

### Features

- Operating voltage: 2.2V~3.6V
- Few external parts
- Low power consumption
- 20/24-pin SOP package

### Applications

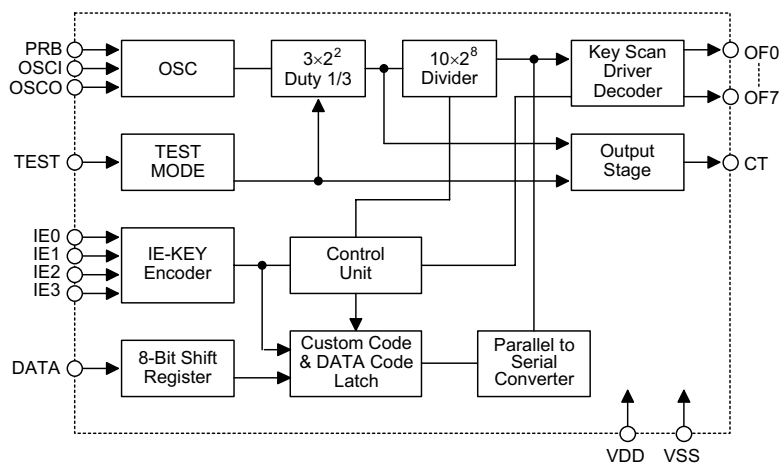
- Television and video cassette recorder controllers
- Car door controllers
- Garage door controllers
- Security systems
- Other remote control systems

### General Description

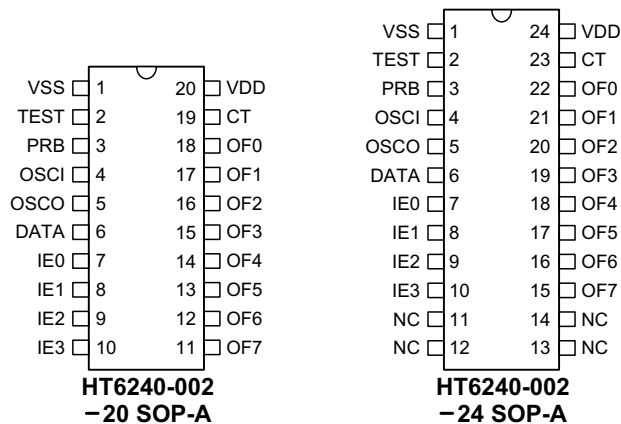
HT6240-002 is designed as infrared remote encoders, usually applied to TV systems. The 4×8 key matrix input and the extension bit input can transmit a max. of 256 in-

structions. HT6240-002 have two different packages: 20-pin SOP and 24-pin SOP.

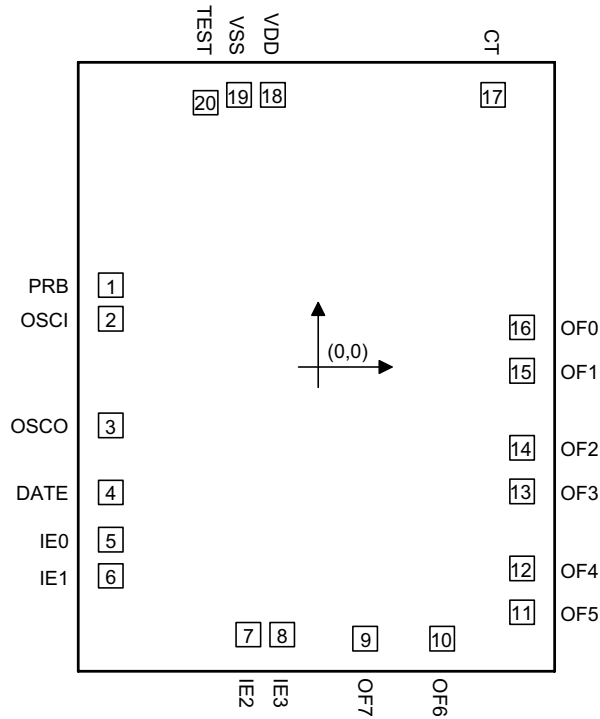
### Block Diagram



### Pin Assignment



**Pad Assignment**



Chip size: 92 × 118 mil<sup>2</sup>

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

**Pad Coordinates**

Unit: mil

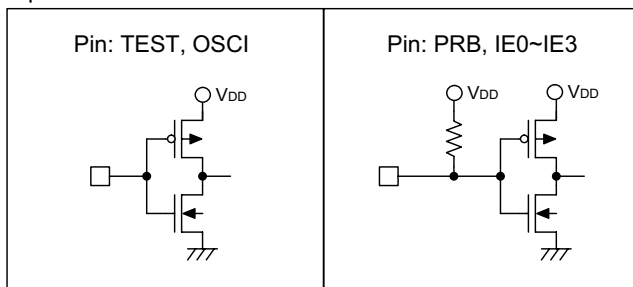
| Pad No. | X      | Y      | Pad No. | X      | Y      |
|---------|--------|--------|---------|--------|--------|
| 1       | -40.88 | 16.11  | 11      | 40.12  | -48.32 |
| 2       | -40.88 | 9.48   | 12      | 40.12  | -39.74 |
| 3       | -40.88 | -11.56 | 13      | 40.12  | -24.57 |
| 4       | -40.88 | -24.78 | 14      | 40.12  | -15.98 |
| 5       | -40.88 | -34.04 | 15      | 40.12  | -0.81  |
| 6       | -40.88 | -41.18 | 16      | 40.12  | 7.78   |
| 7       | -13.77 | -52.78 | 17      | 34.47  | 53.59  |
| 8       | -7.14  | -52.78 | 18      | -8.97  | 53.59  |
| 9       | 9.22   | -53.55 | 19      | -15.60 | 53.59  |
| 10      | 24.40  | -53.55 | 20      | -22.23 | 52.02  |

