Features

- Operating voltage: 3.3V~5.0V
- System frequency: 1024kHz
- 1 channel of voices and 2 channels of melody
- 3 channels mixed playing (1 voice channel+2 melody channels)
- 16.8 seconds of voice capacity (based on a sampling rate of about 6kHz)
- 8 programmable sampling rates of voices
- A maximum of 8192 melody notes
- 32 tempos of melody playing
- 4 octaves of tone level
- 4 envelope decay rates

- Key features:
  - Retriggerable or non-retriggerable
  - Level hold or one-shot trigger
  - 64 key inputs (8×8 matrix) or CPU control input
- FLAG options:
  - Busy output
  - 4Hz flash
  - End-pulse output
  - Volume level display
- 28 pin DIP/SOP for 64 key version

Applications

- Toys
- Educational toys

- Pianos
- Melody generators

General Description

The HT38B4 is a single chip melody and voice synthesizer. It provides 64 key inputs of an 8×8 matrix keypad.

The IC includes a voice capacity of 16.8 seconds as well as 8192 melody notes at maximum. All the data are played according to the instruction of the key function table. The IC can output one channel of voices, 2 channels of melody or a combination of the three channels of voices and melody. Versatile and beautiful voices are generated and ideally suitable for applications on toys, gifts, melody generators, etc.
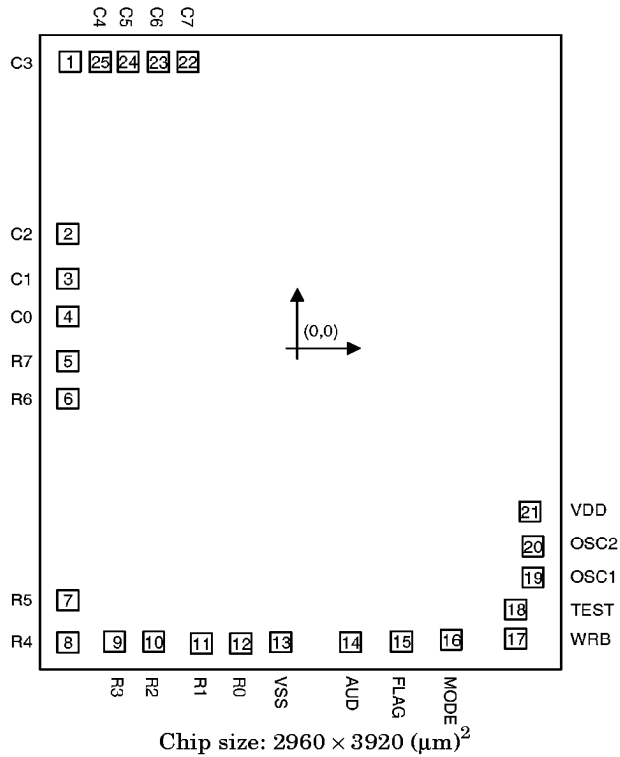
Block Diagram

Pin Assignments

HT38B4
– 28 DIP/SOP

Pad Coordinates

Chip size: $2960 \times 3920 \ (\mu m)^2$
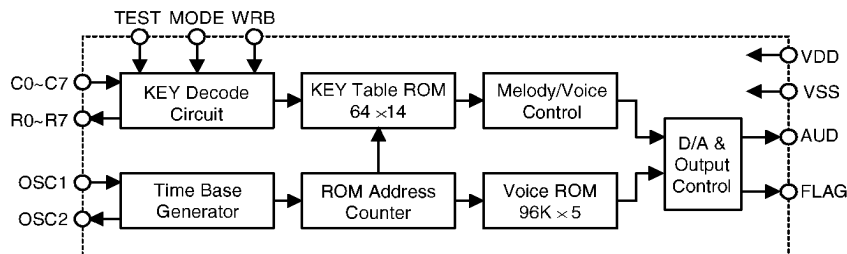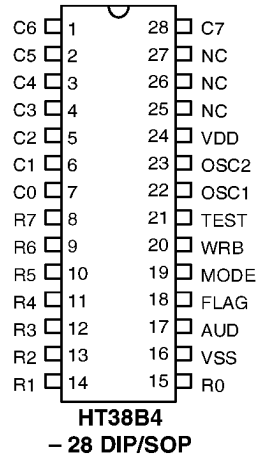
* The IC substrate should be connected to VSS in the PCB layout artwork.

