HT811A0
2.8 Second 2 Keys Voice

Features

- Operating voltage: 2.4V~5.0V
- Directly drives an external transistor
- Low standby current (1μA Typ. for VDD=3V)
- Minimal external components
- 124 words table ROM for key functions
- Programmable silence length and end-pulse width (minimal end-pulse width is 330μs at a 6kHz sampling rate)
- 2.8-second voice capacity
- FLAG1 options: (programmable)
  - 3Hz flash
  - 6Hz flash
  - Busy output
- Two keys
- Key function MODE (by mask option)
  - Normal mode: (one group for each KEY)
  - "TWIN" mode: (two groups for each KEY)
- Section options: (programmable)
  - Retriggerable
  - Non-retriggerable
- Key options: (under normal mode mask operation)
  - Random (only for KEY1)
  - Sequential (only for KEY1)
  - Repeat (for all KEYs, under retriggerable condition)
  - Key debounce time; 22ms, 45ms, (based on a sampling rate of approximately 6kHz)
  - One shot (for all KEYs)
  - Level-trigger
  - Pull-high resistance (for all KEYs)
- Dice form or 8-pin/16-pin DIP/SOP

Applications

- Toys
- Alarm clocks
- Public address system
- Alert & warning system
- Sound effect generators

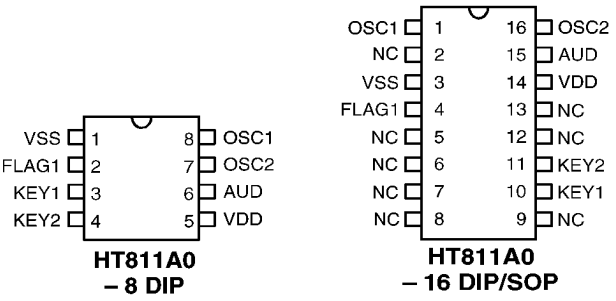
General Description

The HT811A0 is a single-chip LOG-PCM voice synthesizer LSI with 2.8-second voice capacity at a 6kHz sampling rate. The chip when triggered drives a speaker through an external transistor with a current switch D/A converter output. Negligible current will be consumed in the standby state.

The HT811A0 provides two input keys and one programmable output FLAG. With a 2.4V~5.0V power supply, a complete synthesized voice playback system can be easily built with very few external components.

The customer's voice sources are recorded section by section into an internal mask ROM. The sectional playback arrangement instructions of each key are stored in the table ROM. The key features are also programmable. With such a flexible structure, the HT811A0 is excellent for versatile voice applications.

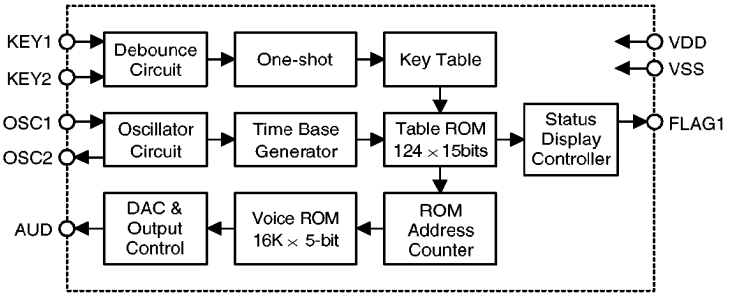
Pin Assignment



HT811A0 – 8 DIP

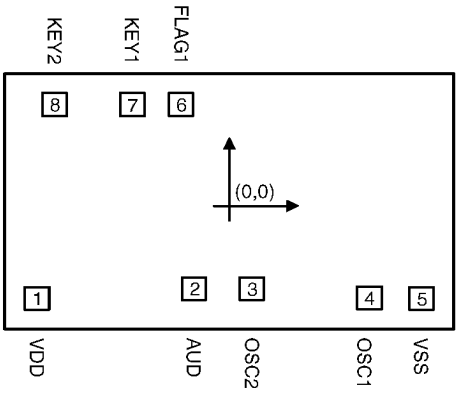
HT811A0 – 16 DIP/SOP

Block Diagram



Pad Coordinates

Unit: μm



Chip size: 1940 × 1380 (μm)^2

Pad No.	X	Y
1	–846.30	–532.80
2	–87.30	–480.70
3	160.00	–477.80
4	578.00	–480.30
5	804.50	–483.30
6	–142.10	482.80
7	–385.90	482.80
8	–705.90	482.80

* The IC substrate should be connected to VSS in the PCB layout artwork.

