CMOSTEK

CMT2210LH

Low Power 315MHz/433.92MHz OOK Receiver

Instruction:

CMT2210LH is a low power, high performance OOK RF receiver. It is suitable for ISM band 315MHz/433.92MHz wireless applications. The CMT2210LH is a real plug and play chip without the register configuration or manual tuning. By selecting 19.7029MHz or 27.1412MHz crystal, the chip can operate at 315MHz or 433.92MHz. This chip supports the symbol rate range of 1~5 Kbps and is ideal for pairing with the low end transmitter based on the encoder or MCU. By selecting the VDD5V pin and VDDL pin open circuit or short circuit on the PCB, the CMT2210LH can operate at two voltage ranges of 3.0V-5.5V or 2.0V-3.6V. When the chip operates at 433.92MHz, the receiver sensitivity of the -109dBm can be achieved with only 4.5mA current. The device is packaged in SOP8 to facilitate the simple and low cost manufacturing. CMT2210LH receiver matching CMT211x transmitter can achieve the cost-effective RF application. For the higher performance receiver chip needs, users can choose CMT221xA, CMT2300A and other chips in the NextGenRF series.

Applications:

- Low cost applications in the consumer electronics and appliances
- Automatic control of homes and buildings
- Infrared receiver replacement
- Industrial monitoring and control
- Wireless metering reading
- Wireless lighting control system
- Wireless alarm and security system
- Remote Keyless Entry (RKE)

Features:

- Working frequency：315MHz/ 433.92MHz
- OOK demodulation
- Symbol rate：1.0 - 5.0 kbps
- Sensitivity：-109 dBm（3.0 kbps），0.1％BER
- Receiver bandwidth：330kHz
- Image rejection ratio：30dB
- Maximum input signal：10 dBm
- Run independently. Input from the antenna. Output the data.
- Configure without the register.
- Supply voltage (optional):
  - 3.0 – 5.5 V (High voltage mode)
  - 2.0 – 3.6 V (Low voltage mode)
- Low power consumption: 4.5 mA
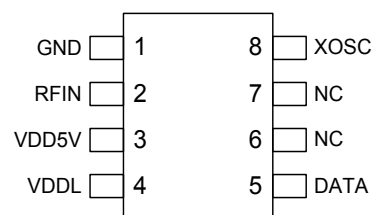- RoHS Compliant
- SOP8 packaging

Ordering information

Product No.	Frequency	Packaging	MOQ
CMT2210LH-ESR	315MHz/433.92MHz	SOP8/Tape	2,500pcs
CMT2210LH-ESB	315MHz/433.92MHz	SOP8/Tube	1,000pcs
For more ordering information, please see page15.			

SOP8

GND	1	8	XOSC
RFIN	2	7	NC
VDD5V	3	6	NC
VDDL	4	5	DATA
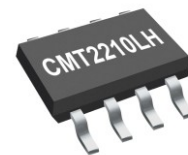
CMT2210LH PIN ARRANGEMENT DIAGRAM
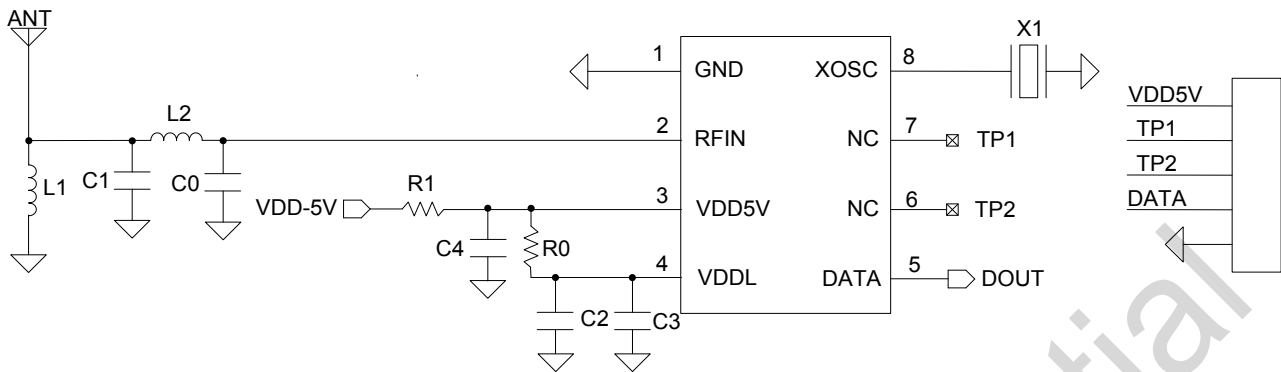
Typical Applications:

Figure1. CMT2210LH Typical Application Schematic Diagram

Remarks：

1. When the CMT2210LH needs to select the 3.0V-5.5V operating voltage range, the R0 is not soldered, that is, the connection between the VDD5V pin and VDDL pin is broken.

2. When the CMT2210LH needs to select the 2.0V-3.6V operating voltage range, R0 is 0, that is, the VDD5V is shorted to the VDDL;

3. The purpose of connecting R1 to VDD-5V is to prevent chips power-up in a complex power environment, so as to better protect the chip.

