

11.2 Second Voice Melody with a CDS Control

Features

- Operating frequency: 1024KHz
- Operating voltage: 2.4V~5.0V
- Low standby current (1 μ A for VDD=3V)
- 2 channels of melody and 1 channel of voices
- Three channels mixed playing (2 melody channels+1 voice channel)
- 11.2 seconds of voice capacity (based on a sampling rate of about 6KHz)
- 32 tempos, 14 beats and 4 octaves of melody playing
- A maximum of 2048 melody notes
- A maximum of 32 sections sequentially playing
- 8 programmable sampling rates of voices
- 2 key inputs
- CDS interface for KEY application
- Key feathers:
 - KEY1: One shot
 - KEY2: Level hold
 - Retriggerable/Non-retriggerable for KEY1
- Mask options:
 - KEY interface: Switch device/CDS device
 - KEY1 operating function: Single-sequential/Repeat sequential
 - FLAG display: Busy/4Hz flash/volume level
 - Key debounce time: 23/46/92/184ms (0 μ s only for KEY1 CDS device)
 - Envelope decay: Fast/Middle/Slow/Slowest
 - Repeating cycle: 1/2/4/Unlimited times
- AUD output controlled by an external CDS
- 14 DIP or 16 DIP/SOP package

Applications

- Toys
- Alarm clocks
- Voice effect generators
- Products with a voice interface

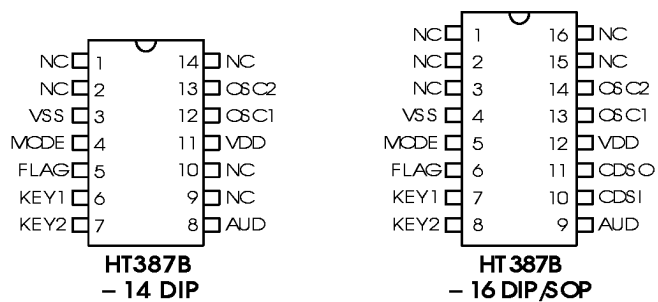
General Description

The HT387B is a single chip melody and voice synthesizer. It provides two channels of melody along with one channel of voices for their individual and combined outputs. Versatile and beautiful voices are thus generated to meet customer's various requirements. The voice capacity of the HT387B can be 11.2 seconds at maximum(based on a sampling rate of about 6KHz).

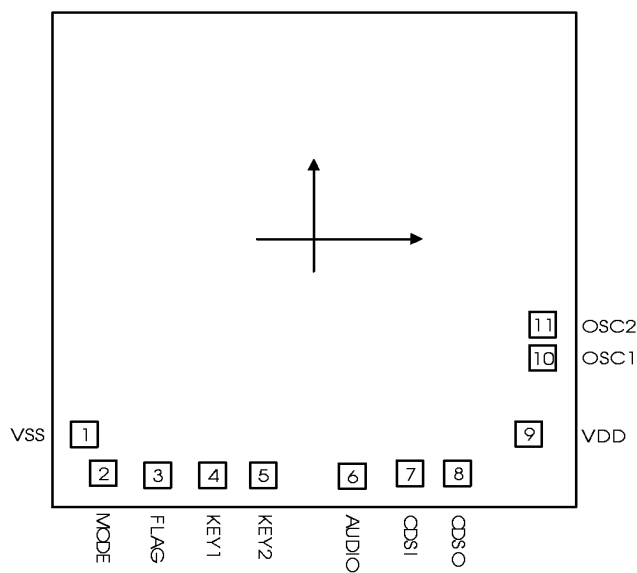
The IC provides 2 key inputs,namely one shot key (KEY1) and level hold key (KEY2), for various sequential playing triggers. Of the 2 keys, KEY1 has an option of being interfaced with a CDS for motion trigger applications.

The HT387B controls an AUD output, namely enable/disable, through an external CDS.

