# HT8657
# Voice Recorder (SRAM)

## Features

- Operating voltage: 4.5V~5.5V
- System frequency: 420kHz
- Standby current: 20μA max.
- ADM algorithm
- SRAM options:
  - 256Kb
  - 64Kb
- Built-in 2-stage microphone amplifier
- Built-in switch capacitor filter
- Current type D/A output
- Voltage type D/A output
- Sampling rate options:
  - 26Kbps (bits per second)
  - 18Kbps
  - 13Kbps
  - 9Kbps
- Addressable memory of 1Mb (4×256Kb) max.
- Memory full indicator

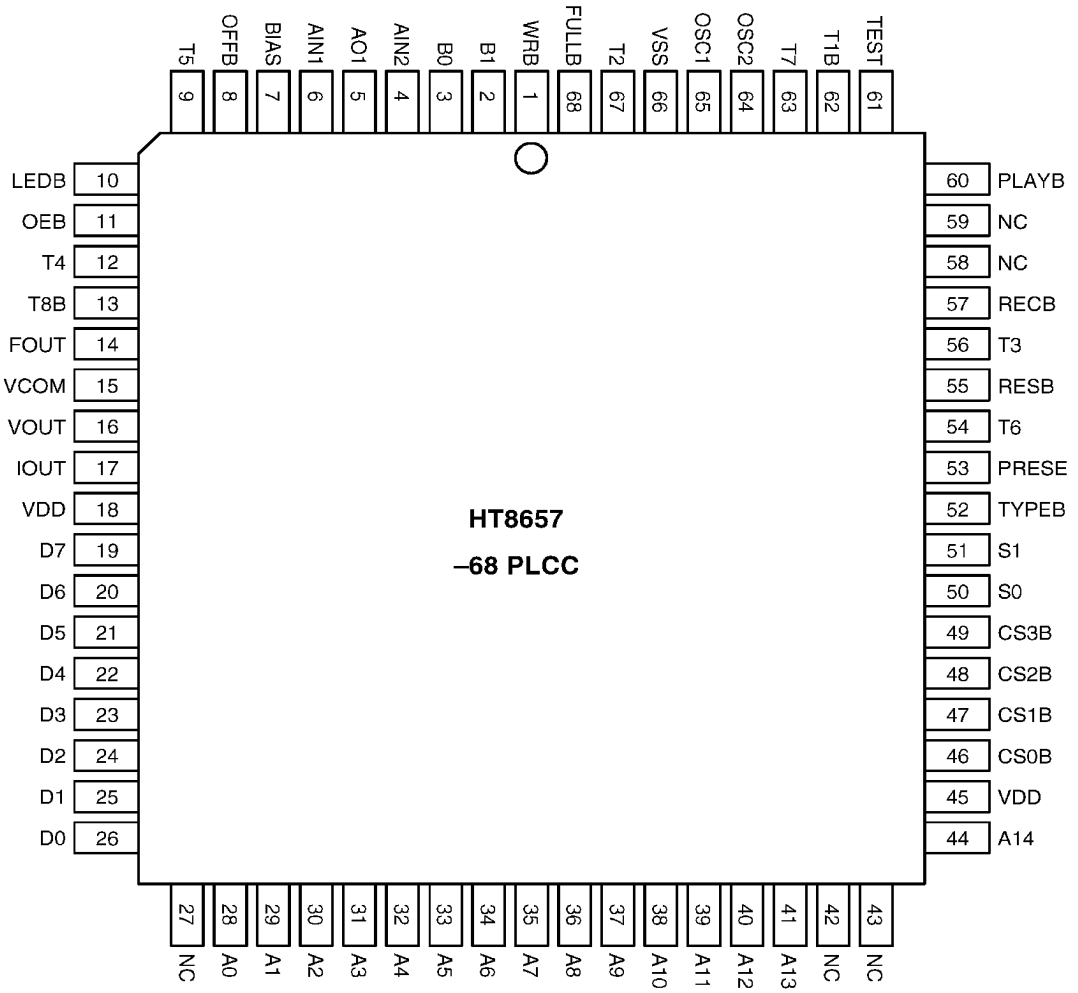
## Applications

- Toys
- Message boxes
- Recorders

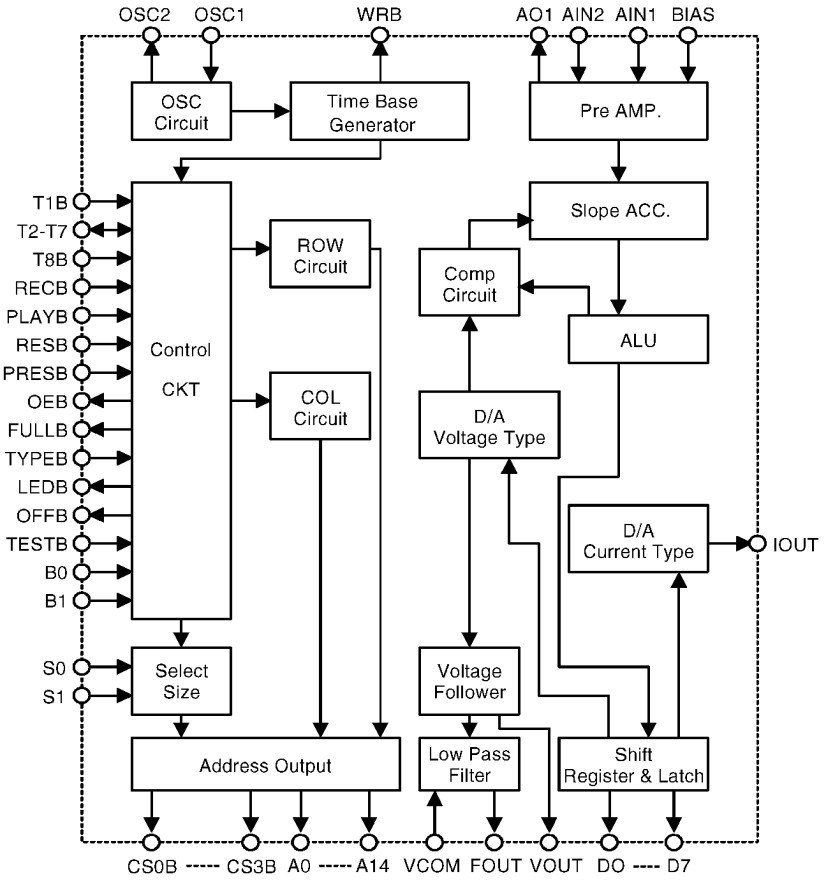
## General Description

The HT8657 is a single chip CMOS LSI designed for recording applications using an ADM algorithm. The IC provides two kinds of recording capacities, namely, 64Kb and 256Kb of SRAM (static random access memory). Recording can be implemented at a sampling rate of either 26, 18, 13 or 9Kbps. A higher sampling rate results in sounds of better quality but sacrifice recording time, and vice versa. The HT8657 provides an internal low pass filter-SCF (switch capacitor filter) for generating sounds of high quality, and it has a built-in MIC (microphone) amplifier for minimizing external required components. The IC can interface with a memory of 1Mb (4×256Kb) at max., to lengthen the recording time.

