Features

- Operating voltage: 2.4V~5.0V
- Low stand-by current (1μA Typ.)
- Voice/sound effect/simple melody output
- 2.8 seconds of voice capacity (Based on F_{SR}=6KHz)
- 64 tone sections
- 16 words for each tone section
- Current type D/A output
- Mask options
  - Voice sampling rate: 3K/4K/6K/8KHz (F_{OSC}=384KHz)
  - Pull-high resistor: 20K/50K/100K/200K
  - KEY1: Direct or sequential/random key
  - Trigger mode: Retriggerable/Non-retrig-
    gerable
  - Key debounce time: 0μs/22ms/45ms/180ms
  - Trigger function: Level hold/one shot/level trigger
  - FLAG1, FLAG2 outputs: 3Hz/sound level/busy
  - Volume output: Full, 3/4, 2/4, 1.5/4
  - Melody/tone decay time: 2 secs/1 sec/0.5 sec/0.25 sec
  - 4 kinds of envelope shapes for melody
- Tone shape: tone+2KHz/noise/tone/silence
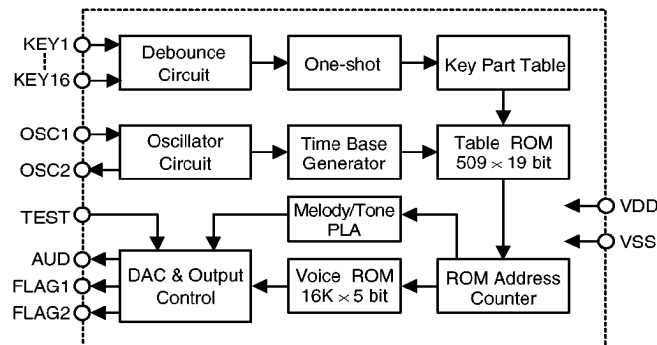- Tempo: 16ms/section~1 sec/section
- 9~16 keys

Applications

- Toys
- Alarm clocks
- Public address system
- Alert & warning system
- Sound effect generators
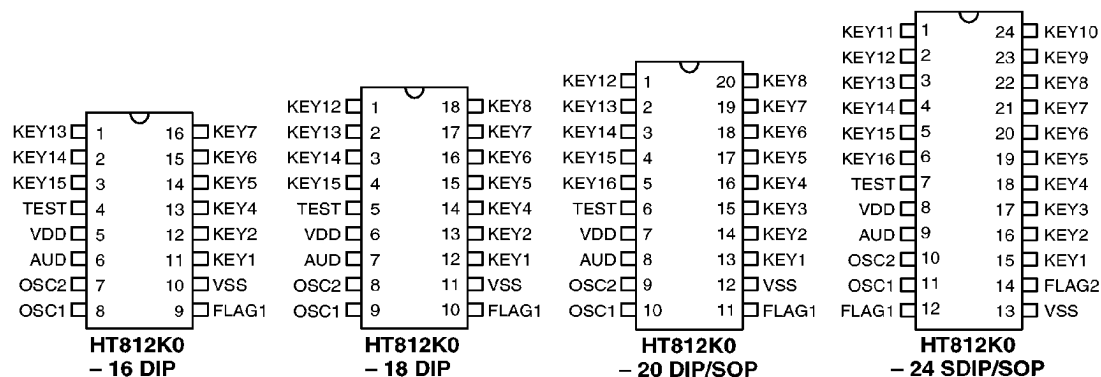- Products with a voice interface