Table1. Typical Application BOM

Symbol	Description	Value(Match to the λ/4 antenna)		Unit	Supplier
		315MHz	433.92MHz		
U1	CMT2210LH, low power 315MHz/433.92MHz OOK receiver	--		--	CMOSTEK
X1	±20 ppm, SMD32*25 mm, crystal	19.7029	27.1412	MHz	EPSON
L1	±10%, 0603 stacked inductor	62	36	nH	Sunlord
L2	±10%, 0603 stacked inductor	68	36	nH	Sunlord
C0	±0.25 pF, 0402 NP0, 50 V	3	3	pF	Sunlord
C1	±0.25 pF, 0402 NP0, 50 V	12	10	pF	Sunlord
C2	±20%, 0603 X7R, 25 V	0.1		uF	Sunlord
C3	±20%, 0603 NP0, 50 V	470		pF	Sunlord
C4	±20%, 0603 X7R, 25 V	0.1		uF	Sunlord
R0	Option： No welded between 3.0V and 5.0V working environment. Welded between 2.0V and 3.6V working environment.	0		Ω	
R1	Protective resistor in series	4.7		Ω	

Terminology:

The terminologies used in this article are described below:

AGC	Automatic Gain Control	PC	Personal computer
AN	Application note	PCB	Printed circuit board
BER	Bit Error Rate	PLL	Phase-locked loop
BOM	Bill of material	PN9	Pseudo-Random Binary Sequence
SC	Basic Spacing between Centers	POR	Power on reset
BW	Bandwidth	PUP	Power up
DC	Direct current	QFN	Quad Flat Non-lead
EEPROM	Electrically erasable programmable read-only memory	RF	Radio frequency
ESD	Electro-Static discharge	RFPDK	RF product development kit
SR	Equivalent series resistance	RoHS	Restriction of Hazardous Substances
IF	Intermediate frequency	RSSI	Received signal strength indicator
LNA	Low Noise Amplifier	Rx	Receiving, receiver
LO	Local oscillator	SAR	Successive approximation register
LPOSC	Low power oscillator	SOP	Small outline package
Max	Maximum	SPI	Serial Peripheral Interface
MCU	Micro controller unit	TH	Threshold
Min	Minimum	Tx	Transmitting, transmitter
MOQ	Minimum Order Quantity	Typ	Typical
NP0	Temperature compensation characteristic	VCO	Voltage controlled oscillator
NC	Not connected	XOSC	Crystal oscillator
OOK	On-off keying	XTAL/Xtal	Crystal

Table of Contents

1. Electrical Characteristics

When V_{DD}= 3.3V，T_{OP}= 25 °C，F_{RF} = 433.92 MHz，the sensitivity is measured by receiving a PN9 sequence and matching to 50Ω according to the 0.1%BER standard. All results are tested on the CMT2210LH-EM unless otherwise stated.

1.1 Recommended Operating Conditions

Table2. Recommended Operating Conditions

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating supply voltage	V_{DD}	When the VDD5V and VDDL are open-circuit, the temperature range is between -40 ℃and +85 ℃.	3.0		5.5	V
		When the VDD5V and VDDL are short-circuit, the temperature range is between -40 ℃and +85 ℃.	2.0		3.6	V
Operating temperature	T_{OP}		-40		85	℃
Supply voltage slope			1			mV/us

1.2 Absolute Maximum Rating

Table3. Absolute Maximum Rating[1]

Parameter	Symbol	Condition	Min.	Max.	Unit
Supply voltage	V_{DD}	VDD5V and VDDL are open-circuit.	-0.3	5.5	V
		VDD5V and VDDL are short-circuit.	-0.3	3.6	V
Interface voltage	V_{IN}		-0.3	V_{DD} + 0.3	V
Junction temperature	T_J		-40	125	℃
Storage temperature	T_{STG}		-50	150	℃
Welding temperature	T_{SDR}	Last at least 30 seconds		255	℃
ESD grade [2]		Human Body Model (HBM)	-2	2	kV
Latching current		@ 85 ℃	-100	100	mA

Remarks：

[1]. Exceeding the "absolute maximum rating" may cause the permanent damage to the device. This value is a pressure rating and does not mean that the equipment function is affected under this pressure condition. But if the device is exposed in the absolute maximum rating condition for a long time, its reliability may be affected.

[2]. CMT2210LH is a high performance RF IC. The operation and assembly of this chip should only be performed on a workbench with good ESD protection.
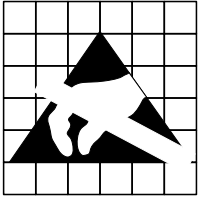
Warning! It is ESD sensitive device. In the operation of the chip, the user should pay attention to ESD precautions, so as to avoid the chip performance degradation or loss of function.

