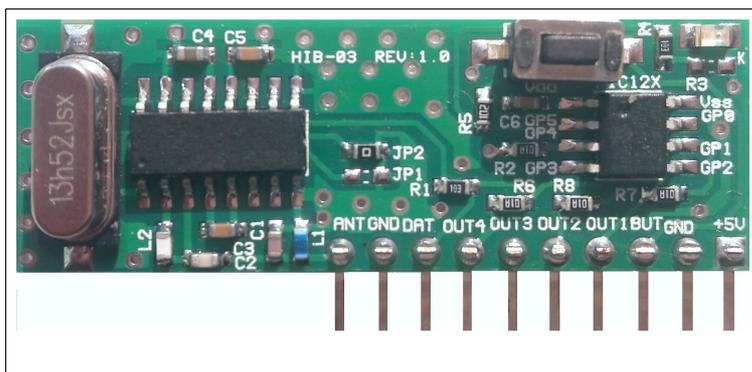


Smart RF Receiver Module with Intelligent Code Learning and Decoding Feature

1. INTRODUCTION

HIB03-PT is an ASK/OOK compatible super heterodyne receiver module with **intelligent code learning and decoding feature**. It is a smart hybrid circuit which integrates RF demodulator and data decoder for PT2260, PT2262, PT2240, EV1527 encoders. It is intended to



use with 433.92 Mhz and 315 Mhz. ISM band applications. The module has an entire phase locked loop (PLL) for precise local oscillator generation.

By incorporating the decoder stage to the RF part, HIB03 smart hybrid reduces the cost of the final project and enhance the code efficiency of application software. This is the major difference of HIB03 from the ordinary receiver modules.

Because the decoder stage of HIB03 is microcontroller based, an important feature is the **Code Learning Capability**. The module **can learn 80 different-coded remote transmitters**. So, there is no need for soldering any address pins nor using a hardware dip-switch for address matching with the transmitters. This is a key feature that HIB03 differs from ordinary remote decoder IC's.

Another important feature of HIB03 is automatic data rate (bit rate) detection of the encoded data. So, no oscillator resistor nor capacitor is connected for data rate adjusting. The module can decode the encoded signal in very wide range of data rate.

2. FEATURES

- Frequency : 433.92 Mhz. / 315 Mhz.
- High Sensitivity: -110dBm @ (433.92Mhz., 1Kbps, BER:%1)
- Wide Range Supply Voltage: From 3.6V to 5.5V
- IF Band: 230 Khz.
- Excellent Selectivity and Noise Rejection.
- Microcontroller based design.

- Decodes and learns transmitters which has PT2260, PT2262, PT2240 and EV1527 encoder ICs.
- Four logical binary outputs (OUT1,OUT2,OUT3, OUT4) capable of driving +/- 25mA. (Active High and Active Low Output models are available. Refer to ordering information.)
- On module learning button.
- Learning button input pin (BUT) for external learn-switch connection.
- On module, RF Signal Led which indicates the received signal from supported transmitters.
- Can learn 80 different-coded remote transmitters. No need any hardware for address matching.
- Automatic data rate detection of the remote encoder. No need any hardware for data rate adjusting.
- An optional demodulated data output (DAT) of the RF part is also available.

3. TYPICAL APPLICATIONS

- Remote Keyless Entry.
- Remote Gate Openers.
- Car Alarm Systems.
- Wireless Security Systems.
- General Remote Control Applications.

