HT82013

ADPCM Synthesizer with External ROMs

Features

- Operating voltage: 3.5V~5.0V
- Directly interface with external parallel ROMs
- Size of external parallel ROMs up to 8Mb×3
- 12-bit analysis and 3 bit ADPCM coding algorithm
- 1368-second voice capacity (based on a 6kHz sampling rate)
- Programmable sound sampling rate (4kHz~11kHz)
- Auto power control for an external power amplifier
- 3.58MHz crystal oscillator/resonator for a system clock (VDD=5V)
- Maximum of eight voice groups
- First playing voice group can be set
- 4-key inputs
- Key options (only one of the four keys can be active at a time)
  - KEY0: Toggle key
  - KEY1: One-shot, non-retriggerable
  - KEY2: One-shot, retriggerable
  - KEY3: Level-hold, repeat
- Playing options
  - Repeat
  - Once

Applications

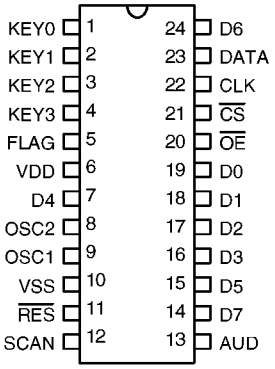
- Toys
- Alarm clocks
- Public address systems
- Alert & warning systems
- Sound effect generators
- Voice interface products

General Description

The HT82013 is a 3-bit ADPCM sound synthesizer LSI implemented in a CMOS technology. It provides a 4-key operation and an external voice ROM interface circuit through the HT82003. Its voice capacity is determined by the type (1M, 2M, 4M or 8M) and number of external ROMs.

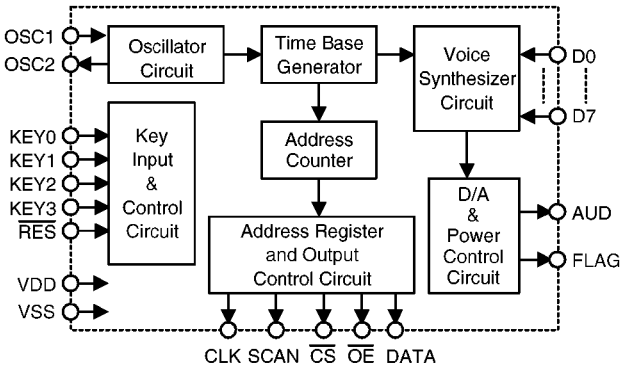
Customer's sound sources are encoded into a 3 bit format by HOLTEK's tools. Sectional playback arrangement instructions of each key are stored in the table ROM. The key features are also programmable. With such a flexible structure, the HT82013 is excellent for versatile sound applications.