1.3 Receiver

Table4. Receiver Specification

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Frequency range	F_{RF}	F_{XTAL} = 19.7029 MHz		315		MHz
		F_{XTAL} = 27.1412 MHz		433.92		MHz
Symbol rate	DR		1		5	kbps
Sensitivity	S_{315}	F_{RF} = 315 MHz, DR = 3 kbps, BER = 0.1%		-109		dBm
	$S_{433.92}$	F_{RF} = 433.92 MHz, DR = 3 kbps, BER = 0.1%		-109		dBm
Saturation input signal level	P_{LVL}			10		dBm
Working current	I_{DD315}	F_{RF} = 315 MHz		4.2		mA
	$I_{DD433.92}$	F_{RF} = 433.92 MHz		4.5		mA
Frequency synthesizer settle time	T_{LOCK}	Start from XOSC stability		150		us
Anti blocking	BI	±1 MHz, continuous wave interference		32		dB
		±2 MHz, continuous wave interference		42		dB
		±10 MHz, continuous wave interference		61		dB
Input 3rd order intercept point	IIP3	FDEV = 1 MHz and 2 MHz double tone test, maximum system gain setting		-23		dBm
Receiver bandwidth	BW_{315}	F_{RF} = 315 MHz		240		kHz
	$BW_{433.92}$	F_{RF} = 433.92 MHz		330		kHz
Receiver startup time [1]	$T_{START-UP}$	From power up to receiving		4.5+T_{XTAL}		ms

Remarks:

[1]. T_{XTAL} is the oscillation time of crystal, which is related to the crystal itself and has nothing to do with the chip.

1.4 Crystal Oscillator

Table5. Crystal Oscillator Specification

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Crystal frequency [1]	$F_{XTAL315}$	F_{RF} = 315 MHz		19.7029		MHz
	$F_{XTAL433.92}$	F_{RF} = 433.92 MHz		27.1412		MHz
Crystal frequency accuracy [2]				±20		ppm
Load capacitance	C_{LOAD}			15		pF
Crystal equivalent resistance	Rm				60	Ω

Crystal start-up time [3]	t_{XTAL}			400		us

Remarks:

[1]. CMT2210LH can use the external reference clock to drive the XIN pin through the coupling capacitor. The peak value of the external clock signal is between 0.3 and 0.7 V.

[2]. The value includes (1) an initial error; (2) a crystal load; (3) aging; and (4) a change with the temperature. The acceptable crystal frequency error is limited by the receiver's bandwidth and the RF frequency deviation between the transmitter and the receiver.

[3]. The parameter is largely related to the crystal.
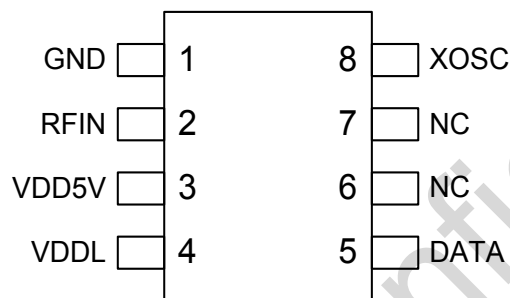
2. Pin Description

Figure2. CMT2210LH Pin Arrangement

Table1. CMT2210LH Pin Description

Pin No.	Name	I/O	Function Description
1	GND	I	GND
2	RFIN	I	The RF signal is input to the LNA
3	VDD5V	I	Power input
4	VDDL	O	Power output
5	DATA	O	Received signal output
6	NC	--	Unconnected
7	NC	--	Unconnected
8	XIN	I	A crystal oscillator input or an external reference clock input