4. PIN DESCRIPTION

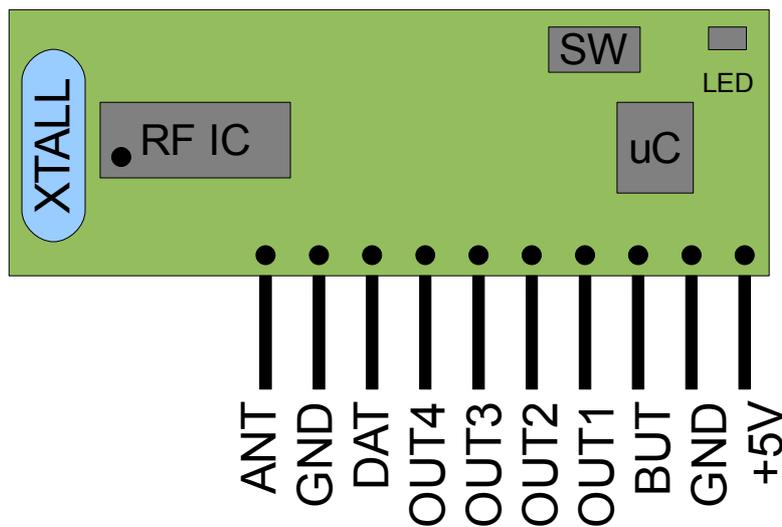


Figure 1. Pin Diagram of HIB03 Module

PIN NAME	DESCRIPTION
ANT	RF Signal Input Pin. Characteristic Empedance: 50 Ohm For $\lambda/4$ dipole antenna: Connect to wire of 23 cm. for 315MHz. and 17cm. for 433 MHz.
GND	Connect to Power Supply Negative Input
DAT	Demodulated Data Output of the RF part
OUT4	Decoded Data Output 4. Activated according to D3 bit of encoder.
OUT3	Decoded Data Output 3. Activated according to D2 bit of encoder.
OUT2	Decoded Data Output 2. Activated according to D1 bit of encoder.
OUT1	Decoded Data Output 1. Activated according to D0 bit of encoder.
BUT	External Learn-Sw (Button) Connection Pin.
GND	Connect to Power Supply Negative Input
+5V	Connect to Power Supply Positive Input

Table 1. Pin Description

5. FUNCTIONAL BLOCK DIAGRAM

HIB03 module consists of mainly two functional blocks. The RF Demodulator Part and the Decoder Part. This is shown in Figure 2. Also there is a detailed block diagram in Figure 3.