**Pad Description**

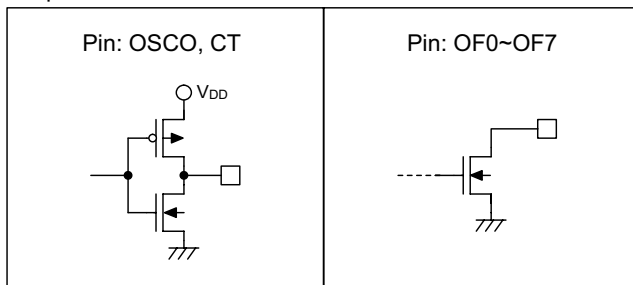
| Pad No. | Pad Name | I/O | Internal Connection  | Description                                 |
|---------|----------|-----|----------------------|---|
| 1       | PRB      | I   | CMOS Pull-high       | Power on reset                              |
| 2       | OSCI     | I   | CMOS                 | Oscillator input                            |
| 3       | OSCO     | O   | CMOS                 | Oscillator output                           |
| 4       | DATA     | I/O | CMOS, NMOS Pull-high | Detect custom code and extended code        |
| 5~8     | IE0~IE3  | I   | CMOS Pull-high       | Detect input from key matrix                |
| 9~16    | OF7~OF0  | O   | NMOS                 | Drive for key scan                          |
| 17      | CT       | O   | CMOS                 | Generates output transmission code          |
| 18      | VDD      | —   | —                    | Positive power supply                       |
| 19      | VSS      | —   | —                    | Negative power supply                       |
| 20      | TEST     | I   | CMOS                 | TEST=Low normal mode<br>TEST=High test mode |

**Approximate internal connection circuits**

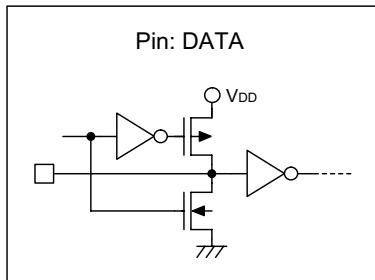
Input terminal



Output terminal



Bidirectional terminal



**Absolute Maximum Ratings**

|                             |                      |                           |                              |
|-----------------------------|----------------------|---------------------------|------------------------------|
| Supply Voltage .....        | -0.3V to 5.2V        | Input Voltage .....       | $V_{SS}-0.3$ to $V_{DD}+0.3$ |
| Output Voltage.....         | $V_{SS}$ to $V_{DD}$ | Storage Temperature ..... | -40°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.

**Recommended Operating Condition**
 $T_a = -20^{\circ}\text{C} \sim 70^{\circ}\text{C}$ , unless otherwise noted

| Symbol    | Parameter                              | Test Conditions |            | Min. | Typ. | Max. | Unit |
|-----------|--|-----------------|------------|------|------|------|------|
|           |  | $V_{DD}$        | Conditions |      |      |      |      |
| $V_{DD}$  | Supply Voltage                         | —               | —          | 2.2  | —    | 3.6  | V    |
| $V_{IH}$  | High-level Input Voltage IE0~IE3, DATA | 3V              | —          | 2.4V | 3V   | 3V   | V    |
|           | High-level Voltage PRB                 | 3V              | —          | 2.1V | 3V   | 3V   |      |
| $V_{IL}$  | Low-level Input Voltage IE0~IE3, DATA  | 3V              | —          | 0    | 0    | 1.2V | V    |
|           | Low-level Input Voltage PRB            | 3V              | —          | 0    | 0    | 0.9V |      |
| $f_{OSC}$ | Clock Oscillating Frequency            | 3V              | —          | —    | 455  | —    | kHz  |

**Electric Characteristics**
 $T_a = 25^{\circ}\text{C}$ ,  $V_{DD} = 3\text{V}$ ,  $V_{SS} = 0\text{V}$ , unless otherwise noted

| Symbol   | Parameter                               | Test Conditions |  | Limits |      |      | Unit          |
|----------|---|-----------------|--|--------|------|------|---------------|
|          |   | $V_{DD}$        | Conditions   | Min.   | Typ. | Max. |               |
| $V_{DD}$ | Supply Voltage                          | —               | $f_{OSC} = 455\text{kHz}$ ,<br>$T_a = -20^{\circ}\text{C} \sim 70^{\circ}\text{C}$ | 2.2    | —    | 3.6  | V             |
| $I_{DD}$ | Supply Current (during operation)       | 3V              | $f_{OSC} = 455\text{kHz}$  | —      | 0.1  | 0.3  | mA            |
| $I_{DD}$ | Supply Current (while not in operation) | 3V              | —  | —      | —    | 1    | $\mu\text{A}$ |
| $I_{OH}$ | High-level Output Current CT            | 3V              | $V_{OH} = 2\text{V}$   | -5     | -10  | —    | mA            |
| $I_{OL}$ | Low-level Output Current CT             | 3V              | $V_{OL} = 0.9\text{V}$   | 0.3    | 0.8  | —    | mA            |
|          | Low-level Output Current DATA           | 3V              | $V_{OL} = 0.9\text{V}$   | 1      | 4    | —    |               |
|          | Low-level Output Current OF0~OF7        | 3V              | $V_{OL} = 0.9\text{V}$   | 1      | 4    | —    |               |
| $R_I$    | Pull-up Resistance PRB                  | 3V              | —  | —      | 80   | —    | k $\Omega$    |
|          | Pull-up Resistance DATA                 | 3V              | —  | —      | 70   | —    |               |
|          | Pull-up Resistance E0~E3                | 3V              | —  | —      | 70   | —    |               |

**Functional Description**

**Key operation**

The input pins (IE0~IE3) and the output pins (OF0~OF7) constitute a max. of 4x8 key matrix which is also called standard key. The extended key is formed by input pin DATA and the scan output (OF5~OF7). The 4x8 key matrix and the extended key can transmit a max. of 256 instruction.

