

## Features

- Operating voltage: 2.4V~5V
- Directly drives an external transistor
- PWM function directly driver speaker
- Low standby current (1μA typ. for V<sub>DD</sub>=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)
- 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
- 6 keys (Directed)
- 8 keys (Matrix key)
- Key options
  - Sequential/Directed
  - Repeat (KEY2~KEY6)
  - STOP key (KEY6)
  - 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
- Alert and warning system
- Sound effect generators

## General Description

The EasyVoice™ is a single-chip voice synthesizer LSI. The chip when triggered drives a speaker directly or through an external transistor with a PWM output. Negligible current is consumed in the standby state.

The HT81XXX provides direct key or Matrix key input 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.

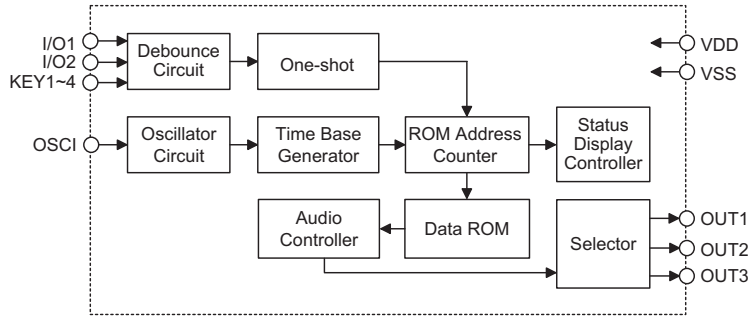
The customer's voice sources are recorded section by section into an internal mask ROM. The instructions of section playback arrangement of each key are stored in the table ROM. The key features are also programmable. With such a flexible structure, the EasyVoice™ is excellent for versatile voice applications.

## Selection Table

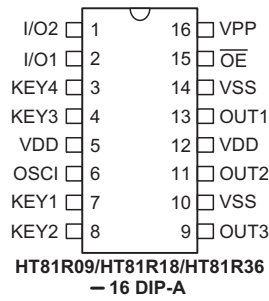
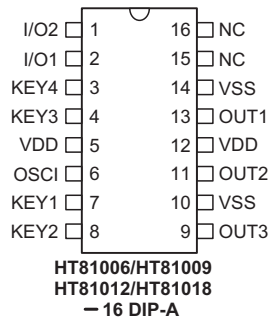
Part No.	Mask	HT81003	HT81006	HT81009	HT81012	HT81018	
	OTP	HT81R03		HT81R09		HT81R18	HT81R36
Voice Capacity		3 sec	6 sec	9 sec	12 sec	18 sec	36 sec

Note: The voice capacity is calculated based on 5kHz sampling rate.  
For 3-second capacity HT81003/HT81R03 devices, refer to the its relevant data sheet.

