CMOSTEK CMT2110/17B

315/433/868/915 MHz OOK Transmitter

Features

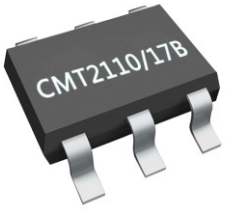
- Frequency Range:
  - 312 to 480 MHz (CMT2110B)
  - 624 to 960 MHz (CMT2117B)
- OOK Modulation
- Symbol Rate: 0.5 to 40ksps
- Output Power: +13 dBm
- Supply Voltage: 2.0 to 3.6 V
- Current Consumption: 17.5 mA @ 433.92MHz
- Sleep Current:< 20 nA
- FCC / ETSI Compliant
- RoHS Compliant
- 6-pin SOT23-6 Package

Applications

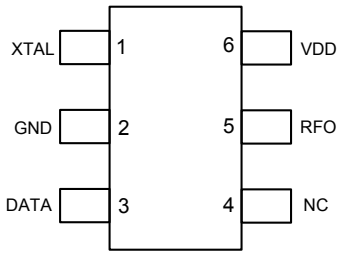
- Low-Cost Consumer Electronics Applications
- Home and Building Automation
- Remote Fan Controllers
- Infrared Transmitter Replacements
- Industrial Monitoring and Controls
- Remote Lighting Control
- Wireless Alarm and Security Systems
- Remote Keyless Entry (RKE)

Ordering Information

Part Number	Frequency	Temp.	MOQ
CMT2110B-ESR	433.92 MHz	-40 to 85 ℃	3,000 pcs
CMT2117B-ESR	868.35 MHz	-40 to 85 ℃	3,000 pcs
More Ordering Info: See Page 16			



SOT23-6



CMT2110/17B

Descriptions

The CMT2110/17B devices are ultra low-cost, highly flexible, high performance, single-chip OOK transmitters for various 315/434/868/915 MHz wireless applications. The CMT2110B covers the frequency range from 312 to 480 MHz while the CMT2117B covers the 624 to 960 MHz frequency range. They are part of the CMOSTEK NextGenRF™ family, which includes a complete line of transmitters, receivers and transceivers. With very low current consumption,the device modulates and transmits the data which is sent from the host MCU. The CMT2110/17B uses a 1-pin crystal oscillator circuitwith the required crystal load capacitance integrated on-chip to minimize the number of external components.The CMT2110/17B transmitter together with the CMT221x receiver enables an ultra low cost RF link.

Typical Application

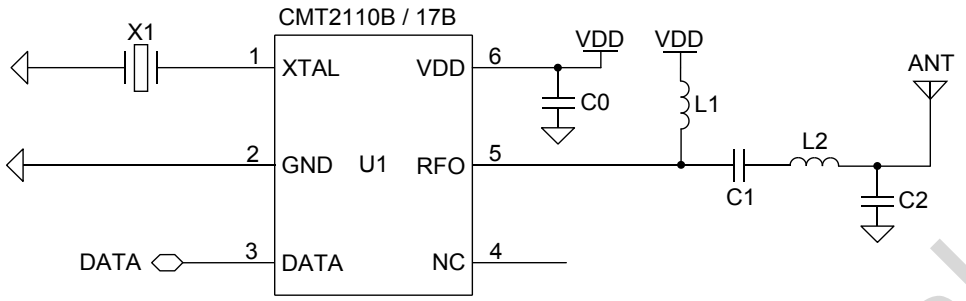


Figure 1. CMT2110 / 17B Typical Application Schematic

Table 1. BOM of 433.92/868.35 MHz Low-Cost Application

Designator	Descriptions	Value		Unit	Manufacturer
		433.92 MHz[1]	868.35 MHz[2]		
U1	CMT2110 / 17B, OOK Transmitter	-		-	CMOSTEK
X1	±20 ppm, SMD32*25 mm crystal	26.2982	26.3136	MHz	EPSON
C0	±20%, 0402 X7R, 25 V	0.1		uF	Sunlord
C1	±5%, 0402 NP0, 50 V	68	56	pF	
C2	±5%, 0402 NP0, 50 V	2.2	5.6	pF	
L1	±5%, 0603 multi-layer chip inductor	180	100	nH	Sunlord
L2	±5%, 0603 multi-layer chip inductor	27	7.5	nH	Sunlord

Note:
[1]. The 433.92MHz Application is for CMT2110B only
[2]. The 868.35 MHz Application is for CMT2117B only.