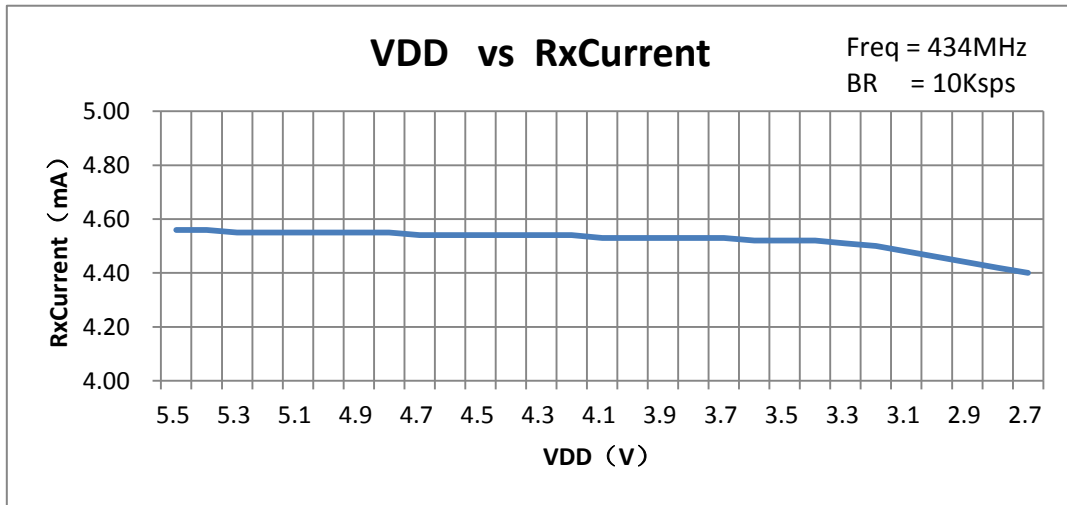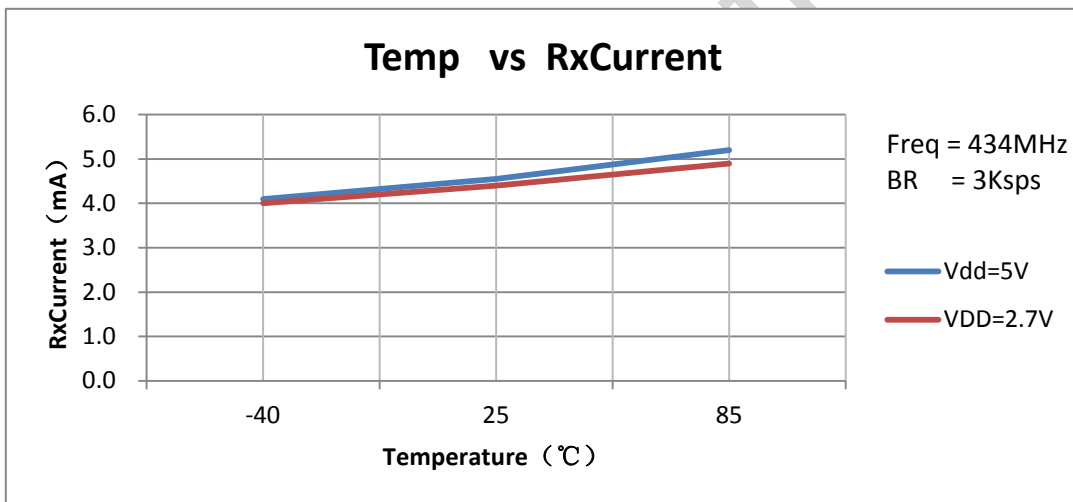# 3. Typical Performance

Figure3. Rx Current vs Supply Voltage
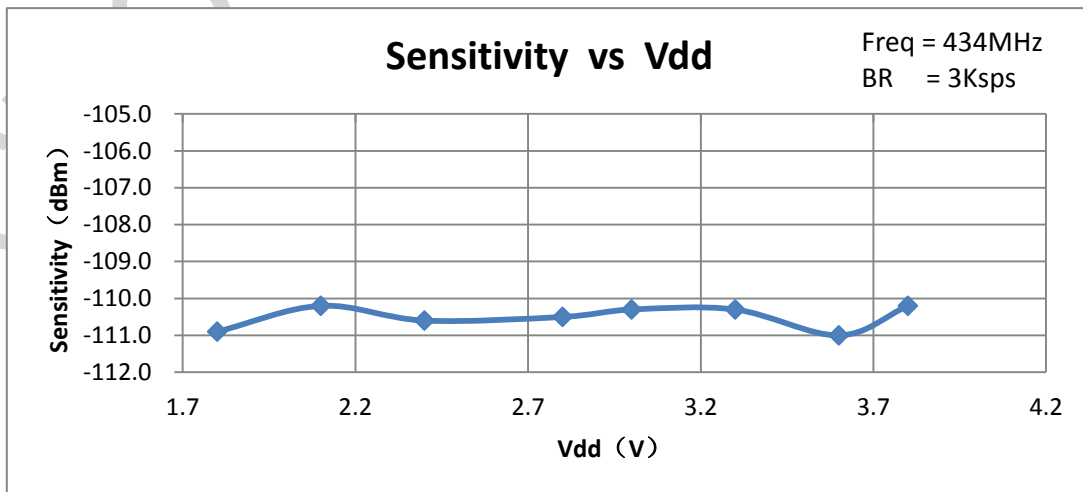

Figure4. Rx Current vs Working Temperature
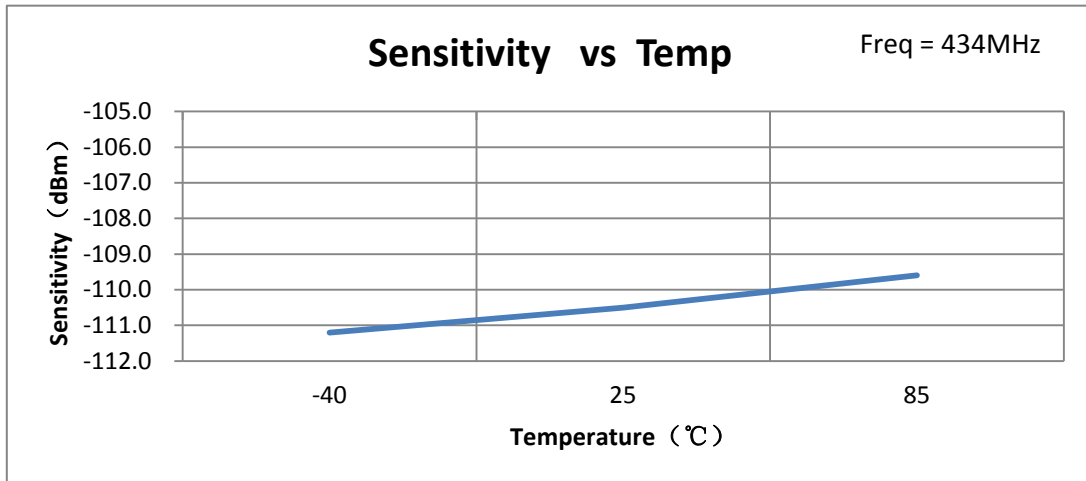