Pin Description

Pin Name	I/O	Internal Connection	Description
OSC1	I	—	Oscillator input pin
VSS	I	—	Negative power supply (GND)
FLAG1	O	NMOS Open Drain	3Hz/6Hz flash output or busy output (by mask option), open drain, active low output
KEY1~ KEY2	I	Pull-High	Trigger key, active low. Key features like debounce time, pull-high resistance and repeat, can be selected by mask option.
NC	—	—	No connection
VDD	I	—	Positive power supply
AUD	O	PMOS Open Drain	Voice output for driving an external transistor
OSC2	O	—	Oscillator output pin

Absolute Maximum Ratings*

Supply Voltage ..... –0.3V to 6V
Storage Temperature ..... –50°C to 125°C
Input Voltage ..... V_{SS}–0.3V to V_{DD}+0.3V
Operating Temperature ..... –20°C to 70°C

*Note: These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

Electrical Characteristics

(Ta=25°C)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
V_{DD}	Operating Voltage	—	—	2.4	—	5.0	V
I_{DD}	Operating Current	3V	No load, F_{OSC}=96kHz	—	200	400	μA
I_{STB}	Standby Current	3V	—	—	1	3	μA
I_O	Max. AUD Output Current	3V	V_{OH}=0.6V	–1.5	–2	—	mA
I_{OL}	FLAG Sink Current	3V	V_{OL}=0.3V	1.5	3.0	—	mA
V_{IH}	"H" Input Voltage	—	—	0.8V_{DD}	—	V_{DD}	V
V_{IL}	"L" Input Voltage	—	—	0	—	0.2V_{DD}	V
f_{OSC}	Oscillating Frequency	3V	R_{OSC}=530kΩ	76	96	116	kHz

Functional Description

The HT811A0 is a mask ROM type voice synthesizer with 2.8-second voice capacity. A group of pre-recorded voice sections is played upon receipt of key trigger input signals. One output FLAG sends signals while playing voices.

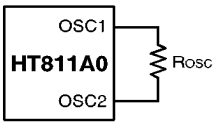
The 2.8-second voice capacity can be divided into sections of arbitrary length. Notice that the silence length and end-pulse width are not included in the memory.

By using HOLTEK's programming tools, the contents and arrangement of sections, key features and FLAG output are all programmable before device fabrication.

The IC provides two key inputs (KEY1~KEY2). Of the two keys, KEY1 can be optioned as a direct, sequential or random trigger key. The remaining key (KEY2) is used as a direct key exclusively.

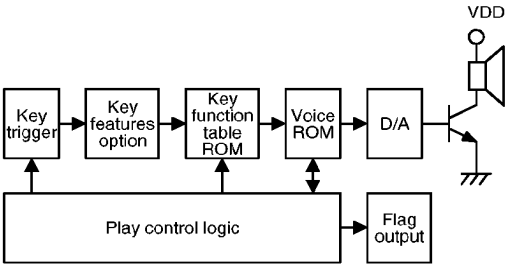
System oscillator

The HT811A0 has a built-in RC oscillator which requires only one external resistor for normal applications. The oscillator frequency is typically 96kHz for an external resistor of 530kΩ. The required oscillator frequency may vary with different sampling rates in the process of voice programming. As a result, the value of the oscillator resistor may be different for different items.



The oscillator is turned on when triggered by a key input. After playing, it is immediately turned off. Then the chip goes into the standby state.

Play function block diagram



Voice ROM

The voice ROM is originally designed to continuously record the 2.8-second voice data at about 6kHz sampling rate. A higher sampling rate will generate voices of good playback quality, but will shorten the total recording time. On the other hand, a lower sampling rate will result in longer recording time but sacrifice voice quality.

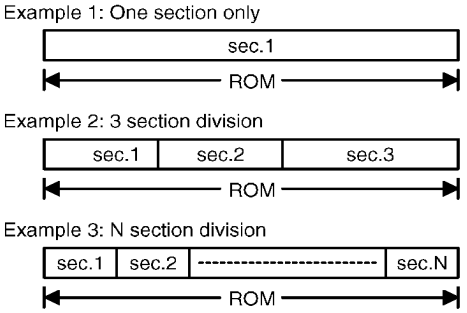
The playback time can be significantly extended by making use of coding efficiency, silence playing, section repeating, section cascade, etc.

