

IS22C022

VERSATILE 20 SEC INSTANT VOICE ROM

SEPTEMBER 1999

FEATURES

- Minimum 20 second voice length at 6 KHz
- Versatile features for playback
- Combination of voice building blocks extends the duration of playback
- Voice data re-use saves memory space
- Four trigger pins, S1 to S4 for eight groups
- SBT for sequential play-all or random play
- Holdable and unholdable, edge and level triggering option
- 15 ms debounce time suitable for CDS
- IRP interrupt pin for master reset
- Three programmable output pins for STP Stop Pulse, BUSY Signal, and LED
- Built-in oscillator with variable sample rate
- Single external resistor to determine sample rate
- Built-in D/A converter, EPROM
- ADPCM data compression provides high sound quality
- Optional pop noise elimination function
- C_{OUT} pin drives speaker with a transistor
- V_{OUT1} and V_{OUT2} drives buzzer or speaker directly
- Auto-power down
- 2.4V-6V single power supply operation
- Low standby current (<5 μ A at 3V)
- Development tools support

GENERAL DESCRIPTION

IS22C022 is a high quality voice synthesizer capable of varying playback duration. A proprietary ADPCM algorithm is used. The audio message is stored in a 512K bits on-chip EPROM which can store up to 20 seconds of voice data at 6 KHz sample rate.

The IS22C022 eliminates the need of complicated circuitry in voice playback but still achieves high voice quality. Sounds such as human speech, animal sounds, musical sounds and even special sound effects can be synthesized. Versatile combinations in sections achieve longer playback duration. In addition, devices can be cascaded to achieve longer voice duration. Two devices can be configured in parallel in order to achieve signal mixing without an external mixer in which speech can be mixed with background music each from one of two different chips.

The IS22C022 provides wide operating voltage range from 2.4V to 6.0V. PWM digital amplifier output pins, V_{OUT1} and V_{OUT2} provides direct drive to buzzer or speaker.

A current output pin, C_{OUT}, enables the device to drive a speaker through a low cost NPN transistor. No complex filtering or amplifier circuit is needed. An automatic ramp-down function eliminates undesired noise at the end of playback.

Group of sections

The voice data memory area of the IS22C022 can be subdivided into 126 sections. Any combination of these sections will form an individual group for data playback. A maximum of eight groups are available with activation controlled by S1 to S4 pins. The SBT pin can be used to trigger multiple groups playback in sequence.

Group Configuration

Voice within each group are combinations of different fixed memory sections of up to 126 sections. These sections are the fundamental voice building blocks for arranging playback without limiting sequencing. This provides flexibility and allows data to be re-used, beneficial for applications with many repeated sounds or words.

An example of group configuration is illustrated below:

| Group No. | Section Entry |
|-----------|-------------------------------------|
| Group 1 | Sec 1 + Sec 2 + Sec 3 Sec 109 |
| Group 2 | Sec 3 + Sec 2 |
| Group 3 | Sec 10 + Sec 11 + Sec 12 |
| Group 4 | Sec110 + Sec 10 + Sec 5 |

Group Configuration

The entry of sections for each group is truly random and without limitation. However, there is a limit in the total number of entries for eight groups, which is 992 in the IS22C022. It is acceptable to allocate all entries into only one group or distribute out to other groups. It depends on how many groups of messages are required.

Programmable Options

Groups in IS22C022 can have independent options. They include:

- Edge or Level trigger
- Unholdable or Holdable trigger
- Retriggerable or non-retriggerable
- Sequential or Random playback
- LED1, LED2, Busy, and Stop pulse are configurable
- Four selections in playback frequency

Selections in Triggering

The IS22C022 can be triggered in different ways, Edge or Level trigger, Holdable or Unholdable, Retriggerable or Non-retriggerable. The combinations of the triggering options provide versatile playback.

By enabling Retrigger, the playback can be controlled in Stop and Start mode. A trigger on any trigger pin will stop the current message and start the next message immediately.

Selections in Playback Frequency

This option provides four choices for each group in frequency which implies it is possible to have four different sampling rates in one chip or one sample rate with a different playback frequency. As a matter of fact, the available choices are also dependent on the pullup resistor value at the OSC pin. For example, if the fundamental frequency choice is F, it can provide choices in x1, x1-1/2, x2, x3.

Selections in Playback Mode

There are two playback modes, Sequential and Random in the IS22C022. If the chip is programmed in Sequential Mode, messages will playback in the order from Group 1 to Group 8 by triggering the SBT pin. If the chip is programmed in Random Mode, messages will be played back randomly by triggering the SBT pin.

Selections in Output Buffer

There are three independent output pins, OUT1, OUT2, and OUT3, available for several combinations of LED1, LED2, Stop Pulse, and Busy Signal for each group. The following table illustrates the four different combinations.

| | OUT1 | OUT2 | OUT3 |
|----|------|------|------|
| 1. | LED1 | LED2 | Busy |
| 2. | STOP | LED1 | LED2 |
| 3. | Busy | Stop | LED1 |
| 4. | LED2 | Busy | Stop |