CT maintains "L" and no transmission code is generated when two or more keys in standard key are pressed.

Table 1 shows the relationship between the key matrix and the transmission code.

Table 1

| Transmission Code<br>Key Input | D1 | D0 |
|--------------------------------|----|----|
| IE0                            | 0  | 0  |
| IE1                            | 0  | 1  |
| IE2                            | 1  | 0  |
| IE3                            | 1  | 1  |

| Transmission Code<br>Scan Output | D4 | D3 | D2 |
|----------------------------------|----|----|----|
| OF0                              | 0  | 0  | 0  |
| OF1                              | 0  | 0  | 1  |
| OF2                              | 0  | 1  | 0  |
| OF3                              | 0  | 1  | 1  |
| OF4                              | 1  | 0  | 0  |
| OF5                              | 1  | 0  | 1  |
| OF6                              | 1  | 1  | 0  |
| OF7                              | 1  | 1  | 1  |

| Transmission Code<br>DATA Input | D7 | D6 | D5 |
|---------------------------------|----|----|----|
| OF5                             | —  | —  | 1  |
| OF6                             | —  | 1  | —  |
| OF7                             | 1  | —  | —  |

**Custom code**

The custom code is made up of input pin DATA and scan output OF0~OF4. It has 8 bits (C0~C7); the lower 3 bits of the custom code (C5, C6 and C7) are fixed as "0".

Fig. 1 shows an example of custom code selection.

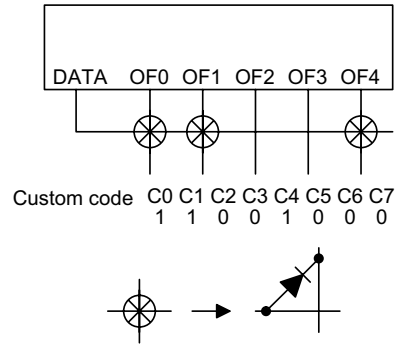


Fig. 1

**Extended bit**

The extended bit is formed by input pin DATA and the scan output (OF5~OF7). Fig. 2 shows an example of extended bit selection.

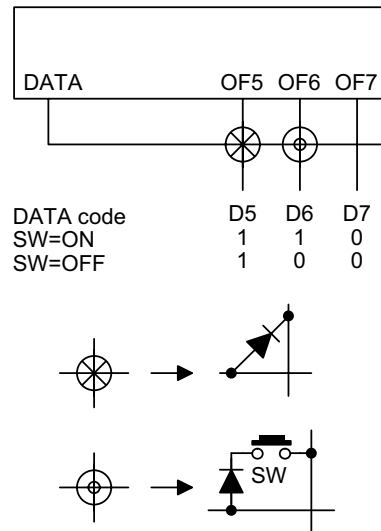


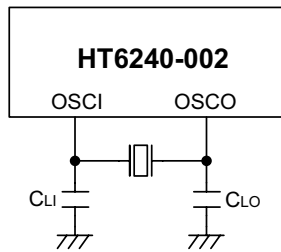
Fig. 2

**Clock oscillating circuit**

HT6240 has built-in feedback resistor and CMOS inverter, so a ceramic resonator can connect between the oscillator circuit input pin (OSCI) and the output pin (OSCO), (see Fig. 3).

When the ceramic resonator is set to 455kHz, the carrier can be set 38kHz.

The oscillating circuit will stop when there is no key pressed to save power dissipation.



Note: These capacitors depend on the resonators. Use the values recommended by the resonator manufacturer.

Fig. 3

**Transmission code**

When the resonator is 455kHz, the carrier of the transmission signal is 38kHz. One pulse width is 0.53ms. Therefore, twenty 38kHz clocks are included in the 0.53ms pulse width. (Fig.4 shows the carrier)

HT6240-002 has two different formats. When the custom code is equal to zero, CT will send the 1st format. Otherwise, it will send the 2nd format.

If the custom code (C0~C7) is "0000 0000" then Fig. 5 shows the formation of the transmission code. Fig. 6 shows the transmission code "0" and "1" and pulse width. Fig. 7 shows the formation of the 1-word transmission code. If a legal key is pressed, HT6240-002 will send at least five words (see Fig. 8).

