

## 11.2 Sec Voice Melody with CDS Control

### Features

- Operating frequency: 1024KHz
- Operating voltage: 2.4V~5.0V
- Low stand-by current (1 $\mu$ A for VDD=3V)
- 2-channel melody and 1-channel voice synthesis
- Three channel mixed play
- 11.2-sec voice capacity (based on about 6KHz sampling rate)
- 32 tempos and 4 octaves for melody play
- 8 programmable voice sampling rates (5.33~10.67KHz)
- A maximum of 2048 note melodies
- CDS interface for KEY1 application
- A maximum of 32 groups of voices and melodies
- Key options:
  - One shot: KEY1
  - Level hold: KEY2
  - Retriggerable
  - Non-retriggerable
- Mask options:
  - KEY1 interface: Switch device, CDS device
  - KEY1 operating function: Single-sequential or repeat sequential
  - FLAG display: Busy, 4Hz flash, sound level
  - Key debounce time: 22ms, 45ms, 90ms, 180ms. (0 $\mu$ s for KEY1 CDS device)
  - Envelope decay: Fast, Middle, Slow
  - AUD output controlled by external CDS.

### Applications

- Toys
- Alarm clocks
- Sound effect generators
- Voice interface to other IC products

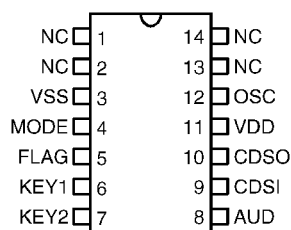
### General Description

The HT387A is a single chip melody and voice synthesizer. Two channel melodies along with a one-channel voice are provided for the individual and combined outputs of voices and melodies. Versatile and beautiful sounds are generated to meet the customer's various needs. The maximum voice capacity is 11.2 secs (based on about 6KHz sampling rate).

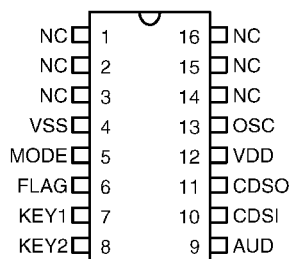
The chip provides 2 key inputs for various sequential playing triggers. KEY1 can be set to interface with the CDS for motion trigger applications.

In addition, the HT387A can control the AUD output, namely enable/disable, through an external CDS.

### Pin Assignment

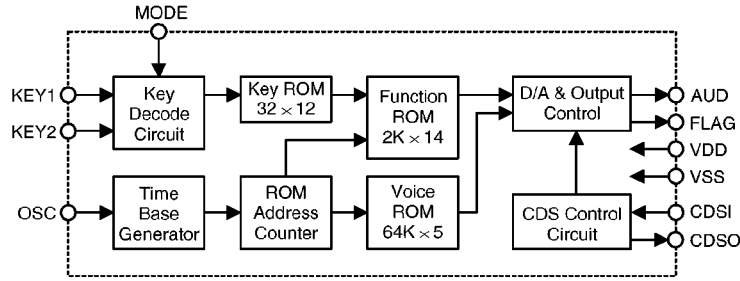


**HT387A**  
- 14 DIP

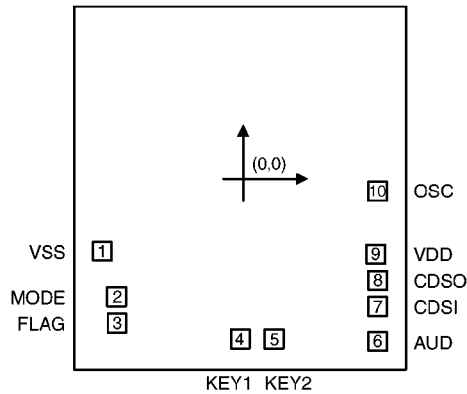


**HT387A**  
- 16 DIP/SOP

**Block Diagram**



**Pad Coordinates**



Unit:  $\mu\text{m}$

Pad No.	X	Y	Pad No.	X	Y
1	-1244.6	-638.9	6	1190.2	-1438.1
2	-1117	-1042.2	7	1190.2	-1129.2
3	-1115.2	-1275.8	8	1190.9	-899.8
4	-24.9	-1415.2	9	1173.7	-667.9
5	276.2	-1415.2	10	1192.5	-108.2

