Serial Input Hex/Quad "Clickless" Volume Control with Master Attenuation

SSM2160/SSM2161

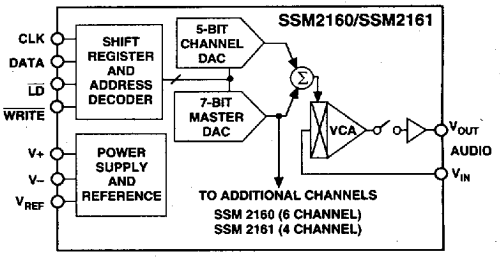
FEATURES

Digitally-Controlled "Clickless" Level Adjustment
SSM2160: Six Channels
SSM2161: Four Channels
Master Control Has 128 1 dB Steps
Each Channel Has 32 1 dB Steps Plus Mute
Step Sizes Can Be Changed Using External Resistors
High Gain Accuracy
100 dB Gain Range
Excellent Audio Characteristics:
–100 dBu SNR (0 dBu = 0.775 V rms, V_S = ±5 V)
+10 dBu Headroom (V_S = ±5 V)
0.008% THD+N (@ 1 kHz, V_{IN} = –10 dBu, Unity Gain)
–80 dB Crosstalk (@ 1 kHz)
Single or Dual Supply Operation
24-Pin Plastic DIP and SOIC Packages (SSM2160)
20-Pin Plastic DIP and SOIC Packages (SSM2161)

APPLICATIONS

Dolby* Pro-Logic Master Volume Control
Home THX† System
DSP Soundfield Processors
Automotive Audio Systems
HDTV Audio Systems

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The SSM2160 and SSM2161 allow digital control of volume for six and four channels, respectively, with a master level control. In order to avoid "clicking," the device uses high performance voltage controlled amplifiers (VCAs) for the audio signal path. The VCA control port effectively isolates DAC charge injection from the audio path, which is the major contributor to clicking in resistor-ladder type attenuators. Each channel is controlled by a dedicated 5-bit DAC, providing 32 steps of adjustment, plus mute. In addition, a master 7-bit DAC feeds every control port, with 128 steps. Therefore, a balance can be achieved among all channels over a 32-step range, and the master control allows adjustment over its entire range while maintaining the desired channel-to-channel balance. Step sizes are defaulted to 1 dB, but channel sizes can be increased or master sizes decreased by the addition of external resistors. Approximately 80 dB of attenuation and up to 20 dB of gain is possible.

The SSM2160/SSM2161 can operate either single or dual supply, with a total supply voltage range of 8 V to 36 V. An on-chip voltage reference is provided for single-supply applications.

*Dolby is a registered trademark of Dolby Laboratories Licensing Corporation.
†Home THX is a registered trademark of Lucasfilm, Ltd.

This is a preliminary data sheet. To obtain the most recent version or complete data sheet, call our fax retrieval system at 1-800-446-6212.

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS (V_S = ±5 V, A_V = 0 dB, 0 dBu = 0.775 Vrms, V_{IN} = –10 dBu, f_{AUDIO} = 1 kHz, f_{CLK} = 250 kHz, R_L = 100 kΩ, –40°C < T_A < +85°C, unless otherwise noted. Typical specifications apply at T_A = +25°C.)

Parameter	Conditions	Min	Typ	Max	Units
AUDIO PERFORMANCE					
Noise	V_{IN} = GND, 20 kHz Bandwidth		–100	TBD	dBu
Headroom	Clip Point = 1% THD+N		+10		dBu
Total Harmonic Distortion Plus Noise	2nd and 3rd Harmonics Only				
	A_V = 0 dB		0.008	TBD	%
	A_V = –20 dB		0.02	TBD	%
	A_V = 0 dB, V_{IN} = +10 dBu		0.8	1.0	%
Channel Separation	Any Channel to Another		80		dB
ANALOG INPUT					
Input Offset Voltage			10		mV
Input Impedance			14		kΩ
GAIN CONTROL ELEMENTS					
Default Step Size—Master	A_VMASTER = 0 dB to –60 dB	TBD	1.0	TBD	dB
Default Step Size—Channel	A_VCHANNEL = 0 dB to +20 dB	TBD	1.0	TBD	dB
Gain Error	Relative to Same Channel				
	A_VMASTER = 0 dB			0.25	dB
	A_VMASTER = –20 dB			0.25	dB
	A_VMASTER = –40 dB			1	dB
	A_VMASTER = –60 dB			2	dB
Gain Match Error	Channel-to-Channel, Same Level Setting				
	A_VMASTER = 0 dB			0.25	dB
	A_VMASTER = –20 dB			0.25	dB
	A_VMASTER = –20 dB, A_VCH = +20 dB			0.25	dB
	A_VMASTER = –40 dB			1	dB
	A_VMASTER = –60 dB			2	dB
Mute Attenuation			–105		dB
ANALOG OUTPUT					
Output Impedance			TBD		Ω
Mute Output Impedance			TBD		Ω
Output Sink Current			TBD		mA
Minimum Resistive Load Drive			TBD		Ω
Maximum Capacitive Drive			TBD		pF
Offset Voltage	Channel Muted		20		mV
CONTROL SECTION					
Logic Input LO				0.8	V
Logic Input HI		2.0			V
Logic Input Current	Logic LO or HI		1		µA
Maximum Clock Frequency		1	2		MHz
Timing Characteristics	See Timing Diagram				
REFERENCE					
Output Voltage	V_S = +10 V (Single Supply)	4.9	5.0	5.1	V
Output Impedance			TBD		Ω
Load Regulation	–10 mA ≤ I_L ≤ +10 mA		0.1		%
POWER SUPPLIES					
Supply Voltage Range	Dual Supply	±4		±15	V
	Single Supply	+8		+30	V
Supply Current	Positive		TBD	TBD	mA
	Negative		20	30	mA
Power Supply Rejection Ratio	Dual Supply		TBD		dB

Specifications subject to change without notice.

ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage
- Dual Supply ..... ±18 V
- Single Supply ..... +36 V

Analog Input Voltage ..... $\pm V_S$
Logic Input Voltage ..... $\pm V_S$
Operating Temperature Range ..... –40°C to +85°C
Storage Temperature ..... –65°C to +150°C
Junction Temperature (T_J) ..... +150°C
Lead Temperature (Soldering, 60 sec) ..... +300°C

THERMAL CHARACTERISTICS

Thermal Resistance[2]

24-Pin Plastic DIP (SSM2160)
- θ_{JA} ..... TBD°C/W
- θ_{JC} ..... TBD°C/W

24-Pin SOIC (SSM2160)
- θ_{JA} ..... TBD°C/W
- θ_{JC} ..... TBD°C/W

20-Pin Plastic DIP (SSM2161)
- θ_{JA} ..... TBD°C/W
- θ_{JC} ..... TBD°C/W

20-Pin SOIC (SSM2161)
- θ_{JA} ..... TBD°C/W
- θ_{JC} ..... TBD°C/W

TRANSISTOR COUNT

Number of Transistors ..... TBD

ESD RATINGS

883 (Human Body) Model ..... TBD kV
EIAJ Model ..... TBD V

NOTES

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

[2]θ_{JA} is specified for worst-case conditions, i.e., θ_{JA} is specified for device in socket for P-DIP and device soldered in circuit board for SOIC package.

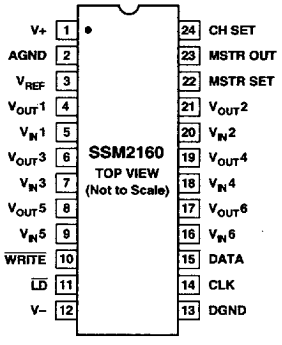
ORDERING GUIDE

Model	Temperature Range	Package Option*
SSM2160N	–40°C to +85°C	N-24
SSM2160R	–40°C to +85°C	R-24
SSM2161N	–40°C to +85°C	N-20
SSM2161R	–40°C to +85°C	R-20

*N = Plastic DIP; R = SOIC. For outline information see Package Information section.

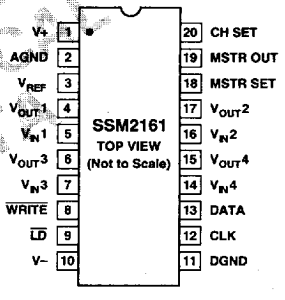
SSM2160 PIN CONFIGURATION

24-Lead Plastic DIP and SOIC



SSM2161 PIN CONFIGURATION

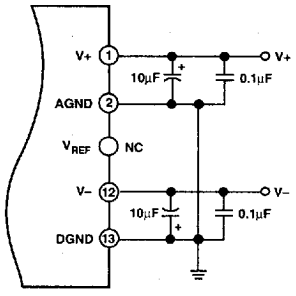
20-Lead Plastic DIP and SOIC



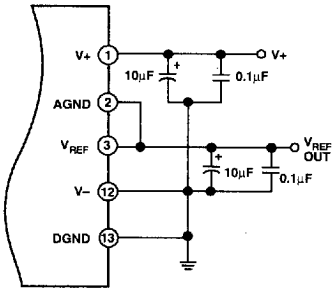
CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the SSM2160/SSM2161 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

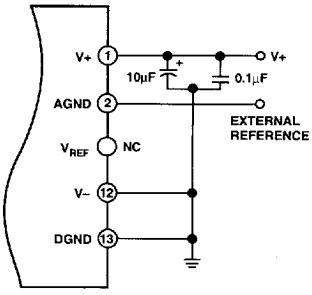
SSM2160 POWER SUPPLY CONNECTIONS



Dual Supply

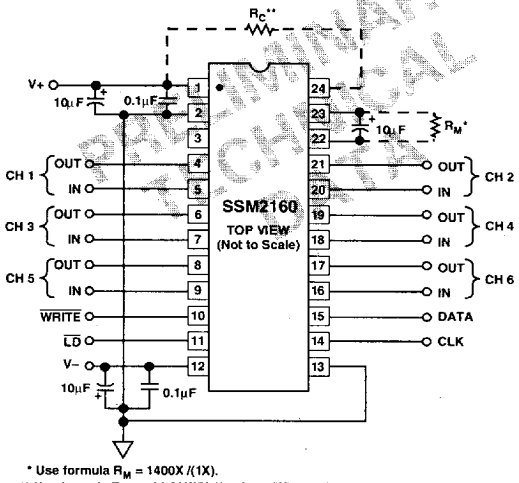


Single Supply



Single Supply Using External Reference

TYPICAL APPLICATION CIRCUIT (DUAL SUPPLY)



* Use formula $R_M = 1400X/(1X)$.
** Use formula $R_{CH} = 44\text{-}20X/(X\text{-}1)$, where "X" equals desired step size in dB.

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