

### Features

- Operating voltage
  - 2.4V~5V for the HT12A
  - 2.4V~12V for the HT12E
- Low power and high noise immunity CMOS technology
- Low standby current: 0.1μA (typ.) at V<sub>DD</sub>=5V
- HT12A with a 38kHz carrier for infrared transmission medium
- Minimum transmission word
  - Four words for the HT12E
  - One word for the HT12A
- Built-in oscillator needs only 5% resistor
- Data code has positive polarity
- Minimal external components
- Pair with Holtek's 2<sup>12</sup> series of decoders
- 18-pin DIP, 20-pin SOP package

### Applications

- Burglar alarm system
- Smoke and fire alarm system
- Garage door controllers
- Car door controllers
- Car alarm system
- Security system
- Cordless telephones
- Other remote control systems

### General Description

The 2<sup>12</sup> encoders are a series of CMOS LSIs for remote control system applications. They are capable of encoding information which consists of N address bits and 12-N data bits. Each address/data input can be set to one of the two logic states. The programmed addresses/data are transmitted together with the header

bits via an RF or an infrared 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 further enhances the application flexibility of the 2<sup>12</sup> series of encoders. The HT12A additionally provides a 38kHz carrier for infrared systems.

### Selection Table

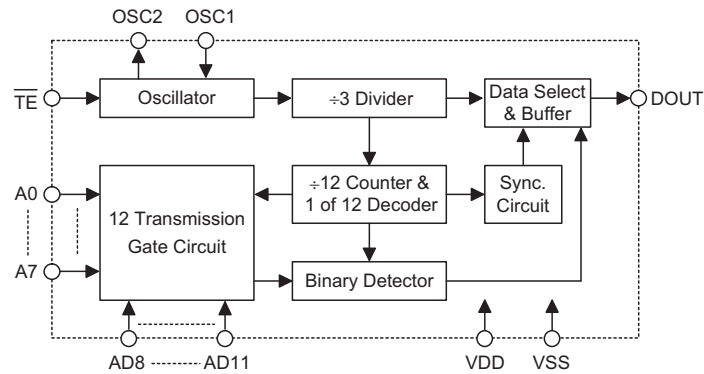
| Function<br>Part No. | Address<br>No. | Address/<br>Data No. | Data No. | Oscillator          | Trigger         | Carrier<br>Output | Negative<br>Polarity | Package      |
|----------------------|----------------|----------------------|----------|---------------------|-----------------|-------------------|----------------------|--------------|
| HT12A                | 8              | 0                    | 4        | 455kHz<br>resonator | D8~D11          | 38kHz             | No                   | 18DIP, 20SOP |
| HT12E                | 8              | 4                    | 0        | RC<br>oscillator    | $\overline{TE}$ | No                | No                   | 18DIP, 20SOP |

Note: Address/Data represents pins that can be either address or data according to the application requirement.

**Block Diagram**

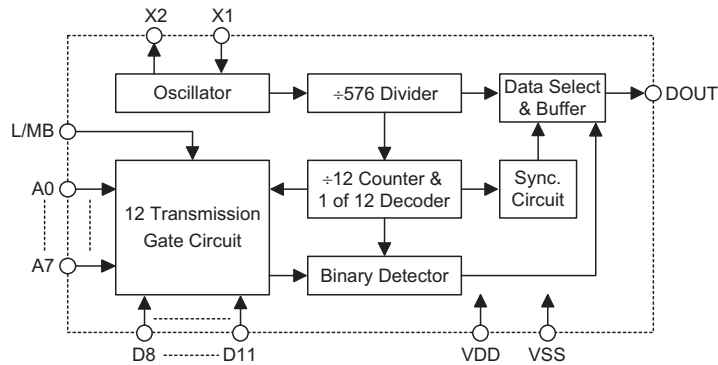
**$\overline{TE}$  Trigger**

HT12E



**DATA Trigger**

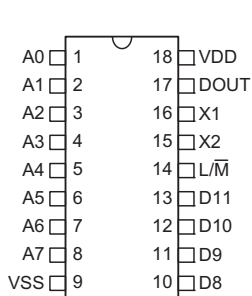
HT12A



Note: The address data pins are available in various combinations (refer to the address/data table).