Section

Section is the basic element constituting the contents of the voice ROM. During programming, the customer's voice sources can be divided into as many sections as required. A section can be composed by a voice or an interval of silence. However, the silent length is not counted in the voice ROM. The total number of sections included should be less than 124 due to the space limitation of the function table ROM. The total length of the included sections is limited by voice ROM.

A section, when triggered by a key input, can be played once, repeatedly or cascaded with other sections, depending on the key function table instructions.

The following are examples of section division:



In addition, a section can be set as retriggerable or non-retriggerable depending on code option.

- Retriggerable

  When the currently playing section is set as retriggerable, it will stop immediately upon receipt of other key inputs.

- Non-retriggerable

  When the currently playing section is set as non-retriggerable, it will go on playing till the whole section is completed, whether or not there is a key input during voice playing.

  For a key group, some sections can be set as retriggerable and some as non-retriggerable. When a retriggerable section of a key group is playing, any input key can be triggered to interrupt its playing. On the other hand, if it is a non-retriggerable section playing, any key interrupt is invalid.

Group

The HT811A0 plays groups according to the key input. A group can be made up of one or more sections. When a key is triggered, the corresponding group is played immediately. For example, triggering KEY2 plays group 2, and so on. The same section is allowed to appear in different groups. However, KEY1 can be made up of multiple groups when it is optioned as a sequential or random key. Otherwise, each key is composed of one group only.

Key function table

The sections in the voice ROM are played according to the instructions of the key function table. The function table contains group information and playing order of sections in the groups. Notice that the total amount of sections included in the groups should be less than 124– the space limitation of the function table ROM.

- KEY1 as a direct key (normal mode)

  Each key is mapped to a group in the function table. If a key is not used, the group mapped to that key is a piece of silence. The following is an example of the function table:

Group 1	sec.1 + sec.2 + sec.3 + sec.5
Group 2	sec.3
Group 3	sec.2 + sec.2 + sec.3 + sec.4
Group 4	sec.5 + sec.3

  As illustrated in the above table, the voice ROM is composed of 5 sections, and 11 sections for the function table. If KEY1 is momentarily triggered, section 1, section 2, section 3 and section 5 are played in sequence and then stopped. Triggering KEY2 plays section 3, and so on. Group3 and Group4 are used for "TWIN" mode.

- KEY1 as a sequential or random key, (normal mode)

  When KEY1 is optioned as a sequential or random key, it can include multiple groups (sub-groups) in the function table. KEY2 however, is used as a direct key exclusively and comprise only one group in the function table. An example is shown below:

Group 1-1	sec.4 + sec.2
Group 1-2	sec.1 + sec.3
:	:
:	:
Group 1-N	sec.2 + sec.3
Group 2	sec.2 + sec.3
Group 3	sec.3 + sec.5
Group 4	sec.1 + sec.5 + sec.2

KEY1 can be made up of sub-groups. Each time KEY1 is triggered, the corresponding sub-groups are played in sequence .

- The playing sequence of sequential KEY1 is: Group 1-1 → Group 1-2 → Group 1-3 ..... → Group 1-N (the last group) → Group 1-1 .....
- The playing sequence of random KEY1 is: Group 1-3 → Group 1-5 ..... → Group 1-N → Group 1-3 → Group 1-5 .....

  That KEY1 functions as a random key is a special case of sequential key, which combines a particular arrangement of sub-group playing sequence.
- Reset of KEY1 playing sequence

  If a sub-group of KEY1 is being played and KEY2 is triggered, the playing sub-group will be terminated, and the newly triggered key group is played instead. The first sub-group will start playing by retriggering KEY1. In other words, the KEY1 playing sequence is reset whenever a key other than KEY1 is triggered (see Figure 1).
- Sub-group selection

  When KEY1 is triggered with pulses, the desired sub-group can be selected by controlling its corresponding pulse number. However, the features of KEY1 have to be set in the following ways:

  - sequential or random
  - retriggerable
  - minimum key debounce time (≅700μs, f_{OSC}=96kHz)

  For instance, if sub-group 1-3 is the previous playing group, sub-group 1-5 will start playing after 2 pulses are applied to KEY1, and so on.