Table 2. Product Selection Table

Product	Frequency	Modulation	Max Output Power	Tx Current Consumption
CMT2110B	312-480 MHz	OOK	+13 dBm	17.5 mA @ 433.92 MHz
CMT2117B	624-960 MHz	OOK	+13 dBm	19.5 mA @ 868.35 MHz

Abbreviations

Abbreviations used in this data sheet are described below

AN	Application Notes	**PA**	Power Amplifier
BOM	Bill of Materials	**PC**	Personal Computer
BSC	Basic Spacing between Centers	**PCB**	Printed Circuit Board
EEPROM	Electrically Erasable Programmable Read-Only Memory	**PN**	Phase Noise
		RCLK	Reference Clock
ESD	Electro-Static Discharge	**RF**	Radio Frequency
ESR	Equivalent Series Resistance	**RFPDK**	RF Product Development Kit
ETSI	European Telecommunications Standards Institute	**RoHS**	Restriction of Hazardous Substances
		Rx	Receiving, Receiver
FCC	Federal Communications Commission	**SOT**	Small-Outline Transistor
Max	Maximum	**SR**	Symbol Rate
MCU	Microcontroller Unit	**TWI**	Two-wire Interface
Min	Minimum	**Tx**	Transmission, Transmitter
MOQ	Minimum Order Quantity	**Typ**	Typical
NP0	Negative-Positive-Zero	**USB**	Universal Serial Bus
OBW	Occupied Bandwidth	**XO/XOSC**	Crystal Oscillator
OOK	On-Off Keying	**XTAL**	Crystal

Table of Contents

1. Electrical Characteristics

V_{DD} = 3.3 V, T_{OP} = 25 ℃, F_{RF} = 433.92 MHz, output power is +10 dBm terminated in a matched 50 Ω impedance, unless otherwise noted.

1.1 Recommended Operating Conditions

Table 3. Recommended Operation Conditions

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Operation Voltage Supply	V_{DD}		2.0		3.6	V
Operation Temperature	T_{OP}	CMT2110 / 17B-ESR	-40		85	℃
Supply Voltage Slew Rate			1			mV/us

1.2 Absolute Maximum Ratings

Table 4. Absolute Maximum Ratings[1]

Parameter	Symbol	Conditions	Min	Max	Unit
Supply Voltage	V_{DD}		-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	℃
Soldering Temperature	T_{SDR}	Lasts at least 30 seconds		255	℃
ESD Rating		Human Body Model (HBM)	-2	2	kV
Latch-up Current			-100	100	mA

Note:

[1]. Stresses above those listed as “absolute maximum ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device under these conditions is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Caution! ESD sensitive device. Precaution should be used when handling the device in order to prevent permanent damage.

1.3 Transmitter Specifications

Table 5. Transmitter Specifications

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Frequency Range[1]	F_{RF}	CMT2110B	312		480	MHz
		CMT2117B	624		960	MHz
Output Power	$P_{OUT(Max)}$			+13		dBm
Current Consumption @ 433.92 MHz	$I_{DD433.92}$	+13 dBm, CW mode		17.5		mA
Current Consumption @ 868.35 MHz	$I_{DD868.35}$	+13 dBm, CW mode		19.5		mA
Sleep Current	I_{SLEEP}			20		nA
Symbol Rate	SR		0.5		40	ksps
Frequency Tune Time	t_{TUNE}			370		us
Phase Noise @ 433.92 MHz	$PN_{433.92}$	100 kHz offset from F_{RF}		-82		dBc/Hz
		200 kHz offset from F_{RF}		-83		dBc/Hz
		400 kHz offset from F_{RF}		-92		dBc/Hz
		600 kHz offset from F_{RF}		-97		dBc/Hz
		1.2 MHz offset from F_{RF}		-107		dBc/Hz
Phase Noise @ 868.35 MHz	$PN_{868.35}$	100 kHz offset from F_{RF}		-77		dBc/Hz
		200 kHz offset from F_{RF}		-78		dBc/Hz
		400 kHz offset from F_{RF}		-87		dBc/Hz
		600 kHz offset from F_{RF}		-93		dBc/Hz
		1.2 MHz offset from F_{RF}		-102		dBc/Hz
Harmonics Output for 433.92 MHz	$H2_{433.92}$	2nd harm @ 867.84 MHz, +13 dBm P_{OUT}		< -45		dBm
	$H3_{433.92}$	3rd harm @ 1301.76 MHz, +13 dBm P_{OUT}		< -45		dBm
Harmonics Output for 868.35 MHz	$H2_{868.35}$	2ndharm @ 1736.7 MHz, +13 dBm P_{OUT}		< -45		dBm
	$H3_{868.35}$	3rdharm @ 2605.05 MHz, +13 dBm P_{OUT}		< -45		dBm
OOK Extinction Ration				60		dB