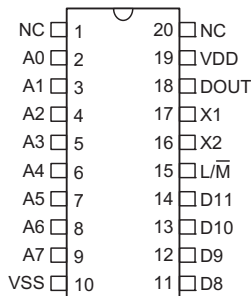
**Pin Assignment**

**8-Address  
4-Data**



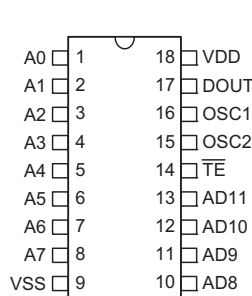
**HT12A  
-18 DIP-A**

**8-Address  
4-Data**



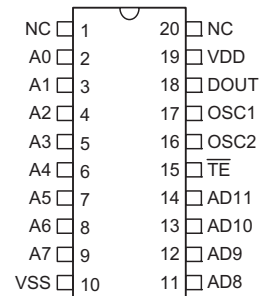
**HT12A  
-20 SOP-A**

**8-Address  
4-Address/Data**



**HT12E  
-18 DIP-A**

**8-Address  
4-Address/Data**



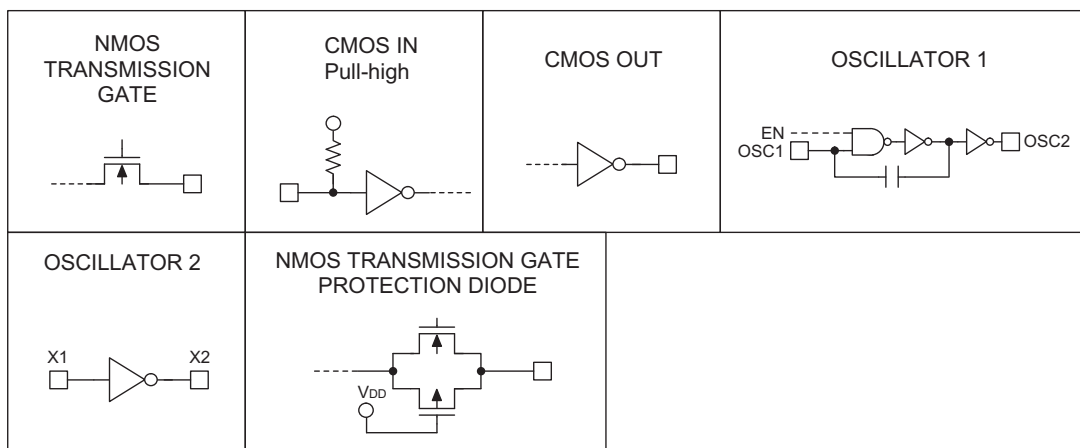
**HT12E  
-20 SOP-A**

**Pin Description**

| Pin Name         | I/O | Internal Connection                             | Description  |
|------------------|-----|---|--|
| A0~A7            | I   | CMOS IN Pull-high (HT12A)                       | Input pins for address A0~A7 setting<br>These pins can be externally set to VSS or left open   |
|                  |     | NMOS TRANSMISSION GATE PROTECTION DIODE (HT12E) |  |
| AD8~AD11         | I   | NMOS TRANSMISSION GATE PROTECTION DIODE (HT12E) | Input pins for address/data AD8~AD11 setting<br>These pins can be externally set to VSS or left open   |
| D8~D11           | I   | CMOS IN Pull-high                               | Input pins for data D8~D11 setting and transmission enable, active low<br>These pins should be externally set to VSS or left open (see Note) |
| DOUT             | O   | CMOS OUT  | Encoder data serial transmission output  |
| $\overline{L/M}$ | I   | CMOS IN Pull-high                               | Latch/Momentary transmission format selection pin:<br>Latch: Floating or VDD<br>Momentary: VSS   |
| $\overline{TE}$  | I   | CMOS IN Pull-high                               | Transmission enable, active low (see Note)   |
| OSC1             | I   | OSCILLATOR 1                                    | Oscillator input pin   |
| OSC2             | O   | OSCILLATOR 1                                    | Oscillator output pin  |
| X1               | I   | OSCILLATOR 2                                    | 455kHz resonator oscillator input  |
| X2               | O   | OSCILLATOR 2                                    | 455kHz resonator oscillator output   |
| VSS              | I   | —   | Negative power supply, ground  |
| VDD              | I   | —   | Positive power supply  |

Note: D8~D11 are all data input and transmission enable pins of the HT12A.

$\overline{TE}$  is a transmission enable pin of the HT12E.