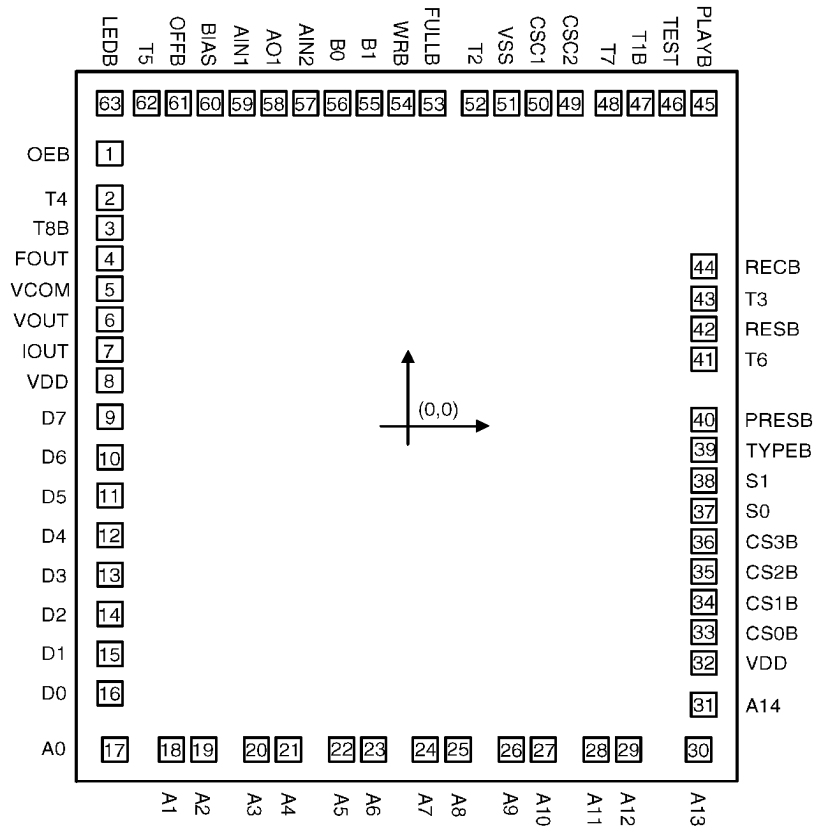
## Pin Assignment



## Block Diagram



## Pad Assignment




Chip size: 155 ×174 (mil)$^2$

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

## Pad Coordinates

Unit: mil

| Pad No. | X | Y | Pad No. | X | Y | Pad No. | X | Y |
|---|---|---|---|---|---|---|---|---|
| 1 | –71.83 | 68.72 | 22 | –16.07 | –81.30 | 43 | 71.23 | 32.13 |
| 2 | –71.83 | 57.59 | 23 | –8.33 | –81.30 | 44 | 71.23 | 40.25 |
| 3 | –71.83 | 49.90 | 24 | 4.12 | –81.30 | 45 | 71.23 | 81.30 |
| 4 | –71.83 | 42.25 | 25 | 12.11 | –81.30 | 46 | 63.58 | 81.30 |
| 5 | –71.83 | 34.60 | 26 | 24.82 | –81.30 | 47 | 55.93 | 81.30 |
| 6 | –71.83 | 26.95 | 27 | 32.56 | –81.30 | 48 | 48.28 | 81.30 |
| 7 | –71.83 | 19.30 | 28 | 45.26 | –81.30 | 49 | 39.02 | 81.30 |
| 8 | –71.83 | 11.60 | 29 | 53.00 | –81.30 | 50 | 31.37 | 81.30 |
| 9 | –71.74 | 2.47 | 30 | 69.91 | –81.30 | 51 | 23.72 | 81.30 |
| 10 | –71.74 | –7.84 | 31 | 71.19 | –70.13 | 52 | 16.07 | 81.30 |
| 11 | –71.74 | –17.43 | 32 | 71.23 | –59.54 | 53 | 5.95 | 81.30 |
| 12 | –71.74 | –27.37 | 33 | 71.23 | –51.89 | 54 | –1.7 | 81.30 |
| 13 | –71.74 | –37.32 | 34 | 71.23 | –44.27 | 55 | –9.35 | 81.30 |
| 14 | –71.74 | –47.26 | 35 | 71.23 | –36.59 | 56 | –17.00 | 81.30 |
| 15 | –71.74 | –57.29 | 36 | 71.23 | –28.94 | 57 | –24.65 | 81.30 |
| 16 | –71.74 | –67.24 | 37 | 71.23 | –21.29 | 58 | –32.30 | 81.30 |
| 17 | –70.51 | –81.30 | 38 | 71.23 | –13.64 | 59 | –39.95 | 81.30 |
| 18 | –56.95 | –81.30 | 39 | 71.23 | –5.99 | 60 | –47.60 | 81.30 |
| 19 | –49.22 | –81.30 | 40 | 71.23 | 1.66 | 61 | –55.25 | 81.30 |
| 20 | –36.51 | –81.30 | 41 | 71.23 | 16.87 | 62 | –62.90 | 81.30 |
| 21 | –28.77 | –81.30 | 42 | 71.23 | 24.52 | 63 | –71.83 | 81.30 |

## Pad Description

| Pad No. | Pad Name | I/O | Internal Connection | Description |
|---|---|---|---|---|
| 1 | OEB | O | NMOS Open Drain | Data output enable |
| 2 | T4 | I/O | — | For IC test only |
| 3 | T8B | I | Pull-High | For IC test only |
| 4 | FOUT | O | — | Audio output through an internal low pass filter |
| 5 | VCOM | I | — | Low pass filter bias |