Notes:

[1]. The frequency range is continuous over the specified range, and it is depend on crystal.

1.4 Crystal Oscillator

Table 6. Crystal Oscillator Specifications

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Crystal Frequency[1]	$F_{XTAL433.92}$	Frequency = 433.92MHz		26.2982		MHz
	$F_{XTAL868.35}$	Frequency = 868.35MHz		26.3136		MHz
Crystal Tolerance[2]				± 20		ppm
Load Capacitance[3]	C_{LOAD}			15		pF
Crystal ESR	Rm				60	Ω
XTAL Startup Time[4]	t_{XTAL}			400		us

Notes:

[1]. The CMT2110/17B can directly work with external reference clock input to XTAL pin (a coupling capacitor is required) with amplitude 0.3 to 0.7 Vpp.

[2]. This is the total tolerance including (1) initial tolerance, (2) crystal loading, (3) aging, and (4) temperature dependence. The acceptable crystal tolerance depends on RF frequency and channel spacing/bandwidth.

[3]. The required crystal load capacitance is integrated on-chip to minimize the number of external components.

[4]. This parameter is to a large degree crystal dependent.

2. Pin Descriptions

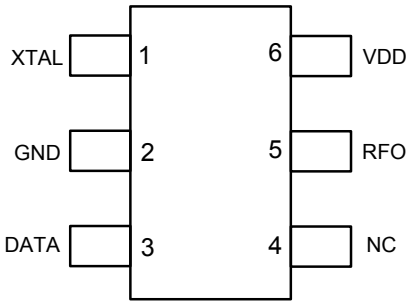


Figure 2. CMT2110/17B Pin Assignments

Table 7.CMT2110/17B Pin Descriptions

Pin Number	Name	I/O	Descriptions
1	XTAL	I	Single-ended crystal oscillator input or External reference clock input
2	GND	I	Ground
3	DATA	I	Data input to be transmitted
4	NC	I	Not connect
5	RFO	O	Power amplifier output
6	VDD	I	Power supply input