**Approximate Internal Connections**


**Absolute Maximum Ratings**

|                              |                                 |                              |                                  |
|------------------------------|---------------------------------|------------------------------|----------------------------------|
| Supply Voltage (HT12A) ..... | $V_{SS}-0.3V$ to $V_{SS}+5.5V$  | Supply Voltage (HT12E) ..... | $-0.3V$ to $13V$                 |
| Input Voltage .....          | $V_{SS}-0.3$ to $V_{DD}+0.3V$   | Storage Temperature .....    | $-50^{\circ}C$ to $125^{\circ}C$ |
| Operating Temperature .....  | $-20^{\circ}C$ to $75^{\circ}C$ |                              |                                  |

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**
**HT12A**
 $T_a=25^{\circ}C$ 

| Symbol     | Parameter                   | Test Conditions |                             | Min.        | Typ. | Max.        | Unit      |
|------------|-----------------------------|-----------------|-----------------------------|-------------|------|-------------|-----------|
|            |                             | $V_{DD}$        | Conditions                  |             |      |             |           |
| $V_{DD}$   | Operating Voltage           | —               | —                           | 2.4         | 3    | 5           | V         |
| $I_{STB}$  | Standby Current             | 3V              | Oscillator stops            | —           | 0.1  | 1           | $\mu A$   |
|            |                             | 5V              |                             | —           | 0.1  | 1           | $\mu A$   |
| $I_{DD}$   | Operating Current           | 3V              | No load<br>$f_{OSC}=455kHz$ | —           | 200  | 400         | $\mu A$   |
|            |                             | 5V              |                             | —           | 400  | 800         | $\mu A$   |
| $I_{DOUT}$ | Output Drive Current        | 5V              | $V_{OH}=0.9V_{DD}$ (Source) | -1          | -1.6 | —           | mA        |
|            |                             |                 | $V_{OL}=0.1V_{DD}$ (Sink)   | 2           | 3.2  | —           | mA        |
| $V_{IH}$   | "H" Input Voltage           | —               | —                           | $0.8V_{DD}$ | —    | $V_{DD}$    | V         |
| $V_{IL}$   | "L" Input Voltage           | —               | —                           | 0           | —    | $0.2V_{DD}$ | V         |
| $R_{DATA}$ | D8-D11 Pull-high Resistance | 5V              | $V_{DATA}=0V$               | —           | 150  | 300         | $k\Omega$ |

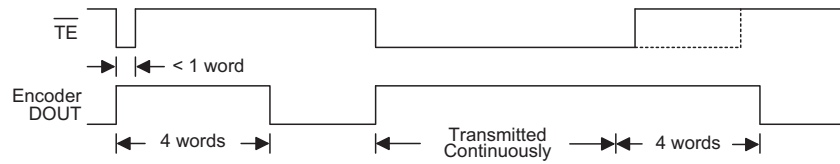
**HT12E**
 $T_a=25^{\circ}C$ 

| Symbol     | Parameter                            | Test Conditions |                             | Min.        | Typ. | Max.        | Unit      |
|------------|--------------------------------------|-----------------|-----------------------------|-------------|------|-------------|-----------|
|            |                                      | $V_{DD}$        | Conditions                  |             |      |             |           |
| $V_{DD}$   | Operating Voltage                    | —               | —                           | 2.4         | 5    | 12          | V         |
| $I_{STB}$  | Standby Current                      | 3V              | Oscillator stops            | —           | 0.1  | 1           | $\mu A$   |
|            |                                      | 12V             |                             | —           | 2    | 4           | $\mu A$   |
| $I_{DD}$   | Operating Current                    | 3V              | No load, $f_{OSC}=3kHz$     | —           | 40   | 80          | $\mu A$   |
|            |                                      | 12V             |                             | —           | 150  | 300         | $\mu A$   |
| $I_{DOUT}$ | Output Drive Current                 | 5V              | $V_{OH}=0.9V_{DD}$ (Source) | -1          | -1.6 | —           | mA        |
|            |                                      |                 | $V_{OL}=0.1V_{DD}$ (Sink)   | 1           | 1.6  | —           | mA        |
| $V_{IH}$   | "H" Input Voltage                    | —               | —                           | $0.8V_{DD}$ | —    | $V_{DD}$    | V         |
| $V_{IL}$   | "L" Input Voltage                    | —               | —                           | 0           | —    | $0.2V_{DD}$ | V         |
| $f_{OSC}$  | Oscillator Frequency                 | 5V              | $R_{OSC}=1.1M\Omega$        | —           | 3    | —           | kHz       |
| $R_{TE}$   | $\overline{TE}$ Pull-high Resistance | 5V              | $V_{TE}=0V$                 | —           | 1.5  | 3           | $M\Omega$ |

