

## 32 to 40 SEC INSTANT VOICE ROM

FEBRUARY 2000

### FEATURES

- Voice length at
  - 8 KHz sampling is 32 seconds
  - 6 KHz sampling is 40 seconds
- Silence compression to save memory
- Eight trigger pins, S1 to S8 for 32 sections
- SBT pin play-all or sequential play-all
- 15 ms debounce time suitable for CDS
- IRP interrupt pin stops playback at once
- STP stop pulse generated at end of playback
- BUSY signal for CPU control
- Two LEDs flash at 3 Hz interval
- 3.0V to 6V single power supply operation
- Low standby current (<5  $\mu$ A at 3V)
- Auto-power down
- Built-in oscillator, D/A converter, EPROM
- ADPCM data compression
- Optional pop noise elimination function
- COUT pin drives speaker with a transistor
- Development tools support
- VOUT1 and VOUT2 drives buzzer directly
- Sampling rate determined by external resistor
- Holdable and unholdable triggering option
- Industrial temperature available

### GENERAL DESCRIPTION

IS22C040 is a high-quality voice synthesizer with a capacity of 32 to 40 seconds. A proprietary ADPCM algorithm is used. The audio message is stored in a 1024-Kbit on-chip EPROM.

The IS22C040 eliminates the need of complicated circuitry in voice playback (Figure 1) but still achieves high voice quality. Sounds such as human speech, animal sounds, musical sounds, and even special sound effects can be synthesized. Devices can be cascaded to achieve longer voice duration (Figure 3). Two devices can be configured in parallel (Figure 4) in order to achieve signal mixing without an external mixer allowing speeches to be mixed with background music synthesis from two different chips.

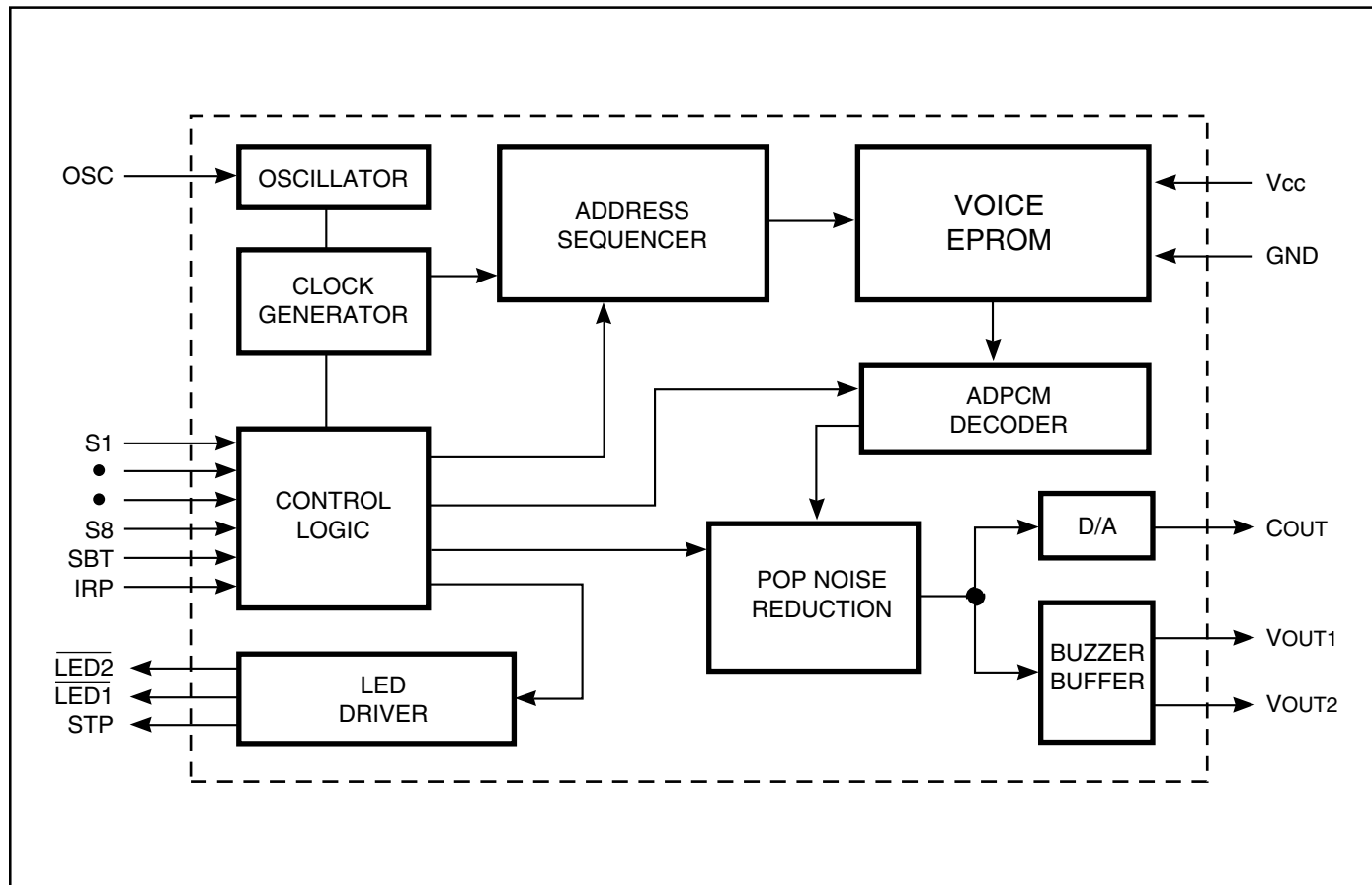
The instant programming nature of the IS22C040 allows a very short production turnaround time. There are no NRE charges that are usually required with conventional voice ROMs. Users now can apply a voice synthesis function as an additional feature to their products even when production volume is relatively small. It is also ideal for trial or engineering prototyping. As a result, the initial investment is minimal and the risk in the product development phase is reduced.