| 6 | VOUT | O | — | Voltage type audio output for an external power AMP |
| 7 | IOUT | O | PMOS Open Drain | Current type audio output for an external transistor |
| 8 | VDD | I | — | Positive power supply |
| 9~16 | D0~D7 | I/O | — | Data buses interfaced with SRAM |

| Pad No. | Pad Name | I/O | Internal Connection | Description |
|---|---|---|---|---|
| 17~31 | A0~A14 | O | CMOS | Address buses interfaced with SRAM |
| 32 | VDD | I | — | Positive power supply |
| 33~36 | CS0B~CS3B | O | CMOS | Chip selection enable for SRAM1~SRAM4 |
| 37, 38 | S0, S1 | I | Pull-High | SRAM chip number selection |
| 39 | TYPEB | I | Pull-High | SRAM type selection:<br>VDD/Open: 64Kb<br>VSS: 256Kb |
| 40 | PRESB | I | Pull-High | Play mode reset |
| 41 | T6 | I/O | — | For IC test only |
| 42 | RESB | I | Pull-High | System reset |
| 43 | T3 | I/O | — | For IC test only |
| 44 | RECB | I | Pull-High | Record/pause trigger input (toggle function) |
| 45 | PLAYB | I | Pull-High | Play/pause trigger input (toggle function) |
| 46 | TEST | I | — | For IC test only |
| 47 | T1B | I | Pull-High | For IC test only |
| 48 | T7 | I/O | — | For IC test only |
| 49 | OSC2 | O | — | Oscillator output |
| 50 | OSC1 | I | — | Oscillator input |
| 51 | VSS | I | — | Negative power supply (GND) |
| 52 | T2 | I/O | — | For IC test only |
| 53 | FULLB | O | NMOS Open Drain | Memory full indicator (active low) |
| 54 | WRB | O | CMOS | SRAM write enable |
| 55, 56 | B0, B1 | I | Pull-High | Sampling rate selection |
| 57 | AIN2 | I | — | Internal AMP second stage input (inverted) |
| 58 | AO1 | O | — | Internal AMP first stage output |
| 59 | AIN1 | I | — | Internal AMP first stage input (inverted) |
| 60 | BIAS | I | — | For OP bias de-coupling |
| 61 | OFFB | O | CMOS | System activating or inactivating indicator |
| 62 | T5 | I/O | — | For IC test only |
| 63 | LEDB | O | NMOS Open Drain | LED indicator:<br>Record: LED is turned off<br>Play: LED is turned off |

## 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: 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.

## Electrical Characteristics

(Ta=25°C)