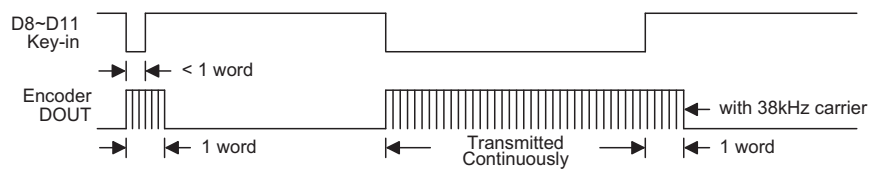
## Functional Description

### Operation

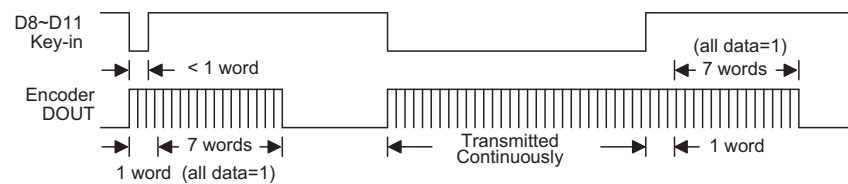
The 2<sup>12</sup> series of encoders begin a 4-word transmission cycle upon receipt of a transmission enable ( $\overline{TE}$  for the HT12E or D8~D11 for the HT12A, active low). This cycle will repeat itself as long as the transmission enable ( $\overline{TE}$  or D8~D11) is held low. Once the transmission enable returns high the encoder output completes its final cycle and then stops as shown below.



Transmission timing for the HT12E



Transmission timing for the HT12A ( $L/\overline{M}$ =Floating or VDD)

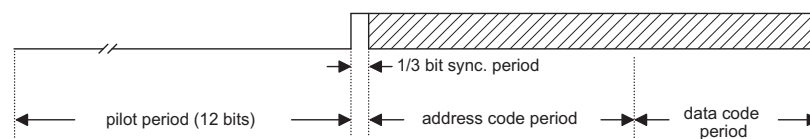


Transmission timing for the HT12A ( $L/\overline{M}$ =VSS)

### Information Word

If  $L/\overline{M}=1$  the device is in the latch mode (for use with the latch type of data decoders). When the transmission enable is removed during a transmission, the DOUT pin outputs a complete word and then stops. On the other hand, if  $L/\overline{M}=0$  the device is in the momentary mode (for use with the momentary type of data decoders). When the transmission enable is removed during a transmission, the DOUT outputs a complete word and then adds 7 words all with the "1" data code.

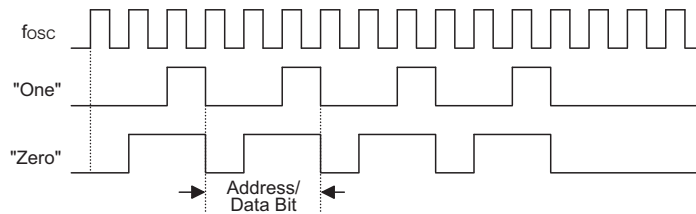
An information word consists of 4 periods as illustrated below.



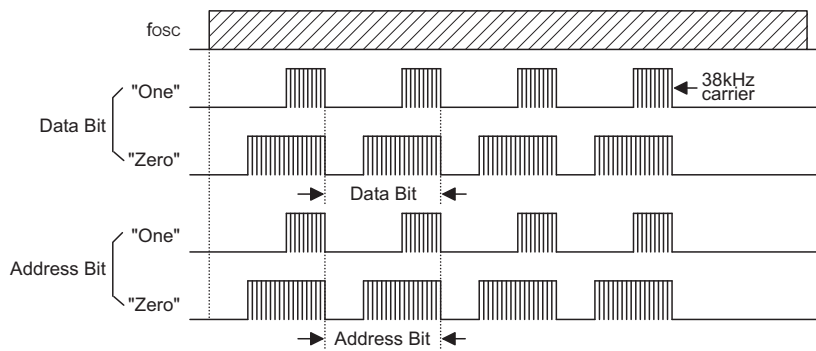
Composition of information

**Address/Data Waveform**

Each programmable address/data pin can be externally set to one of the following two logic states as shown below.



Address/Data bit waveform for the HT12E



Address/Data bit waveform for the HT12A

The address/data bits of the HT12A are transmitted with a 38kHz carrier for infrared remote controller flexibility.

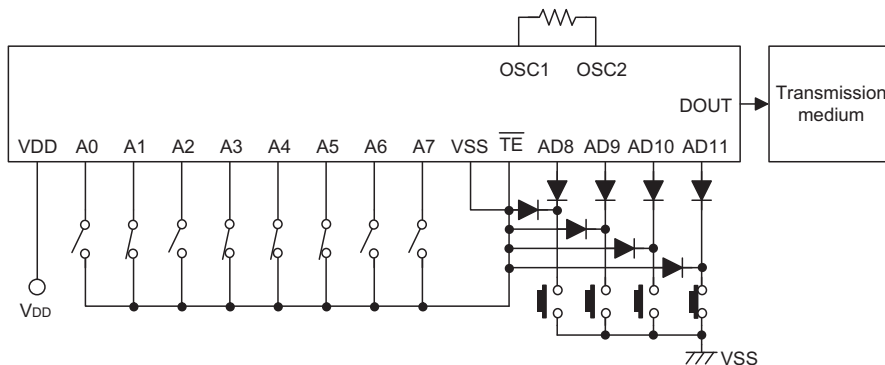
**Address/Data Programming (Preset)**

The status of each address/data pin can be individually pre-set to 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 encoder.

