HOLTEK

HT16550
22 Second Music Voice

Features

- Operating voltage: 2.4V~5.0V
- Directly driving an external transistor
- Low stand-by current (1μA Typ. for VDD=3V)
- Minimum external components
- 509 notes (Max.) for table ROM
- Programmable silence length (0~4 secs) and end-pulse width (The minimal pulse width is 330μs when the sampling rate is about 6KHz)
- 22-second voice capacity (Based on a sampling rate of about 6KHz)
- 2 flag outputs:
  - BUSYB: Busy output
  - ENDB: End-pulse output

- Key options (6 independent function keys, but only one of the KEYs can be used)
  - KEY1: Rretriggerable
  - KEY2: Non-retriggerable
  - KEY3: Microphone trigger
  - KEY4: Level-hold trigger
  - KEY5: Toggle trigger
  - KEY6: CDS trigger
- Pull-high resistance options for KEY1, KEY2, KEY4 and KEY5:
  - 100KΩ
  - 50KΩ

Applications

- Toys
- Alarm clocks
- Public address system

- Alert & warning system
- Sound effect generators
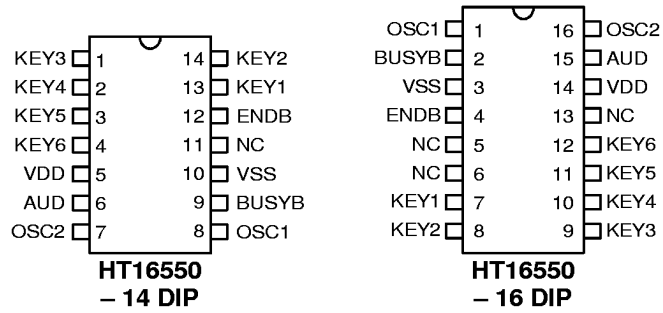- Products with a voice interface

General Description

The HT16550 is a single-chip PCM voice synthesis LSI with 22-second voice capacity at about 6KHz sampling rate. The 22-second capacity can be divided into sections of arbitrary length. The chip includes an on-chip ROM for voice data storage, a current mode D/A converter, a table ROM for playing sequentially programmed sounds and a μ-law table for higher quality.

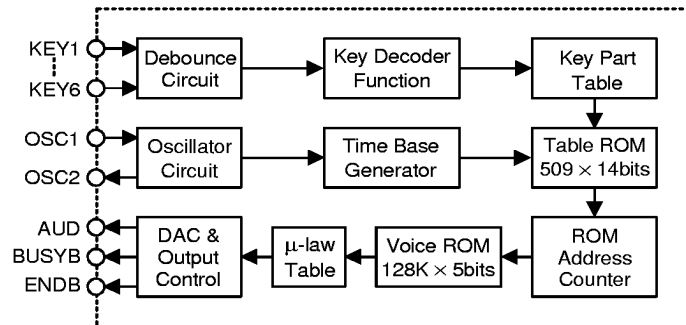The HT16550 provides 6 kinds of trigger keys

and 2 output flags. With 2.4V~5.0V power supply, a complete synthesized voice playback system can be easily built with very few external components.

The customer's voice sources are recorded section by section into an internal mask ROM. The instructions of sectional playback arrangement of each key are stored in the table ROM. The IC is offered in a dice form, 16 DIP or 14 DIP.
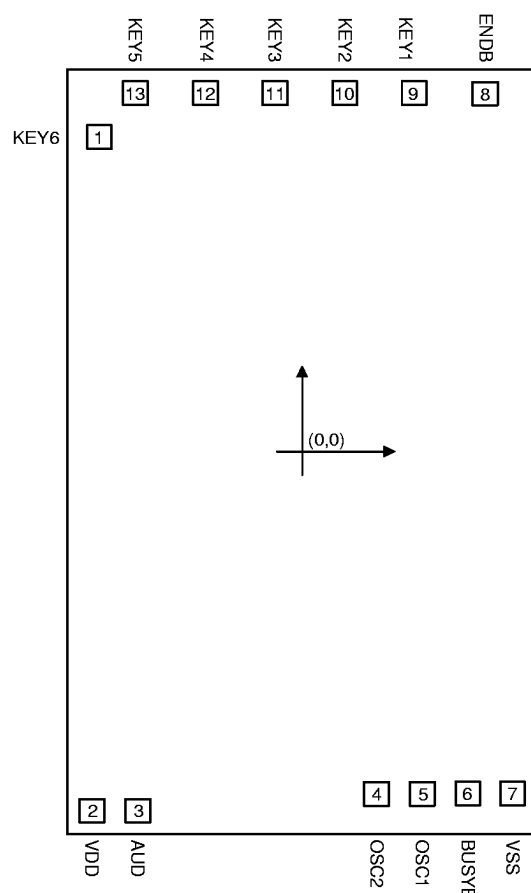
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Pin Assignments