Chip size:  $2740 \times 3300 (\mu\text{m})^2$

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

**Pad Description**

Pad No.	Pad Name	I/O	Internal Connection	Description
1	VSS	I	—	Negative power supply (GND)
2	MODE	I	Pull-High	Used to decide retriggerable or non-retriggerable state of the KEY1 MODE=VSS, Non-retriggerable mode MODE=VDD or Open, Retriggerable mode The MODE pin should be set before power is turned on; after power is switched on, any MODE change is ignored.
3	FLAG	O	NMOS Open Drain	Open drain, active low output, can be optioned as busy or flash or sound level output.
4	KEY1	I	Pull-High	Single sequential or repeat-sequential play, one shot trigger input, low active
5	KEY2	I	Pull-High	Sequential play, level hold trigger input, low active
6	AUD	O	PMOS Open Drain	Voice output for driving an external transistor
7	CDSI	I	CMOS	AUD output enable/disable control. CDSI=0, AUD output enable CDSI=1, AUD output disable

Pad No.	Pad Name	I/O	Internal Connection	Description
8	CDSO	O	NMOS Open Drain	CDS interface power control for reducing power consumption. Refer to the functional description.
9	VDD	I	—	Positive power supply
10	OSC	I	—	Oscillator input pin

### Absolute Maximum Ratings

Supply Voltage .....	-0.3V to 6V	Storage Temperature .....	-50°C to 125°C
Input Voltage.....	V <sub>SS</sub> -0.3V to V <sub>DD</sub> +0.3V	Operating Temperature.....	-20°C to 70°C

### Electrical Characteristics

 (T<sub>a</sub>=25°C)

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
		V <sub>DD</sub>	Condition				
V <sub>DD</sub>	Operating Voltage	—	—	2.4	3	5	V
I <sub>DD</sub>	Operating Current	3V	F <sub>OSC</sub> =1024KHz No load	—	500	1000	μA
I <sub>STB</sub>	Stand-by Current	3V	—	—	1	3	μA
I <sub>O</sub>	Max. AUD Output Current	3V	V <sub>OH</sub> =0.6V	-1.5	-2	—	mA
I <sub>OL</sub>	FLAG, CDSO Sink Current	3V	V <sub>OL</sub> =0.3V	1.5	3	—	mA
V <sub>IH</sub>	"H" Input Voltage	—	—	0.8V <sub>DD</sub>	—	—	V
V <sub>IL</sub>	"L" Input Voltage	—	—	—	—	0.2V <sub>DD</sub>	V
R <sub>PH1</sub>	KEY2 Pull-High Resistance (SW Device Input)	3V	V <sub>IN</sub> =0V	50	100	150	KΩ
R <sub>PH2</sub>	KEY1 Pull-High Resistance (CDS Device Input)	3V	V <sub>IN</sub> =V <sub>IL</sub>	600	1000	1500	KΩ
			V <sub>IN</sub> =V <sub>IH</sub>	50	100	150	
F <sub>OSC</sub>	System Frequency	3V	R <sub>OSC</sub> =180KΩ	900	1024	1140	KHz

### Functional Description

The HT387A is a single chip melody and voice synthesizer which stores the customer's specified voices and melodies in the ROM which are played back by KEY1/KEY2 trigger input. The voice storage capacity is 11.2 secs (based on about 6KHz sampling rate) and 2048 notes (Max.) are provided for melody composition.

The IC provides a FLAG output as well as 2 keys for different trigger source (push button and CDS) applications. In addition, the AUD output enable/disable control is offered through an external CDS interface.

#### Programming

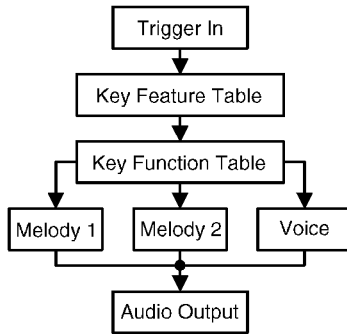
After the customer's voice/melody sources, re-

corded audio tapes, CD or other media and key function specifications are received, the HOLTEK engineers will edit the sources, compose the melodies with the CAD tools and verify the results on an EV (Emulation & Verify) board. After that, the edited codes are recorded into the ROM by programming one layer of the mask.