During information transmission these bits are transmitted with a preceding synchronization bit. If the trigger signal is not applied, the chip enters the standby mode and consumes a reduced current of less than 1µA for a supply voltage of 5V.

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

The following figure shows an application using the HT12E:



The transmitted information is as shown:

|                          |    |    |    |    |    |    |    |    |     |     |      |      |
|--------------------------|----|----|----|----|----|----|----|----|-----|-----|------|------|
| <b>Pilot &amp; Sync.</b> | A0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | AD8 | AD9 | AD10 | AD11 |
|                          | 1  | 0  | 1  | 0  | 0  | 0  | 1  | 1  | 1   | 1   | 1    | 0    |

### Address/Data Sequence

The following provides the address/data sequence table for various models of the 2<sup>12</sup> series of encoders.

| Part No. | Address/Data Bits |    |    |    |    |    |    |    |     |     |      |      |
|----------|-------------------|----|----|----|----|----|----|----|-----|-----|------|------|
|          | 0                 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8   | 9   | 10   | 11   |
| HT12A    | A0                | A1 | A2 | A3 | A4 | A5 | A6 | A7 | D8  | D9  | D10  | D11  |
| HT12E    | A0                | A1 | A2 | A3 | A4 | A5 | A6 | A7 | AD8 | AD9 | AD10 | AD11 |

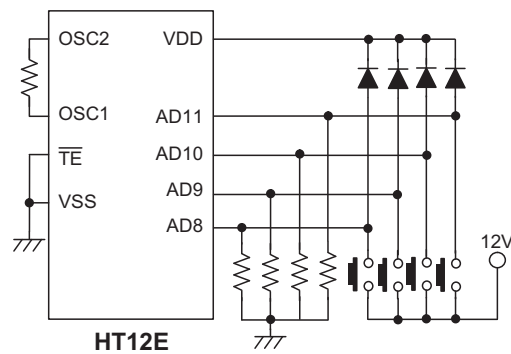
### Transmission Enable

For the HT12E encoders, transmission is enabled by applying a low signal to the  $\overline{\text{TE}}$  pin. For the HT12A encoders, transmission is enabled by applying a low signal to one of the data pins D8~D11.

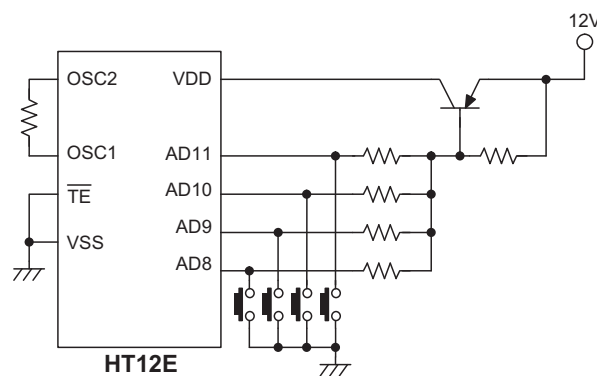
### Two Erroneous HT12E Application Circuits

The HT12E must follow closely the application circuits provided by Holtek (see the "Application circuits").

- Error: AD8~AD11 pins input voltage > V<sub>DD</sub>+0.3V



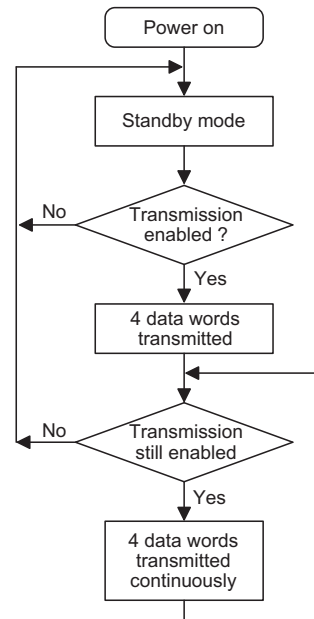
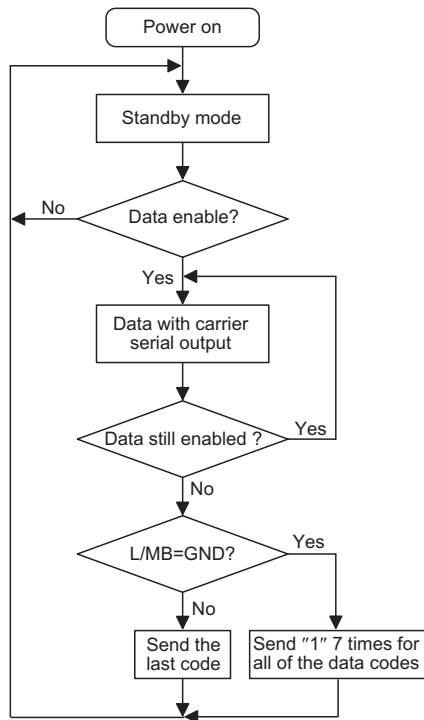
- Error: The IC's power source is activated by pins AD8~AD11