Pin Assignments



Pad Coordinate



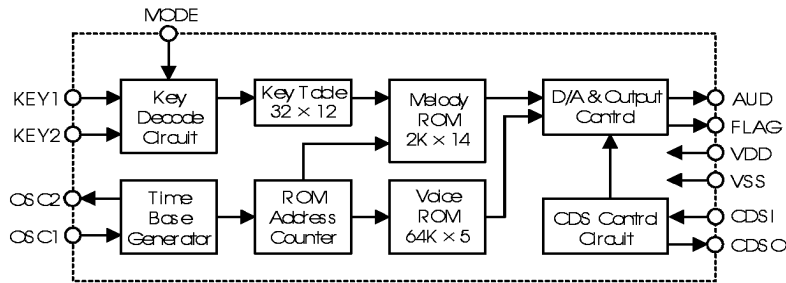
Chip size: $2700 \times 3030 (\mu\text{m})^2$

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

Pad Coordinate

 Unit: μm

Pad No.	X	Y	Pad No.	X	Y
1	-1212.90	-1080.95	7	506.80	-1297.15
2	-1113.30	-1294.15	8	759.30	-1297.15
3	-824.40	-1307.15	9	1133.50	-1078.95
4	-536.80	-1307.15	10	1208.50	-658.05
5	-268.00	-1307.15	11	1208.50	-473.05
6	203.40	-1312.15			

Block Diagram

Pad Description

Pad No.	Pad Name	I/O	Internal Connection	Description
1	VSS	I	—	Negative power supply(GND)
2	MODE	I	Pull-High	The MODE pin decides the retriggerable or non-retriggerable state of KEY1: MODE=VSS, Non-retriggerable MODE=VDD or Open, Retriggerable This pin should be set before power is turned on. After power is switched on, any change to MODE is ignored.
3	FLAG	O	NMOS Open Drain	Open drain, active low output of busy, 4 Hz flash or volume level
4	KEY1	I/O	Pull-High	Single-sequential or repeat-sequential playing, one shot trigger input, low active Output mode for IC test only
5	KEY2	I/O	Pull-High	Sequential play, level hold trigger input, low active Output mode for IC test only

Pad No.	Pad Name	I/O	Internal Connection	Description
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 enabled CDSI=1, AUD output disabled
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	OSC1	I	—	Oscillator input pin
11	OSC2	O	—	Oscillator output pin

Absolute Maximum Ratings

Supply Voltage -0.3V to 6V Storage Temperature -50°C to 125°C
Input Voltage $V_{SS}-0.3V$ to $V_{DD}+0.3V$ 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	3	5	V
I _{DD}	Operating Current	3V	No load, F _{OSC} =1024KHz	—	500	1000	μA
I _{STB}	Stand-by Current	3V	—	—	1	3	μA
I _{AUD}	Max. AUD Output Current	3V	V _{OH} =0.6V	-1.5	-2	—	mA
I _{OL}	FLAG, CDSO Sink Current	3V	V _{OL} =0.3V	2.5	5	—	mA
V _{IH}	“H” Input Voltage	—	—	0.8V _{DD}	—	V _{DD}	V
V _{IL}	“L” Input Voltage	—	—	0	—	0.2V _{DD}	V
R _{PH1}	KEY Pull-High Resistance (Switch Device Input)	3V	V _{IN} =0V	50	100	150	KΩ
R _{PH2}	KEY Pull-High Resistance (CDS Device Input)	3V	V _{IN} =V _{IL}	600	1000	1500	KΩ
			V _{IN} =V _{IH}	150	300	450	
F _{OSC}	System Frequency	3V	R _{OSC} =43KΩ	820	1024	1230	KHz

Functional Description

The HT387B is a single chip melody and voice synthesizer with 11.2 seconds of voice capacity (based on a sampling rate of about 6KHz). A maximum of 2048 notes can be programmed for melody composition.

The IC includes a FLAG output as well as 2 key inputs (KEY1~KEY2) with different triggering functions (one shot and level hold). The AUD output enable/disable control is offered through an external CDS interface.

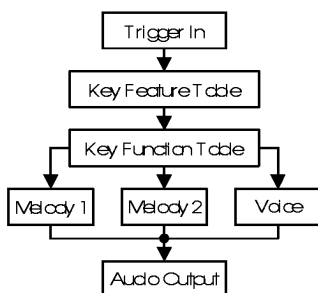
Programming

HOLTEK's engineers will edit the sources, compose the melodies with CAD tools and verify the results on an EV (evolution) board after receiving the customer's voice/melody sources (recorded audio tapes, CD or other media) and key function specifications. Then the edited codes will be recorded into the voice ROM by programming a layer of the mask.

