HT813K0
5.6 Second Tone Voice

Features

- Operating voltage: 2.4V~5.0V
- Low standby current (1μA Typ.)
- Voice/sound effect/simple melody output
- 5.6-second voice capacity (based on a 6kHz sampling rate)
- 64 tone sections
- 16 words for each tone section
- Current type D/A output
- Mask options
  - Voice sampling rate: 3kHz/4kHz/6kHz/8kHz (f_{OSC}=384kHz)
  - KEY1: Direct or sequential/random key
  - Trigger mode: Retriggerable/Non-retriggerable
  - Pull-high resistor: 20kΩ/50kΩ/100kΩ/200kΩ

- Key debounce time: 0μs/22ms/45ms/180ms
- Trigger function: Level hold/one shot/level trigger
- FLAG1, FLAG2 outputs: 3Hz/soundlevel/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
- Four kinds of envelope shapes for melody
- Tone shape: tone+2kHz/noise/tone/silence
- Tempo: 16ms/section~1sec/section
- 9~16 keys
- Dice form or 16-pin/18-pin/20-pin/24-pin DIP, 20-pin/24-pin SOP

Applications

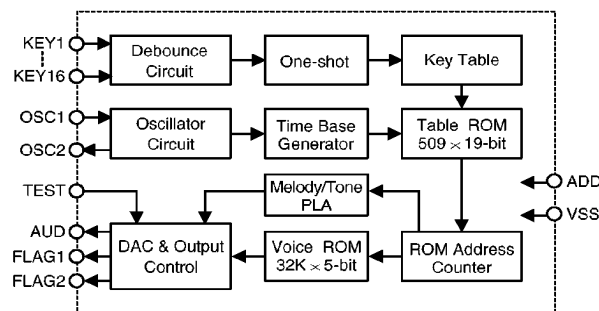- Toys
- Alarm clocks
- Public address system
- Alert & warning system
- Sound effect generators
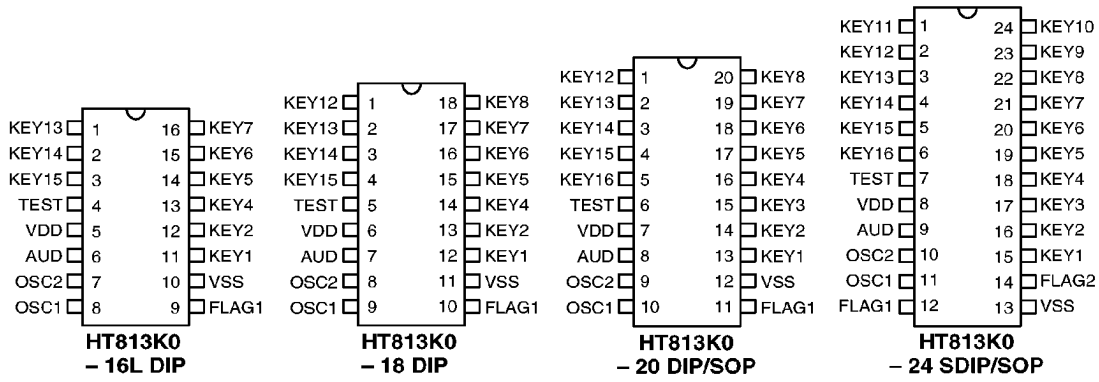- Voice interface products