Flowchart

• HT12A

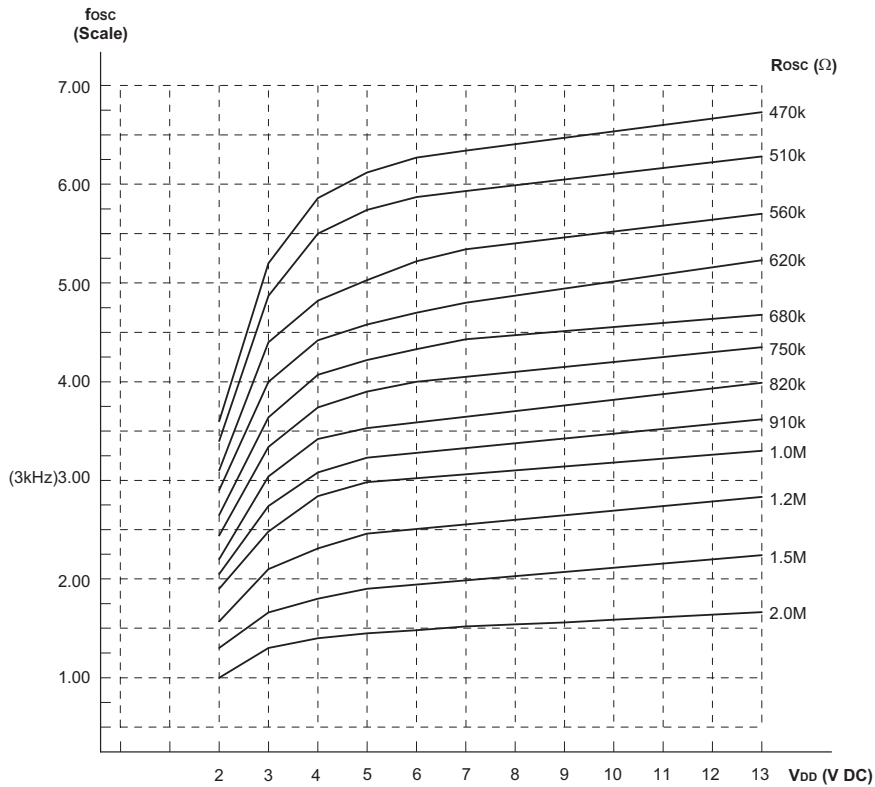
• HT12E



Note: D8~D11 are transmission enables of the HT12A.  
 $\overline{\text{TE}}$  is the transmission enable of the HT12E.

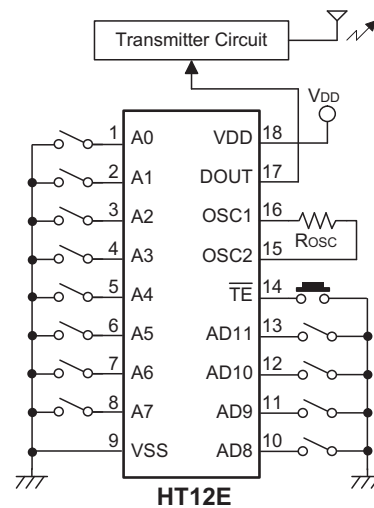
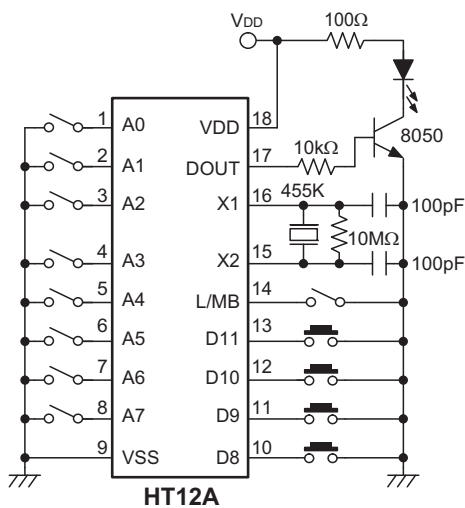


