APLUS   API8208A

VERSATILE 20 SEC INSTANT VOICE ROM

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, TG1 to TG4 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

- $V_{OUT}1$ and $V_{OUT}2$ drives buzzer or speaker directly

- Auto-power down

- 3.0V-6V single power supply operation

- Low standby current (<5 μA at 3V)

- Development tools support

GENERAL DESCRIPTION

API8208A 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 API8208A 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 API8208A provides wide operating voltage range from 3.0V to 6.0V. PWM digital amplifier output pins, $V_{OUT}1$ and $V_{OUT}2$ 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 API8208A 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 TG1 to TG4 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 API8208A 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 API8208A 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 API8208A 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 API8208A 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.

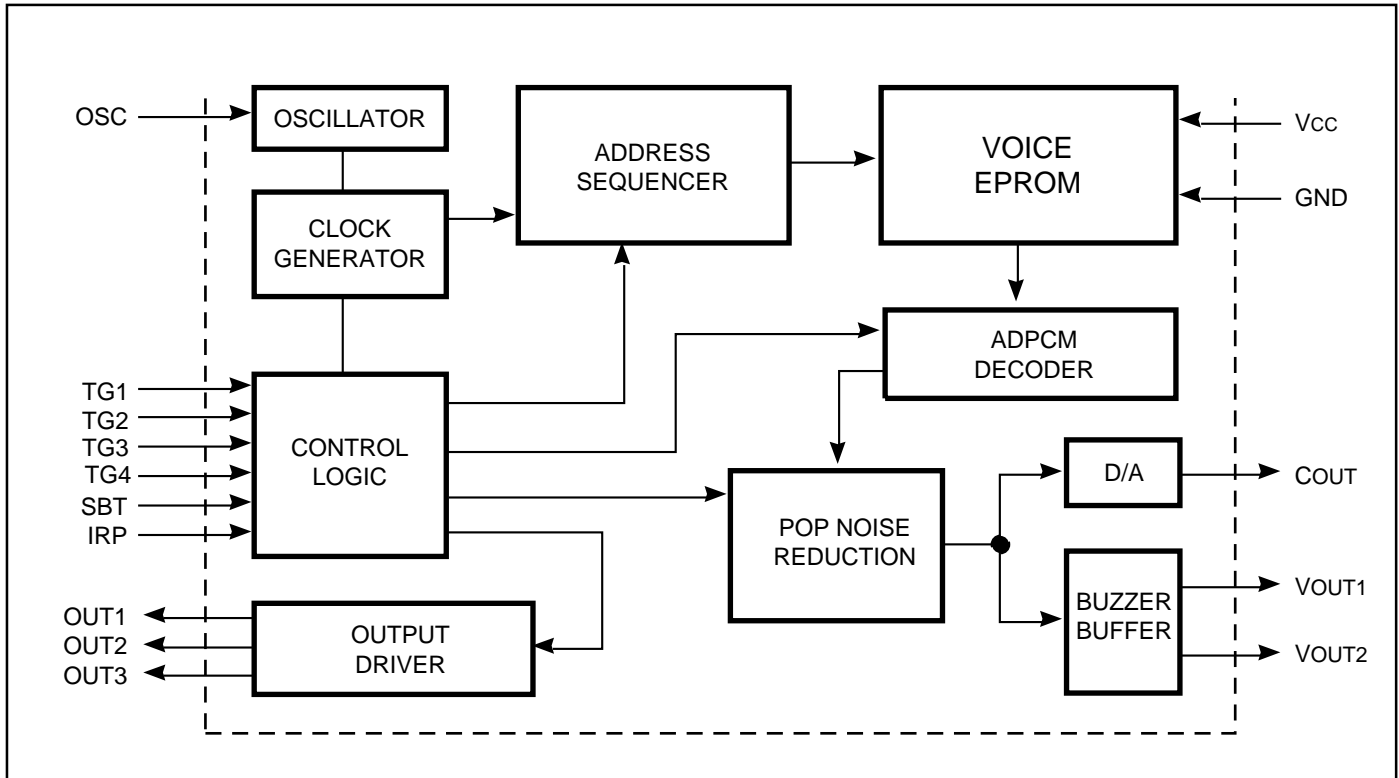|	OUT1	OUT2	OUT3
1.	LED1	Busy	LED2
2.	Stop	LED2	LED1
3.	Busy	LED1	Stop
4.	LED2	Stop	Busy

