HOLTEK

HT3874
4.2 Second Voice Melody

Features

- Operating frequency: 1024KHz
- Operating voltage: 2.4V~5.0V
- Low standby current (1μA for VDD=3V)
- 2 channels of melody and 1 channel of voices
- Three channel mixed playing (2 melody channels+1 voice channel)
- 4.2 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 decided by MODE pin
- 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: 23/46/92/184 ms (0μs for KEY1 CDS device)
  - Envelope decay: Fast/Middle/Slow/Slowest
  - Repeating cycle: 1/2/4/Unlimited times
- AUD output controlled by an CDS
- 14 DIP or 16 DIP/SOP package

Applications

- Toys
- Alarm clocks

- Voice effect generators
- Products with a voice interface

General Description

The HT3874 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 HT3874 can be 4.2 seconds at maximum (based on a sampling rate of about 6KHz).

The chip includes 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 triggering applications.

The HT3874 controls an AUD output, namely enable/disable, through an external CDS.

Pin Assignments

HT3874
– 14 DIP

HT3874
– 16 DIP/SOP

Pad Coordinates

Chip size: $2690 \times 2250 \ (\mu m)^2$
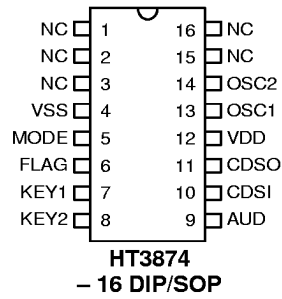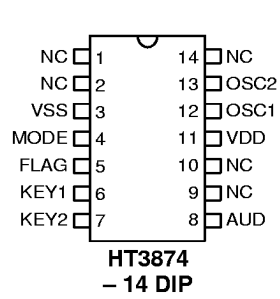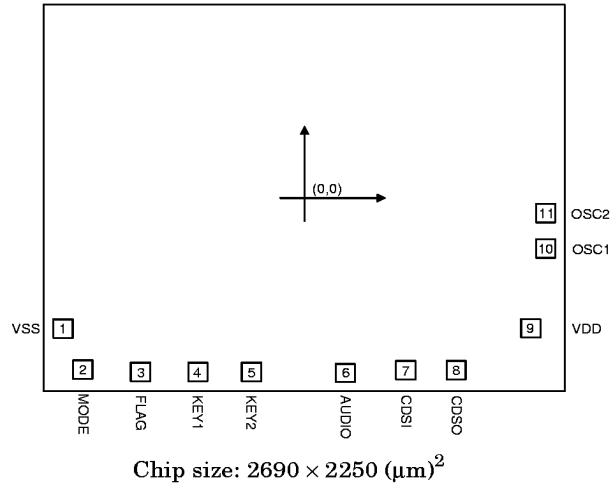
* The IC substrate should be connected to VSS in the PCB layout artwork.

Pad Coordinates

Unit: μm

Pad No.	X	Y	Pad No.	X	Y
1	−1211.20	−686.85	7	508.50	−903.05
2	−1111.60	−900.05	8	761.00	−903.05
3	−822.70	−913.05	9	1135.20	−684.85
4	−535.10	−913.05	10	1210.20	−265.15
5	−266.30	−913.05	11	1210.20	−80.15
6	205.10	−918.05			

Block Diagram
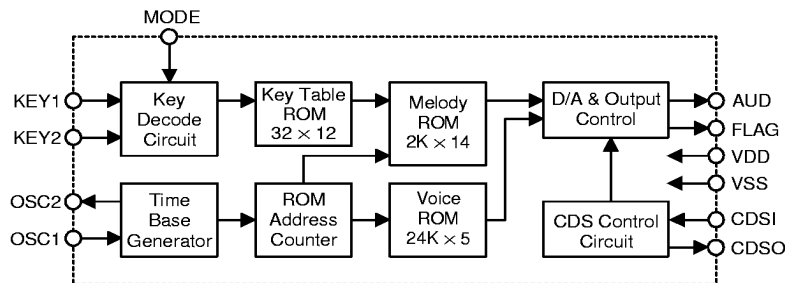
Pad Description

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 on. Once power is turned on, any change made to MODE is ignored.
3	FLAG	O	NMOS Open Drain	active low output of busy, 4 Hz flash or volume level by mask option
4	KEY1	I/O	Pull-High	Single-sequential or repeat-sequential playing, one shot trigger input, low active Output mode for test IC only
5	KEY2	I/O	Pull-High	Sequential playing, level hold trigger input, low active output mode for test IC only
6	AUD	O	PMOS Open Drain	Voice output for driving an external transistor

