# HT6221/HT6222
# Multi-Purpose Encoders

## Features

- Operating voltage: 1.8V~3.5V
- DOUT with 38kHz carrier for IR medium
- Low standby current
- Minimum transmission word: one word
- 455kHz ceramic resonator or crystal
- 16-bit address codes
- 8-bit data codes

- PPM code method
- Three double-active keys
- Maximum active keys
  - HT6221: 32 keys
  - HT6222: 64 keys
- Low power and high noise immunity CMOS technology

## Applications

- Television and video cassette recorder controllers
- Burglar alarm systems
- Smoke and fire alarm systems
- Garage door controllers

- Car door controllers
- Car alarm systems
- Security systems
- Other remote control systems

## General Description

The HT6221/HT6222 are CMOS LSI encoders designed for use in remote control systems. They are capable of encoding 16-bit address codes and 8-bit data codes. Each address/data input can be set to one of the two logic states, 0 and 1.

The HT6221/HT6222 contain 32 keys (K1~K32) and 64 keys (K1~K64), respectively. When one of the keys is triggered, the programmed address/data is transmitted together with the header bits via an IR (38kHz carrier) transmission medium.
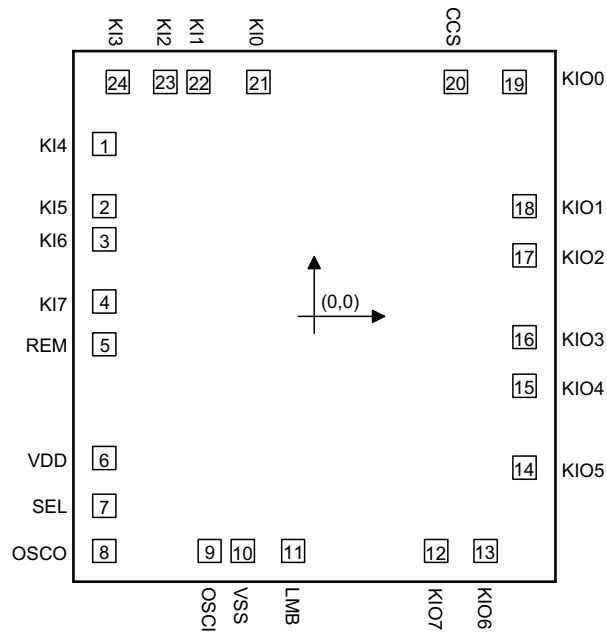
## Block Diagram

## Pin Assignment



**HT6221**
**– 20 DIP/SOP**

**HT6222**
**– 24 DIP/SOP**
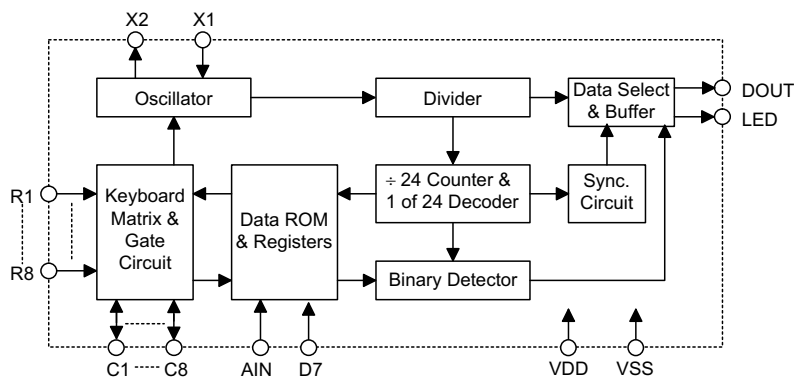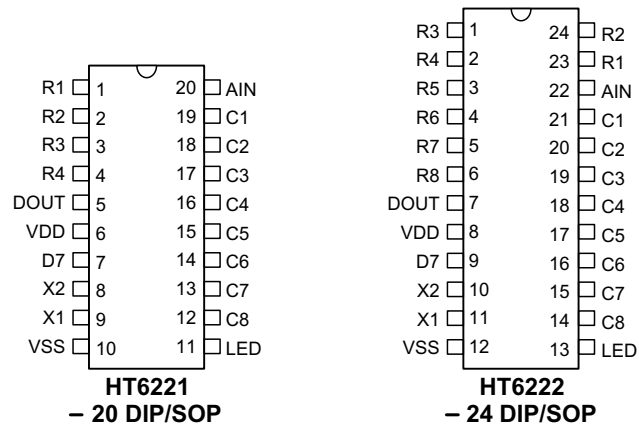
## Pad Assignment



