

## 41 Matrix Key Multi-Function Piano with a Memory

### Features

- Operating voltage: 2.4V~5V
- System operating frequency: 512KHz
- 12 × 7 matrix input keys
- Auto power-off
- Power ON/OFF toggle input
- 41 tones, tone area: G2~B5
- 8 rhythms
- 8 timbres
- 16 steps of tempo speed
- 4 pulsatile sounds
- 12 demo songs
- Memory function with 62 notes
- 40 pin dual-in-line package

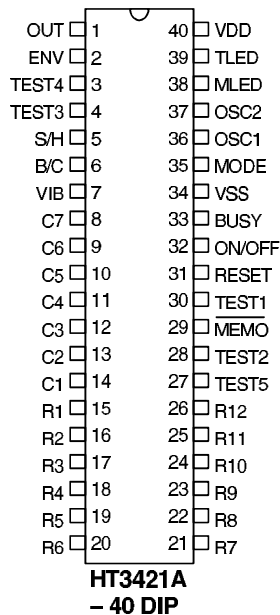
### General Description

The HT3421A is a 41-key musical instrument LSI implemented in the CMOS technology. The chip provides 8 rhythms, 8 timbres, 4 pulsatile sounds, 12 demo songs, and a 62-note memory storage function. The 12 × 7 matrix control keys of the HT3421A control both basic keys and function selection inputs.

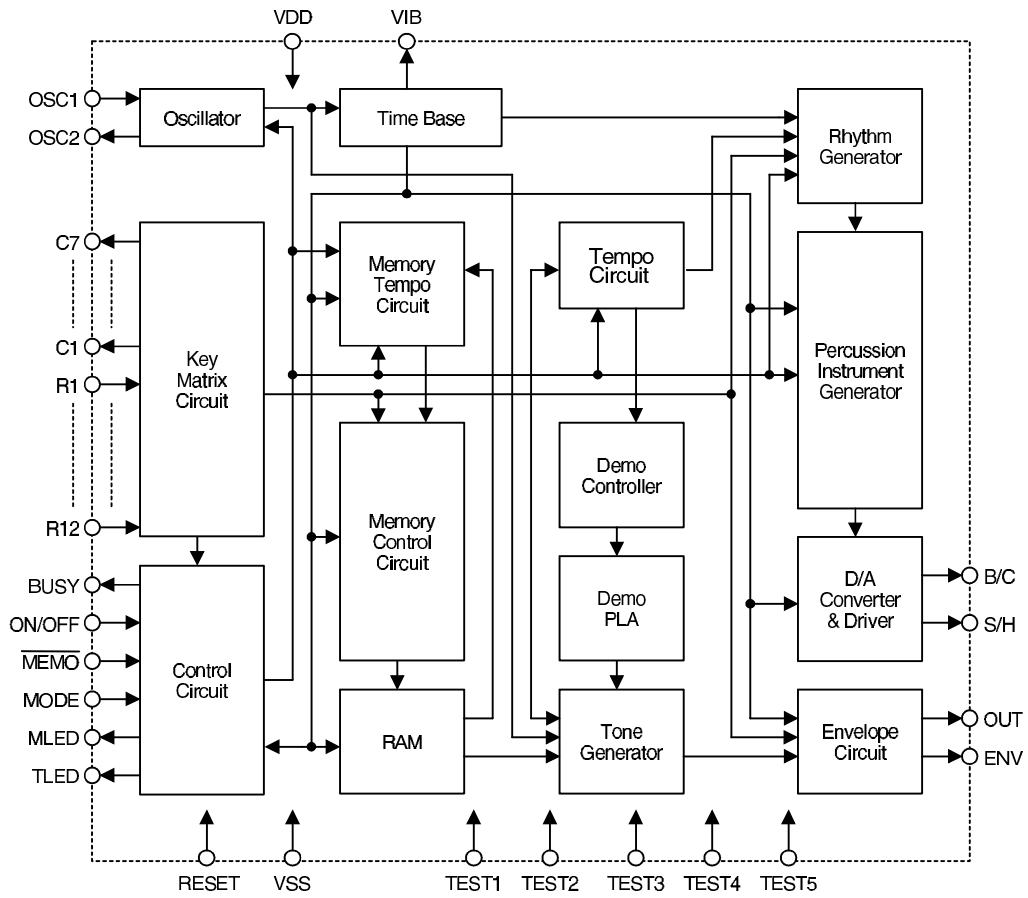
In the Memory mode, the chip can store a tone of 62 notes. Pressing of the Replay key plays the stored songs, or pressing of OKP1 or OKP2 plays the stored songs tone by tone.

