HT81003
EasyVoice™ 3-Second Speech

Features

- Operating voltage: 2.4V~5V
- Directly drives an external transistor
- PWM function directly driver speaker
- Low standby current (1μA typ. for V_{DD}=3V)
- Minimal external components
- 240 notes table ROM for key functions
- Programmable silence length and end-pulse width (minimal end-pulse width is 1.3ms at 8kHz sampling rate)
- 3-sec voice capacity (based on a 5kHz sampling rate)
- Controllable volume
- FLAG1 options
  - End-pulse output
  - 3Hz, 3HzB flash
  - 6Hz, 6HzB flash
  - Busy output
  - OFF
- FLAG2 options
  - 3Hz flash
  - 6Hz flash
  - Busy output
  - OFF
- 2 keys
- Key options
  - Sequential/Directed
  - Repeat (KEY2)
  - STOP key (KEY2)
  - Key debounce time: 1.2ms, 22ms, 45ms (based on a 8kHz sampling rate)
  - One shot/Normal
  - Pull-high resistance: 0, 50kΩ, 100kΩ, 200kΩ
- Section options
  - Retriggerable
  - Non-retriggerable
- Dice form or 16-pin DIP package

Applications

- Leisure products
- Alarm clocks
- Public address system
- Alert and warning system
- Sound effect generators

General Description

The HT81003 is a Mask ROM type. The HT81003 is a single-chip voice synthesizer LSI with 3-second voice capacity at 5kHz sampling rate. The chip when triggered drives a speaker through an external transistor with a PWM output. Negligible current is consumed in the standby state.

The HT81003 provides 2-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. The key features are also programmable. With such a flexible structure, the HT81003 is excellent for versatile voice applications.

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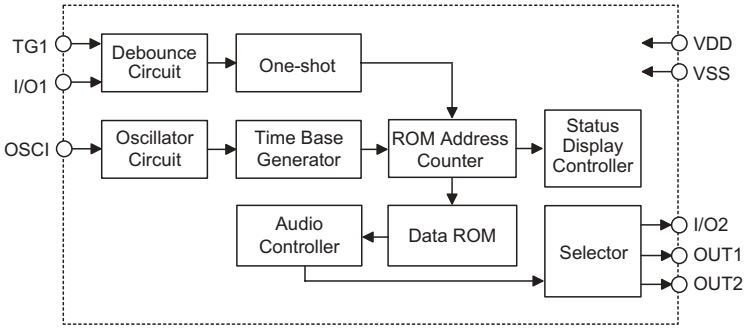
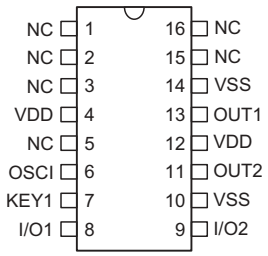
Block Diagram

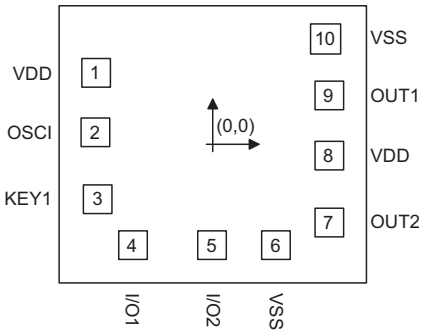


Pin Assignment



HT81003
–16 DIP-A

Pad Assignment



Chip size: 42.3×46.7 (mil)^2

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

Unit: μm

Pad Coordinates

Pad No.	X	Y	Pad No.	X	Y
1	–387.35	20.06	6	214.30	–340.60
2	–391.70	–200.11	7	383.00	–77.60
3	–202.25	–377.40	8	379.05	–347.50
4	–67.25	–377.40	9	383.00	192.30
5	68.25	–377.40	10	397.50	457.50

Pin Description

Pin No.	Pin Name	I/O	Internal Connection	Description
1, 2, 3, 5, 15, 16	NC	—	—	No connection
4, 12	VDD	—	—	Positive power supply
6	OSCI	I	Oscillator Input Pin	Oscillator input pin
7	KEY1	I	Pull-high	Trigger key 1, active low
8	I/O1	I	NMOS Pull-high	Trigger key 2, active low/NMOS output
9	I/O2	I/O	Pull-high Input/NMOS	Pull-high/transistor output/NMOS output
10, 14	VSS	—	—	Negative power supply, ground
11	OUT2	O	CMOS	PWM output +/NMOS output
13	OUT1	O	CMOS	PWM output –/NMOS output