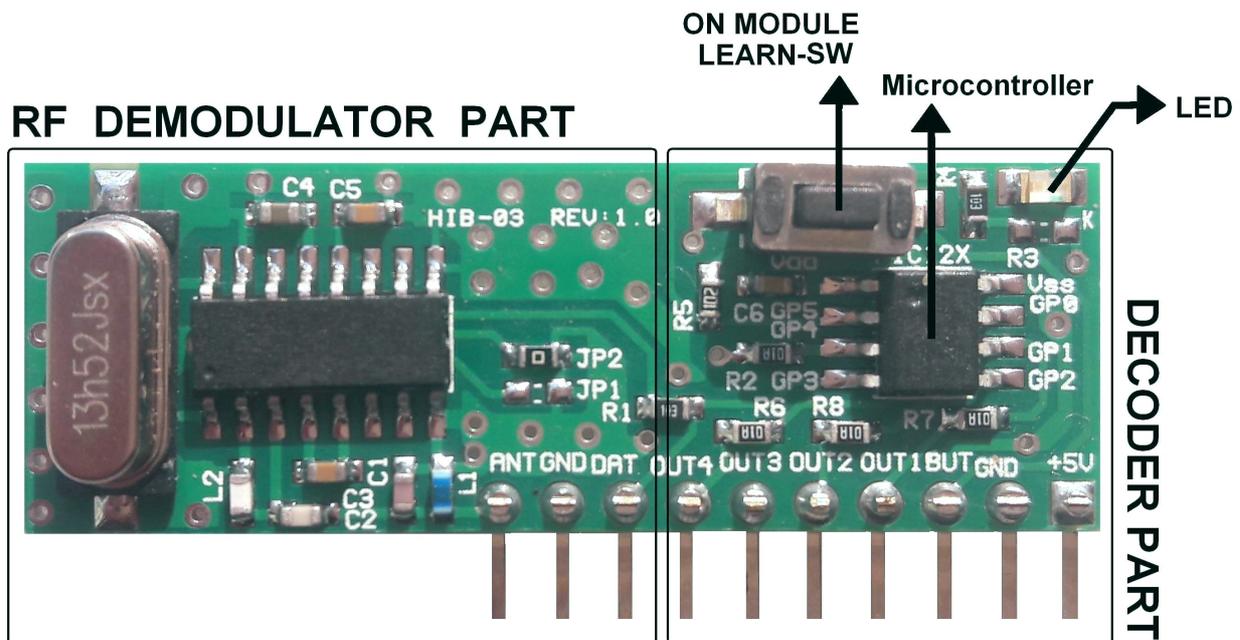


Figure 2. Functinal Blocks of HIB03 Module

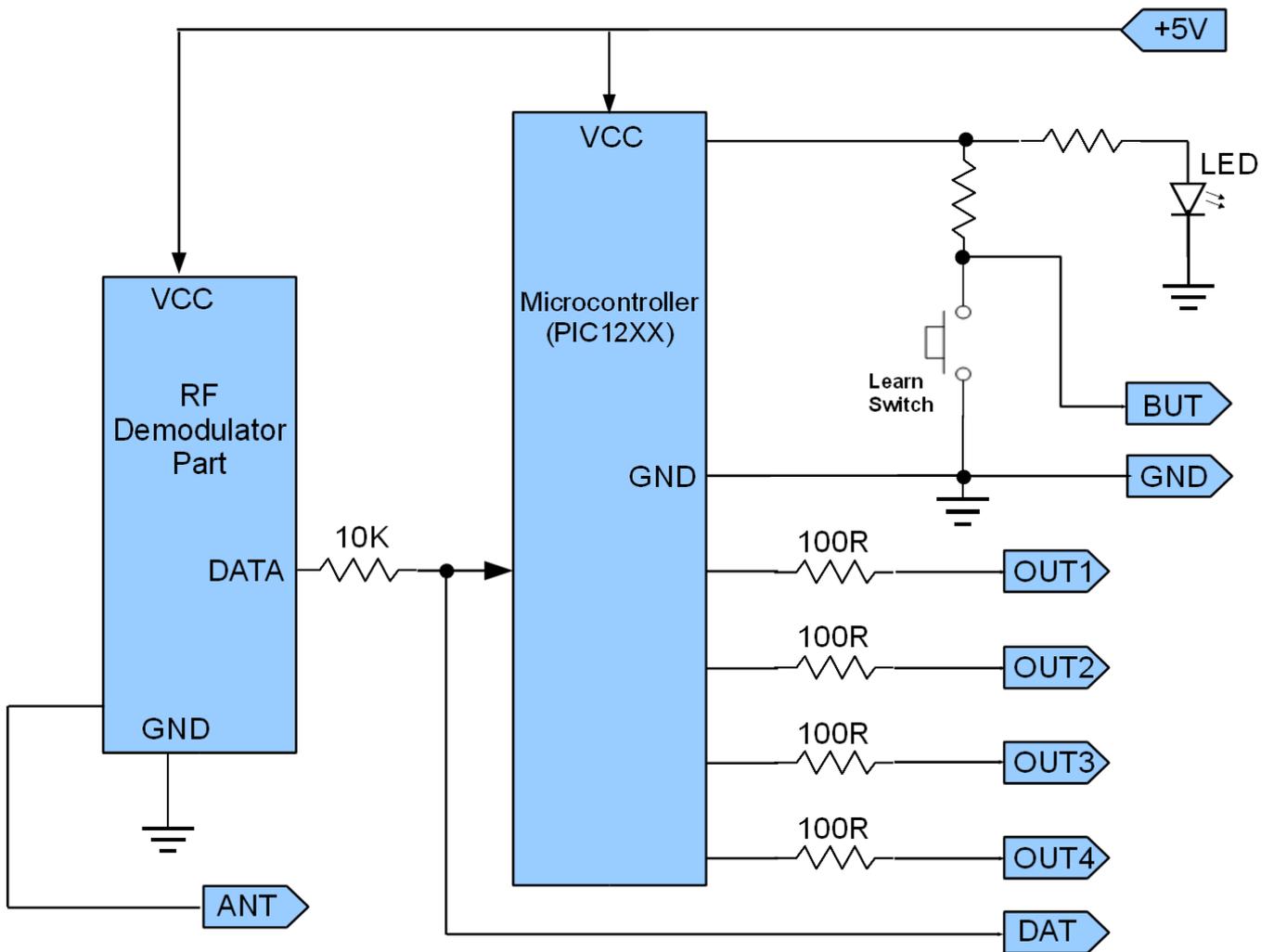


Figure 3. Detailed Block Diagram of HIB03 Module

6. THEORY OF OPERATION

When a RF Signal is reached to the HIB03 module, the demodulated signal (data) is decoded by microcontroller. If the decoded data conforms to PT22XX encoders' data form, the LED on the module turns on. As long as the PT22XX signal is received the led is on. When the transmitter's signal is cut, the led turns off. The LED indicates that, **any** PT22XX encoder signal is received. However the outputs (OUT1-OUT4) are activated for only teached transmitters. So, the first step before using the module is teaching the remote control units.

