2^{12} Series of Encoders

Features

- Operating voltage
  - 2.4V~5V for the HT12A
  - 2.4V~12V for the HT12E/EA
- Low power and high noise immunity CMOS technology
- Low standby current: 0.1μA (typ.) at V_{DD}=5V
- HT12A with a 38kHz carrier for infrared transmission medium
- Minimum transmission word
  - Four words for the HT12E/EA
  - One word for the HT12A

- Built-in oscillator needs only 5% resistor
- Data code polarity
  - HT12A/E/EA: Positive polarity
- Minimal external components
- 18-pin DIP or 20-pin SOP package available for HT12A
- 14/18-pin DIP or 16/20-pin SOP or 16-pin NSOP package available for HT12E

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^{12} 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/EA or a DATA trigger on the HT12A further enhances the application flexibility of the 2^{12} series of encoders. The HT12A additionally provides a 38kHz carrier for infrared systems.
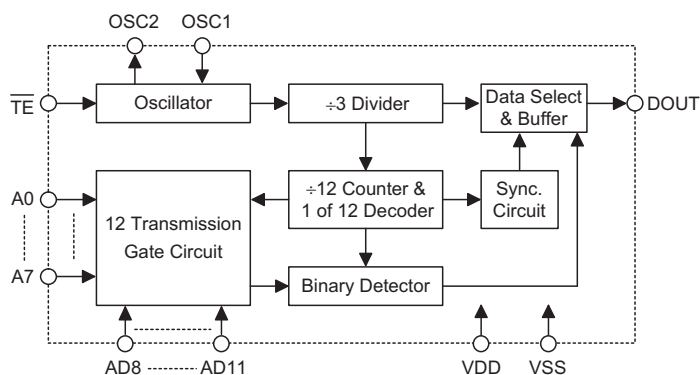
Selection Table

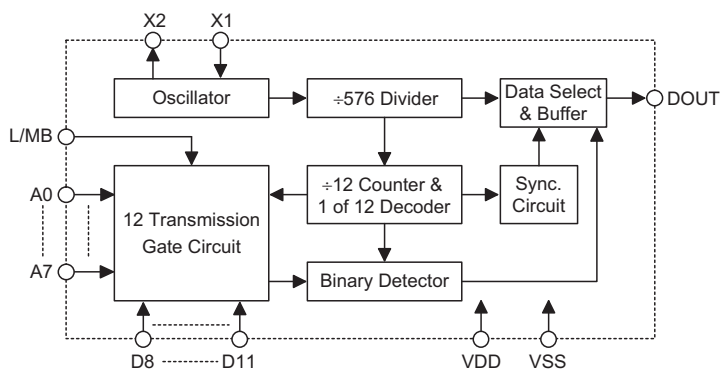| Function / Part No.	Address No.	Address/ Data No.	Data No.	Oscillator	Trigger	Package	Carrier Output	Negative Polarity
HT12A	8	0	4	455kHz resonator	D8~D11	18 DIP 20 SOP	38kHz	No
HT12E/EA	8	4	0	RC oscillator	$\overline{TE}$	14/18 DIP 16/20 SOP 16 NSOP	No	No

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Block Diagram

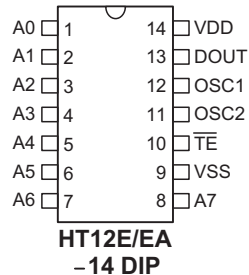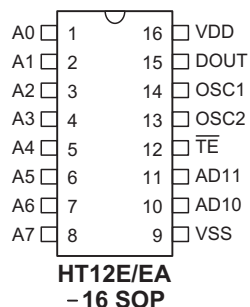**$\overline{\text{TE}}$ trigger**

HT12E/EA

DATA trigger

HT12A

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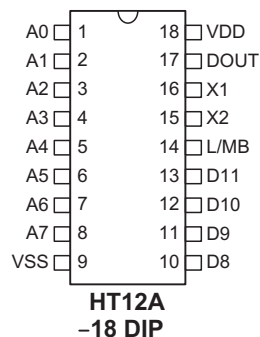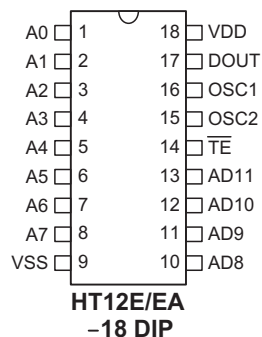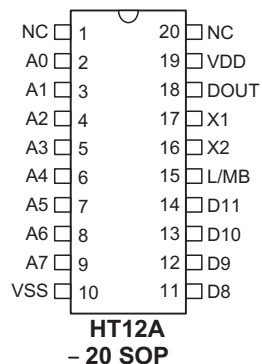
Pin Assignment