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Pad No.	Pad Name	I/O	Internal Connection	Description
7	CDSI	I	CMOS	AUD output enable/disable control CDSI=VSS, AUD output enable CDSI=VDD, AUD output disable
8	CDSO	O	NMOS Open Drain	CDS interface power control for reducing power consumption(refer to the function description)
9	VDD	I	—	Positive power supply
10	OSC1	I	—	Oscillation input pin
11	OSC2	O	—	Oscillator output pin

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

Electrical Characteristics

(Ta=25°C)

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
		V_{DD}	Condition				
V_{DD}	Operating Voltage	—	—	2.4	3	5.0	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

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Functional Description

HT3874 is a single chip melody and voice synthesizer with 4.2 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 provides 2 key inputs (KEY1~KEY2) with different triggering functions (one shot and level hold) and a FLAG output. 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 result on an EV (evolution) board after receiving customer's voice/melody sources (recorded audio tape, CD or other media) and key function specifications. Then, the edited codes will be recorded into a voice ROM by programming a layer of the mask.
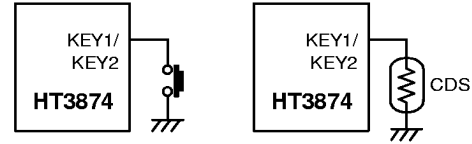
Play

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
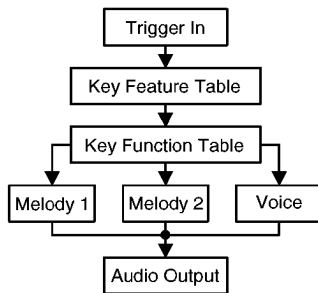
Triggering sources

The HT3874 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 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	100KΩ (VDD=3V)	23/46/92/184ms
	KEY2		
CDS trigger	KEY1	Active	0/23/46/92/184 ms
	KEY2		23/46/92/184ms

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 when power is turned on. KEY1 is set to the

retriggerable mode if MODE=VDD. It, on the other hand, is 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 into 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$\cong$100KΩ (VDD=3V)

    – 23/46/92/184ms debounce time by mask option

    – Single-sequential or repeat-sequential output by mask option

      Single-sequential output (only for KEY1)

      In this mode, after KEY1 is triggered, its first section comes into play until the whole section is completed. Its 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 decided by the status of the MODE pin. The trigger input is effective only when a high to low transition occurs.

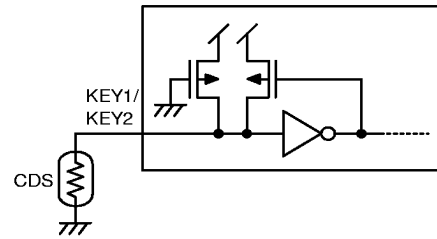   Repeat-sequential mode

      In this mode, after KEY1 is triggered, a section of KEY1 will repeat playing until the 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 1000KΩ when the input voltage of KEY1 or KEY2 is lower than V_{IL}. It turns out to be about 300KΩ 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).

Direct trigger

Motion trigger
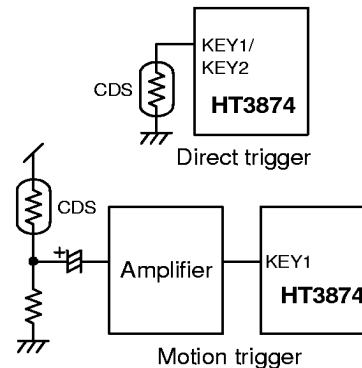
– Single-sequential or repeat-sequential key trigger output by mask option (only for KEY1)

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Oscillator

The HT3874 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 state. The following diagram demonstrates the way of connecting the circuits.
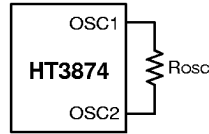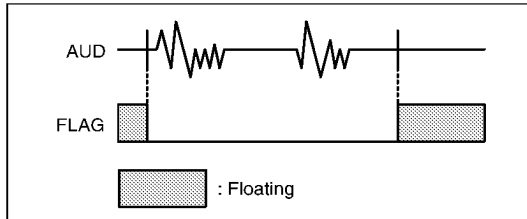
FLAG output

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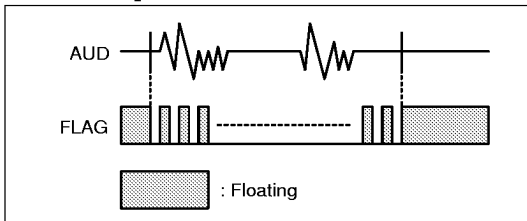
• Busy output

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.