Play

The functions of each key specified by the customer are recorded in the key function table. A group of 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

The HT387B provides 2 kinds of triggering sources as described below:

- **Key trigger**
A push button key can be used as an input device of KEY1 and KEY2. KEY1 and KEY2 support the trigger by mask option.
- **CDS trigger**
The CDS trigger allows CDS as a trigger input device of KEY1 and KEY2 by mask option.

Key features

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

KEY Option	KEY	R _{PH}	Debounce
Key trigger	KEY1	100K Ω (VDD=3V)	23/46/92/184ms
	KEY2		
CDS trigger	KEY1	Active	0/23/46/92/184ms
	KEY2		23/46/96/184ms

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

Key functions

The key functions of KEY1 and KEY2 are listed in the following table.

KEY	Option	Function
KEY1	Key trigger or CDS trigger	One shot
KEY2	Key trigger or CDS trigger	Level hold

• MODE

The retriggerable or non-retriggerable state of KEY1 is decided by the status of the MODE pin. The chip will read in the status of the MODE pin after power is turned on. KEY1 is set to the retriggerable mode if MODE=VDD. It , on the other hand, set to the non-retriggerable mode if MODE=VSS. After power is turned on, all changes made to the MODE pin are ignored especially when the IC is active. Otherwise the IC will go to an unknown state.

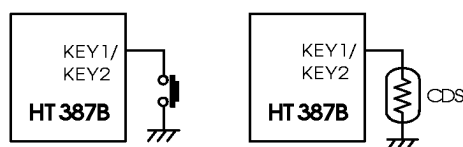
MODE	KEY1
VDD or Open	Retriggerable
VSS	Non-retriggerable

The MODE pin is built in with an active pull-high resistor when initially set to VSS for the sake of reducing power consumption.

• Key/CDS trigger option

KEY1 and KEY2 can operate with a push button key or a CDS by mask option.

* Key trigger



The key trigger allows a push button key to be used as a trigger device. It provides the following features:

- Pull-high resistance $\approx 100K\Omega$ ($V_{DD}=3V$)
- 23/46/92/184ms debounce time by mask option
- Single-sequential or repeat-sequential output by mask option. (only for KEY1)

Single-sequential output mode

In this mode, after KEY1 is triggered, its first section will begin playing until the whole section is completed. The next section is then the output section of the following triggering input. The trigger function is a one-shot key with a retriggerable or non-retriggerable function which is decided by the status of the MODE pin. The trigger input is effective only when a high to low transition occurs.

Repeat-sequential mode

In this mode, after KEY1 is triggered, a section of KEY1 will repeat playing until its repeating cycle ends. The repeating cycle can be set as 1, 2, 4 or unlimited times.

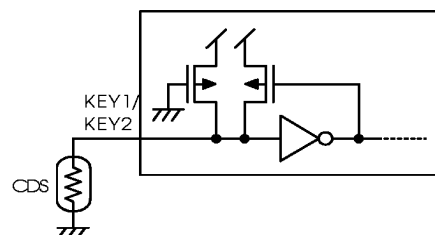
* CDS trigger

The CDS trigger allows CDS to be used as a

trigger device. It provides the following features:

- Active pull-high resistor

An active pull-high resistor constructs a



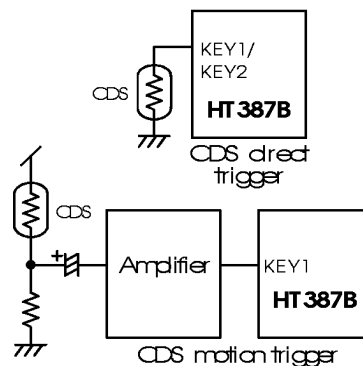
schmitt trigger structure and improves the efficiency of input detection. The pull-high resistor is about $1000K\Omega$ when the input voltage of KEY1 or KEY2 is lower than V_{IL} . It turns out to be about $300K\Omega$ when the input voltage is higher than V_{IH} .