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.
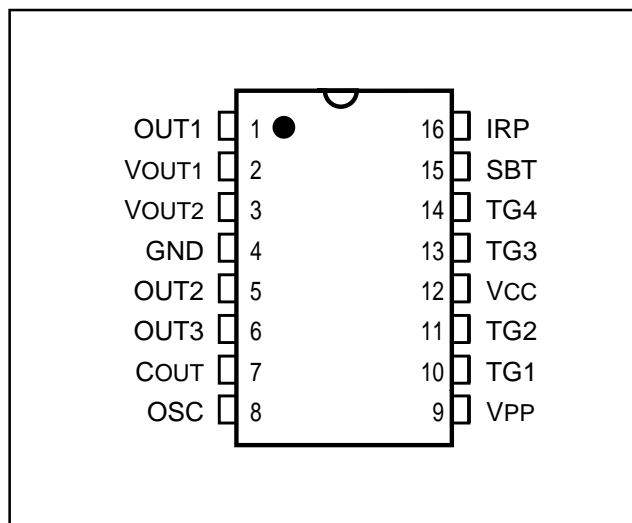
Software Support

APLUS 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
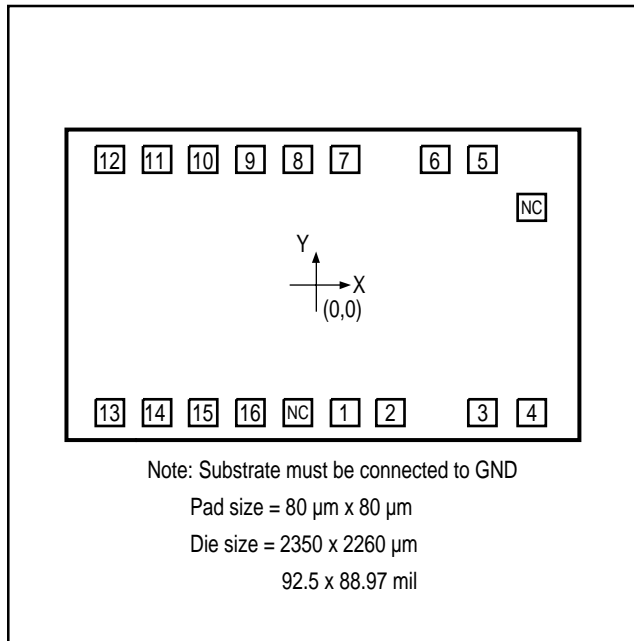

PIN CONFIGURATIONS
300-mil PDIP

PIN DESCRIPTION

OUT1	Programmable output 1
OUT2	Programmable output 2
OUT3	Programmable output 3
$V_{OUT}1$	PWM audio signal output for buzzer and speaker
$V_{OUT}2$	PWM audio signal output for buzzer and speaker
GND	Power ground
C_{OUT}	Current output from internal DAC for speaker playback
OSC	Oscillator resistor pin to control sampling frequency
V_{PP}	Program power supply, no connect when voice playback
TG1	Trigger switch 1, internal pull low, active high
TG2	Trigger switch 2, internal pull low, active high
V_{CC}	Positive power supply
TG3	Trigger switch 3, internal pull low, active high
TG4	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.

APLUS

API8208A

BONDING DIAGRAM

Note: Substrate must be connected to GND

Pad size = 80 µm x 80 µm

Die size = 2350 x 2260 µm

92.5 x 88.97 mil

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	TG1	−566	1017
11	TG2	−810	1017
12	V_{CC}	−1059	1017
13	TG3	−934	−1017
14	TG4	−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		3.0	4.5	5.0	V
I_{SB}	Standby Current	Vcc = 3.0V, I/O Open	—	1	5	µA
I_{OP}	Operating Current	Vcc = 3.0V, I/O Open	—	—	100	µA
V_{IH}	Input HIGH Voltage	Vcc = 3.0V	2.5	3.0	3.5	V
V_{IL}	Input LOW Voltage	Vcc = 2.0V	−0.3	0	0.3	V
I_{OH}	V_{OUT} HIGH Operating Current	Vcc = 3.0V, V_{OUT} = 3.0V	—	−12	—	mA
I_{OL}	V_{OUT} LOW Operating Current	Vcc = 3.0V, V_{OUT} = 0V	—	12	—	mA
I_{CO}	C_{OUT} Operating Current	Vcc = 3.0V, V_{COUT} = 0.7V	—	−2	—	mA
I_{STPH}	STP HIGH Operating Current	Vcc = 3.0V, V_{STP} = 3.0V	—	−5	—	mA
I_{STPL}	STP LOW Operating Current	Vcc = 3.0V, V_{STP} = 0V	—	5	—	mA
I_{LED}	LED Output Current	Vcc = 2.2V − 6.0V	6	8	10	mA
ÐF/F	Frequency Stability	(F_{OSC} [3V] − F_{OSC} [3.5V]) / F_{OSC} (3.0V)	—	—	5	%