HT16550 – 14 DIP

KEY3	1	14	KEY2
KEY4	2	13	KEY1
KEY5	3	12	ENDB
KEY6	4	11	NC
VDD	5	10	VSS
AUD	6	9	BUSYB
OSC2	7	8	OSC1

HT16550 – 16 DIP

OSC1	1	16	OSC2
BUSYB	2	15	AUD
VSS	3	14	VDD
ENDB	4	13	NC
NC	5	12	KEY6
NC	6	11	KEY5
KEY1	7	10	KEY4
KEY2	8	9	KEY3

Block Diagram

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Pad Coordinates

Chip size: 1670×2900 (μm)^2

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

Unit: μm

Pad No.	X	Y	Pad No.	X	Y
1	−684.90	1110.90	8	617.60	1262.30
2	−709.30	−1265.90	9	377.40	1264.80
3	−554.70	−1265.90	10	144.10	1264.80
4	250.40	−1205.00	11	−92.30	1264.80
5	405.40	−1205.00	12	−326.70	1264.80
6	558.30	−1203.00	13	−562.50	1264.80
7	709.70	−1204.50			

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Pin Description (16 Pin Version)

Pin No.	Pin Name	I/O	Internal Connection	Description
1	OSC1	I	—	Oscillator input pin
2	BUSYB	O	NMOS Open Drain	Busy output for display or control, open drain, active low output
3	VSS	I	—	Negative power supply (GND)
4	ENDB	O	NMOS Open Drain	End-pulse output for display or control, open drain, active low output
5,6	NC	—	—	No connection
7	KEY1	I	Pull-High	A retriggerable key, low active. Any trigger can interrupt the LSI during playing.
8	KEY2	I	Pull-High	A non-retriggerable key, low active. When the LSI is playing, all triggers are ignored until it is completed.
9	KEY3	I	Pull-High	A microphone trigger key, low active. Its functions are on a par with the functions of KEY2 except that the debounce time of KEY3 is 20μs. VDD should be connected when KEY3 is not used.
10	KEY4	I	Pull-High	A level-hold trigger key, low active. The LSI will keep playing as long as KEY4 is pressed and held down.
11	KEY5	I	Pull-High	A toggle trigger key, low active. KEY4 functions as an ON/OFF key, and its initial state is set to OFF.
12	KEY6	I	Pull-High	A CDS trigger key with a built-in Schmitt trigger circuit, low active. The functions of KEY6 are the same as those of KEY4 except that KEY4 can go on playing as long as it's pressed and held down. But after KEY6 is triggered, its sound group will not stop until it's completed, whether or not KEY6 is continuously pressed or subsequently held down during the output of that sound group. VDD should be connected when KEY6 is not used.
13	NC	—	—	No connection
14	VDD	I	—	Positive power supply
15	AUD	O	PMOS Open Drain	Voice output for driving an external transistor
16	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

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Electrical Characteristics

(Ta=25°C)

