Features

- Operating voltage:
  2.4V~5V for the HT12A/B/C
  2.4V~12V for the HT12E
- Low power, high noise immunity CMOS technology
- Low stand-by current
- Minimum transmission word:
  Four words for the HT12E
  One word for the HT12A/B/C
- Built-in oscillator, needs only 5% resistor
- HT12A/B/C with 38KHz carrier for Infra-Red transmission media
- Data code polarity:
  HT12A/C/E: Positive polarity
  HT12B: Negative polarity
- Minimal external components

Applications

- Burglar alarm system
- Smoke and fire alarm system
- Garage door controller
- Car door controller
- Car alarm system
- Security system
- Cordless telephone
- Other remote control system

General Description

The $2^{12}$ series of encoders are CMOS LSIs for Remote Control System applications. They are capable of encoding 12 bits of information consisting of N address bits and 12-N data bits. Each address/data input can be set to one of two logic states. The programmed address/data information will be transmitted together with header bits via an RF or Infra-Red transmission medium upon receipt of a trigger signal. The capability to select a $\overline{TE}$ trigger on the HT12E or a DATA trigger on the HT12A/B/C further enhance application flexibility. The HT12A/B/C provides a 38KHz carrier for Infra-Red systems.

Selection Table

<table>
<thead>
<tr>
<th>Item</th>
<th>Function</th>
<th>Address No.</th>
<th>Address/ Data No.</th>
<th>Data No.</th>
<th>Oscillator</th>
<th>Trigger</th>
<th>Package</th>
<th>Carrier Output</th>
<th>Negative Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>HT12A</td>
<td>8</td>
<td>0</td>
<td>4</td>
<td>455K Hz resonator</td>
<td>D8~D11</td>
<td>18 DIP/ 20 SOP</td>
<td>38K Hz</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>HT12B</td>
<td>8</td>
<td>0</td>
<td>4</td>
<td>455K Hz resonator</td>
<td>D8~D11</td>
<td>18 DIP/ 20 SOP</td>
<td>38K Hz</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>HT12C</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>455K Hz resonator</td>
<td>D2~D11</td>
<td>16 DIP/ 16 SOP</td>
<td>38K Hz</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>HT12D</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>RC oscillator</td>
<td>D2~D11</td>
<td>16 DIP/ 16 SOP</td>
<td>38K Hz</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>HT12E</td>
<td>8</td>
<td>4</td>
<td>0</td>
<td>RC oscillator</td>
<td>$\overline{TE}$</td>
<td>18 DIP/ 20 SOP</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

Note: Address/Data represents pins that can be address or data according the decoder requirement.
Block Diagram

**TE trigger**
HT12E

```
+3 Divider

Oscillator

OSC2 OSC1

+12 Counter &
1 of 12 Decoder

Sync. Circuit

Binary Detector

12 Transmission
Gate Circuit

A7

AD8 AD11

TE

A0

VDD VSS

DOUT
```

**DATA trigger**
HT12A/B/C

```
+128 Divider

Oscillator

X2 X1

L/MB

+12 Counter &
1 of 12 Decoder

Sync. Circuit

Binary Detector

Address

Data

VDD VSS

DOUT
```

Note: Address Data pins are available in various combinations, refer to address/data table.
### Pin Description

<table>
<thead>
<tr>
<th>Pin Name</th>
<th>I/O</th>
<th>Internal Connection</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0~A7</td>
<td>I</td>
<td>TRANSMISSION GATE</td>
<td>Input pin for address A0~A7 setting. Can be externally set to VDD or VSS.</td>
</tr>
<tr>
<td>AD8~AD11</td>
<td>I</td>
<td>TRANSMISSION GATE</td>
<td>Input pin for address/data AD8~AD11 setting. Can be externally set to VDD or VSS (HT12E only.).</td>
</tr>
<tr>
<td>D2~D11</td>
<td>I</td>
<td>CMOS IN Pull-High</td>
<td>Input pin for data D2~D11 setting and transmission enable. Active low. Can be externally set to VSS or open. See note.</td>
</tr>
<tr>
<td>DOUT</td>
<td>O</td>
<td>CMOS OUT</td>
<td>Encoder data serial transmission output.</td>
</tr>
<tr>
<td>L/MB</td>
<td>I</td>
<td>CMOS IN Pull-High</td>
<td>Latch/Momentary transmission format select pin. Latch: floating or VDD Momentary: VSS</td>
</tr>
<tr>
<td>TE</td>
<td>I</td>
<td>CMOS IN Pull-High</td>
<td>Transmission enable, active low. See note.</td>
</tr>
<tr>
<td>OSC1</td>
<td>I</td>
<td>OSCILLATOR 1</td>
<td>Oscillator input pin.</td>
</tr>
<tr>
<td>OSC2</td>
<td>O</td>
<td>OSCILLATOR 1</td>
<td>Oscillator output pin.</td>
</tr>
<tr>
<td>X1</td>
<td>I</td>
<td>OSCILLATOR 2</td>
<td>455KHz resonator oscillator input.</td>
</tr>
<tr>
<td>X2</td>
<td>O</td>
<td>OSCILLATOR 2</td>
<td>455KHz resonator oscillator output.</td>
</tr>
<tr>
<td>VSS</td>
<td>I</td>
<td>—</td>
<td>Negative power supply (GND).</td>
</tr>
<tr>
<td>VDD</td>
<td>I</td>
<td>—</td>
<td>Positive power supply.</td>
</tr>
</tbody>
</table>

Note: D2~D11 are data input and transmission enable pins for the HT12A/B/C.