Learning Mode (Teaching A Remote Control) : Press the Learn Switch on the module. After releasing the switch, the module enters into learning mode. If any button on the remote control unit is pressed within 10 seconds, the address codes of PT2260/PT2262/PT2240/EV1527 encoders are written to a non-volatile memory space and the module exits from learning mode. If there isn't any PT22XX signal received within 10 seconds, the module also exits from learning mode.

There are 8 tri-state address codes in PT2260 and PT2262. They are represented with 16 bits in module memory. For PT2240 and EV1527 there are 20 address bits. Also the encoder type is written to the memory. Data bits of encoders are not written to the memory. Because data bits are used for setting or clearing the outputs (OUT1-OUT4). Refer to datasheets of relevant encoder ICs for details.

The memory size is 80. It means 80 different-coded encoders can be taught. After the memory is full, 81th encoder data is not written.

Erasing Mode (Erasing Remote Control Memory): Although the remote encoders are written to memory one by one, they are bulk erased. To do this, press the Learn switch for 10 seconds without releasing. After 10 seconds, the LED on the module blinks 3 times to indicate the whole memory is erased.

The Outputs of HIB03 Module (OUT1-OUT4): Outputs of HIB03 are 0-5V CMOS type outputs. The outputs are only activated for the previously learned transmitters. Outputs are momentary type. This means; The outputs are activated as soon as the module receives a learned PT22XX code. When the transmitter's signal is cut, the outputs are deactivated to their default logic levels. There are two versions of HIB03-PT module. The most common one is “**outputs active high**” version. The other is “**outputs active low**” version.

In Active High version, the default states of outputs are logic low. When a valid encoder signal is received, relevant outputs are set to logic high level. The outputs are set or cleared according to the encoder's data bits. There are 4 data pins in PT22XX encoders. They are D0,D1,D2,D3. If any of the data bits are set to logic high level, relevant module outputs go to logic high. So, in Active High version, module outputs are logically equal to encoder's data bits;

$$\mathbf{OUT1=D0 , OUT2=D1 , OUT3=D2 , OUT4=D3.}$$

As the outputs are momentary type, they are set/cleared as soon as the transmitter sends the encoder data. When the signal is cut, the outputs are reverted to their default state (Logic Low Level).

In Active Low version, the default states of outputs are logic high. When a valid encoder signal is received, relevant outputs are set to logic low level. The outputs are set or cleared according to the encoder's data bits. If any of encoder data bits are set to logic high, relevant outputs go to logic low state. So, in Active Low version, module outputs are logically equal to **inverse of** encoder data bits;

$$\mathbf{OUT1=\overline{D0} , OUT2=\overline{D1} , OUT3=\overline{D2} , OUT4=\overline{D3}.}$$

As the outputs are momentary type, they are set/cleared as soon as the transmitter sends

the encoder data. When the signal is cut, the outputs are reverted to their default state (Logic High Level).

The outputs of the module are capable to drive up to 25mA sink or source current. However, microcontroller output ports in the module are connected to module output pins with 100 Ohm resistors. This is intended as a protection against to accidentally shorting the output pins.

Timing of Module Outputs: PT2260, PT2262, PT2240 and EV1527 encoders' **code word** is formed with address bits, data bits and synchronous bits. As soon as these ICs are powered, they send the code words repeatedly.

Also in these type of encoders, the data rate of the code word is mostly adjusted with an RC oscillator. So, the data rate and corresponding to this, total code word time varies from one remote control unit to other.