3. Typical Performance Characteristics

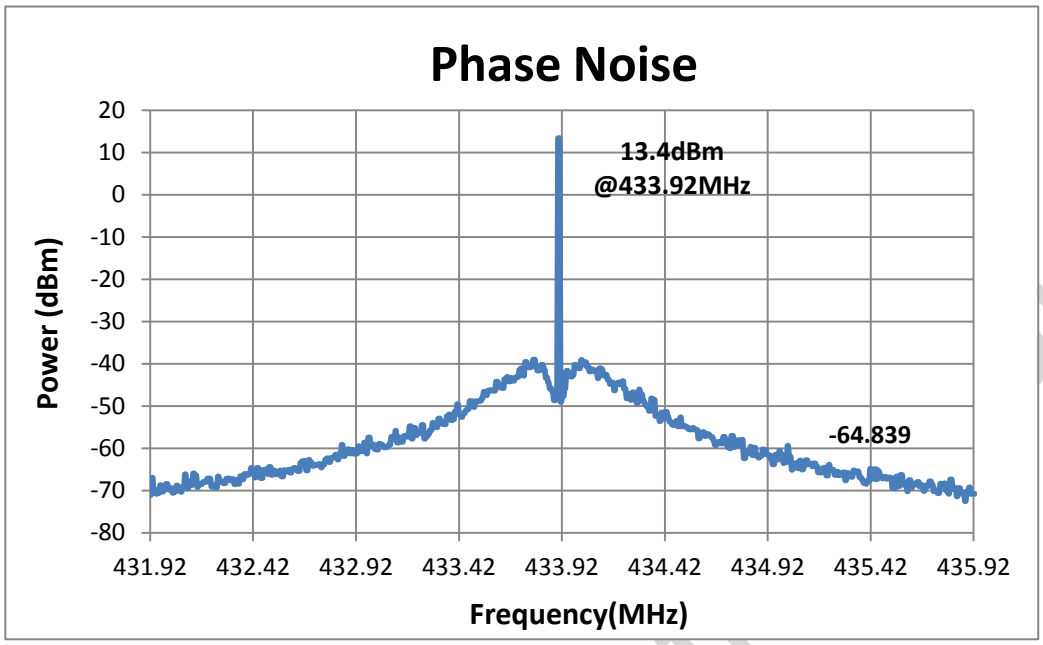


Figure 1. Phase Noise, F_{RF} = 433.92 MHz, P_{OUT} = +13 dBm, CW mode

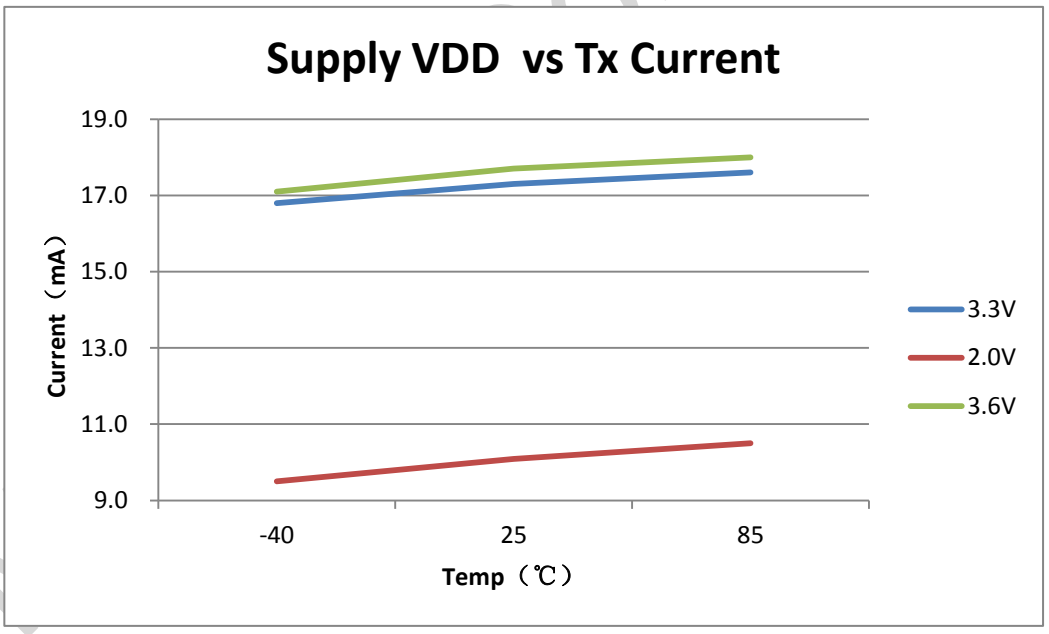


Figure 4. Tx Power – Rx Current – Supply VDD

F_{RF} = 433.92 MHz, P_{OUT} = +13 dBm, CW mode

4. Typical Application Schematics

4.1 Low-Cost Application Schematic

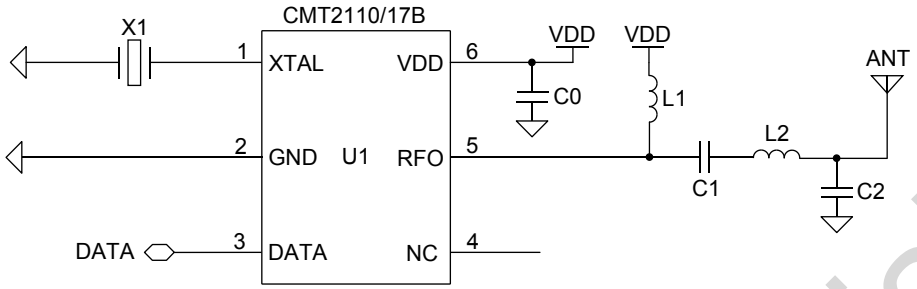


Figure 5. Application Schematic

Notes:

1. The general layout guidelines are listed below. For more design details, please refer to " AN170 CMT2110/17B Schematic and PCB Layout Design Guideline"
   - Use as much continuous ground plane metallization as possible.
   - Use as many grounding vias (especially near to the GND pins) as possible to minimize series parasiticinductance between the ground pour and the GND pins.
   - Avoid using long and/or thin transmission lines to connect the components.
   - Avoid placing the nearby inductors in the same orientation to reduce the coupling between them.
   - Place C0 as close to the CMT2110/17B as possible for better filtering.
2. The table below shows the BOM of 433.92/868.35 MHz Low-Cost Application.For the BOM of 315/915 MHz application, please refer to "AN170 CMT2110/17B Schematic and PCB Layout Design Guideline".

Table 8. BOM of 433.92/868.35 MHz Low-Cost Application

Designator	Descriptions	Value		Unit	Manufacturer
		433.92 MHz[1]	868.35 MHz[2]		
U1	CMT2110/17B, OOK Transmitter	-		-	CMOSTEK
X1	±20 ppm, SMD32*25 mm crystal	26.2982	26.3136	MHz	EPSON
C0	±20%, 0402 X7R, 25 V	0.1		uF	
C1	±5%, 0402 NP0, 50 V	68	56	pF	
C2	±5%, 0402 NP0, 50 V	2.2	5.6	pF	
L1	±5%, 0603 multi-layer chip inductor	180	100	nH	Sunlord
L2	±5%, 0603 multi-layer chip inductor	27	7.5	nH	Sunlord

Note:
[1]. The 433.92 MHz Application is for CMT2110B only.
[2]. The 868.35 MHz Application is for CMT2117B only.

4.2 FCC/ETSI Compliant Application Schematic

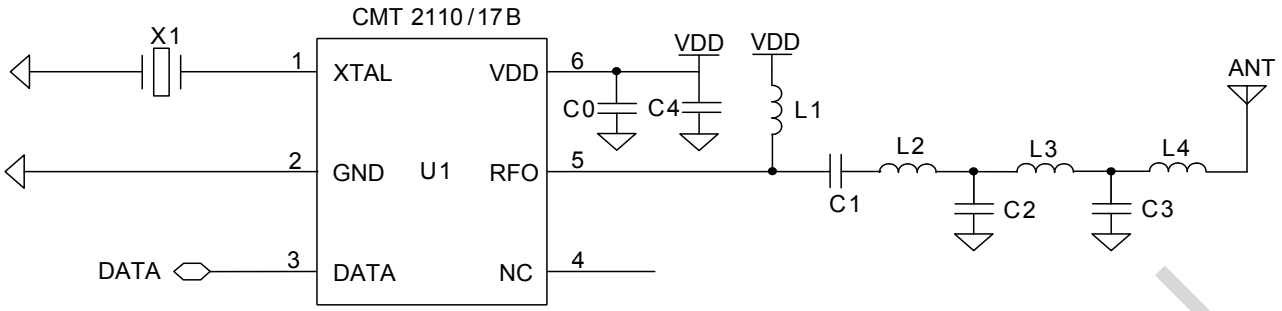


Figure 6. FCC/ETSI Compliant ApplicationSchematic

Notes:

1. The general layout guidelines are listed below. For more design details, please refer to “AN170 CMT2110/17B Schematic and PCB Layout Design Guideline”.
   - Use as much continuous ground plane metallization as possible.
   - Use as many grounding vias (especially near to the GND pins) as possible to minimize series parasiticinductance between the ground pour and the GND pins.
   - Avoid using long and/or thin transmission lines to connect the components.
   - Avoid placing the nearby inductors in the same orientation to reduce the coupling between them.
   - Place C0 as close to the CMT2110/17B as possible for better filtering.
2. The table below shows the BOM of 433.92/868.35 MHz FCC/ETSI Compliant Application.For the BOM of 315/915 MHz application, please refer to “AN170 CMT2110/17B Schematic and PCB Layout Design Guideline”.

