PMI

Audio Silicon Specialists™

SSM-2047
MUSIC VOICING SYSTEM

SSM Audio Products

DESCRIPTION

The SSM 2047 is a dedicated signal processing array designed to conform to the demands of state-of-the-art electronic music systems. Provided on-chip is a four-pole 2045 type low-pass voltage controlled filter and three output VCA's which give individual channel as well as mixable left and right stereo outputs.

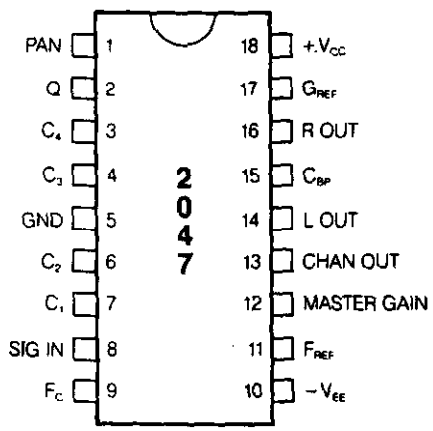
The filter section has been designed for low distortion, wide dynamic range, low offset and has excellent control rejection performance. A voltage controlled feedback amplifier gives built-in electronic Q control with a minimum of in-band loss at the oscillation point.

The output VCA's are low control feedthrough, full class A devices connected in parallel rather than series for less noise and distortion build up. The master gain and stereo pan pins have exponential (dB/volt) control characteristics.

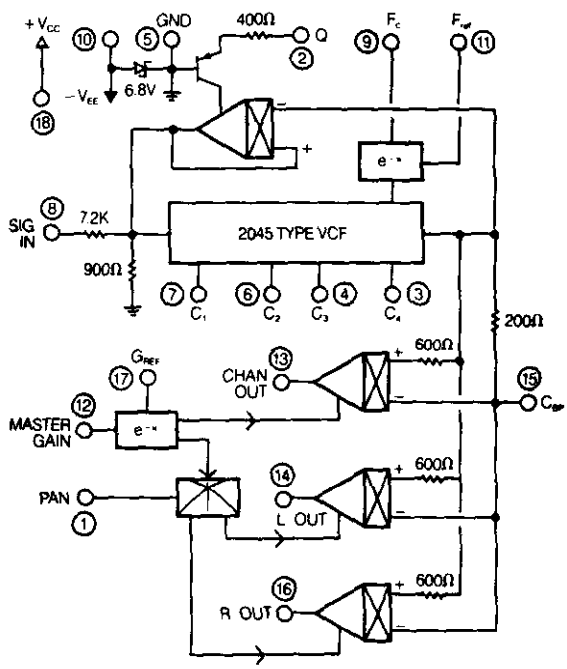
The system as a whole delivers a characteristic "fat" sound and unit-to-unit frequency and amplitude variability is reduced by external reference resistors.

FEATURES

- 92 dB VCF Dynamic Range
- Full Class A Signal Path
- Low Distortion VCF And VCAs
- dB/Volt Master Gain And Pan Controls
- Exceptionally Low Control Feedthrough
- Only 6dB Filter Signal Loss At Oscillation
- Signal Can Be Removed From Stereo Mix When Channel Output Used
- Low Part To Part Frequency And Gain Variability
- Output VCAs In Parallel Rather Than Series
- "Fat" Sound



PIN OUT (TOP VIEW)



BLOCK DIAGRAM

Revised February 1987
Patent Pending

The SSM 2047 has been granted mask work protection under the Semiconductor Chip Protection Act of 1983.