#### Play

The functions specified by customers for each key are recorded in the key function table. A group of voice sections and melody is played according to the instruction of the key function table each time the chip receives a key trigger input.

**Trigger signal flow**



**Trigger sources**

Two kinds of trigger sources are supported, as described in the following:

- **Key trigger**  
Push button keys can be used as the input device for both KEY1 and KEY2. KEY2 is designed to support the key trigger. On the other hand, KEY1 supports the key trigger through mask option.
- **CDS trigger**  
CDS can be used as the trigger input device for KEY1 by mask option.

**Key functions**

The key functions of KEY1 and KEY2 are listed below.

	Option	Function
KEY1	Key trigger CDS trigger	One-shot
KEY2	Key trigger only	Level hold

**Key features**

Key features, such as pull-high resistance and debounce time, are listed below.

KEY1 Option	KEY	R <sub>PH</sub>	Debounce
Key trigger	KEY1	100KΩ (VDD=3V)	22/45/90/ 180ms
	KEY2		Follow KEY1
CDS trigger	KEY1	Active	0/22/45/ 90/180ms

Note: Only one key can be active at a time.

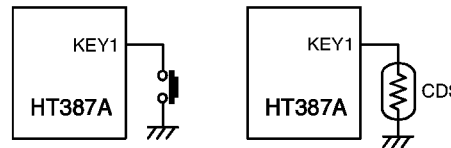
**KEY1 description**

- **MODE**  
The retriggerable or non-retriggerable function of KEY1 is set by the MODE pin. The chip will read the status of the MODE pin when the power is turned on. KEY1 will be set to the retriggerable mode when MODE=VDD. On the other hand, KEY1 is set to the non-retriggerable mode when MODE=VSS. Once the power is switched on, any change of the status of the MODE pin is not allowed, especially when the IC is active. Otherwise the IC will go to an unknown state.

MODE	KEY1
VDD or Open	Retrigger
VSS	Non-retrigger

The MODE pin is built with an active pull-high resistor to reduce the power consumption when MODE is set to VSS initially.

- **Key/CDS trigger option**  
KEY1 can be selected to operate with push button key or with a CDS by mask option.



- \* **Key trigger**  
If the key trigger option is selected, a push button key can be used as a trigger device and the following features are provided:
  - Pull-high resistance≅100KΩ (VDD=3V)
  - 22, 45, 90 or 180ms debounce time by mask option  
Notice that the debounce time of KEY2 should be set to be the same as that of KEY1.
  - Single sequential or repeat-sequential output by mask option.
    - a. **Single sequential output mode**  
In this mode, when KEY1 is triggered, the first section is played until that section is finished. The following section is the output section for the next trigger input. The trigger function is one-shot with a retriggerable or non-retriggerable function, which is decided by the status of the MODE pin. Notice that the trigger input is valid only when a high to low transition occurs.

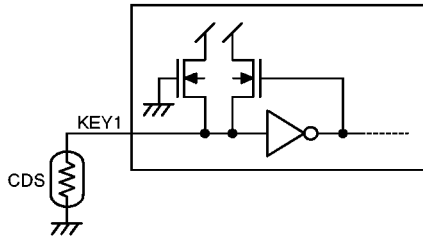
b. Repeat-sequential mode

In this mode, when KEY1 is triggered, one section is repeatedly played till other triggers occur and is then changed to the subsequent section.

\* CDS trigger

CDS can be used as a trigger device after the CDS trigger option is selected. Additionally, the following features are provided:

- Active pull-high resistor

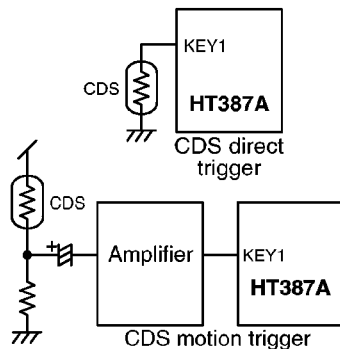


An active pull-high resistor can be applied to construct a schmitt trigger structure; hence the efficiency of the input detection can be enhanced. The pull-high resistor is about 1000KΩ when the input voltage of KEY1 is lower than  $V_{IL}$ . On the other hand, the pull-high resistor is about 100KΩ when the input voltage is higher than  $V_{IH}$ .