Table 9. BOM of 433.92/868.35 MHz FCC/ETSI Compliant Application

Designator	Descriptions	Value		Unit	Manufacturer
		433.92 MHz[1]	868.35 MHz[2]		
U1	CMT2110/17B, OOK Transmitter	-		-	CMOSTEK
X1	±20ppm, SMD32*25 mm crystal	26.2982	26.3136	MHz	EPSON
C0	±20%, 0402 X7R, 25V	0.1		uF	Murata GRM15
C1	±5%, 0402 NP0, 50V	18	15	pF	Murata GRM15
C2	±5%, 0402 NP0, 50V	4.3	4.3	pF	Murata GRM15
C3	±5%, 0402 NP0, 50V	4.3	2.2	pF	Murata GRM15
C4	±5%, 0402 NP0, 50V	220	220	pF	Murata GRM15
L1	±5%, 0603 multi-layerchip inductor	180	100	nH	Sunlord
L2	±5%,0603 multi-layerchip inductor	51	12	nH	Sunlord
L3	±5%,0603 multi-layerchip inductor	47	15	nH	Sunlord
L4	±5%,0603 multi-layerchip inductor	36	15	nH	Sunlord

Note:
[1]. The 433.92 MHz Application is for CMT2110B only.
[2]. The 868.35 MHz Application is for CMT2117B only.

5. Functional Descriptions

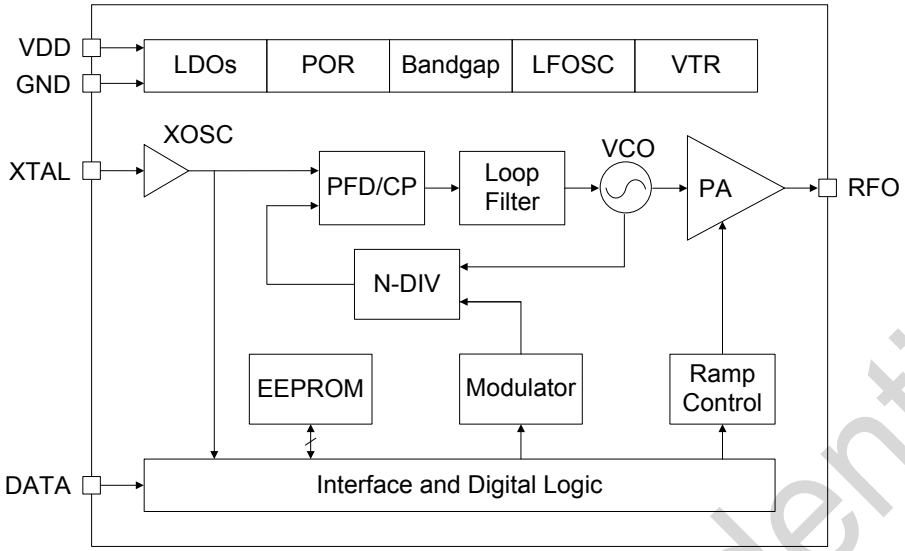


Figure 7. CMT2110/17B Functional Block Diagram

5.1 Overview

The CMT2110/17B is an ultra low-cost, highly flexible, high performance, single-chip OOK transmitter for various 315/434/868/915 MHz wireless applications.The CMT2110B covers the frequency range from 312 to 480 MHz while the CMT2117B covers the 624 to 960 MHz frequency range. They are part of the CMOSTEK NextGenRF™ family, which includes a complete line of transmitters, receivers and transceivers. The chip is optimized for the low cost system, low power consumption, battery powered application with its highly integrated and low power design.

The functional block diagram of the CMT2110/17B is shown in the figure above. The CMT2110/17B is based on direct synthesis of the RF frequency, and the frequency is generated by a low-noise integer-N frequency synthesizer. It uses a 1-pin crystal oscillator circuit with the required crystal load capacitance integrated on-chip to minimize the number of external components. Every analog block is calibrated on each Power-on Reset (POR) to the highly accurate reference voltage internally. The calibration can help the chip to finely work under different temperatures and supply voltages. The CMT2110/17B uses the DATA pin for the host MCU to send in the data. The input data will be modulated and sent out by a highly efficient PA which output power is +13 dBm. RF Frequency, The CMT2110/17B operates from 2.0 to 3.6 V so that it can finely workwith most batteries to their useful power limits. Working under 3.3 V supply voltage when transmitting signal at +13 dBm power, it only consumes 17.5 mA at 433.92 MHz and 19.5 mA at 868.35 MHz（CW Mode）.

