



$2^{16}/2^{12}$  RF Encoder

**HT16C2T3/HT16E2T3/HT16G2T3**  
**HT16C2T4/HT16E2T4/HT16G2T4**  
**HT12C2T3/HT12E2T3**  
**HT12C2T4/HT12E2T4**

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## Features

- Operating voltage: 2V ~ 3.6V
- Low standby current: 1μA (typ.) at V<sub>DD</sub>=3V
- Data trigger function
- Provides 2 compound Data trigger pins
- Minimum four transmission words
- Integrated oscillator – no external resistor
- Positive polarity data codes
- Integrated complete UHF transmitter
- Frequency range 300MHz to 450MHz
- Support ASK/OOK modulation
- Output power up to 10dBm
- Minimal external components
- 20-pin SSOP

## Applications

- Burglar alarm systems
- Smoke and fire alarm systems
- Personal alarm system
- Car/Garage door controllers
- Home/office/car security systems
- Cordless telephones
- Other remote control systems

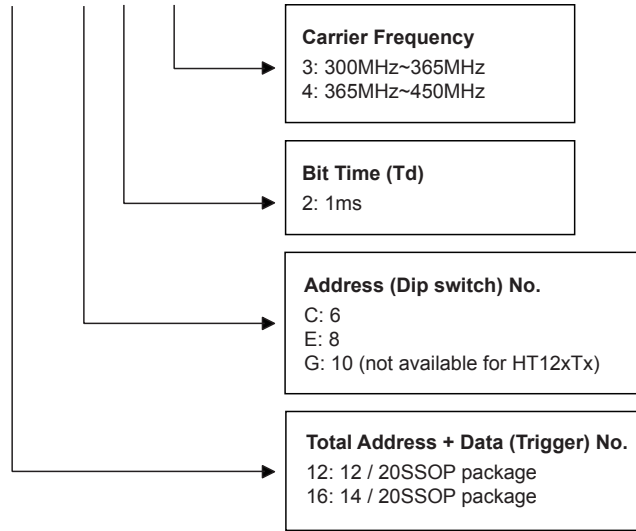
## General Description

The HT16x2Tx/HT12x2Tx are a series of encoders which include a 300M~450MHz ASK transmitter for remote control system applications. These highly integrated devices are true “switch-in, antenna-out” monolithic devices. They are capable of encoding information consisting of N address bits and 16- N data bits. Each address/data input can be set to one of two logic states. The programmed addresses/data is transmitted together with the header bits via RF upon receipt of a trigger signal. The capability to select a DATA trigger on the HT16x2Tx/HT12x2Tx further enhances the application flexibility of the 2<sup>16</sup> series of encoders.