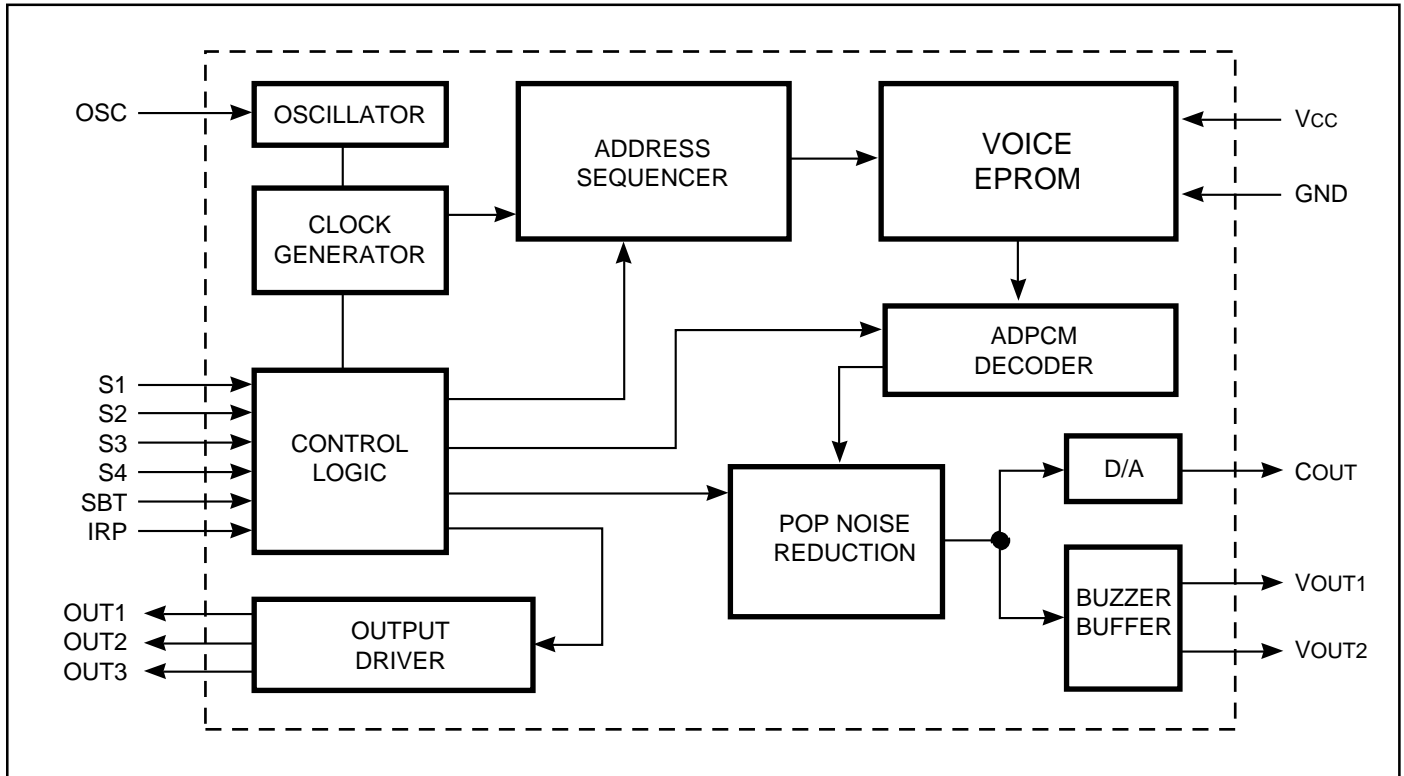
LED1 and LED2 are complemented outputs flashing at approximately a 3 Hz rate. Stop pulse (STOP) gives a 15 ms positive pulse at the end of the playback for each Group with option have or do not have the Stop pulse.

Busy is active high and Section dependent but not Group dependent. Even if same section in different group may have different output in Busy output. For instance, BUSY can be high for Section 4 in Group 1 but low in Group 4. BUSY can be used as a synchronous signal. During standby mode all three outputs must be low.

Software Support

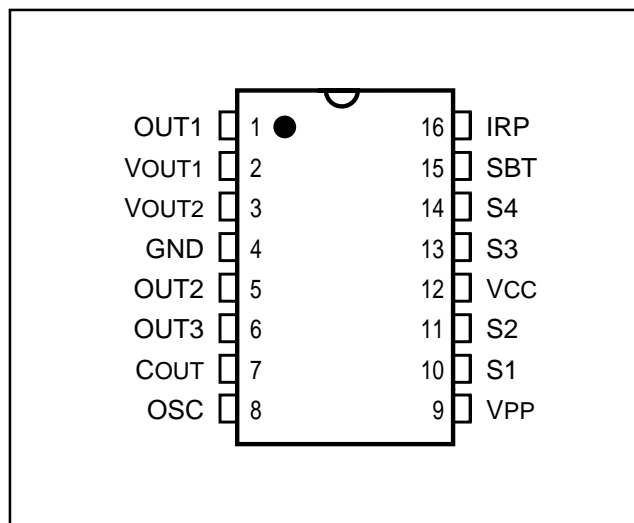
ISSI provides dedicated software to the customer. With this tool, the customer can compose their own messages and configure the chip to fit into their applications very easily.