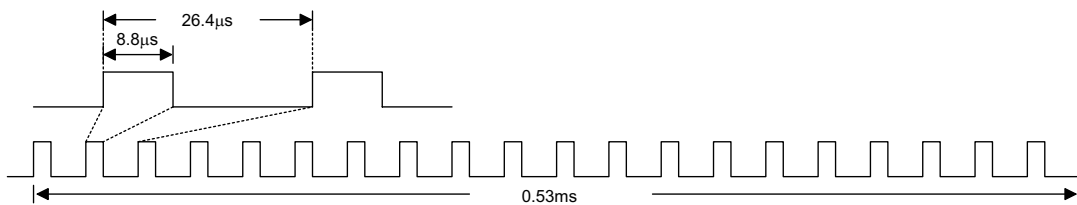


Fig. 4 Carrier

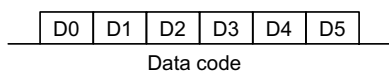


Fig. 5 Formation of the transmission code

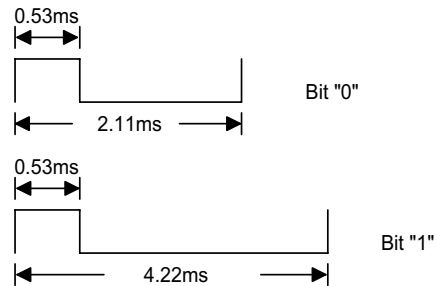


Fig. 6 Transmission code "0" and "1" and pulse width of HT6240-002

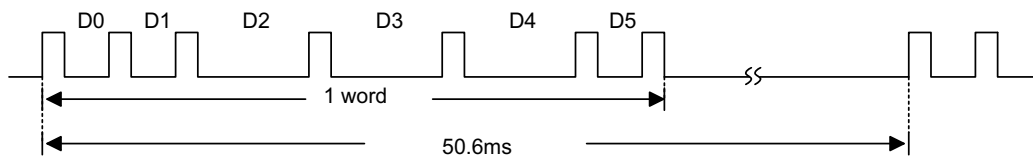


Fig. 7 The formation of the 1-word transmission code

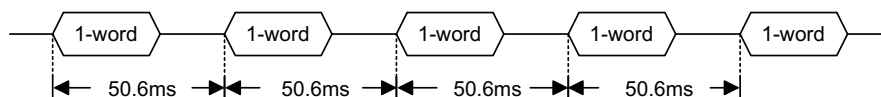


Fig. 8 A legal key will send at least five words

On table 2, the relationship between the key matrix and the transmission code is shown when custom code="0000 0000". The asterisks means that HT6240-002 can just send five words at a time even if a legal key is pressed for a long time. The others mean that HT6240-002 will send five or six words, even some more words if a legal key is still pressed.

Table 2

|     | OF0 | OF1 | OF2 | OF3 | OF4 | OF5 | OF6 | OF7 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| IE0 | 00  | 04  | 08  | 0C  | 10* | 14* | 18* | 1C* |
| IE1 | 01  | 05  | 09* | 0D* | 11* | 15* | 19* | 1D* |
| IE2 | 02  | 06  | 0A* | 0E* | 12* | 16* | 1A* | 1E* |
| IE3 | 03  | 07  | 0B* | 0F* | 13* | 17* | 1B* | 1F* |

There are 64 instructions when the custom code="0000 0000" in HT6240-002. The transmission output CT is still "L" and the transmission code will not be sent when two or more keys are pressed simultaneously.

If custom code ≠ "0000 0000" then Fig. 9 shows the formation of the transmission code. The transmission code consists of a head pulse, 8-bit custom code and 8-bit data code. Fig. 10 shows bit "0" and bit "1".

The formation of a 1-word transmission code without carrier is shown in detail in Fig.11. Output CT should combine with the carrier when CT is high.

CT will send at least three words if we press a legal key. CT may send three or four words, or several words depending on the length of time the legal key is pressed. (see Fig. 12)

**Power on reset function (PRB)**

The power on reset function can be activated by connecting a capacitor to PRB pin while power is applied. The time ( $t_C$ ) must be longer than 0.1ms when the voltage in PRB pin ( $V_C$ ) becomes higher than  $0.3V_{DD}$  after the voltage in  $V_{DD}$  pin exceeds 2.2V.

When the power on reset function is activated, the standby state continues until an "L" is input to IE0~IE3.

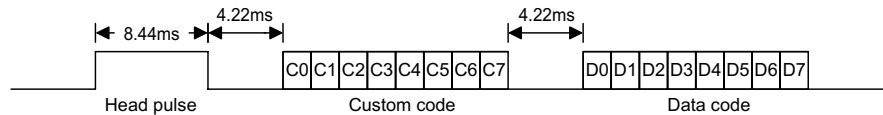


Fig. 9 The formation of the transmission code when custom code ≠ "0000 0000"