  To make easy selection of KEY1 sub-groups, KEY2 should be programmed as silence. Then this silence key has to be triggered to reset KEY1. By so doing, the playing sub-group of KEY1 is directly specified by the pulse number applied to KEY1 (see Figure 2).

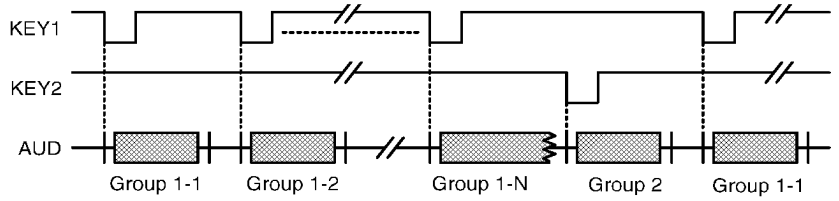


Figure 1 Reset of KEY1 playing sequence

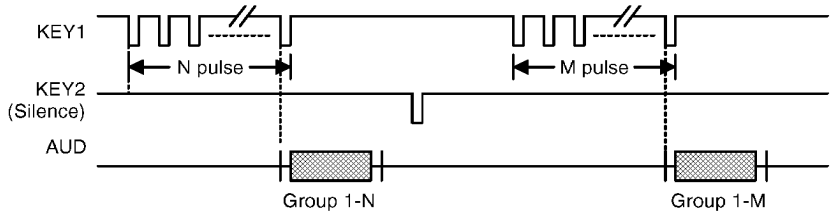


Figure 2 KEY1 sub-group selection

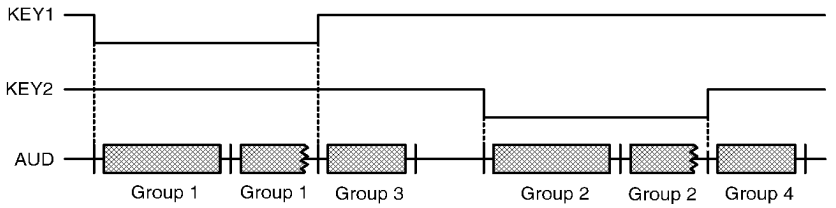


Figure 3 One Key two groups function (TWIN mode)

- KEY1~KEY2 as a repeat key (normal mode)

  KEY1~KEY2 all function as repeat key if one of the two keys is set as a repeat key. In other words, once the mode of one of KEY1~KEY2 is determined, the remaining key are set accordingly.

  As a repeat key, the sections included can be played sequentially and repeatedly till other input key is triggered.

  When the KEY1~KEY2 are set as repeat keys, the key function should be optioned as retriggerable keys.

- KEY1, KEY2 as two group keys (TWIN mode)

  One KEY can play two groups, if KEY1 is held down, the group 1 can be played repeatedly till KEY1 is released and the group 3 will be played one cycle, immediately by the rising edge of KEY1. On the other hand, KEY2 can play group 2 and group 4 by the same function of KEY1. (see Figure 3)

Key features

- Key priority

  When two or more keys are triggered simultaneously, the output voice is decided by the priority key as shown below:

  KEY1>KEY2

- Key debounce time

  There are two kinds of key-in debounce time to be selected by mask option, namely 22ms, 45ms. The key debounce time varies with the value of the system frequency.

- Pull-high resistance

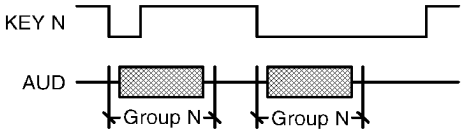
  Four kinds of key input pin pull-high resistance can be selected by mask option, namely 20kΩ, 50kΩ, 100kΩ and 200kΩ. The resistance may vary with VDD, temperatures and the chip itself due to process variations.

- Trigger mode (normal mode)

  The 2 keys can optioned as one-shot trigger mode or level-trigger mode.

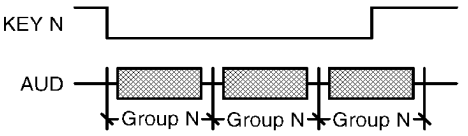
  - One shot

    When one of the two keys (KEY1~KEY2) is pressed and held down, or pressed momentarily the group corresponding to that held or pressed key will play once.



  - Level trigger

    When one of the two keys is pressed and held down, the corresponding group will keep playing. Once the pressed key is released, the group will not stop till the included sections are all completed.