In the Demo mode, one of the 12 demo songs can be played. The timbre of the demo song can also be altered according to the instrument chosen.

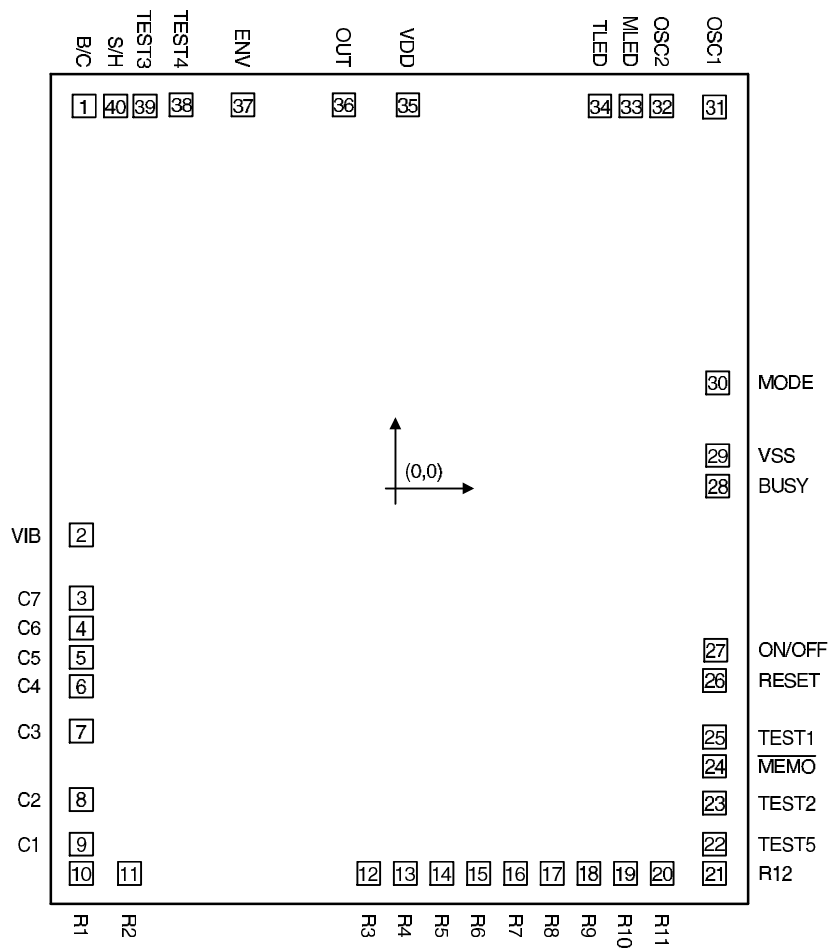
### Pin Assignment



Block Diagram



Pad Assignment



Chip size:  $179 \times 214 \text{ (mil)}^2$

\* 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       |
|---------|--------|---------|---------|--------|---------|
| 1       | -82.17 | 100.34  | 21      | 82.85  | -100.60 |
| 2       | -82.90 | -11.99  | 22      | 82.85  | -92.95  |
| 3       | -82.90 | -28.56  | 23      | 82.85  | -82.24  |
| 4       | -82.90 | -36.38  | 24      | 82.85  | -72.55  |
| 5       | -82.90 | -44.03  | 25      | 82.85  | -64.90  |
| 6       | -82.90 | -51.64  | 26      | 82.85  | -50.11  |
| 7       | -82.90 | -63.33  | 27      | 83.19  | -42.20  |
| 8       | -82.90 | -81.26  | 28      | 83.70  | 0.81    |
| 9       | -82.90 | -92.95  | 29      | 83.70  | 8.80    |
| 10      | -82.90 | -100.60 | 30      | 83.70  | 27.84   |
| 11      | -70.32 | -100.60 | 31      | 82.85  | 100.00  |
| 12      | -7.67  | -100.60 | 32      | 69.08  | 100.34  |
| 13      | 1.93   | -100.60 | 33      | 61.01  | 100.34  |
| 14      | 11.54  | -100.60 | 34      | 52.93  | 100.34  |
| 15      | 21.14  | -100.60 | 35      | 2.61   | 100.68  |
| 16      | 30.75  | -100.60 | 36      | -14.22 | 100.68  |
| 17      | 40.35  | -100.60 | 37      | -40.65 | 100.68  |
| 18      | 50.00  | -100.60 | 38      | -56.80 | 100.68  |
| 19      | 59.56  | -100.60 | 39      | -66.24 | 100.34  |
| 20      | 69.17  | -100.60 | 40      | -73.97 | 100.34  |