Pin Assignment

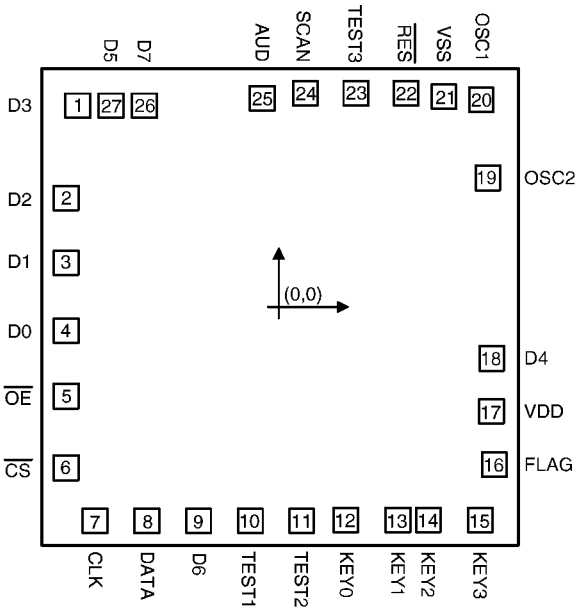


HT82013
– 24 SDIP/SOP

Block Diagram



Pad Assignment



Chip size: 2980×2550 (μm)^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	–1224.25	988.5	15	1227.25	–1045.0
2	–1296.25	535.5	16	1312.25	–774.0
3	–1296.25	217.5	17	1295.75	–513.0
4	–1296.25	–119.0	18	1296.25	–252.0
5	–1296.25	–437.0	19	1273.25	635.0
6	–1296.25	–789.5	20	1234.75	1018.0
7	–1120.25	–1050.0	21	1007.75	1034.5
8	–804.75	–1050.0	22	777.75	1050.0
9	–490.75	–1050.0	23	470.75	1050.0
10	–175.25	–1050.0	24	162.75	1050.0
11	139.25	–1050.0	25	–101.25	1024.5
12	407.25	–1045.0	26	–819.25	988.5
13	725.25	–1045.0	27	–1023.25	988.5
14	910.25	–1045.0			

Pad Description

Pad No	Pad Name	I/O	Internal Connection	Descriptions
1~4	D3~D0	I	Pull-High	D0~D3 receive data from an external ROM and a group setting scan input
5	$\overline{OE}$	O	Pull-High	External ROM data output enable control
6	$\overline{CS}$	O	CMOS	Connects to an external address expander chip of the HT82003, functions as a chip selection pin
7	CLK	O	CMOS	Outputs a clock to the HT82003 for an address counter
8	DATA	O	CMOS	Outputs data to the HT82003 for initialization process of the HT82003
9	D6	I	Pull-High	D6 receives data from an external ROM and a group setting scan input
10, 11	TEST1, TEST2	O	CMOS	For IC test only
12~15	KEY0~KEY3	I	Pull-High	Trigger key input, active low (refer to the functional description)
16	FLAG	O	CMOS	Active low output of busy/end-pulse by code option The busy output is particularly for an external amplifier power control
17	VDD	—	—	Positive power supply

Pad No	Pad Name	I/O	Internal Connection	Descriptions
18	D4	I	Pull-High	D4 receives data from an external ROM and a group setting scan input
19	OSC2	O	—	Oscillator output
20	OSC1	I	—	Oscillator input
21	VSS	—	—	Negative power supply (GND)
22	$\overline{RES}$	I	Pull-High	Input for resetting the chip inside Reset is active at a low-going edge or low level
23	TEST3	O	CMOS	For IC test only
24	SCAN	O	CMOS	Group setting scan output, active low (refer to the functional description)
25	AUD	O	PMOS Open Drain	Audio output for an external transistor or amplifier
26	D7	I	Pull-High	D7 receives data from an external ROM and a group setting scan input
27	D5	I	Pull-High	D5 receives data from an external ROM and a group setting scan input

Absolute Maximum Ratings*

Supply Voltage ..... –0.3V to 5.5V
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

*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.

D.C. Characteristics

(Ta=25°C)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
V_{DD}	Operating Voltage	—	—	3.5	—	5.0	V
I_{DD}	Operating Current	5V	No load, f_{SYS}=3.58MHz	—	1.5	3	mA
I_{STB}	Standby Current	5V	No load, Halt mode	—	—	5	μA
V_{IL}	Input Low Voltage	5V	—	0	—	$0.2V_{DD}$	V
V_{IH}	Input High Voltage	5V	—	$0.8V_{DD}$	—	5V	V
I_{OL}	CLK, $\overline{CS}$, SCAN, FLAG, Sink Current	5V	V_{OL}=0.5V	2.5	5	—	mA
I_O	Max. AUD Output Current	5V	V_{OH}=0.6V	–3	–5	—	mA
I_{OH1}	CLK, $\overline{CS}$, SCAN, FLAG, Source Current	5V	V_{OH1}=4.5V	–0.5	–1	—	mA
R_{PH1}	Pull-High Resistor	5V	V_{IL1}=0V	30	—	300	kΩ
R_{PH2}	$\overline{RES}$ Pull-High Resistor	5V	V_{IL2}=0V	10	—	300	kΩ

A.C. Characteristics

(Ta=25°C)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
f_{SYS}	System Frequency	5V	Crystal, Oscillator or Resonator	—	3.58	4	MHz
t_{RES}	Reset Pulse Width	—	V_{DD}=5V	5	—	—	ms

Functional Description

The HT82013 is a 3-bit ADPCM sound synthesizer LSI. It provides 4 key inputs (KEY0~KEY3) and an external parallel ROM interface. Of the 4 keys (KEY0~KEY3), KEY0 is a key that controls the power on/off state. The external ROMs store the customer's sound data and key definitions.