Chip size: $94 \times 104 \ (\text{mil})^2$

* 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 | −41.99 | 34.43 | 13 | 34.17 | −46.88 |
| 2 | −41.99 | 22.02 | 14 | 41.95 | −30.26 |
| 3 | −41.99 | 15.39 | 15 | 41.95 | −13.98 |
| 4 | −41.99 | 2.98 | 16 | 41.95 | −4.12 |
| 5 | −41.99 | −5.61 | 17 | 41.95 | 12.16 |
| 6 | −41.99 | −28.31 | 18 | 41.95 | 22.02 |
| 7 | −41.99 | −37.83 | 19 | 39.99 | 46.84 |
| 8 | −41.99 | −46.88 | 20 | 28.26 | 46.84 |
| 9 | −20.95 | −46.88 | 21 | −11.18 | 46.84 |
| 10 | −14.32 | −46.88 | 22 | −23.16 | 46.84 |
| 11 | −4.25 | −46.88 | 23 | −29.79 | 46.84 |
| 12 | 24.31 | −46.88 | 24 | −39.27 | 46.84 |

## Pin Description

**HT6222**

| Pin No. | Pin Name | I/O | Internal Connection | Description |
|---|---|---|---|---|
| 1~6 | R3~R8 | I | CMOS IN Pull-low | Row control for keyboard matrix, active high |
| 7 | DOUT | O | CMOS OUT | Serial data output pin, with a 38kHz carrier |
| 8 | VDD | — | — | Positive power supply, 1.8V~3.5V for normal operation |
| 9 | D7 | I | CMOS IN | Most significant data bit (D7) code setting |
| 10 | X2 | O | OSCILLATOR | 455kHz resonator oscillator output |
| 11 | X1 | I | OSCILLATOR | 455kHz resonator oscillator input |
| 12 | VSS | — | — | Negative power supply |
| 13 | LED | O | CMOS OUT | Transmission enable indicator output |
| 14~21 | C8~C1 | I/O | CMOS IN/OUT Pull-low | Column control for keyboard matrix |
| 22 | AIN | I | CMOS IN Pull-high Pull-low | Low byte address codes (8 bits) scan input |
| 23~24 | R1~R2 | I | CMOS IN Pull-low | Row control for keyboard matrix, active high |

March 2, 2000

**Approximate internal connection circuits**
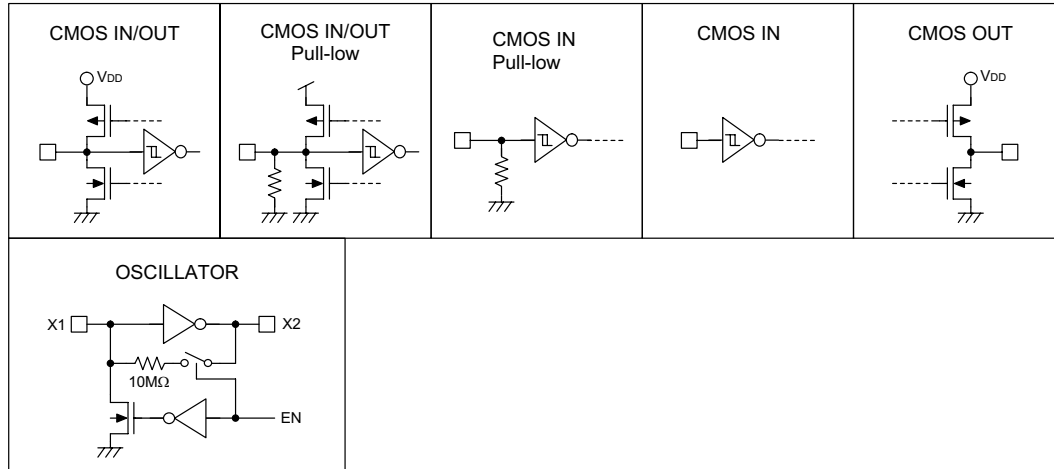


## Absolute Maximum Ratings

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 75°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 Characteristic