8-Address

```
        ┌───┬───┐
A0 ──┤1      14├── VDD
A1 ──┤2      13├── DOUT
A2 ──┤3      12├── OSC1
A3 ──┤4      11├── OSC2
A4 ──┤5      10├── TE
A5 ──┤6       9├── VSS
A6 ──┤7       8├── A7
        └───────┘
```

HT12E/EA
−14 DIP

8-Address
2-Address/Data

```
        ┌───┬───┐
A0 ──┤1      16├── VDD
A1 ──┤2      15├── DOUT
A2 ──┤3      14├── OSC1
A3 ──┤4      13├── OSC2
A4 ──┤5      12├── TE
A5 ──┤6      11├── AD11
A6 ──┤7      10├── AD10
A7 ──┤8       9├── VSS
        └───────┘
```

HT12E/EA
−16 SOP

8-Address
4-Data

```
        ┌───┬───┐
A0 ──┤1      18├── VDD
A1 ──┤2      17├── DOUT
A2 ──┤3      16├── X1
A3 ──┤4      15├── X2
A4 ──┤5      14├── L/MB
A5 ──┤6      13├── D11
A6 ──┤7      12├── D10
A7 ──┤8      11├── D9
VSS ─┤9      10├── D8
        └───────┘
```

HT12A
−18 DIP

8-Address
4-Address/Data

```
        ┌───┬───┐
A0 ──┤1      18├── VDD
A1 ──┤2      17├── DOUT
A2 ──┤3      16├── OSC1
A3 ──┤4      15├── OSC2
A4 ──┤5      14├── TE
A5 ──┤6      13├── AD11
A6 ──┤7      12├── AD10
A7 ──┤8      11├── AD9
VSS ─┤9      10├── AD8
        └───────┘
```

HT12E/EA
−18 DIP

8-Address
4-Data

```
        ┌───┬───┐
NC ──┤1      20├── NC
A0 ──┤2      19├── VDD
A1 ──┤3      18├── DOUT
A2 ──┤4      17├── X1
A3 ──┤5      16├── X2
A4 ──┤6      15├── L/MB
A5 ──┤7      14├── D11
A6 ──┤8      13├── D10
A7 ──┤9      12├── D9
VSS ─┤10     11├── D8
        └───────┘
```

HT12A
− 20 SOP

8-Address
4-Address/Data

```
        ┌───┬───┐
NC ──┤1      20├── NC
A0 ──┤2      19├── VDD
A1 ──┤3      18├── DOUT
A2 ──┤4      17├── OSC1
A3 ──┤5      16├── OSC2
A4 ──┤6      15├── TE
A5 ──┤7      14├── AD11
A6 ──┤8      13├── AD10
A7 ──┤9      12├── AD9
VSS ─┤10     11├── AD8
        └───────┘
```

HT12E/EA
− 20 SOP

Pin Description

Pin Name	I/O	Internal Connection	Description
A0~A7	I	CMOS IN Pull-high (HT12A) / NMOS TRANSMISSION GATE (HT12E) / NMOS TRANSMISSION GATE PROTECTION DIODE (HT12EA)	Input pins for address A0~A7 setting These pins should be set to VDD or VSS. (Only for the HT12E/EA)
AD8~AD11	I	NMOS TRANSMISSION GATE (HT12E) / NMOS TRANSMISSION GATE PROTECTION DIODE (HT12EA)	Input pins for address/data AD8~AD11 setting These pins should be set to VDD or VSS (only for the HT12E/EA).
D8~D11	I	CMOS IN Pull-high	Input pins for data D8~D11 setting and transmission enable, active low These pins should be externally set to VSS or left open (see Note)
DOUT	O	CMOS OUT	Encoder data serial transmission output
L/MB	I	CMOS IN Pull-high	Latch/Momentary transmission format selection pin: Latch: Floating or VDD Momentary: VSS
$\overline{\text{TE}}$	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 (GND)
VDD	I	—	Positive power supply

