

PRELIMINARY MARCH 1978

FEATURES

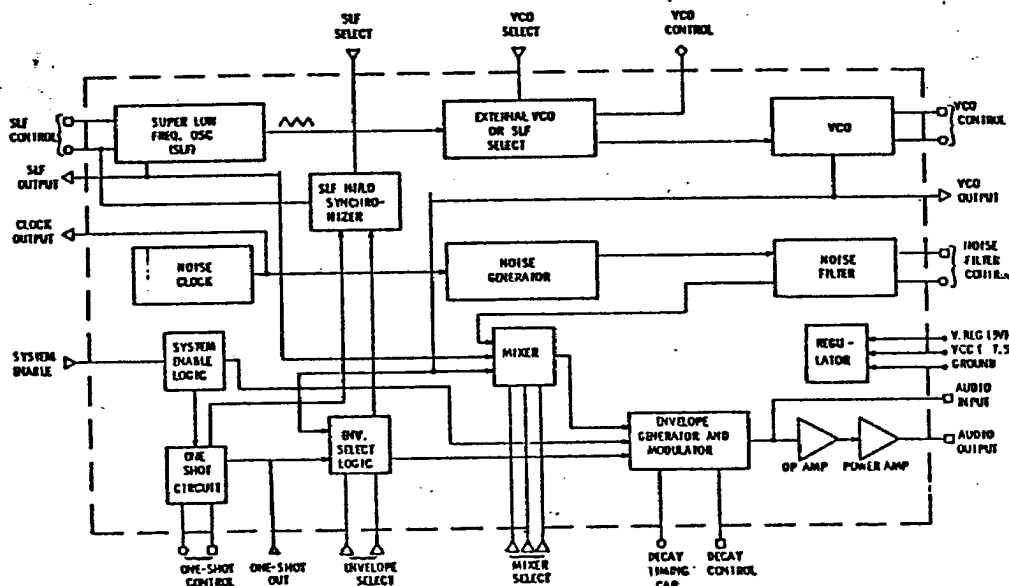
- On Board Audio Amplifier
- Generates Noise, Tone, Low-Frequency (or mixture) Based Sounds
- Allows "Custom" Sounds to be Created Easily
- Low-Power Requirements
- Internal Clock for Implementing Simultaneous Sounds
- Stand Alone or Compatible with Microprocessor Systems

DESCRIPTION

The SN76488N Complex Sound Generator is a linear/I²L device which provides noise, tone or low-frequency (or a combination thereof) based complex sounds. Programming is via external components, that are user-defined, which allows a wide variety of sounds to be created. The SN76488N is designed for ultimate flexibility in user-defined sounds, and may be applied in any application requiring audio feedback to the operator (i.e., arcade/home video games, pinball games, toys, etc.; consumer oriented equipment, such as timers, alarms, controls, etc.; industrial equipment for indicators, alarms, feedback controls, etc.).

BLOCK DIAGRAM

- ◁ Denotes Output
 ○ Denotes Programming Via Capacitor
 □ Denotes Programming Via Resistor
 ▷ Denotes Programming Via Logic Level
 ◇ Denotes Programming Via Analog Voltage



ADVANCED CIRCUITS

COMPLEX SOUND GENERATOR WITH AUDIO AMP

OPERATION

1. SLF (SUPER LOW FREQUENCY OSCILLATOR)

The SLF is normally operated in the range of 0.1 - 30 Hz, but will operate up to 20 KHz. The frequency is determined by the SLF control resistor and capacitor.

The SLF feeds a 50% duty cycle square wave to the "mixer"; it also feeds a triangular wave to the "Ext. VCO/SLF Select" logic, which is fed through to control the VCO when VCO control is high (further explanation found in "Section 2: VCO"). The SLF's output square wave is available external with 20 ma sink capability.