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
		V_{DD}	Condition				
V_{DD}	Operating Voltage	—	—	2.4	—	5.0	V
I_{DD}	Operating Current	3V	No load, F_{OSC}=96KHz	—	200	400	μA
I_{STB}	Stand-by Current	3V	—	—	1	3	μA
I_{AUD}	Max. AUD Output Current	3V	V_{OH}=0.6V	–1	–1.5	—	mA
I_{OL}	BUSYB, ENDB Sink Current	3V	V_{OL}=0.3V	1.5	5.0	—	mA
R_{PH1}	Pull-High Resistance of KEY3	3V	V_{IL}=0V	25	50	100	KΩ
R_{PH2}	Pull-High Resistance of KEY6	3V	Non-active	50	100	150	KΩ
			Active	600	1000	1500	KΩ
V_{IH}	"H" Input Voltage	—	KEY1~KEY5	0.8V_{DD}	—	V_{DD}	V
V_{IL}	"L" Input Voltage	—	KEY1~KEY5	0	—	0.2V_{DD}	V
V_H	KEY6 High Trigger Voltage	3V	—	2.0	—	3	V
V_L	KEY6 Low Trigger Voltage	3V	—	0	—	0.8	V
T_{KB1}	Debounce Time of KEY3	3V	F_{OSC}=96KHz	—	20	40	μs
T_{KB2}	Debounce Time of the Other KEYs (Except the KEY3)	3V	F_{OSC}=96KHz	10	20	40	ms
F_{OSC}	System Frequency	3V	R_{OSC}=170KΩ	76	96	116	KHz

Functional Description

The HT16550 is a mask ROM type voice synthe-sizer with 22-second voice capacity. A group of pre-recorded voice sections is played upon receipt of key trigger input signals. Two flag signals are output when playing voices.

The 22-second capacity can be divided into sec-tions of arbitrary length. (Notice that the si-lence length and end-pulse width are not included in the memory.)

By using HOLTEK's programming tools, the contents and arrangement of sections as well as key features are all programmable before de-vice fabrication.

The IC provides 6 key inputs (KEY1~KEY6). Each key represents a different triggering func-tion, namely retriggerable, non-retriggerable,

microphone trigger, level-hold trigger, toggle trigger and CDS trigger. Only one of the 6 KEYs can be used at a time. The debounce time of KEY3 is set to 20μs for the sake of sensitivity enhancement. While, the debounce time of the remaining 5 keys (KEY1~KEY3, KEY4~KEY6) are all set to 22ms. A more detailed description of the 6 triggering functions is stated in the following.

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Key features

- Retriggerable

    KEY1 is a retriggerable key. A group of KEY1 comes into play after KEY1 is triggered. The currently playing group of KEY1 will stop immediately and its first section starts to play if KEY1 is re-pressed.

- Non-retriggerable

    KEY2 is a non-retriggerable key. A group of KEY2 comes into play after KEY2 is pressed. The currently playing group of KEY2 will not stop till the whole group is completed, whether or not it is retriggered in the process of group playing.

- Microphone trigger

    KEY3 is a microphone trigger key. It is triggered by connecting to an external microphone. Once the microphone is triggered, the LSI will start playing. In the microphone trigger mode, any new trigger to the microphone is ignored in the process of sound output until that output is completed. This function is similar to the function of non-retriggerable.

    The key debounce time of KEY3 should be set to $20\mu s$ to increase its sensitivity.

- Level-hold trigger

    KEY4 is a level-hold trigger key. When KEY4 is pressed and held down, its group will keep playing till KEY4 is released. After that, the system enters the idle state.

- Toggle trigger

    KEY5 is a toggle trigger key. A toggle trigger key is analogous to an ON/OFF key in that an initial press of KEY5 starts playing its group, and the second press terminates the playing, and so on. Notice that the initial state of KEY5 is set to the OFF mode.

- CDS trigger

    KEY6 is a CDS trigger key with an internal active resistance. The internal resistance will be switched to a high impedance and the group of KEY6 will be output when the external signal is less than V_L. However, the internal resistance will change to a low impedance and the group currently playing will stop when the input signal is higher than V_H. If the input signal remains in the state less than V_L, the group of KEY6 will be played once.

System oscillator

The HT16550 is built with an RC oscillator which requires only one external resistor for normal applications. The oscillator frequency is typically 96KHz for an external resistor of $170K\Omega$. Nonetheless, the required oscillator frequency may vary with different sampling rates for voice programming. As a result, the values of oscillator resistor may be different for different items.

The oscillator is turned on when triggered by an input key. After playing, the oscillator is turned off and the chip goes into the standby state.
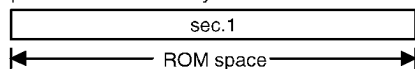
Voice ROM

The voice ROM is originally designed for continuously recording the 22-second voice data at 6 KHz sampling rate. A higher sampling rate will generate sounds of good playback quality but shortens the total recording time. On the other hand, a lower sampling rate will result in longer recording time but sacrifice the voice quality.