Pad Coordinates

Unit: μm

Pad No.	X	Y	Pad No.	X	Y
1	−1298.10	1712.90	14	307.00	−1752.50
2	−1309.90	684.20	15	598.90	−1747.50
3	−1309.90	415.50	16	882.80	−1737.50
4	−1309.90	190.70	17	1250.70	−1737.50
5	−1309.90	−78.00	18	1250.70	−1562.50
6	−1309.90	−302.80	19	1349.90	−1371.00
7	−1309.90	−1507.10	20	1349.90	−1186.00
8	−1309.90	−1759.50	21	1332.50	−977.00
9	−1043.50	−1759.50	22	−626.20	1712.90
10	−818.70	−1759.50	23	−794.20	1712.60
11	−546.50	−1759.50	24	−962.20	1712.60
12	−321.70	−1759.50	25	−1129.90	1712.90
13	−94.10	−1752.00			

Pin Description

Pin No	Pin Name	I/O	Internal Connection	Description
1, 28	C6, C7	I	Pull-High	In matrix key mode: Column scanning input In CPU mode: Not used
2~7	C5~C0	I	Pull-High	In matrix key mode: Column scanning input In CPU mode: Key address input
8~15	R7~R0	O	NMOS Open Drain	In matrix key mode: Row scanning output In CPU mode: Not used
16	VSS	—	—	Negative power supply (GND)
17	AUD	O	PMOS Open Drain	Voice output for driving an external transistor
18	FLAG	O	NMOS Open Drain	Open drain, active low output of busy/4Hz/end-pulse/voice level (refer to the functional description)
19	MODE	I	CMOS	CPU/Matrix key mode selection input MODE= VSS: CPU mode MODE= VDD: Matrix key mode
20	WRB	I	Pull-High	Key address strobe input for CPU mode, active low
21	TEST	I	Pull-High	For IC test only
22	OSC1	I	—	Oscillator input pin
23	OSC2	O	—	Oscillator output pin
24	VDD	—	—	Positive power supply

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: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of this device at these or any other conditions above those indicated in the operational sections of this specification is not implied and exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Electrical Characteristics

(Ta=25°C)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
V_{DD}	Operating Voltage	—	—	3.3	4.5	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	–2	—	mA
I_{OL}	FLAG 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}	Pull-High Resistance	5V	CPU mode	50	100	150	kΩ
R_{PH2}	Pull-High Resistance	3V	Key mode	50	100	150	kΩ
F_{OSC}	System Frequency	3V	*R_{OSC}=37kΩ	920	1024	1150	kHz

* The user can select the resistance between 43kΩ to 36kΩ to match the frequency.

Functional Description

The HT38B4 is a single chip melody and voice synthesizer. It provides 1 channel of voices along with 2 channels of melody. The voice capacity is 16.8 seconds at a sampling rate of about 6kHz. A maximum of 8192 notes can be programmed for melody composition.

The IC provides two sources of key input trigger, namely an 8×8 keypad or CPU commands.

Programming

HOLTEK's engineers will edit the sources, compose the melodies with CAD tools and verify the result on an EV (evolution) board after receiving the customer's voice/melody sources (recorded audio tape, 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.

Trigger signal flow

Following is a table illustrating the flow of key trigger signals.