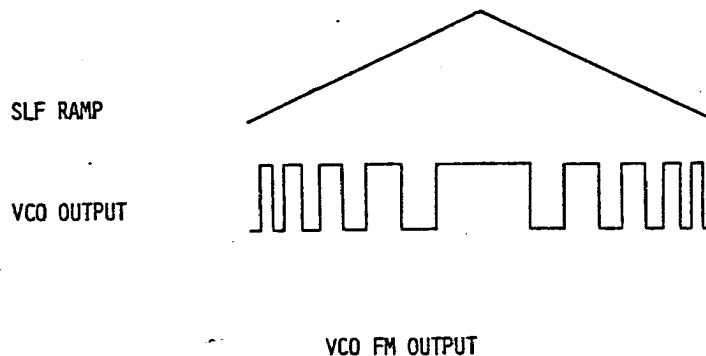
2. VCO (VOLTAGE CONTROLLED OSCILLATOR)

The VCO circuitry produces a tone output whose frequency is dependent upon the voltage at the input of the VCO. The higher the external control pin voltage is, the lower the frequency is. The controlling voltage may be either the SLF output, or it may be an externally applied signal on the VCO control pin. The selection of control modes (external - ; internal - SLF) is via the binary logic level on VCO Select pin according to the following table:

<u>VCO SELECT</u>	<u>CONTROL MODE</u>
0	External
1	Internal (SLF)

VCO CONTROL MODE SELECTION

The input at the "External VCO Control" may be a DC voltage, producing a frequency modulated output from the VCO. A frequency modulated waveform also results when the SLF ramp controls the VCO, as shown below:



OPERATION (CONT'D)

An alternate method to apply an external voltage to the VCO input is to place the controlling voltage on the SLF control capacitor pin. In some applications this may be more convenient than using the external control pin input. The frequency "range" of the VCO is internally determined at an approximate ratio of 10:1. The minimum frequency of the VCO may be determined by adjusting the RC time constant of the "VCO Control" resistor and the "VCO Control" capacitor.

3. NOISE CLOCK

The "Noise Clock" clocks the "Noise Generator". An external noise clock may be supplied external for multiplexing purposes.

4. NOISE GENERATOR/FILTER

The noise generator is a binary psuedo random white noise generator whose output passes through the noise filter before being inputed to the mixer. The filter is a variable band width low-pass filter.

5. The "mixer" logic selects one, or a combination, of the inputs from the generators and feeds the output to the "envelope Generator and Modulator".

MIXER SELECT			MIXER OUTPUT
C	B	A	
0	0	0	VCO
0	0	1	SLF
0	1	0	NOISE
0	1	1	VCO/NOISE
1	0	0	SLF/NOISE
1	0	1	SLF/VCO/NOISE
1	1	0	SLF/VCO
1	1	1	INHIBIT

MIXER SELECT LOGIC

ADVANCED CIRCUITS

COMPLEX SOUND GENERATOR WITH AUDIO AMP

OPERATION (CONT'D)

6. SYSTEM ENABLE LOGIC

The "System Enable" logic provides an enable/inhibit for the system output. The sound output is controlled according to the following table:

<u>SYSTEM ENABLE</u>	<u>OUTPUT</u>
0	Enabled
1	Inhibited

SYSTEM ENABLE LOGIC

This input also triggers the "One-Shot" logic for momentary sounds, such as gunshots, bells, explosions. The "One-Shot" logic is triggered by the negative-going edge. System enable pin must be held low for the entire duration of the one-shot sound (including attack and decay period). The one-shot logic is operable only when the proper "Envelope Select Logic" selection is made.

7. "ONE-SHOT" LOGIC

The duration of the "One-Shot" is defined by a programming resistor and capacitor. The SLF is slaved to the "one shot" by a logic control input. The SLF capacitor will be released from a high level or a low level according to the following table.

<u>SLF CONTROL</u>	<u>CAPACITOR</u>
1	HIGH
0	LOW

8. ENVELOPE SELECT LOGIC

The envelope select logic determines the envelope that is applied to the mixer output according to the following table:

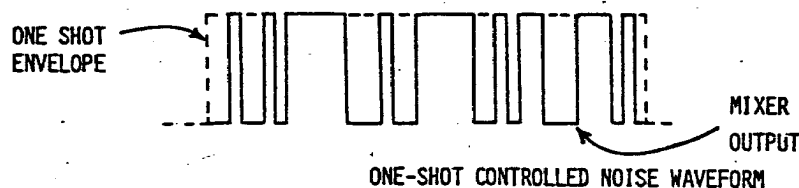
ENVELOPE SELECT 1	ENVELOPE SELECT 2	SELECTED FUNCTION
0	0	VCO
0	1	MIXER ONLY
1	0	ONE-SHOT
1	1	VCO WITH ALTERNATING POLARITY

ENVELOPE SELECT LOGIC OUTPUT

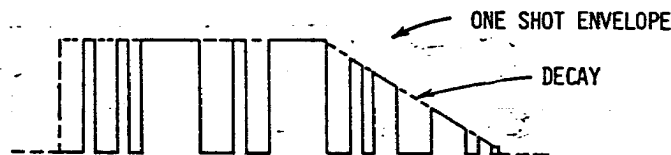
OPERATION (CONT'D)

9. DECAY CONTROL

The decay circuitry alters the fall of the envelope. An example of a noise waveform utilizing the envelope generator under one-shot control is:



By utilizing the decay control inputs, the waveform may be affected in the following manner:



The amount of decay is determined by the "Decay Control" resistor (R_d) and the "Decay Timing Capacitor".