**Block Diagram**

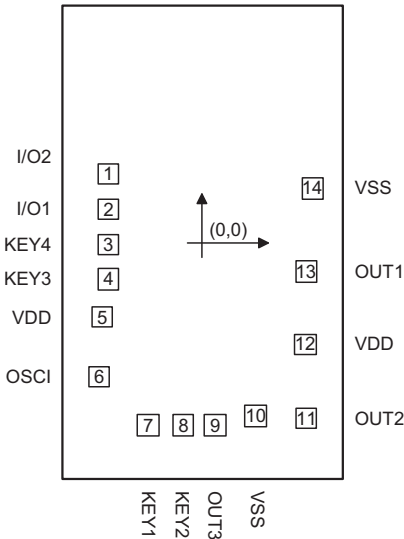


**Pin Assignment**



**Pad Assignment**

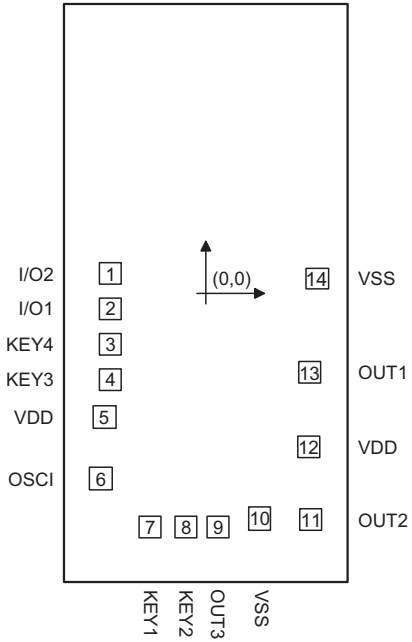
**HT81006/HT81009**



Chip size: 41.9 × 70.3 (mil)<sup>2</sup>

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

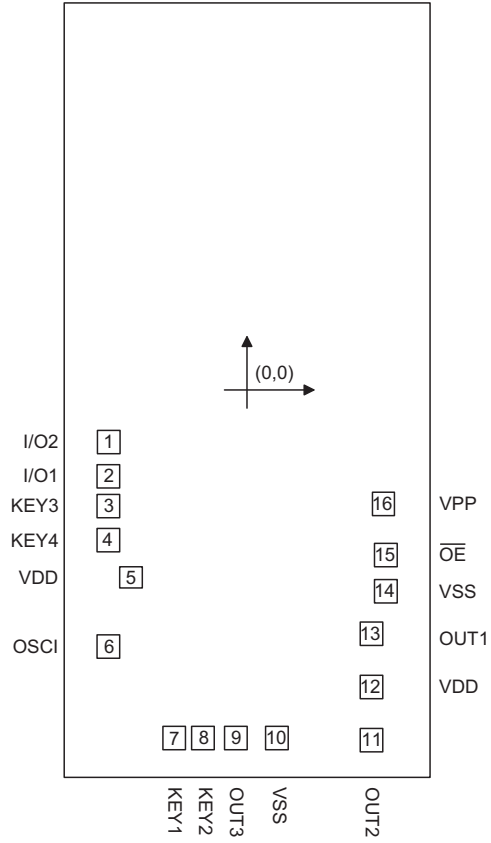
HT81012/HT81018



Chip size:  $41.9 \times 84.4 \text{ (mil)}^2$

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

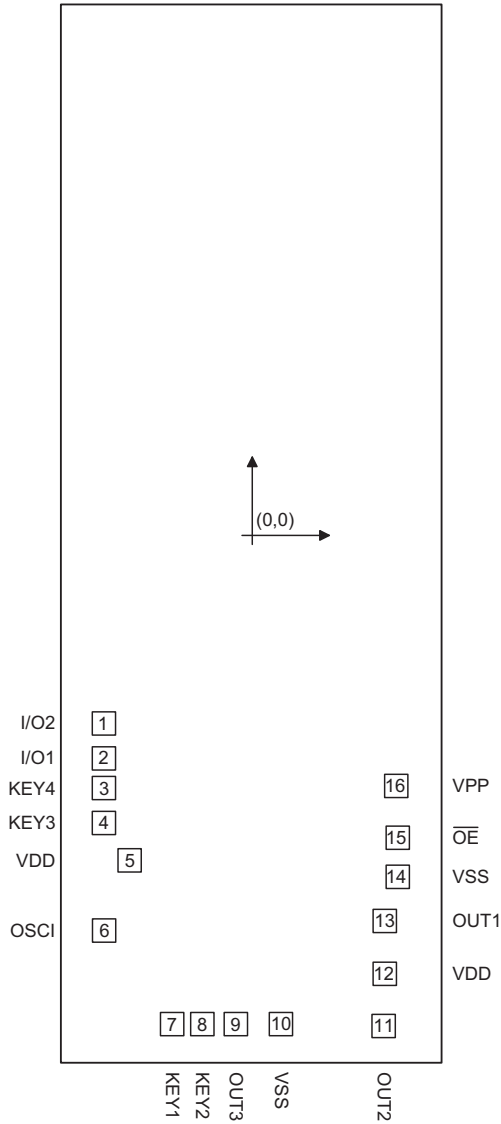
HT81R09



Chip size:  $51 \times 102.8 \text{ (mil)}^2$

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

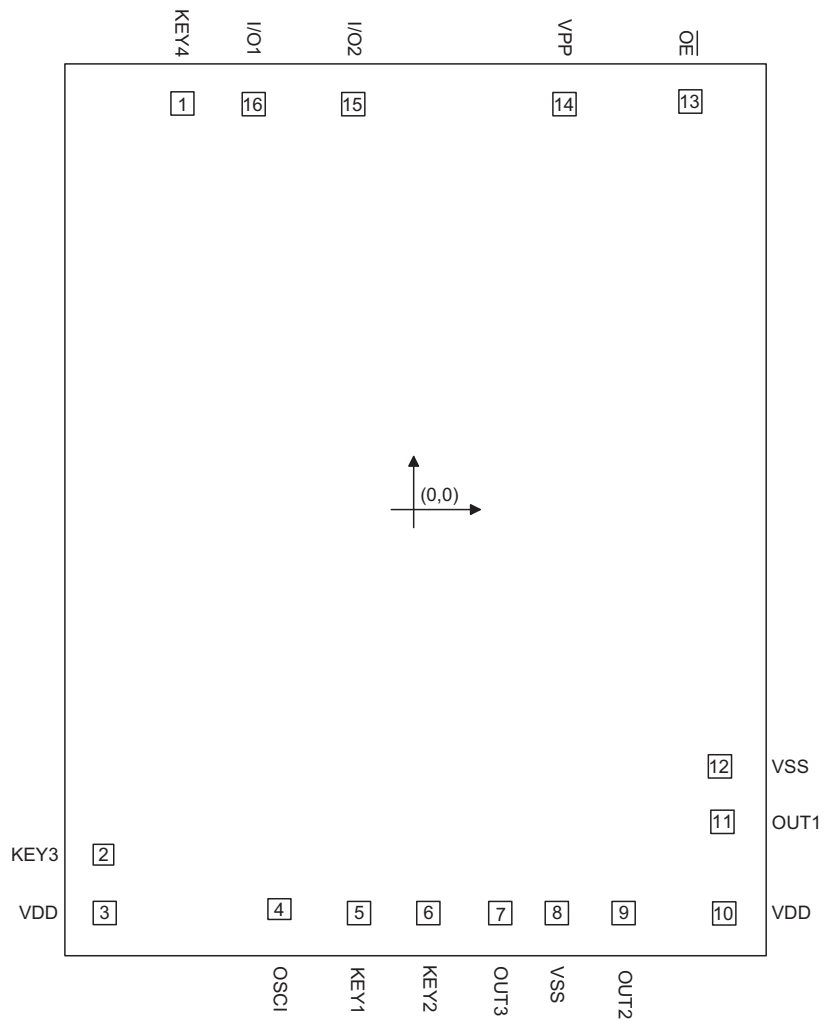
HT81R18



Chip size: 51.6 × 138 (mil)<sup>2</sup>

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

HT81R36



Chip size:  $96.5 \times 121.1 \text{ (mil)}^2$

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

**Pad Coordinates**
**HT81006/HT81009**

 Unit:  $\mu\text{m}$ 

Pad No.	X	Y	Pad No.	X	Y
1	-342.450	254.150	8	-70.700	-672.700
2	-342.450	124.150	9	44.250	-672.700
3	-342.450	-7.700	10	191.500	-639.900
4	-342.450	-135.000	11	377.150	-646.800
5	-364.900	-272.350	12	373.200	-376.900
6	-376.670	-495.876	13	377.150	-107.000
7	-198.050	-672.700	14	401.150	200.700

**HT81012/HT81018**

 Unit:  $\mu\text{m}$ 

Pad No.	X	Y	Pad No.	X	Y
1	-342.400	74.150	8	-70.700	-852.700
2	-342.400	-55.850	9	44.300	-852.700