- 0, 22, 45, 90 or 180ms debounce time by mask option

A 0 debounce time can be selected for KEY1 to raise the sensitivity of the CDS input. The KEY2 debounce time can be independently selected as 23 or 46 ms in this case.

The CDS application can be operated as a direct trigger or a motion trigger.



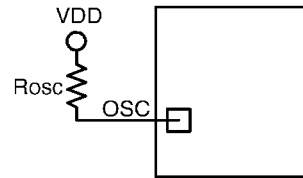
KEY2 description

KEY2 is a "level hold" key with a debounce time of 23ms or 46ms. The time period of music playing depends on the duration for which KEY2 is pressed. Once KEY2 is released the output will immediately stop playing. Pressing KEY2 again will restart the output from the beginning of the next group which is ordered in sequence.

The debounce time of KEY2 is the same as that of KEY1 when KEY1 is in the switch trigger mode. However, the KEY2 debounce time can be optioned as 22, 45, 90 or 180ms when KEY1 is in the CDS mode.

Oscillator

The HT387A has a built-in oscillator which works with an external oscillation resistor. The oscillator will be turned off when the system is in the stand-by mode. The following diagram shows the way that the circuit is connected.



FLAG output

The FLAG pin can be programmed by mask option to yield one of the following functions:

- Busy output

The FLAG pin is turned low and the FLAG LED is switched on when a sound output occurs. On the other hand, FLAG is floating and the FLAG LED is switched off when the sound output is terminated.

- 4Hz flash output

The FLAG LED flashes with a 4Hz rate, and the LED turn-on duty is 25% when a sound is output.

- Sound level display

The brightness of the LED will vary with the volume.

**Melody output**

Two independent melody channels can be output with 32 tempos, 4 octaves and 14 beats, all of which are programmable. In addition, three kinds of envelope decay can be selected.

- 32 tempos (Beats/Min.):

60.98	62.50	65.79	69.44	73.55
78.125	83.33	86.21	89.29	92.59
96.15	100	104.17	108.70	113.64
119.05	121.95	125	131.58	138.89
147.06	156.25	166.67	172.41	178.57
185.19	192.31	200	208.33	217.39
227.27	238.10			

- 4 octaves:

C3#~C4, C4#~C5, C5#~C6, C6#~C7

- 14 beats:

$\frac{1}{8}, \frac{1}{6}, \frac{1}{4}, \frac{1}{3}, \frac{1}{2}, \frac{2}{3}, \frac{3}{4}, 1, 1\frac{1}{2}, 2, 3, 4, 5.$

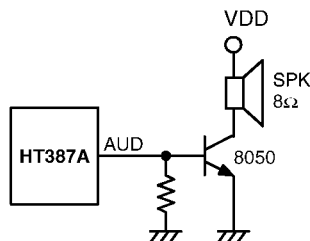
- Envelope decay:

The melody output decay time is decided by the envelope decay. Three kinds of envelope decay (Fast, Middle, Slow) are provided by mask option.

**AUD**

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

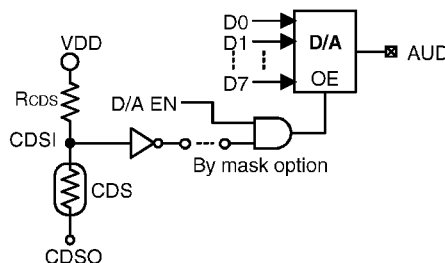
The 8050 type transistor with  $h_{FE} \geq 150$  is recommended as an output driver.



- AUD output control

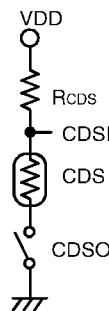
The HT387A provides CDSI for controlling the enable/disable output of the AUD. The CDS resistance varies with the brightness of

light. The AUD can be output only when the CDS receives light with enough brightness. The output control function is thus achieved. For example, applications such as clocks will terminate time telling during the night or when the light is turned off. Following is the application circuit:



As for the sensitivity of the CDS to light, it can be controlled and adjusted by  $R_{CDS}$ .