A key trigger signal of the HT38B4 can be from an 8×8 keypad or CPU command decided by the connection of the MODE pin. Key features such as retriggerable/non-retriggerable and one-shot/level-trigger are all programmable and stored in the key feature table. Following is a table illustrating the flow of key trigger signals.
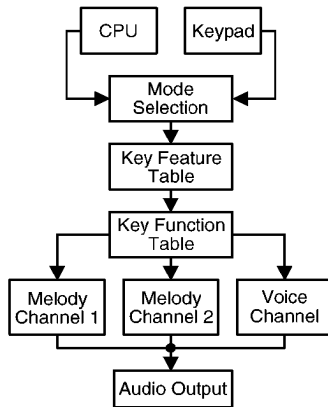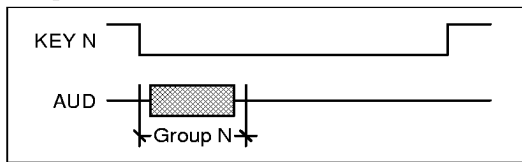

Play

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

Key features

The key trigger (from an 8×8 keypad) can be set as one of the following two trigger modes, namely one-shot and level triggers by mask option.

- One shot

  When a key is optioned as a one shot trigger key, music corresponding to that key will play once, whether it is pressed momentarily or kept held.

- Level hold trigger

  The duration time of music playing depends on the time of pressing and holding a level trigger key. After a key is optioned as a level trigger key, music corresponding to that key will start playing by pressing and holding the level trigger key. Once the level trigger key is released, music will not stop till it is completed. That is to say, music will play once if a level trigger key is pressed and held within the duration time of a group playing. It, however, will re-play if the time of pressing and holding a level trigger key is longer than the duration of music playing.

Each of the above two trigger modes has an option of being retriggerable or non-retriggerable as shown:
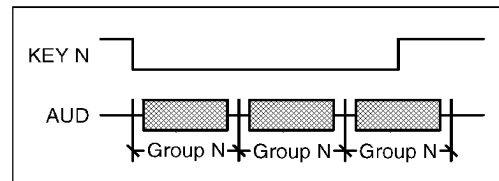
- Retriggerable

  In the retriggerable mode, the according music comes into play by a momentary key trigger. Any further key input can terminate the playing music and start playing the music corresponding to the newly triggered key.

  On the other hand, if the playing music is triggered by a key pressed and held down, whether it can be forcefully stopped by a new key input depends on the following key priority: KEY1>KEY2......>KEY63>KEY64.

- Non-retriggerable

  In the non-retriggerable mode, the playing music will not stop till it is completed, regardless of a new key input.

Mode

The operation mode, namely CPU control input or key input, of the HT38B4 is controlled by the status of the MODE pin as shown:

MODE	Rrigger Source
VDD	8×8 keypad
VSS	CPU
Floating	Inapplicable

CPU mode

The CPU mode has no level trigger function. All keys remain in the one-shot and retriggerable state. The C0~C5 and WRB pins receive data corresponding to the KEY0~KEY63 trigger input in the CPU mode. The key data on C0~C5 should be valid at the rising edge of WRB. The following table illustrates the relation between the key number and its data:

KEY No.	C5	C4	C3	C2	C1	C0
KEY0	0	0	0	0	0	0
KEY1	0	0	0	0	0	1
KEY2	0	0	0	0	1	0
KEY62	1	1	1	1	1	0
KEY63	1	1	1	1	1	1

WRB and C0~C5 should keep high in the standby state to minimize the standby current.

Key trigger mode

The HT38B4 receives a direct key trigger input using an 8×8 keypad if MODE=VDD. The key matrix is constructed by C0~C7 and R0~R7. C0~C7 are all high in the standby state and no voices are output. Once a key is pressed, C0~C7 start scanning to detect which key is pressed. The output voice is specified by the key function table of the pressed key. When a key is pressed and held down, other key inputs are all inhibited.

- Key debounce time
  The debounce time of all keys is internally set as 22ms.