Oscillator Frequency vs. Supply Voltage



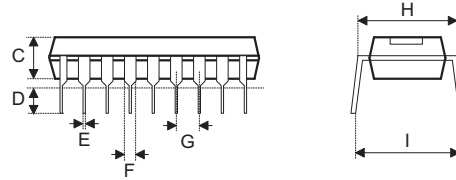
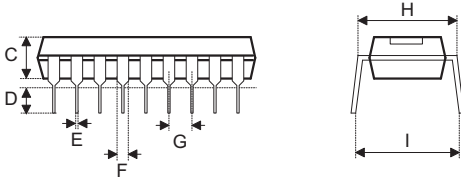
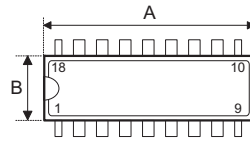
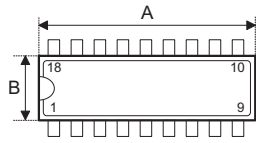
The recommended oscillator frequency is  $f_{OSC D} (\text{decoder}) \cong 50 f_{OSCE} (\text{HT12E encoder})$   
 $\cong \frac{1}{3} f_{OSCE} (\text{HT12A encoder})$

Application Circuits



**Package Information**

**18-pin DIP (300mil) Outline Dimensions**



**Fig1. Full Lead Packages**

**Fig2. 1/2 Lead Packages**

- MS-001d (see fig1)

| Symbol | Dimensions in mil |      |      |
|--------|-------------------|------|------|
|        | Min.              | Nom. | Max. |
| A      | 880               | —    | 920  |
| B      | 240               | —    | 280  |
| C      | 115               | —    | 195  |
| D      | 115               | —    | 150  |
| E      | 14                | —    | 22   |
| F      | 45                | —    | 70   |
| G      | —                 | 100  | —    |
| H      | 300               | —    | 325  |
| I      | —                 | —    | 430  |

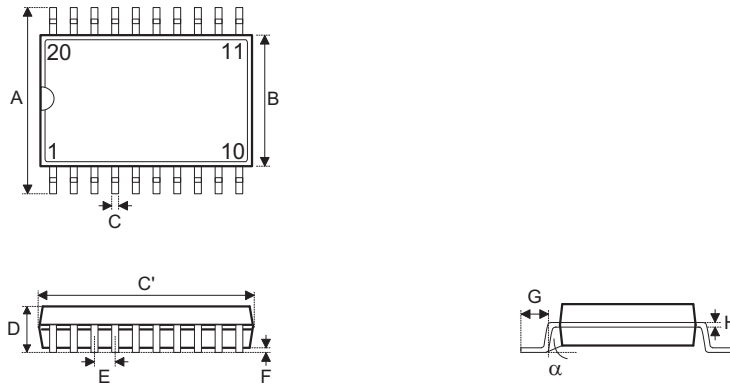
- MS-001d (see fig2)

| Symbol | Dimensions in mil |      |      |
|--------|-------------------|------|------|
|        | Min.              | Nom. | Max. |
| A      | 845               | —    | 880  |
| B      | 240               | —    | 280  |
| C      | 115               | —    | 195  |
| D      | 115               | —    | 150  |
| E      | 14                | —    | 22   |
| F      | 45                | —    | 70   |
| G      | —                 | 100  | —    |
| H      | 300               | —    | 325  |
| I      | —                 | —    | 430  |

- MO-095a (see fig2)

| Symbol | Dimensions in mil |      |      |
|--------|-------------------|------|------|
|        | Min.              | Nom. | Max. |
| A      | 845               | —    | 885  |
| B      | 275               | —    | 295  |
| C      | 120               | —    | 150  |
| D      | 110               | —    | 150  |
| E      | 14                | —    | 22   |
| F      | 45                | —    | 60   |
| G      | —                 | 100  | —    |
| H      | 300               | —    | 325  |
| I      | —                 | —    | 430  |