The IS22C040 provides a wide voltage operating range from 3.0V to 6.0V. A pair of PWM output pins, VOUT1 and VOUT2 provide direct drive to a buzzer (Figure 2). Voice quality from a buzzer is comparable to speaker output and power consumption is much lower.

A current output pin, COUT, enables the device to drive a speaker with a low cost NPN transistor. No complex filtering or amplifier circuit is needed. An automatic ramp up/down function eliminates the undesired noise at the end of playback.

Up to 32 sections are accessible through S1 to S8. The SBT trigger pin can be programmed to playback all 32 sections or sequentially from section 1 to 32. An interrupt pin (IRP) and stop pulse (STP) or BUSY signals provide handshaking with microprocessors or other IS22C040 devices. All trigger pins give 15 ms debounce time and is ideal for CDS applications as in Figure 6. Two LED drivers are available, flashing on and off at approximately 3Hz intervals (Figure 5). The internal voltage compensation oscillator requires only one external resistor. Different sampling frequencies are determined by the external oscillator resistor value.

## BLOCK DIAGRAM



## Programmable Options

The IS22C040 provides different control functions for user specified applications. They include:

- Non-sequential or Sequential Play-all
- Unholdable or Holdable trigger
- STOP or BUSY signal selection
- Automatic ramp-up/ramp-down or no ramp-up/ramp-down

## Silence Compression

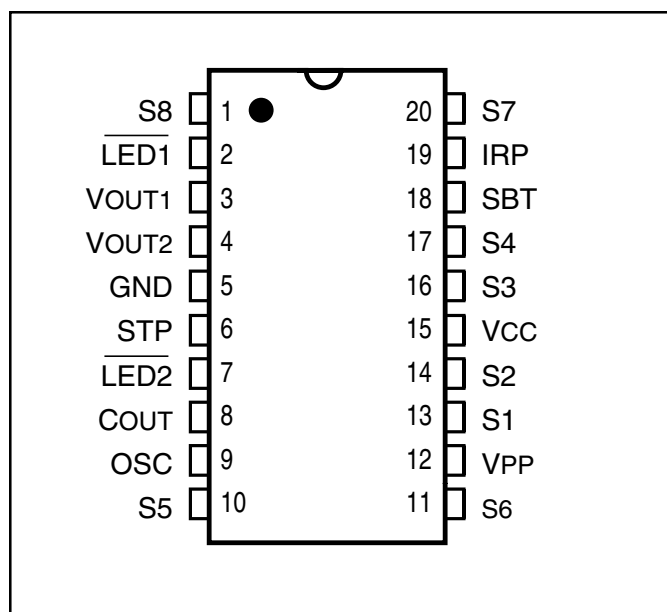
If a particular sound sequence includes periods of silence, the IS22C040 will automatically compress the silence to save memory space. This compression will not affect playback of the sound sequence.

## SECTION TRIGGERING

S1	S2	S3	S4	S5	S6	S7	S8	Section
HIGH	NC	NC	NC	NC	NC	NC	NC	1
NC	HIGH	NC	NC	NC	NC	NC	NC	2
NC	NC	HIGH	NC	NC	NC	NC	NC	3
NC	NC	NC	HIGH	NC	NC	NC	NC	4
NC	NC	NC	NC	HIGH	NC	NC	NC	5
NC	NC	NC	NC	NC	HIGH	NC	NC	6
NC	NC	NC	NC	NC	NC	HIGH	NC	7
NC	NC	NC	NC	NC	NC	NC	HIGH	8
HIGH	HIGH	NC	NC	NC	NC	NC	NC	9
NC	HIGH	HIGH	NC	NC	NC	NC	NC	10
NC	NC	HIGH	HIGH	NC	NC	NC	NC	11
NC	NC	NC	HIGH	HIGH	NC	NC	NC	12
NC	NC	NC	NC	HIGH	HIGH	NC	NC	13
NC	NC	NC	NC	NC	HIGH	HIGH	NC	14
NC	NC	NC	NC	NC	NC	HIGH	HIGH	15
HIGH	NC	NC	NC	NC	NC	NC	HIGH	16
HIGH	HIGH	HIGH	NC	NC	NC	NC	NC	17
NC	HIGH	HIGH	HIGH	NC	NC	NC	NC	18
NC	NC	HIGH	HIGH	HIGH	NC	NC	NC	19
NC	NC	NC	HIGH	HIGH	HIGH	NC	NC	20
NC	NC	NC	NC	HIGH	HIGH	HIGH	NC	21
NC	NC	NC	NC	NC	HIGH	HIGH	HIGH	22
HIGH	NC	NC	NC	NC	NC	HIGH	HIGH	23
HIGH	HIGH	NC	NC	NC	NC	NC	HIGH	24
HIGH	HIGH	HIGH	HIGH	NC	NC	NC	NC	25
NC	HIGH	HIGH	HIGH	HIGH	NC	NC	NC	26
NC	NC	HIGH	HIGH	HIGH	HIGH	NC	NC	27
NC	NC	NC	HIGH	HIGH	HIGH	HIGH	NC	28
NC	NC	NC	NC	HIGH	HIGH	HIGH	HIGH	29
HIGH	NC	NC	NC	NC	HIGH	HIGH	HIGH	30
HIGH	HIGH	NC	NC	NC	NC	HIGH	HIGH	31
HIGH	HIGH	HIGH	NC	NC	NC	NC	HIGH	32