- Key priority
 KEY0>KEY1>KEY2>......>KEY62>KEY63

FLAG output

The FLAG pin can be programmed by mask option, giving one of the following 4 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 once the voice output is terminated.
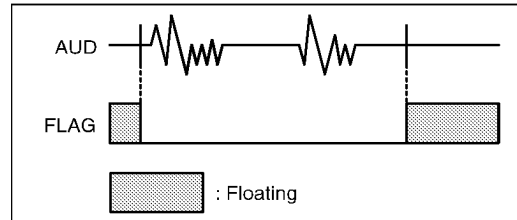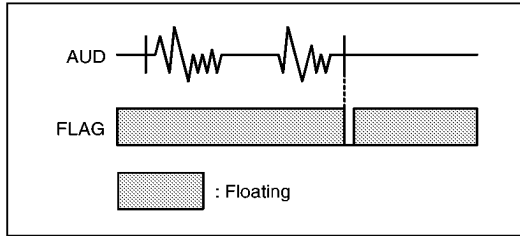

- 4Hz flash output

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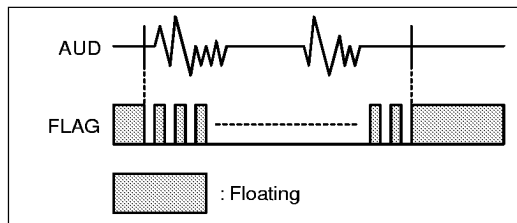
- End-pulse output

  The FLAG pin outputs an active low pulse when the voice output is completed.

- Volume level display

  The brightness of LED varies with the volume.

Melody output

Two independent channels of tone outputs are available with 32 tempos, 4 octaves and 14 beats programming. 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:

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

- Envelope decay:

 The envelope decay decides the tone output decay time. Four kinds of envelope decay can be
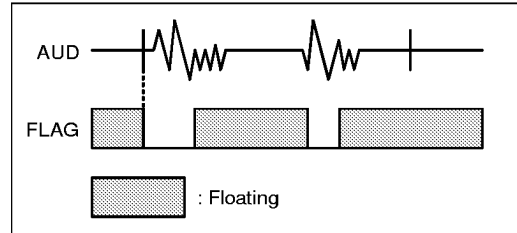
  selected by mask option, namely Fast, Middle, Slow and Slowest.

Mask options

- KEY function mode: retriggerable/non-retrigerable, level hold trigger/one shot trigger
- FLAG output: busy/4Hz/end-pulse/volume level
- Envelope decay rate: Fast/Middle/Slow /Slowest
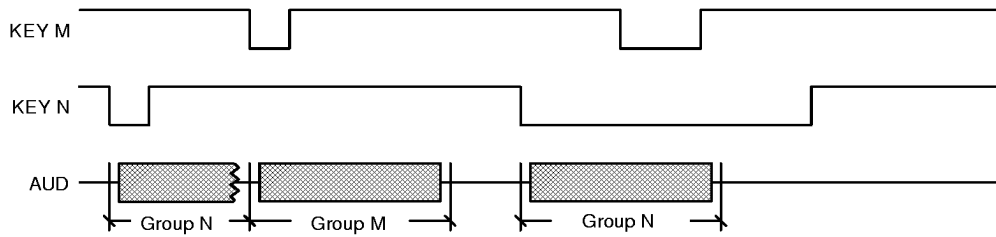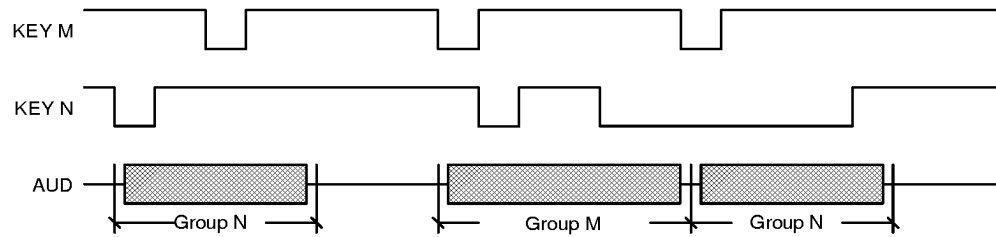
Timing Diagram