SAMPLING FREQUENCY vs Rosc FOR API8208A

Common Sampling Rate vs. Oscillator Resistor

Sampling Frequency KHz	Rosc Kohm
5.0	290
5.5	262
6.0	240
6.5	220
7.0	201
7.5	187
8.0	174
8.5	162
9.0	153
9.5	143
10.0	135
10.5	127
11.0	120
12.0	108

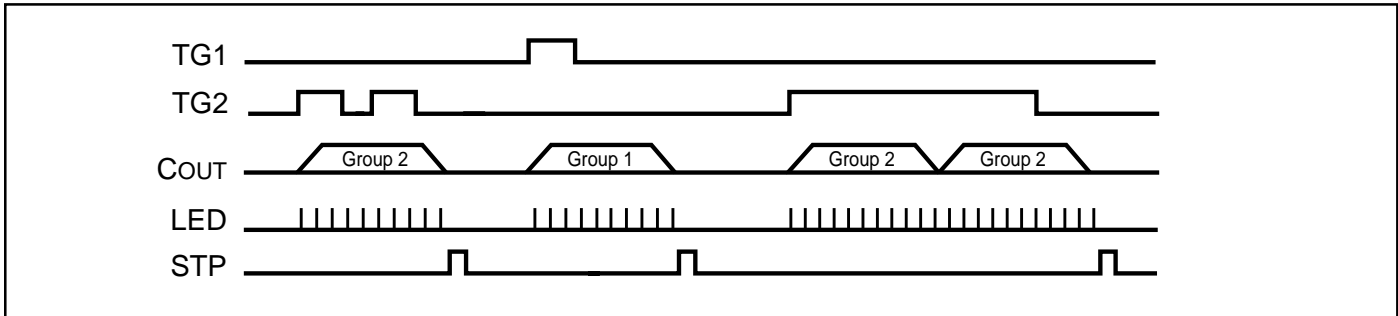## SAMPLING FREQUENCY vs Rosc FOR API8208A

Common Resistors vs. Sampling Rate

Sampling Frequency KHz	Rosc KOhm
13.0	100
14.0	91
16.0	82
22.0	54

TIMING WAVEFORMS

1. Level, Unholdable, Non-retriggerable
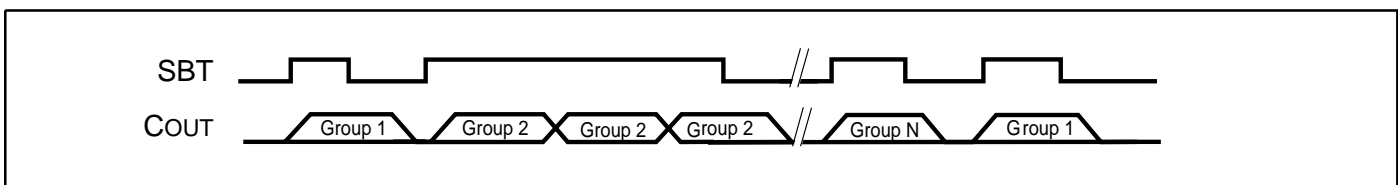   **a. Trigger is shorter than a Group output**   **b. Trigger is longer than a Group output**

