SGS-THOMSON MICROELECTRONICS

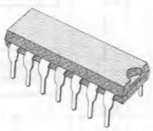
SAA1094

THREE-TONE RINGER

ADVANCE DATA

- ON-CHIP RECTIFIER BRIDGE AND TRANSIENT PROTECTION
- DIRECT DRIVE OF PIEZOCERAMIC OR DYNAMIC TRANSDUCERS
- NOISE SUPPRESSION BY DIGITAL FREQUENCY FILTER AND LEVEL DETECTOR
- USES LOW COST CERAMIC RESONATOR FOR MAIN OSCILLATOR
- REPETITION RATE OF TONE SEQUENCE ADJUSTABLE BY RC TIME CONSTANT

DIP14



ORDER CODE : SAA1094-2

DESCRIPTION

The SAA1094 replaces the electromechanical telephone bell and calls the subscriber by a melodic tone sequence. It derives its power supply by rectifying the ac ringing signal, requires only a minimum of additional components and is compatible with the conventional telephone network.

PIN CONNECTION

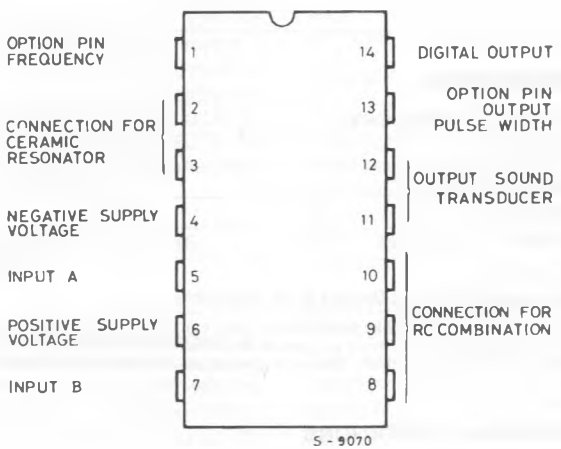
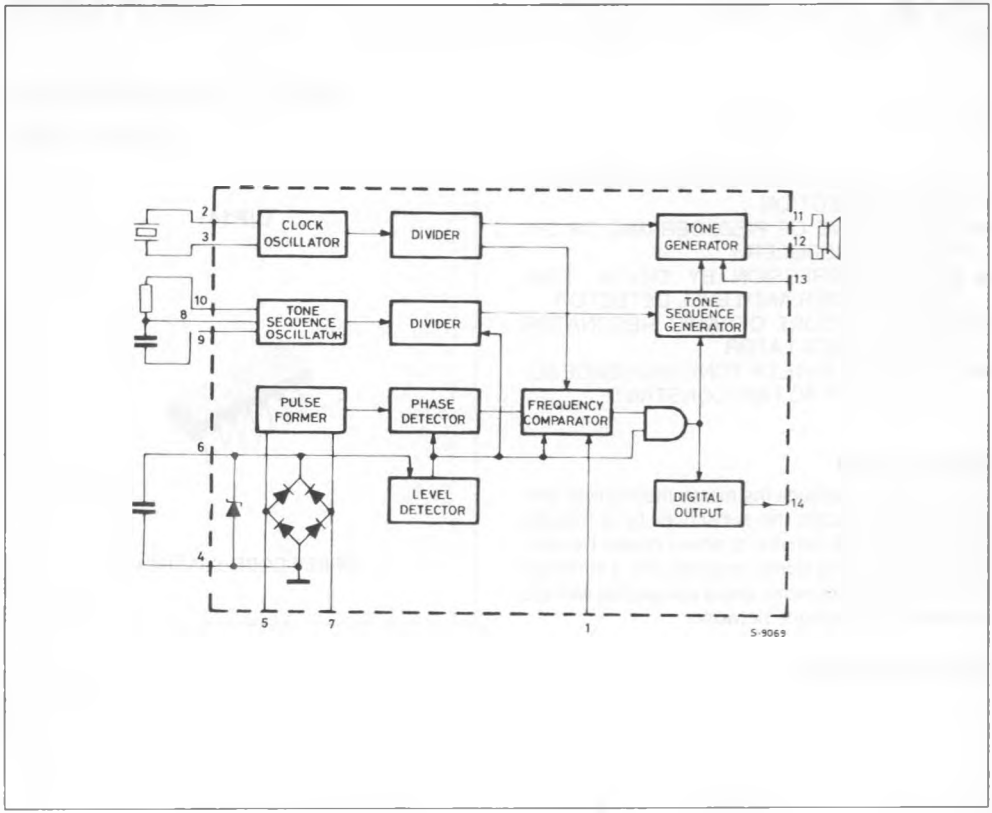