CPU mode (MODE=0)
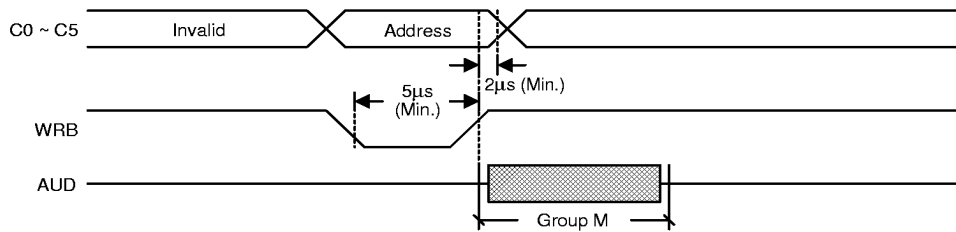
Note: The minimum period between 2 WRB signal is 400µs.

4th Dec '97
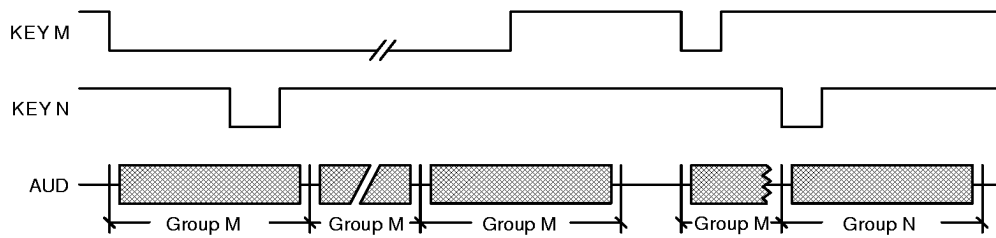
Matrix mode (MODE=1)

- One shot & retriggerable

KEY M

KEY N

AUD

Group N Group M Group N

- One shot & non-retriggerable

KEY M

KEY N

AUD

Group N Group M Group N

- Level-trigger & retriggerable

KEY M

KEY N

AUD

Group M Group M Group M Group M Group N

- Level-trigger & non-retriggerable

KEY M

KEY N

AUD

Group M Group M Group M Group M
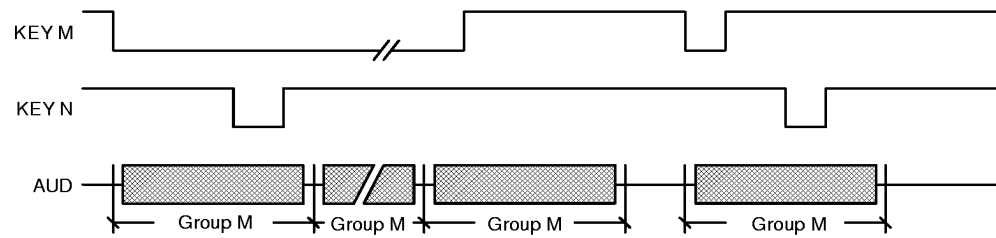
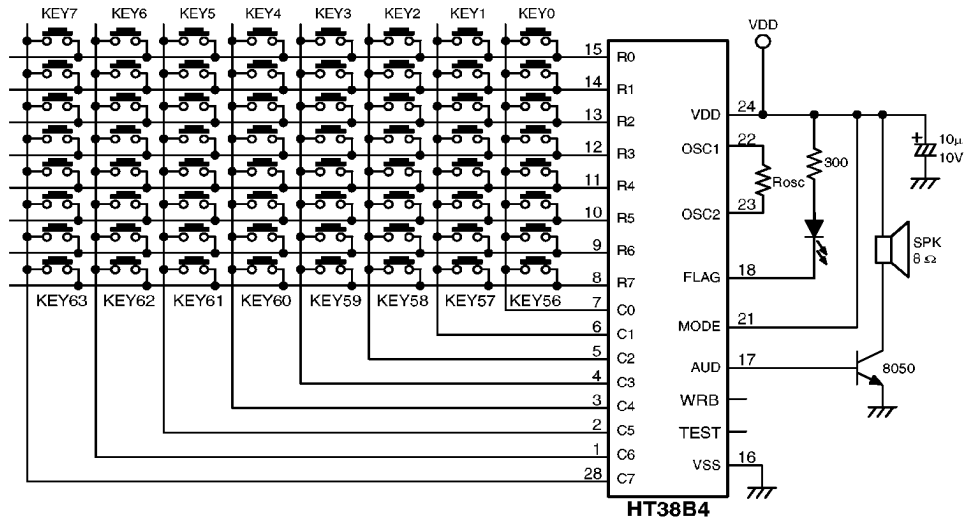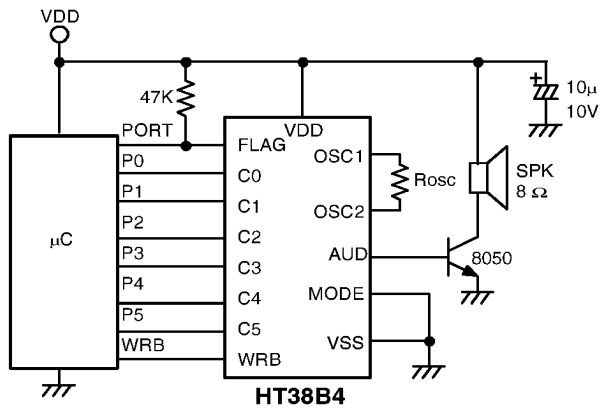Note: The key priority: KEY M > KEY N.