By taking advantages of coding efficiency, silence playing, section repeating and section cascade, the playback time can be significantly extended.
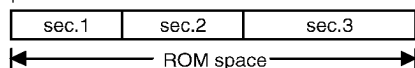
- Section

    Section is the basic element of the contents of voice ROM. During programming, the customer's voice sources can be divided into as many sections as required. A section can be composed of a voice or an interval of silence. The silence length will not be counted in voice ROM. The total number of sections included should be less than 509 due to the space limitations of the function table ROM. As for the total length of the sections included, it is limited by the voice ROM.

    A section when triggered by a key input can be played once, repeatedly or cascaded with other sections depending on the key function table instructions. Following are some examples of section division:
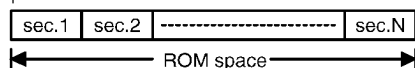
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Example 1: One section only

sec.1

◄───── ROM space ─────►

Example 2: 3 section division

sec.1	sec.2	sec.3

◄───── ROM space ─────►

Example 3: N section division

sec.1	sec.2	-----------------------	sec.N

◄───── ROM space ─────►

• Group

The HT16550 provides a group. The group can be made up of one or more sections. When a key is triggered, the group is played immediately.

• Key function table

Sections in the voice ROM are played according to the instructions of key function table. The function table contains group information and the playing order of sections in the groups. Notice that the total amount of the voice sections included in groups should be less than 509–the space limitation of the function table ROM.

Status display

The HT16550 provides 2 kinds of outputs, indicating the LSI status.

• End-pulse output

The ENDB pin outputs an active low pulse when the voice output is completed. The pulse width is programmable depending on the customer's requirements (default: 2ms, 90ms or 360ms).

AUD

FLAG
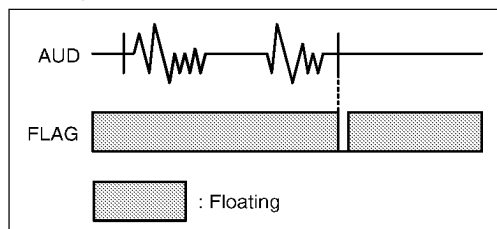
▨ : Floating

• Busy output

When voices are playing, the BUSYB output is turned low, indicating that the chip is busy.

The ENDB and BUSYB pins are both set to floating when the chip is in the standby state.

AUD

FLAG
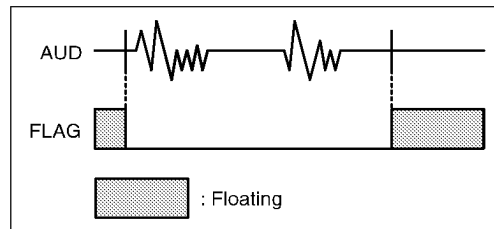
▨ : Floating

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. However, the AUD pin becomes floating when the chip is in the stand-by state.
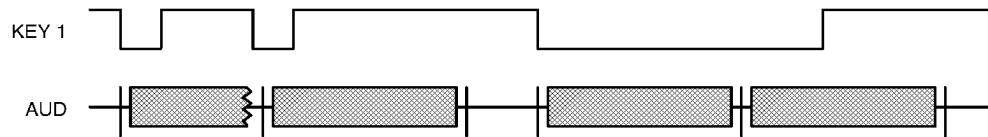
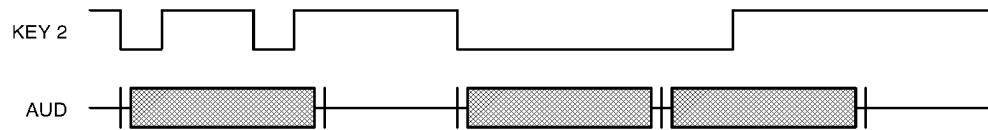The 8050 type transistor with $h_{FE} \cong 150$ is recommended for an output driver.