3	-342.400	-187.700	10	191.550	-819.900
4	-342.400	-315.000	11	377.200	-826.800
5	-364.850	-452.350	12	373.250	-556.900
6	-376.620	-675.876	13	377.200	-287.000
7	-198.000	-852.700	14	401.200	20.700

**HT81R09**

 Unit:  $\mu\text{m}$ 

Pad No.	X	Y	Pad No.	X	Y
1	-477.700	-173.500	9	-39.850	-1153.850
2	-477.700	-286.500	10	106.150	-1153.850
3	-477.700	-386.500	11	428.750	-1164.925
4	-477.700	-499.500	12	428.750	-988.600
5	-396.450	-621.950	13	428.750	-812.275
6	-476.100	-851.000	14	476.700	-669.700
7	-250.400	-1153.850	15	476.700	-547.424
8	-150.400	-1153.850	16	468.100	-377.600

**HT81R18**

 Unit:  $\mu\text{m}$ 

Pad No.	X	Y	Pad No.	X	Y
1	-485.200	-621.000	9	-47.350	-1601.350
2	-485.200	-734.000	10	98.650	-1601.350
3	-485.200	-834.000	11	437.700	-1612.425
4	-485.200	-947.000	12	437.700	-1436.100
5	-403.950	-1069.450	13	437.700	-1259.775
6	-483.600	-1298.500	14	485.650	-1117.200
7	-257.900	-1601.350	15	485.650	-994.924
8	-157.900	-1601.350	16	477.050	-825.100

**HT81R36**

 Unit:  $\mu\text{m}$ 

Pad No.	X	Y	Pad No.	X	Y
1	-800.500	1382.800	9	712.200	-1372.000
2	-1071.700	-1175.050	10	1053.500	-1372.000
3	-1066.600	-1372.000	11	1053.500	-1067.650
4	-468.200	-1361.000	12	1043.900	-874.750
5	-193.300	-1371.600	13	941.200	1389.700
6	43.900	-1371.600	14	513.175	1384.300
7	290.900	-1371.700	15	-210.400	1382.800
8	485.000	-1372.000	16	-555.200	1382.800

