HT819D0
4.2 Second LOG-PCM Speech

Features

- Operating voltage: 2.4V~5.0V
- Directly driving an output transistor
- Low stand-by current (1μA Typ. for VDD=3V)
- Minimum external components
- FLAG1 options:
  - End-pulse output
  - 3HzB flash
  - 6HzB flash
  - Voice output indication
  - Busy output
- FLAG2 options:
  - 3Hz flash
  - 6Hz flash
  - Busy output
- 252 table ROM for key functions
- Volume controllable
- 6 keys
- Key options:
  - Stop key: KEY6
  - Random (only for KEY1)
  - Sequential (only for KEY1)
  - Repeat (for all KEYs)
  - Key debounce time (for all KEYs): 700μs, 22ms, 45ms, 180ms (based on a sampling rate of approximate 6KHz)
  - One shot (for all KEYs)
  - Pull-high resistance (for all KEYs)
- Section options:
  - Retriggerable
  - Non-retriggerable
- Programmable silence length and end-pulse width (The minimal end-pulse width is 330μs when the sampling rate is 6KHz.)
- 4.2-second voice capacity

Applications

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

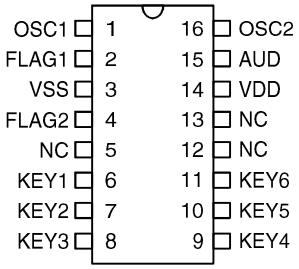
General Description

The HT819D0 is a single-chip LOG-PCM voice synthesis LSI with 4.2-second voice capacity at 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 stand-by state.

The HT819D0 provides 6 key inputs and 2 programmable FLAG outputs. With 2.4V~5.0V power supply, a complete synthesized voice playback system can be easily built with very few external components.

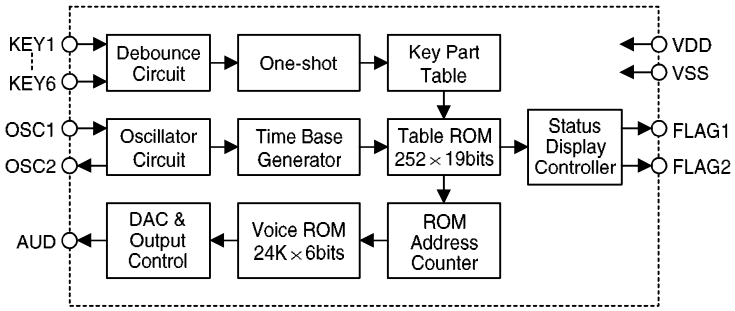
The customer's voice sources are recorded section by section into an internal mask ROM. The instructions of section playback arrangement of each key are stored in the table ROM. Also the key features are programmable. With such a flexible structure, the HT819D0 is excellent for versatile voice applications.

Pin Assignment

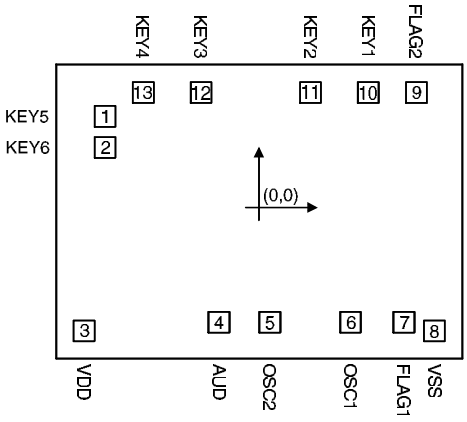


HT819D0
– 16 DIP/SOP

Block Diagram



Pad Coordinates



Unit: μm

Pad No	X	Y	Pad No.	X	Y
1	–885.05	522.30	8	1008.85	–710.50
2	–885.05	344.50	9	905.45	660.50
3	–1005.05	–710.50	10	628.05	660.50
4	–229.95	–660.50	11	296.45	660.50
5	62.35	–660.50	12	–333.95	660.50
6	526.75	–660.50	13	–665.55	660.50
7	833.85	–660.50			

Chip size: 2290 × 1750 $(\mu m)^2$

* 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
FLAG1	O	NMOS Open Drain	3HzB/6HzB flash output, busy output, end-pulse or voice output indication (by code option). Open drain, active low output
VSS	I	—	Negative power supply (GND)
FLAG2	O	NMOS Open Drain	3Hz/6Hz flash output or busy output (by code option). Open drain, active low output