The HT387A also provides the CDSO pin to control the power on/off state of the CDS. The power of CDS will be switched off to reduce the power consumption when the IC is in the stand-by state, the CDSO is floating. However, the power of CDS will be switched on when one of the keys is triggered, the CDSO is activated low, and the LSI will read-in the CDSI state to decide the AUD output. When the value of CDSI is less than  $V_{IL}$ , AUD output is enabled; the AUD output is disabled when the value of CDSI is greater than  $V_{IH}$ .

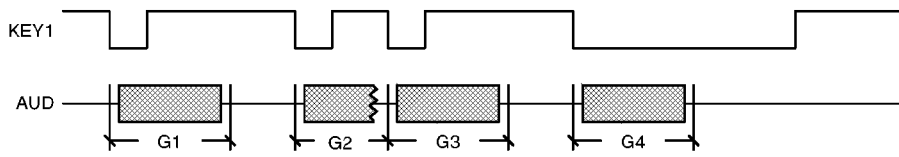


**Mask options**

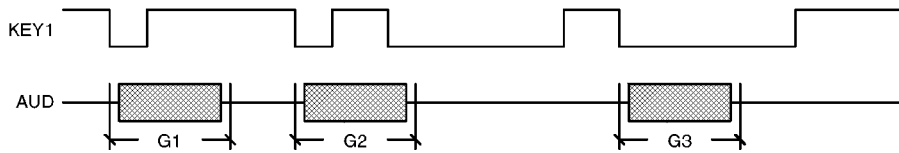
- Key debounce time (22, 45, 90, 180ms)
- FLAG output (Busy, 4Hz, Sound level)
- KEY1 interface (SW device, CDS device)
- KEY1 operating function (Sequential, repeat-sequential)
- Envelope decay

## Timing Diagram

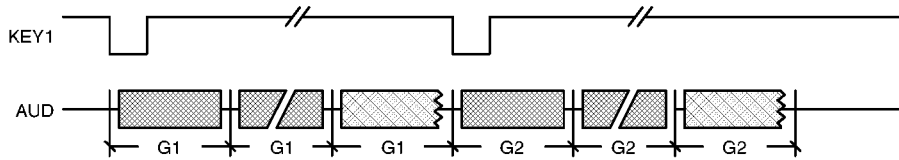
### Retrigger mode (single-sequential)



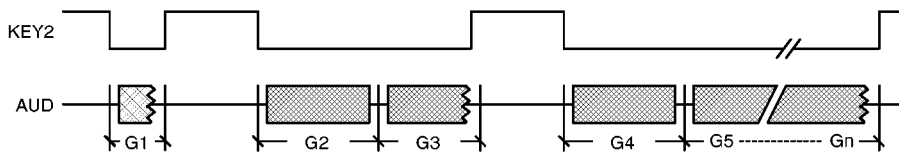
### Non-retrigger mode (single-sequential)



### Repeat-sequential mode

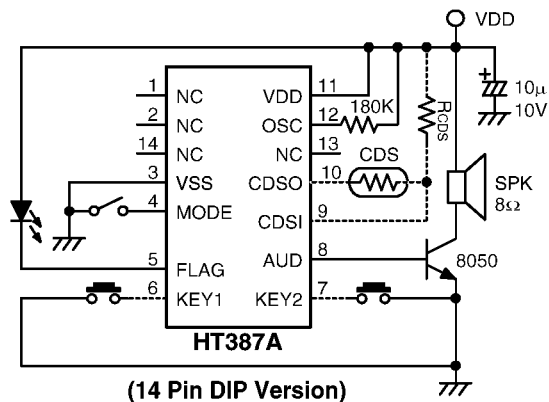
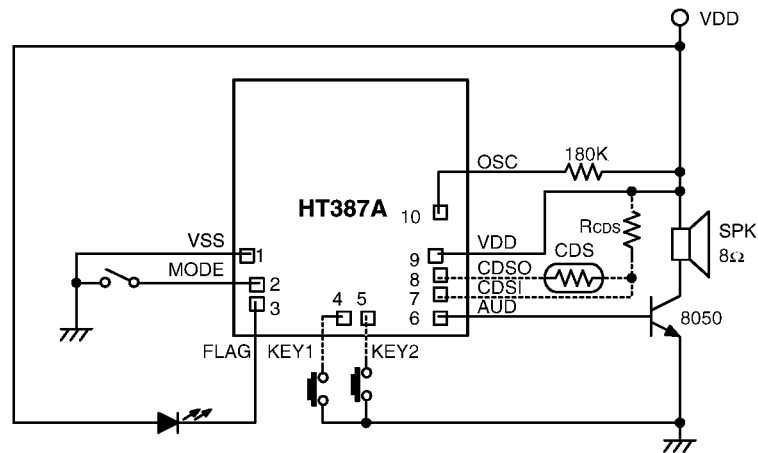