Figure5. Sensitivity vs Supply Voltage

Sensitivity vs Temp

Freq = 434MHz

Figure6. Sensitivity vs Working Temperature

Sensitivity vs BitRate

Freq = 434MHz
BER = 0.1%

Figure7. Sensitivity vs Bit Rate

Sensitivity vs BER

Freq = 434MHz

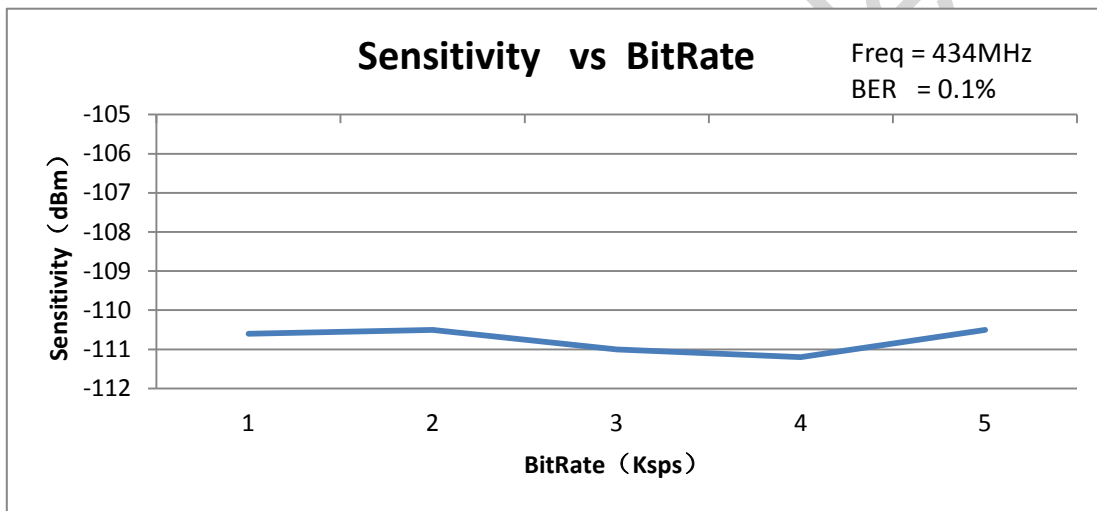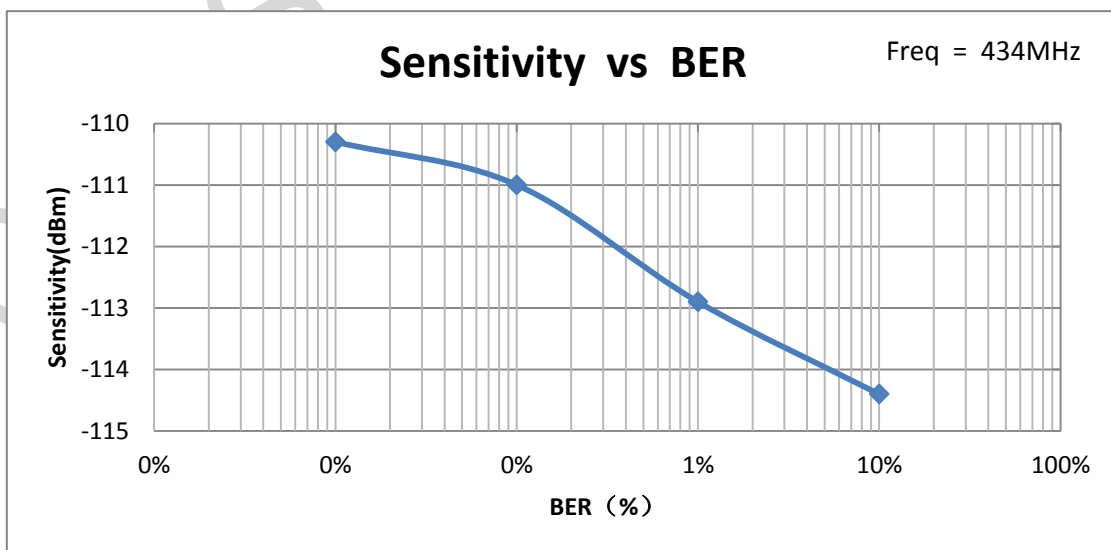**Figure8. Sensitivity vs Bit Error Rate**