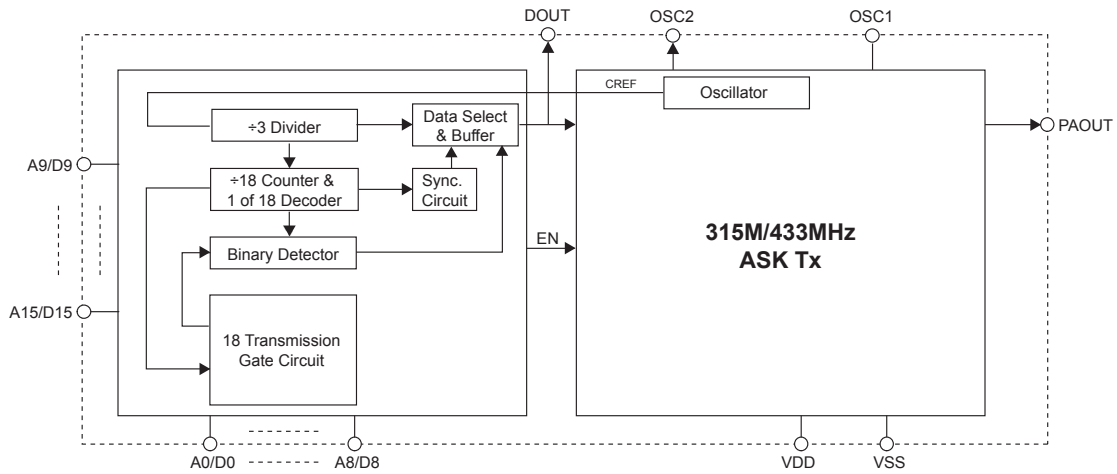
The devices offer high performance in the areas of power delivery and operating temperature. In terms of power, the devices are capable of delivering +10 dBm into a 50Ω load. This power level enables a small form factor transmitter such as a key fob transmitter to operate near the maximum limit of transmission regulations. In terms of temperature, the devices can operate from -40°C to 85°C with minor frequency drift. When compared with SAW solutions, wider operation temperatures are obtainable. The also offer exceptional ease of use. It is only necessary to provide a crystal reference frequency source, which has a frequency equal to the RF carrier frequency divided by 32, together with a few additional external components to implement a complete and versatile transmitter. The devices operate using ASK/OOK - Amplitude Shift Keying/On-Off Keyed - UHF receiver types from wide-band super-regenerative radios to narrow-band, high performance super-heterodyne receivers.

**Naming for Selection Guide**

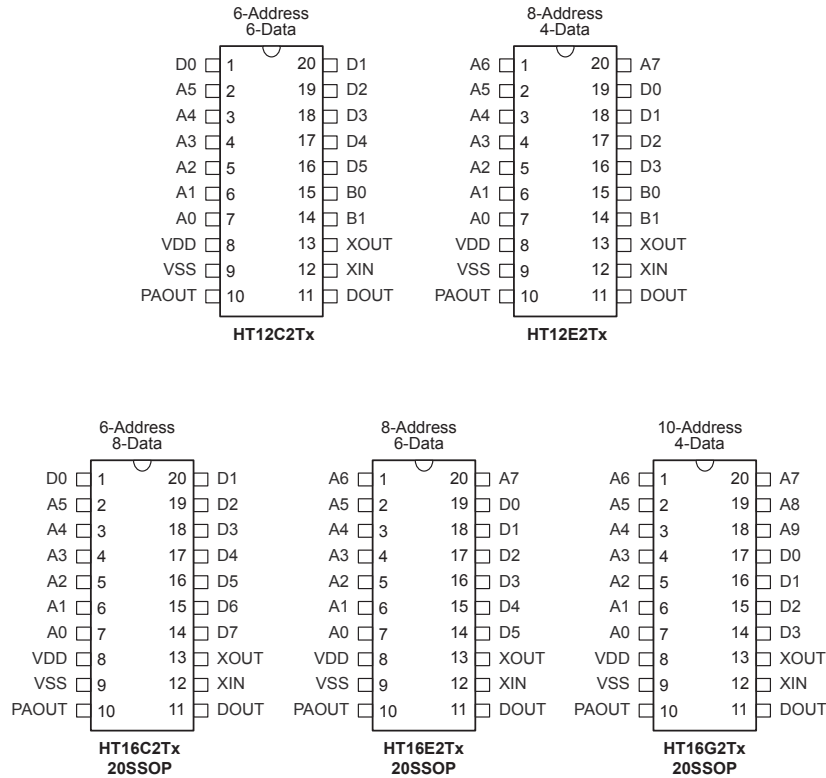
**HTxx\_x\_x\_Tx**



**Block Diagram**



## Pin Assignment



## Pin Description

Pin Name	Type	Description
VDD	—	Positive power supply.
VSS	—	Negative power supply.
AX	I	DIP switch input Internal pull high provided
DX	I	Push button input and transmission enable - active Low Can be externally set to V <sub>DD</sub> or left open
B0	I	Compound pin of pin16 and pin19 for HT12x2Tx only Ex. In HT12C2Tx, if B0 is pulled low, that means D5 and D2 are pulled low together.
B1	I	Compound pin of pin 16 and pin 17 for HT12x2T only
DOUT	O	Encoder data output
PAOUT	O	RF transmit Signal
XIN	I	Crystal pin – frequency is RF carrier frequency divided by 32 e.g: for 315MHz RF carrier a 9.84375MHz crystal should be selected
XOUT	O	