Figure 1 : Block Diagram.



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
	Supply Current	I5, I7 = ± 25	V
V_I	Input Voltage	V_I V_{SS} – 0.3 to V_{DD} + 0.3	V
	Output Current	I11, I12, I14 = ± 10	mA
T_{op}	Operating Ambient Temperature	– 25 to + 60	°C
T_{stg}	Storage Temperature Furthermore, the Conditions of Section 9 are Applicable	– 40 to + 125	°C

Stresses in excess of thos listed unter "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 in excess of those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating condition for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min.	Typ.	Max.	Unit
f_C	Clock Oscillator Frequency		455		kHz
	Power Supply (see functional description)				

ELECTRICAL CHARACTERISTICS (at V6-4 = 10 V ; f_C = 455 KHz ; T_{amb} = 25 °C)

Symbol	Parameter	Min.	Typ.	Max.	Unit
I5, I7	Current Consumption, Outputs whithout Load		1.4	2.2	mA
f_{IN}	Frequency range of the ac input current into pins 5 and 7 which gives an output signal at pins 11 and 12 ; (test circuit - fig. 7).				
	a) Pin 1 unconnected	23		54	Hz
	b) Pin 1 connected to Pin 4 = V_{SS}	12		54	Hz
	c) Pin 1 connected to Pin 6 = V_{AD} dc Operation (see section 3)				
f_{IN}	Frequency ranges of the ac input current into pins 5 and 7 which do no produce output signals at pins 11 and 12 ;				
	(test circuit - fig. 8)	0		18	Hz
	a) Pin 1 is unconnected	60		∞	Hz
R_{ON}	On-resistance of Outputs :				
	Pin 11, Pin 12, at I_{OL} = 5 mA or I_{OH} = – 5 mA			90	Ω
	Pin 14, at I_{OL} = 5 mA			500	Ω
	Pin 14, at I_{OH} = – 5 mA			300	Ω
f_{01}	Frequency of the Output Signal at Pin 11, Pin 12		813		
f_{02}			1083		
f_{03}			1354		
	Start-up Time of Clock Oscillator			10	ms
V6-4	Internal Supply Voltage Limitation at I5, I7 = 10 mA	15		22	V
	Switching Levels of Voltage Level Detector :				
V6-4 ON	Turn-on Level	6		7.5	V
V6-4 OFF	Turn-off Level	3		4.5	V

GENERAL DESCRIPTION

The SAA1094 replaces the customary electromechanical telephone bell and calls the subscriber by a melodic tone sequence, using a small magnetic or piezo-ceramic sound transducer. The melody ringer circuit, together with its transducer is powered by the ringing current from the enge. This makes it compatible with the conventional telephone network and, in addition, no battery or mains connections are needed (fig. 2). It is also possible to apply a DC signal instead of the AC ringing signal (fig. 3). As shown in fig. 2 and 3 the amount of additional components is reduced to a minimum.

FUNCTIONAL DESCRIPTION OF THE TONE RINGER CIRCUIT

POWER SUPPLY

The tone ringer circuit (fig. 2) derives the power required for its operation from the ringing AC supplied by the exchange via linea a and b. Together with the loop resistance, the specified 1 µF isolating capacitor and a 2.2 kΩ resistor is needed to ensure a minimum impedance.