BLOCK DIAGRAM



PIN CONFIGURATIONS

300-mil PDIP



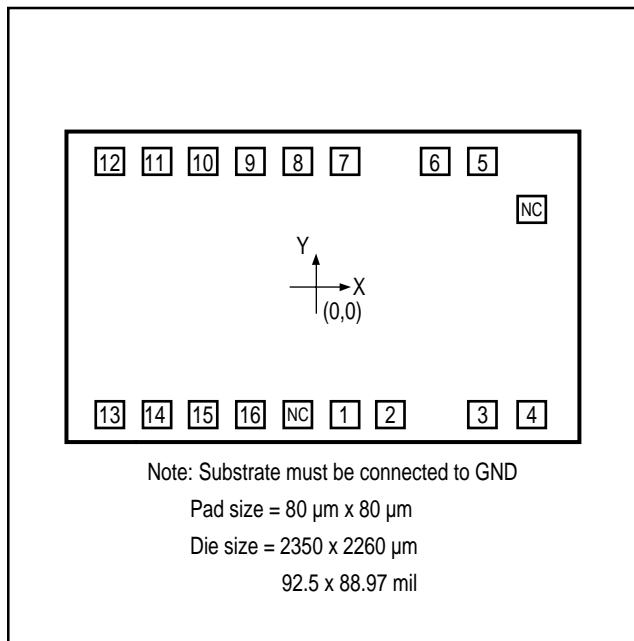
PIN DESCRIPTION

| | |
|-------|--|
| OUT1 | Programmable output 1 |
| OUT2 | Programmable output 2 |
| OUT3 | Programmable output 3 |
| Vout1 | PWM audio signal output for buzzer and speaker |
| Vout2 | PWM audio signal output for buzzer and speaker |
| GND | Power ground |
| Cout | Current output from internal DAC for speaker playback |
| OSC | Oscillator resistor pin to control sampling frequency |
| VPP | Program power supply, no connect when voice playback |
| S1 | Trigger switch 1, internal pull low, active high |
| S2 | Trigger switch 2, internal pull low, active high |
| Vcc | Positive power supply |
| S3 | Trigger switch 3, internal pull low, active high |
| S4 | Trigger switch 4, internal pull low, active high |
| SBT | Sequential trigger, internal pull low, active high |
| IRP | Interrupt to stop playback, internal pull low, active high |

Note:

1. The following pins are used to program data into the memory: pins 4, 5, 6, 8, 9, 12, 15 and 16.

BONDING DIAGRAM



Note:
 Programming requires connection to
 pins 4, 5, 6, 8, 9, 12, 15, and 16.

BONDING PARAMETERS

| Pin | Name | X | Y |
|-----|-------------------|-------|-------|
| 1 | OUT1 | -6 | -1017 |
| 2 | V _{OUT1} | 297 | -1017 |
| 3 | V _{OUT2} | 803 | -1017 |
| 4 | GND | 1058 | -1017 |
| 5 | OUT2 | 927 | 1017 |
| 6 | OUT3 | 697 | 1017 |
| 7 | C _{OUT} | 199 | 1017 |
| 8 | OSC | -103 | 1017 |
| 9 | V _{PP} | -358 | 1017 |
| 10 | S1 | -566 | 1017 |
| 11 | S2 | -810 | 1017 |
| 12 | V _{CC} | -1059 | 1017 |
| 13 | S3 | -934 | -1017 |
| 14 | S4 | -689 | -1017 |
| 15 | SBT | -444 | -1017 |
| 16 | IRP | -200 | -1017 |

ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|-----------------------|--------------------------------------|---|------|
| V _{CC} - GND | Terminal Voltage with Respect to GND | -0.5 to +7.0 | V |
| V _{IN} | | GND - 0.3 < V _{IN} < V _{CC} + 0.3 | V |
| V _{OUT} | | GND < V _{OUT} < V _{CC} | V |
| T _A | Operating Temperature | -10 to +85 | °C |
| T _{STG} | Storage Temperature | -55 to +125 | °C |

DC CHARACTERISTICS

| Symbol | Parameter Description | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------|---|---|------|------|------|------|
| V _{CC} | Operating Voltage | | 2.4 | 3.0 | 6.0 | V |
| I _{SB} | Standby Current | V _{CC} = 3.0V, I/O Open | — | 1 | 5 | μA |
| I _{OP} | Operating Current | V _{CC} = 3.0V, I/O Open | — | — | 100 | μA |
| V _{IH} | Input HIGH Voltage | V _{CC} = 3.0V | 2.5 | 3.0 | 3.5 | V |
| V _{IL} | Input LOW Voltage | V _{CC} = 2.0V | -0.3 | 0 | 0.3 | V |
| I _{OH} | V _{OUT} HIGH Operating Current | V _{CC} = 3.0V, V _{OUT} = 3.0V | — | -12 | — | mA |
| I _{OL} | V _{OUT} LOW Operating Current | V _{CC} = 3.0V, V _{OUT} = 0V | — | 12 | — | mA |
| I _{CO} | C _{OUT} Operating Current | V _{CC} = 3.0V, V _{COUT} = 0.7V | — | -2 | — | mA |
| I _{STPH} | STP HIGH Operating Current | V _{CC} = 3.0V, V _{STP} = 3.0V | — | -5 | — | mA |
| I _{STPL} | STP LOW Operating Current | V _{CC} = 3.0V, V _{STP} = 0V | — | 5 | — | mA |
| I _{LED} | LED Output Current | V _{CC} = 2.2V – 6.0V | 6 | 8 | 10 | mA |
| ΔF/F | Frequency Stability | (F _{osc} [3V] – F _{osc} [3.5V]) / F _{osc} (3.0V) | — | — | 5 | % |

SAMPLING FREQUENCY vs R_{osc} FOR IS22C022

Common Sampling Rate vs. Oscillator Resistor

| Sampling Frequency KHz | R _{osc} Kohm |
|---------------------------|--------------------------|
| 5.0 | 1,920 |
| 5.5 | 1,750 |
| 6.0 | 1,610 |
| 6.5 | 1,490 |
| 7.0 | 1,380 |
| 7.5 | 1,290 |
| 8.0 | 1,200 |
| 8.5 | 1,130 |
| 9.0 | 1,070 |
| 9.5 | 1,010 |
| 10.0 | 961 |
| 10.5 | 915 |
| 11.0 | 874 |
| 12.0 | 835 |