10. OUTPUT AMPLIFIER

The output amplifier is designed to interface with an 8 ohm speaker AC coupled with approximately 100 mW output capability.

11. REGULATOR

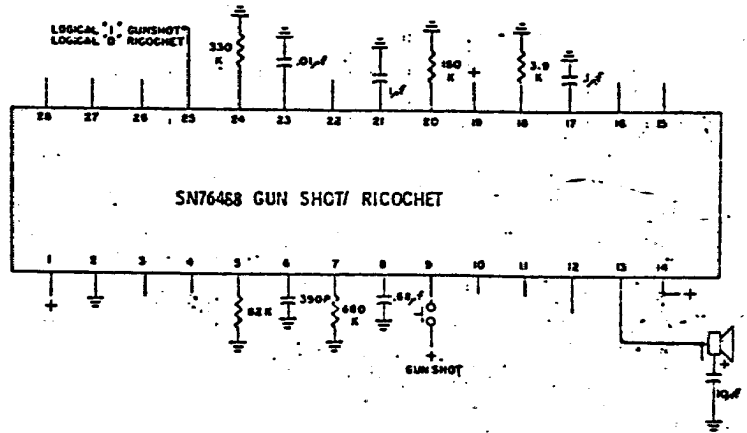
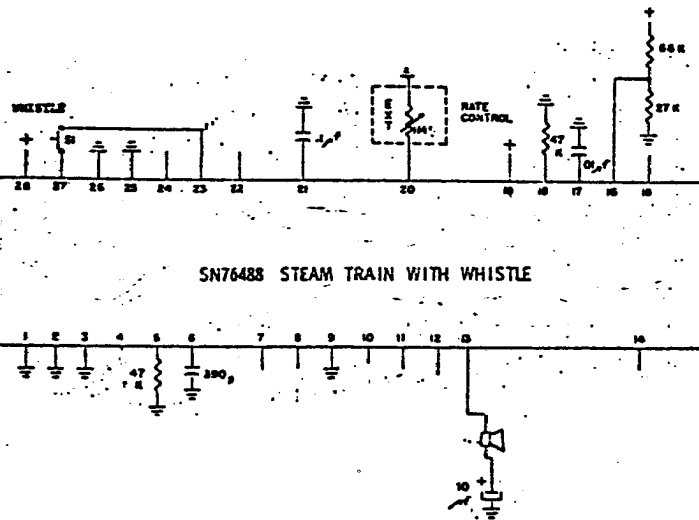
Either a 5 volt regulated supply may be applied or a 7.5 volt min/9.0 volt max unregulated supply may be applied. The 5V regulated supply can be used as a 5 volt regulated supply for the rest of the system with a current supply of up to 10 mA out of the IC.

12. NOTE:

Control resistors and capacitors may be eliminated if the desired sound does not require that generator or logic section. For dedicated sound, the logic inputs may be hard wired for high or low logic levels. Individual sounds (single or multiple) will determine which of the other components are required. Internal 6K ohm limit resistors are in each via programming resistor line.

ADVANCED CIRCUITS

COMPLEX SOUND GENERATOR WITH AUDIO AMP.



- DETERMINE INDIVIDUAL SCHEMATIC FOR EACH DESIRED SOUND.
- RE-EVALUATE SOUND/SCHEMATICS WHILE ATTEMPTING TO MAXIMIZE COMMON VALUES AMONG EXTERNAL COMPONENTS.
- DETERMINE SWITCHING/TIMING REQUIREMENTS FOR EACH SOUND AND FOR SYSTEM.
- IMPLEMENT SWITCHING REQUIREMENTS INTO MICROPROCESSOR PROGRAM, MECHANICAL SWITCHES, (I.E. TRIGGER), AND/OR ELECTRONIC SWITCHES.

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