### Level hold



Application Circuit

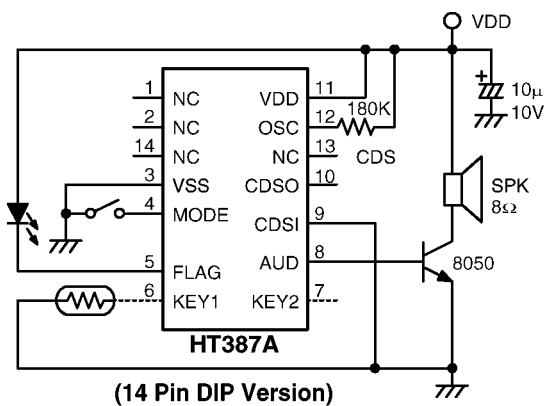
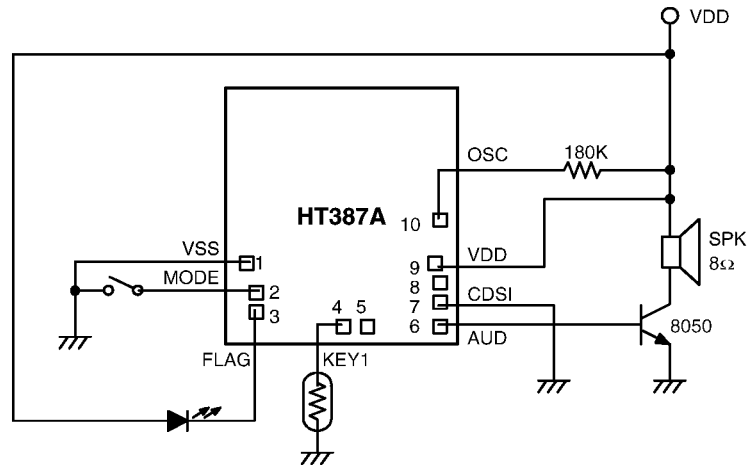
Key trigger application



- Note: 1. The substrate should be connected to VSS in the PCB layout artwork.
2. The mode has to be set before the power is turned on.  
 After the power is turned on, the KEY1 operation state is decided and any change of MODE is not allowed.  
 MODE=VSS: Non-retriggerable mode.  
 MODE =OPEN or VDD: Retriggerable mode.
3. If the external CDS is disconnected, the CDSI should be connected to VSS.



CDS direct trigger



Note: 1. The substrate should be connected to VSS in the PCB layout artwork.