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

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

Approximate internal connection circuits

NMOS TRANSMISSION GATE	CMOS IN Pull-high	CMOS OUT	OSCILLATOR 1

OSCILLATOR 2	NMOS TRANSMISSION GATE PROTECTION DIODE
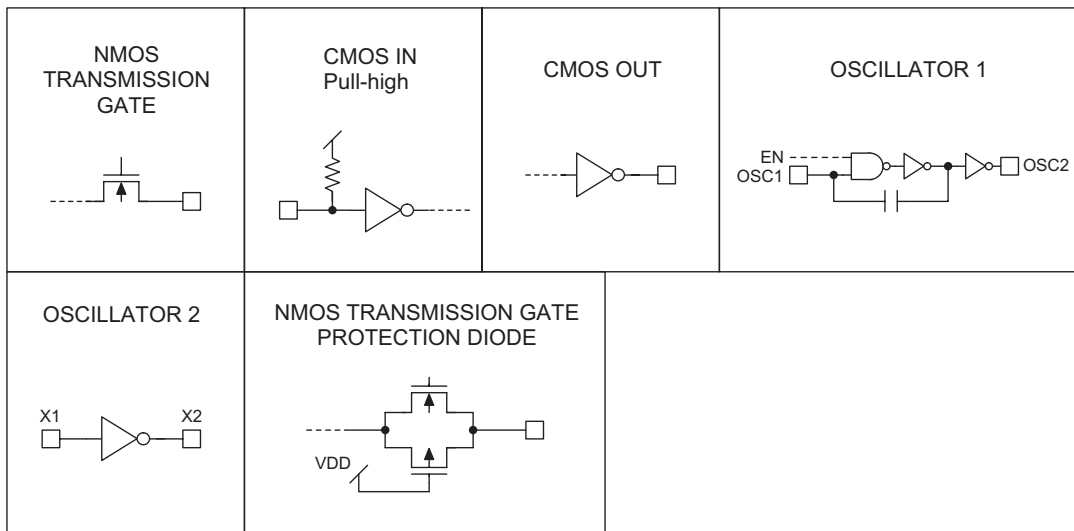
Absolute Maximum Ratings

Supply Voltage (HT12A) ....–0.3V to 5.5V

Input Voltage....................V_{SS}–0.3 to V_{DD}+0.3V

Operating Temperature...............–20°C to 75°C

Supply Voltage (HT12E/EA) ....–0.3V to 13V

Storage Temperature.................–50°C to 125°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 Ta=25°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	μA
		5V		—	0.1	1	μA
I_{DD}	Operating Current	3V	No load f_{OSC}=455kHz	—	200	400	μA
		5V		—	400	800	μA
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}	D2~D11 Pull-high Resistance	5V	V_{DATA}=0V	—	150	300	kΩ

HT12E/EA Ta=25°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	μA
		12V		—	2	4	μA
I_{DD}	Operating Current	3V	No load f_{OSC}=3kHz	—	40	80	μA
		12V		—	150	300	μA
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}=1.1MΩ	—	3	—	kHz
$R_{\overline{TE}}$	$\overline{TE}$ Pull-high Resistance	5V	$V_{\overline{TE}}$=0V	—	1.5	3	MΩ

Functional Description

Operation

The 2^{12} series of encoders begin a 4-word transmission cycle upon receipt of a transmission enable ($\overline{\text{TE}}$ for the HT12E/EA or D8~D11 for the HT12A, active low). This cycle will repeat itself as long as the transmission enable ($\overline{\text{TE}}$ 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.
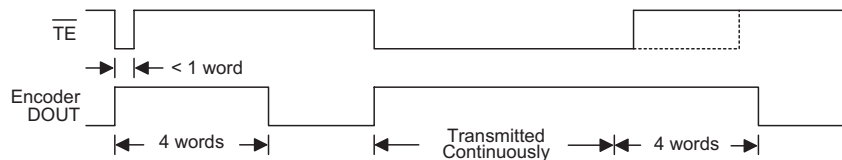
Transmission timing for the HT12E/EA
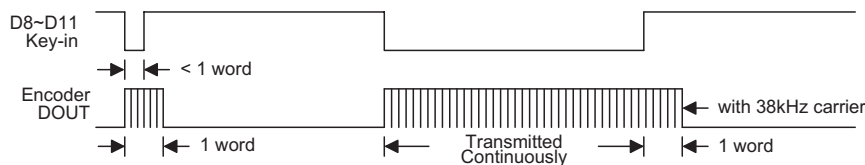
Transmission timing for the HT12A (L/MB=Floating or VDD)
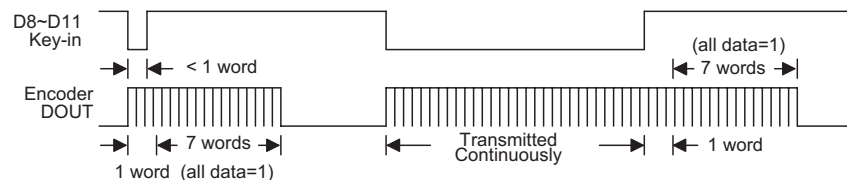
Transmission timing for the HT12A (L/MB=VSS)