The HT82013 provides addresses of A0~A19 through a 20-stage binary counter of the HT82003. The HT82003 offers 3-chip selection pins, namely $\overline{CS}0$~$\overline{CS}2$, for external ROM control. The output of $\overline{CS}_N$+1 will replace the output of $\overline{CS}_N$ if the outputs of Q0~Q19 exceed the maximum address of an external ROM. The maximum capacity of external ROMs can be expanded up to 8Mb×3 (refer to Figure 1).

The customer's sound source is analyzed and coded through HOLTEK's tools. The encoded data are stored in the external ROMs as shown in the following table:

Sound length

Memory Type	Sampling Rate	Voice Capacity
1Mb×3	6kHz	171 secs
2Mb×3	6kHz	342 secs
4Mb×3	6kHz	684 secs
8Mb×3	6kHz	1368 secs

Section

Section is the basic element constituting the contents of the voice ROM. During programming, the customer's sound sources can be divided into as many sections as required. A section can be composed of a sound or an interval of silence. However, the silence length is not counted in the voice ROM. The length of each section, is determined by the requirements of the sound contents.

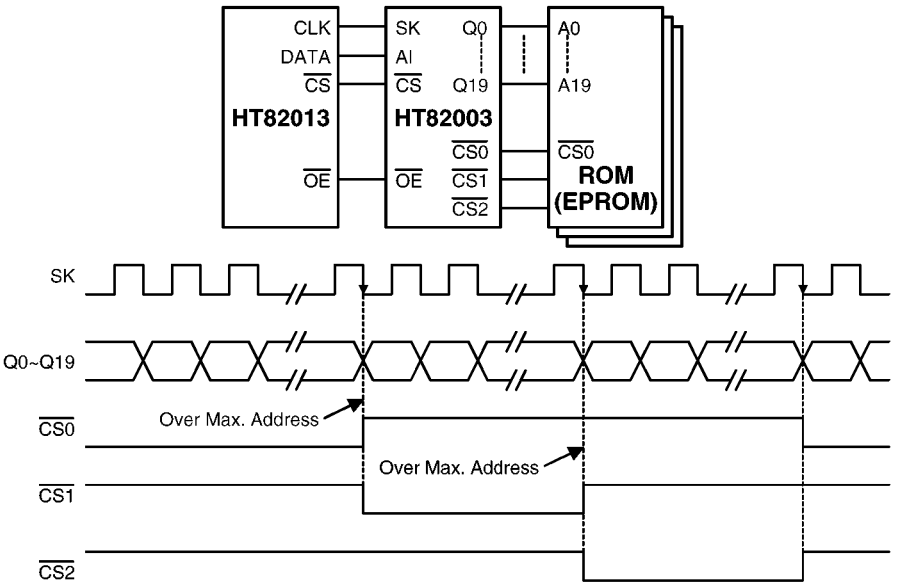
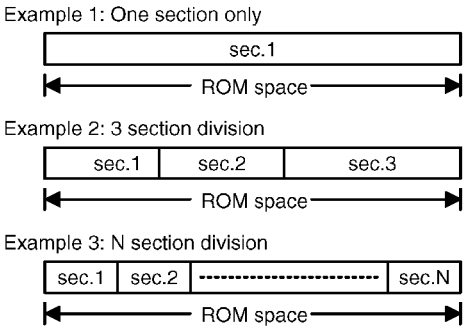


Figure 1 Group selection

A section when triggered by a key input can be played once, repeatedly or cascaded with other sections depending on the instructions of the key function table.
The following are examples of section division:



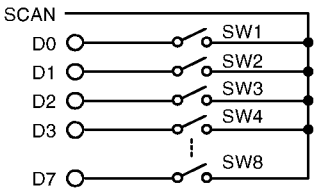
Group

The HT82013 can be divided into eight groups at max. Each group can be made up of one or more sections. A section is allowed to appear in different groups. The following table illustrates the composition of the groups :

Group 1	sec.1+sec.3
Group 2	sec.2+sec.4+sec.4
Group 3	sec.5
:	:
:	:
Group 8	sec.1+sec.2+sec.1

Group selection

All of the eight groups are shared and used by KEY0~KEY3. The initial playing group can be user-defined. Once it is defined, the SCAN pin will output a low-level signal after power is on or during system initialization. The HT82013 will read-in the state of SW1~SW8 from D0~D7 to know which group is the first output group.