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{DD}$ | Conditions | | | | |
| $V_{DD}$ | Operating Voltage | — | — | 4.5 | — | 5.5 | V |
| $I_{DD}$ | Operating Current | 5V | No load, $f_{OSC}$=420kHz | — | 1.5 | 3.0 | mA |
| $I_{STB}$ | Standby Current | 5V | — | — | 600 | 1000 | μA |
| $I_O$ | Max. IOUT Source Current | 5V | $V_{OH}$=0.6V | –1.5 | –3.0 | — | mA |
| $I_{OL}$ | LED Sink Current | 5V | $V_{OL}$=0.5V | 3.0 | 5.0 | — | mA |
| $V_{IH}$ | "H" Input Voltage | — | — | 0.7$V_{DD}$ | — | — | V |
| $V_{IL}$ | "L" Input Voltage | — | — | — | — | 0.3$V_{DD}$ | V |
| $V_{OUT}$ | Max. VOUT Output Voltage | 5V | $R_L$>50kΩ | — | 1.5 | — | $V_{P-P}$ |
| $f_{OSC}$ | Oscillating Frequency | 5V | $R_{OSC}$=68kΩ | — | 420 | — | kHz |

## Functional Description

The HT8657 is a single chip LSI with an external SRAM (Static Random Access Memory). It is designed for sound recording applications. The recording length of the IC is determined by the data rate as well as the size of the external memory. The type and amount of SRAM and the sampling rate should be set before power is turned on. The HT8657 provides two kinds of D/A output for different applications, namely, voltage type and current type. For the current type of output, a sound signal drives a speaker through external transistors. As for the voltage type, an OP amplifier is recommended for an output driver. There are also two voltage type outputs, one is filtered by an internal low pass filter to improve the sound quality as well as minimize external required components. The other one, is non-filtered, and a sound signal can be filtered with an external circuit to determine its audio cut-off frequency and band width.

### Operation mode initial setting

The HT8657 loads the statuses of the S0, S1, B0, B1 and TYPEB pins to a mode register when power is initially turned on or when the system is reset. These pins are internally built with pull-high resistors so that all inputs with "1" are the default value of the mode register. The external resistors are connected to VSS and define the operation mode of the IC as shown in table 1.

### Recording capacity

The HT8657 provides four kinds of voice sampling rate, namely, 26Kbps, 18Kbps, 13Kbps and 9Kbps (based on a system frequency of 420kHz). They can be selected through the connection of the B0 and B1 pins. The voice sampling rate determines the recording capacity of the IC in addition to the DRAM. A higher sampling rate will generate sounds of better quality but sacrifice recording time, and the recording time is defined as shown in Table 2.

| S0 | S1 | B0 | B1 | TYPEB | Description |
|---|---|---|---|---|---|
| 0 | 0 | X | X | X | SRAM chip: 4 pcs. |
| 1 | 0 | X | X | X | SRAM chip: 3 pcs. |
| 0 | 1 | X | X | X | SRAM chip: 2 pcs. |
| 1 | 1 | X | X | X | SRAM chip: 1 pc. |
| X | X | 0 | 0 | X | Sampling rate: 9Kbps |
| X | X | 1 | 0 | X | Sampling rate: 13Kbps |
| X | X | 0 | 1 | X | Sampling rate: 18Kbps |
| X | X | 1 | 1 | X | Sampling rate: 26Kbps |
| X | X | X | X | 0 | SRAM type: 256Kb |
| X | X | X | X | 1 | SRAM type: 64Kb |

Table 1

Notes: 1: Hi level
0: Low level
X: Don't care

| Sampling Rate | SRAM | Recording Time |
|---|---|---|
| 26Kbps | 256Kb×4 | 40 seconds |
| 18Kbps | 256Kb×4 | 56 seconds |
| 13Kbps | 256Kb×4 | 80 seconds |
| 9Kbps | 256Kb×4 | 112 seconds |

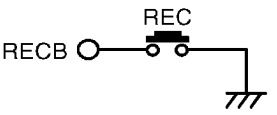
Table 2

### Memory selection

The HT8657 provides an SRAM interface circuit. There are two kinds of SRAM to be selected, namely 64Kb and 256Kb, which are determined by the connection of the TYPEB pin. The number of SRAM can also be set. The chip can interface with a max. of four SRAMs determined by the connection of the S0 and S1 pins. The type along with the total number of SRAM decides the recording length at a designated voice sampling rate.

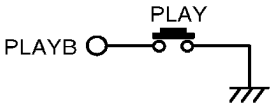
### Record function

The HT8657 enters the recording state from standby state when the REC key is triggered and the memories are not full. In the recording state, sounds coming from an external microphone are coded by an internal ADM (adaptive delta modulation) algorithm and saved in an external memory until all memories are full or the REC key is retriggered. If the REC key is retriggered in the process of recording, recording will pause and the recording counter will stop counting. At this time, if the memories are not full and the REC key is retriggered, the IC will continue recording sounds from the pause position. Once the memories are full, recording will be terminated, the FULLB pin will reset to low and any further re-triggers to the REC key will all be ignored.



### Play function

The HT8657 will play back the recorded sounds at a sampling rate the same as the rate of recording the sounds, after recording is terminated and the PLAY key is triggered as well. During playing, if the PLAY key is retriggered, playing back will pause and the playing counter will stop counting. Playing back will be re-activated at the pause position if the PLAY key is retriggered.