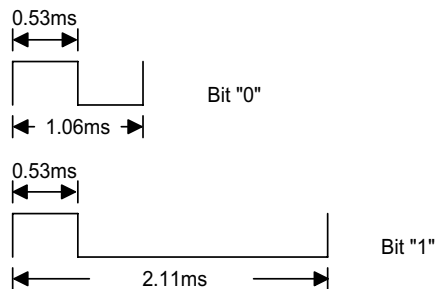


Fig. 10

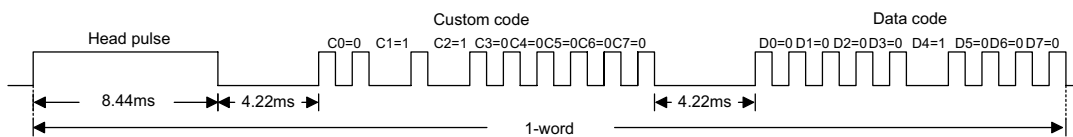


Fig. 11

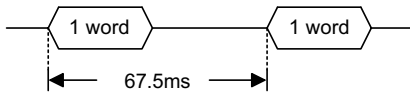


Fig. 12

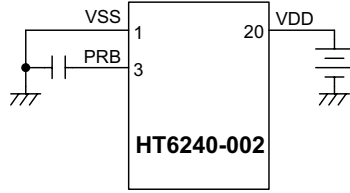


Fig. 13 Example of power-on reset function

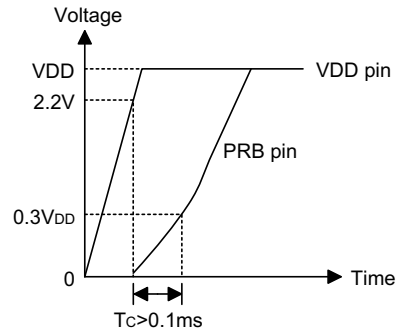
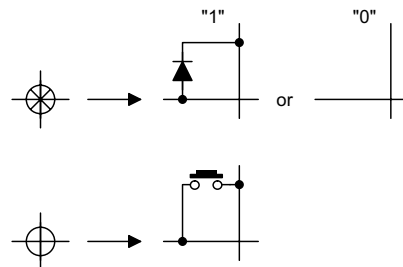
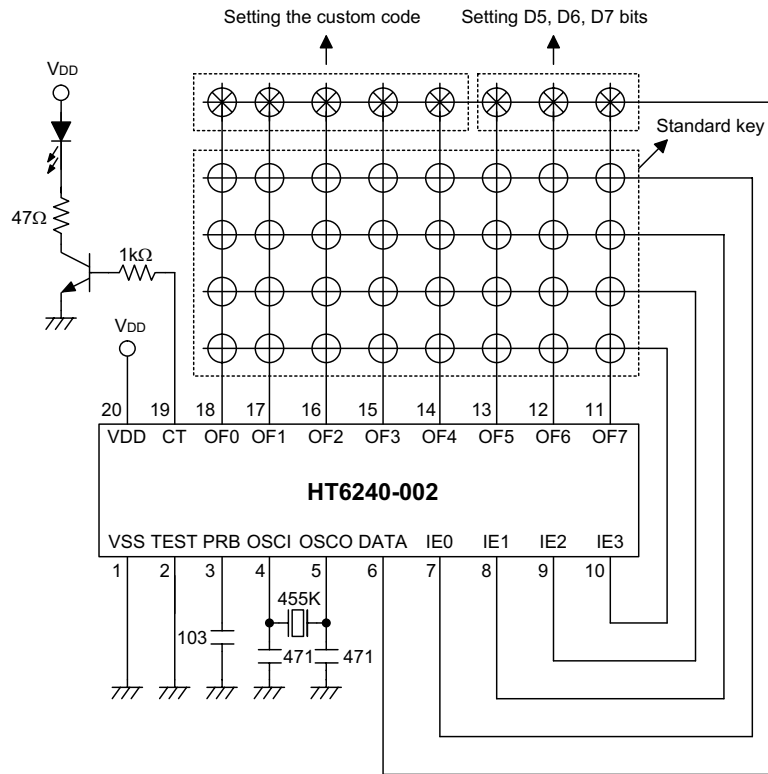


Fig. 14 Relationship between the PRB pin and the voltage

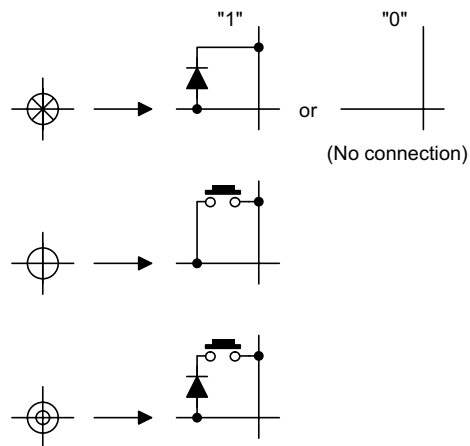
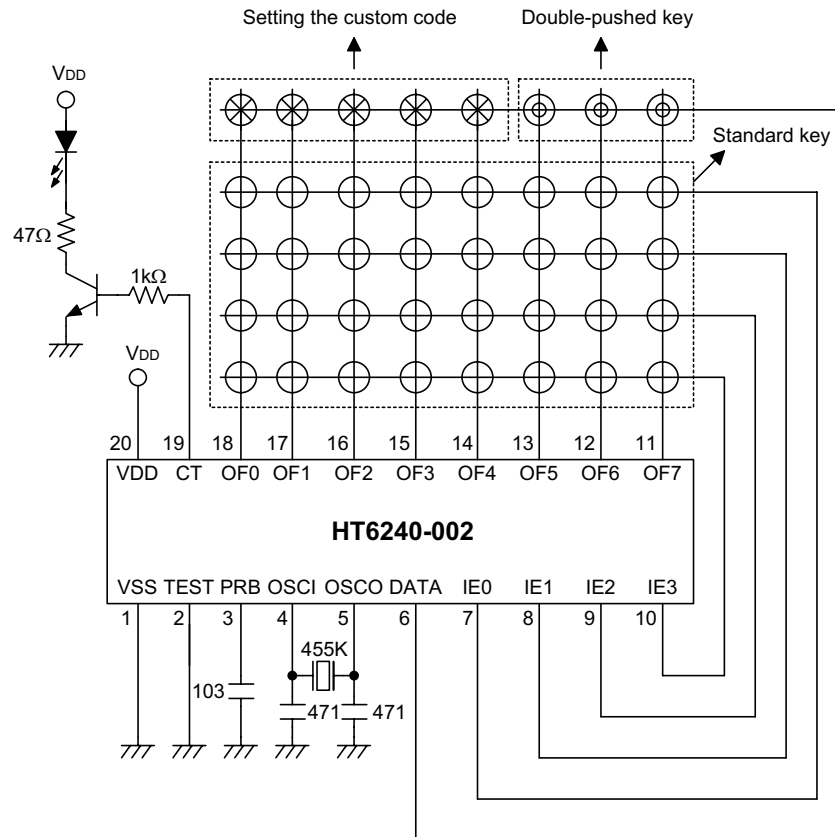
### Application Circuits