**Pin Description**

Pin No.	Pin Name	I/O	Internal Connection	Description
1	I/O2	I/O	NMOS Pull-high	Trigger key 6, active low/NMOS output
2	I/O1	I	NMOS Pull-high	Trigger key 5, active low/NMOS output
3	KEY4	I	Pull-high	Trigger key 4, active low
4	KEY3	I	Pull-high	Trigger key 3, active low
5, 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	KEY2	I	Pull-high	Trigger key 2, active low
9	OUT3	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 -/CMOS output
13	OUT1	O	CMOS	PWM output +/CMOS output
15, 16	NC	—	—	No connection - HT81R36 OTP device except
	$\overline{\text{OE}}$ , VPP	—	—	HT81R36 OTP device only

**Absolute Maximum Ratings**

Supply Voltage .....	$V_{SS}-0.3\text{V}$ to $V_{SS}+6.0\text{V}$	Storage Temperature .....	$-50^{\circ}\text{C}$ to $125^{\circ}\text{C}$
Input Voltage .....	$V_{SS}-0.3\text{V}$ to $V_{DD}+0.3\text{V}$	Operating Temperature .....	$-20^{\circ}\text{C}$ to $70^{\circ}\text{C}$

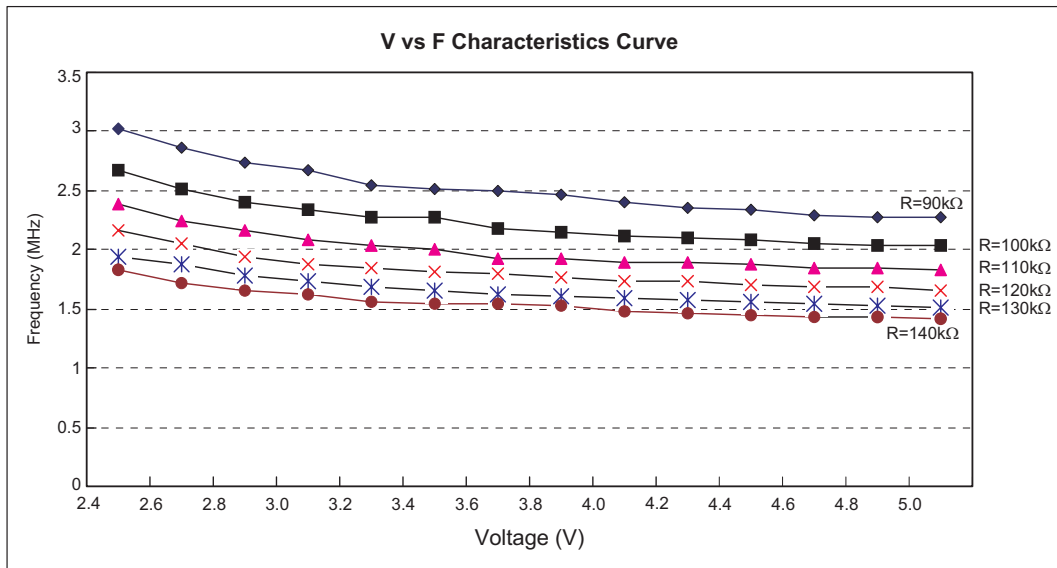
Note: These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions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



**Electrical Characteristics**

Ta=25°C

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V <sub>DD</sub>	Conditions				
V <sub>DD</sub>	Operating Voltage	3V	—	2.4	3	5	V
I <sub>DD</sub>	Operating Current	3V	No load	—	1000	1200	μA
I <sub>STB</sub>	Standby Current	3V	OSC stop	—	1	3	μA
I <sub>OL1</sub>	PWM Output Current	3V	V <sub>OL</sub> =0.2V <sub>DD</sub>	90	110	—	mA
I <sub>OH1</sub>		3V	V <sub>OH</sub> =0.8V <sub>DD</sub>	-10	-20	—	
I <sub>OL2</sub>	I/O2 (TR)	3V	V <sub>OL</sub> =0.1V <sub>DD</sub>	1	3	—	mA
I <sub>OH2</sub>	Tr Output Current	3V	V <sub>OH</sub> =0.9V <sub>DD</sub>	-1	-2	—	mA
I <sub>OL3</sub>	I/O1 (FLAG Sink Current)	3V	V <sub>OL</sub> =0.1V <sub>DD</sub>	3	5	—	mA
V <sub>IH</sub>	"H" Input Voltage	—	—	0.8V <sub>DD</sub>	—	V <sub>DD</sub>	V
V <sub>IL</sub>	"L" Input Voltage	—	—	0	—	0.2V <sub>DD</sub>	V
R <sub>PH</sub>	Input Pull-high Resistor	3V	R=50kΩ (option)	40	50	60	kΩ
			R=100kΩ (option)	80	100	120	
			R=200kΩ (option)	160	200	240	
f <sub>OSC</sub>	Oscillating Frequency	3V	R=110kΩ (f <sub>OSC</sub> =2MHz)	1.6	2	2.4	MHz

**Characteristics Curve**


### Functional Description

The EasyVoice™ is voice synthesizer with 6, 9, 12, 18 or 36-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.