FLAG

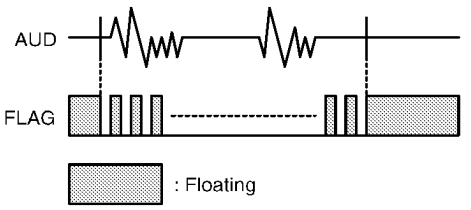
When voices are playing, FLAG1 pin is activated to output one of the following signals through code option.

FLAG1, can be set as one of the following signal outputs:

None, 3Hz flash, 6Hz flash, or Busy output

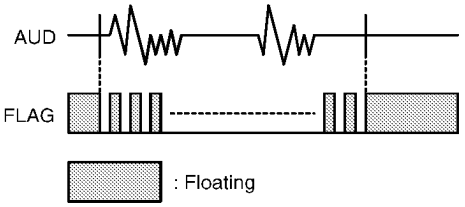
- 3Hz flash

  When voices are playing, the FLAG1 pin outputs a 3Hz signal to drive an LED. The signal is active low, 25% duty. Once the voice output is terminated, the FLAG1 pin becomes a floating output.



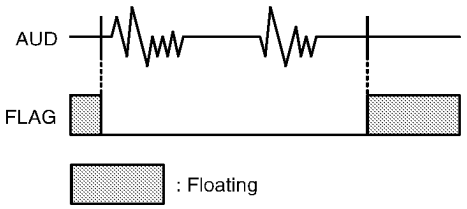
• 6Hz flash

When voices are playing, the FLAG1 pin outputs a 6Hz signal to drive an LED. The signal is active low, 25% duty. Once the voice output is terminated, the FLAG1 pin becomes a floating output.



• Busy output

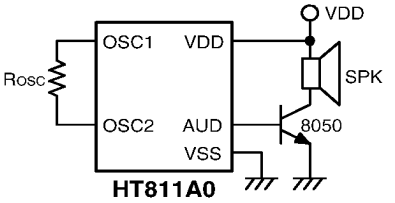
When a voice group is playing, the output of FLAG1 is turned low, indicating that the chip is busy.



AUD

The AUD pin is a PMOS open drain structure. It outputs voice signals to drive a speaker through an external NPN transistor when the chip is active. However, the AUD pin becomes a floating output when the chip is in the standby state.

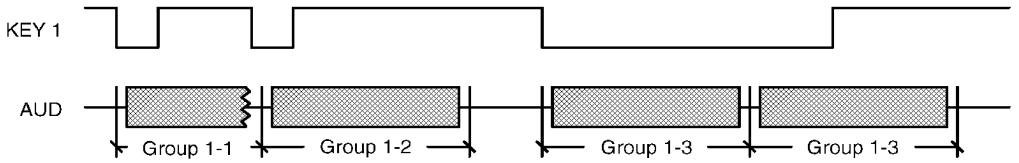
The 8050 type transistor with $h_{FE} \cong 150$ is recommended for an output driver.