When the module receives a signal, firstly it searches for the synchronous bit of PT22XX encoder. If a low bit is received whose length is between 5.5 ms and 30 ms., the module assumes that, this may be a synchronous bit of any PT22XX code and starts decoding. The first step in decoding is calculating the data rate from the captured synchronous bit. After this, acceptable short and long data pulses are defined according to the calculation. After this definition, all the incoming code bits are checked if they fit to the defined pulse lengths or not. If they don't fit to this definition or they don't fit to code word format of PT22XX encoders, decoding operation is cancelled and the module reverts to the synchronous searching mode. If the incoming bits fit to format of PT22XX encoders, they are taken into account.

The first code word which arrives into module is used to calculate the data rate and appropriate timings. It is not used in decoding. It is a discarded code. After this, the module approves minimum 2 same code words to treat the signal as a PT22XX encoder signal. This is because for increasing the noise immunity. So, there is a code word counter in software which counts the consecutive uninterrupted code words. If 2 code words of any PT22XX encoder are received, the LED on the module turns on independent from it is a valid (memorized) code or not. If the received code words are valid, the module drives the output pins according to the data bits received.

In **active high(AH)** models of module, activated outputs go to logic high level after the second valid code. In **active low (AL)** models, activated outputs go to logic low level after the second valid code. Activated outputs remain in high (or low) level for minimum of **2.Tcw + 90 ms.** duration, where **Tcw** is code word period. This timing is shown in Figure 4.