#### Example (1)

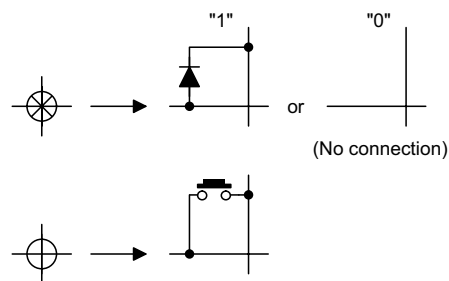
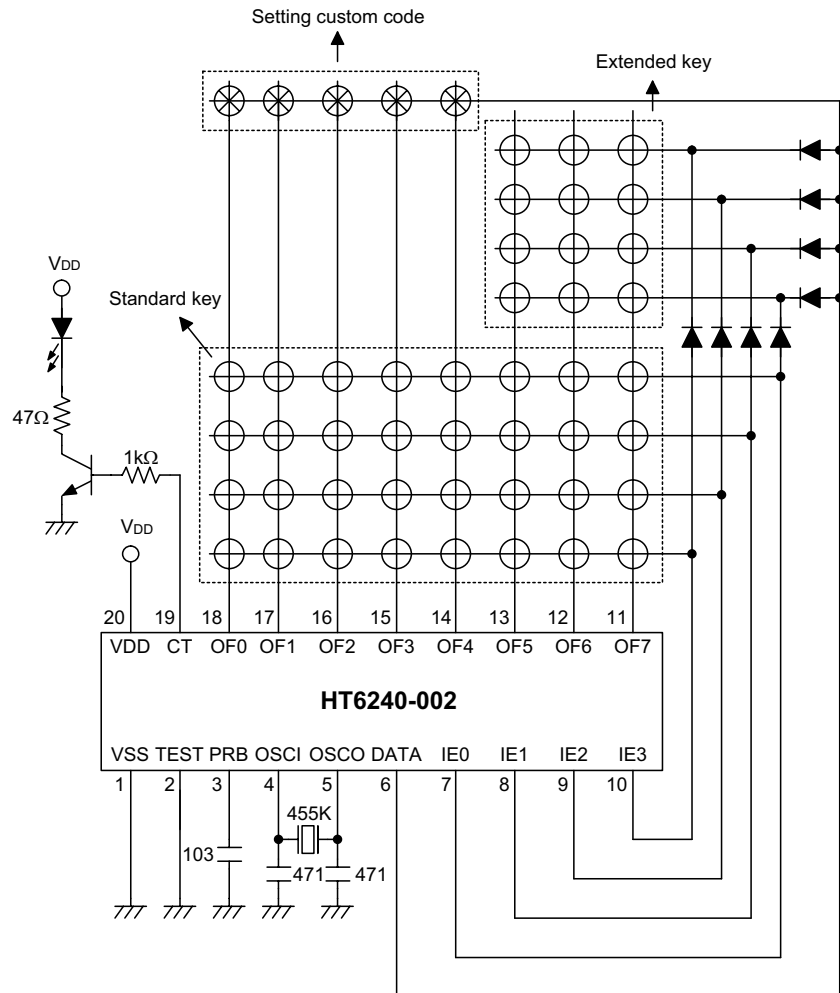




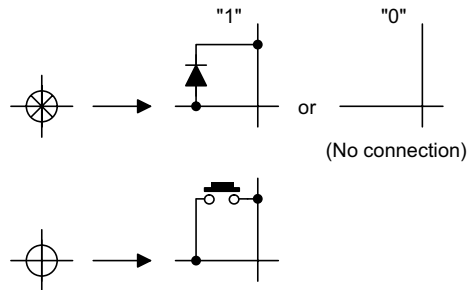
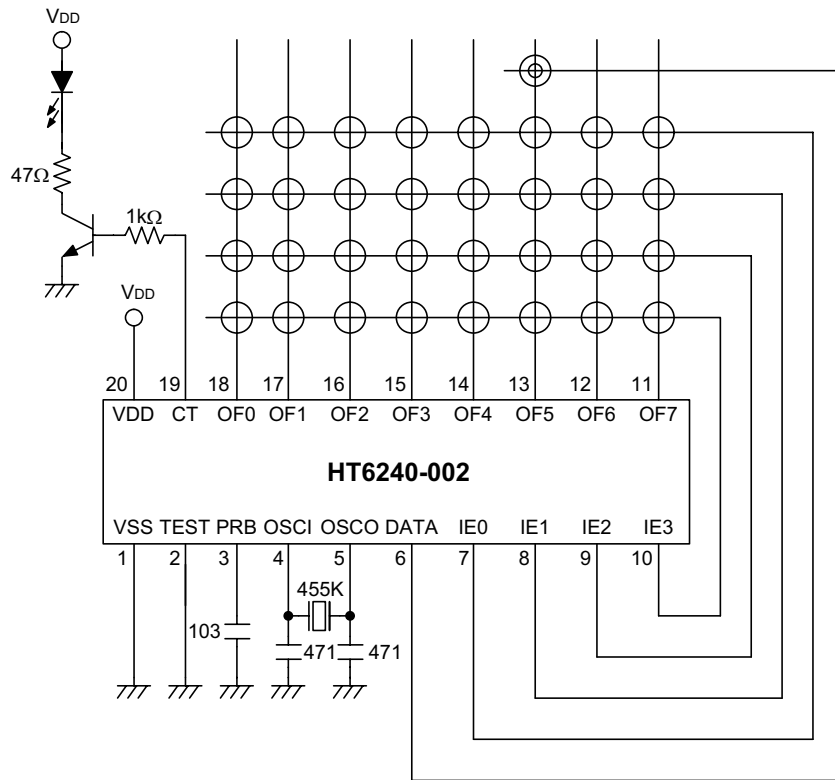
Example (2)