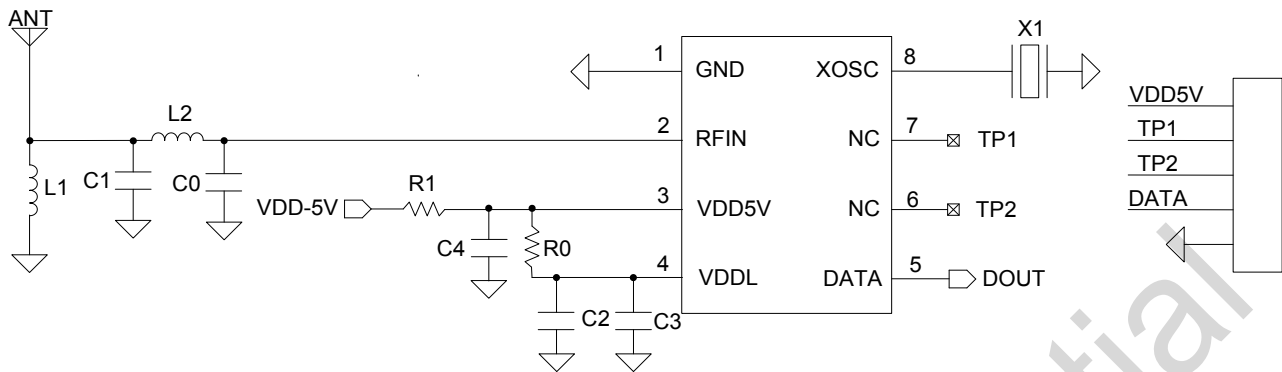# 4. Typical Application Schematic Diagram

Figure9. Typical Application Schematic Diagram

Application Notes:

1. The PCB LAYOUT rules are shown below：

    ■ Try to design the large and continuous ground.

    ■ L1, L2, C0 and C1 are as close to the chip as possible, to reduce the distribution parameters of LNA and its loop, to prevent the loop from too long and to introduce noise signals.

    ■ Crystal X1 should be as close as possible to the chip CMT2210LH, so as to shorten the track between the crystal and the chip.

    ■ As many as possible grounding vias are placed along the edge of the plate to reduce the radiation of the RF signal and the interference from the outside. The spacing of the vias is much smaller than the 1/10 wavelength (operating frequency).

    ■ C2, C3, and C4 try to be near CMT2210LH to achieve better filtering results.

    ■ The metal case of the crystal grounds.

2. For more details on the design, please refer to the *AN158 CMT2210LH schematic and the PCB layout guidelines.*

Table7. BOM matching the 315MHz / 433.92MHz typical application

Symbol	Description	Value(Match to the λ/4 antenna)		Unit	Supplier
		315MHz	433.92MHz		
U1	CMT2210LH, low power 315MHz/433.92 MHz OOK receiver	--		--	CMOSTEK
X1	±20 ppm, SMD32*25 mm, crystal	19.7029	27.1412	MHz	EPSON
L1	±10%, 0603 stacked inductor	62	36	nH	Sunlord
L2	±10%, 0603 stacked inductor	68	36	nH	Sunlord
C0	±0.25 pF, 0402 NP0, 50 V	3	3	pF	Sunlord
C1	±0.25 pF, 0402 NP0, 50 V	12	10	pF	Sunlord
C2	±20%, 0603 X7R, 25 V	0.1		uF	Sunlord
C3	±20%, 0603 NP0, 50 V	470		pF	Sunlord
C4	±20%, 0603 X7R, 25 V	0.1		uF	Sunlord

R0	Option： No welded between 3.0V and 5.0V working environment. Welded between 2.0V and 3.6V working environment.	0	**Ω**	
R1	Protective resistor in series	4.7	**Ω**	