Rosc — OSC1 VDD
OSC2 AUD
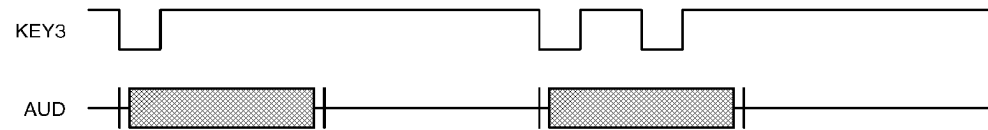VSS
HT16550

VDD
SPK
8050
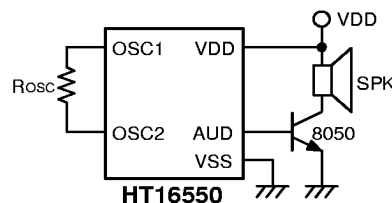
Timing Diagram

Key operation

• Retriggerable

KEY 1

AUD

• Non-retriggerable

KEY 2

AUD

• Microphone trigger

KEY3

AUD

• Level-hold trigger

KEY 4

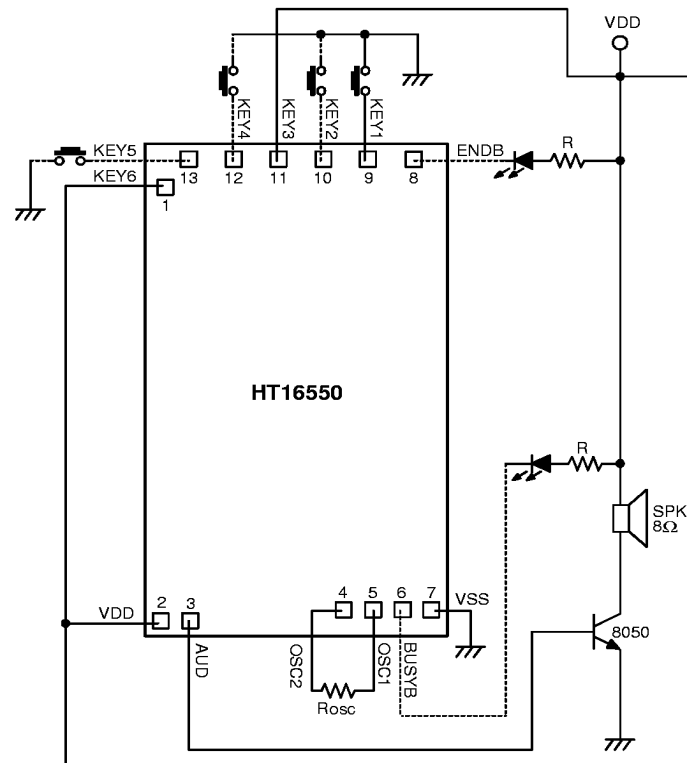AUD

• Toggle trigger

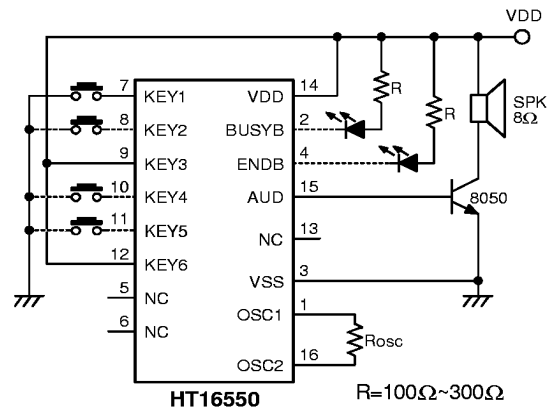KEY 5

AUD

• CDS trigger

KEY 6

AUD
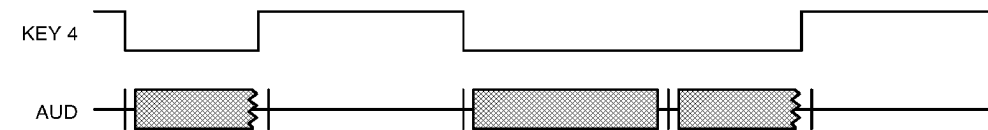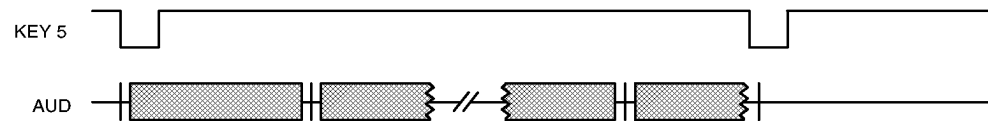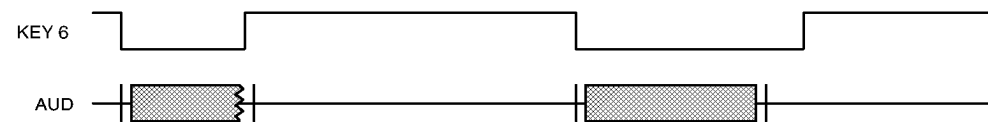
Application Circuits

KEY trigger application (Only one of the KEYs can be selected)