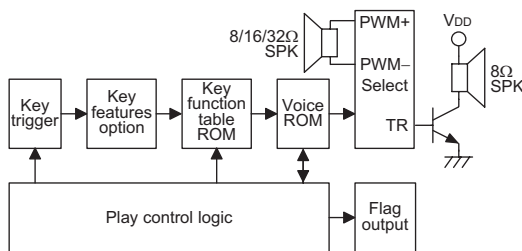
The HT81XXX voice capacity can be divided into sections of arbitrary length. Notice that the silence length and end-pulse width are not included in the memory.

By using Holtek's programming tools (HT-VDS81W), the contents and arrangement of sections, as well as key features and FLAG output are all programmable before device fabrication.

The IC provides 6 direct key inputs (KEY1~KEY6), KEY1 can be optioned as a direct, sequential trigger key. KEY2~KEY6 can be selected as a stop or a direct key.

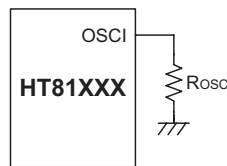
The IC provides matrix key (KEY1~KEY8), 6 programming pins (KEY1, KEY2, KEY3, KEY4, I/O1 and I/O2) can be divided to 8 key that can be optioned as normal or one shot trigger.

### 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

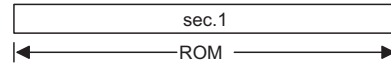
The voice ROM is originally designed to continuously record the 6, 9, 12, 18 or 36-sec voice data at about 5kHz sampling rate. A higher sampling rate will generate voices of better playback quality, but will shorten the total recording time. On the other hand, a lower sampling rate will result in longer 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.

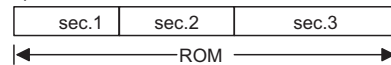
### Section

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 240 due to the space limitation of the function table ROM. The total length of the included sections is limited by the voice ROM.

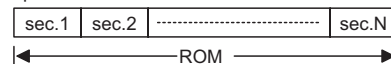
Example 1: One section only



Example 2: 3 section division



Example 3: N section division



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 ( $\cong 1.2\text{ms}$ ,  $f_{\text{OSC}}=2\text{MHz}$ )

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).

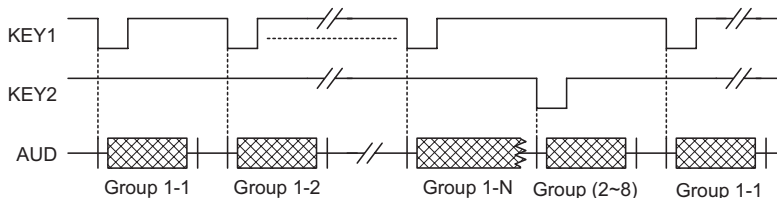


Figure 1. Reset of KEY1 Playing Sequence

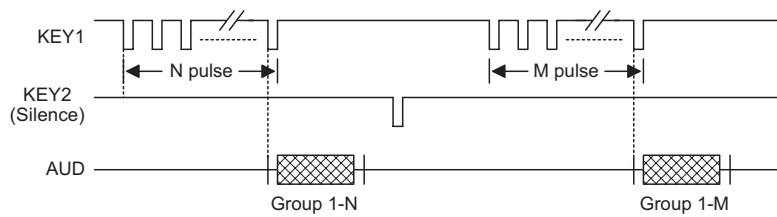
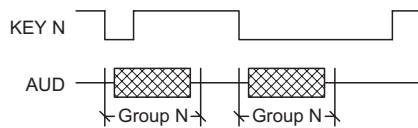


Figure 2. KEY1 Sub-Group Selection

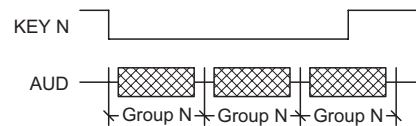
- KEY6 as a stop key (by mask option)  
When KEY6 functions as a stop key, any voice output can be stopped by pressing KEY6.
- KEY2~KEY6 as a repeat key  
As a repeat key, the sections included can be played sequentially and repeatedly until other key input is triggered.

**Key Features**

- Key priority  
When six keys are triggered simultaneously, the output voice is determined by the key priority as shown below:  
KEY1>KEY2>KEY3>KEY4>KEY5>KEY6
- 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 be optioned as one-shot trigger mode or normal mode.
  - ♦ One shot  
When one of the six keys (KEY1~ KEY6) 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.