Ta=25°C

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------------|---|------|------|------|------|
| | | $V_{DD}$ | Conditions | | | | |
| $V_{DD}$ | Operating Voltage | — | — | 1.8 | 3 | 3.5 | V |
| $I_{STB}$ | Standby Current | 3V | Oscillator stops | — | 0.1 | 1.0 | μA |
| $I_{DD}$ | Operating Current | 3V | $f_{OSC}$=455kHz No load | — | 200 | 400 | μA |
| $I_{OH1}$ | Output Source Current for DOUT | 3V | $V_O$=2.7V | –2.0 | –4.0 | — | mA |
| $I_{OL1}$ | Output Sink Current for DOUT | 3V | $V_O$=0.3V | 50 | 100 | — | μA |
| $I_{OH2}$ | Output Source Current for LED | 3V | $V_O$=2.7V | –10 | –60 | — | μA |
| $I_{OL2}$ | Output Sink Current for LED | 3V | $V_O$=0.3V | 1.2 | 2.0 | — | mA |
| $I_{OH3}$ | Output Source Current for C1~C8 | 3V | $V_O$=2.7V | –0.6 | –2.0 | — | mA |

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | | $V_{DD}$ | Conditions | | | | |
| $I_{OL3}$ | Output Sink Current for C1~C8 | 3V | $V_O$=0.3V | 10 | 30 | — | μA |
| $V_{IH1}$ | Input High Voltage for R1~R8 | 3V | — | 1.9 | — | 3.0 | V |
| $V_{IL1}$ | Input Low Voltage for R1~R8 | 3V | — | 0 | — | 0.8 | V |
| $V_{IH2}$ | Input High Voltage for C1~C8 | 3V | — | 1.1 | — | 3.0 | V |
| $V_{IL2}$ | Input Low Voltage for C1~C8 | 3V | — | 0 | — | 0.6 | V |
| $V_{IH3}$ | Input High Voltage for AIN | 3V | — | 1.25 | — | 3.0 | V |
| $V_{IL3}$ | Input Low Voltage for AIN | 3V | — | 0 | — | 0.6 | V |
| $R_{PH1}$ | Input Pull-high Resistance for AIN | 3V | $V_{IN}$=0V | 100 | 200 | 400 | kΩ |
| $R_{PL1}$ | Input Pull-low Resistance for AIN | 3V | $V_{IN}$=3V | 70 | 150 | 250 | kΩ |
| $R_{PL2}$ | Input Pull-low Resistance for R1~R8 | 3V | $V_{IN}$=3V | 120 | 200 | 320 | kΩ |
| $R_{PL3}$ | Input Pull-low Resistance for C1~C8 | 3V | $V_{IN}$=3V | 300 | 500 | 1500 | kΩ |
| $f_{OSC}$ | System Frequency | — | 455kHz ceramic resonator | — | 455 | — | kHz |

## Functional Description

### Keyboard scan

The HT6221/HT6222 remain in the halt mode during the standby state (at this time, the oscillator stops, and the standby current<1μA). The HT6221 consists of 32 active keys, and the HT6222 has 64 active keys. The keyboard forms of the HT6221/ HT6222 are shown below.

• The HT6221 keyboard form
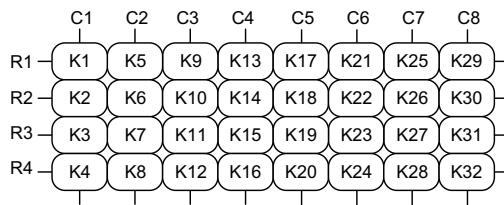


• The HT6222 keyboard form

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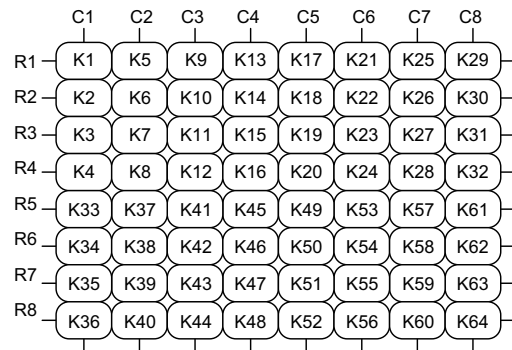
When one of the keys (32 or 64 keys) is triggered for over 36ms, the oscillator is enabled and the chip is activated. If the key is pressed and held for 108ms or less, the 108ms transmission codes are enabled and comprised of a header code (9ms), an off code (4.5ms), low byte address codes (9ms~18ms), high byte address codes (9ms~18ms), 8-bit data codes (9ms~18ms), and the inverse codes of the 8-bit data codes (18ms~9ms). After the pressed key is held for 108ms, if the key is still held down, the transmission codes turn out to be a composition of header (9ms) and off codes (2.5ms) only.