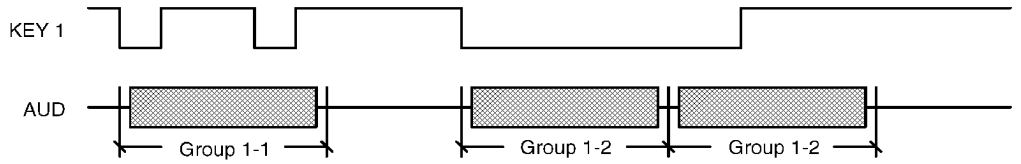
Timing Diagram

One key operation

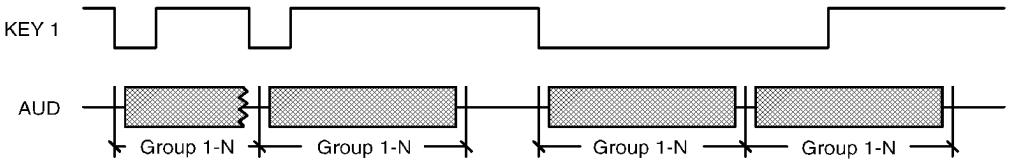
• Sequential-retriggerable



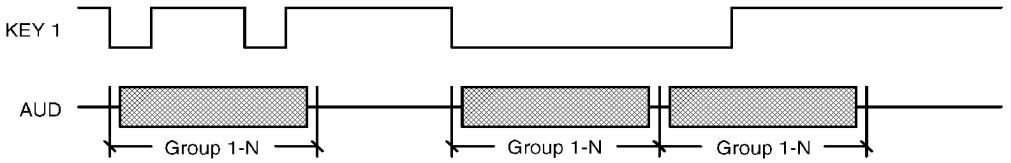
• Sequential-nonretriggerable



• Random-retriggerable



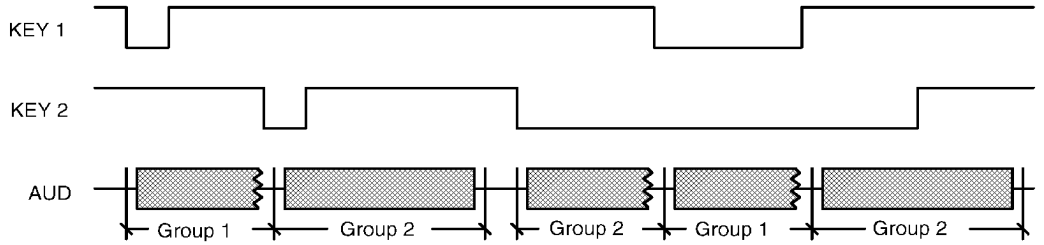
• Random-nonretriggerable



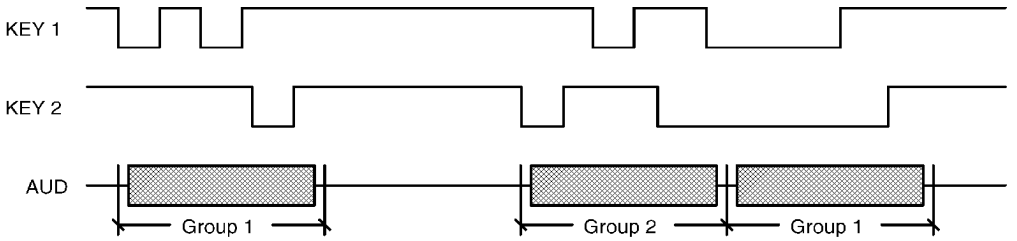
Note: Group 1-N may be any of the KEY1's groups