## Absolute Maximum Ratings

Logic Supply Voltage .....	2V to 3.6V
Logic Input Voltage .....	V <sub>SS</sub> -0.3V to V <sub>DD</sub> +0.3V
Storage Temperature .....	-55°C to 150°C
Operating Temperature .....	-40°C to 85°C

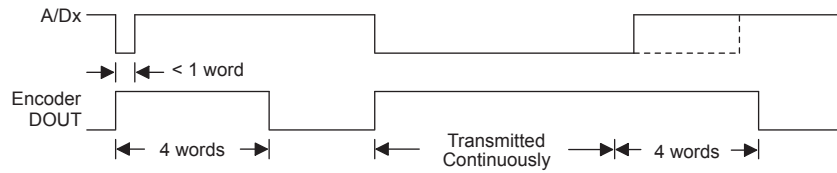
Note: These are stress ratings only. Stresses exceeding the range specified under “Absolute Maximum Ratings” may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

Specifications apply for V<sub>DD</sub> = 3.0V, Ta = 25°C, Freq X’talOSC = 13.560MHz, EN = VDD. Bold values indicate -20°C to 70°C unless otherwise noted. 1kbps data rate 50% duty cycle. R<sub>L</sub> 50ohm load (matched)

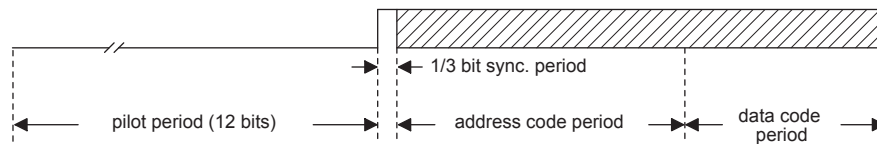
Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Units
		V <sub>DD</sub>	Conditions				
V <sub>IH</sub>	“H” Input Voltage	—	—	0.8V <sub>DD</sub>	—	—	V
V <sub>IL</sub>	“L” Input Voltage	—	—	—	—	0.2V <sub>DD</sub>	V
R <sub>PH</sub>	Pull-high Resistance	3	Dx	—	150	—	KΩ
T <sub>d</sub>	One bit data width for HT12x2Tx/HT16x2Tx	3	—	0.9	1.0	1.1	ms
I <sub>H</sub>	Data High Current	3V	@ 315MHz, POUT = +10dBm @ 433.92MHz	—	13.5	—	mA
I <sub>L</sub>	Data Low current	3V	@ 315MHz @ 433.92 MHz	—	3.0	—	mA
I <sub>STBY</sub>	DIN disabled current	3V	—	—	1	—	μA
<b>RF and Crystal</b>							
—	Output power level	3V	@315MHz, V <sub>DD</sub> =3.3V @433.92MHz, V <sub>DD</sub> =3.3V	—	10	—	dBm
—	Harmonic output for 315 MHz	3V	@630MHz, 2nd harm. @945MHz, 3rd harm.	—	-43 -52	—	dBc
—	Harmonic output for 433.92 MHz	3V	@867.84MHz, 2nd harm. @1301.76MHz, 3rd harm.	—	-40 -47	—	dBc
—	Extinction ratio for ASK 10Kbps	3V	—	—	70	—	dBc
—	Occupied Bandwidth	3V	@315MHz @433.92MHz	—	<700 <1000	—	kHz
—	315 MHz Single Side Band Phase Noise	3V	@ 100kHz from Carrier @ 1000kHz from Carrier	—	-73 -77	—	dBc/Hz
—	433.92 MHz Single Side Band Phase Noise	3V	@ 100kHz from Carrier @ 1000kHz from Carrier	—	-72 -76	—	dBc/Hz
—	XTLIN, XTLOUT	3V	Pin capacitance	—	2	—	pF
—	External Capacitance	3V	See application circuit C3, C4 @315MHz @433.92MHz	—	15 18	—	pF
—	Output Blanking	3V	STDBY transition from LOW to HIGH (=Pilot period)	—	12	—	bits
—	ASK to RF Out Response Time	3V	Delta between ASK Input Transition from Low to High to RF Output Transition from Low to High	—	1	—	μs