The supplied alternating current is fed to pins 5 and 7 of the tone ringer and is rectified by means of an integrated bridge circuit in the SAA1094. The rectified current charges the electrolytic capacitor at pin 4 and 6. The direct voltage V 6-4 generated across this capacitor is the supply for the internal circuit. It mainly depends on the loop resistance and on the ringing frequency. Its maximum value is limited by an internal Zener diode to about 20 V.

CLOCK SIGNAL GENERATION

The clock oscillator, integrated in the SAA1094 tone ringer Ic requires only an inexpensive ceramic resonator connected to pins 2 and 3, for example the 455 KHz type Murata CSB 455E. The frequency of this oscillator is used to derive the three input tone frequencies and the clocks for the output frequency comparator.

MONITORING THE INPUT RINGING FREQUENCY

The frequency f_{IN} of the ringing AC supplied to the inputs pins 5 and 7 is monitored in the SAA1094 by a frequency comparator. The result of the frequency comparison is used as one criterion for activiting the tone generator (see section 4 for the other crite-

rion). The circuit generates output tones only if the input ringing signal is inside a specified frequency band. Three different modes can be selected by the option pin 1.

a) Pin 1 unconnected :

In this mode a frequency f_{IN} from 23 to 54 Hz will be accepted for producing the output tone sequence.

b) Pin 1 connected to pin 4 = 0

In this mode a frequency f_{IN} from 12 to 54 Hz will be accepted. Due to this option, the SAA1094 can also be employed in telephone systems having a ringing frequency below 20 Hz.

c) Pin 1 connected to pin 6 = 1

In this mode the result of the frequency comparison has no influence. A DC signal can be applied to the SAA1094 at pins 4 and 6 or pin 5 and 7 for producing the output tone sequence.

A digital noise suppression circuit in the SAA1094 ensures that noise signals in the range from 0 Hz to 20 KHz and with a maximum amplitude of 9 V RMS will not affect the correct function of the SAA1094 if the input ringing signal applied to the terminal a and b fig. 2 has an amplitude of 50 V RMS and a frequency in the range specified for producing an output signal.

VOLTAGE LEVEL DETECTOR

The voltage level V 6-4 is monitored in the SAA1094 and used as another criterion for activiting the tone generator. The tone sequence will be started when V 6-4 increases to a level around 6 V. The tone sequence will be ended when V 6-4 decays to a level around 3 V.

TONE SEQUENCER

The ringing signal produced by the SAA1094 is a sequence which is determined by the external RC network of the tone sequence oscillator and by the ratio of the frequency divider. the relationship between repetition rate f_R and oscillator frequency f_{OS} is :

$$f_R = \frac{f_{OS}}{3 \cdot 32}$$

The repetition frequency can be adjusted from 2.4 Hz ± 0.2 Hz to 25 Hz ± 3.5 Hz using the connection scheme of Fig. 4 and the following component values :

C = 4.7 nF
R3 = 43 kW
R4 = 0 to 600 kW

The repetition frequency can be calculated using the formula :

$$f_R\,(\text{Hz}) = \frac{10^6}{134.4 \cdot C \cdot (20 + R)}$$

with C (nF) = capacitance between pins 8 and 9, R (KΩ) = resitance between pins 8 and 10.

The repetion frequency depends slightly on the supply voltage V 6-4. The variation is equal of less than + 4 % per 1 V.