Pin Name	I/O	Internal Connection	Description
KEY1~KEY6	I	Pull-High	Trigger key, low active. Key features such as debounce time, pull-high resistance and repeat are all mask options.
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
Input Voltage ..... V_{SS}–0.3V to V_{DD}+0.3V
Storage Temperature ..... –50°C to 125°C
Operating Temperature ..... –20°C to 70°C

Electrical Characteristics

(Ta=25°C)

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
		V_{DD}	Condition				
V_{DD}	Operating Voltage	—	—	2.4	—	5.0	V
I_{DD}	Operating Current	3V	No load, F_{OSC}=96KHz	—	200	400	μA
I_{STB}	Stand-by 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}	System Frequency	3V	R_{OSC}=530KΩ	76	96	116	KHz

Functional Description

The HT819D0 is a mask ROM type voice synthesizer with 4.2-second voice capacity. A group of pre-recorded voice sections is played upon receipt of key trigger input signals. Two FLAG signals are output while playing voices.

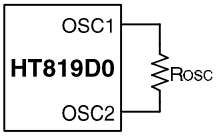
By using HOLTEK's programming tools, the contents and arrangement of sections, key features and FLAG output are all programmable before device fabrication.

The IC provides 6 key inputs (KEY1~KEY6). Of the 6 keys, KEY1 can be optioned as a direct, sequential or random trigger key. KEY6 can be selected as a stop or direct key. As for the remaining 5 keys (KEY2~KEY6), they are used as direct keys exclusively.

The 4.2-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.)

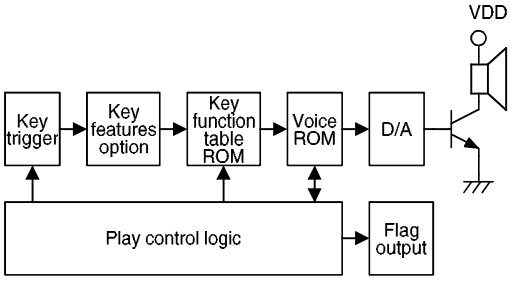
System oscillator

The HT819D0 is built with an 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. Given this, the value of the oscillator resistor may be different with respect to 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 stand-by state.

Play function block diagram



Voice ROM

The voice ROM is originally designed for continuously recording the 4.2-second voice data at about 6KHz sampling rate. Notice that although a higher sampling rate can generate voices of better playback quality, the total recording time is shortened. On the other hand, a lower sampling rate results in longer recording time but sacrifices the voice quality.

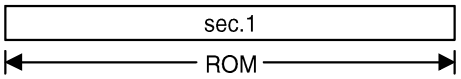
The playback time can be significantly extended by making use of coding efficiency, silence playing, section repeating, section cascade, etc.

Section

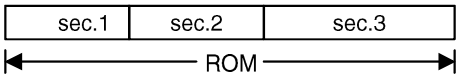
Section is the basic element constituting the contents of voice ROM. During programming, the customer's voice sources can be divided into as many sections as required. A section can be comprised by a voice or an interval of silence. However, the silent length is not counted in voice ROM. The entire number of sections included should be less than 252 due to the space limitation of the function table ROM. As for the total length of the sections included, it 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. Following are some examples of section division:

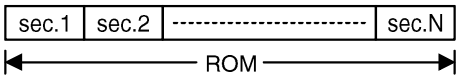
Example 1: One section only



Example 2: 3 section division



Example 3: N 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 be stopped immediately upon receipt of other key inputs.

- Non-retriggerable

  On the other hand, when the currently playing section is selected as non-retriggerable, it will go on playing till the whole section is completed, whether or not there is a key input in the process of playing.

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

Group

The HT819D0 plays groups on the basis of the key input. A group can be made up of one or more sections. When a key is triggered, the corresponding group comes into play. For example, triggering KEY2 plays group 2, and so forth. 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 comprised by one group only.

Key function table

The sections in voice ROM are played according to the instructions of key function table. The function table contains group information as well as playing order of sections in the groups. Notice that the total amount of sections included in the groups should be less than 252– the space limitation of the function table ROM.

- KEY1 as a direct key

  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. 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, voice ROM is composed of 5 sections and the function table of 11 sections. 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 forth.