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	3V	—	2.4	3	5	V
I_{DD}	Operating Current	3V	No load	—	1000	1200	μA
I_{STB}	Standby Current	3V	OSC stop	—	1	3	μA
I_{OL1}	PWM Output Current	3V	V_{OL}=0.2V_{DD}	90	110	—	mA
I_{OH1}		3V	V_{OH}=0.8V_{DD}	–10	–20	—	
I_{OL2}	I/O2 (TR)	3V	V_{OL}=0.1V_{DD}	1	3	—	mA
I_{OH2}	Tr Output Current	3V	V_{OH}=0.9V_{DD}	–1	–2	—	mA
I_{OL3}	I/O1 (FLAG Sink Current)	3V	V_{OL}=0.1V_{DD}	3	5	—	mA
V_{IH}	"H" Input Voltage	—	—	0.8V_{DD}	—	V_{DD}	V
V_{IL}	"L" Input Voltage	—	—	0	—	0.2V_{DD}	V
R_{PH}	Input Pull-high Resistor	3V	R=50kΩ (option)	40	50	60	kΩ
			R=100kΩ (option)	80	100	120	
			R=200kΩ (option)	160	200	240	

Functional Description

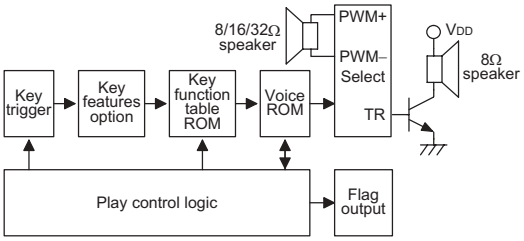
The EasyVoice™ is voice synthesizer with 3-second voice capacity. A group of pre-recorded voice sections is played upon receipt of key trigger input signals. Two FLAG signals are output while playing voices.

The 3-sec 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, as well as key features and FLAG output are all programmable before device fabrication.

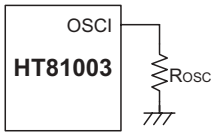
The IC provides 2 key inputs (KEY1~KEY2), KEY1 can be optioned as a direct, sequential trigger key. Key 2 can be selected as a stop or a direct key.

Play function block diagram



System oscillator

The EasyVoice™ has a built-in RC oscillator which requires only one external resistor for normal applications. The oscillator frequency is typically 2MHz for an external resistor of 150kΩ. 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 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 standby state.

Voice ROM

The voice ROM is originally designed to continuously record the 3-sec voice data at about 5kHz sampling rate. A higher sampling rate will generate voices of better 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 the voice quality.

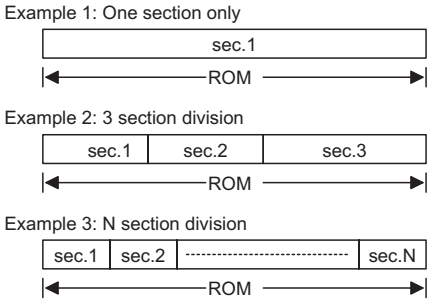
The playback time can be significantly extended by making use of coding efficiency, silence playing, section repeating, section cascade, etc.

Section

Section is the basic element constituting the contents of the voice ROM. During programming, the customer's voice sources can be divided into as many sections as required. A section can be composed of 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 256 due to the space limitation of the function table ROM. The total length of the included sections is limited by the 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 selected as non-retriggerable, it will go on playing until the whole section is completed, whether or not there is a key input in the process of 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 key can be triggered to interrupt its playing. If it is a non-retriggerable section playing, any key interrupt is invalid.

Group

The EasyVoice™ 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. 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 key. Otherwise, each key is composed by one group only.

Key function table

The voice ROM sections are played according to the instructions of the key function table. The function table contains group information and the playing order of the sections in the groups. Notice that the total amount of sections included in the groups should be less than 256 which is 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. The following is an example of the function table:

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

  As illustrated in the table, voice ROM is composed of 4 sections, and 5 sections for the function table. If KEY1 is momentarily triggered, section 1, section 2, section 3 and section 4 are played in sequence and then stopped. Triggering KEY2 plays section 3.

- KEY1 as a sequential key
  When KEY1 is optioned as a sequential key, it can include multiple groups (sub-groups) in the function table. However, KEY2 is used as a direct key exclusively and comprise of 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

  As indicated in the above table, KEY1 can be made up of sub-groups. The corresponding sub-groups is played 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 .....
  - Reset of KEY1 playing sequence
    If a sub-group of KEY1 group is being played and KEY2 is triggered, the playing sub-group will be terminated, and the newly triggered key group is played in stead. 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 ways:
    - sequential
    - retriggerable
    - minimum key debounce time (≅1.2ms, f_{OSC}=2MHz)

    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 a selection of KEY1 sub-groups more easy, 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).