To avoid mistakes made by keyboard scanning or simultaneous two-key inputs (except for the three double-key active functions (K21+K22, K21+K23, and K21+K24), the HT6221/HT6222 are facilitated with 36ms starting time.

The HT6221/HT6222 also provide three double-key active functions (K21+K22, K21+K23, and K21+K24) for tape deck recording operations. The double-key operation rules are shown in timing 4 and timing 6.

**Transmission codes**

The transmission codes of the HT6221/6222 consist of a 9ms header code, a 4.5ms off code, 16-bit address codes (18ms~36ms), 9ms~18ms 8-bit data codes, and the inverse code of the 8-bit data codes. The following is an illustration of the transmission codes:

Output format for the DOUT
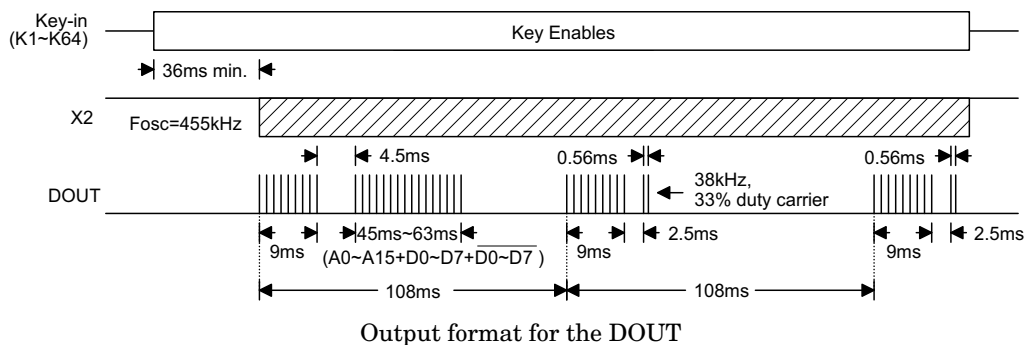
The output code carrier of the DOUT pin is shown in Timing 2:

38kHz carrier
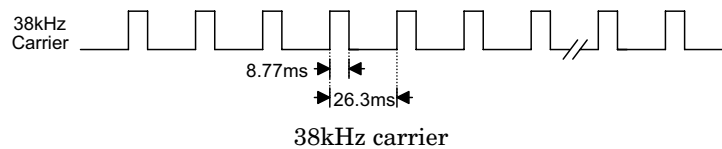
The transmission codes employ the PPM (Pulse Position Modulation) method to represent their two logic states by "0" (1.12ms) and "1" (2.24ms) as shown in Timing 3:

Logic states
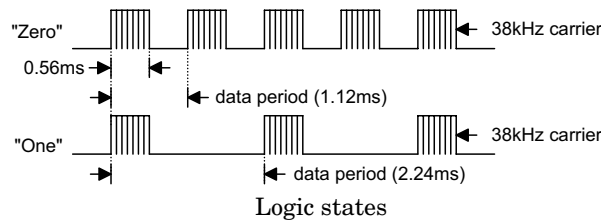
- Setting the address codes (A0~A15)

  The algorithm rule of the address codes (A0~A15) can be selected by mask option.

  In this case, the 16-bit on-chip MASK ROM (ROM1 and ROM2) are available, and the value of ROM1 (8 bits) and ROM2 (8 bits) are decided by one MASK LAYER. The current value of ROM1 and ROM2 are both "00H". The A0~A7 are set by logical OR between the external switch S0~S7 and the ROM1. The A8~A15 equal some bits inverted to A0~A7, the inversion are decided by Logical OR between the external switch S8~S15 and the ROM2.

  For example:

  The following is an illustration of these rules in selecting the address codes (A0~A15).