For example, group 3 will be output first, followed by group 4, and so on, when SW3 is turned on and one of KEY0~KEY3 is triggered. In this case, the sequence of 3, 4, 5...8, 1, 2 constitutes the playing cycle of the HT82013.

If more than one switch is turned on at a time, the output is determined by the following priority: SW1 > SW2 ... > SW7 > SW8

On the other hand, if no switch is turned on, D0~D7 will read in high-level signals instead, and SW1 will be the default value and group 1 is the first output group.

Power-on status

The HT82013 provides two kinds of power-on operations, namely, auto playing and standby. The chip will play the designated group in auto playing operation, after power is on or during system reset. Otherwise, it will directly enter the standby state

Key functions

The operating functions of KEY0~KEY3 are described as follows (only one key can be active at a time):

Key	Function
KEY0	Power control key, toggle function
KEY1	One shot, non-retriggerable
KEY2	One shot, retriggerable
KEY3	Level hold

- KEY0

  Triggering KEY0 will output sounds from its first group when the system is in the standby mode. The playing group can be stopped by re-triggering KEY0. KEY0, in this case, functions as a stop key. On the other hand, if a key other than KEY0 (KEY1~KEY3) is pressed, the corresponding group will start playing. Triggering KEY0 will stop playing the current group. Then the system enters the standby mode. (refer to Figure 1)

- KEY1

  KEY1 is a one-shot and non-retriggerable key. As a one-shot key, the group corresponding to KEY1 will play once, whether or not KEY1 is pressed momentarily or kept held. The non-retriggerable function of KEY1 will ignore any key input till its playing group is completed. The system will enter an idle state if the playing group of KEY1 is finished and no new key trigger is input. (refer to Figure 2)

- KEY2

  KEY2 is a one-shot and retriggerable key. As a retriggerable key, the playing group of KEY2 will stop if a new key trigger is input. (refer to Figure 3)

- KEY3

  KEY3 is a level hold key. As a level hold key, the playing group of KEY3 will repeat playing as long as KEY3 is pressed and held down. Once this key is released, the playing group will immediately stop. (refer to Figure 4)

- Key debounce time: 250μs, 22ms, 45ms or 180ms

Programming

The recorded sound data can be transformed into an ADPCM code of 3-bit format through HOLTEK's CAD tools. The coded data along with user defined functions including key debounce time, sampling rate, power-on status, active group number, external voice ROM type and number and repeat playing cycle are saved in the external voice ROMs.

Sampling rate

The HT82013 provides eight kinds of sampling rate for code sounds, namely, 4kHz~11kHz. A higher sampling rate will generate sounds of better quality but will shorten the total recording time. On the other hand, a lower sampling rate will result in longer recording time but sacrifice sound quality.

FLAG output

The HT82013 includes two FLAG outputs defined by the users. When playing sounds, the FLAG pin is activated to output one of the following signals:

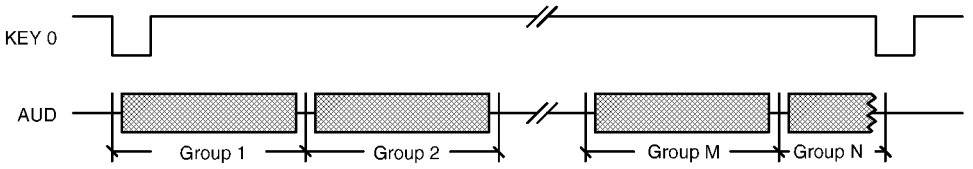


Figure 1

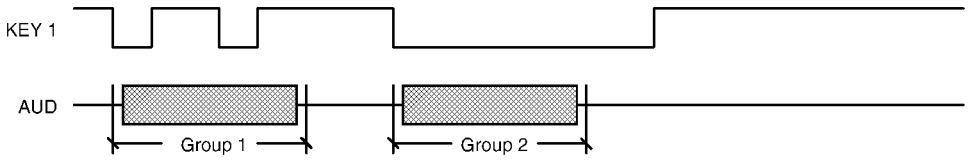
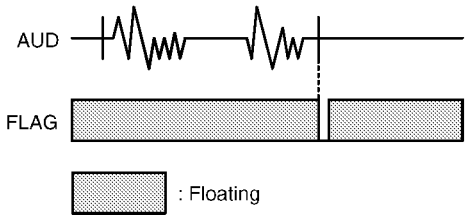


Figure 2

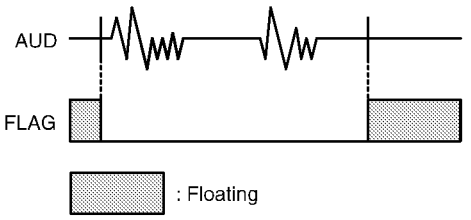
- End-pulse output

  The FLAG pin outputs an active low pulse once the sound output is completed.



- Busy output

  The FLAG pin outputs a low_level signal when sounds are playing, indicating that the chip is busy. On the other hand, it outputs a high_level signal when the chip is in the standby state.



Playing functions

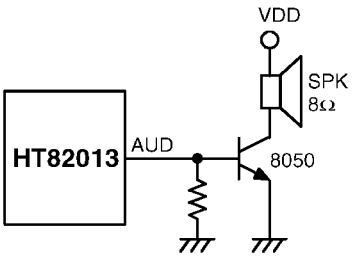
The HT82013 consists of a maximum of eight groups for each key. The groups of each key can be set as repeat playing or play once. For example, group1~group8 of KEY2 can be selected as play once, but that of KEY3 as repeat playing. Triggering KEY0 can stop any repeat playing group. Then, the system enters the standby state. (refer to Figure 5)

AUD

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

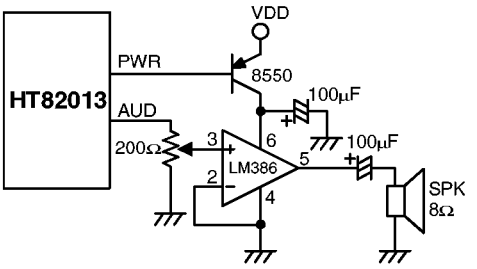
- For transistor

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



- Power amplifier

  The HT82013 provides a FLAG pin to control power consumption in the standby state for power amplifier applications. The output of the FLAG pin is set as busy. An external power amplifier is recommended for a speaker output if a better audio frequency response and more power is required.