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

$R=100\Omega\sim300\Omega$
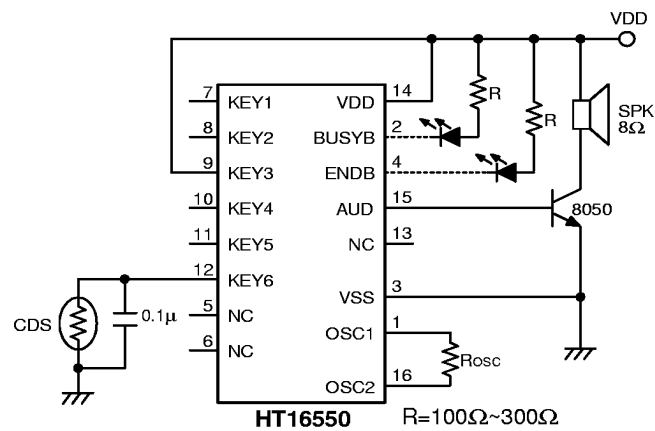
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Microphone trigger application

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

R1, R2 adjust for the senstivity
R=100Ω~300Ω

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CDS trigger application

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

R=100Ω~300Ω

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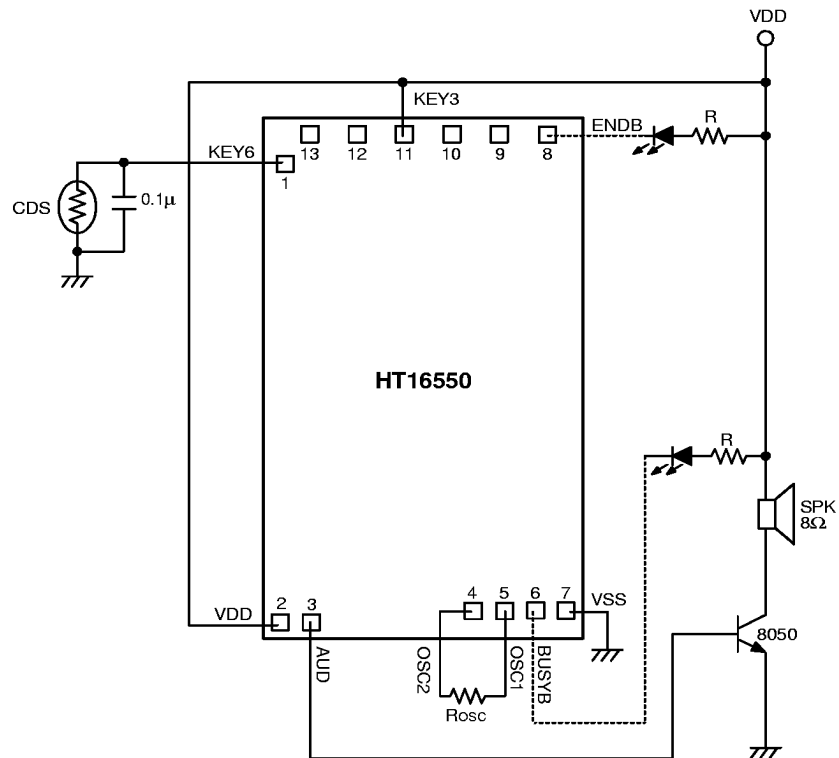
Standard Item List

Item	Name	R_{OSC}
HT16551	ROCK A BYE BABY	160KΩ

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