(Switch Open: 0, Switch Close: 1)
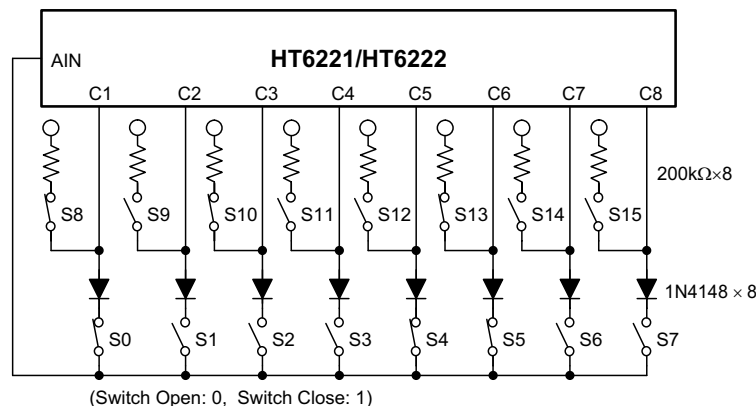
External Switch S0~S15: | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |

On-chip ROM1, ROM2: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

bit0 ---------- bit7  bit0 ---------- bit7

S0~S7 OR ROM1

A0~A7: | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |

S8~S15 OR ROM2

A8'~A15': | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |

A0 $\overline{A1}$ A2 $\overline{A3}$ $\overline{A4}$ A5 $\overline{A6}$ $\overline{A7}$

A8~A15: | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 |

Complement
$\left( \begin{array}{l} \text{1: noninversion} \\ \text{0: inversion} \end{array} \right)$

- Values of the data codes (D0~D7)

The HT6221/HT6222 contain 32 and 64 active keys, respectively. Each key corresponds to a data code. For tape deck recording, the HT6221/HT6222 provide three double-key functions. The double-key, single-key, and double-key operation rules are shown in Table 3, Table 4, Timing 4, Timing 5 and Timing 6.

Table 3: Double-key data code table

| KEY | Data Codes D0~D6 | Data Code D7 |
|---|---|---|
| K21+K22 | 1010110 | 0/1 |
| K21+K23 | 0110110 | 0/1 |
| K21+K24 | 1110110 | 0/1 |

Note: D7 is defined by an external switch
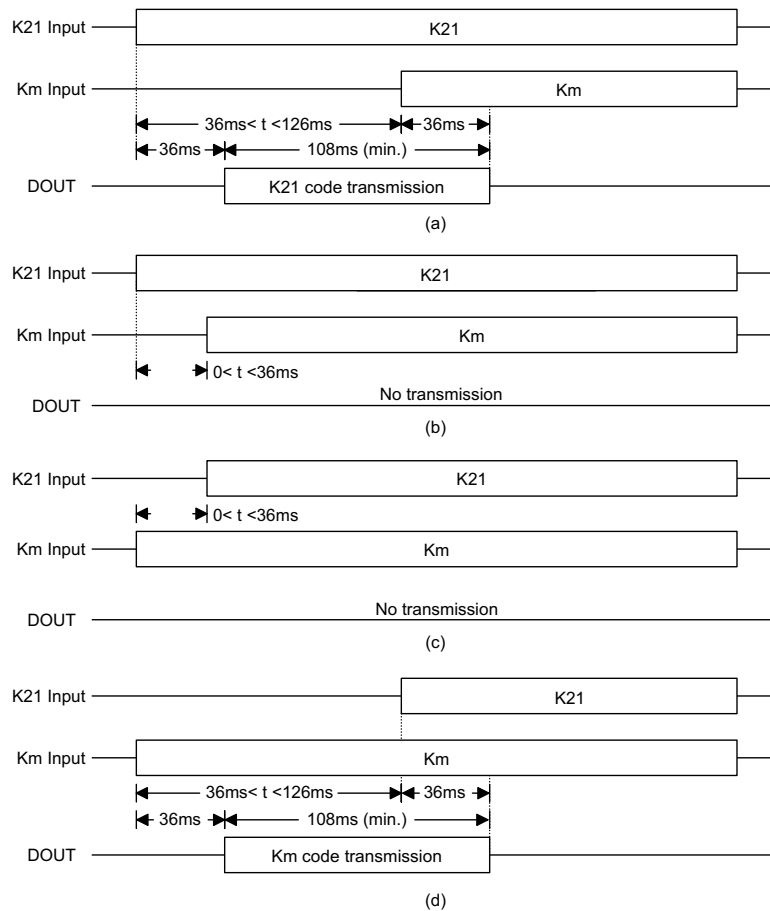
Table 4: K1~K64 single-key data code table