Example (3)

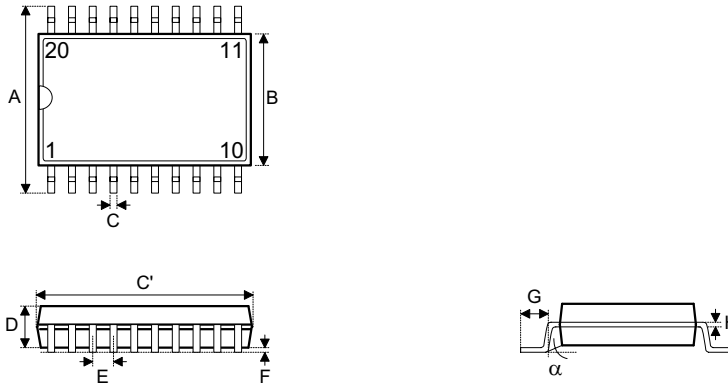


Example (4)



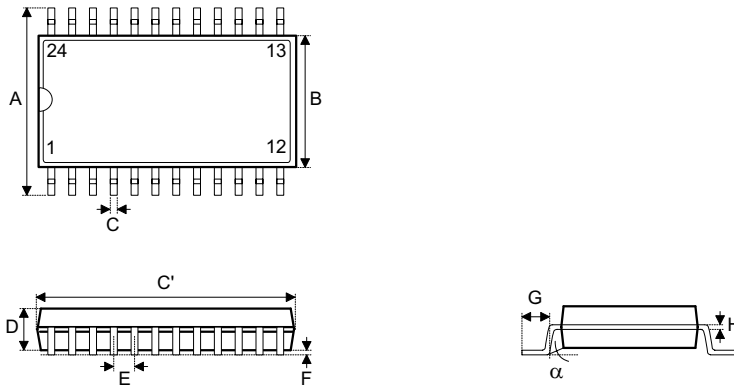
**Package Information**

20-pin SOP (300mil) outline dimensions

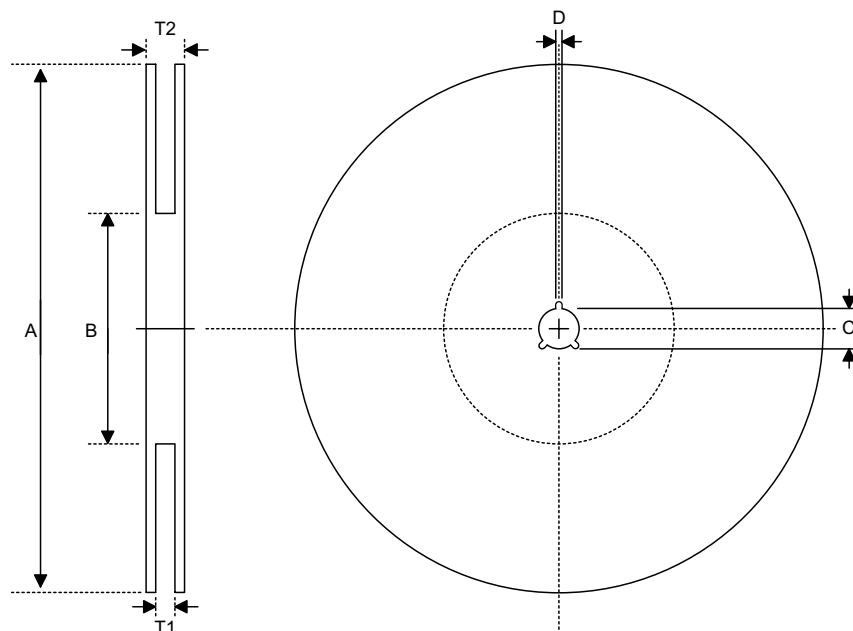


| Symbol   | Dimensions in mil |     |     |
|----------|-------------------|-----|-----|
|          | Min               | Nom | Max |
| A        | 394               | —   | 419 |
| B        | 290               | —   | 300 |
| C        | 14                | —   | 20  |
| C'       | 490               | —   | 510 |
| D        | 92                | —   | 104 |
| E        | —                 | 50  | —   |
| F        | 4                 | —   | —   |
| G        | 32                | —   | 38  |
| H        | 4                 | —   | 12  |
| $\alpha$ | 0°                | —   | 10° |

**24-pin SOP (300mil) outline dimensions**



| Symbol   | Dimensions in mil |      |      |
|----------|-------------------|------|------|
|          | Min.              | Nom. | Max. |
| A        | 394               | —    | 419  |
| B        | 290               | —    | 300  |
| C        | 14                | —    | 20   |
| C'       | 590               | —    | 614  |
| D        | 92                | —    | 104  |
| E        | —                 | 50   | —    |
| F        | 4                 | —    | —    |
| G        | 32                | —    | 38   |
| H        | 4                 | —    | 12   |
| $\alpha$ | 0°                | —    | 10°  |