TG1

TG2

COUT   Group 2   Group 1   Group 2   Group 2

LED

STP

2. Level Holdable
   a. Trigger is shorter than a Group output   **b. Trigger is longer than a Group output**

TG1

TG2

COUT   Group 2   Group 1   Group 2   Group 2

LED
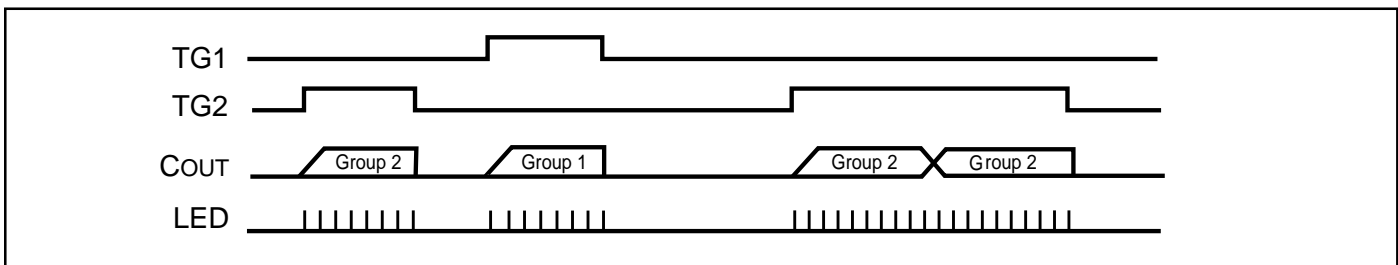
3. Single Button Trigger (SBT), Sequential
   a. Level Unholdable

SBT

COUT   Group 1   Group 2   Group 2   Group 2   Group N   Group 1

b. Level Holdable

SBT

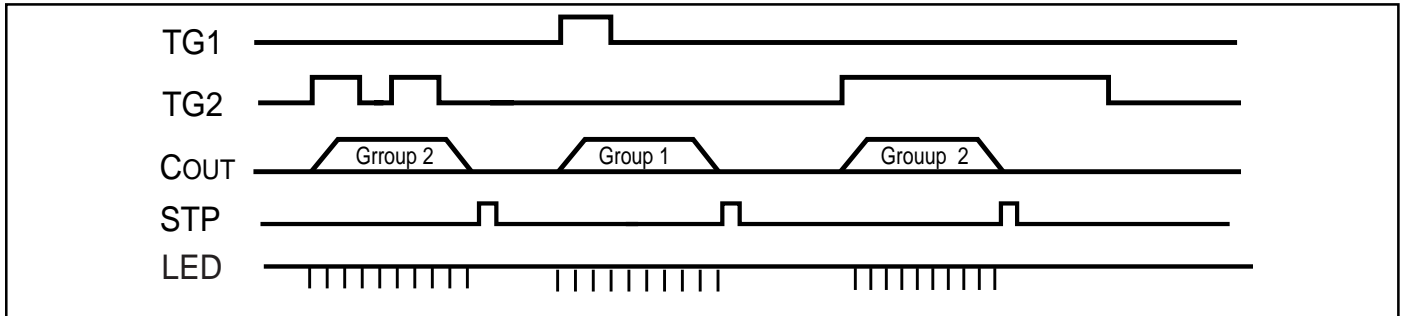COUT   Group 1   Group 2   Group 2   Group 2   Group N   Group 1
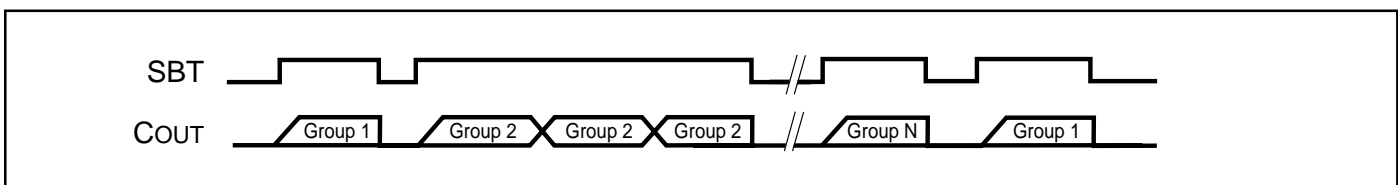
Where N is up to 8.