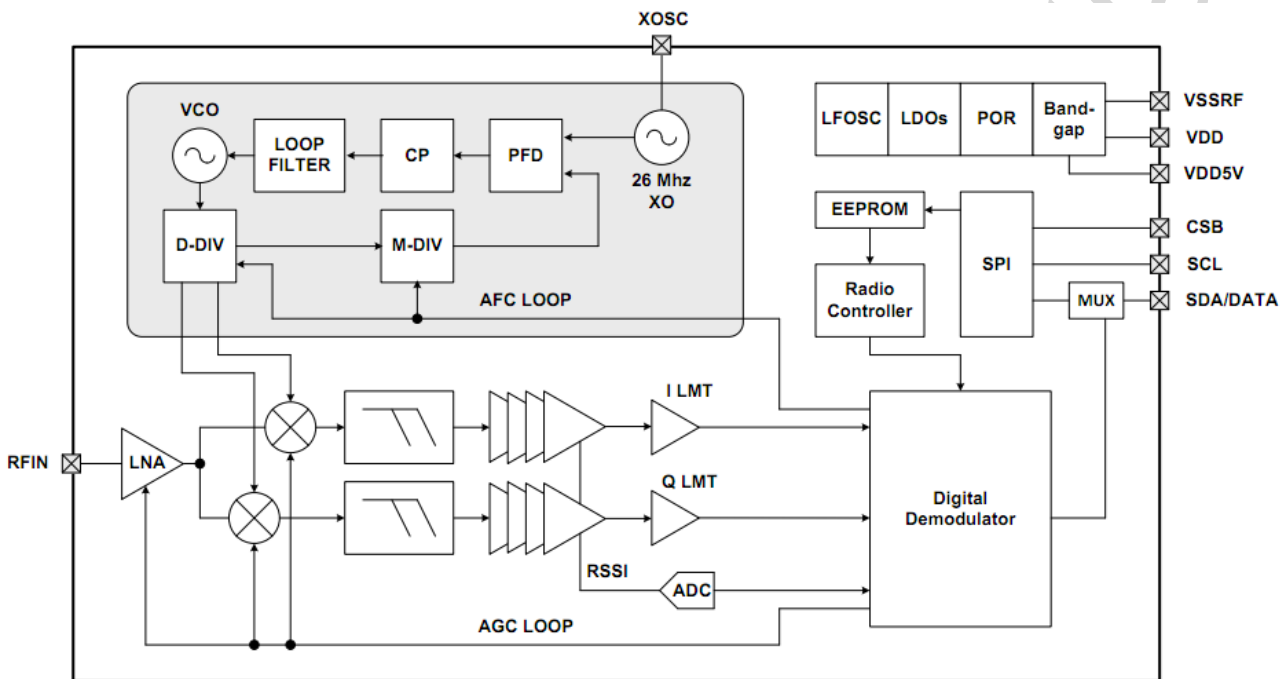# 5. Function Descriptions:

Figure10. Function Module Diagram

5.1 Summary

CMT2210LH is a digital-analog hybrid receiver. The product adopts the 26MHz crystal to provide the reference frequency and digital clock for PLL, supports OOK demodulation output with the data rate of 1.0-5.0Ksps, and supports the periodic reset with the configurable time to avoid the crash phenomenon caused by various external reasons. CMT2210LH supports two kinds of voltage, which can be used in the application of 5V system, and also can be chosen as the application of 3V system.

The chip uses LNA+MIXER+IFFILTER+LIMITTER+PLL's low intermediate frequency structure to achieve the wireless reception function below Sub-1G frequency. The analog front-end is responsible for mixing RF signals into intermediate frequency, and converting the real time RSSI into the 8-bit digital signal through SAR-ADC, and sending them to the interior to do the OOK demodulation and correlation processing. At the same time, the internal circuit will mix the intermediate frequency signal down to the zero frequency

(Baseband) and do a series of filtering and judging process, while AGC dynamically control the analog front-end. Finally, the original signal is demodulated and output through the DATA pin.

The parameters of the chip are stored in an internal EEPROM, and the user can modify or adjust the working parameters of the chip by the RFPDK.

5.2 Demodulation Mode, Frequency and Symbol Rate

CMT2210LH supports the OOK demodulation of 1.0-5.0ksps symbol rate. It supports for free ISM bands near 315 MHz and 433.92MHz. The following table gives the information about the demodulation mode, frequency and symbol rate of the CMT2210LH.

Table 9. Demodulation mode, frequency and symbol rate

Parameter	Value	Unit
Demodulation mode	OOK	-
Frequency	315 / 433.92	MHz
Symbol rate	1.0–5.0	Ksps

5.3 Function Module Description

5.3.1 RF Front-end and Automatic Gain Control

CMT2210LH is an OOK modulated receiver with the low intermediate frequency architecture. The receiver's RF front-end consists of a low noise amplifier (LNA), an I / Q mixer (Mixer), an intermediate frequency filter (IF Filter), and a wideband power detector (WB Power Detector). The RF front-end amplifies and converts the RF input signals from the antenna to the intermediate frequency for the further processing.

With the help of the broadband power detector and RF attenuation network of RF front-end, the automatic gain control (AGC) loop can adjust the RF front-end gain. The chip can also achieve the best system linearity, selectivity and sensitivity even under the condition of strong interference outside the band.

With only one low-cost matching circuit, the LNA input can be matched to 50Ω or other types of antennas.

5.3.2 Intermediate Frequency (IF) Filter

The signal from the RF front-end is filtered by an integrated 3rd order band pass image rejection filter. When the device operates at 433.92 MHz, the intermediate frequency bandwidth is 330 kHz. The center frequency and bandwidth will be adjusted automatically according to the selected crystal frequency.

5.3.3 Received Signal Strength Indicator

The output signal of the IF filter is amplified by the cascade I/Q logarithmic amplifier, and then sent to the

demodulator for demodulation. I/Q dual logarithmic amplifiers include the received signal strength indicator (RSSI). The indicator generates the DC level in proportion to the input signal level within the I/Q path. The sum of levels of these two paths is used as an indication of the received signal strength, with a dynamic range of more than 66dB.

5.3.4 Successive Approximation Register

The 8-bit SAR-ADC in CMT2210LH transforms the RSSI output into the digital signal for OOK demodulation.