- 0, 23, 46, 92 or 184ms debounce time by mask option

The debounce time of KEY1 can be set as 0 for the sake of increasing the sensitivity of CDS motion trigger input. The debounce time of KEY2 can be optioned as 23, 46, 92 or 184ms.

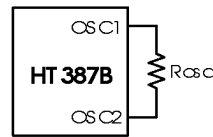
The CDS application can be operated as a direct trigger or motion trigger (refer to the application circuit for details).

- Single-sequential or repeat-sequential output by mask option (only for KEY1)



Oscillator

The HT387B is built-in with an RC oscillator which requires only one external oscillation resistor. The oscillator is turned off when the system is in the stand-by mode. The following diagram demonstrates the way of connecting the circuit.

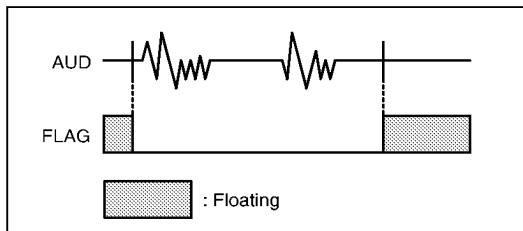


FLAG output

The FLAG pin can be programmed to yielding one of the following functions:

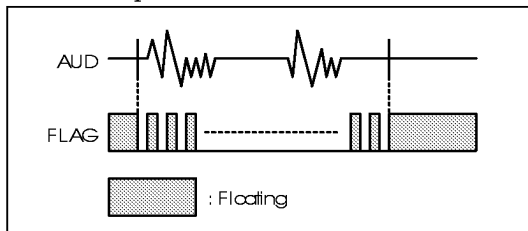
- Busy output

The FLAG pin is turned low and the FLAG LED is switched on when a voice output occurs. It becomes floating and the FLAG LED is switched off when the voice output is terminated.



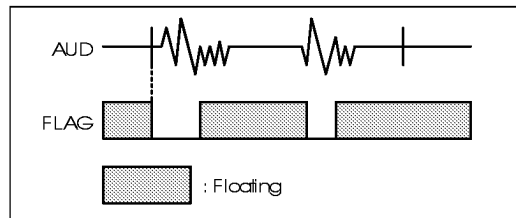
- 4Hz flash output

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



- Volume level display

The brightness of LED varies with the volume.



Melody output

Two independent channels of melody outputs are available with 32 tempos, 4 octaves and 14 beats programmable. Four 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:

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

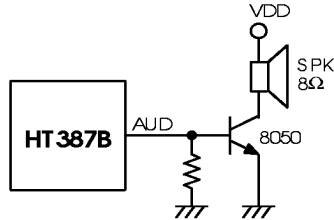
- Envelope decay:

The envelope decay decides the melody output decay time. Four kinds of envelope decay (Fast, Middle, Slow, Slowest) are provided by mask option.

AUD

The AUD pin is a PMOS open drain structure. It outputs voice signals to drive a speaker through an external NPN transistor when the chip is active. This pin becomes floating when the chip is in the standby state.

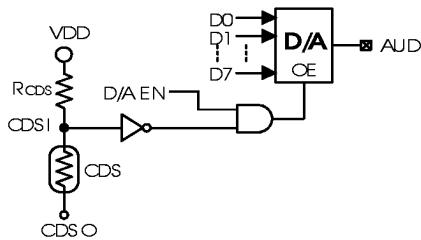
The 8050 type transistor with $h_{FE} \approx 150$ is recommended for an output driver.



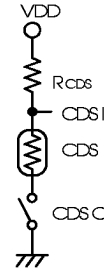
• AUD output control

The HT387B provides a CDSI to control the enable/disable output of AUD. The CDS resistance varies with the brightness of the light. AUD will be output only when CDS receives light with enough brightness. The output control function is achieved accordingly. Applications such as clocks can control the time telling, terminating time telling for example, during the night or when the light is turned off. Following is the internal control diagram.