TONE GENERATOR

The ringing signal is a sequence of three tones. their frequencies are derived from the clock frequency at division rates of 560, 420 and 336. Depending of the clock frequency f_C the tone frequencies are

813 Hz, 1083 Hz, 1354 Hz for f_C = 455 kHz or

800 Hz, 1067 Hz, 1333 Hz for f_C = 448 kHz

This is a harmonic ratio of 3 : 4 : 5. the sequence will be started if two conditions are fulfilled : the input ringing signl f_{IN} has to be inside a specified frequency band and the supply voltage V 6-4 has to be increased to the turn-on level. The sequence always starts with the lowest tone. The sequence ends, if f_{IN} departs from the specified frequency band or if V 6-4 is lowered to the turn-off level.

TONE OUTPUT

The output amplifier of the SAA1094 tone ringer is a push pull bridge circuit. It supplies two square wave signals of opposite phase at pin 11 and pin 12. The high value of the signal equals the potential of pin 6 and the low value equals the potential of pin 4, if no load is connected to the outputs. Optionally, the pulsewidth of the squarewave output signal can be limited to 0.2 ms internally, in order to save the components of an external limiting circuit containing a capacitor. The shorter pulse-width is of advantage in the case of an electromagnetic transducer being used which will operate with increased efficiency in this case. The connection of pin 13 determines the mode : when connected to pin 4, the pulsewidth is not affected. If pin 13 is left unconnected, the pulsewidth will be 0.2 ms. The waveform of the current through the load is shown for both cases in Fig. 5.

DIGITAL OUTPUT

The digital output pin 14 can be used for connecting a supplementary load to the supply terminals pins 4 and 6 when the tone generation is deactivated. Without the supplementary load the voltage V 6-4 may decrease significantly upon activation of the tone generation.

The digital output is at the voltage level of pin 6 as long as the two conditions (f_{IN} and V 6-4) for the tone generation are not fulfilled. A supplementary load current can then be drawn through an external resistor between pins 14 and 4. As soon as the conditions for the tone generation are fultilled, the digital output switches to the voltage level of pin 4.

OVERLOAD PROTECTION

The SAA1094 can withstand an alternating voltage of 110 V at a frequency of 50 Hz across terminals a and b fig. 2 for 15 seconds.

The circuit will not be damaged by a transient voltage test with the following test conditions :

Voltage across the charge capacitor	2 kV
Pulse tinming	10/700 µs
Pulse sequence	30 s
Number of transients	16
Polarity change after	5 transients
Test circuit	Fig. 6

Figure 2 : SAA1094 with Power Supplied by the AC Ringing Signal..

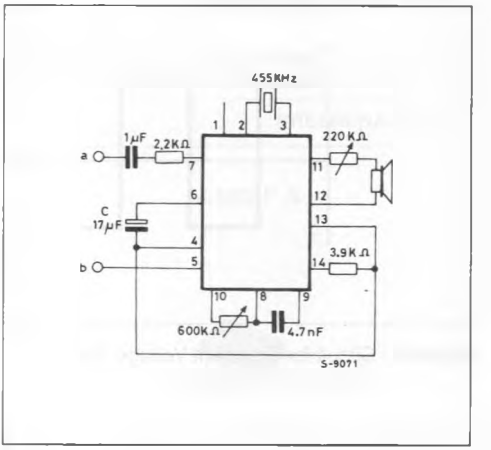


Figure 3 : SAA1094 with Power Supplied by DC.

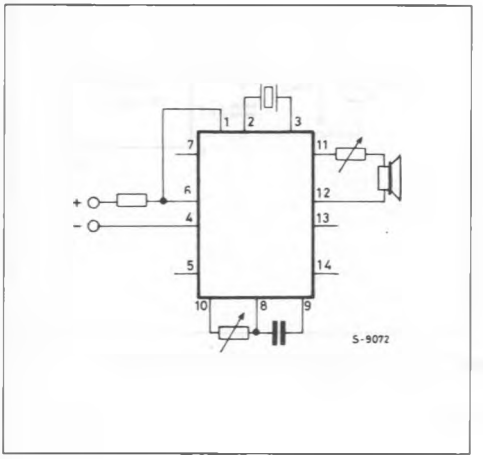


Figure 4 : Circuit Connection Scheme for Repetition Frequency Adjustement Described in Section 5.