- KEY2 as a stop key (by mask option)
  When KEY2 functions as a stop key, any voice output can be stopped by pressing KEY2.

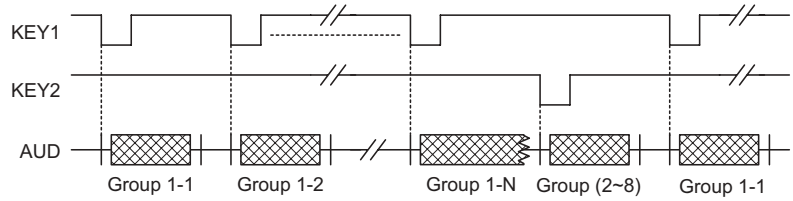


Figure 1. Reset of KEY1 playing sequence

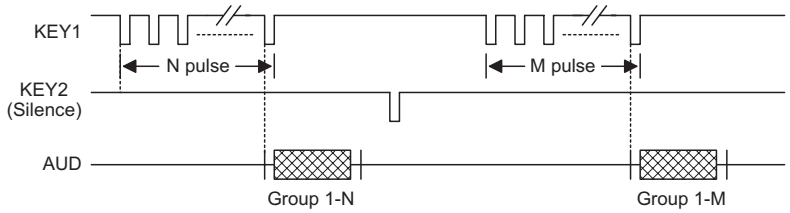
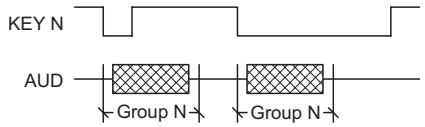


Figure 2. KEY1 sub-group selection

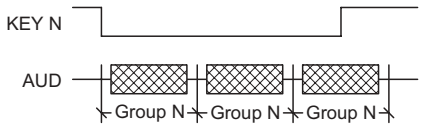
- KEY2 as a repeat key
  As a repeat key, the sections included can be played sequentially and repeatedly until other key input is triggered.

Key features

- Key priority
  When two keys are triggered simultaneously, the output voice is determined by the key priority as shown below:
  KEY1>KEY2
- Key debounce time
  There are three kinds of key-in debounce time to be selected by mask option, namely, 1.2ms, 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, 0kΩ, 50kΩ, 100kΩ and 200kΩ. The resistance may vary with VDD, temperatures and the chip itself due to process variations.
- Trigger mode
  The two keys can optioned as one-shot trigger mode or normal mode.
  - One shot
    When one of the two keys (KEY1, KEY2) is pressed momentarily or held down, the group corresponding to that key will play once.



  - Normal trigger
    When one of the two keys is pressed and held down, the corresponding group will continue playing. Once the pressed key is released, the group will not stop until the included sections are all completed.



FLAG

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

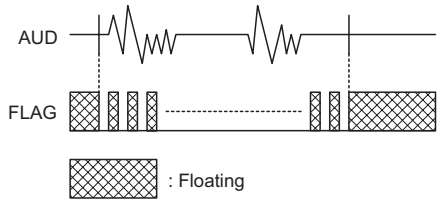
FLAG1 can be optioned as one of the following signal outputs:

OFF, 3HzB flash, Busy, 6HzB flash, 3hz, 6Hz or End-pulse output

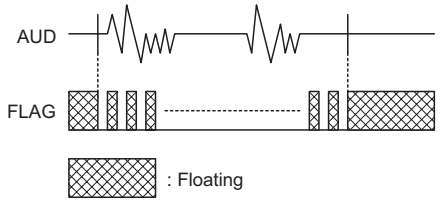
FLAG2, on the other hand, can be set as one of the following signal outputs:

OFF, 3Hz flash, 6Hz flash, or Busy output

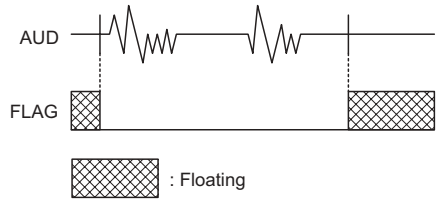
- 3Hz/3HzB flash
  When voices are playing, FLAG1 as well as FLAG2 pin outputs a 3Hz signal to drive a LED. The signal is active low, 25% duty. Once the voice output is terminated, the FLAG1 and FLAG2 pins become floating outputs. When the FLAG1 and the FLAG2 pins are optioned as 3HzB and 3Hz output,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



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

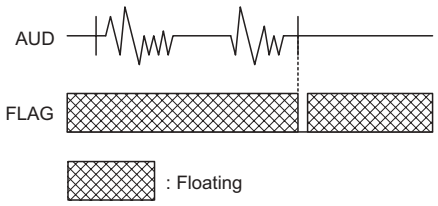


In addition to the above-stated output signals, FLAG1 can also generate one of the following signals by code option:

♦ End-pulse output

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

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



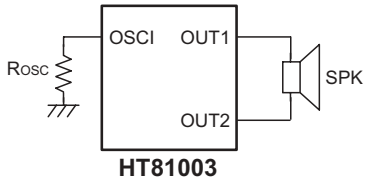
Volume control

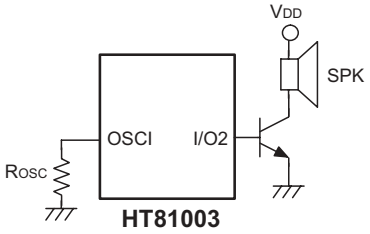
The function of the volume control can be set by mask option. A code is written in the function table for the purpose of controlling the volume of each section output after the volume control function is chosen. There are two volume options, namely; full range and half range.

I/O2

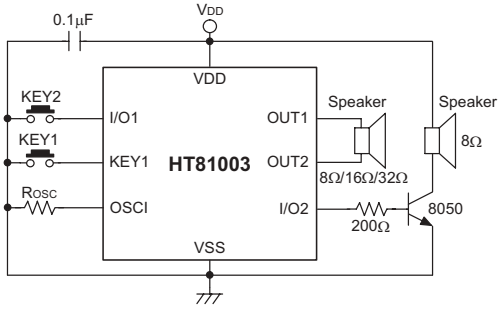
The I/O2 pin is a PWM structure. It outputs voice signals to drive a speaker through an external NPN transistor when the chip is active. The OUT1 and OUT2 pins are configured as PWM structure which can drive 8/16/32Ω speaker directly.

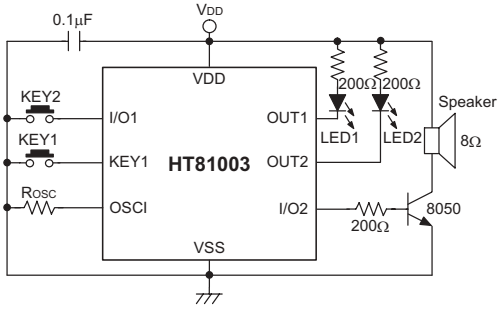
An 8050 type transistor with h_{FE}≅150 is recommended for an output driver.

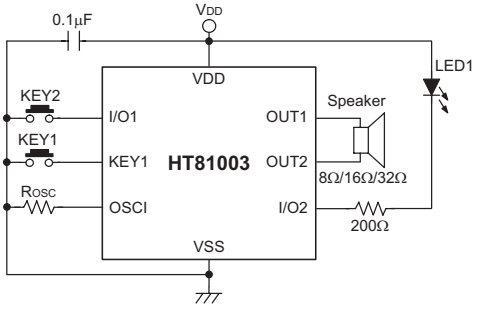


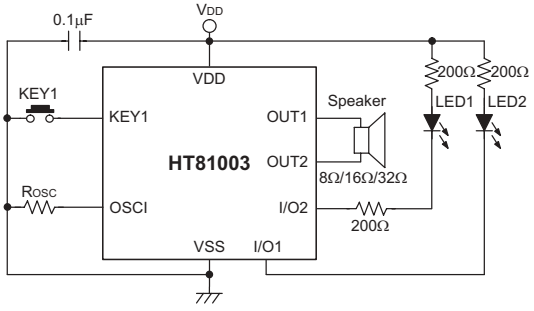


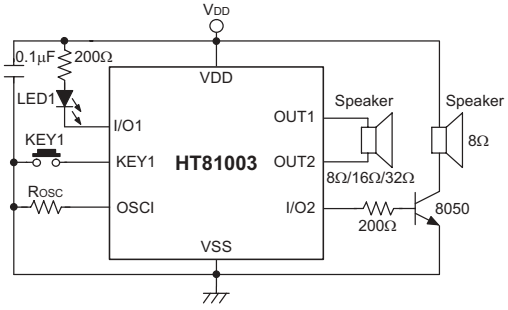
Application Circuits

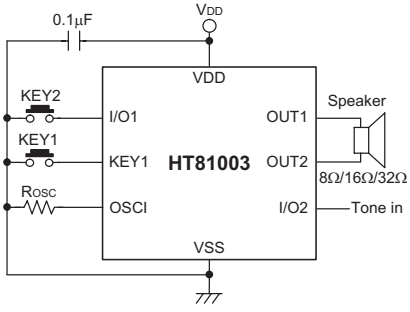












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