• Volume level display

The brightness of LED varies with the volume.
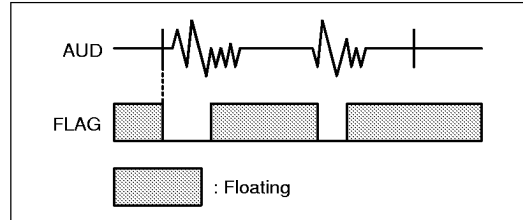
Melody output

Two independent channels of melody output 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:

$C3^{\#}{\sim}C4$, $C4^{\#}{\sim}C5$, $C5^{\#}{\sim}C6$, $C6^{\#}{\sim}C7$

• 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. It provides four kinds of envelope decay (Fast, Middle, Slow, Slowest) by mask options.

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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. The AUD pin becomes floating when the chip is in the stand-by state.

The 8050 type transistor with $h_{FE}\cong150$ is recommended for an output driver.
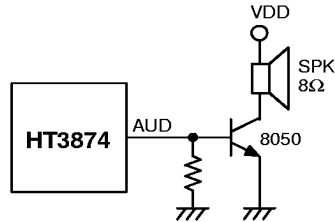
• AUD output control

The HT3874 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}.
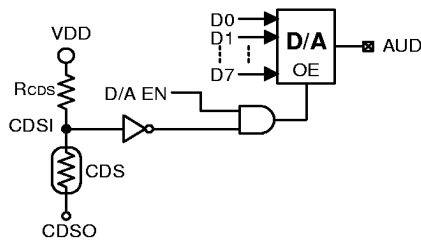
The HT3874 provides a CDSO pin to control the power on/off state of CDS. The power of CDS is switched off and CDSO is floating when the IC is in the standby state. Power consumption can thus be reduced. The power of CDS, on the other hand, is switched on when one of KEY1~KEY2 is triggered and CDSO is 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}.
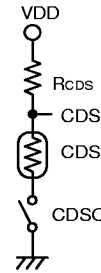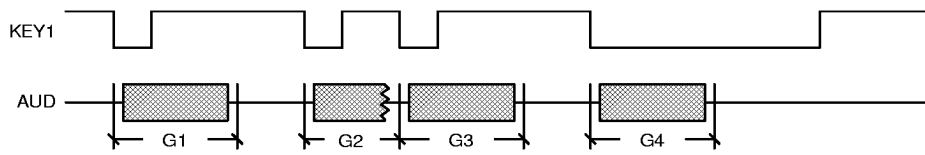

Mask options

• Key debounce time (23/46/92/184ms)
• 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)
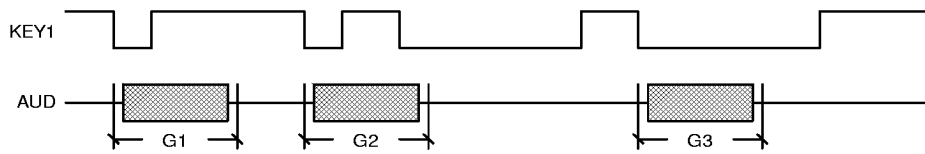• Repeating cycle (1/2/4/Unlimited times)
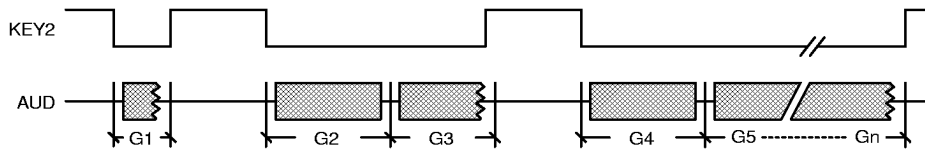
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Timing Diagram

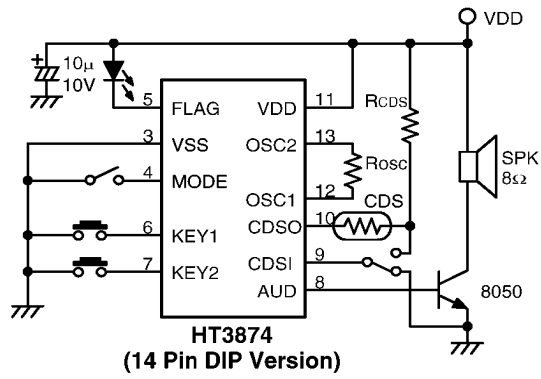**Retriggerable mode (one shot)**

Non-retriggerable mode (one shot)