## Functional Description

The devices will execute a 4-word transmission cycle upon receipt of a transmission enable signal, which is a low signal on DX. The transmission cycle will repeat itself as long as the transmission enable, DX is held low. Once the transmission enable returns to a high level, the encoder output completes its final cycle and then stops as shown below.



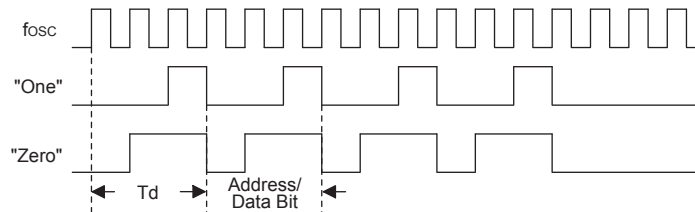
An information word consists of 4 periods as illustrated below:



**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:



## Bit Time (Td)

Since the bit time is derived from the crystal frequency, HT16xTx/HT12xTx provides a voltage and temperature invariance bit time. The formulation of the bit time related with crystal selection is shown below:

$$\begin{aligned} \text{HT16x2T3/HT12x2T3: } T_d &= 24 / (f_{cx} \times 2500) \\ \text{HT16x2T4/HT12x2T4: } T_d &= 168 / (f_{cx} \times 12500) \\ \text{Note: } f_c &= \text{crystal} / 10^6 \end{aligned}$$

For example:

RF carrier range: 315MHz

	<b>Td</b> <b>(Crystal = 9.84375MHz)</b>
HT16x2T3/HT12x2T3	0.975ms

RF carrier range: 433MHz

	<b>Td</b> <b>(Crystal = 13.56MHz)</b>
HT16x2T4/HT12x2T4	0.99ms

### Code Word

A group of code bits is called a code word. A code word consists of one Pilot-code (Synchronous bit) followed by address/ data bits. Refer to the diagram below:

#### HT16C2Tx:

Pilot-code	A0~A5	D0~D7	1 1
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#### HT16E2Tx:

Pilot-code	A0~A7	D0~D5	1 1
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#### HT16G2Tx:

Pilot-code	A0~A9	D0~D3	1 1
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#### HT12C2Tx:

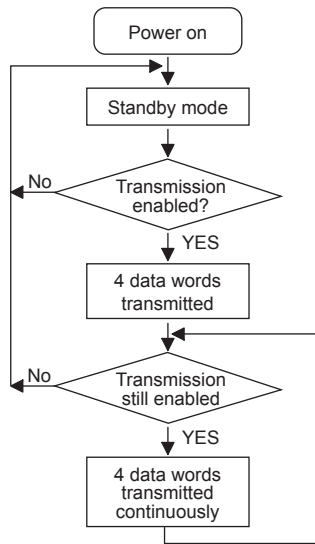
Pilot-code	A0~A5	D0~D5
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#### HT12E2Tx:

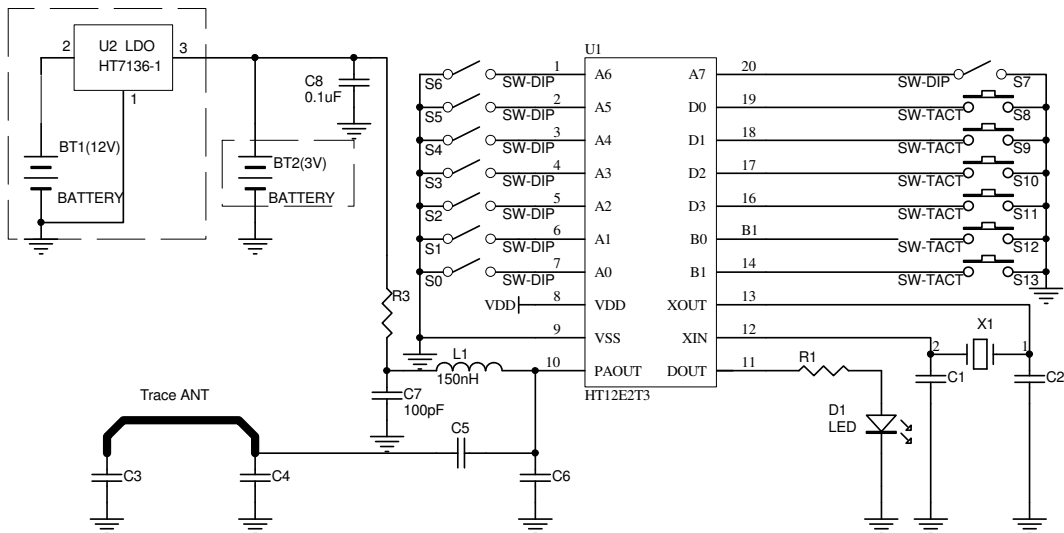
Pilot-code	A0~A7	D0~D3
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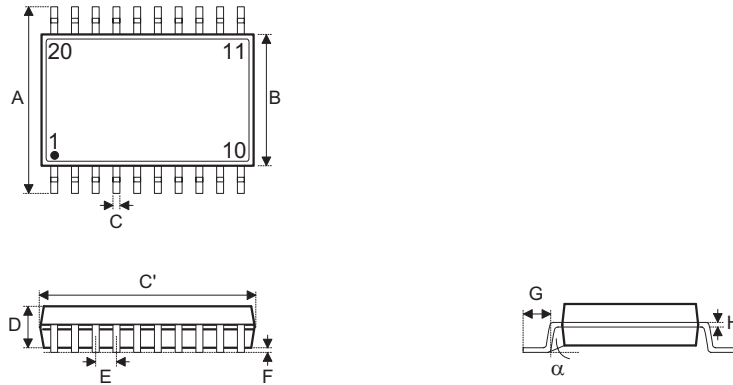
**Operation Flowchart**



**Application Circuit**



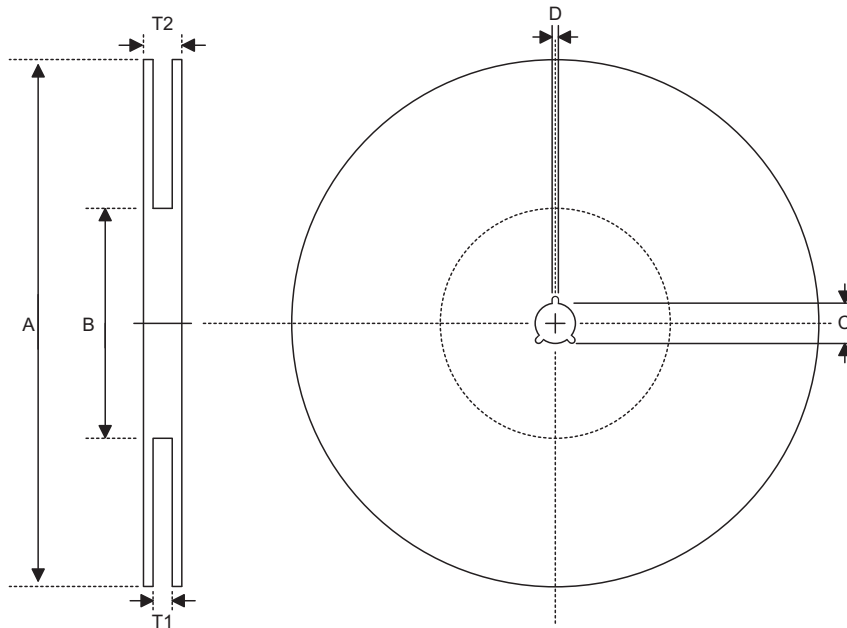
- Note: 1. When using a 6~12V battery, an HT7136 LDO should be added  
 2. 315MHz RF uses a 9.84375MHz Crystal  
 433MHz RF uses a 13.56MHz Crystal