## PIN CONFIGURATION

## 20-Pin 300-mil PDIP



## PIN DESCRIPTIONS

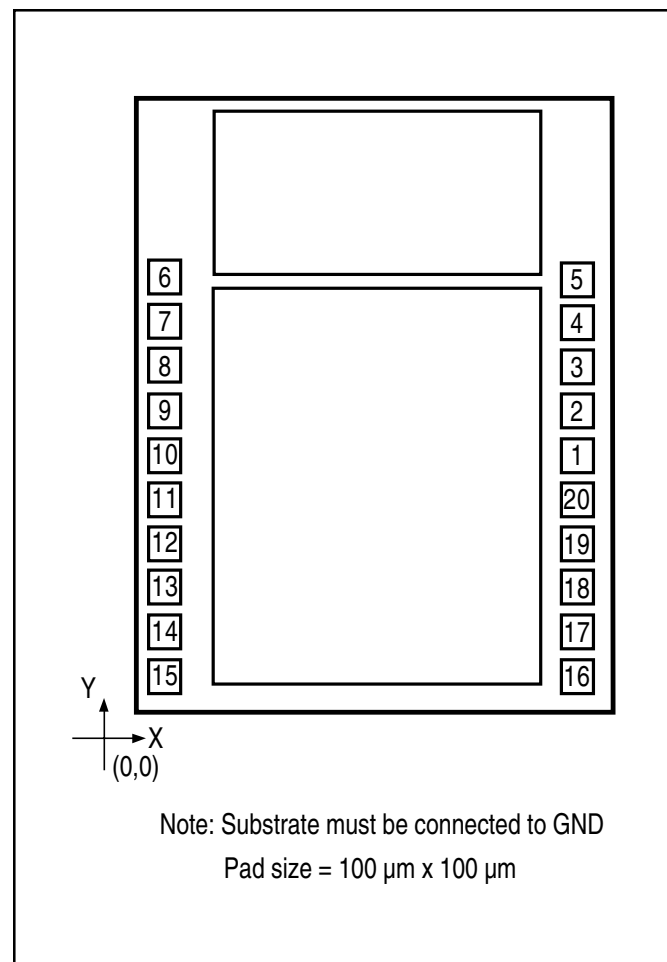
Name	I/O	Function
S8	I	Trigger Switch 8, Internal Pull LOW, Active HIGH
LED1	O	Drives First LED Flash at 3 Hz, Active LOW
VOUT1	O	PWM Audio Signal Output for Buzzer
VOUT2	O	Compliment PWM Audio Signal Output for Buzzer
GND	—	Power Ground
STP/BUSY	O	Generate 30 ms Pulse or Busy Signal After Voice Playback
LED2	O	Drives Second LED Flash at 3 Hz, Active LOW
COU	O	Current Output from Internal DAC for Speaker Playback
OSC	I	Oscillator Resistor Pin to Control Sampling Frequency
S5	I	Trigger Switch 5, Internal Pull LOW, Active HIGH

Name	I/O	Function
S6	I	Trigger Switch 6, Internal Pull LOW, Active HIGH
VPP	—	Program Power Supply, No Connect When Voice Playback
S1	I	Trigger Switch 1, Internal Pull LOW, Active HIGH
S2	I	Trigger Switch 2, Internal Pull LOW, Active HIGH
VCC	—	Positive Power Supply
S3	I	Trigger Switch 3, Internal Pull LOW, Active HIGH
S4	I	Trigger Switch 4, Internal Pull LOW, Active HIGH
SBT	I	One Key or Sequential Trigger, Internal Pull LOW, Active HIGH
IRP	I	Interrupt to Stop Playback, Internal Pull LOW, Active HIGH
S7	I	Trigger Switch 7, Internal Pull LOW, Active HIGH

**Note:**

1. The following pins are used to program data into the memory on the chip: pins 5, 6, 7, 9, 12, 15, 18 and 19.

## BONDING DIAGRAM



## BONDING PARAMETERS

Pin	Name	X	Y
1	S8	3451.9	1599.7
2	$\overline{\text{LED1}}$	3451.9	1861.0
3	V <sub>OUT1</sub>	3451.9	2147.6
4	V <sub>OUT2</sub>	3451.9	2444.5
5	GND	3368.10	2803.35
6	STP	137.18	2795.93
7	$\overline{\text{LED2}}$	100.4	2486.3
8	C <sub>OUT</sub>	100.4	2245.0
9	OSC	100.4	1790.0
10	S5	100.4	1469.5
11	S6	100.4	1230.0
12	V <sub>PP</sub>	100.4	989.6
13	S1	100.4	662.3
14	S2	100.4	422.7
15	V <sub>CC</sub>	187.05	113.78
16	S3	3372.5	141.8
17	S4	3451.9	581.5
18	SBT	3451.9	836.0
19	IRP	3451.9	1090.6
20	S7	3451.94	1345.13

**ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>**

Symbol	Parameter	Value	Unit
V <sub>TERM</sub>	Terminal Voltage with Respect to GND	−0.5 to +7.0	V
T <sub>BIAS</sub>	Temperature Under Bias	−40 to +85	°C
T <sub>STG</sub>	Storage Temperature	−55 to +125	°C

**Notes:**

1. Stress greater than 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 operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

**OPERATING RANGE**

Range	Ambient Temp.	V <sub>CC</sub>
Commercial	0°C to +70°C	3.0V to 6.0V
Industrial	−40°C to +85°C	3.0V to 6.0V

**DC CHARACTERISTICS**

Symbol	Parameter Description	Condition	Min.	Typ.	Max.	Unit
V <sub>CC</sub>	Operating Voltage		3.0	4.5	6.0	V
I <sub>SB</sub>	Standby Current	V <sub>CC</sub> = 3.0V, I/O Open	—	1	5	μA
I <sub>OP</sub>	Operating Current	V <sub>CC</sub> = 3.0V, I/O Open	—	—	100	μA
V <sub>IH</sub>	Input HIGH Voltage	V <sub>CC</sub> = 3.0V	2.5	3.0	3.5	V
V <sub>IL</sub>	Input LOW Voltage	V <sub>CC</sub> = 3.0V	−0.3	0	0.3	V
I <sub>OH</sub>	V <sub>OUT</sub> LOW O/P Current	V <sub>CC</sub> = 3.0V, V <sub>OUT</sub> = 0V	—	−12	—	mA
I <sub>OL</sub>	V <sub>OUT</sub> HIGH O/P Current	V <sub>CC</sub> = 3.0V, V <sub>OUT</sub> = 3.0V	—	12	—	mA
I <sub>CO</sub>	C <sub>OUT</sub> O/P Current	V <sub>CC</sub> = 3.0V, V <sub>COUT</sub> = 0.7V	—	−2	—	mA
I <sub>STPH</sub>	STP LOW O/P Current	V <sub>CC</sub> = 3.0V, V <sub>STP</sub> = 0V	—	−5	—	mA
T <sub>STPL</sub>	STP HIGH O/P Current	V <sub>CC</sub> = 3.0V, V <sub>STP</sub> = 3.0V	—	5	—	mA
I <sub>LED</sub>	Output Current LED	V <sub>CC</sub> = 3.0V – 6.0V	6	8	10	mA
ΔF/F	Frequency Stability	$\frac{F_{osc}(3V) - F_{osc}(3.5V)}{F_{osc}(3V)}$	—	—	5	%