- KEY1 as a sequential (random) key

  When KEY1 is optioned as a sequential or random key, KEY1 can include multiple groups (sub-groups) in the function table. However, the remaining 5 keys (KEY2~KEY6) are used as direct keys exclusively and comprise only one group in the function table. Below is an example:

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

As indicated in the above table, KEY1 can be made up of sub-groups. The according sub-groups come into play in sequence each time KEY1 is triggered.

* 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 group is being played and one of KEY2~KEY6 is triggered, the playing sub-group will be terminated, and the newly triggered key group come into play 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, a desired sub-group can be selected by controlling its corresponding pulse number. However, the features of KEY1 have to be set in the following way:

  - 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 input to KEY1, and so on.

To make selection of KEY1 sub-groups more easily, one of KEY2~KEY6 should be programmed as silence. Then this silence key has to be triggered to reset KEY1. By so doing, the playing sub-group is directly specified by the pulse number applied to KEY1 (see Figure 2).

- KEY6 as a stop key (by mask option)

  When KEY6 functions as a stop key, any voice output can be stopped by pressing KEY6.

- KEY1~KEY5 as a repeat key

  KEY1~KEY5 all function as a repeat key if one of the 5 keys is set as a repeat key. That is to say, once the mode of one of KEY1~KEY5 is determined, the remaining 4 keys are set accordingly.

  As a repeat key, the sections included can be played sequentially and repeatedly till other trigger is input. KEY6 has no other choice but functions as a stop key when KEY1~KEY5 are set as repeat keys.

Key features

- Key priority

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

  KEY1>KEY2>.....KEY5>KEY6

- Key debounce time

  There are 4 kinds of key-in debounce time to be selected by mask option, namely 700μs, 22ms, 45ms and 180ms. The key debounce time varies with the value of 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

  All of the 6 keys are internally set as one-shot trigger mode.

FLAG

When voices are playing, both FLAG1 and FLAG2 pins are activated to output one of the following signals through code option.

FLAG1 can be optioned as one of the following signal outputs:

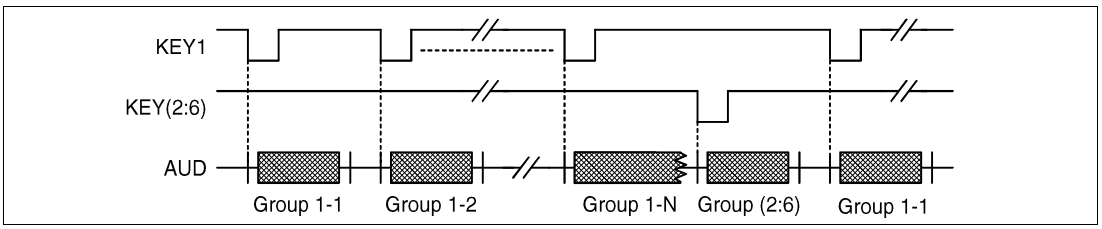


Figure 1 Reset of KEY1 playing sequence

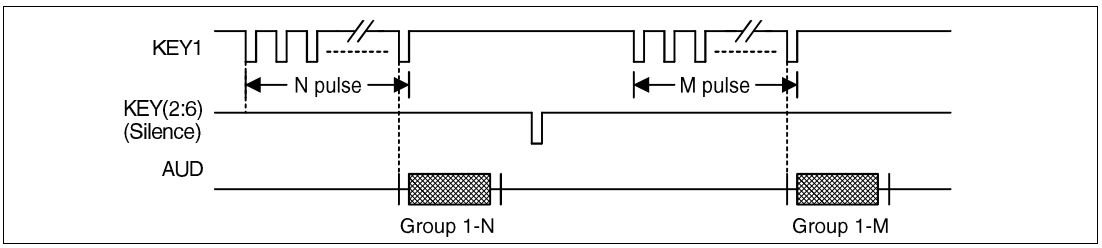


Figure 2 KEY1 sub-group selection

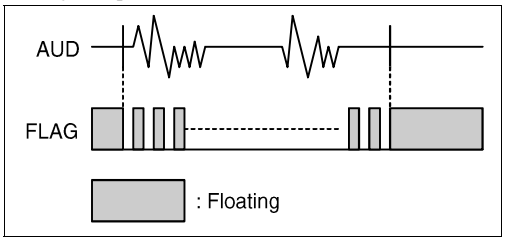
None, 3HzB flash, Busy, 6HzB flash, Voice indicator, or End-pulse output.