TE is the transmission enable pin for the HT12E.

### Approximate internal connection circuits

```
<table>
<thead>
<tr>
<th>TRANSMISSION GATE</th>
<th>CMOS IN Pull-High</th>
<th>CMOS OUT</th>
<th>OSCILLATOR 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>EN OSC1 OSC2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OSCILLATOR 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ME X2</td>
</tr>
</tbody>
</table>
```


## Absolute Maximum Ratings

- Supply Voltage (HT12A/B/C): -0.3V to 5.5V
- Supply Voltage (HT12E): -0.3V to 13V
- Input Voltage: VSS-0.3 to VDD+0.3V
- Storage Temperature: -50°C to 125°C
- Operating Temperature: -20°C to 75°C

## Electrical Characteristics

### HT12A/B/C

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD</td>
<td>Operating Voltage</td>
<td>—</td>
<td>2.4</td>
<td>3</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>ISTB</td>
<td>Stand-by Current</td>
<td>—</td>
<td>—</td>
<td>0.1</td>
<td>1</td>
<td>μA</td>
</tr>
<tr>
<td>IDD</td>
<td>Operating Current</td>
<td>3V Oscillator stop</td>
<td>—</td>
<td>—</td>
<td>0.1</td>
<td>μA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5V No Load.</td>
<td>—</td>
<td>—</td>
<td>0.1</td>
<td>μA</td>
</tr>
<tr>
<td>IDOUT</td>
<td>Output Drive Current</td>
<td>3V FOSC=455KHz</td>
<td>—</td>
<td>200</td>
<td>400</td>
<td>μA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5V VOH=0.9VDD (Source)</td>
<td>—</td>
<td>400</td>
<td>800</td>
<td>μA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VOL=0.1VDD (Sink)</td>
<td>—</td>
<td>400</td>
<td>800</td>
<td>μA</td>
</tr>
<tr>
<td>VIH</td>
<td>&quot;H&quot; Input Voltage</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>mA</td>
</tr>
<tr>
<td>VIL</td>
<td>&quot;L&quot; Input Voltage</td>
<td>—</td>
<td>—</td>
<td>0.8VDD</td>
<td>—</td>
<td>mA</td>
</tr>
<tr>
<td>RDATA</td>
<td>D2–D11 Pull High Resistance</td>
<td>5V VDATA=0V</td>
<td>—</td>
<td>150</td>
<td>300</td>
<td>KΩ</td>
</tr>
</tbody>
</table>

### HT12E

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD</td>
<td>Operating Voltage</td>
<td>—</td>
<td>2.4</td>
<td>5</td>
<td>12</td>
<td>V</td>
</tr>
<tr>
<td>ISTB</td>
<td>Stand-by Current</td>
<td>—</td>
<td>—</td>
<td>0.1</td>
<td>1</td>
<td>μA</td>
</tr>
<tr>
<td>IDD</td>
<td>Operating Current</td>
<td>3V Oscillator stop</td>
<td>—</td>
<td>—</td>
<td>4</td>
<td>μA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12V No Load.</td>
<td>—</td>
<td>40</td>
<td>80</td>
<td>μA</td>
</tr>
<tr>
<td>IDOUT</td>
<td>Output Drive Current</td>
<td>3V FOSC=3KHz</td>
<td>—</td>
<td>150</td>
<td>300</td>
<td>μA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5V VOH=0.9VDD (Source)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VOL=0.1VDD (Sink)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>mA</td>
</tr>
<tr>
<td>VIH</td>
<td>&quot;H&quot; Input Voltage</td>
<td>—</td>
<td>—</td>
<td>0.8VDD</td>
<td>—</td>
<td>VDD</td>
</tr>
<tr>
<td>VIL</td>
<td>&quot;L&quot; Input Voltage</td>
<td>—</td>
<td>—</td>
<td>0</td>
<td>0.2VDD</td>
<td>V</td>
</tr>
<tr>
<td>FOSC</td>
<td>Oscillator Frequency</td>
<td>5V ROSC=1.1MΩ</td>
<td>—</td>
<td>3</td>
<td>—</td>
<td>KHZ</td>
</tr>
<tr>
<td>RTE</td>
<td>TE Pull High Resistance</td>
<td>5V VTE=0V</td>
<td>—</td>
<td>1.5</td>
<td>3</td>
<td>MΩ</td>
</tr>
</tbody>
</table>
Functional Description

Operation

Upon receipt of a transmission enable (TE for the HT12E or D2-D11 for the HT12A/B/C, active low, the encoder begins a 4 word transmission cycle. This cycle is repeated as long as the transmission enable (TE or D2-D11) is held low. After the transmission enable returns high the encoder output completes it's final cycle and then stops as in Fig.1 for the HT12E and Fig.2,3 for the HT12A/B/C.