SPECIFICATIONS

OPERATING TEMPERATURE
$0°C \leq T_A \leq 75°C$

STORAGE TEMPERATURE
$-25°C \leq T_S \leq +125°C$

The following specifications apply for V_S = +15V and T_A = 25°C

PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS
General					
Positive Supply Range	+9	+15	+18	V	
Negative Supply Range[1]	−18	−15	−5	V	
Positive Supply Current	8.15	10.2	12.25	mA	$V_{PIN\,9} = V_{PIN\,12} = GND$
Negative Supply Current	6.5	8.15	9.8	mA	$V_{PIN\,9} = V_{PIN\,12} = GND$
Filter Section @ $I_{F\,REF}$ = 10.0µA					
Signal Input Level (PIN 8)		1.35	2.7	Vpp	
Input Impedance (PIN 8)	5.75	7.2	8.64	KΩ	
Output Offset (PIN 15)		±5	±15	mV	
Frequency Control Feedthrough[2] (PIN 15)		−36	−28	dB	$-90mV \leq V_{PIN\,9} \leq +90mV$
Frequency Control Range (PIN 9)		12	14	OCTAVES	
Center Frequency Variability	0.92	1.00	1.08	F/F_{NOM}	$V_{PIN\,9} = GND$
F_C Input Bias Current (PIN 9)		1.25	2.5	µA	$V_{PIN\,9} = GND$
Frequency Control Sensitivity (PIN 9)	−20	−19.3	−18.7	mV/OCTAVE	
F_C Scale Factor Drift		+3300		ppm/C°	
Q Current Required For Oscillation (PIN 2)	65	75	85	µA	
Q Control Feedthrough[2] (PIN 15)		−26	−16	dB	$0 \leq I_Q \leq 60\mu A$
Dynamic Range[3] (Clipping to Noise Floor)		92		dB	$V_{PIN\,9} = -90mV$ *(Filter Wide Open)*
In Band Distortion[3] $4F_{IN} \leq F_C$		0.1		%	
Max Distortion[3] $F_{IN} \simeq F_C$		1.0		%	
Output VCAs @ $I_{G\,REF}$ = 300µA					
Max VCA Gain (PINS 13, 14, and 16)	2250	2450	2650	µmohs	$V_{PIN\,12}$ = OV, $V_{PIN\,1} \simeq +300mV$ or $-300mV$
Output Leakage (PINS 13, 14, and 16)	−1		+1	nA	$V_{PIN\,12} = +400mV$
Left/Right Gain Matching (PINS 14, 16)	−0.5		+0.5	dB	$V_{PIN\,1} = V_{PIN\,12} = GND$
Gain Control Input Bias Current (PIN 12)		1.0	2.25	µA	$V_{PIN\,12}$ = OV
Pan Control Input Bias Current (PIN 1)		0.5	2.25	µA	$V_{PIN\,1}$ = OV
Control Feedthrough[2]		−41.5	−30	dB	
Signal to Noise[2,3]		82		dB	
Distortion[2,3]		0.3		%	

Note 1: Resistor in series with pin 10 required for $V_S < -6.8V$. Due to internal zener diode between pin 10 and ground, negative supply voltages between −6V and −9V should be avoided.
Note 2: These specifications are referred to a 1.8Vpp signal into pin 8.
Note 3: Due to automatic test limitations, these specifications are monitored by sample bench testing.

*Final specifications are subject to change.

GENERAL

The 2047 will operate with positive supply voltages in the range from +9 to +18 volts. Due to the internal zener diode connected between ground and pin 10, a resistor in series with pin 10 to the negative supply must be included for negative supplies below −6.8 volts. The resistor's value is determined by the equation:

$$R_s = \left| 6.8 + V_{EE} \right| / 9.8mA \text{ for } V_{EE} < -6.8V$$

A minus 5 volt supply can be connected directly to pin 10. It may be best to avoid negative supply voltages between −6 and −9 volts which are close to the zener breakdown voltage.

The 2047 requires two external resistors to establish the filter center frequency and the maximum gain of the output VCAs. These resistors significantly reduce the variation in these parameters that would be caused by using on-chip resistors. The voltage at pin 11, the filter reference current pin, is 2.5 volts above ground. The resistor between this pin and the negative supply or pin 10 should establish a 10μA current source. Pin 17's voltage is a few hundred millivolts below ground. The resistor between this pin and the negative supply or pin 10 will produce a current that determines the maximum gain of the output VCAs. This current should be no more than 300μA for best performance. If the negative supply is lower than the voltage on pin 10, connecting the resistors to $-V_{EE}$ will establish currents with greater accuracy. However, the supply should be well regulated and free of noise. If this is not the case, the resistors and the bypass capacitor should be connected to pin 10.

FILTER SECTION

The filter section in the 2047 is very similar in design and performance to that of the SSM 2045. The only major difference is that the output voltage swing has been reduced since it is not brought out directly. This has dictated different capacitor values for C_2 and C_4 than used with the 2045. Also a 7.2k input attenuator resistor is internal to the device. The input (pin 8) referred clip point is about 2.7 V peak to peak. The maximum input signal should be kept a few dB below this. The frequency control (pin 9) should be terminated to ground through a resistor of 1kΩ or less. A series resistor from the pin to a control voltage source and the ground connected resistor form an input attenuator that determines the overall frequency control scale factor. The scale factor is about −19.3mV/Octave at the pin. This will have a temperature drift of 3300ppm/C° unless one uses a tempsistor with similar drift as the ground connected resistor. (See note below.) The frequency control range is in excess of twelve octaves. Usually the sweep range is restricted to 1000 to 1 which corresponds to about ±95mV at pin 9.

The Q control has been designed, like the 2045, to give only a 6dB in-band signal loss at the oscillation point. This slight loss will keep headroom nearly constant as Q is increased. The Q control input (pin 2) is the emitter of a grounded base pnp through a 400Ω short circuit protection resistor. The onset of sine wave oscillation will occur with about 75μA sourced into the pin. An external series resistor is usually connected from the pin to the Q control voltage source.

OUTPUT VCA's

Three output VCA's are provided, channel and left-right stereo. These are connected in parallel rather than series for less noise and distortion build up. The inputs of the VCAs are internally connected to the filter output. Pin 15 has been provided for a capacitor which effectively acts as a D.C. block between the filter and the VCA's. This prevents any filter offset voltage from degrading the control rejection performance of the VCAs. The gain control (pin 12) controls the gain of all three VCA's. The control sensitivity is −10dB/30mV at the pin. A control attenuator is usually connected between the pin and the gain control voltage source.