FLAG2, on the other hand, can be set as one of the following signal outputs:

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

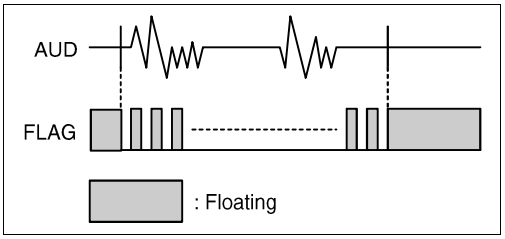
- 3Hz/3HzB flash

  When voices are playing, the FLAG1 as well as FLAG2 pin outputs a 3Hz signal to drive an LED. The signal is active low, 25% duty. Once the voice output is terminated, the FLAG1 and FLAG2 pins become floating. When the FLAG1 and FLAG2 pins are optioned as 3HzB and 3Hz outputs, they will be alternately output at a 3Hz rate.



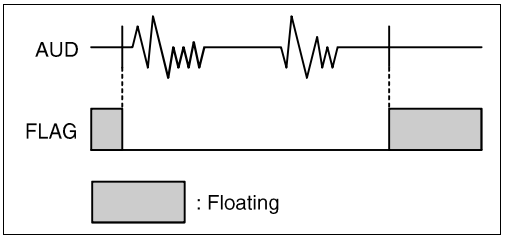
- 6Hz/6HzB flash

  When voices are playing, the FLAG1 as well as FLAG2 pin outputs a 6Hz signal to drive an LED. The signal is active low, 25% duty. Once the voice output is terminated, the FLAG1 and FLAG2 pins becomes floating. When the FLAG1 and FLAG2 pins are optioned as 6HzB and 6Hz outputs, they will be alternately output at a 6Hz rate.



- Busy output

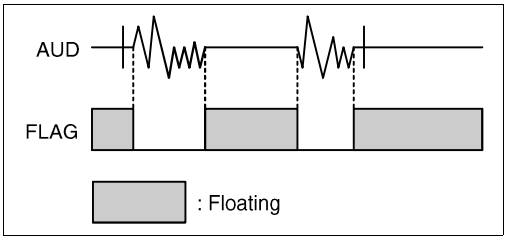
  When a voice group is playing, the outputs of both FLAG1 and FLAG2 are turned low, indicating that the chip is busy.



In addition to the above-stated output signals, FLAG1 can also generate one of the following signals by code option:

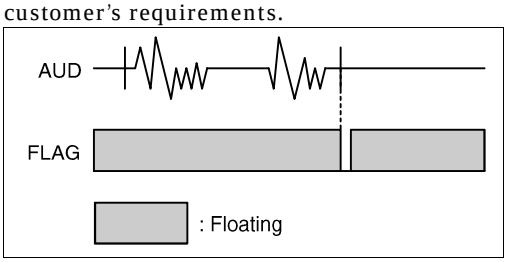
- Voice indicator output

  FLAG1 is active low when voices are playing. FLAG1 is also turned low when a voice section is output. FLAG1 becomes floating after the silence section is output or the voice output is terminated.



- End-pulse output

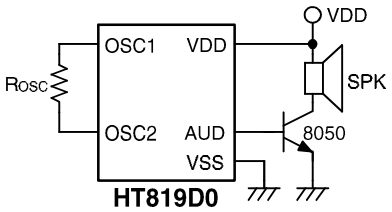
  The FLAG1 pin outputs an active low pulse when the voice output is completed. The pulse width can be programmed depending on the customer's requirements.



The FLAG1 as well as FLAG2 pins are both floating when the chip is in the standby state.

Volume control

The function of volume control can be set by mask option. A code is written in the function table for the sake of controlling the volume of each section output after the volume control function is chosen. There are two volume options, namely full range and half range.