Information word

If L/MB=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/MB=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.
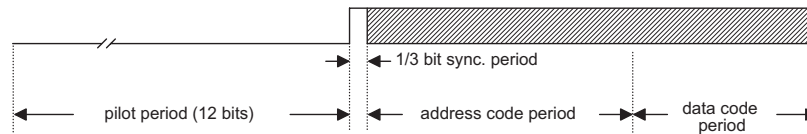
Composition of information

Address/data waveform

Each programmable address/data pin can be externally set to one of the following two logic states as shown below.
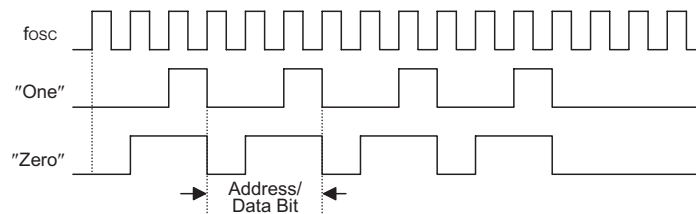
Address/Data bit waveform for the HT12E/EA
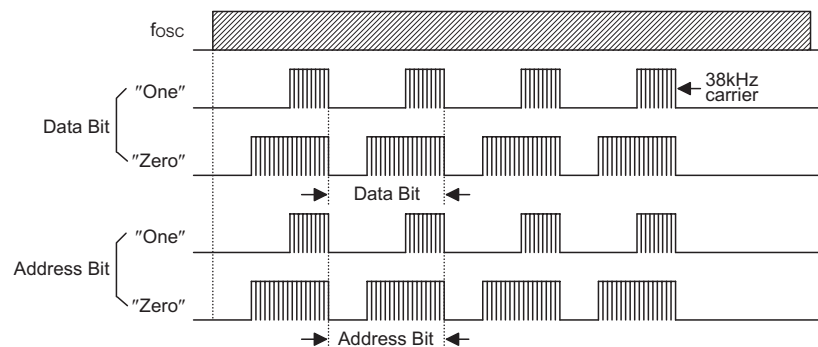
Address/Data bit waveform for the HT12A

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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/EA 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/EA:
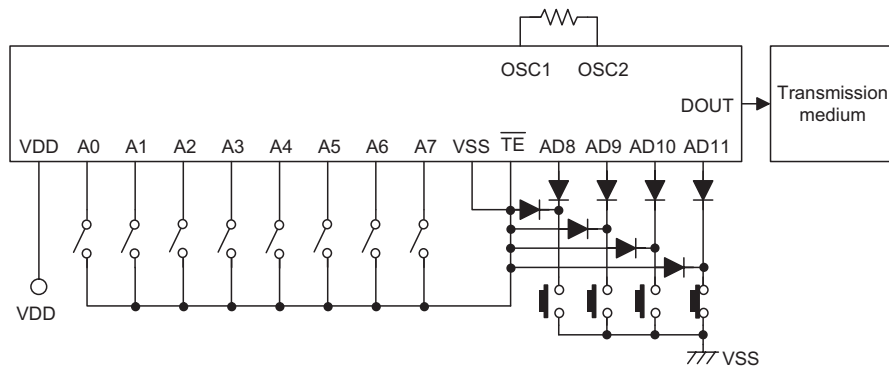
The transmitted information is as shown:

Pilot & Sync.	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^{12} series of encoders. The correct device should be selected according to the individual address and data requirements.