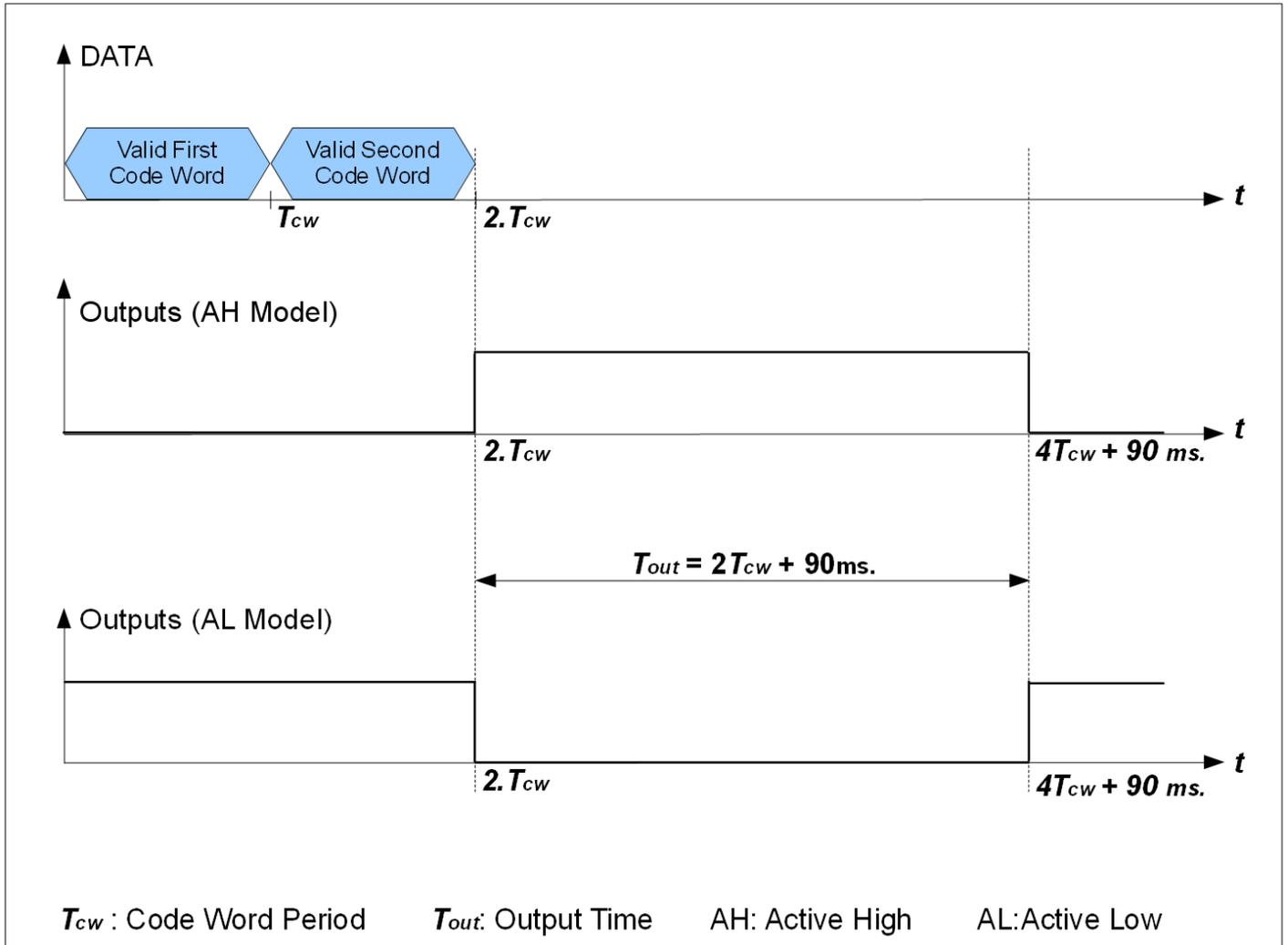


Figure 4. Timing of Outputs For Two Valid Code Words

As the remote control units transmit the signal repetadly, if the count of received code words are more than 2, the outputs will be activated after the second valid code and remain activated as soon as the module receives the same valid codes. If the incoming signal is cut, the outputs will remain activated for the duration of **$2T_{cw} + 90 \text{ ms.}$** after the last valid code received. This timing is shown in Figure 5.