AUD

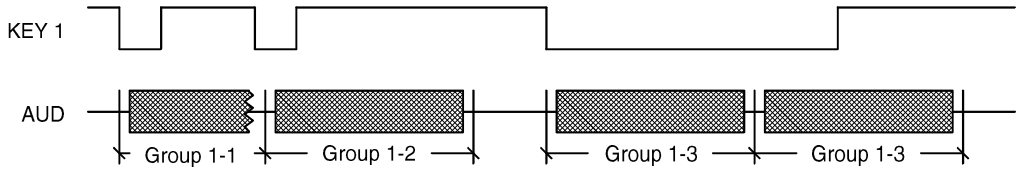
The AUD pin is a PMOS open drain structure. It outputs voice signals to drive a speaker through an external NPN transistor when the chip is active. However, the AUD pin becomes floating when the chip is in the standby state.

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

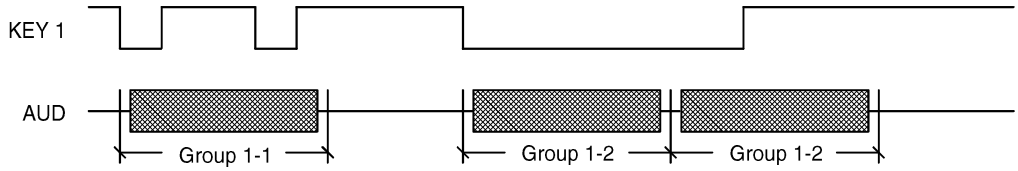
Timing Diagram

One key operation

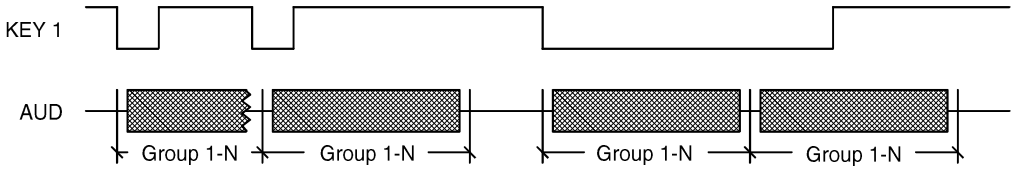
- Sequential-retriggerable



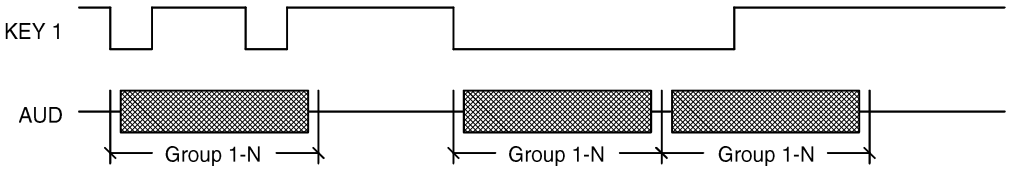
- Sequential-nonretriggerable



- Random-retriggerable



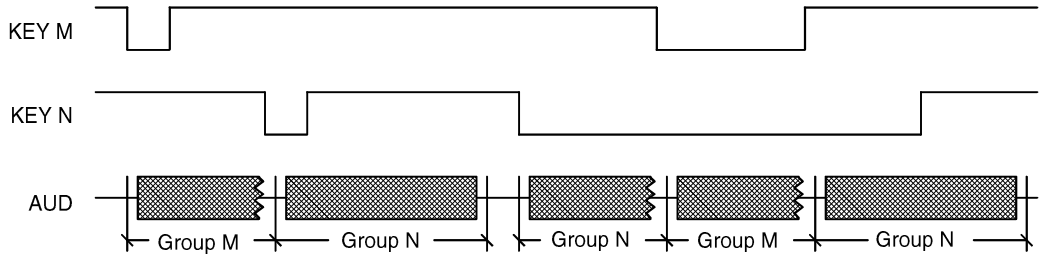
• Random-nonretriggerable



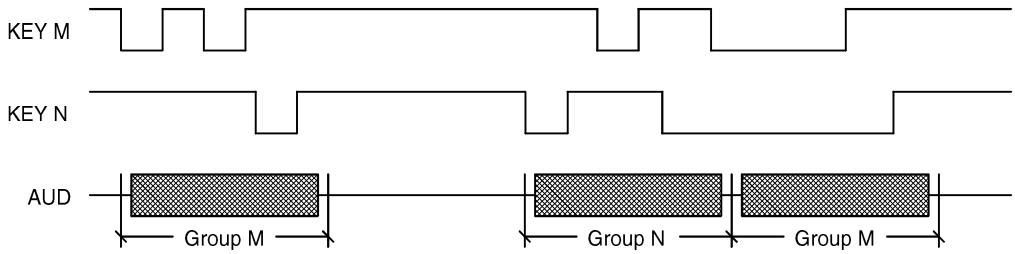
Note: Group 1-N may be any one of the KEY1's groups.