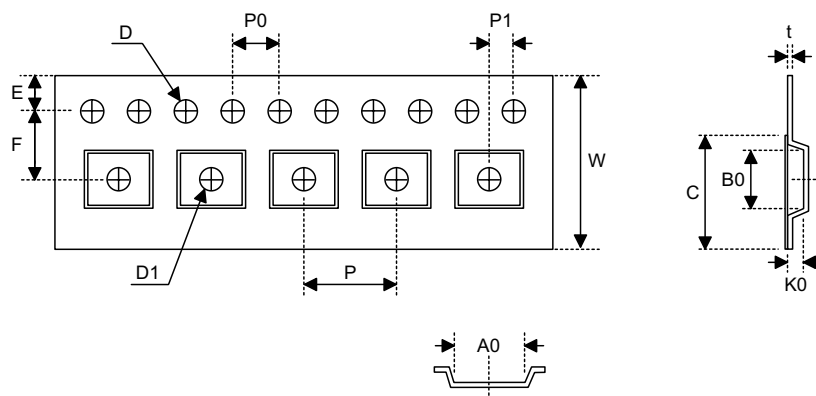
**Product Tape and Reel Specifications**
**Reel dimensions**

**SOP 20W**

| Symbol | Description           | Dimensions in mm |
|--------|-----------------------|------------------|
| A      | Reel Outer Diameter   | 330±1.0          |
| B      | Reel Inner Diameter   | 62±1.5           |
| C      | Spindle Hole Diameter | 13.0+0.5<br>-0.2 |
| D      | Key Slit Width        | 2.0±0.5          |
| T1     | Space Between Flange  | 24.8+0.3<br>-0.2 |
| T2     | Reel Thickness        | 30.2±0.2         |

**SOP 24W**

| Symbol | Description           | Dimensions in mm |
|--------|-----------------------|------------------|
| A      | Reel Outer Diameter   | 330±1.0          |
| B      | Reel Inner Diameter   | 62±1.5           |
| C      | Spindle Hole Diameter | 13.0+0.5<br>-0.2 |
| D      | Key Slit Width        | 2.0±0.5          |
| T1     | Space Between Flange  | 24.8+0.3<br>-0.2 |
| T2     | Reel Thickness        | 30.2±0.2         |

## Carrier tape dimensions



## SOP 20W

| Symbol | Description                              | Dimensions in mm |
|--------|--|------------------|
| W      | Carrier Tape Width                       | 24.0+0.3<br>-0.1 |
| P      | Cavity Pitch                             | 12.0±0.1         |
| E      | Perforation Position                     | 1.75±0.1         |
| F      | Cavity to Perforation (Width Direction)  | 11.5±0.1         |
| D      | Perforation Diameter                     | 1.5+0.1          |
| D1     | Cavity Hole Diameter                     | 1.5+0.25         |
| P0     | Perforation Pitch                        | 4.0±0.1          |
| P1     | Cavity to Perforation (Length Direction) | 2.0±0.1          |
| A0     | Cavity Length                            | 10.8±0.1         |
| B0     | Cavity Width                             | 13.3±0.1         |
| K0     | Cavity Depth                             | 3.2±0.1          |
| t      | Carrier Tape Thickness                   | 0.3±0.05         |
| C      | Cover Tape Width                         | 21.3             |

## SOP 24W

| Symbol | Description                              | Dimensions in mm |
|--------|--|------------------|
| W      | Carrier Tape Width                       | 24.0±0.3         |
| P      | Cavity Pitch                             | 12.0±0.1         |
| E      | Perforation Position                     | 1.75±0.1         |
| F      | Cavity to Perforation (Width Direction)  | 11.5±0.1         |
| D      | Perforation Diameter                     | 1.55+0.1         |
| D1     | Cavity Hole Diameter                     | 1.5+0.25         |
| P0     | Perforation Pitch                        | 4.0±0.1          |
| P1     | Cavity to Perforation (Length Direction) | 2.0±0.1          |
| A0     | Cavity Length                            | 10.9±0.1         |
| B0     | Cavity Width                             | 15.9±0.1         |
| K0     | Cavity Depth                             | 3.1±0.1          |
| t      | Carrier Tape Thickness                   | 0.35±0.05        |
| C      | Cover Tape Width                         | 21.3             |

**Holtek Semiconductor Inc. (Headquarters)**

No.3, Creation Rd. II, Science Park, Hsinchu, Taiwan  
Tel: 886-3-563-1999  
Fax: 886-3-563-1189  
<http://www.holtek.com.tw>

**Holtek Semiconductor Inc. (Taipei Sales Office)**

4F-2, No. 3-2, YuanQu St., Nankang Software Park, Taipei 115, Taiwan  
Tel: 886-2-2655-7070  
Fax: 886-2-2655-7373  
Fax: 886-2-2655-7383 (International sales hotline)

**Holtek Semiconductor Inc. (Shanghai Sales Office)**

7th Floor, Building 2, No.889, Yi Shan Rd., Shanghai, China 200233  
Tel: 021-6485-5560  
Fax: 021-6485-0313  
<http://www.holtek.com.cn>

**Holtek Semiconductor Inc. (Shenzhen Sales Office)**

5/F, Unit A, Productivity Building, Cross of Science M 3rd Road and Gaoxin M 2nd Road, Science Park, Nanshan District, Shenzhen, China 518057  
Tel: 0755-8616-9908, 8616-9308  
Fax: 0755-8616-9533

**Holtek Semiconductor Inc. (Beijing Sales Office)**

Suite 1721, Jinyu Tower, A129 West Xuan Wu Men Street, Xicheng District, Beijing, China 100031  
Tel: 010-6641-0030, 6641-7751, 6641-7752  
Fax: 010-6641-0125

**Holtek Semiconductor Inc. (Chengdu Sales Office)**

709, Building 3, Champagne Plaza, No.97 Dongda Street, Chengdu, Sichuan, China 610016  
Tel: 028-6653-6590  
Fax: 028-6653-6591

**Holmate Semiconductor, Inc. (North America Sales Office)**

46729 Fremont Blvd., Fremont, CA 94538  
Tel: 510-252-9880  
Fax: 510-252-9885  
<http://www.holmate.com>

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