General Description

The HT813K0 is a single chip PCM voice and sound effect synthesizer. It provides 5.6 seconds of voice capacity at a 6kHz sampling rate (F_{SR}=6kHz) and 64 sections of sound effects/simple melodies. 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.
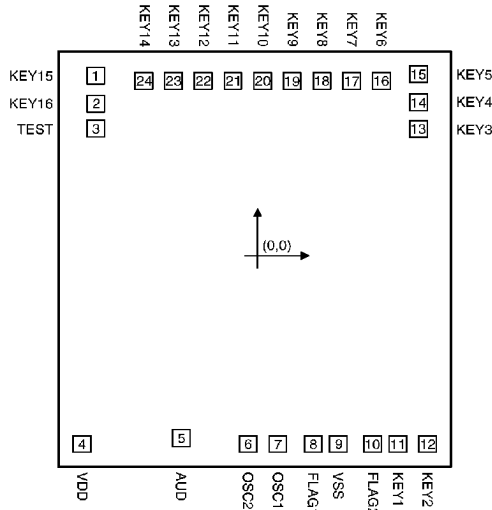
Block Diagram

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Pin Assignment

HT813K0
– 16L DIP

KEY13	1	16	KEY7
KEY14	2	15	KEY6
KEY15	3	14	KEY5
TEST	4	13	KEY4
VDD	5	12	KEY2
AUD	6	11	KEY1
OSC2	7	10	VSS
OSC1	8	9	FLAG1

HT813K0
– 18 DIP

KEY12	1	18	KEY8
KEY13	2	17	KEY7
KEY14	3	16	KEY6
KEY15	4	15	KEY5
TEST	5	14	KEY4
VDD	6	13	KEY2
AUD	7	12	KEY1
OSC2	8	11	VSS
OSC1	9	10	FLAG1

HT813K0
– 20 DIP/SOP

KEY12	1	20	KEY8
KEY13	2	19	KEY7
KEY14	3	18	KEY6
KEY15	4	17	KEY5
KEY16	5	16	KEY4
TEST	6	15	KEY3
VDD	7	14	KEY2
AUD	8	13	KEY1
OSC2	9	12	VSS
OSC1	10	11	FLAG1

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– 24 SDIP/SOP

KEY11	1	24	KEY10
KEY12	2	23	KEY9
KEY13	3	22	KEY8
KEY14	4	21	KEY7
KEY15	5	20	KEY6
KEY16	6	19	KEY5
TEST	7	18	KEY4
VDD	8	17	KEY3
AUD	9	16	KEY2
OSC2	10	15	KEY1
OSC1	11	14	FLAG2
FLAG1	12	13	VSS

Pad Coordinates

Unit: µm

Chip size: 2460×2790 (µm)^2

Pad No.	X	Y	Pad No.	X	Y
1	−1004.95	1172.35	13	1004.95	825.65
2	−1004.95	989.45	14	1004.95	999.65
3	−1004.95	828.45	15	1004.95	1183.25
4	−1091.45	−1224.55	16	772.85	1139.05
5	−473.25	−1184.55	17	587.85	1139.05
6	−56.65	−1224.55	18	402.85	1139.05
7	128.35	−1224.55	19	217.85	1139.05
8	348.25	−1224.55	20	32.85	1139.05
9	505.45	−1224.55	21	−152.15	1139.05
10	718.25	−1224.05	22	−337.15	1139.05
11	875.45	−1224.55	23	−522.15	1139.05
12	1060.45	−1224.55	24	−707.15	1139.05

* 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

Pad No.	Pad Name	I/O	Internal Connection	Description
4	VDD	I	—	Positive power supply
5	AUD	O	PMOS Open Drain	Voice/tone output for 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 selected 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

*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_{OP}	Operating Current	3V	No load, f_{OSC}=384kHz	—	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	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}	Oscillating Frequency	3V	R_{OSC}=51kΩ	—	384	—	kHz

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Functional Description

The HT813K0 is a voice and melody synthesizer LSI with 5.6-second voice capacity at 6kHz sampling rate and 64 sections of sound effects/simple melodies. The 5.6 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 HT813K0 provides a maximum of 16 keys (KEY1~KEY16), 2 status indicator driving pins and a current type D/A output. Of these 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 (5.6 seconds) can be partitioned into the desired number of sections depending on the size of the ROM table. The length of each section is determined by the requirements of the voice contents. For example:
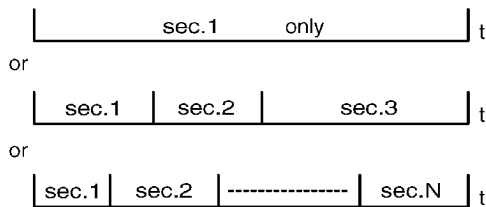
* Melody section

The HT813K0 provides a maximum of 64 melodies/tone sections. 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 total amount of groups included in the HT813K0 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 HT813K0 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 is played in sequence.