| KEY | Data Codes D0~D6 | Data Code D7 | KEY | Data Codes D0~D6 | Data Code D7 |
|---|---|---|---|---|---|
| K1 | 0000 000 | 0/1 | K33 | 0000 001 | 0/1 |
| K2 | 1000 000 | 0/1 | K34 | 1000 001 | 0/1 |
| K3 | 0100 000 | 0/1 | K35 | 0100 001 | 0/1 |
| K4 | 1100 000 | 0/1 | K36 | 1100 001 | 0/1 |
| K5 | 0010 000 | 0/1 | K37 | 0010 001 | 0/1 |
| K6 | 1010 000 | 0/1 | K38 | 1010 001 | 0/1 |
| K7 | 0110 000 | 0/1 | K39 | 0110 001 | 0/1 |
| K8 | 1110 000 | 0/1 | K40 | 1110 001 | 0/1 |
| K9 | 0001 000 | 0/1 | K41 | 0001 001 | 0/1 |
| K10 | 1001 000 | 0/1 | K42 | 1001 001 | 0/1 |
| K11 | 0101 000 | 0/1 | K43 | 0101 001 | 0/1 |
| K12 | 1101 000 | 0/1 | K44 | 1101 001 | 0/1 |
| K13 | 0011 000 | 0/1 | K45 | 0011 001 | 0/1 |
| K14 | 1011 000 | 0/1 | K46 | 1011 001 | 0/1 |
| K15 | 0111 000 | 0/1 | K47 | 0111 001 | 0/1 |
| K16 | 1111 000 | 0/1 | K48 | 1111 001 | 0/1 |
| K17 | 0000 100 | 0/1 | K49 | 0000 101 | 0/1 |
| K18 | 1000 100 | 0/1 | K50 | 1000 101 | 0/1 |
| K19 | 0100 100 | 0/1 | K51 | 0100 101 | 0/1 |
| K20 | 1100 100 | 0/1 | K52 | 1100 101 | 0/1 |
| K21 | 0010 100 | 0/1 | K53 | 0010 101 | 0/1 |
| K22 | 1010 100 | 0/1 | K54 | 1010 101 | 0/1 |
| K23 | 0110 100 | 0/1 | K55 | 0110 101 | 0/1 |
| K24 | 1110 100 | 0/1 | K56 | 1110 101 | 0/1 |
| K25 | 0001 100 | 0/1 | K57 | 0001 101 | 0/1 |

| KEY | Data Codes D0~D6 | Data Code D7 | KEY | Data Codes D0~D6 | Data Code D7 |
|---|---|---|---|---|---|
| K26 | 1001 100 | 0/1 | K58 | 1001 101 | 0/1 |
| K27 | 0101 100 | 0/1 | K59 | 0101 101 | 0/1 |
| K28 | 1101 100 | 0/1 | K60 | 1101 101 | 0/1 |
| K29 | 0011 100 | 0/1 | K61 | 0011 101 | 0/1 |
| K30 | 1011 100 | 0/1 | K62 | 1011 101 | 0/1 |
| K31 | 0111 100 | 0/1 | K63 | 0111 101 | 0/1 |
| K32 | 1111 100 | 0/1 | K64 | 1111 101 | 0/1 |

Note: D7 is defined by an external switch
 D7=0 : connect to VDD
 D7=1 : connect to VSS

Invalid double-key input

Kn Input ——— | Kn |

|◄ 36ms ►|◄————————— t >108ms —————————►|

DOUT ——— | Kn code transmission |

(a)

Kn Input ——— | Kn |

|◄————— t <108ms —————►|

|◄ 36ms ►|◄————— 108ms —————►|

DOUT ——— | Kn code transmission |

(b)
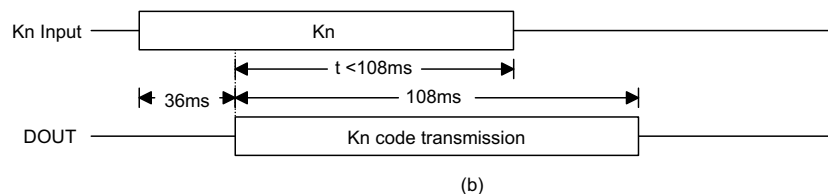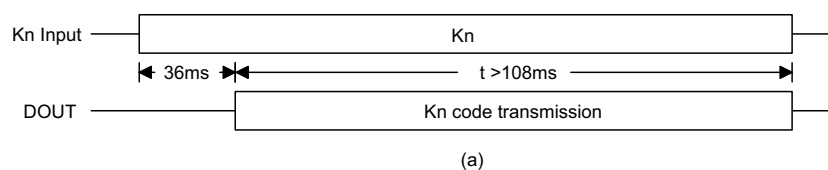
Note: Kn can be one of K1~K64