General Description

The HT812K0 is a single chip PCM voice and sound effect synthesizer. It provides 2.8 seconds of voice capacity at a 6KHz sampling rate (F_{SR}=6KHz) and 64 sections of sound effect/simple melody. A maximum of 16 keys are available. Of the 16 keys, KEY1 can be optioned as a direct or sequential/random key so that it can play an interlaced voice/sound effect/simple melody and generate various special sound effects for toys and sound effect generator applications.
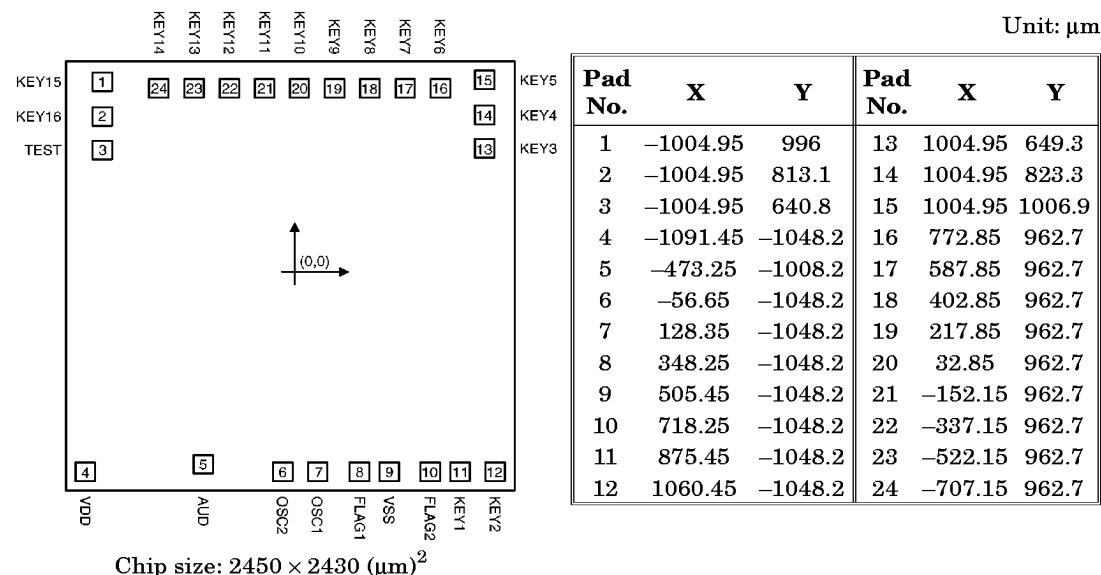
Block Diagram

Pin Assignment

HT812K0 – 16 DIP

HT812K0 – 18 DIP

HT812K0 – 20 DIP/SOP

HT812K0 – 24 SDIP/SOP

Pad Coordinates

Unit: μm

Pad No.	X	Y	Pad No.	X	Y
1	−1004.95	996	13	1004.95	649.3
2	−1004.95	813.1	14	1004.95	823.3
3	−1004.95	640.8	15	1004.95	1006.9
4	−1091.45	−1048.2	16	772.85	962.7
5	−473.25	−1008.2	17	587.85	962.7
6	−56.65	−1048.2	18	402.85	962.7
7	128.35	−1048.2	19	217.85	962.7
8	348.25	−1048.2	20	32.85	962.7
9	505.45	−1048.2	21	−152.15	962.7
10	718.25	−1048.2	22	−337.15	962.7
11	875.45	−1048.2	23	−522.15	962.7
12	1060.45	−1048.2	24	−707.15	962.7

Chip size: $2450 \times 2430 \ (\mu m)^2$

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

Pad Description

Pad No.	Pad Name	I/O	Internal Connection	Description
1,2	KEY15,KEY16	I	Pull-High	Trigger key, low active
3	TEST	I	Pull-High	For IC test only

20th Dec '95

Pad No.	Pad Name	I/O	Internal Connection	Description
4	VDD	I	—	Positive power supply
5	AUD	O	PMOS Open Drain	Voice/tone output driving an external transistor
6	OSC2	O	—	Oscillator output pin
7	OSC1	I	—	Oscillator input pin
8	FLAG1	O	NMOS Open Drain	End-pulse/3Hz flash/busy output or sound level display (by mask option), active low
9	VSS	I	—	Negative power supply (GND)
10	FLAG2	O	NMOS Open Drain	End-pulse/3Hz flash/busy output or sound level display (by mask option), active low
11~24	KEY1~KEY14	I	Pull-High	Trigger key, low active. KEY1 can be optioned as a direct or sequential/random key.