SAMPLING FREQUENCY vs R_{osc} FOR IS22C022

Common Resistors vs. Sampling Rate

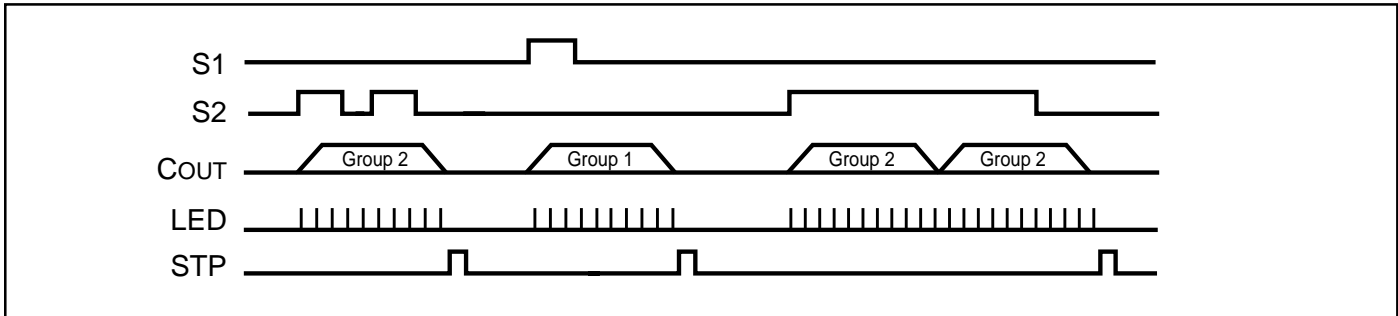
| R _{osc} Kohm | Sampling Frequency KHz |
|--------------------------|---------------------------|
| 2000 | 4.8 |
| 1500 | 6.5 |
| 1300 | 7.5 |
| 1200 | 8.0 |
| 1000 | 9.5 |
| 910 | 10.5 |
| 820 | 11.7 |
| 750 | 12.7 |
| 680 | 14.0 |
| 560 | 16.7 |
| 510 | 18.1 |
| 470 | 19.5 |

TIMING WAVEFORMS

1. Level, Unholdable, Non-retriggerable

a. Trigger is shorter than a Group output

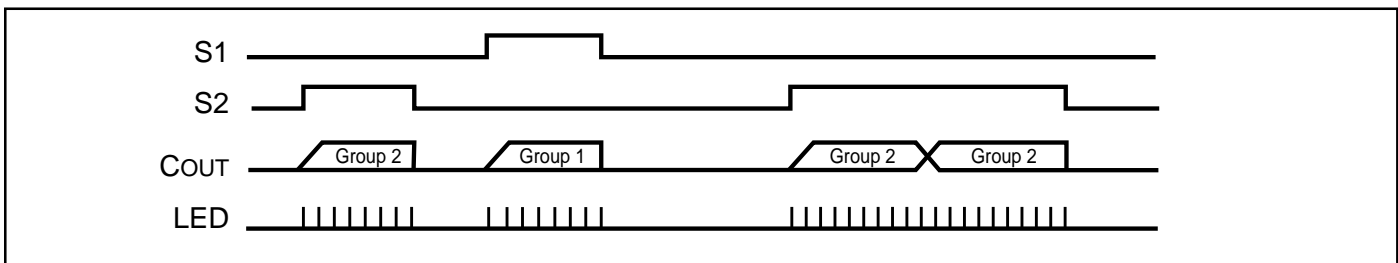
b. Trigger is longer than a Group output



2. Level Holdable

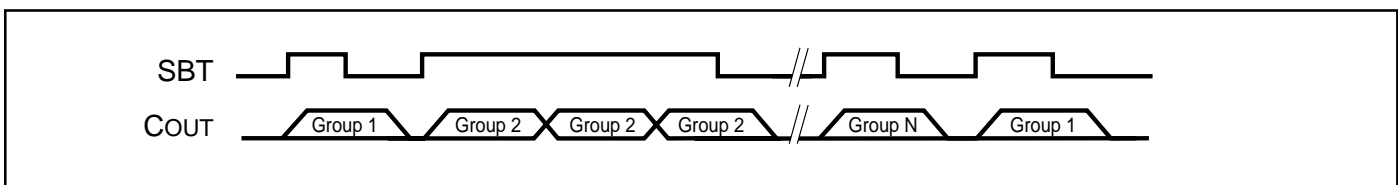
a. Trigger is shorter than a Group output