### SAMPLING FREQUENCY vs Rosc FOR IS22C040

Common Sampling Rate vs. Oscillator Resistor

Sampling Frequency KHz	Rosc Kohm
5.0	2775
5.5	2536
6.0	2362
6.5	2189
7.0	2039
7.5	1908
8.0	1793
8.5	1689
9.0	1598
9.5	1516
10.0	1445
10.5	1375
11.0	1313
12.0	1206
13.0	1103
14.0	1025
15.0	956
16.0	895
17.0	843
18.0	796
19.0	754
20.0	716
21.0	683
22.0	651

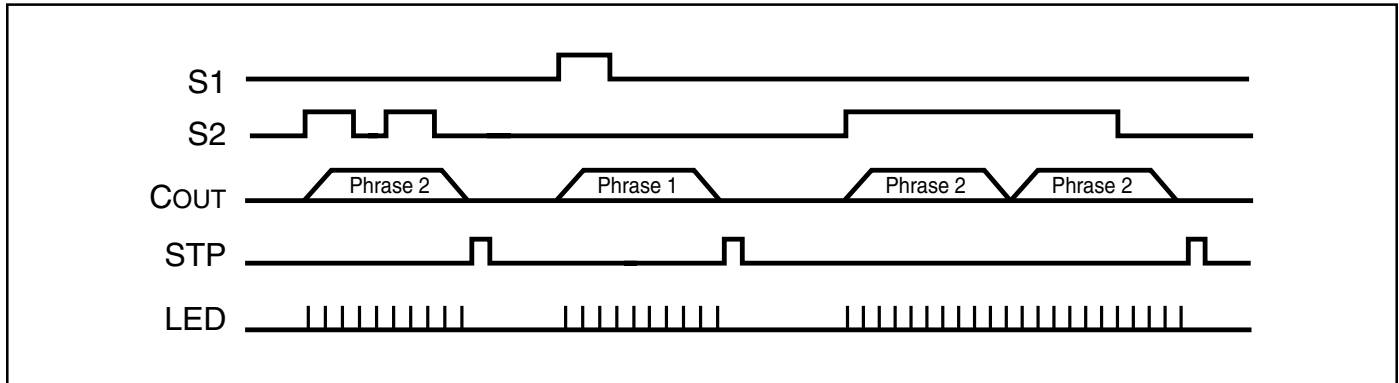
### SAMPLING FREQUENCY vs Rosc FOR IS22C040

Common Resistors vs. Sampling Rate

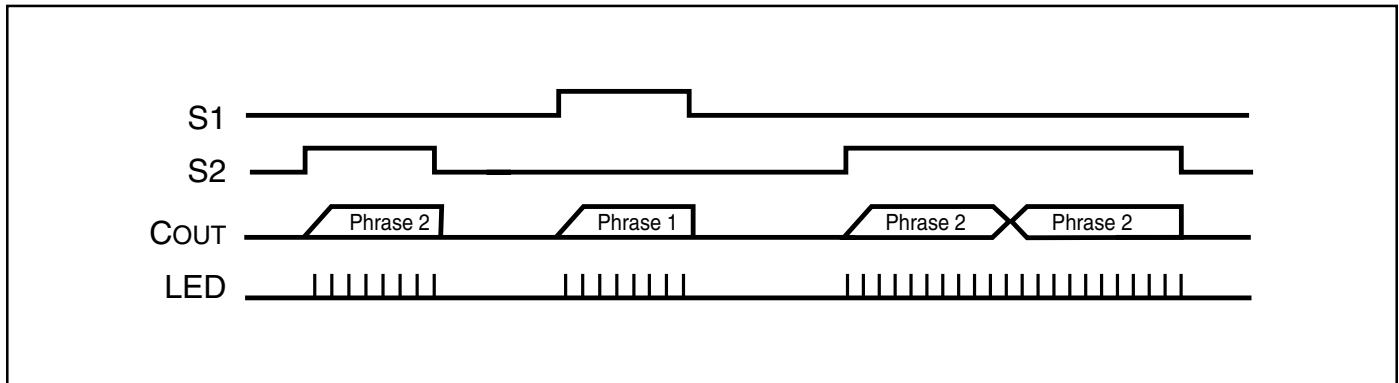
Rosc Kohm	Sampling Frequency KHz
3000	4.59
2700	5.13
2500	5.57
2400	5.81
2000	7.03
1500	9.49
1300	11.0
1200	11.93
1000	14.2
910	15.69
820	17.44
750	9.08
680	21.2