4. Edge, Unholdable, Non-retriggerable
   a. Trigger is shorter than a Group output   **b. Trigger is longer than a Group output**
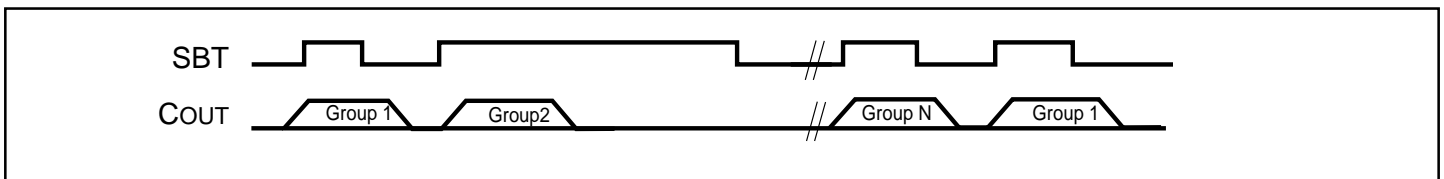
TG1
TG2
COUT — Grroup 2 — Group 1 — Grouup 2
STP
LED

5. Edge Holdable
   a. Trigger is shorter than a Group output   **b. Trigger is longer than a Group output**

TG1
TG2
COUT — Group 2 — Group 1 — Group 2
LED
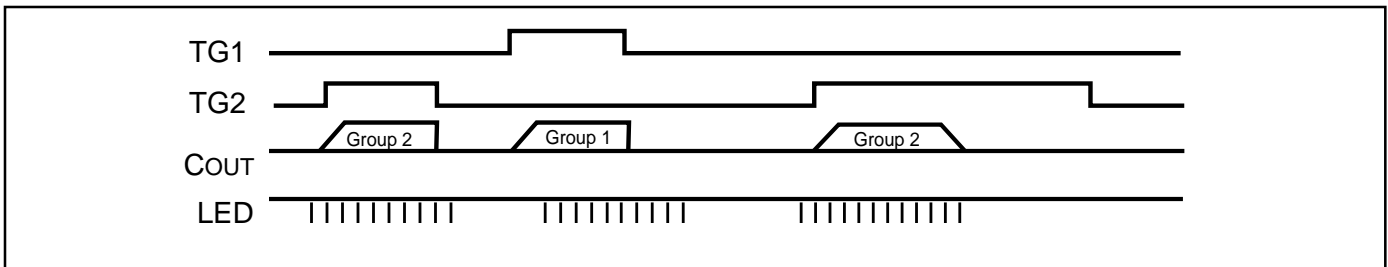
6. Single Button Trigger (SBT), Sequential
   a. Edge Unholdable

SBT
COUT — Group 1 — Group2 — Group N — Group 1

   b. Edge Holdable

SBT
COUT — Group 1 — Group 2 — Group N — Group1
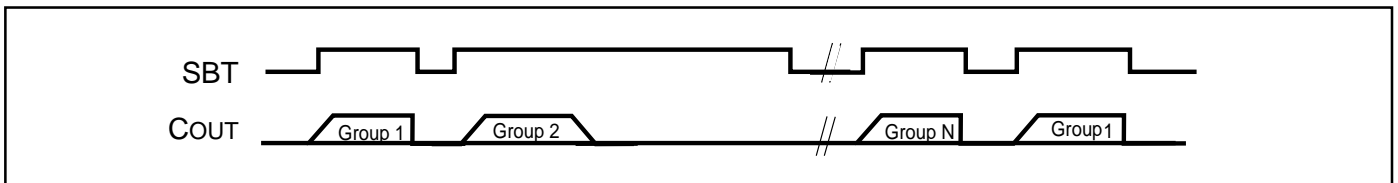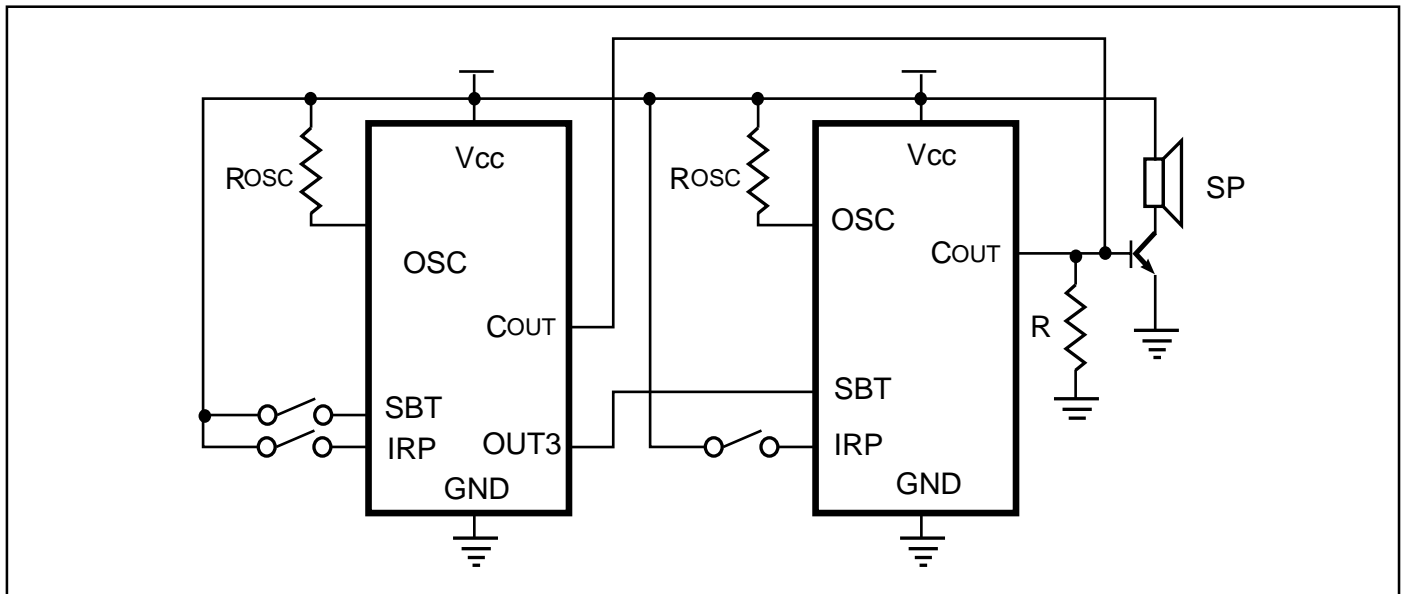
Where N is up to 8.