b. Trigger is longer than a Group output

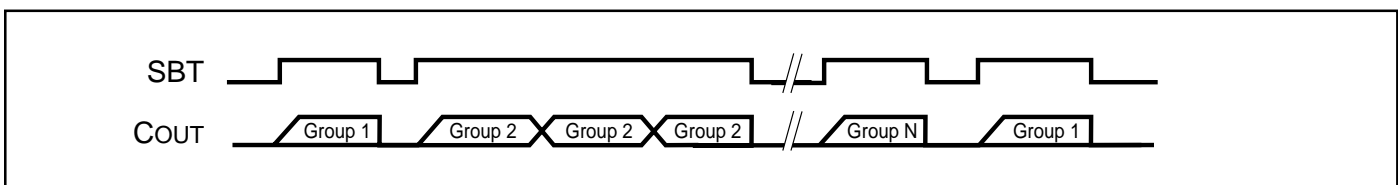


3. Single Button Trigger (SBT), Sequential

a. Level Unholdable



b. Level Holdable

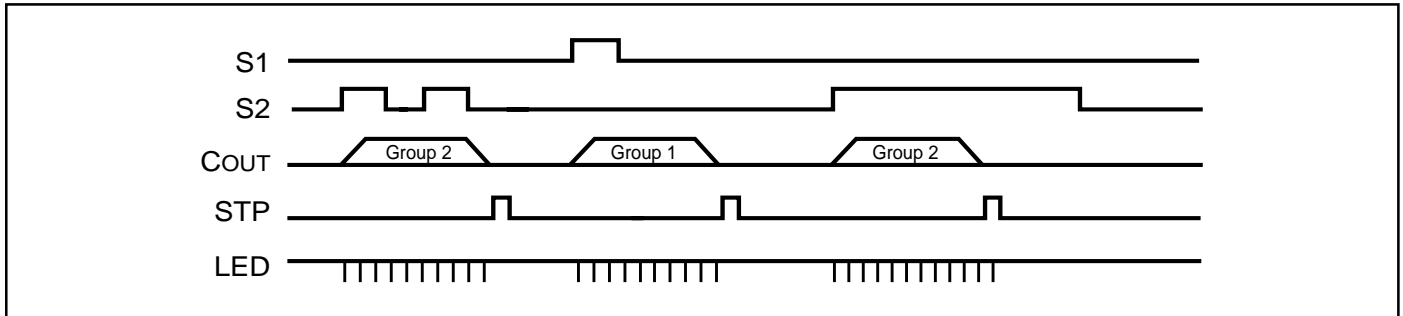


Where N is up to 8.

4. Edge, Unholdable, Non-retriggerable

a. Trigger is shorter than a Group output

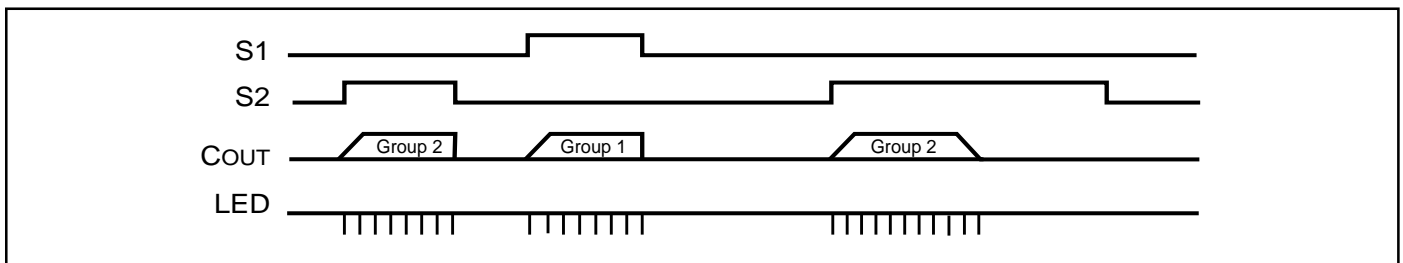
b. Trigger is longer than a Group output



5. Edge Holdable

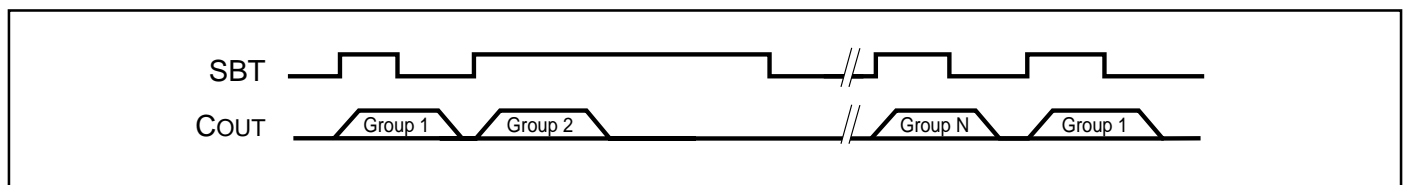
a. Trigger is shorter than a Group output