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)

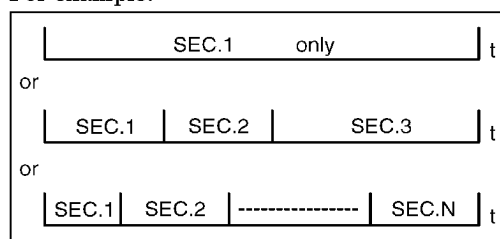| Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
		V_{DD}	Condition				
V_{DD}	Operating Voltage	—	—	2.4	—	5.0	V
I_{OP}	Operating Current	3V	No load, F_{OSC}=384KHz	—	200	400	μA
I_{STB}	Stand-by Current	3V		—	1	3	μA
I_O	Max. AUD Output Current	3V	V_{OH}=0.6V	−1.5	−2	—	mA
I_{OL}	FLAG Sink Current	3V	V_{OL}=0.3V	2	3	—	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}=51KΩ	—	384	—	KHz

20th Dec '95

Functional Description

The HT812K0 is a voice and melody synthesis LSI with 2.8-second voice capacity at 6KHz sampling rate and 64 sections of sound effects/simple melodies. The 2.8 seconds of voice capacity can be divided into sections of arbitrary length (Notice that the silence length is not included in the memory). As for the 64-section tone table, various sound effects can be generated.

The HT812K0 provides a maximum of 16 keys (KEY1~KEY16), 2 status indicator driving pins and a current type D/A output. Of the 16 keys, only KEY1 can be optioned as a sequential (random) or a direct key. The remaining 15 keys (KEY2~KEY16) are used as direct keys exclusively.

Voice section and group

• Voice section

The total synthesized voice contents (2.8 seconds) can be partitioned into desired number of sections depending on the size of ROM table. As for the length of each section, it is decided by the requirements of voice contents. For example:

```
        ┌─────────────────────────────────┐
        │         SEC.1      only          │ t
    or  └─────────────────────────────────┘

        ┌─────────┬─────────┬─────────────┐
        │  SEC.1  │  SEC.2  │    SEC.3     │ t
    or  └─────────┴─────────┴─────────────┘

        ┌─────┬───────┬────────────┬───────┐
        │SEC.1│ SEC.2 │------------│ SEC.N │ t
        └─────┴───────┴────────────┴───────┘
```

• Melody section

The HT812K0 provides 64 melody/tone sections at maximum. Each section is composed of 16 tone codes and each code stands for a period of tone output. The tone frequency envelope shape, envelope length and speed of tone (tempo) are all programmable. Therefore, a variety of sound effects and melodies can be generated.

• Group

A group can consist of one or more sections and be made up solely of voice or melody or a combination of both sounds. The same voice and melody sections can appear in different groups, as shown below:

```
┌────────────────────────────────────────┐
│ Group 1: SEC.1+SEC.2+Melody.1+SEC.5     │
│ Group 2: SEC.3+Melody.2+Melody.1        │
│ Group 3: SEC.2+SEC.1                     │
│ Group 4: SEC.2+Melody.3+SEC.4           │
│              ⋮                          │
│                                          │
│ Group 16: None                           │
└────────────────────────────────────────┘
```

The maximum amount of groups included in the HT812K0 is decided by the setting of KEY1, as described in the following.

∗ KEY1 as a direct key

When KEY1 is selected as a direct key, the maximum amount of groups included in the HT812K0 is 16. And the sum of the voice and melody sections of the 16 groups has to be less than 509. When one of the 16 keys is triggered, the sections of the corresponding group come into play in sequence.

∗ KEY1 as a sequential (or random) key

When KEY1 is set as a sequential (or random) key, the maximum amount of groups included in the HT812K0 can be defined by the user under the condition that the entire number of the voice and melody sections of the groups is less than 509. Of the 16 keys, only KEY1 can consist of more than one groups. The remaining 15 keys (KEY2~KEY16) are comprised by one group exclusively.

For example:

```
┌────────────────────────────────────────┐
│ Group 1-1: SEC.1+SEC.4                   │
│ Group 1-2: SEC.3+Melody.1                │
│              ⋮                          │
│                                          │
│ Group 1-N: SEC.2+SEC.1+Melody.1+SEC.1    │
│ Group 2: Melody.1+Melody.3+SEC.1         │
│ Group 3: SEC.2+SEC.3                      │
│              ⋮                          │
│                                          │
│ Group 16: SEC.1+Melody.2+Melody.3        │
└────────────────────────────────────────┘
```

4   20th Dec '95

Each time KEY1 is triggered, the according group comes into play in sequence. When the last group is finished the KEY1 group sequence will be recycled by successive trigger inputs.