5.2 Modulation, Frequency and Symbol Rate

The CMT2110/17B supports OOK modulation with the symbol rate up to 40 ksps. The CMT2110B covers the frequency range from 312 to 480 MHz, while the CMT2117B covers the frequency range from 624 to 960 MHz, including the license free ISM frequency band around 315 MHz, 433.92 MHz,868.35 MHz and 915 MHz.

Table 10. Modulation, Frequency and Symbol Rate

Parameter	Value	Unit
Modulation	OOK	-
Frequency(CMT2110B)	312 to 480	MHz
Frequency(CMT2117B)	624 to 960	MHz
Symbol Rate	0.5 to 40	ksps

5.3 Power Amplifier

A highly efficient single-ended Power Amplifier (PA) is integrated in the CMT2110/17 B to transmit the modulated signal out. Depending on the application, the user can design a matching network for the PA to exhibit optimum efficiency at the desired output power for a wide range of antennas, such as loop or monopole antenna. Typicalapplication schematics and the required BOM are shown in “Chapter 4 Typical Application Schematic”. For the schematic,layout guideline and the other detailedinformation please refer to “AN170　CMT2110/17B Schematic and PCB Layout Design Guideline”.

5.4 Crystal Oscillator and RCLK

The CMT2110/17B uses a 1-pin crystal oscillator circuitwith the required crystal load capacitance integrated on-chip. Figure shows the configuration of the XTAL circuitry and the crystal model. The recommended specification for the crystal is about 26 MHz with ±20 ppm, ESR (Rm) <60 Ω, load capacitance C_{LOAD} about 15 pF.To save the external load capacitors, a set of variable load capacitors C_L is built inside the CMT2110/17B to support the oscillation of the crystal.

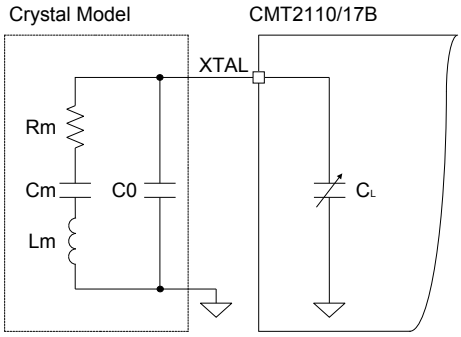


Figure 8. XTAL Circuitry and Crystal Model

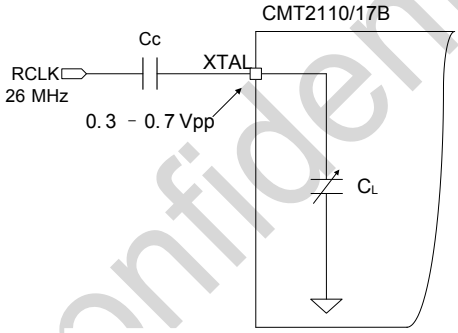


Figure 9. RCLK Circuitry

If a about 26 MHz RCLK (reference clock) is available in the system, the user can directly use it to drive the CMT2110/17B by feeding the clock into the chip via the XTAL pin. This further saves the system cost due to the removal of the crystal. Acoupling capacitor is required if the RCLK is used. The recommended amplitude of the RCLK is 0.3 to 0.7 Vpp on the XTAL pin. Also, the user should set the internal load capacitor C_L to its minimum value. See Figure for the RCLK circuitry.

6. Working States and Transmission Control Interface

6.1 Working States

The CMT2110/17B has 4 different working states: SLEEP, XO-STARTUP, TUNE and TRANSMIT.

SLEEP

When the CMT2110/17B is in the SLEEP state, all the internal blocks are turned off and the current consumption is minimized to 20 nA typically.

XO-STARTUP

After detecting a valid control signal on DATA pin, the CMT2110/17B goes into the XO-STARTUP state, and the internal XO starts to work. The valid control signal can be a rising edge on the DATA pin, which can be configured on the RFPDK. The host MCU has to wait for the t_{XTAL} to allow the XO to get stable. The $t_{XTAL}$is to a large degree crystal dependent. A typical value of t_{XTAL} is provided in Table .