**TIMING DIAGRAM****PULSE TRIGGERED**

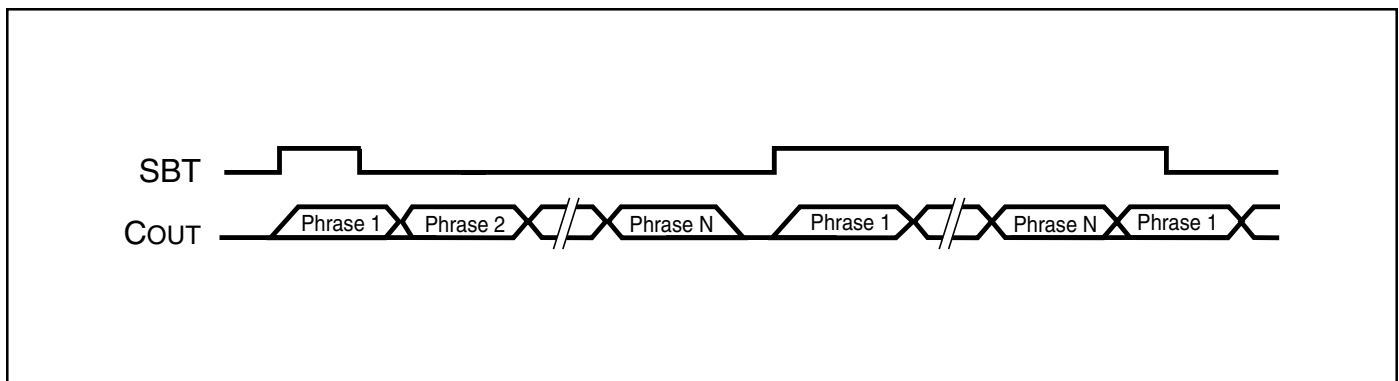
- a. Trigger is shorter than a phrase output      b. Trigger is longer than a phrase output

**LEVEL TRIGGERED**

- a. Trigger is shorter than a phrase output      b. Trigger is longer than a phrase output