b. Trigger is longer than a Group output

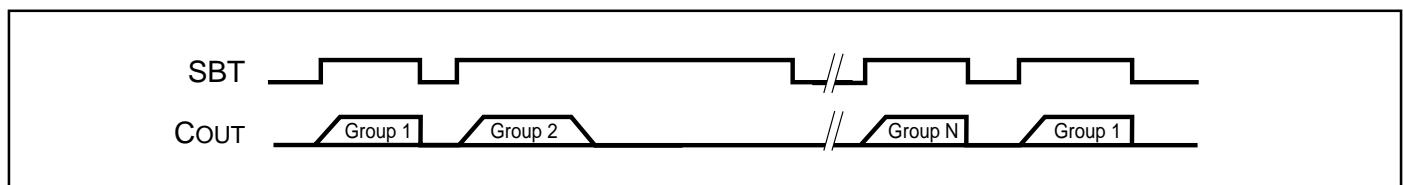


6. Single Button Trigger (SBT), Sequential

a. Edge Unholdable



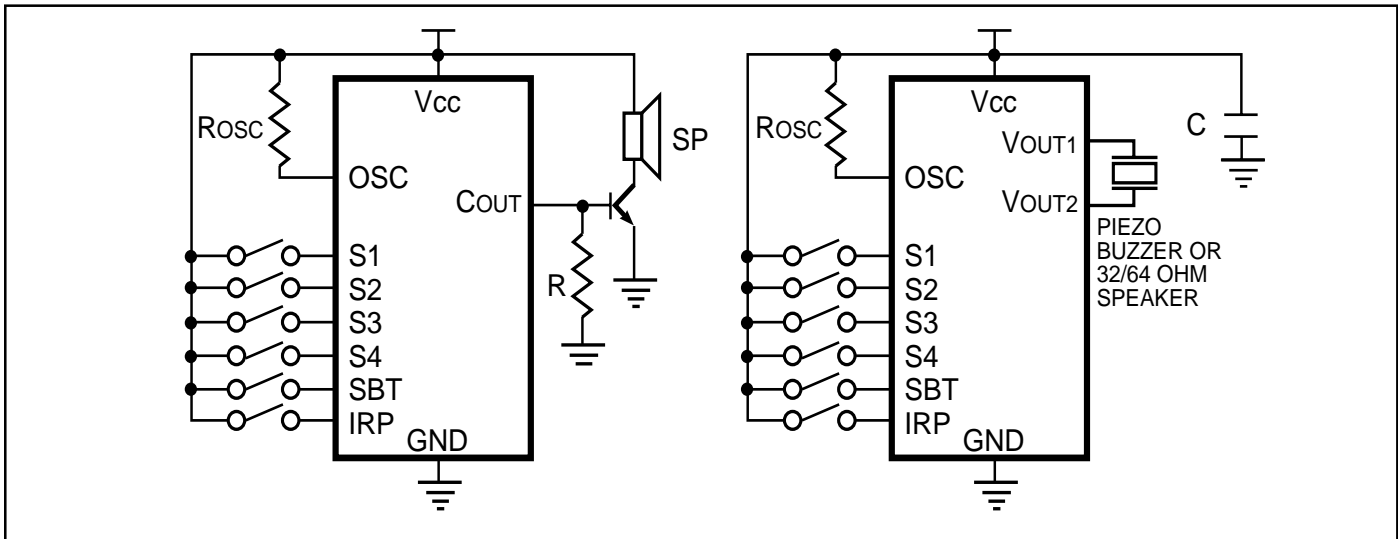
b. Edge Holdable



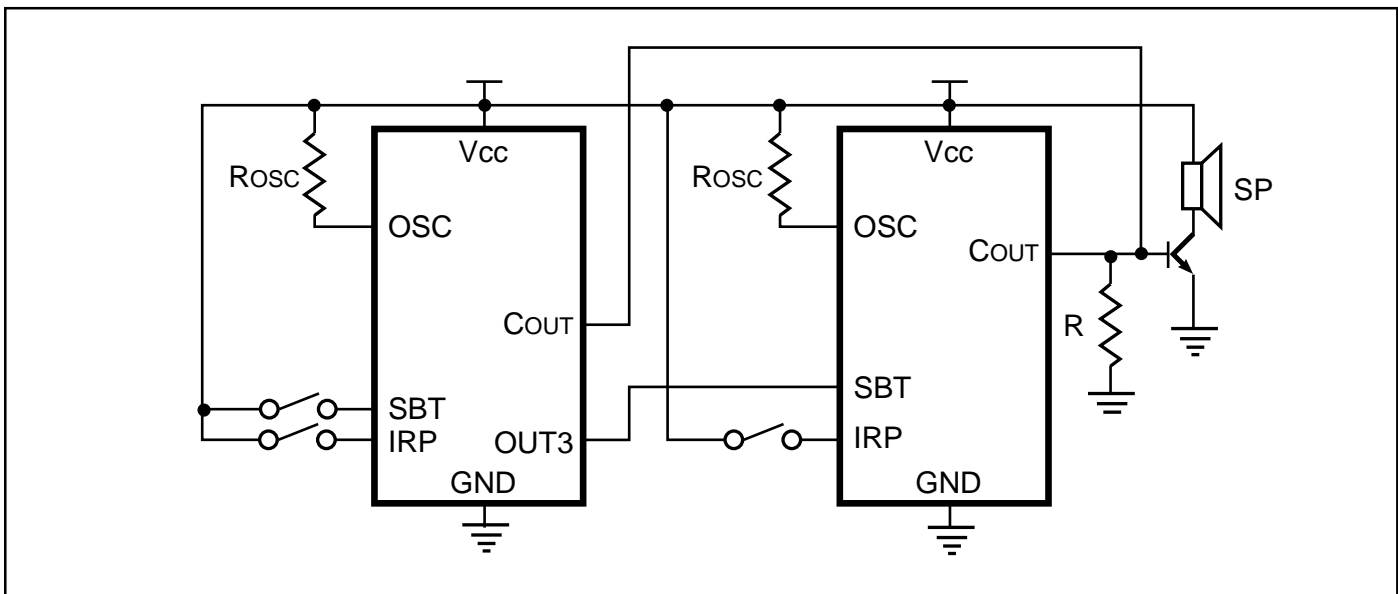
Where N is up to 8.