Key operation functions

KEY1~KEY16 all function as trigger keys. The HT812K0 provides three trigger functions, namely "one shot", "level hold" and "level trigger", for the 16 keys by mask option. All of the three trigger functions have an option of being retriggerable or non-retriggerable.
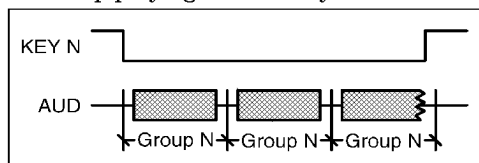
- Trigger function
  - * One shot
    When one of the 16 keys (KEY1~KEY16) is pressed and held down, the group corresponding to that held key will play once. The according group will also play once when one of the 16 keys is pressed momentarily.
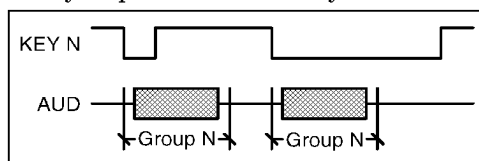
  - * Level hold
    When one of the 16 keys is triggered, the group corresponding to the triggered key will keep playing till that key is released.

  - * Level trigger
    When one of the 16 keys is pressed and held down, the according group will keep playing. Once the pressed key is released, the group will not stop till the included sections are all completed.
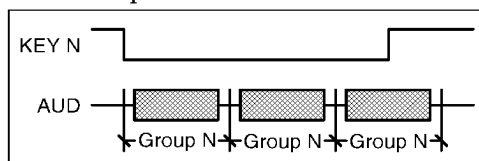
- Trigger mode
  - * Retriggerable
    When a group is playing by a momentary key trigger, any further key input can terminate the currently play group and start playing the group corresponding to the newly triggered key. However, if a group of KEY1~KEY16 is playing but the key corresponding to the playing group is still held down, whether or not the currently playing group will be forcefully stopped depends on the key priority, namely KEY1>KEY2> KEY3>KEY4...>KEY16.

  - * Non-retriggerable
    In the non-retriggerable mode, when one of the 16 keys (KEY1~KEY16) is pressed, the corresponding group will not start playing till the currently playing group is completed.

AUD output

The AUD pin is a PMOS open drain structure. It outputs voice and tone 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 stand-by state.

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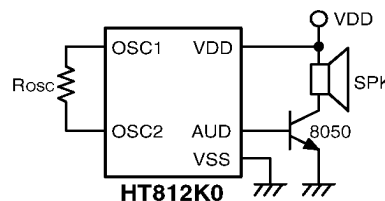
System oscillator

The HT812K0 has an RC oscillator which requires only one external resistor for normal applications. The oscillator frequency is typically 384KHz for an external resistor of 51KΩ.
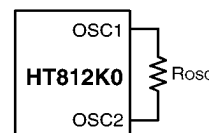
The oscillator is turned on when triggered by a key input. After playing, the oscillator is turned off and the chip goes into the stand-by state.

5   20th Dec '95

Mask options

The HT812K0 provides the following mask options for different applications. Before manufacture, all of the options must be defined to enable a proper system operation.

- Mask options for keys:
  * Keys debounce time: 0µs/22ms/45ms/180ms
  * Pull high resistor: 20K/50K/100K/200K
  * Trigger function: Level hold/One shot/Level trigger
  * Trigger mode: Retriggerable/Non-retriggerable

- FLAG1, FLAG2 outputs: 3Hz/sound level/busy
  * 3Hz flash

    When voices are playing, the FLAG LED flashes with a 3Hz rate. The LED turned on duty is 25%.