* KEY1 as a sequential or random key
  When KEY1 is selected as a sequential or random key, the total amount of the groups included can be defined by the user under the condition that the total number of the voice and melody sections of the groups is less than 509. Of the 16 keys, only KEY1 can be made up of more than one group. The remaining 15 keys (KEY2~KEY16) can include 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

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Each time KEY1 is triggered, the corresponding group is played in sequence. When the last group is finished the KEY1 group sequence will be repeated by successive trigger inputs.

Key operation functions

KEY1~KEY16 all function as trigger keys. By mask option, the HT813K0 provides three trigger functions for the 16 keys, namely, "one shot", "level hold" and "level trigger". All of the three trigger functions can be optioned as retriggerable or non-retriggerable.
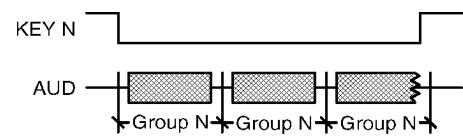
• Trigger function
  • One shot
    When one of the 16 keys (KEY1~KEY16) is triggered and held down or pressed momentarily, the group corresponding to that key will play once.

```
KEY N ___|‾|_____|‾|_____
AUD   ___[▨▨▨]___[▨▨▨]____
         |←Group N→|  |←Group N→|
```
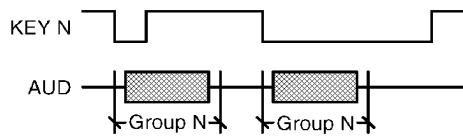
  • Level hold
    When one of the 16 keys is triggered, the group corresponding to the triggered key will keep playing till that key is released.

```
KEY N ___|‾‾‾‾‾‾‾‾‾‾‾‾‾|____
AUD   ___[▨▨▨][▨▨▨][▨▨≷____
         |←Group N→|Group N→|Group N→|
```

  • Level trigger
    When one of the 16 keys is triggered 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.

```
KEY N ___|‾‾‾‾‾‾|_____
AUD   ___[▨▨▨][▨▨▨][▨▨▨]__
         |←Group N→|Group N→|Group N→|
```
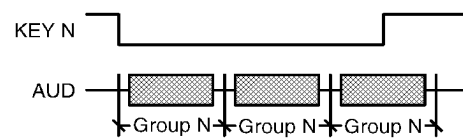
• Trigger mode
  • Retriggerable
    When a group is played by a momentary key trigger, any further key input can terminate the currently playing group and start playing the group corresponding to the newly triggered key. However, if a group of KEY1~KEY16 is playing but the key corresponding to the playing group is still held down, whether the currently playing group will be forcefully stopped or not 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

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 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.
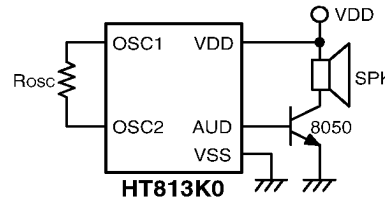
System oscillator

The HT813K0 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.

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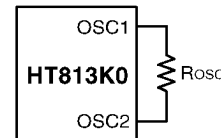
The oscillator is turned on when triggered by a key input. After playing, the oscillator is turned off and the chip goes into the standby state.

Mask options

The HT813K0 provides the following mask options for different applications. Before manufacturing, all of the options have to be defined to enable a proper system of operation.

- Mask options for keys:
  - Key debounce time: 0μs/22ms/45ms/180ms
  - Pull-high resistor: 20kΩ/50kΩ/100kΩ/200kΩ
  - 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%.