APPLICATION CIRCUITS

TYPICAL APPLICATION

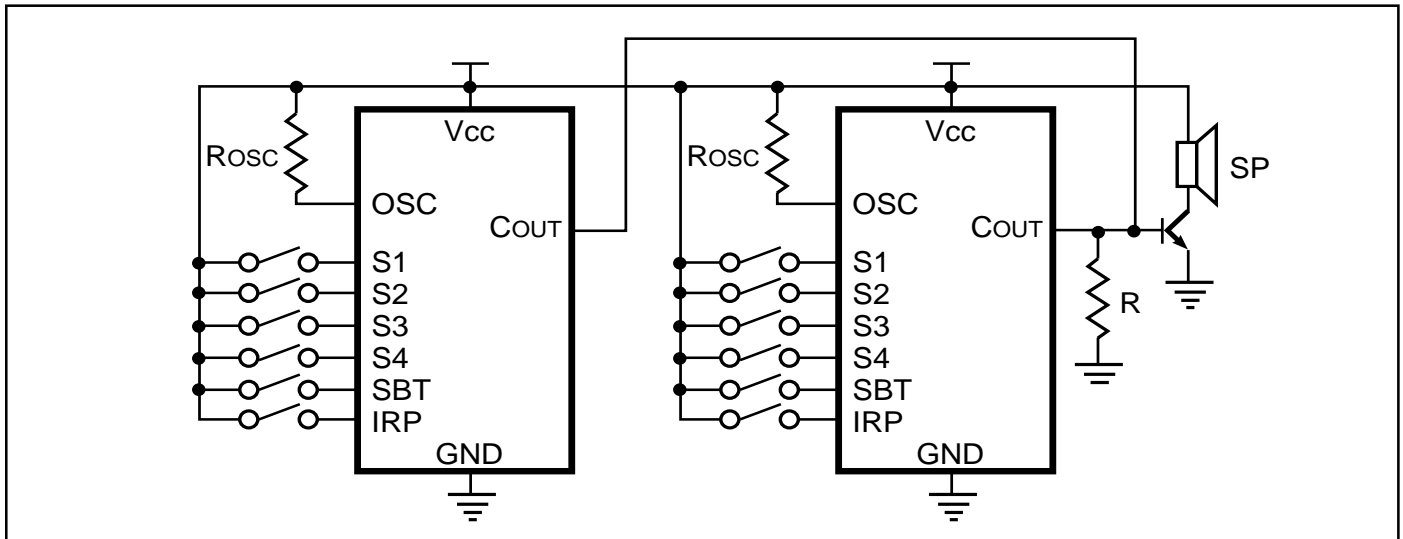


CASCADE APPLICATION

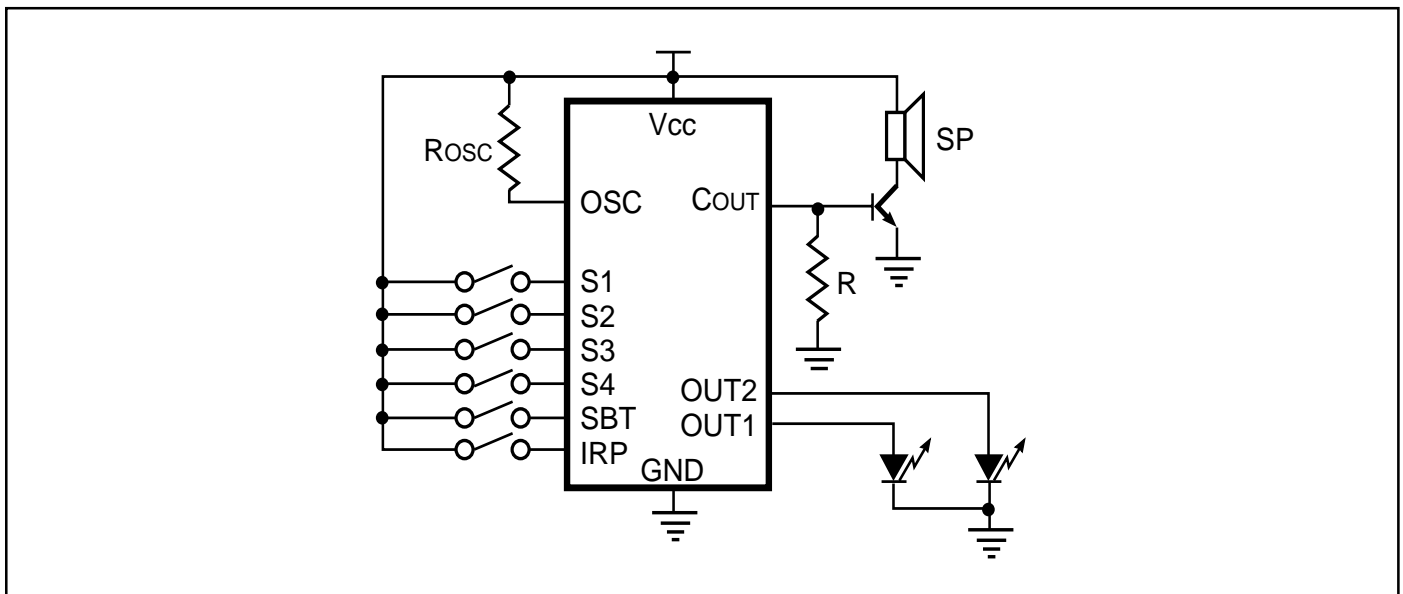
**Notes:**

1. To directly drive a speaker or buzzer, C is needed ($C = 0.1 \mu\text{F}$).
2. $R = 330 \text{ Ohm}$ (if using transistor 8050 and $V_{cc} = 4.5\text{V}$).
3. $SP = 8 \text{ Ohm}$ speaker.
4. To determine the value of R_{osc} , refer to the Sampling Frequency vs. R_{osc} tables on page 5.