Valid single-key input

K21 Input ——— | K21 |

Km Input ——— | Km |

|◄ 36ms ►|

|◄ 36ms ►|◄——— t >126ms ———►|◄——— 108ms (min.) ———►|

DOUT ——— | K21 code transmission | K21+Km code transmission |
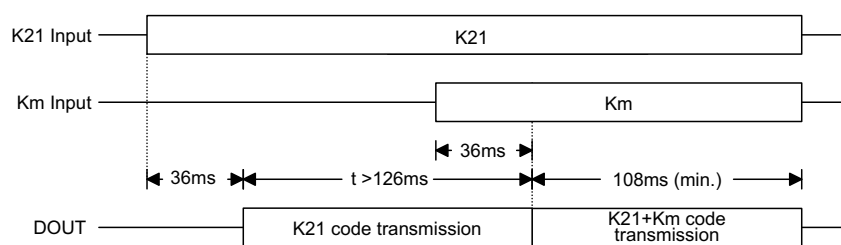
Note: Km can be one of K22~K24

Valid double-key input

## DOUT and LED

After the transmission codes are sent, the DOUT pin generates transmission codes with a carrier, and the LED goes low to drive a transmission indicator.

## Application Circuits

**Application circuit 1**
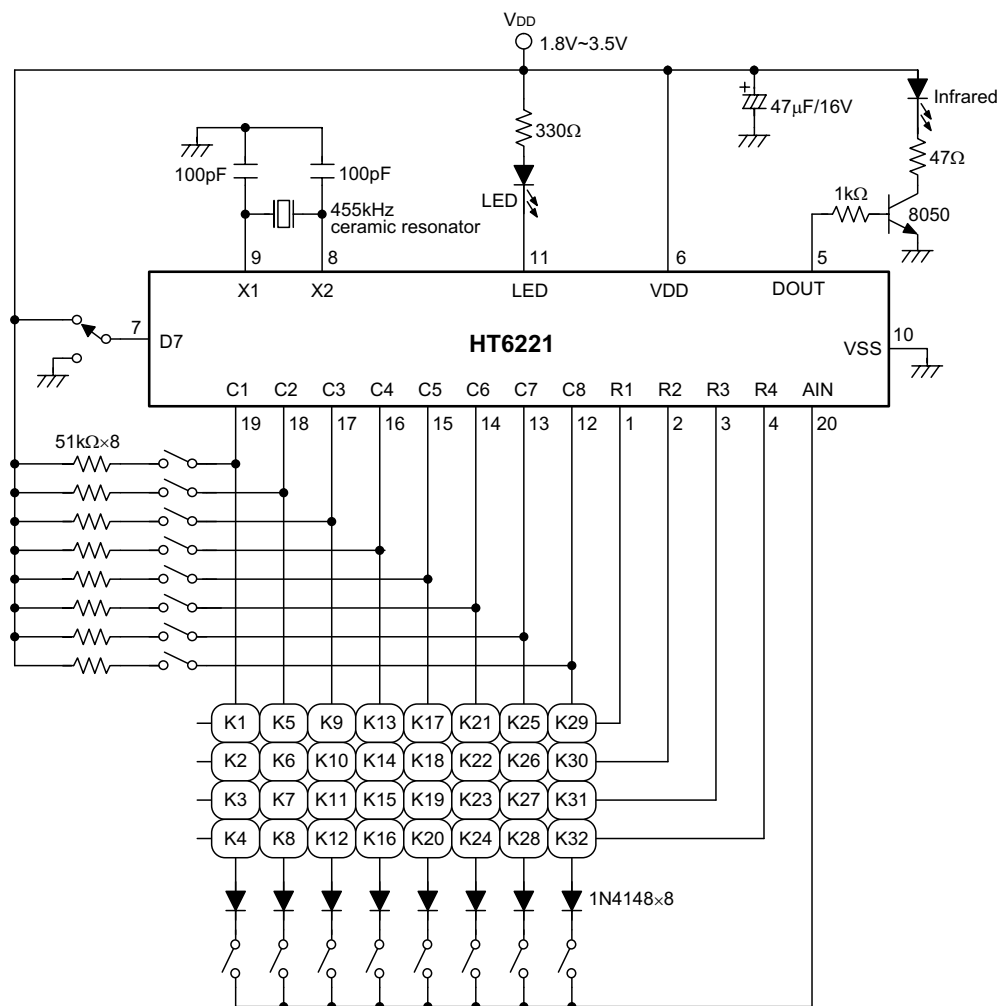


Note: Typical infrared diode: EL-1L2 (KODENSHI CORP.)