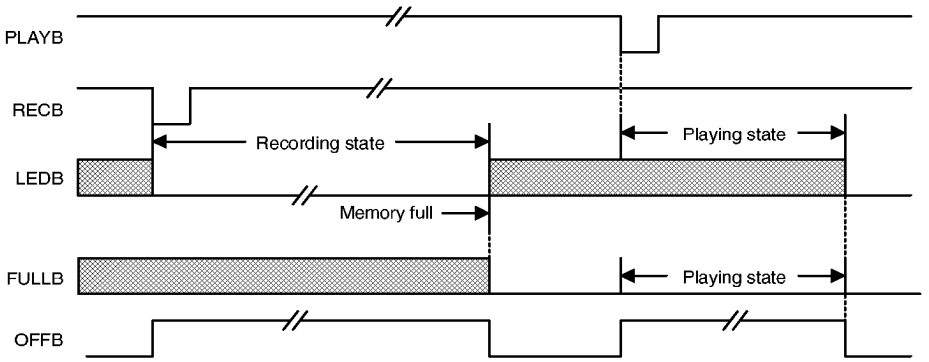



### System reset

Pressing the RES key not only resets the system but also erases all data in the SRAMs. The initial setting will be read in the mode register in addition to resetting the recording and playing counters. Pressing the PRES key, will reset the playing counter and the chip will play the recorded data from address 0.

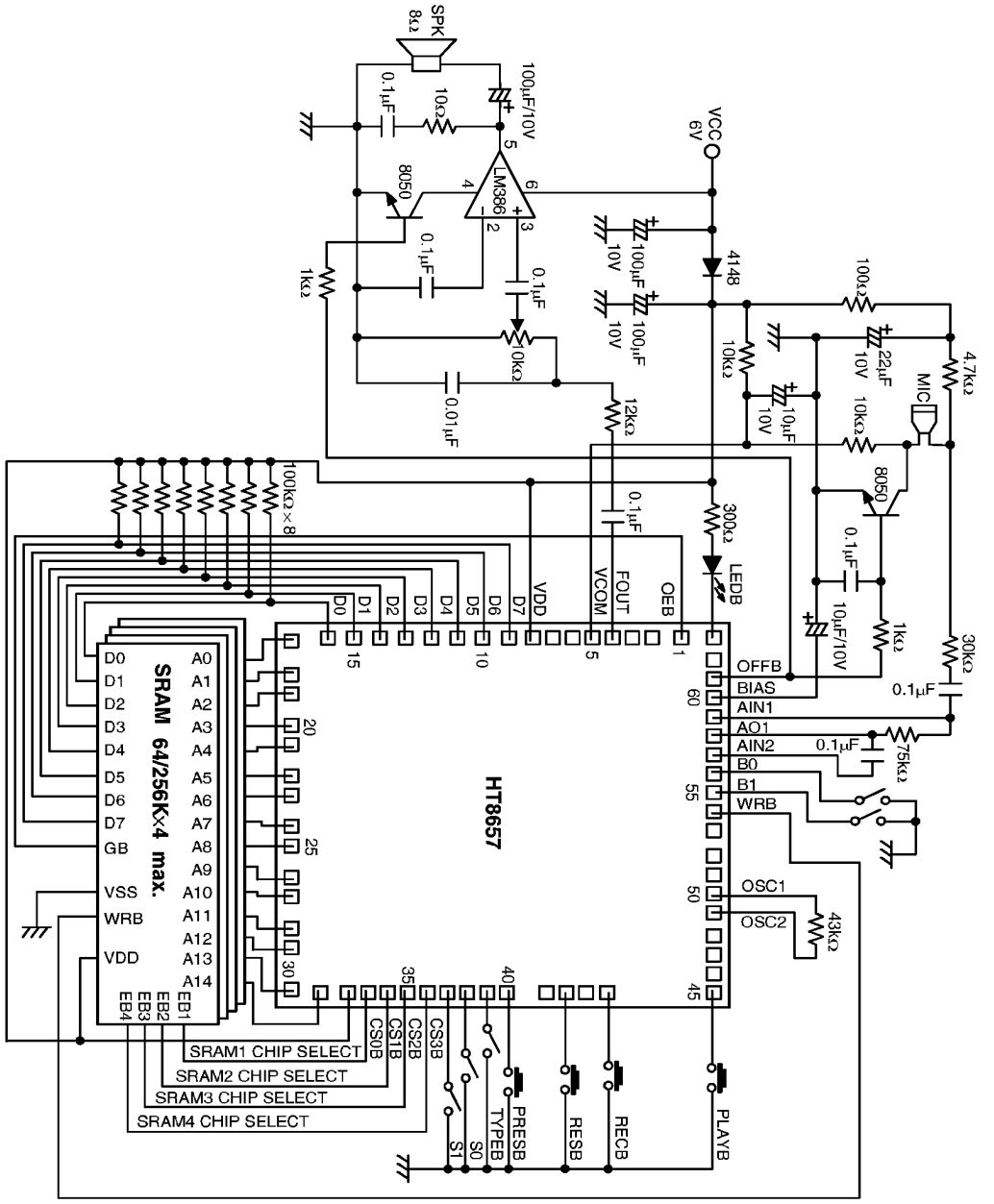
### Indicate function

The HT8657 provides an LEDB pin to indicate the operation status of the chip through an external LED display. LEDB is of high impedance and an external LED is turned off in the standby and playing states. LEDB, however, remains at a low level and LED is switched on in the recording state. Once the memories are full, the FULLB pin will stay at a low level. Otherwise, it is floating. The OFFB pin outputs a high level signal when the system is active (either in the recording or playing state). On the other hand, it outputs a low level signal when the system is in the idle state.