Multi-key operation

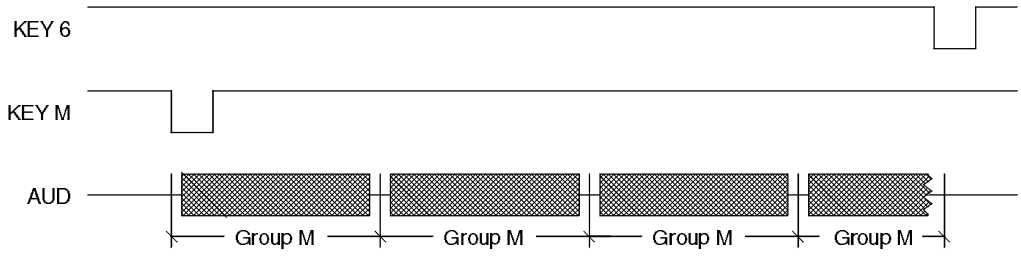
• Retriggerable



• Non-retriggerable



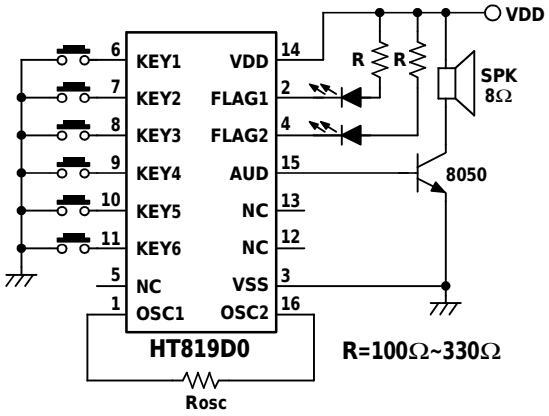
• Repeat



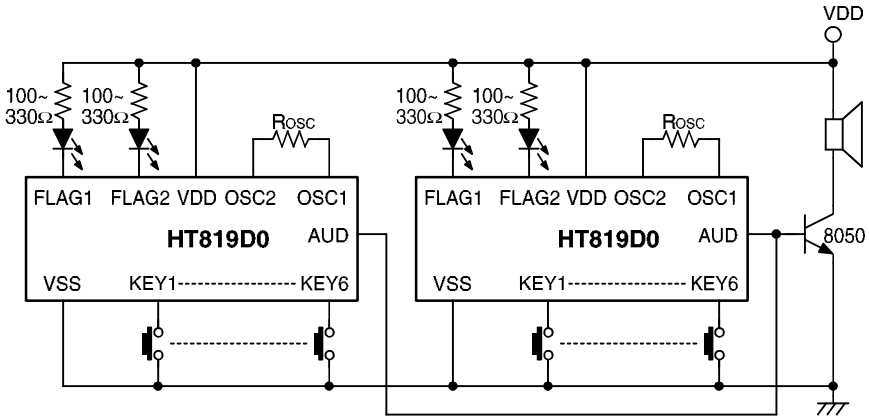
Note: M, N=1:6

Application Notes

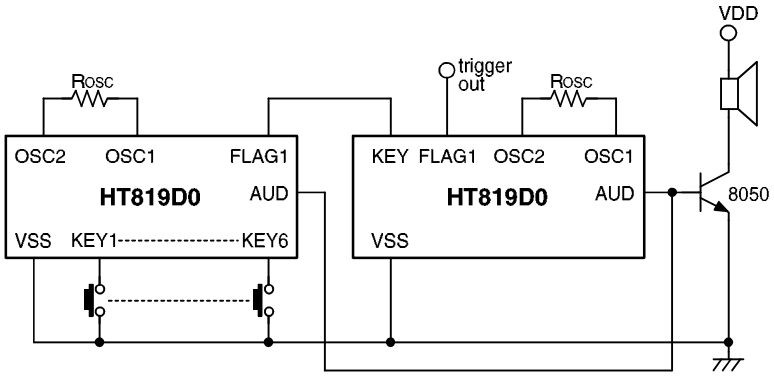
Normal application



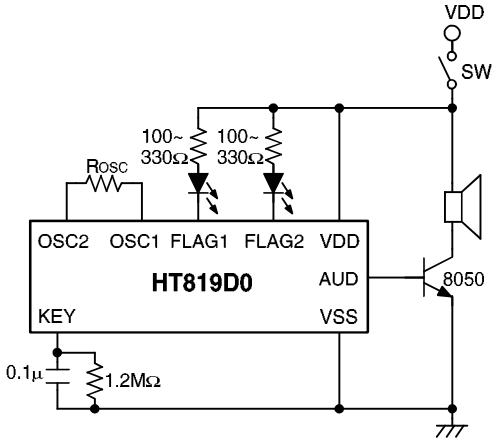
Parallel application



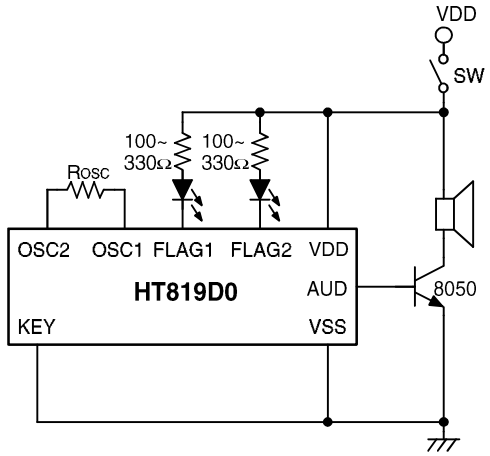