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/EA	A0	A1	A2	A3	A4	A5	A6	A7	AD8	AD9	AD10	AD11

Transmission enable

For the HT12E/EA 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 HT12EA application circuits

The HT12EA differs from the HT12E in that protection diodes are provided on the input pins, (see the "Approximate internal connection circuits"). The HT12EA must follow closely the application circuits provided by Holtek (see the "Application circuits").

• Error: AD8~AD11 pins input voltage > VDD+0.3V
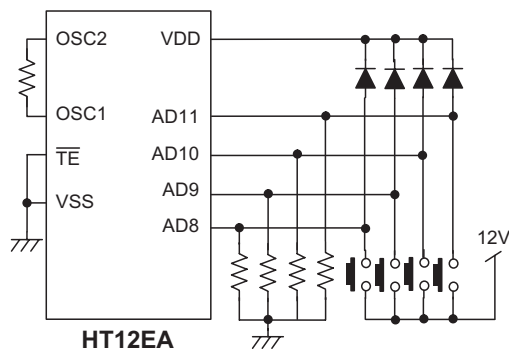
HT12EA

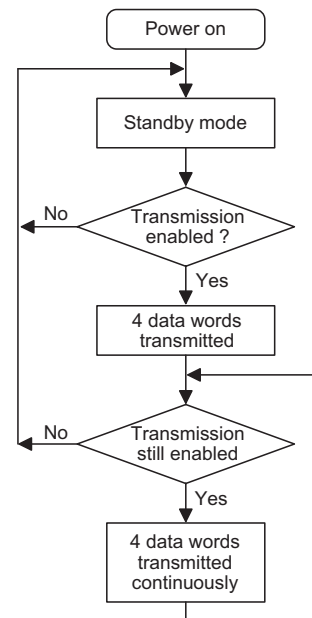• Error: The IC′s power source is activated by pins AD8~AD11
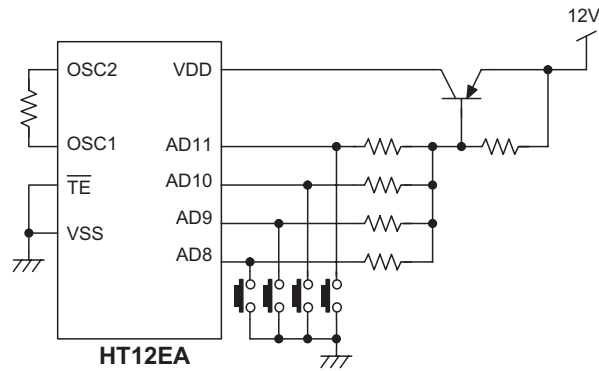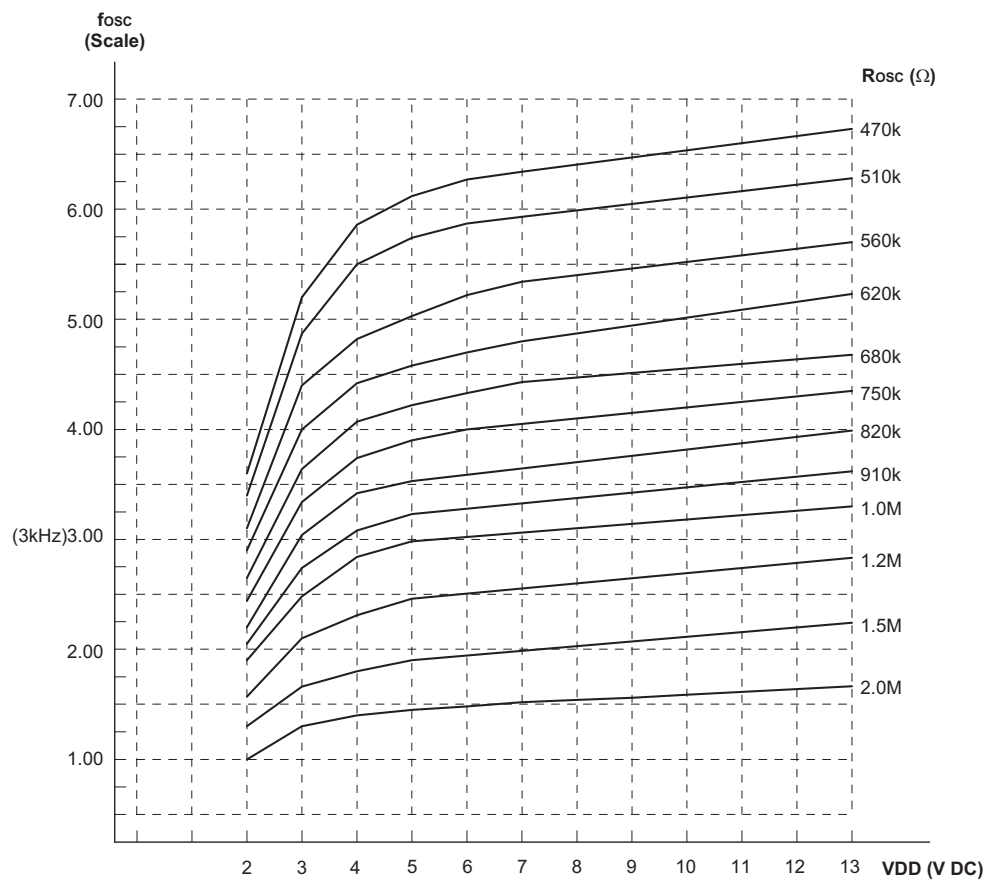