**Pin Description**

| Pin No. | Pin Name | I/O | Internal Connection | Description  |
|---------|----------|-----|---------------------|--|
| 1       | OUT      | O   | Transmission Gate   | Tone output  |
| 2       | ENV      | O   | CMOS                | Envelope effect output   |
| 3       | TEST4    | —   | —                   | For IC test only   |
| 4       | TEST3    | —   | —                   | For IC test only   |
| 5       | S/H      | O   | PMOS Open Drain     | Snare-Drum or Hi-Hat pulsatile sound output  |
| 6       | B/C      | O   | PMOS Open Drain     | Bass-Drum or Cow-Bell pulsatile sound output   |
| 7       | VIB      | O   | CMOS                | Vibrato ON: VIB provides a 4Hz signal output.<br>Vibrato OFF: VIB is a low-level output. |
| 8~14    | C7~C1    | O   | NMOS Open Drain     | Matrix control key scanning outputs  |

| Pin No. | Pin Name                 | I/O | Internal Connection | Description   |
|---------|--------------------------|-----|---------------------|---|
| 15~26   | R1~R12                   | I   | CMOS Pull-High      | Matrix control key scanning inputs  |
| 27      | TEST5                    | —   | —                   | For IC test only  |
| 28      | TEST2                    | —   | —                   | For IC test only  |
| 29      | $\overline{\text{MEMO}}$ | I   | CMOS Pull-High      | Connect this pin to VSS/VDD to work in either the memory or play mode.  |
| 30      | TEST1                    | —   | —                   | For IC test only  |
| 31      | RESET                    | I   | CMOS Pull-High      | Power on reset  |
| 32      | ON/OFF                   | I   | CMOS Pull-High      | At power on, the system is in the OFF state. Press the ON/OFF key to alternate the system from OFF to ON or vice versa. When power is auto off, there will be no tone output for 5 minutes. |
| 33      | BUSY                     | O   | CMOS                | BUSY is high while the system is operating, but low when the system is in the stand-by state.   |
| 34      | VSS                      | I   | —                   | Power supply (ground)   |
| 35      | MODE                     | I   | CMOS Pull-High      | Toggle selection of play mode or memory mode<br>The system is in the play mode at power-on.   |
| 36      | OSC1                     | I   | —                   | Oscillator input  |
| 37      | OSC2                     | O   | —                   | Oscillator output   |
| 38      | MLED                     | O   | NMOS Open Drain     | Memory mode indication output   |
| 39      | TLED                     | O   | NMOS Open Drain     | Tempo indication output   |
| 40      | VDD                      | I   | —                   | Power supply (positive)   |

### Absolute Maximum Ratings

Supply Voltage ..... -0.3V to 5.5V      Storage Temperature..... -50°C to 120°C  
 Input Voltage.....  $V_{SS}-0.3V$  to  $V_{DD}+0.3V$       Operating Temperature..... 0°C to 70°C

**Electrical Characteristics**

(Ta=25°C)