The pan control (pin 1) determines the relative amount of signal that will appear in the left/right stereo outputs. The sum of the signals in the two outputs is always constant. The control sensitivity rapidly approaches −10dB/30mV away from center in the output being attenuated. Again, an external control attentuator is usually provided from the pan control voltage source to the pan pin. It may be desirable to remove the signal from the stereo mix when the channel output is in use. This can be accomplished with a switch on the channel jack which connects the positive supply to a resistor which goes to the control attenuator at the pan pin. The resistor's value should be chosen to give about +1.5V at the pin when it is connected to the supply.

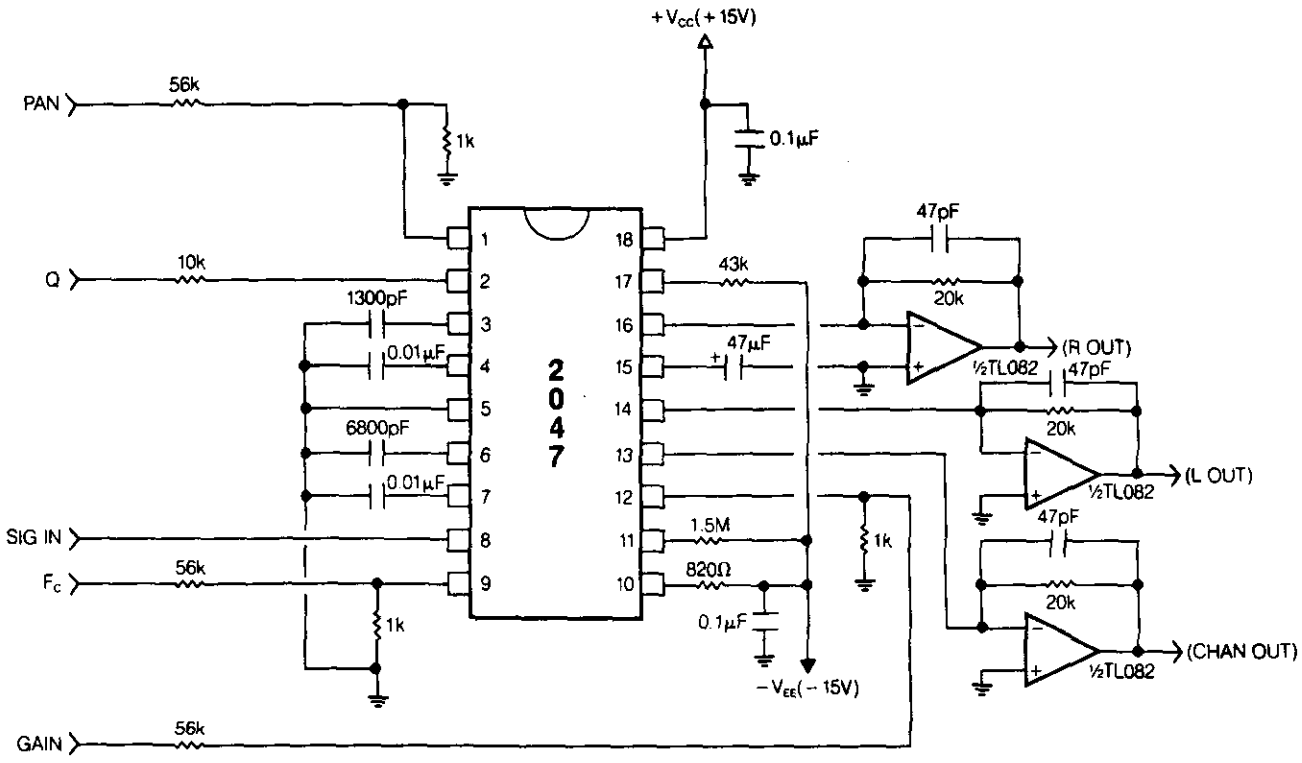
The VCA's all have current outputs. This allows signal summing by simply connecting the appropriate outputs of many 2047s to a single op amp current to voltage convertor. The voltage compliance of the outputs is only ±300mV. However, if this is not a problem, the output(s) can also be connected to a small resistor to ground.

NOTE: RCD Components LP¼
Manchester N.H. U.S.A.
TEL: (603) 669-0054 TLX 943512

TEMPCO Resistors

TYPICAL CONNECTION

The figure below shows a typical connection of the SSM 2047 powered from ± 15 volt supplies. The 43k and 1.5M resistors establish the 300μA and 10μA current references for VCA gain and filter center frequency respectively. Again, the negative supply should be well regulated and free of noise or the resistor values should be scaled and the connections moved to pin 10 with the bypass capacitor.



SSM 2047 TYPICAL CONNECTION