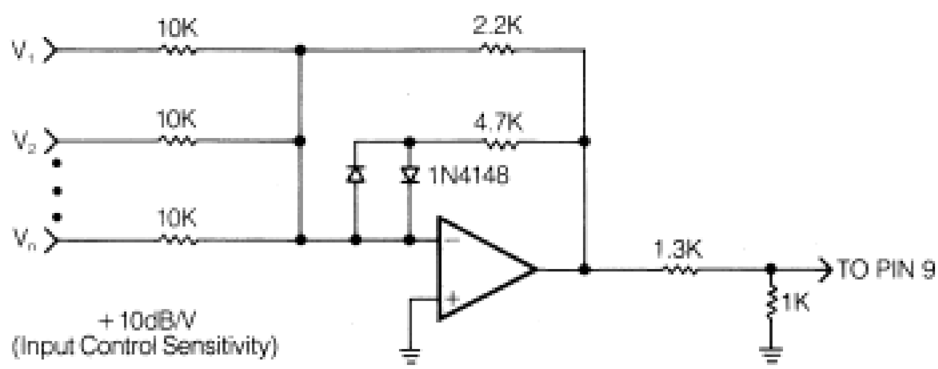
dB/V Control (Pin 9)

The control pin on the 2013 is a high impedance input with an overall control range of +40dB to less than control sensitivity is −1dB/10mV to within ±1.5dB over a ±36dB range. The R_1, R_2 attenuator to pin 9 allow tailor the gain sensitivity of the device to the available control voltage range. (The control sensitivity is −10m Negative voltages give current gain and positive voltages give attenuation.) If more gain accuracy is required range and/or if a control summer is required, the circuit below is recommended.

Trimming (Pins 2, 3)

The 2013 has been designed for minimum distortion, offset and control feedthrough at unity current gain. I optimum performance in applications requiring more than 10 to 20dB of gain, a trim point has been provided. Si in the 2013 is more variable from device to device at high current gain, the trim allows one to get the best ove figures vs. gain on a repeatable basis. The procedure is to apply a control voltage to pin 9 corresponding to t desired current gain and set the input level so that the output is just below clipping. The trim is then adjusted to g distortion.

Control feedthrough in the 2013 can be reduced by using the optional adjustment shown in the typical connec The procedure is to apply a control voltage which corresponds to the maximum amount of desired gain and output to zero.



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