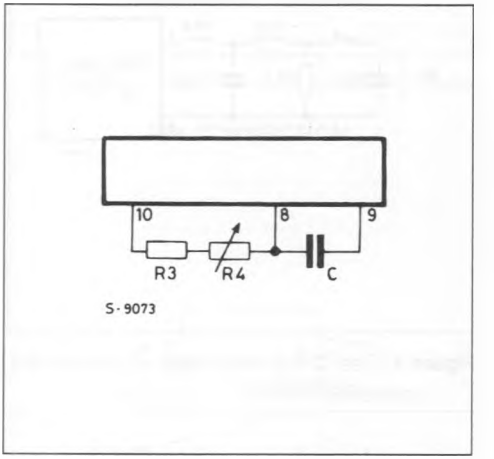


Figure 5a/5b : Diagram of Output Current through a Load between Pins 11 and 12.

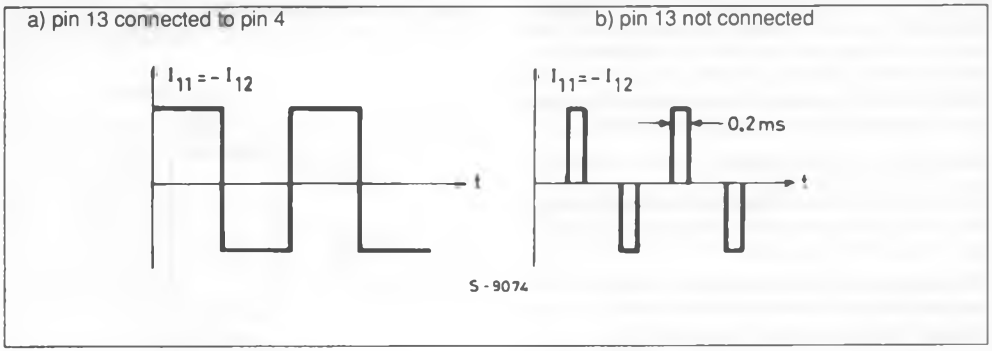


Figure 6 : Circuit for Transient Voltage Test Described in Section 9.

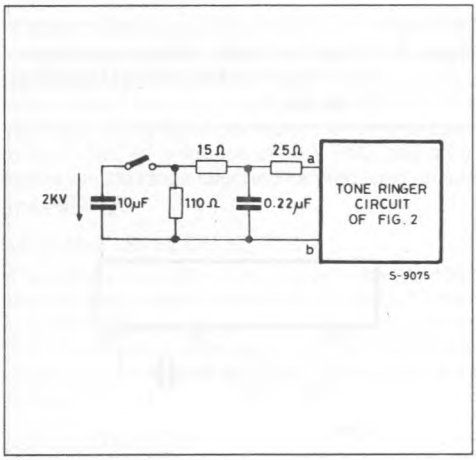


Figure 7 : Test Circuit which Activates the Output Signal Generator (see also frequency specification).

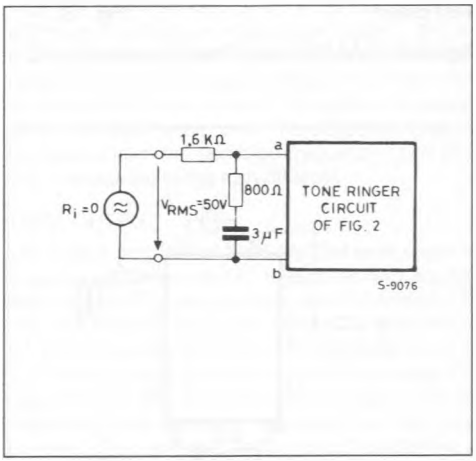


Figure 8 : Test Circuit which does not Activate the Output Signal Generator (see also frequency specification).