5.3.5 Crystal Oscillator

CMT2210LH uses a single ended crystal oscillator circuit with the required load capacitance integrated within the chip. The recommended crystal is 19.7029MHz/27.1412MHz, with an accuracy of + 20 ppm, an equivalent resistance (ESR) <60 and a load capacitance (CLOAD) of 15pF. In order to save the external load capacitance, the load capacitance required by the crystal oscillation is integrated in the CMT2210LH chip.

If there is a suitable clock source (RCLK) in the application system, which can be used as the reference clock of CMT2210LH, the user can drive the XIN pin of the chip through the DC blocking capacitor. This will save one crystal and further reduce the system cost. The recommended RCLK peak to peak value is between 0.3V to 0.7V (at the XTAL pin).

5.3.6 Frequency Synthesizer

The frequency synthesizer is used to generate the local oscillator (LO) frequency required for the I/Q mixer. By the 19.7029 MHz or 27.1412 MHz reference clock provided by a crystal or external clock source, the frequency synthesizer can generate the 315MHz /433.92MHz working frequency. The internal high performance VCO operates at the 2x LO frequency without the external inductor. The chip can work stably in various conditions when it is powered up, and further save the system power consumption and stray radiation.

6. Ordering Information

Table10. CMT2210LH Ordering Information

Product Number	Descriptions	Packaging	Packing	Condition	MOQ/ Integer multiple
CMT2210LH-ESR[1]	Low power 315MHz/433.92MHz OOK receiver	SOP8	Tape & Reel	2.0 to 3.6 V 3.0 to 5.5 V -40 to 85 ℃	2,500
CMT2210LH-ESB[1]	Low power 315MHz/433.92MHz OOK receiver	SOP8	Tube	2.0 to 3.6 V 3.0 to 5.5 V -40 to 85 ℃	1,000
Remarks:					

[1]. "E" represents the extended industrial grade. The temperature range is from -40 to +85.

   "S" represents the SOP8 packaging.

   "R" represents the tape reel packing. MOQ is 2500pcs; "B" represents the tube packing.MOQ is 1000pcs.

For more information about the product, please visit www.cmostek.com.

For purchasing or price requirements, please contact sales@cmostek.com or local sales representative.

7. Packaging Information

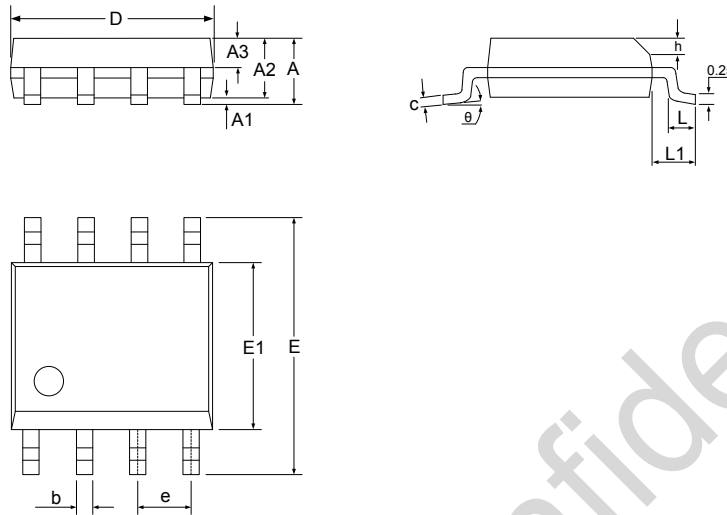CMT2210LH packaging is SOP8. The packaging information is as below.

Figure11. SOP8 Packaging

Table11. SOP8 Packaging Size

Symbol	Size (mm)		
	Min.	Typ.	Max.
A	-	-	1.75
A1	0.10	-	0.225
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	-	0.48
c	0.21	-	0.26
D	4.70	4.90	5.10
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	1.27 BSC		
h	0.25	-	0.50
L	0.50	-	0.80
L1	1.05 BSC		
θ	0	-	8°

8. Top Marking

CMT2210LH
YYWW①②③④⑤⑥
◯

Figure12. CMT2210LH Top Marking

Table12. CMT2210LH Top Marking Description

Marking method	Laser
Pin 1 mark	Circle diameter = 1 mm
Font height	0.6 mm, right aligned.
Font width	0.4 mm
Line 1 marking	CMT2210LH represents the model.
Line 2 marking	YYWW is the date code set by the packaging factory. YY represents the last 2 digits of the year. WW represents the manufacturing week. ①②③④ represents the internal tracking coding

9. Other Documents

Table13. CMT2210LH Related Documents

Doc. No.	Doc. name	Descriptions
AN157	CMT2210LH Configuration Guideline	Introduce the configuring CMT2210LH details by RFPDK
AN158	CMT2210LH schematic and PCB layout guideline	Introduce CMT2210LH schematic and PCB layout design rules, RF matching network and other layout considerations. It is the Chinese version.

10. Document Modification Record

Table14. Document Modification Record Sheet

Version	Chapter	Modification descriptions	Date
0.1	All	Initial release version	2017-10-08
0.2	All	Fix spelling and grammar mistakes	2017-10-10

11. Contact Information

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