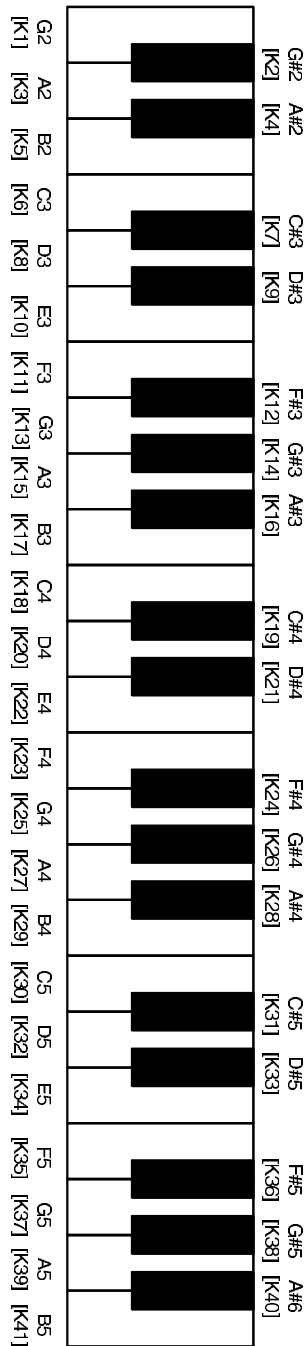
| Symbol           | Parameter                       | Test Condition  |                        | Min.               | Typ. | Max.               | Unit |
|------------------|---------------------------------|-----------------|------------------------|--------------------|------|--------------------|------|
|                  |                                 | V <sub>DD</sub> | Condition              |                    |      |                    |      |
| V <sub>DD</sub>  | Operating Voltage               | —               | —                      | 2.4                | 4.5  | 5                  | V    |
| I <sub>STB</sub> | Stand-by Current                | 4.5V            | —                      | —                  | 5    | 10                 | μA   |
| I <sub>DD</sub>  | Operating Current               | 4.5V            | No load                | —                  | 0.3  | 1                  | mA   |
| I <sub>OL1</sub> | Tone Output Sink Current        | 4.5V            | V <sub>OL</sub> =0.45V | 2.6                | 4.4  | —                  | mA   |
| I <sub>OL2</sub> | Envelop Output Sink Current     | 4.5V            | V <sub>OL</sub> =0.45V | 5                  | 8.6  | —                  | mA   |
| I <sub>OH1</sub> | S/H (B/C) Output Source Current | 4.5V            | V <sub>OH</sub> =4V    | -1.2               | -1.8 | —                  | mA   |
| I <sub>OH2</sub> | Vibrato Output Source Current   | 4.5V            | V <sub>OH</sub> =4V    | -0.6               | -1   | —                  | mA   |
| I <sub>OL3</sub> | C1~C7 Output Sink Current       | 4.5V            | V <sub>OL</sub> =0.45V | 1.8                | 3.0  | —                  | mA   |
| I <sub>IL</sub>  | R1~R12 Input Low Current        | 4.5V            | V <sub>IL</sub> =0.45V | -0.12              | -0.2 | —                  | mA   |
| I <sub>OH3</sub> | BUSY Output Source Current      | 4.5V            | V <sub>OH</sub> =4V    | -1.8               | -3   | —                  | mA   |
| I <sub>OL4</sub> | MLED Output Sink Current        | 4.5V            | V <sub>OL</sub> =0.45V | 1.2                | 2.0  | —                  | mA   |
| I <sub>OL5</sub> | TLED Output Sink Current        | 4.5V            | V <sub>OL</sub> =0.45V | 1                  | 1.8  | —                  | mA   |
| V <sub>IL</sub>  | “L” Input Voltage               | —               | —                      | —                  | —    | 0.2V <sub>DD</sub> | V    |
| V <sub>IH</sub>  | “H” Input Voltage               | —               | —                      | 0.7V <sub>DD</sub> | —    | —                  | V    |
| F <sub>OSC</sub> | System Frequency                | 4.5V            | R <sub>OSC</sub> =48KΩ | —                  | 512  | —                  | KHz  |

**Functional Description**
**Matrix control key position & description**

|            | C1  | C2  | C3  | C4    | C5         | C6   | C7   |
|------------|-----|-----|-----|-------|------------|------|------|
| <b>R1</b>  | K31 | K19 | K7  | Bass  | Tmp up     | Tim1 | Rhm1 |
| <b>R2</b>  | K32 | K20 | K8  | Bell  | Tmp down   | Tim2 | Rhm2 |
| <b>R3</b>  | K33 | K21 | K9  | Snare | Rhm ON     | Tim3 | Rhm3 |
| <b>R4</b>  | K34 | K22 | K10 | Hat   | Rhm        | Tim4 | Rhm4 |
| <b>R5</b>  | K35 | K23 | K11 | —     | Rhm OFF    | Tim5 | Rhm5 |
| <b>R6</b>  | K36 | K24 | K12 | —     | Demo       | Tim6 | Rhm6 |
| <b>R7</b>  | K37 | K25 | K13 | K1    | Vib        | Tim7 | Rhm7 |
| <b>R8</b>  | K38 | K26 | K14 | K2    | Sust       | Tim8 | Rhm8 |
| <b>R9</b>  | K39 | K27 | K15 | K3    | Memo clear | —    | —    |
| <b>R10</b> | K40 | K28 | K16 | K4    | Replay     | —    | —    |
| <b>R11</b> | K41 | K29 | K17 | K5    | OKP1       | —    | —    |
| <b>R12</b> | —   | K30 | K18 | K6    | OKP2       | —    | —    |