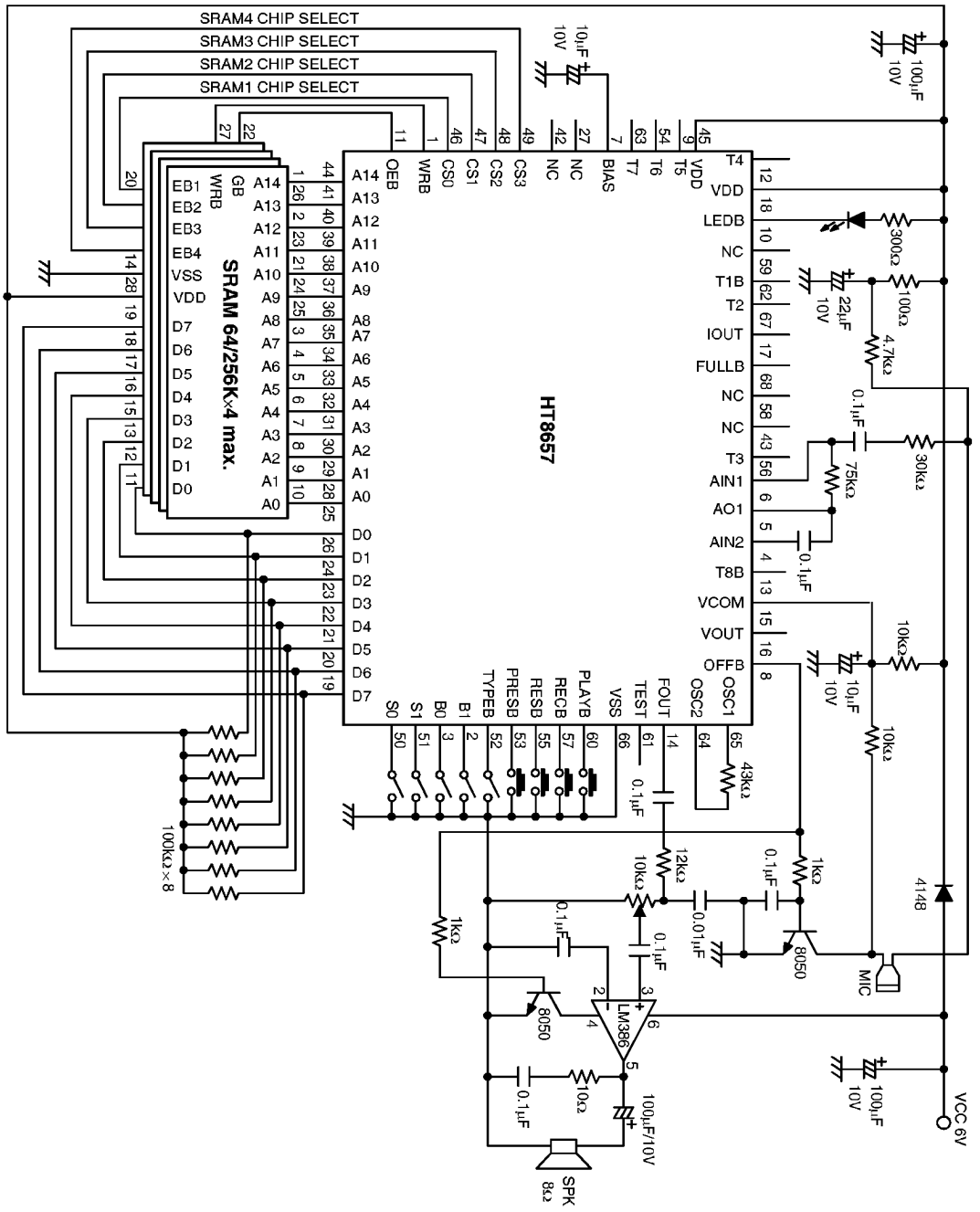


## Application Circuits

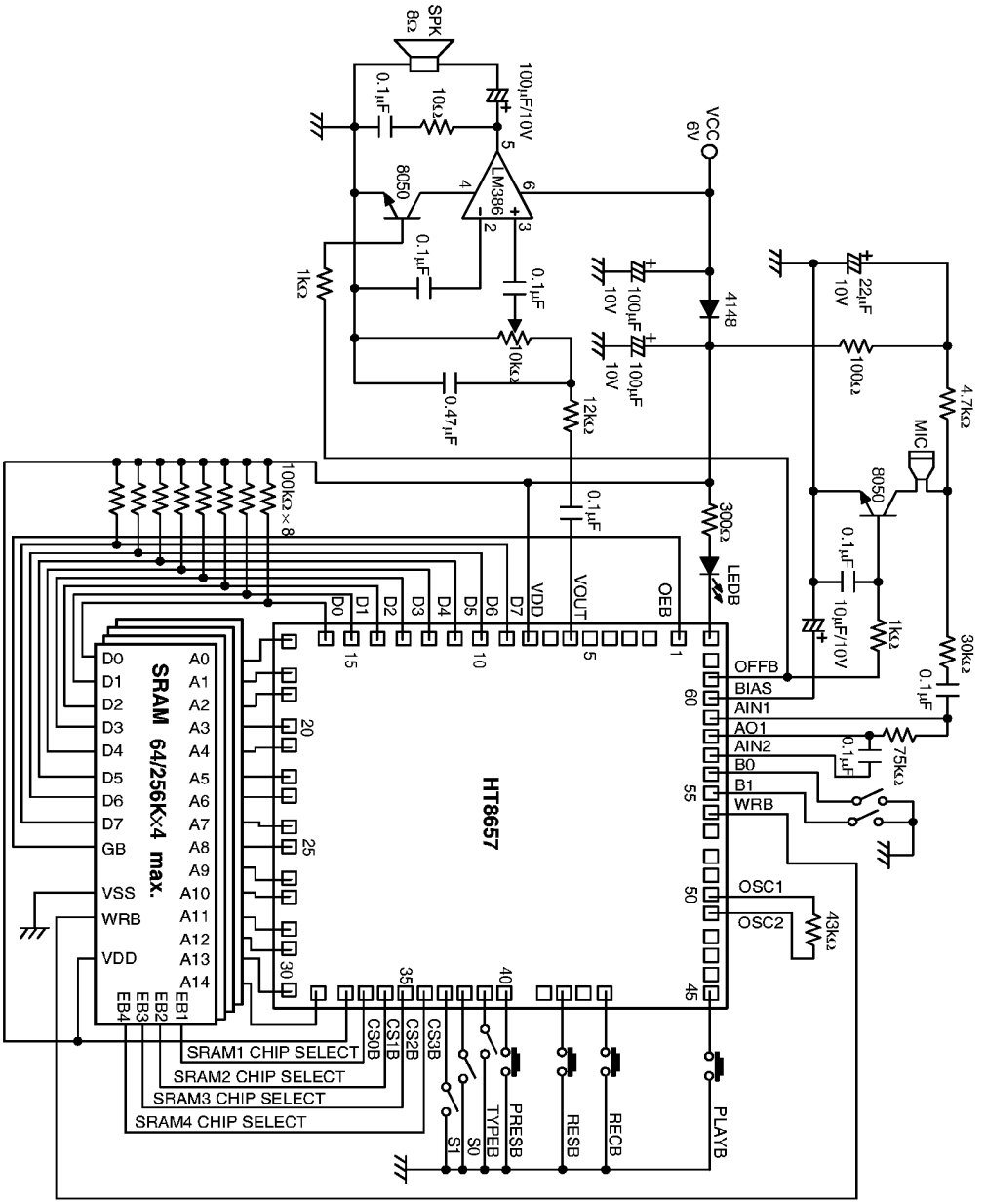
**LM386 output stage driven with an internal low pass filter**