![Diagram of HT12E Transmission Timing](image)

**Fig.1 Transmission timing for the HT12E**

![Diagram of HT12A/B/C (L/MB=Floating or VDD) Transmission Timing](image)

**Fig.2 Transmission timing for the HT12A/B/C (L/MB=Floating or VDD)**

![Diagram of HT12A/B/C (L/MB=VSS) Transmission Timing](image)

**Fig.3 Transmission timing for the HT12A/B/C (L/MB=VSS)**

Information word

The L/MB is the Latch/Momentary selection pin. With L/MB=1 the device is in the latch mode (for use with latch data decoders). When the transmission enable is removed during a transmission, the DOUT pin outputs a complete word and then stops. With L/MB=0 the device is in the momentary mode (for use with latch data decoders). When the transmission enable is removed during a transmission, the DOUT now outputs a complete word and adds 7 words all of which have "1" data codes.

An information word is composed of 3 periods as in Fig.4.

![Diagram of Information Composition](image)

**Fig.4 Composition of Information**
Address/data waveform

Each programmable address/data pin can be externally set to one of the two following logic states as in Fig.5 (for the HT12E) and Fig.6,7 (for the HT12A/B/C):

![Waveform Diagram](image)

Fig.5 Address/Data bit waveform for HT12E

![Waveform Diagram](image)

Fig.6 Address/Data bit waveform for the HT12A/C

The HT12B data code polarity is inverted:

![Waveform Diagram](image)

Fig.7 Address/Data bit waveform for the HT12B

The address/data bits of the HT12A/B/C are transmitted with a 38KHz carrier for Infra-Red remote controller flexibility.
Address/data programming (preset)

The status of each address/data pin can be individually preset to a logic "high" or "low". If a transmission enable signal is applied, the encoder scans and transmits the status of the 12 bits of address/data serially in the order A0 to AD11 for the HT12E encoder and A0 to D11 for the HT12A/B/C encoder.

During information transmission these bits will be transmitted with a preceding synchronization bit. When the trigger signal is not applied, the chip enters a stand-by mode and consumes a reduced current which is less than 1μA for a 5V supply voltage.

Usual applications preset the address pins with individual security codes by means of DIP switches or PCB wiring, while the data is selected by push button or electronic switches.

The following figure shows an application using the HT12E:

![Diagram of HT12E encoder](image)

The transmitted information is shown as follows:

<table>
<thead>
<tr>
<th>Pilot &amp; Sync.</th>
<th>A0</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
<th>A5</th>
<th>A6</th>
<th>A7</th>
<th>AD8</th>
<th>AD9</th>
<th>AD10</th>
<th>AD11</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Address/Data sequence

The following table provides the address/data sequence table for the various models of the $2^{12}$ series encoders. The correct device should be selected according to individual address and data requirements.

<table>
<thead>
<tr>
<th>HOLTEK Part No.</th>
<th>Address/Data Bits</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10 11</td>
<td></td>
</tr>
<tr>
<td>HT12A  A0 A1 A2 A3 A4 A5 A6 A7 D8 D9 D10 D11</td>
<td></td>
</tr>
<tr>
<td>HT12B  A0 A1 A2 A3 A4 A5 A6 A7 D8 D9 D10 D11</td>
<td></td>
</tr>
<tr>
<td>HT12C  A0 A1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11</td>
<td></td>
</tr>
<tr>
<td>HT12E  A0 A1 A2 A3 A4 A5 A6 A7 AD8 AD9 AD10 AD11</td>
<td></td>
</tr>
</tbody>
</table>
Transmission enable

For the HT12E encoder, transmission is enabled by applying a low signal to the TE pin. For the HT12A/B/C encoders transmission is enabled by applying a low signal to any one of the data pins D2~D11.

Flowchart

HT12A/B/C

1. Power on
2. Stand-by mode
3. Data enable?
   - Yes: Data with carrier serial output
     - Yes: Data still enabled?
       - Yes: L/MB=GND?
         - Yes: Send the last code
         - No: Send 7 times "1" for all of the data code
       - No: Send the last code
   - No: Send 7 times "1" for all of the data code

HT12E

1. Power on
2. Stand-by mode
3. Transmission enabled?
   - No: Transmission still enabled
     - Yes: 4 data words transmitted continuously
   - Yes: 4 data words transmitted

Note: D2~D11 are transmission enables for the HT12A/B/C.

TE is the transmission enable for the HT12E.
Oscillator frequency chart for the HT12E

Recommended oscillator frequency is \( F_{OSCD} \) (Decoder) = \( 50 \times F_{OSCE} \) (HT12E)

\[
\frac{1}{3} F_{OSCE} \text{ (HT12A/B/C)}
\]
Application Circuits

Application circuit 1

Application circuit 2

Application circuit 3

Application circuit 4

Note: Typical infrared diode: EL-1L2 (KODENSHI CORP.).
Typical RF transmitter: JR-220 (JUWA CORP.)