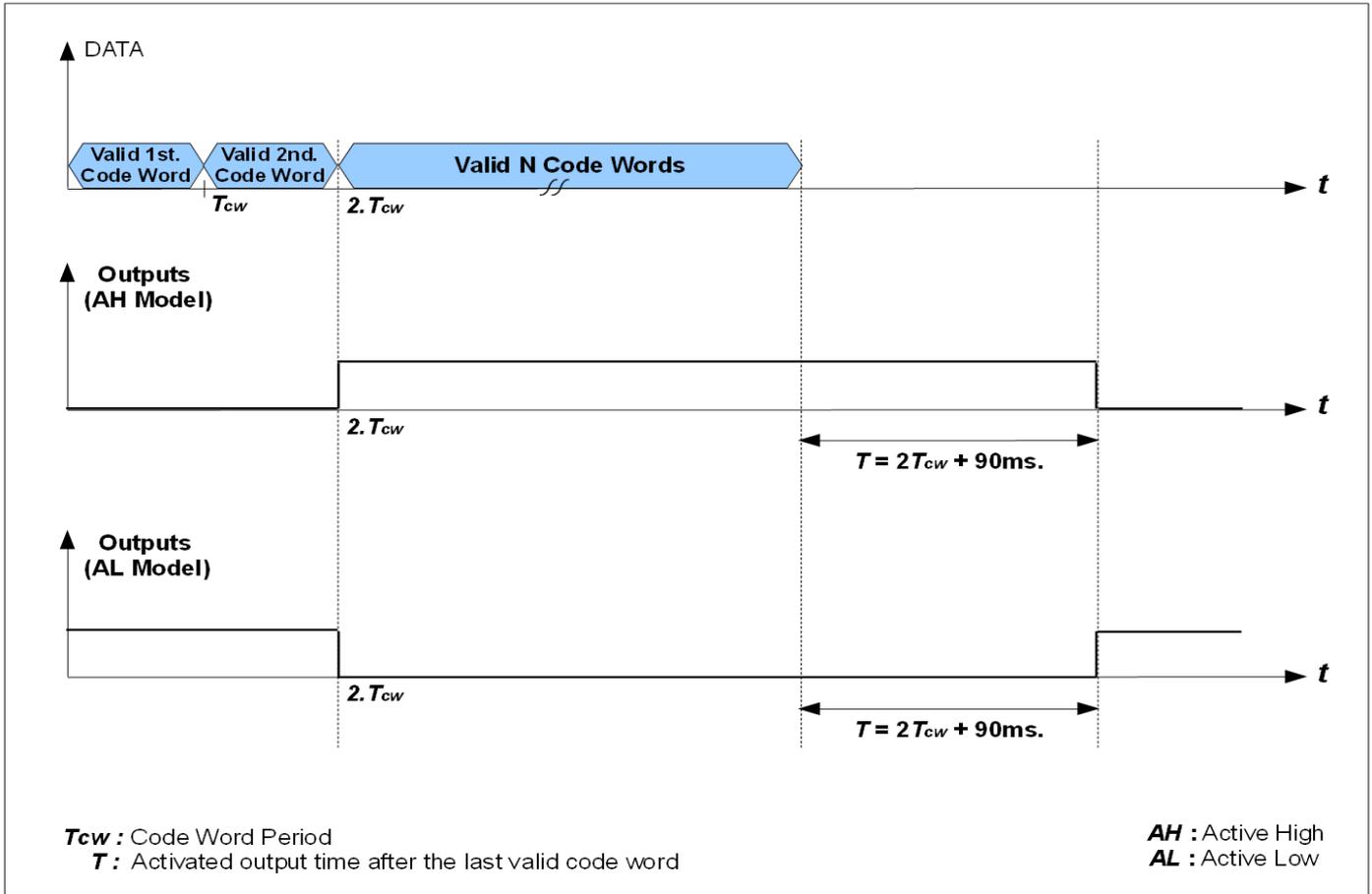


Figure 5. Timing of Outputs For More Valid Codes

7. ELECTRICAL CHARACTERISTICS

(Condition: Ta=25°C, Supply Voltage: +5V, Frequency:315MHz unless otherwise specified)

Parameter	Specification			Unit	Notes
	Min	Typ	Max		
Receiver Sensitivity		-110		dBm	Data Rate:1Kbps, BER = %1
Supply Voltage	3.6	5	5.5	V	DC
Supply Current		6.8		mA	Led is Off, Outputs Low
Accepted PT22XX Shortest Pulse Width (β)	180		980	μ s	Shortest high or low data width in microseconds.(Defined as β)
Accepted PT22XX Low Synchronous Width (31. β)	5.58		30.38	ms.	Synchronous low data width in milliseconds.(Equal to31. β)
Tcw : Accepted PT22XX Code Word Period (128. β)	23.04		125.44	ms.	Total code word duration in milliseconds. (Equal to 128. β)
Tout: Output Active Time After The Last Valid Code	2.Tcw+90		2.Tcw+98	ms.	Output active duration after the last received valid code word.
Operating Temperature	-20		+70	°C	

Table 2. Electrical Characteristics of 315 MHz Smart RF Module

(Condition: Ta=25°C, Supply Voltage:+5V, Frequency: 433.92MHz. unless otherwise specified)

Parameter	Specification			Unit	Notes
	Min	Typ	Max		
Receiver Sensitivity		-110		dBm	Data Rate:1Kbps, BER = %1
Supply Voltage	3.6	5	5.5	V	DC
Supply Current		8		mA	Led is Off, Outputs Low
Accepted PT22XX Shortest Pulse Width (β)	180		980	μ s	Shortest high or low data width in microseconds.(Defined as β)
Accepted PT22XX Low Synchronous Width ($31.\beta$)	5.58		30.38	ms.	Synchronous low data width in miliseconds. (Equal to $31.\beta$)
Tcw : Accepted PT22XX Code Word Period ($128.\beta$)	23.04		125.44	ms.	Total code word duration in miliseconds. (Equal to $128.\beta$)
Tout: Output Active Time After The Last Valid Code	$2.Tcw+90$		$2.Tcw+98$	ms.	Output active duration after the last received valid code word.
Operating Temperature	-20		+70	°C	