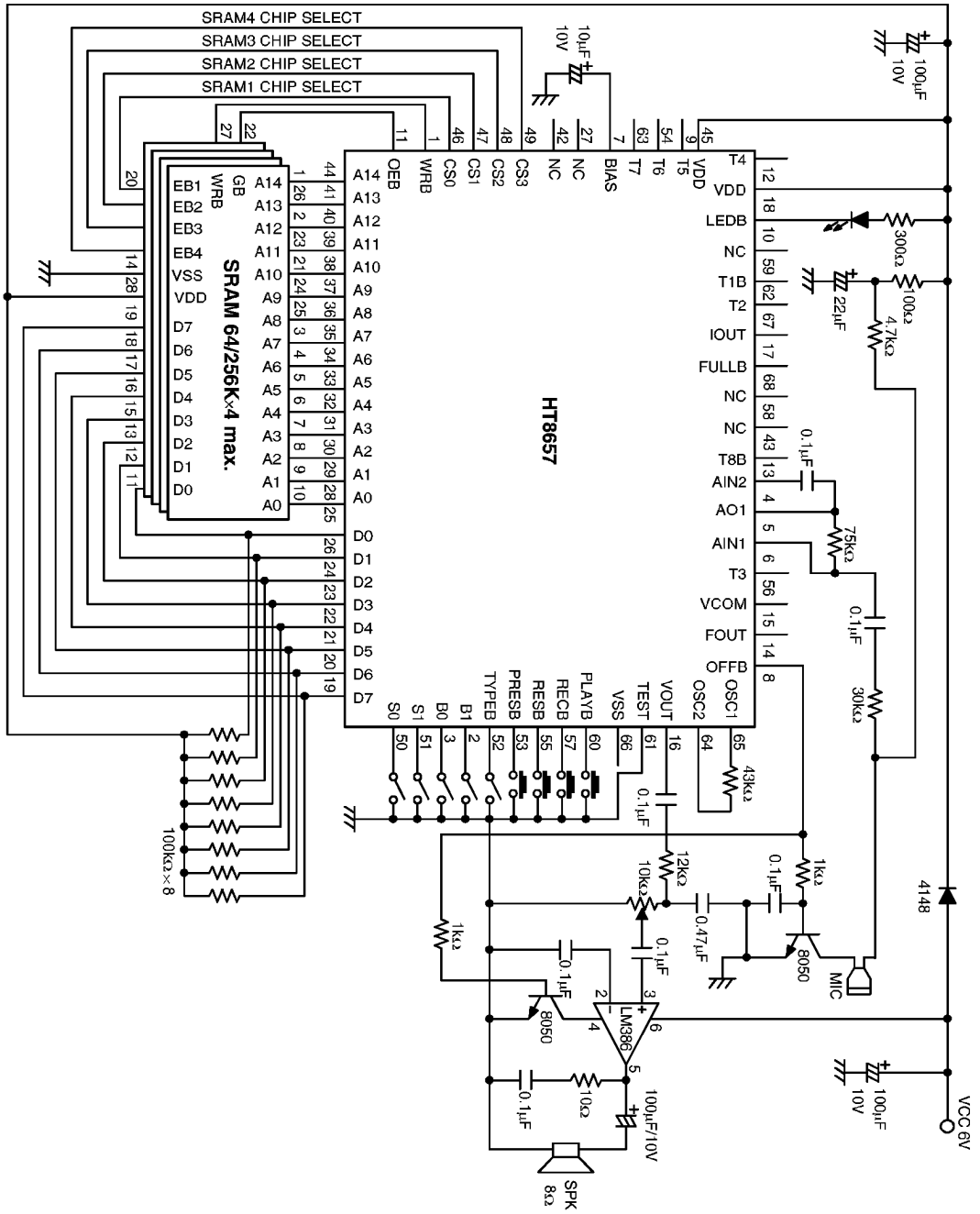

* The IC substrate should be connected to VDD in the PCB layout artwork.



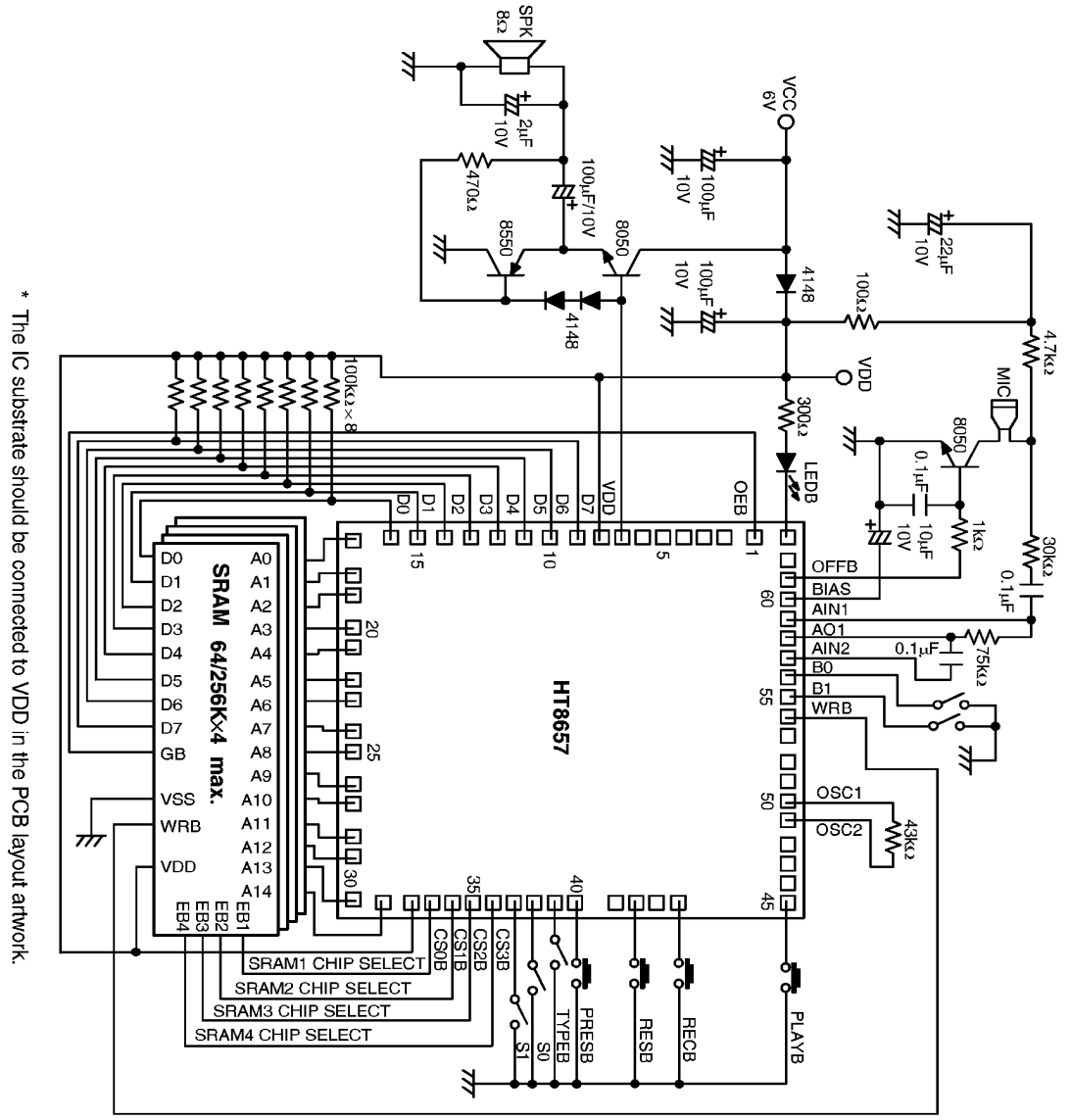
**LM386 output stage driven with an external low pass filter**




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



**Current type output driving a transistor output stage**

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