**Package Information**
**20-pin SSOP (150mil) Outline Dimensions**


Symbol	Dimensions in inch		
	Min.	Nom.	Max.
A	0.228	—	0.244
B	0.150	—	0.158
C	0.008	—	0.012
C'	0.335	—	0.347
D	0.049	—	0.065
E	—	0.025	—
F	0.004	—	0.010
G	0.015	—	0.050
H	0.007	—	0.010
α	0°	—	8°

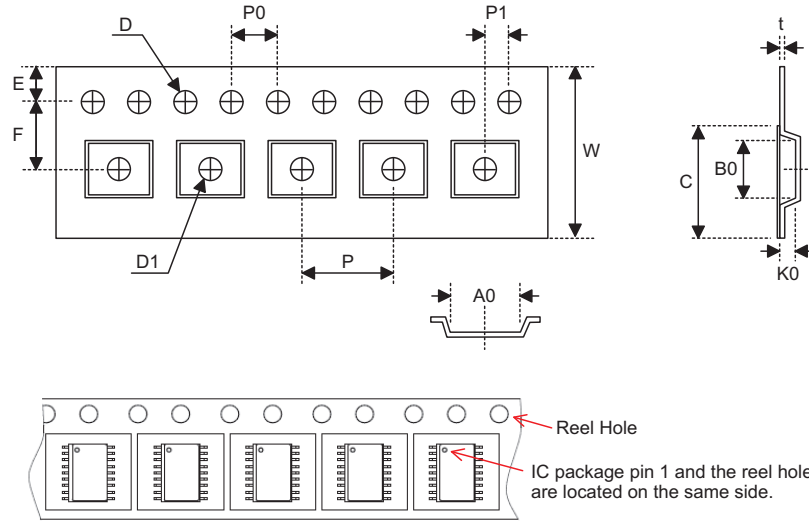
Symbol	Dimensions in mm		
	Min.	Nom.	Max.
A	5.79	—	6.20
B	3.81	—	4.01
C	0.20	—	0.30
C'	8.51	—	8.81
D	1.24	—	1.65
E	—	0.64	—
F	0.10	—	0.25
G	0.38	—	1.27
H	0.18	—	0.25
α	0°	—	8°

**Reel Dimensions**



**SSOP 20S (150mil)**

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	16.8 <sup>+0.3/-0.2</sup>
T2	Reel Thickness	22.2±0.2

**Carrier Tape Dimensions**

**SSOP 20S (150mil)**

Symbol	Description	Dimensions in mm
W	Carrier Tape Width	16.0 <sup>+0.3/-0.1</sup>
P	Cavity Pitch	8.0±0.1
E	Perforation Position	1.75±0.10
F	Cavity to Perforation (Width Direction)	7.5±0.1
D	Perforation Diameter	1.5 <sup>+0.17/-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	6.5±0.1
B0	Cavity Width	9.0±0.1
K0	Cavity Depth	2.3±0.1
t	Carrier Tape Thickness	0.30±0.05
C	Cover Tape Width	13.3±0.1

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