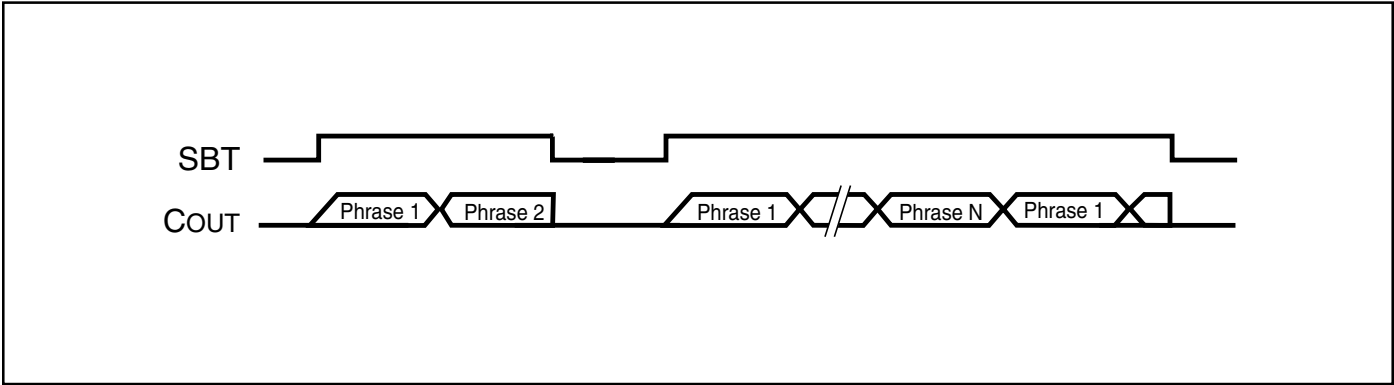
**SINGLE BUTTON TRIGGER, NON-SEQUENTIAL PLAY-ALL (SBT)**

- a. Pulse Triggered



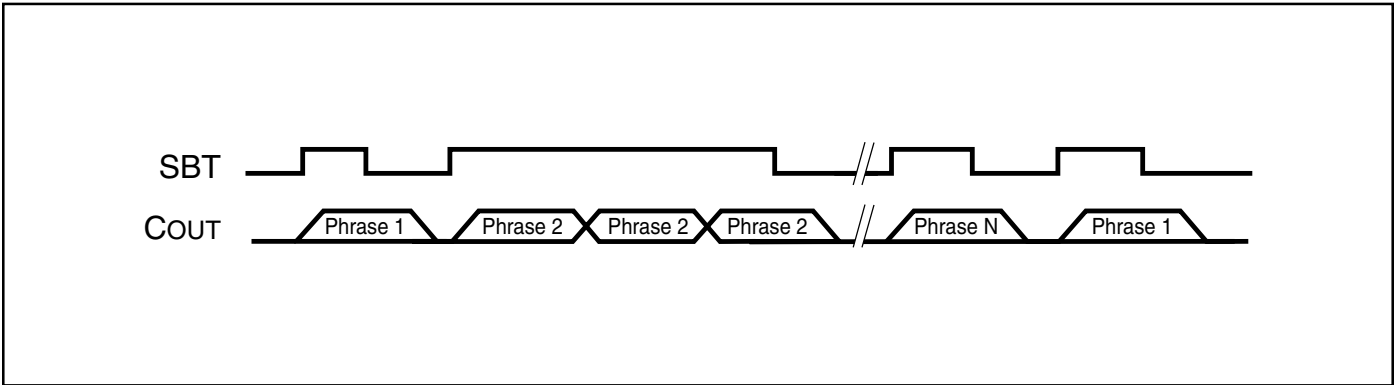


b. Level Triggered

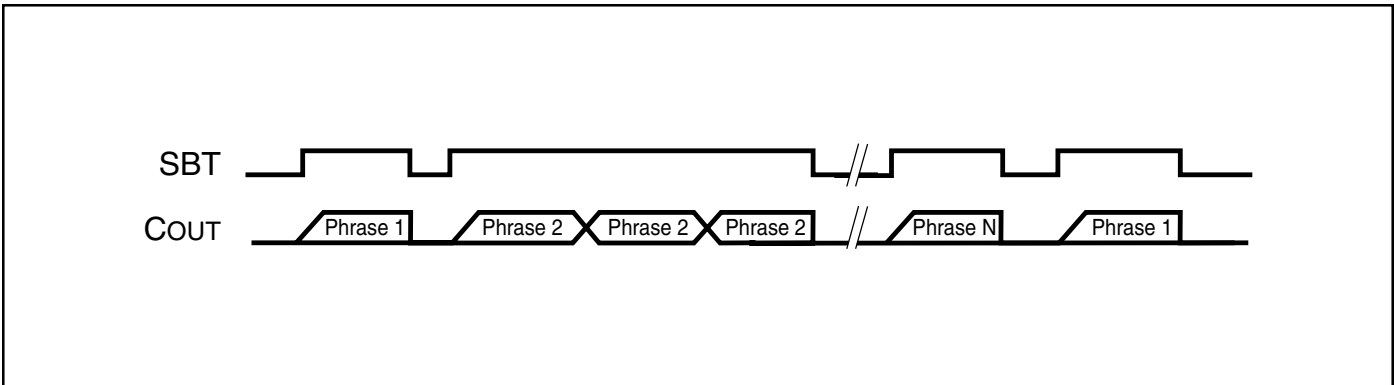


**SINGLE BUTTON TRIGGER, SEQUENTIAL (SBT)**

a. Pulse Triggered



b. Level Triggered