PRALLEL APPLICATION



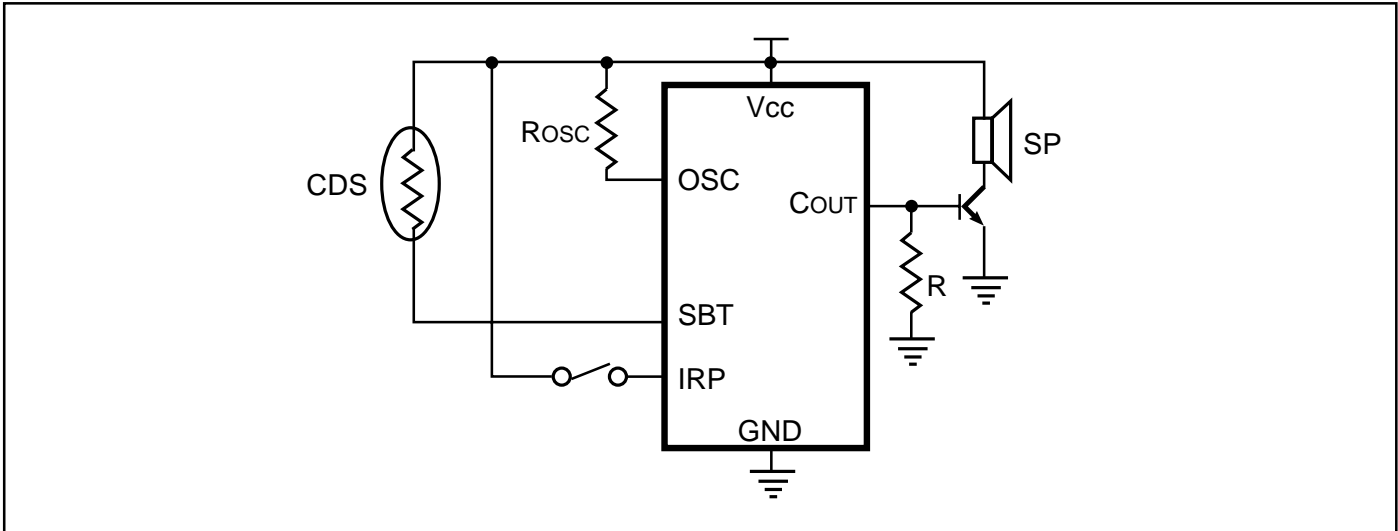
LED APPLICATION

**Notes:**

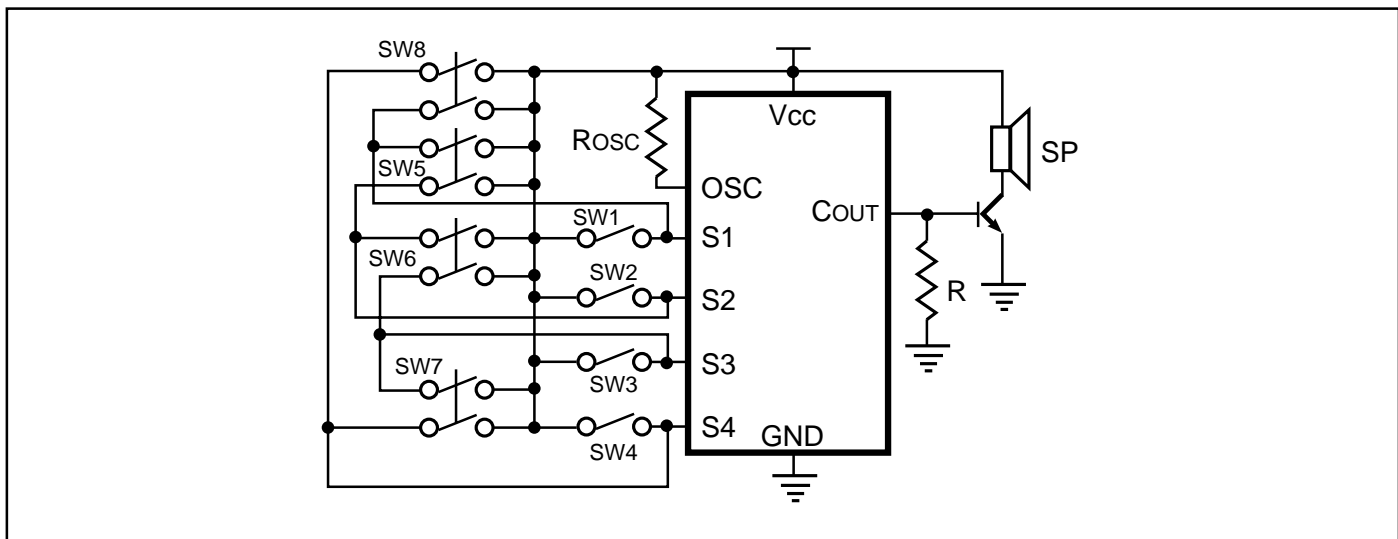
The following are typical values:

1. β of NPN transistor > 130.
2. SP = 8Ω , 1/4W.
3. Piezo buzzer resonant frequency = 1 KHz.

CDS APPLICATION



8-SEGMENT TRIGGER APPLICATION



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

| Order Part No. | Package |
|----------------|---------------------|
| IS22C022X | Unpackaged |
| IS22C022P | 300-mil Plastic DIP |

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Integrated Silicon Solution, Inc.

2231 Lawson Lane
 Santa Clara, CA 95054
 Tel: 1-800-379-4774
 Fax: (408) 588-0806
 E-mail: sales@issi.com
www.issi.com