APPLICATION CIRCUITS

TYPICAL APPLICATION
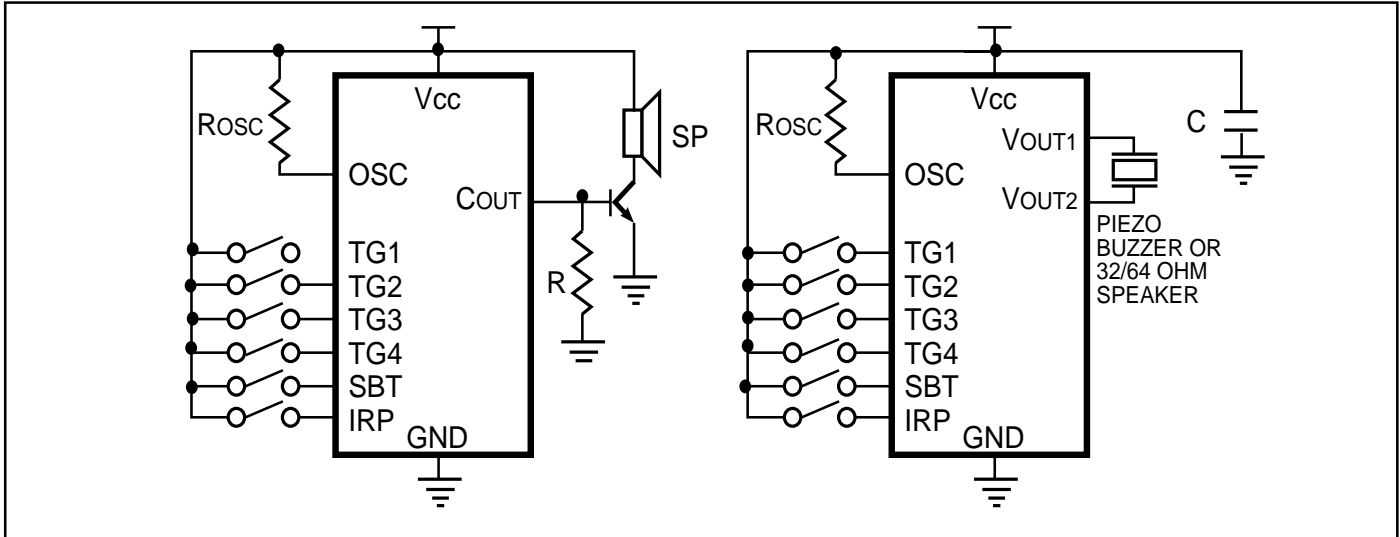
CASCADE APPLICATION

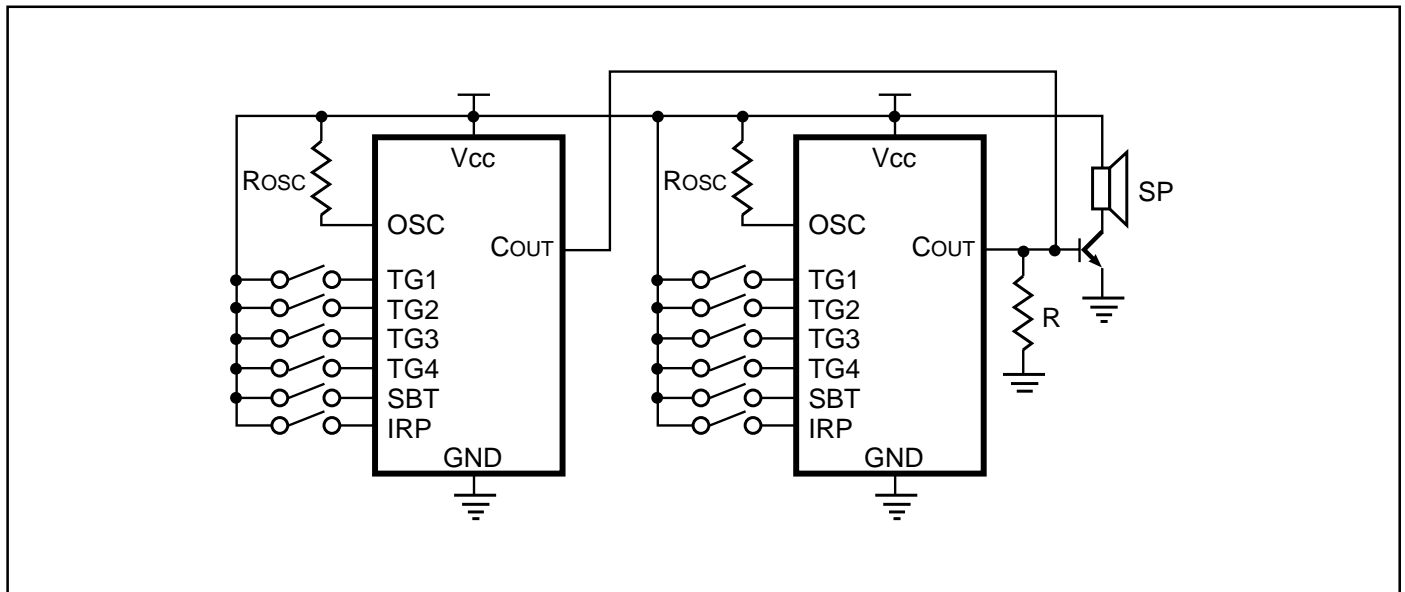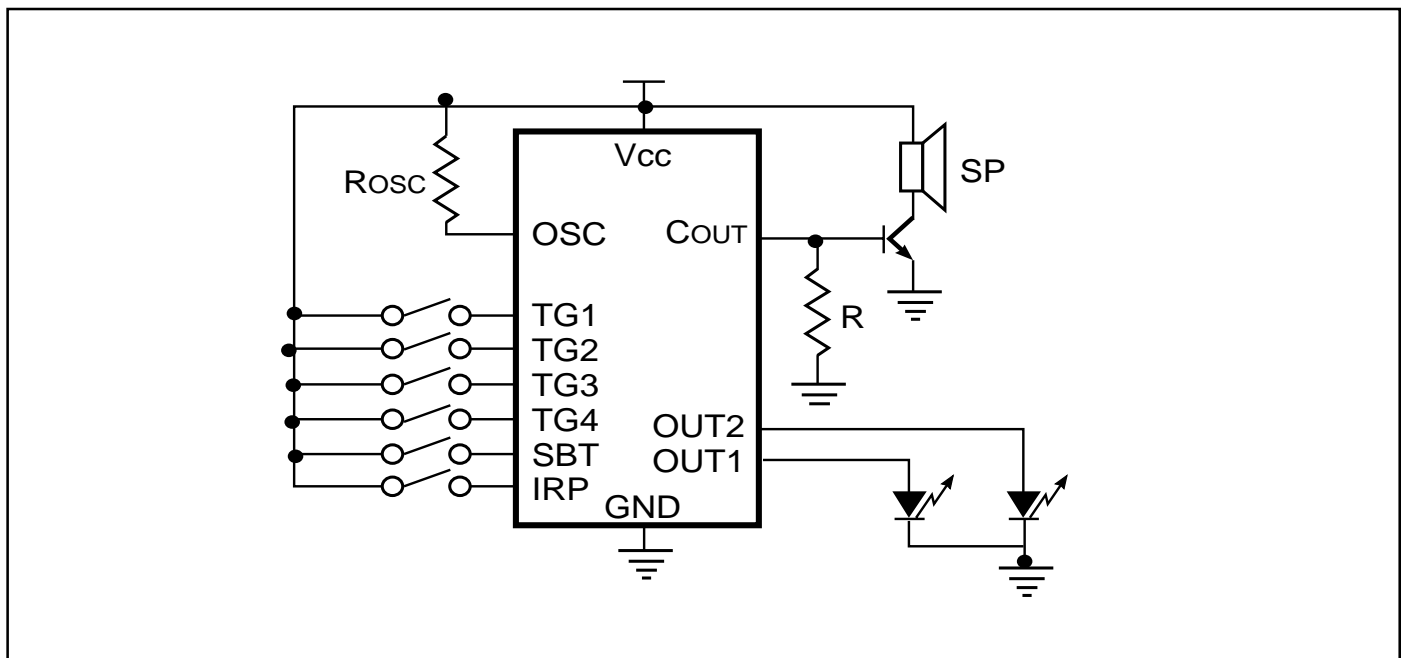**Notes:**