Cascade or external driving



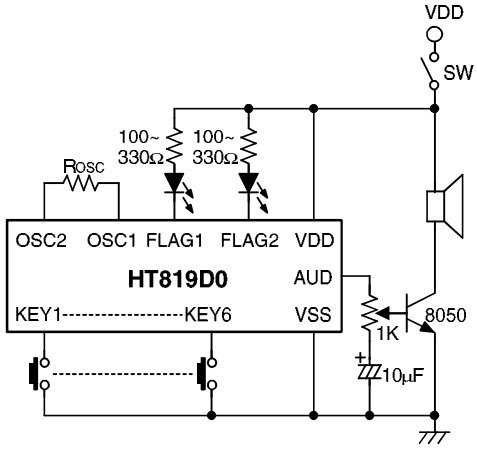
Power-on play (one shot)



Power-on play (continuously)

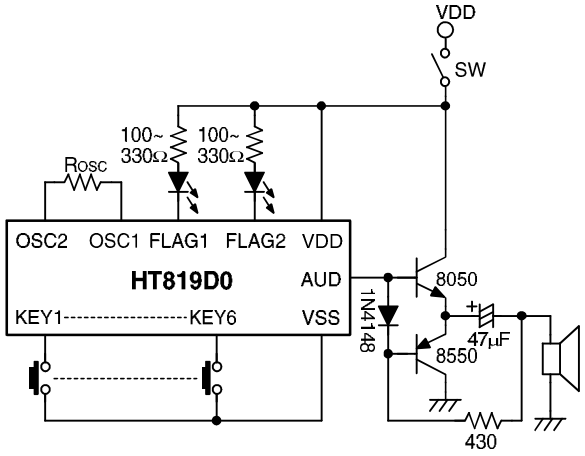


With volume adjusting

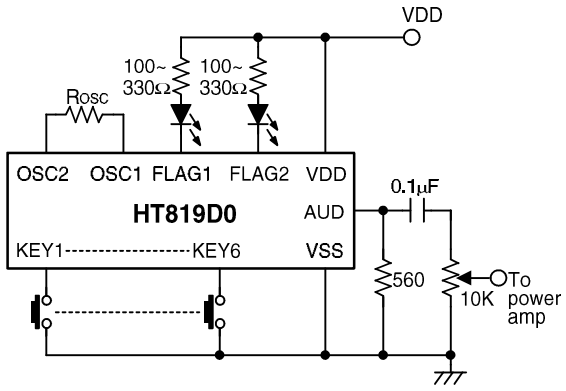


Push-pull output

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



Standard Item List

Item	Name	ROSC	Remarks
HT819D1	ANIMAL VOICE	460KΩ	