## APPLICATION CIRCUITS

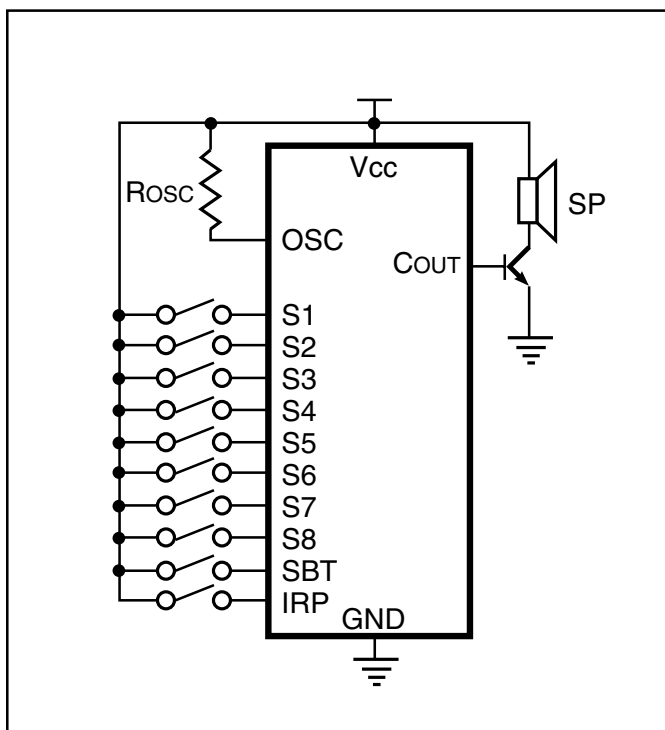


Figure 1. Typical Application with Speaker

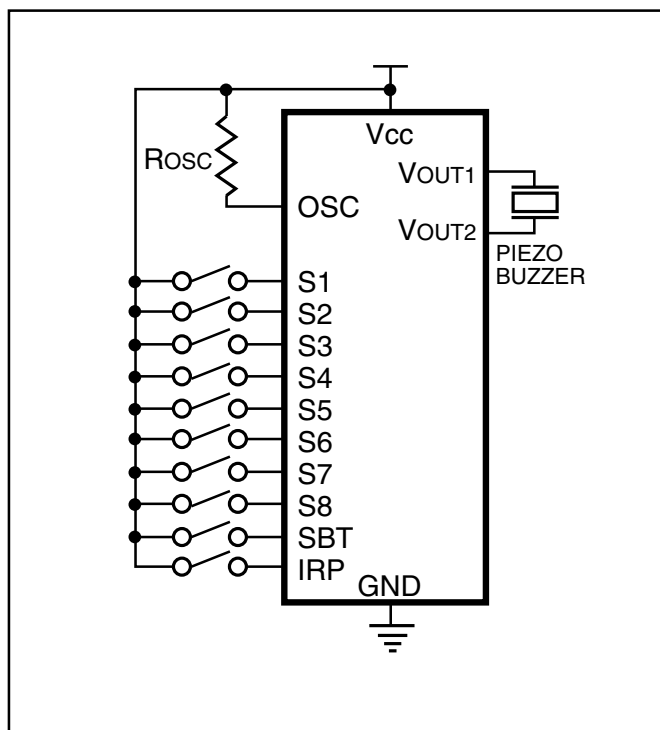


Figure 2. Typical Application with Piezo Buzzer

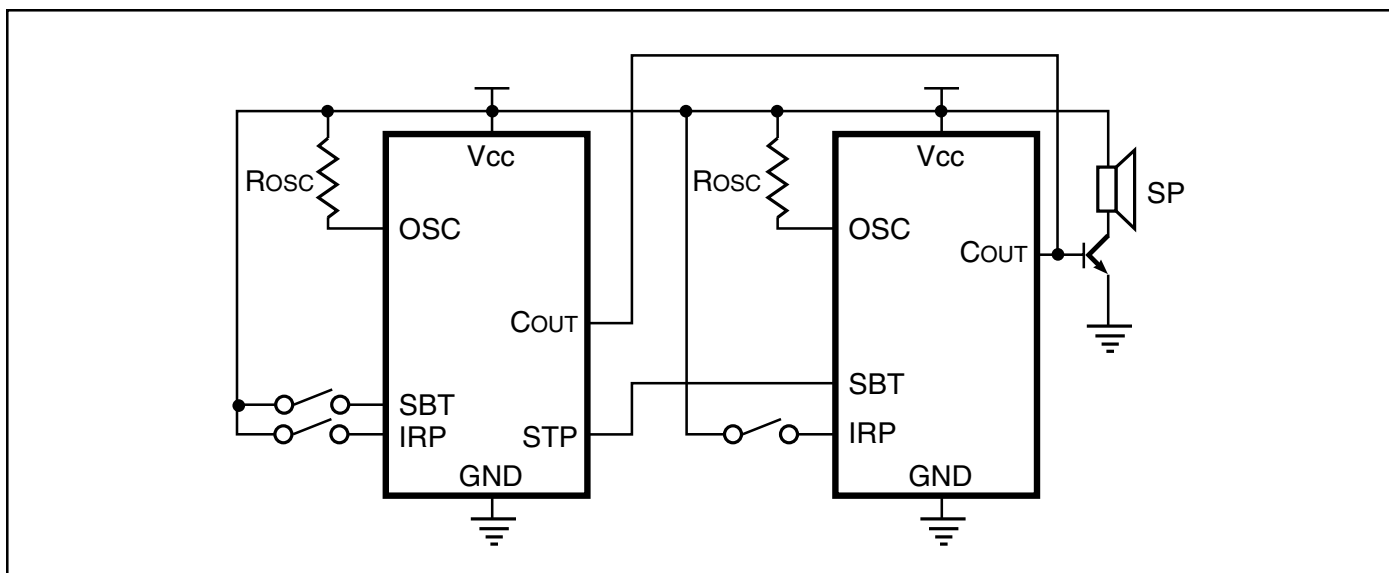
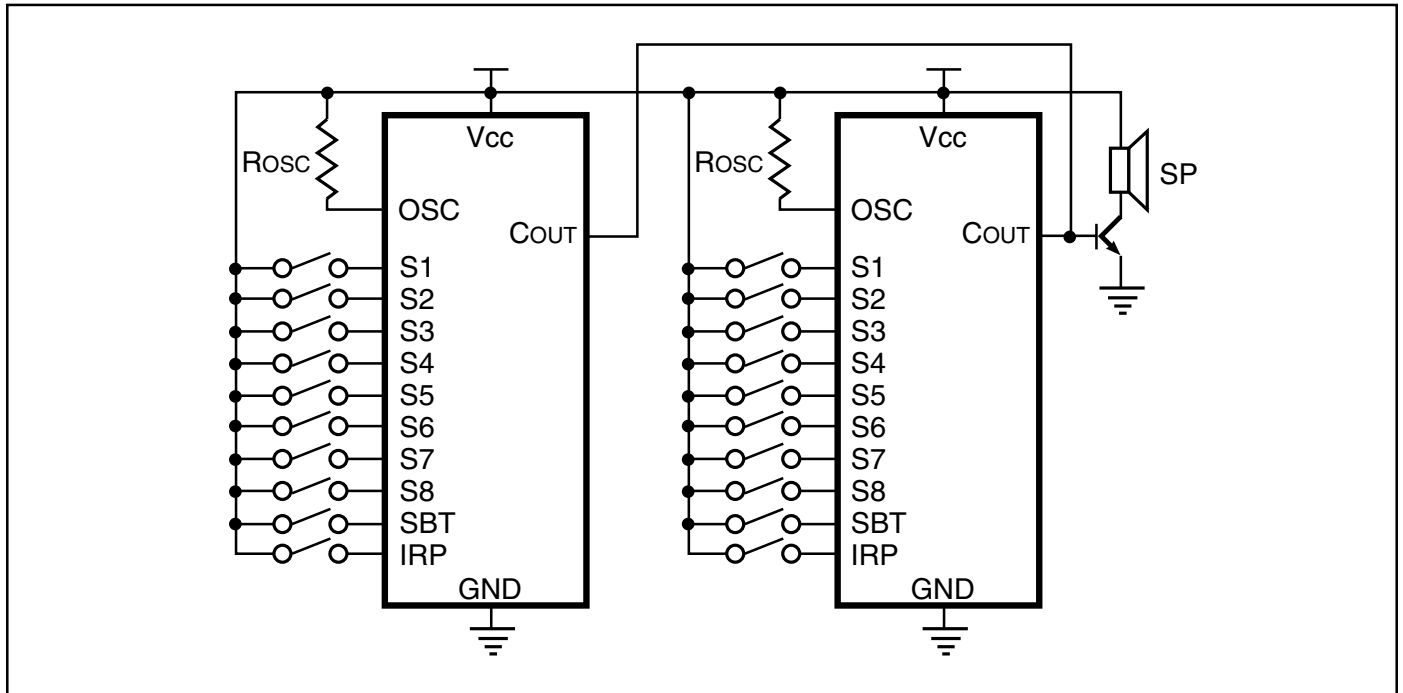
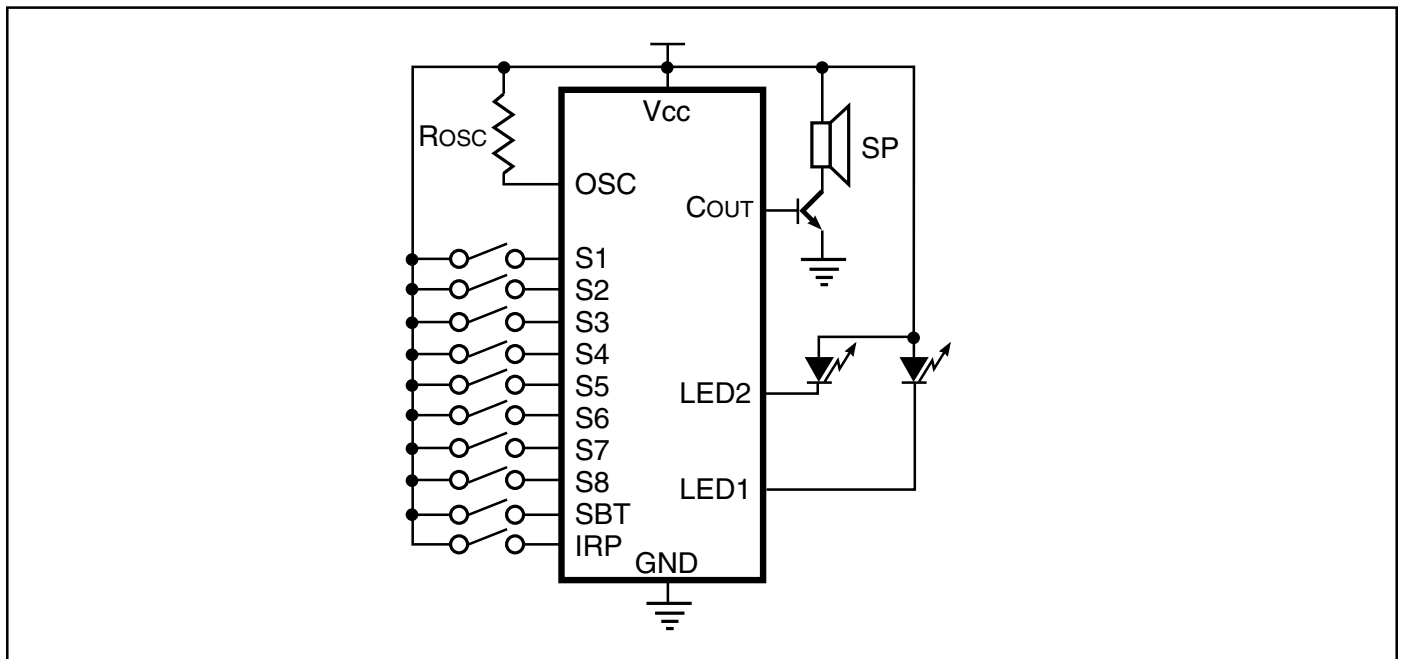