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



The HT387B provides a CDSO pin to control the power on/off state of CDS. The power of CDS is switched off and CDSO is floating when the IC is in the standby state. Power consumption can thus be reduced. The power of CDS, on the other hand, is switched on when one of KEY1~KEY2 is triggered and CDSO is active low. At this time, the LSI will read-in the status of CDSI to decide the AUD output. When the value of CDSI is less than V_{IL} , the AUD output is enabled. It, however, is disabled when the value of CDSI is greater



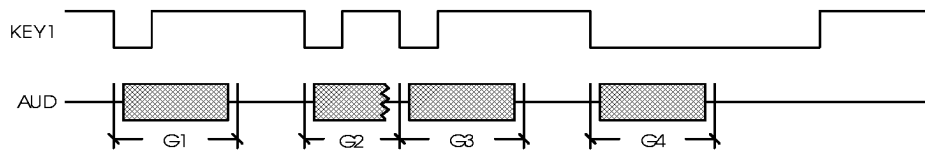
than V_{IH} .

Mask options

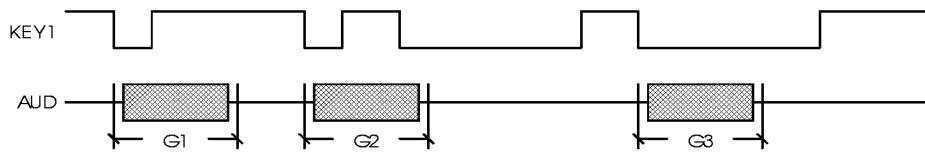
- Key debounce time (23, 46, 92, 184ms, 0μs for KEY1 only)
- FLAG output (Busy, 4Hz, Volume level)
- KEY interface (Switch device, CDS device)
- KEY1 operating function (Single-sequential, Repeat-sequential)
- Envelope decay (Fast, Middle, Slow, Slowest)
- Repeating cycle (1, 2, 4, Unlimited times)

Timing Diagram

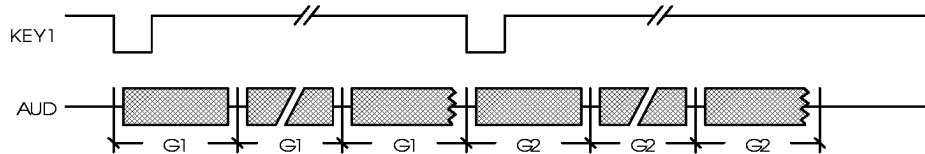
Retriggerable mode (Play once)



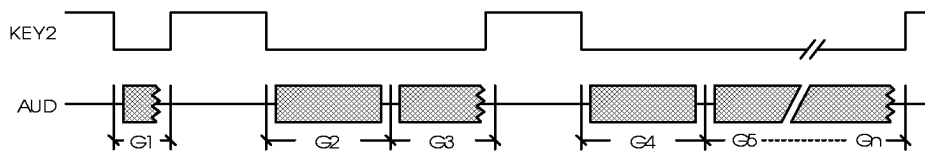
Non-retriggerable mode (Play once)



Repeat function (Unlimited)

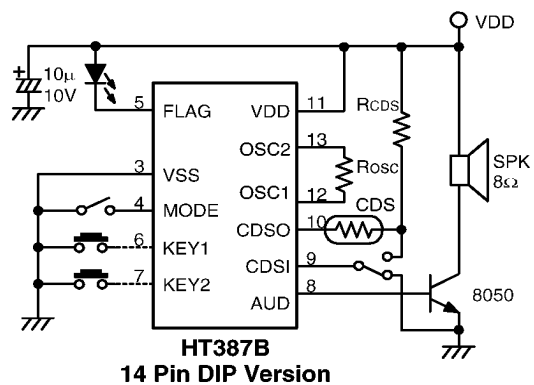


Level hold

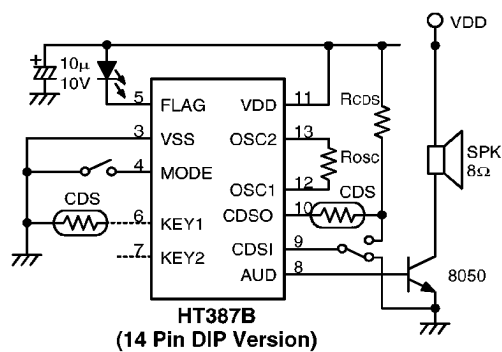


Application Circuits

Key trigger application



CDS direct trigger



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