1. To direct dirve a speaker or buzzer, C is needed (C = 0.1 µF).
2. R = 330 Ohm (if using transistor 8050 and Vcc = 4.5V).
3. SP = 8 Ohm speaker.
4. To determine the value of R_{OSC}, refer to the Sampling Frequency vs. R_{OSC} tables on page 5.
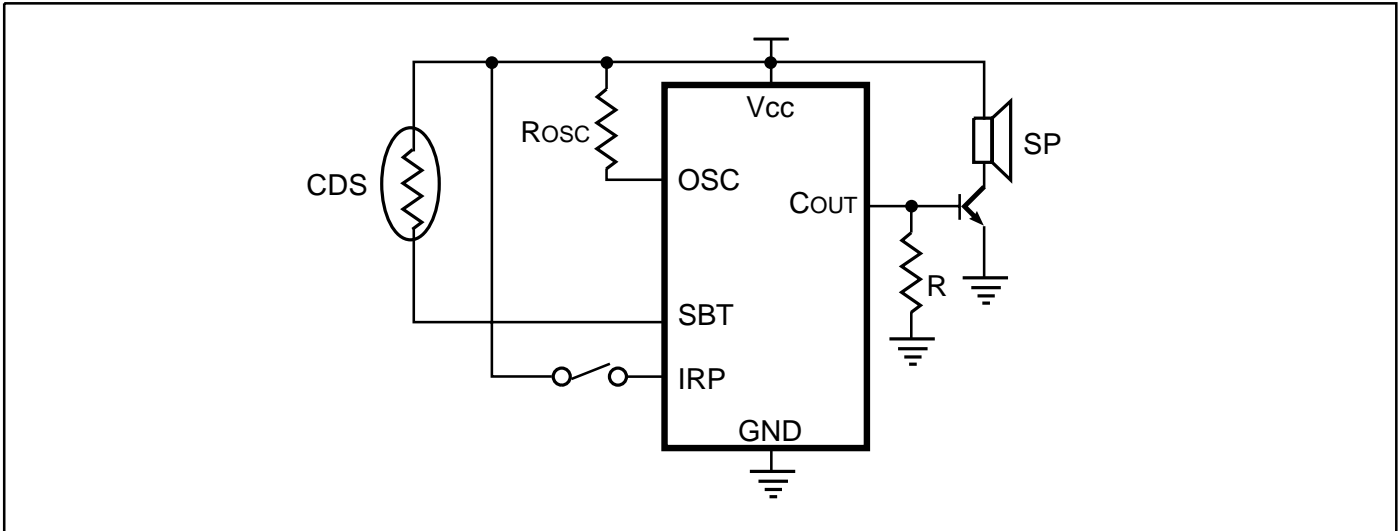
PARALLEL APPLICATION

LED APPLICATION

Notes:

The following are typical values:

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

CDS APPLICATION

8-SEGMENT TRIGGER APPLICATION