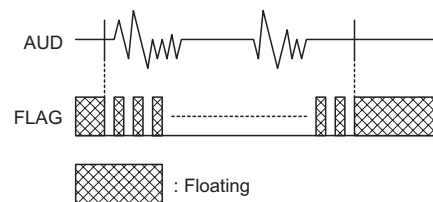
FLAG1 can be optioned as one of the following signal outputs:

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:

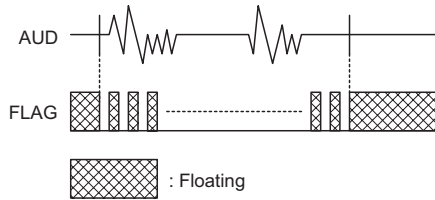
OFF, 3Hz flash, 6Hz flash, or Busy output.

- 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.



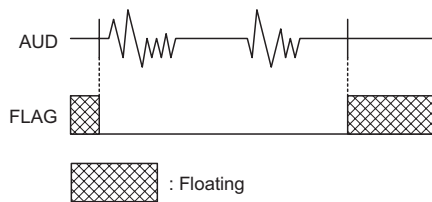
• 6Hz/6HzB flash

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.

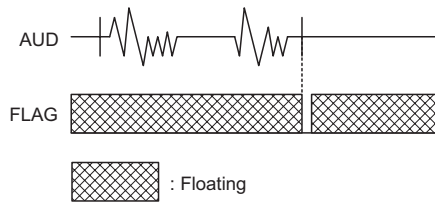


In addition to the above-stated output signals, FLAG1 can also generate one of the following signals by code option:

♦ 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.



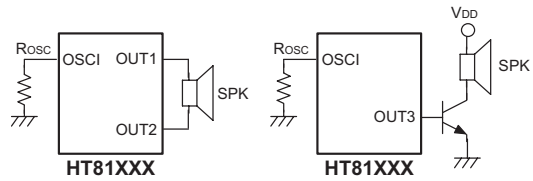
**Volume Control**

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**

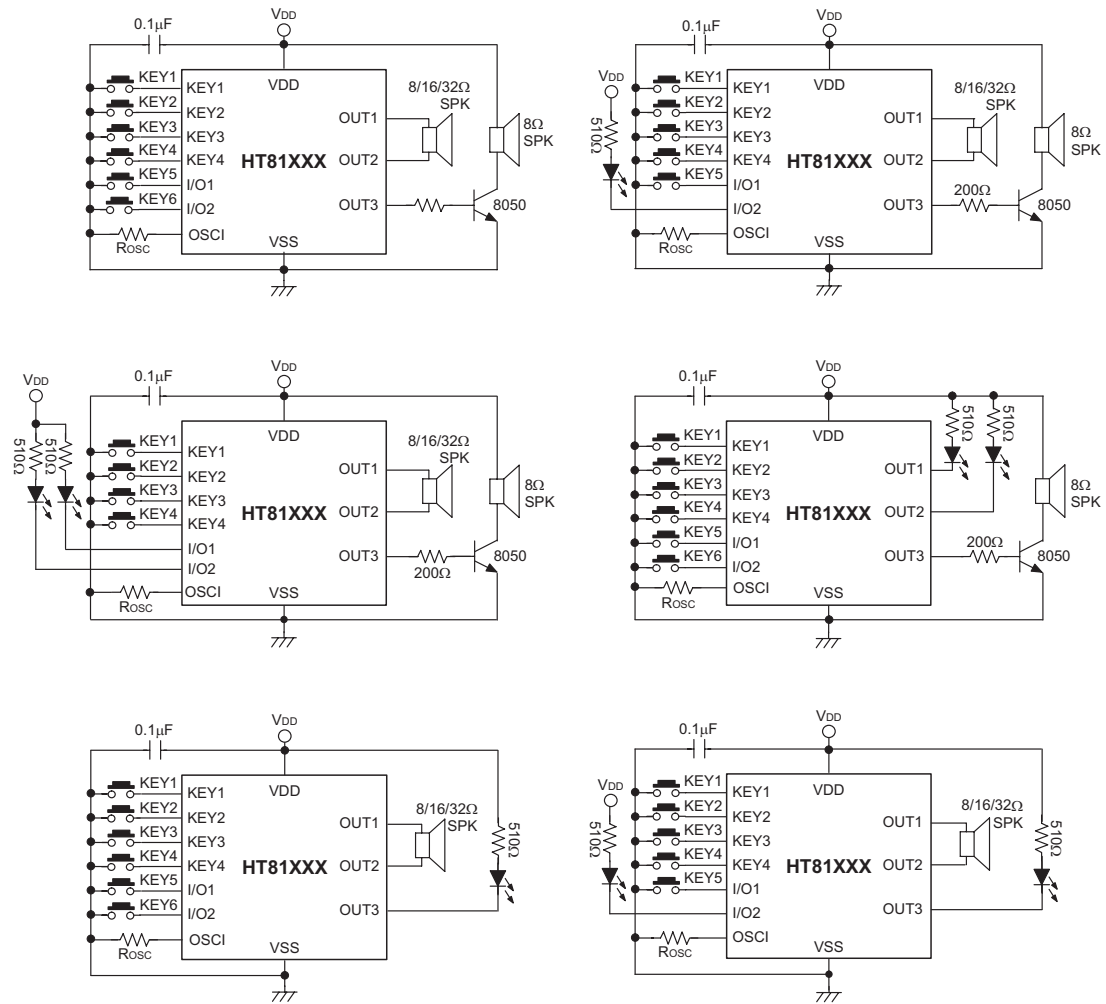
The I/O2 pin is a PWM structure. It outputs voice signals to drive a speaker through an external NPN transistor when the chip is active. The OUT1 and OUT2 pins are configured as PWM structure which can drive 8/16/32Ω speaker directly.