| <b>Key Name</b> | <b>Description</b>   |
|-----------------|--|
| K1~K41          | Scale from G2 to B5<br>There is a half-pitch variation among K1~K41. If a key is pressed and held and the other key is pressed as well, the later tone will replace the former tone. Refer to item 2 for the contrast keyboard position. |
| Bass            | Bass drum sound select input<br>Pressing this key adds a single note bass drum sound.  |
| Bell            | Cow bell sound select input<br>Pressing this key adds a single note bell sound.  |
| Snare           | Snare drum sound select input<br>Pressing this key adds a single note snare drum sound.  |
| Hat             | Hi-Hat sound select input<br>Pressing this key adds a single note hi-hat sound.  |
| Tmp up          | 16-level tempo speed selection<br>Set to level 8 at power-on<br>Tempo will speed up while pressing this key until the maximal speed is reached.  |
| Tmp down        | Pressing this key lowers the tempo speed until the minimum speed is reached.   |
| Rhm ON          | Rhythm enabled<br>Set to OFF at power-on   |
| Rhm             | Rhythm enable/disable toggle selection   |
| Rhm OFF         | Rhythm disabled  |
| Demo            | Selection of demo song playing<br>One of the provided 12 demo songs can be chosen by pressing the corresponding key (see section 3 for details). If no key is pressed the first song will be chosen instead.                             |
| Vib             | Vibrato effect ON/OFF toggle selection<br>Set to OFF at power-on   |
| Sust            | Sustain effect ON/OFF toggle selection<br>Set to ON at power-on  |
| Memo clear      | Clear the contents of the memory<br>Used only in the Memory mode   |
| Replay          | Press this key to re-play the song (in memory).  |
| OKP1, OKP2      | This key functions as a Replay function, but it plays only one tone.   |
| Tim1~Tim8       | Timbre selection<br>It is set to Tim1 at power-on (refer to 4 for the instrument names).   |
| Rhm1~Rhm8       | Rhythm selection<br>It is set to Rhm1 at power-on (refer to 5 for the rhythm names).   |

K1~K41 and their corresponding keyboard tone outputs are as shown:



**Demo songs and corresponding keys**

First, press the Demo key to enter the Demo mode, and then press a key to select a song.

| No. | Select Key | Demo Song Name              |
|-----|------------|-----------------------------|
| 1   | K18        | American Patrol             |
| 2   | K20        | It Is a Small World         |
| 3   | K22        | Old Macdonald Had a Farm    |
| 4   | K23        | Yankee Doodle               |
| 5   | K25        | This Old Man                |
| 6   | K27        | Wooden Heart                |
| 7   | K29        | Happy Birthday to You       |
| 8   | K30        | Silent Night                |
| 9   | K32        | Home Sweet Home             |
| 10  | K34        | Symphony No. 9              |
| 11  | K35        | Mary Had a Little Lamb      |
| 12  | K37        | Twinkle Twinkle Little Star |

While the demo song is playing, other “Select keys” can be pressed to alter the song.

The timbre of the demo song can be changed by pressing Tim1~Tim8. Pulsatile sounds can be added by pressing the Bass, Bell, Snare, or Hat input.

During the playing of a song, pressing the demo song key will terminate the output.

The following is a list of the 8-instrument timbre:

| Key  | Instrument  |
|------|-------------|
| Tim1 | Piano       |
| Tim2 | Oboe        |
| Tim3 | Ukulele     |
| Tim4 | Flute       |
| Tim5 | Trumpet     |
| Tim6 | Saxophone   |
| Tim7 | Music Box   |
| Tim8 | Church Bell |

The 8-rhythm list is as shown:

| Key  | Rhythm  |
|------|---------|
| Rhm1 | Chacha  |
| Rhm2 | March   |
| Rhm3 | Rock    |
| Rhm4 | Swing   |
| Rhm5 | 8 Beat  |
| Rhm6 | Beguine |
| Rhm7 | Ballad  |
| Rhm8 | Waltz   |

**Memory mode**

The system enters the memory mode by using either the MEMO or MODE switch. The indicator LED will also indicate the system is in the memory mode. This toggle action MODE switch is effective only if the MEMO switch is connected to VDD or left open. The MEMO switch has an overriding effect and functions irrespective of the condition of the MODE switch.