Figure 3. Cascade Application

## APPLICATION CIRCUITS



**Figure 4. Parallel Application**  
(Mixing two speeches or speech with background music)



**Figure 5. LED Application**

## APPLICATION CIRCUITS

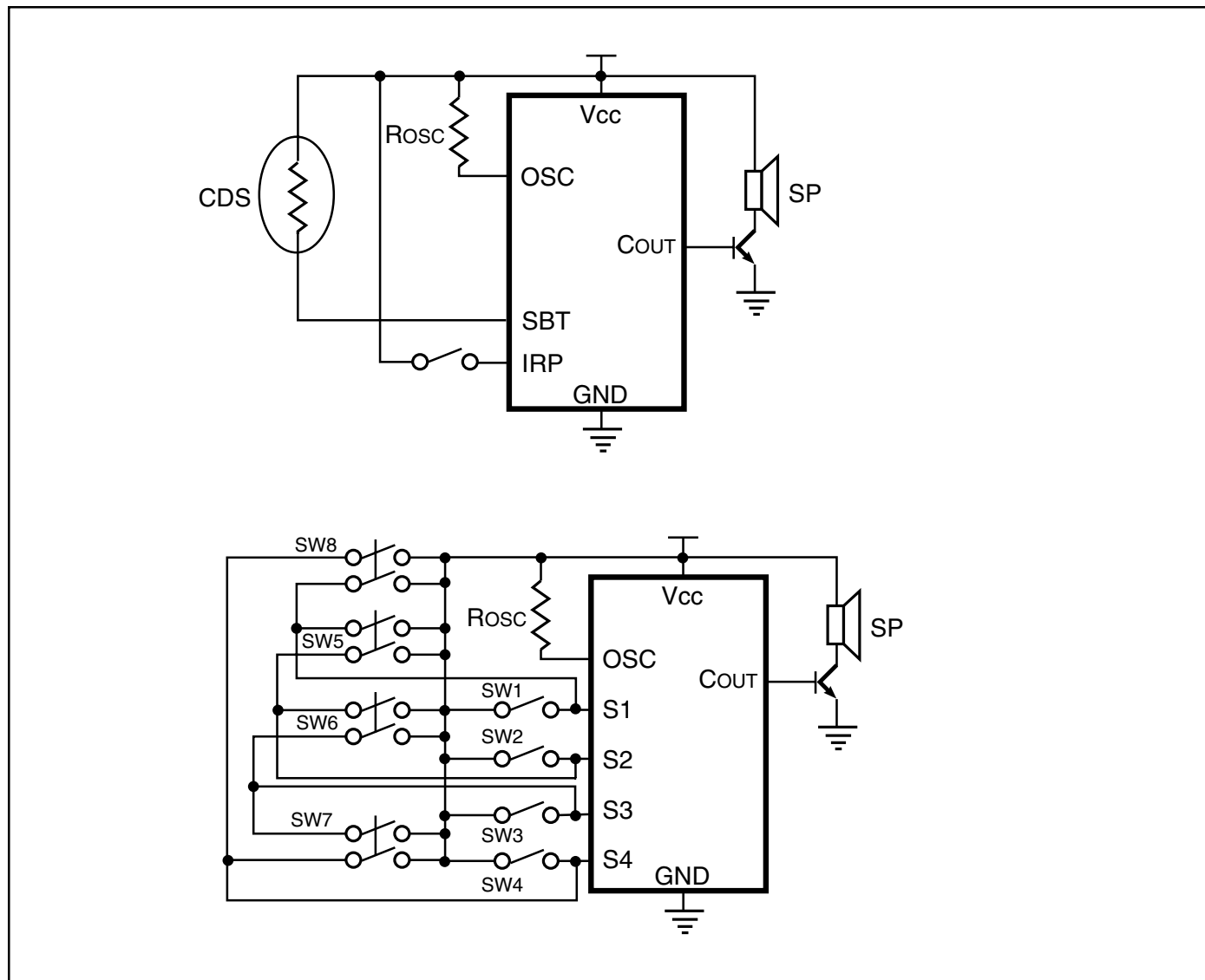


Figure 6. CDS Application and Additional Trigger

**Notes:**

The following are typical values:

1. R<sub>osc</sub> = 2.0 MW.
2.  $\beta$  for N (NPN transistor) > 130.
3. SP = 8W, 1/4W.
4. Piezo buzzer resonant frequency = 1 KHz.

**ORDERING INFORMATION****Commerical Range: 0°C to +70°C**

Order Part No.	Package
IS22C040X	Unpackaged
IS22C040P	20-Pin 300-mil Plastic DIP

**Industrial Range: -40°C to +85°C**

Order Part No.	Package
IS22C040XI	Unpackaged
IS22C040PI	20-Pin 300-mil Plastic DIP

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