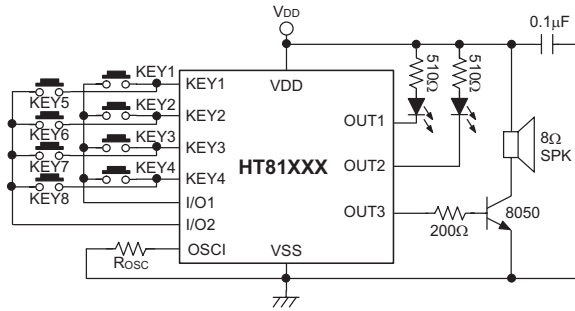
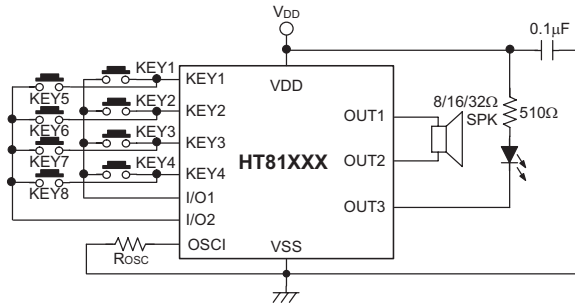
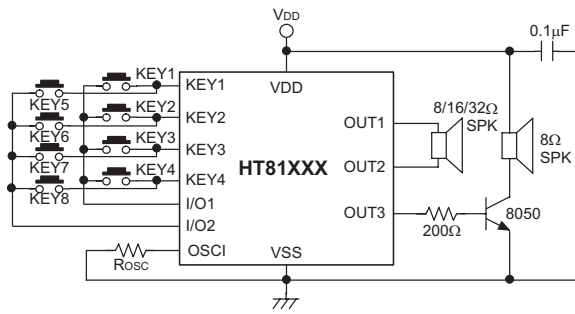
An 8050 type transistor with  $h_{FE} \cong 150$  is recommended for an output driver.