Level hold

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Application Circuits

Key trigger application

**HT3874
(14 Pin DIP Version)**

CDS direct trigger

**HT3874
14 Pin DIP Version**
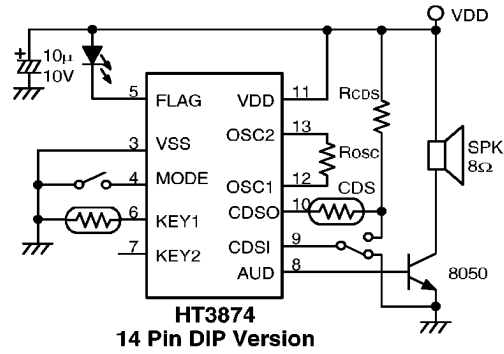
CDS motion trigger-1
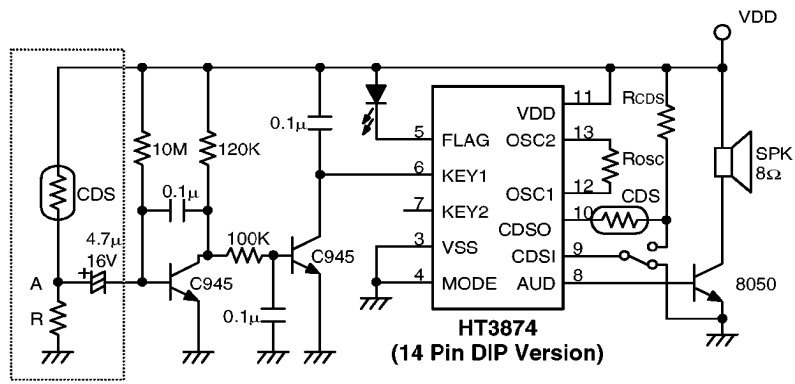
CDS motion trigger-2
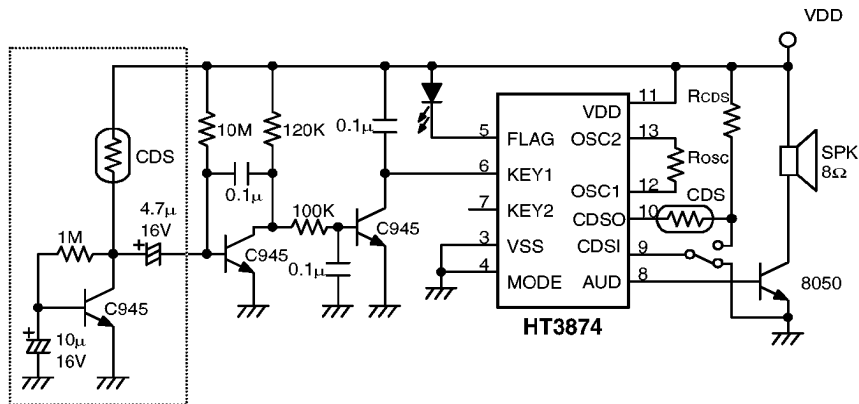
Standard Item List

HT3874A (Xmas MELODY)

Group	Song Name
G0	Jingle Bells
G1	Frosty The Snow Man
G2	Santa Claus Is Coming To Town
G3	We Wish You A Merry Xmas
G4	Silver Bells
G5	Rudolph The Red-nosed Reindeer
G6	Silent Night
G7	12 Days Of Xmas
G8	Parade
G9	White Xmas
G10	Deck The Hall
G11	The First Noel

key interface: CDS device

Flag display: Busy output

HT3874B (Voice Man & Woman Say I Love you) + (Melody & Bell)

Group	Song Name
G1	Wedding March
G2	Bridal March
G3	Jesu, Joy of Man's Desiring
G4	Wedding Day at Troldhaugen
G5	Ave Maria
G6	Liebestraum
G7	Nocturne op.9, no.2
G8	La Reine De Saba
G9	Serenade
G10	Only Love
G11	Salut D'amour
G12	Rhapsody on a Theme of Paganini

key interface: switch derice

Flag display: Busy output