HT12EA

Flowchart
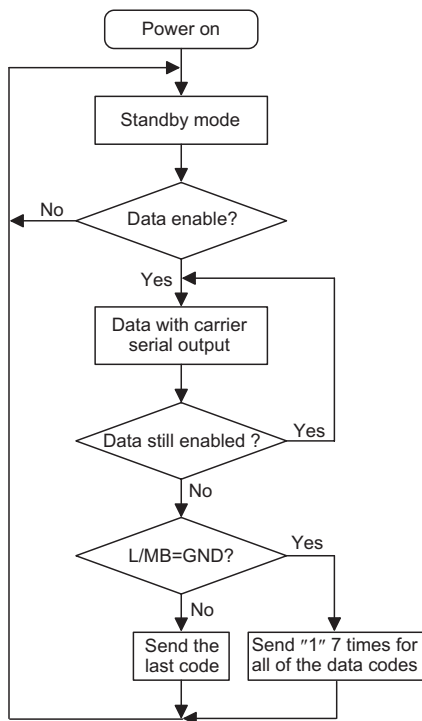
• HT12A

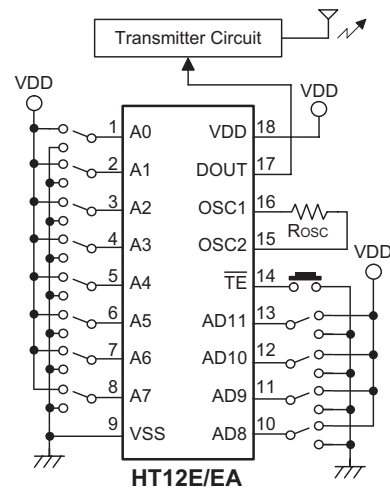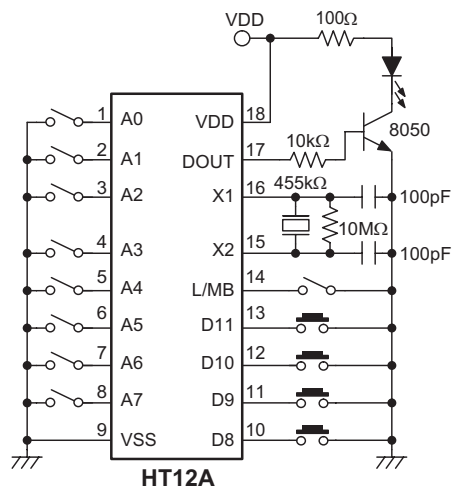• HT12E/EA

Notes: D8~D11 are transmission enables of the HT12A.

$\overline{TE}$ is the transmission enable of the HT12E/EA.

Oscillator frequency vs supply voltage

The recommended oscillator frequency is f_{OSCD} (decoder) $\cong 50\ f_{OSCE}$ (HT12E/EA encoder)

$$\cong \frac{1}{3}\ f_{OSCE}\ (\text{HT12A encoder})$$

Application Circuits

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

Typical RF transmitter: JR-220 (JUWA CORP.)

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