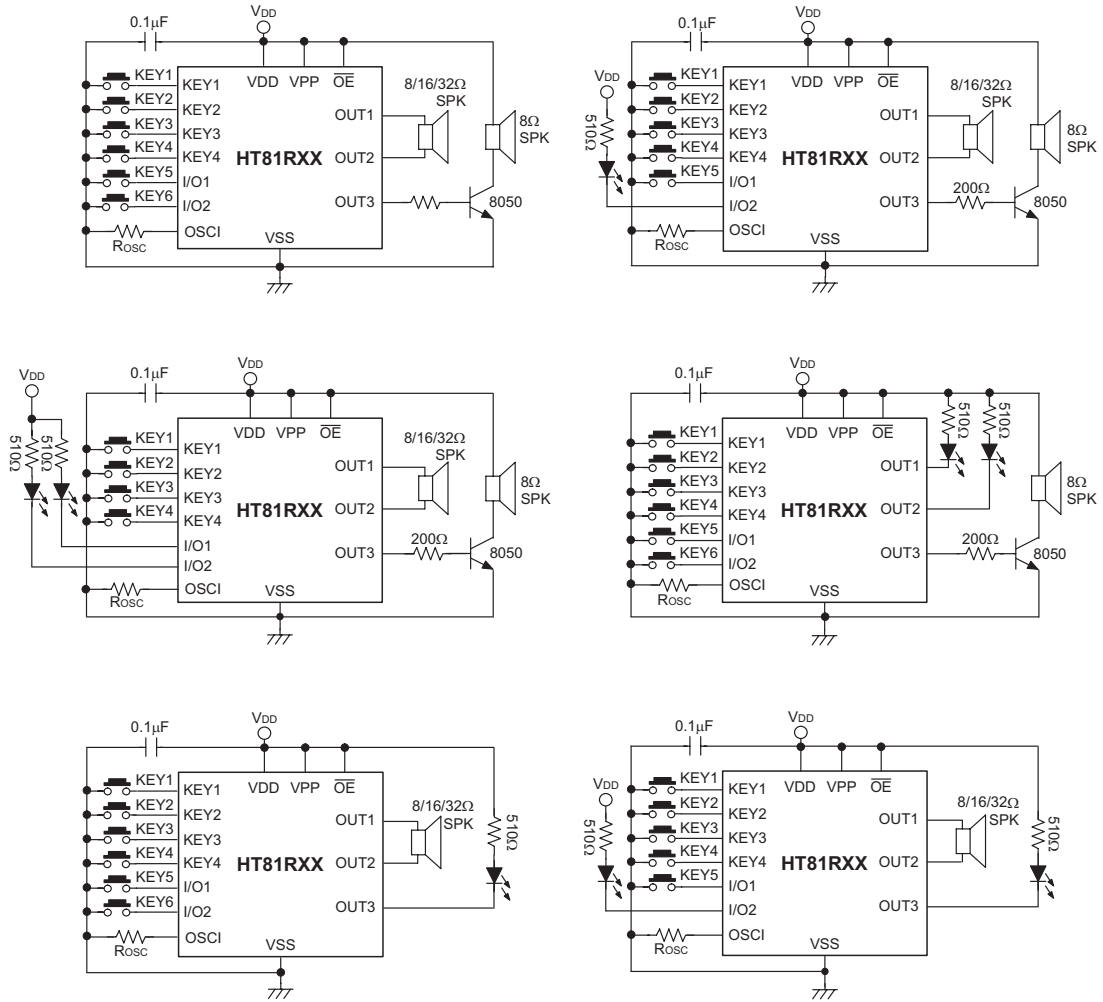
Application Circuits

Mask Type

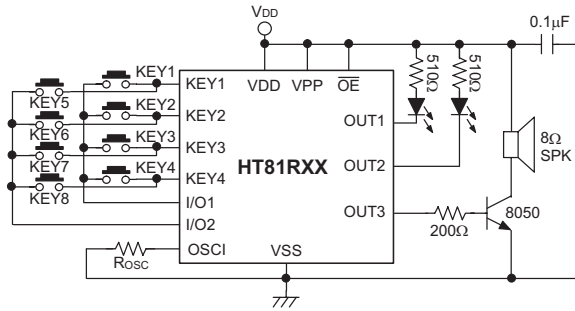
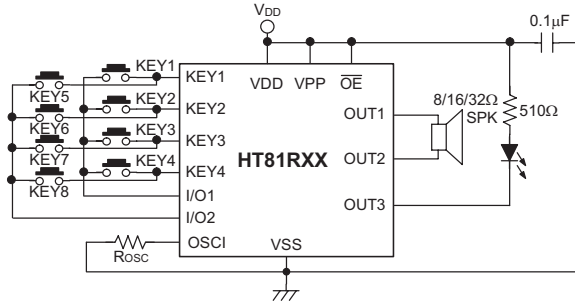
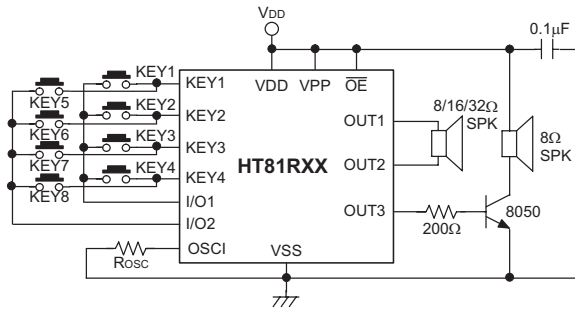




OTP Type

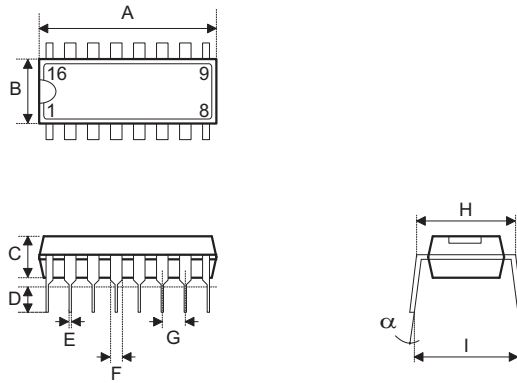






**Package Information**

**16-pin DIP (300mil) Outline Dimensions (Plastic)**



Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	745	—	775
B	240	—	260
C	125	—	135
D	125	—	145
E	16	—	20
F	50	—	70
G	—	100	—
H	295	—	315
I	335	—	375
$\alpha$	0°	—	15°

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