**20-pin SOP (300mil) Outline Dimensions**

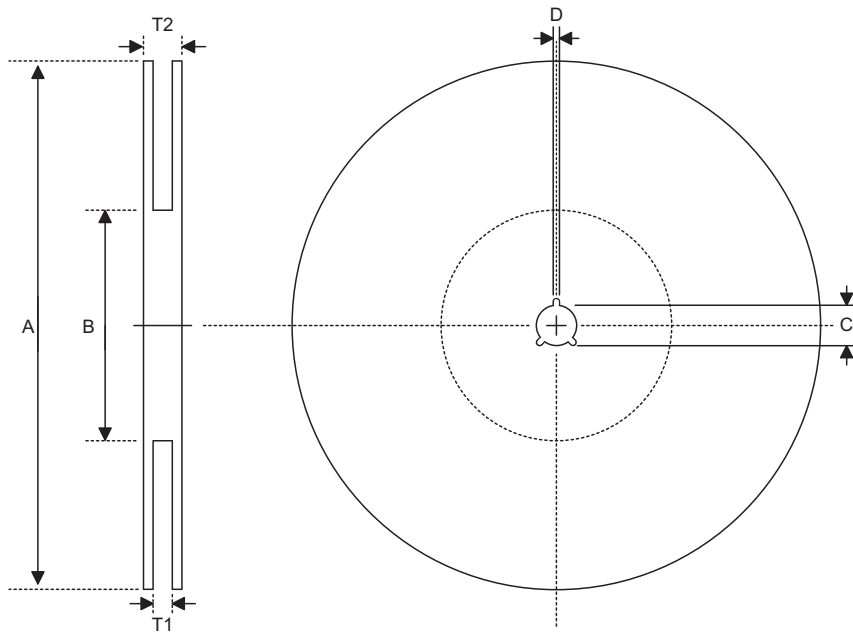


• MS-013

| Symbol   | Dimensions in mil |      |      |
|----------|-------------------|------|------|
|          | Min.              | Nom. | Max. |
| A        | 393               | —    | 419  |
| B        | 256               | —    | 300  |
| C        | 12                | —    | 20   |
| C'       | 496               | —    | 512  |
| D        | —                 | —    | 104  |
| E        | —                 | 50   | —    |
| F        | 4                 | —    | 12   |
| G        | 16                | —    | 50   |
| H        | 8                 | —    | 13   |
| $\alpha$ | 0°                | —    | 8°   |

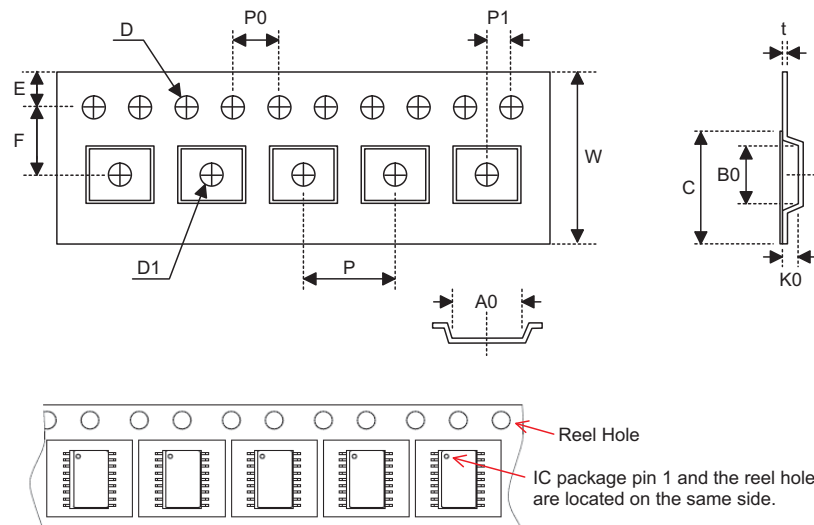
**Product Tape and Reel Specifications**

**Reel Dimensions**



SOP 20W

| Symbol | Description           | Dimensions in mm          |
|--------|-----------------------|---------------------------|
| A      | Reel Outer Diameter   | 330.0±1.0                 |
| B      | Reel Inner Diameter   | 100.0±1.5                 |
| C      | Spindle Hole Diameter | 13.0 <sup>+0.5/-0.2</sup> |
| D      | Key Slit Width        | 2.0±0.5                   |
| T1     | Space Between Flange  | 24.8 <sup>+0.3/-0.2</sup> |
| T2     | Reel Thickness        | 30.2±0.2                  |

**Carrier Tape Dimensions**

**SOP 20W**

| Symbol | Description                              | Dimensions in mm            |
|--------|--|-----------------------------|
| W      | Carrier Tape Width                       | 24.0 <sup>+0.3/-0.1</sup>   |
| P      | Cavity Pitch                             | 12.0±0.1                    |
| E      | Perforation Position                     | 1.75±0.10                   |
| F      | Cavity to Perforation (Width Direction)  | 11.5±0.1                    |
| D      | Perforation Diameter                     | 1.5 <sup>+0.1/-0.0</sup>    |
| D1     | Cavity Hole Diameter                     | 1.50 <sup>+0.25/-0.00</sup> |
| 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                   | 0.30±0.05                   |
| C      | Cover Tape Width                         | 21.3±0.1                    |

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