    In the stand-by state, the FLAG pin is floating.
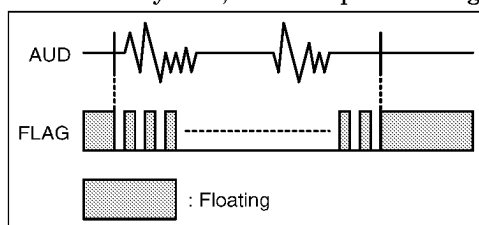
  * Busy output

    When voices are playing, the FLAG pin is turned low and the FLAG LED is switched on. Once the voice output is terminated, FLAG becomes floating and the FLAG LED is switched off.
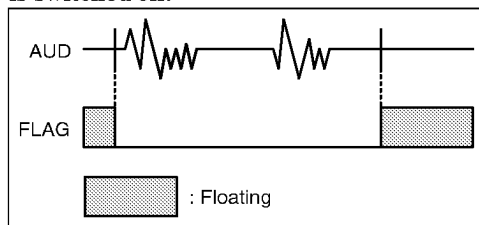
  * Sound level display

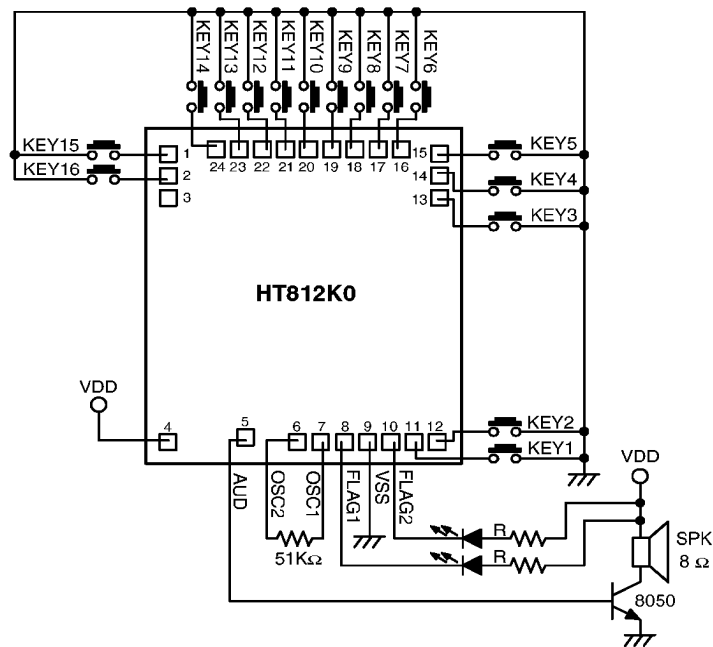   The brightness of the LED will vary with the volume in the voice output state.
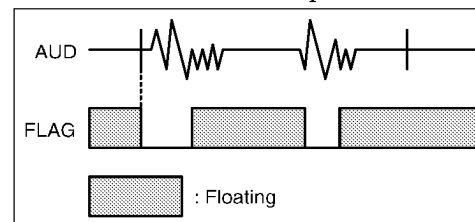
Programmable items

- Voice section
- Voice sampling rate: 3K, 4K, 6K, 8KHz (F_{OSC}=384KHz)
- Volume output: Full, 3/4, 2/4, 1.5/4
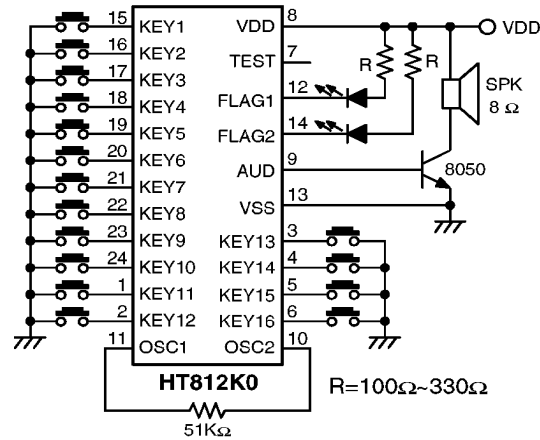- Tempo
- Decay time and envelope shape

  There are four programmable envelope shapes and decay time to smooth out tone and melody sounds.

  * Decay time: 2 secs, 1 sec, 0.5 sec, 0.25 sec
  * Tone shape: tone+2KHz, noise, tone, silence
  * Envelope shapes:
    (1) No envelope
    (2) ⌎
    (3) ⟍
    (4) ⌒

Application Circuit

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

20th Dec '95

Standard Item List

Item	Name
HT812K1	TEL. Voice+Tone (Chinese)

20th Dec '95