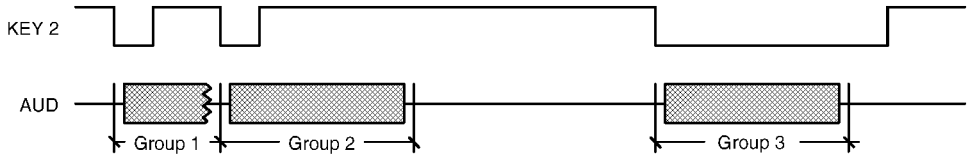


Figure 3

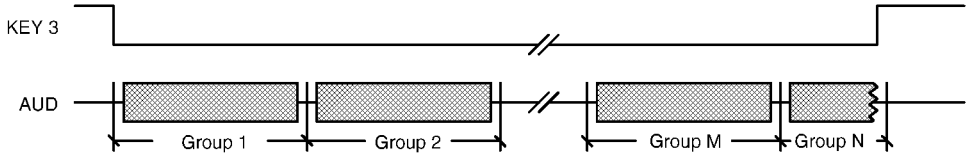


Figure 4

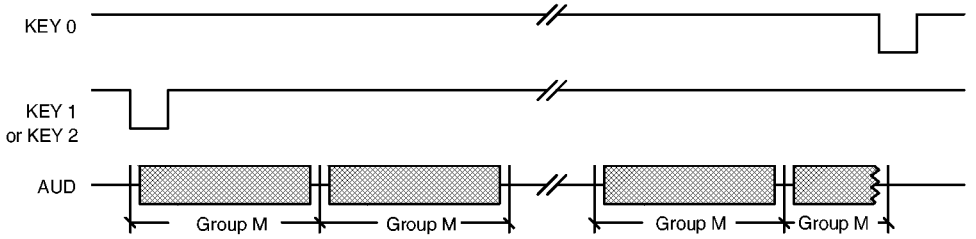
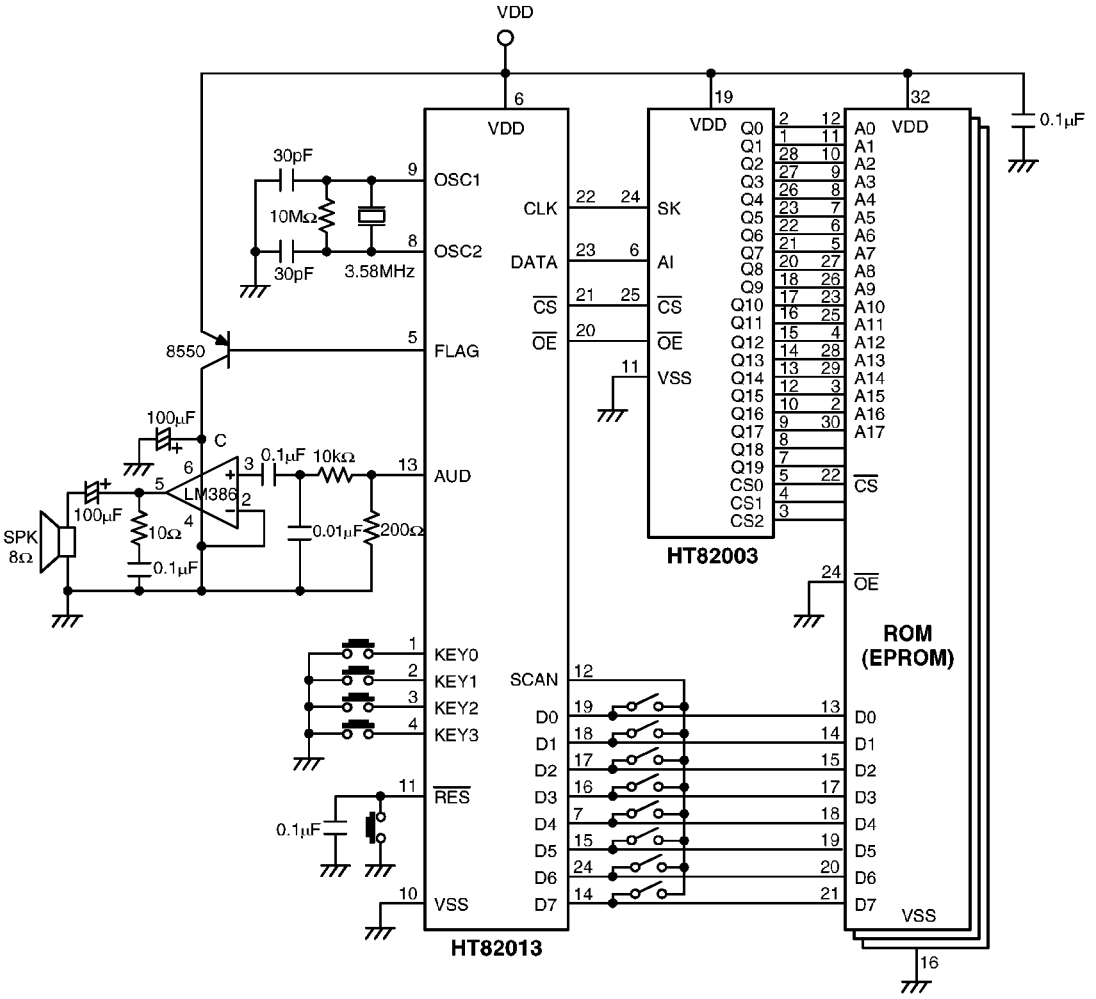


Figure 5

Application Circuits

Application with an LM386 AMP



Application with a transistor