Multi-key operation

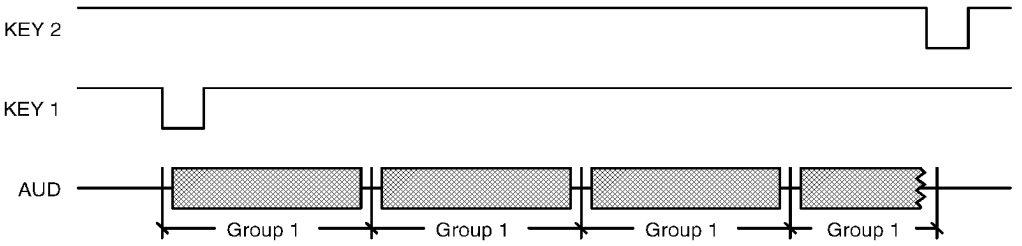
• Retriggerable



• Non-retriggerable

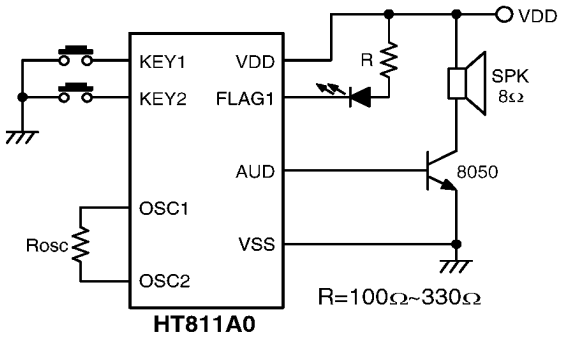


• Repeat

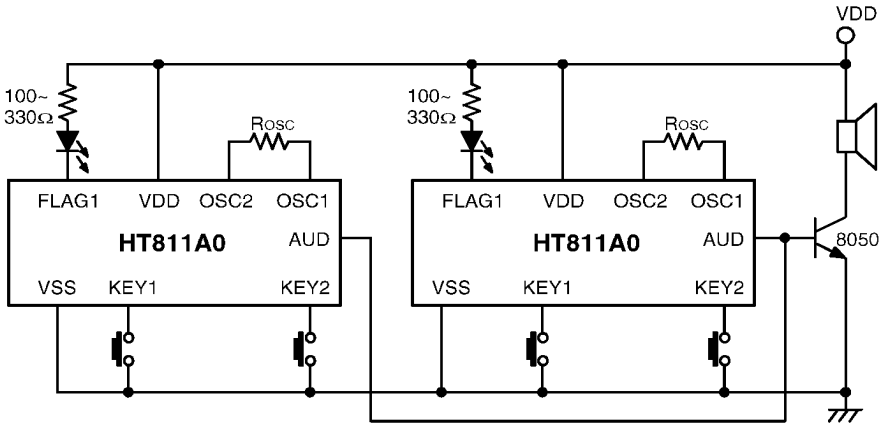


Application Circuits

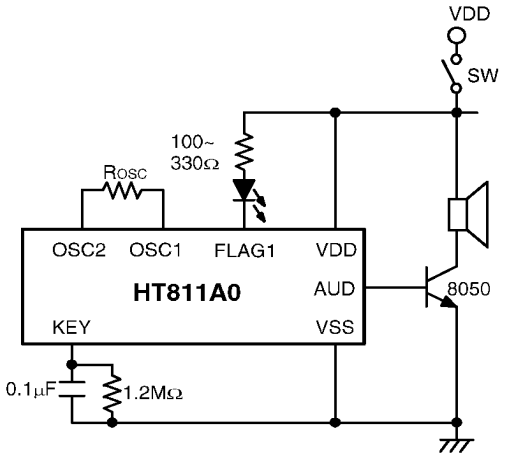
General application



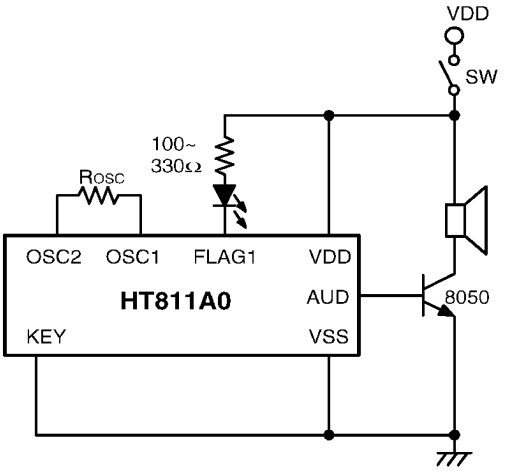
Parallel application



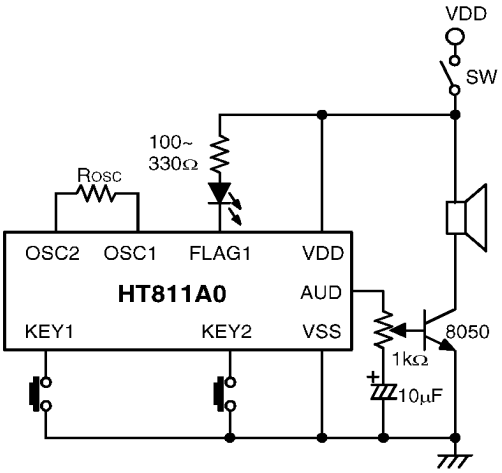
Power-on play (one shot)



Power-on play (continuous)

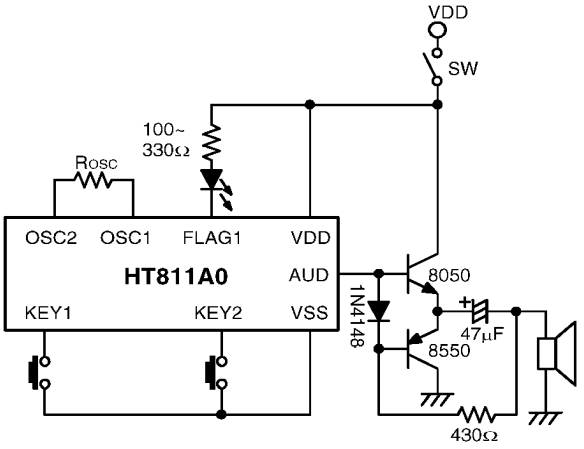


With volume adjustment



Push-pull output

To prevent the speaker and driver transistor from damage due to excess power dissipation which results from a high voltage power supply (4.5V~5.5V), the following push-pull output stage is recommended.



Coupling to power amplifier