**Application circuit 2**
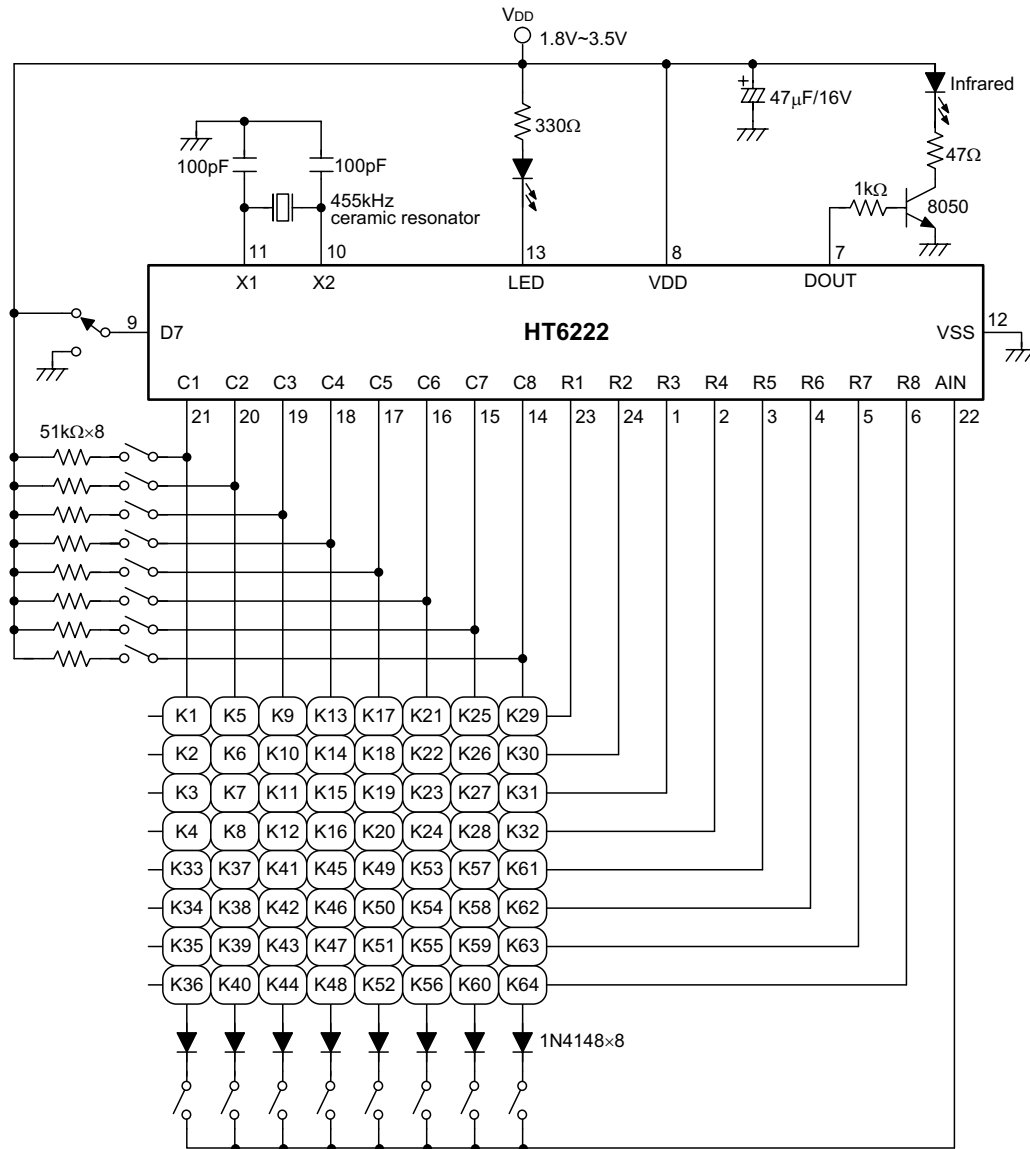


Note: Typical infrared diode: EL-1L2 (KODENSHI CORP.)

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