Table 3. Electrical Characteristics of 433.92 MHz Smart RF Module

8. MECHANICAL DIMENSIONS

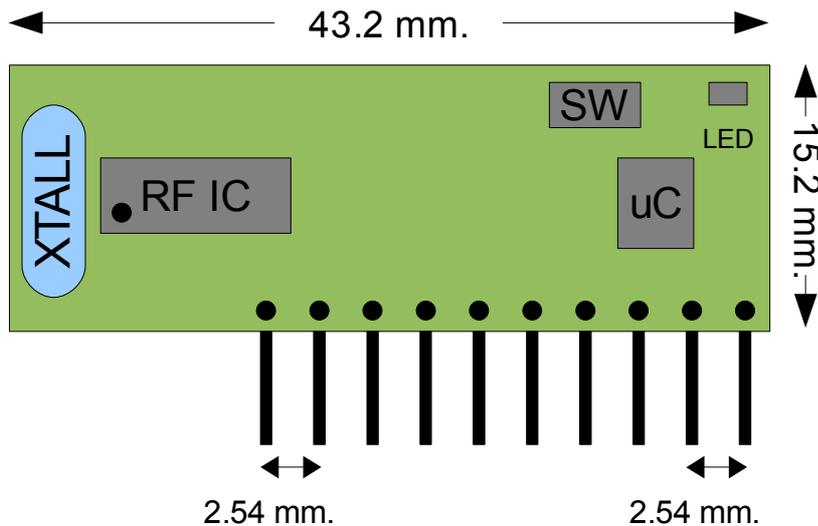
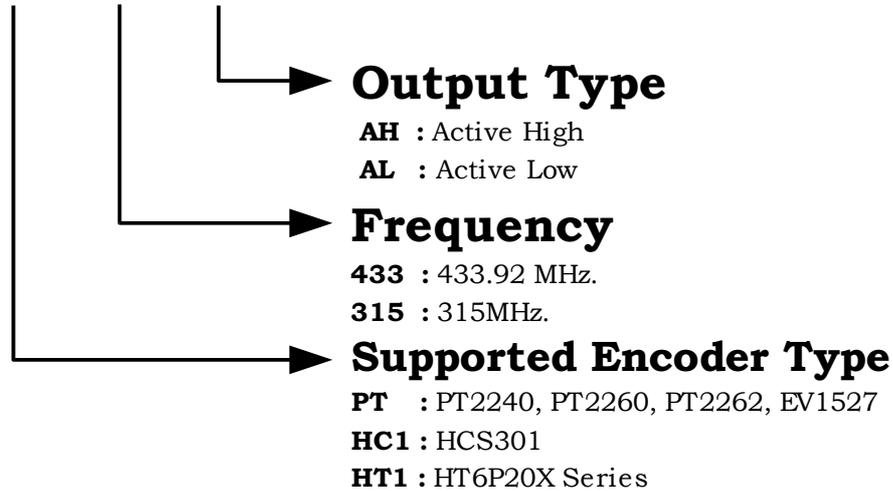


Figure 6. Mechanical Dimensions

9 . ORDERING INFORMATION & DEVICE VARIETIES**HIB03-XXX-FFF-YY**

PART NUMBER	DESCRIPTION
HIB03-PT-433-AH	433.92 MHz. Smart RF Module with PT22XX Decoder and Active High Outputs
HIB03-PT-433-AL	433.92 MHz. Smart RF Module with PT22XX Decoder and Active Low Outputs
HIB03-PT-315-AH	315 MHz. Smart RF Module with PT22XX Decoder and Active High Outputs
HIB03-PT-315-AL	315 MHz. Smart RF Module with PT22XX Decoder and Active Low Outputs

Table 4. Ordering Information of HIB03 Module Through This Data Sheet

PART NUMBER	DESCRIPTION
HIB03-HC1-433-AH	433.92 MHz. Smart RF Module with HCS301 Decoder and Active High Outputs
HIB03-HC1-433-AL	433.92 MHz. Smart RF Module with HCS301 Decoder and Active Low Outputs
HIB03-HC1-315-AH	315 MHz. Smart RF Module with HCS301 Decoder and Active High Outputs
HIB03-HC1-315-AL	315 MHz. Smart RF Module with HCS301 Decoder and Active Low Outputs
HIB03-HT1-433-AH	433.92 MHz. Smart RF Module with HT6P20X Series Decoder and Active High Outputs
HIB03-HT1-433-AL	433.92 MHz. Smart RF Module with HT6P20X Series Decoder and Active Low Outputs
HIB03-HT1-315-AH	315 MHz. Smart RF Module with HT6P20X Series Decoder and Active High Outputs
HIB03-HT1-315-AL	315 MHz. Smart RF Module with HT6P20X Series Decoder and Active Low Outputs

Table 5. Future Models of HIB03 Module.

Note: Future Models of HIB03 module will be available soon. Also note that custom design solutions are available upon requests. For technical support and custom design requests please contact us ; info@rfhybrid.com