    The FLAG pin becomes a floating output in the standby state.
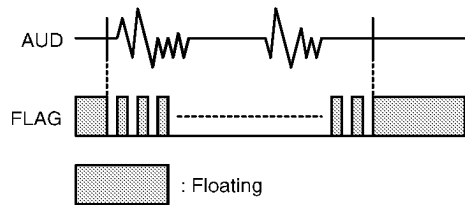
: Floating

- 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, the FLAG becomes a floating output and the FLAG LED is switched off.

: Floating
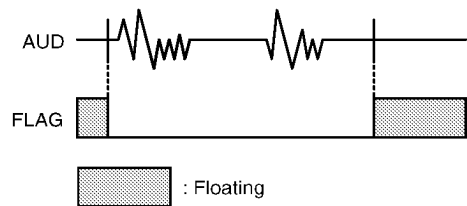
- Sound level display

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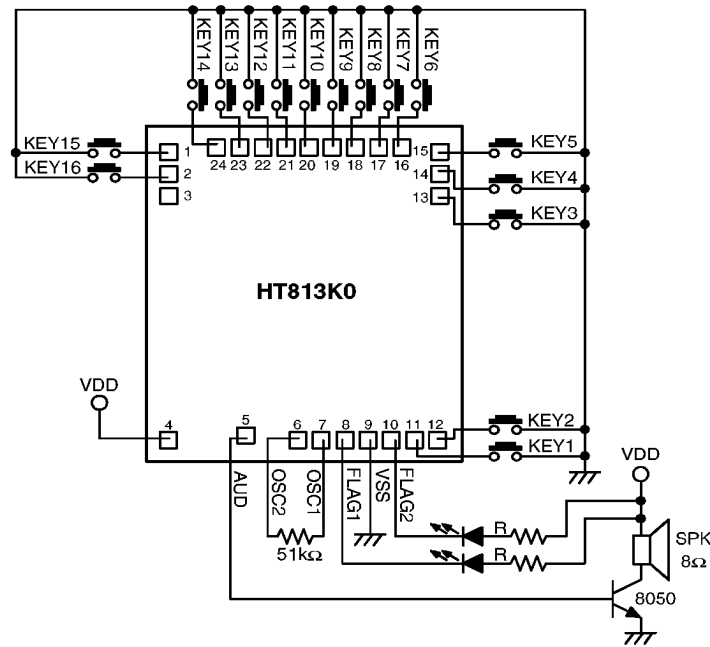

: Floating
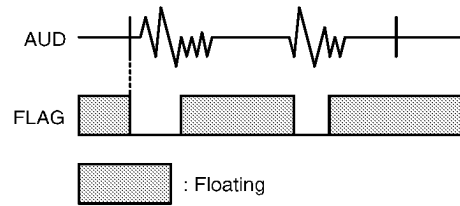
Programmable items

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

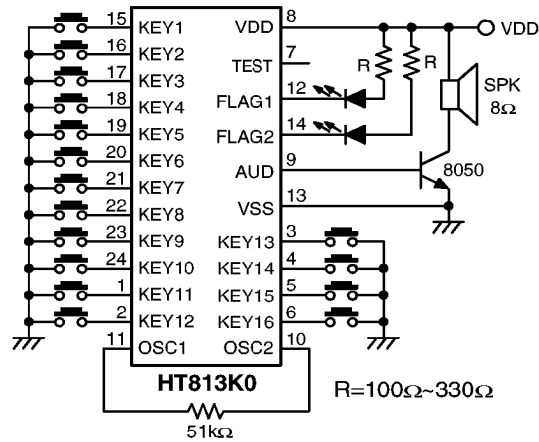 There are four programmable envelope shapes and decay time to smooth out tone and melody sounds.

  - 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.

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Standard Item List

Item	Name
HT813K1	Mobile phone toy

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