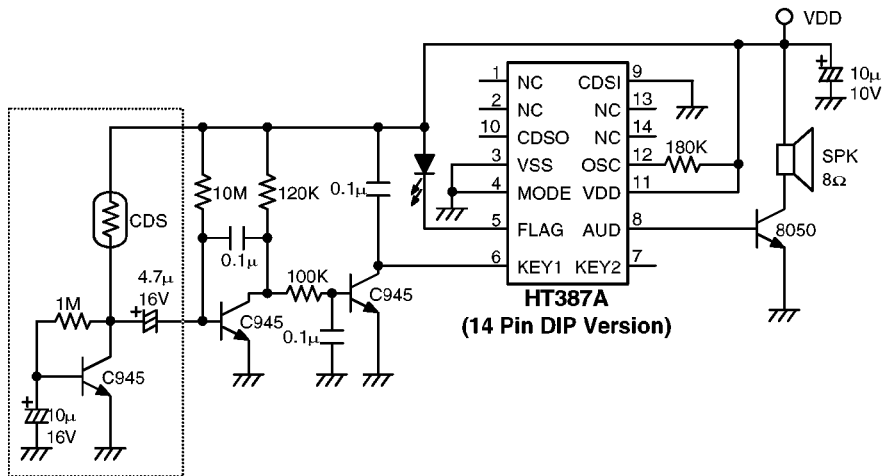
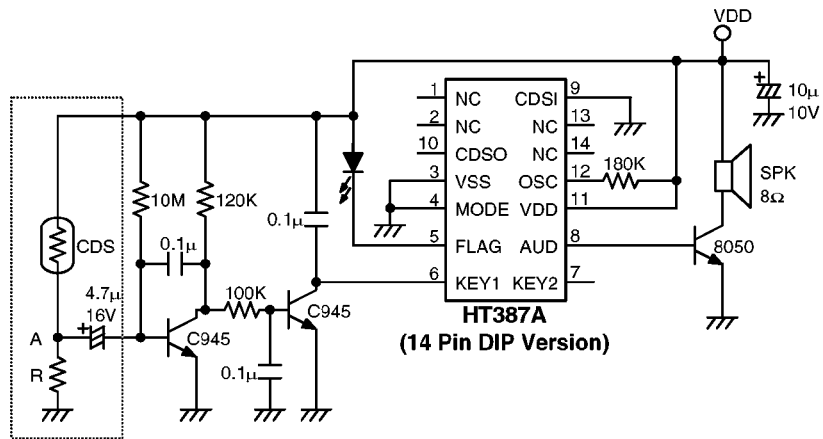
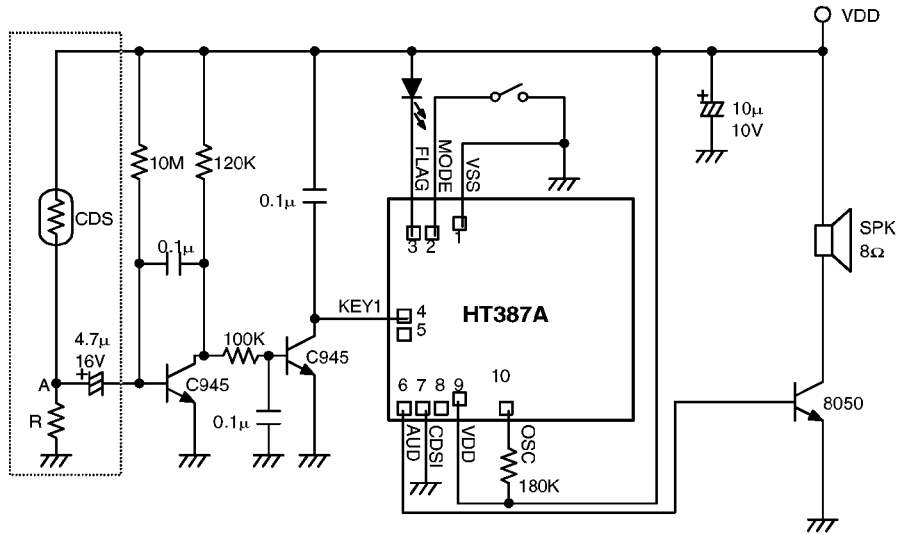
2. The mode has to be set before the power is turned on.

After the power is turned on, the KEY1 operation state is decided and any change of MODE is not allowed.

MODE=VSS: Non-retriggerable mode.

MODE =OPEN or VDD: Retriggerable mode.

CDS motion trigger



Note: 1. The substrate should be connected to VSS in the PCB layout artwork.

2. For various resistance CDS, adjust R to let A point bias to  $\frac{1}{2}$  VDD.

# HT387A Melody & Voice Body Option Table

File Name: \_\_\_\_\_

Contents: \_\_\_\_\_

Check Sum: \_\_\_\_\_ (0000H~1FFFFH)

1. Key Debounce Option:

- KEY2
  - 22ms
  - 45ms
  - 90ms
  - 180ms
- KEY1
  - Same as the KEY2
  - 0 $\mu$ s

2. KEY1 Pad Option:

- Normal key
- CDS interface

3. Repeat Option:

- No
- Yes

4. FLAG Out:

- Busy
- 4Hz
- Sound Level

5. Audio Output Controlled By Enable (CDS):

- No
- Yes

The Above Option Table is  
Confirmed By: (Customer)

Prepared By: (HOLTEK)

\_\_\_\_\_  
(Name, Date & Company Chop)

\_\_\_\_\_  
(Name , Date)