Application Circuits

MATRIX mode

CPU mode

9   4th Dec '97

Standard Item List

HT38B4A

Key No.	Song Name
KEY0	This is a steamboat
KEY1	This is a train
KEY2	This is a helicopter
KEY3	This is a fire engine
KEY4	This is an ambulance
KEY5	This is a bicycle
KEY6	This is a police car
KEY7	This is a bus
KEY8	This is a cow
KEY9	This is a tiger
KEY10	This is a duck
KEY11	This is a rooster
KEY12	This is a dog
KEY13	This is a bird
KEY14	This is a cat
KEY15	This is an elephant
KEY16	Isle of Capri
KEY17	Old macdonald had a farm
KEY18	Comin round the mountain
KEY19	Turkey in the straw
KEY20	Oh, Susannah
KEY21	The yellow rose of Texas
KEY22	Three blind mice
KEY23	Joy to the world
KEY24	Music box dancer
KEY25	On top of old smokey
KEY26	Home
KEY27	Waltz in a flat Op.39,No.15
KEY28	Bear in the forest
KEY29	Michael finnigan
KEY30	Bingo
KEY31	Cardle song

Key No.	Song Name
KEY32	Here comes the bridge
KEY33	Jingle bells
KEY34	London bridge is falling down
KEY35	Santa claus is coming to town
KEY36	The twelve days of Christmas
KEY37	Rudolph the red-nosed reindneer
KEY38	Deck the hall
KEY39	Frosty the snow man
KEY40	Do4
KEY41	Re4
KEY42	Mi4
KEY43	Fa4
KEY44	So4
KEY45	La4
KEY46	Ti4
KEY47	Do5
KEY48	"Kick drum" sound
KEY49	"Snare drum" sound
KEY50	"Claps" sound
KEY51	"Car horn" sound
KEY52	"Cowbell" sound
KEY53	"Whistle" sound
KEY54	"Ha" sound
KEY55	"Ye" sound
KEY56	"Disco" rhythm
KEY57	"Tango" rhythm
KEY58	"Rhumba" rhythm"
KEY59	Swing" rhythm
KEY60	"Waltz" rhythm
KEY61	"March" rhythm
KEY62	Waltz" rhythm
KEY63	"Mamba" rhythm