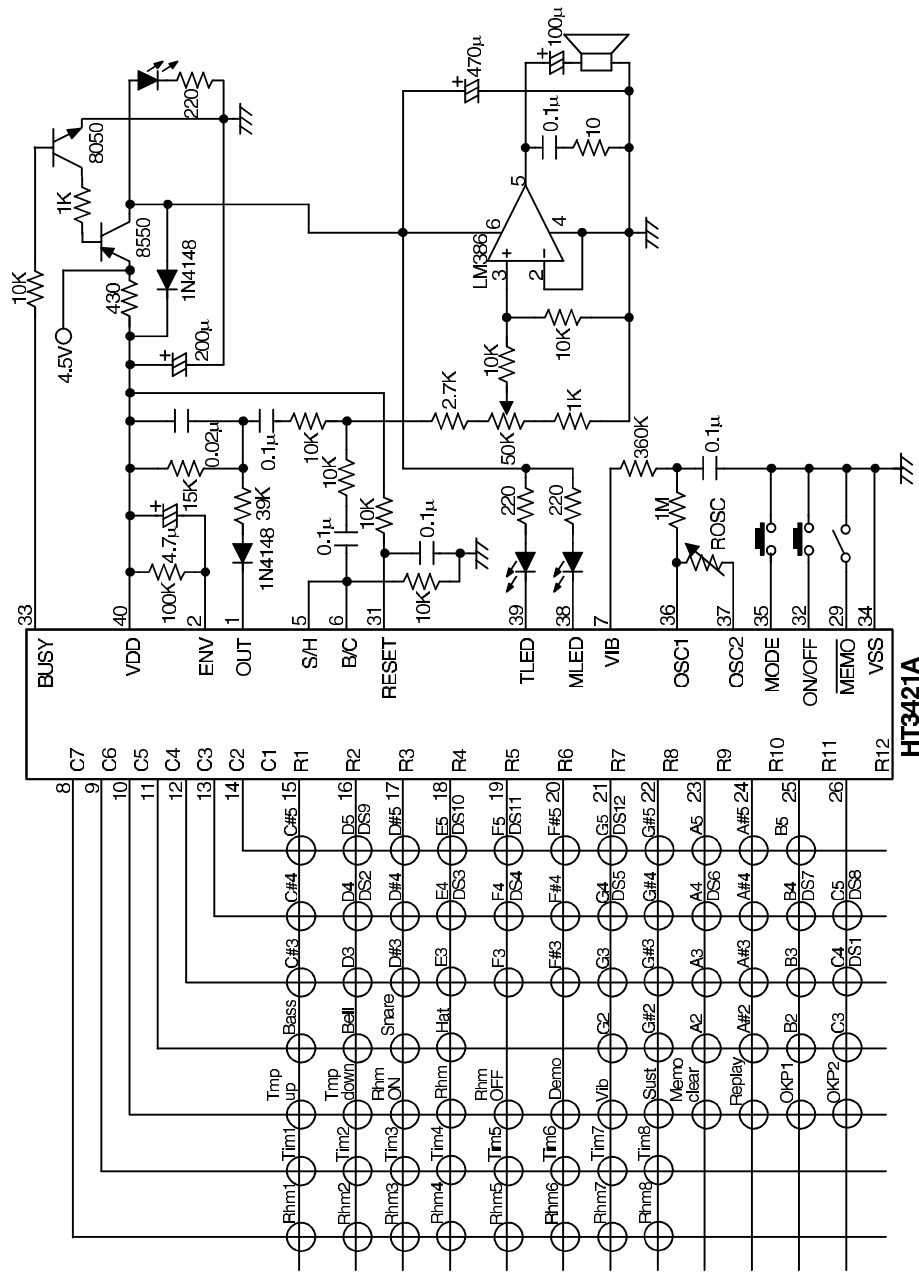
| MEMO        | Action  |
|-------------|---|
| VDD or Open | Initially in the play mode but MODE switch can toggle between play/memory |
| VSS         | In the memory mode only, and MODE switch has no effect                    |

In the memory mode, each sequential pressing of K1~K41 (G2~B5) will be stored, except the rhythm and pulsatile sounds. Pressing of the Memo clear key will erase the contents of the memory.

In either the play or memory mode, the stored song can be played by pressing the Replay key or the stored song is played tone by tone by pressing OKP1 or OKP2.

While in the memory mode, the demo song can be played by pressing the Demo key. Once the demo mode is quit, the system will return to the memory mode.

Application Circuit



DSn: Demo Song No1 ~ No12.  
 \*Note: Vary Rosc to obtain 512KHz system frequency [Rosc=48K].