TUNE

The frequency synthesizer will tune the CMT2110/17B to the desired frequency in the time t_{TUNE}. The PA can be turned on to transmit the incoming data only after the TUNE state is done, before that the incoming data will not be transmitted. See Figure 3 for the details.

TRANSMIT

The CMT2110/17B starts to modulate and transmit the data coming from the DATA pin. The transmission can be ended by: driving the DATA pin low for t_{STOP} time, where the t_{STOP} is fixed for 20 ms.

Table 11. Timing in Different Working States

Parameter	Symbol	Min	Typ	Max	Unit
XTAL Startup Time [1]	t_{XTAL}		400		us
Time to Tune to Desired Frequency	t_{TUNE}		370		us
Hold Time After Rising Edge	t_{HOLD}	10			ns
Time to Stop The Transmission	t_{STOP}		20		ms
Notes: [1]. This parameter is to a large degree crystal dependent.					

6.2 Transmission Control Interface

The CMT2110/17B uses the DATA pin for the host MCU to send in data for modulation and transmission. The DATA pin is used as pin for data transmission, as well as controlling the transmission. The transmission can be started by detecting rising on the DATA pin, and stopped by driving the DATA pin low for t_{STOP} as shown in the table above.

As shown in the Figure 310, once the CMT2110/17B detects a rising edge on the DATA pin, it goes into the XO-STARTUP state. The user has to pull the DATA pin high for at least 10 ns (t_{HOLD}) after detecting the rising edge, as well as wait for the sum of t_{XTAL} and t_{TUNE} before sending any useful information (data to be transmitted) into the chip on the DATA pin. The logic state of the DATA pin is “Don’tCare” from the end of t_{HOLD} till the end oft_{TUNE}.In the TRANSMIT state, PA sends out the input data after they are modulated. The user has to pull the DATA pin low for t_{STOP} in order to end the transmission.

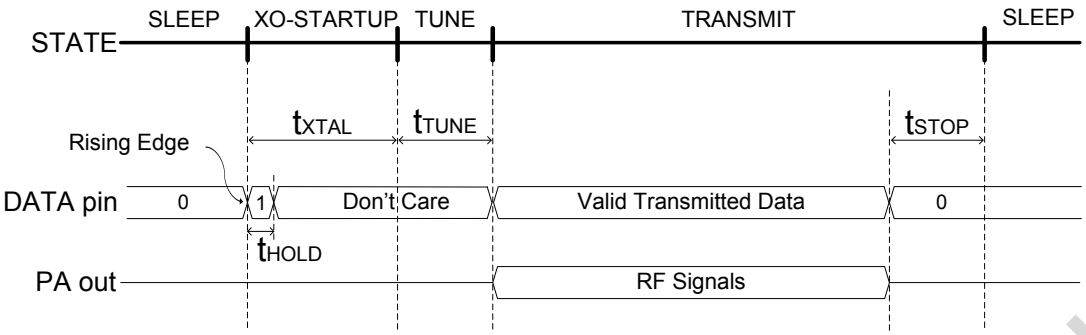


Figure 3. Transmission Enabled by DATA Pin Rising Edge

7. Ordering Information

Table 11. CMT2110/17B Ordering Information

Part Number	Descriptions	Package Type	Package Option	Operating Condition	MOQ / Multiple
CMT2110B-ESR[1]	Low-Cost 315/433 OOK Transmitter	SOT23-6	Tape & Reel	2.0 to 3.6V, -40 to 85℃	3,000
CMT2117B-ESR[1]	Low-Cost 868/915 MHz OOK Transmitter	SOT23-6	Tape & Reel	2.0 to 3.6 V, -40 to 85 ℃	3,000

Notes:

[1]. "E" stands for extended industrial product grade, which supports the temperature range from -40 to +85 ℃.
"S" stands for the package type of SOT23-6.
"R" stands for the tape and reel package option, the minimum order quantity (MOQ) for this option is 3,000 pieces.

Visit www.cmostek.com/products to know more about the product and product line.
Contact sales@cmostek.com or your local sales representatives for more information.

8. Package Outline

The 6-pin SOT23-6 illustrates the package details for the CMT2110/17B. Table 12 lists the values for the dimensions shown in the illustration.

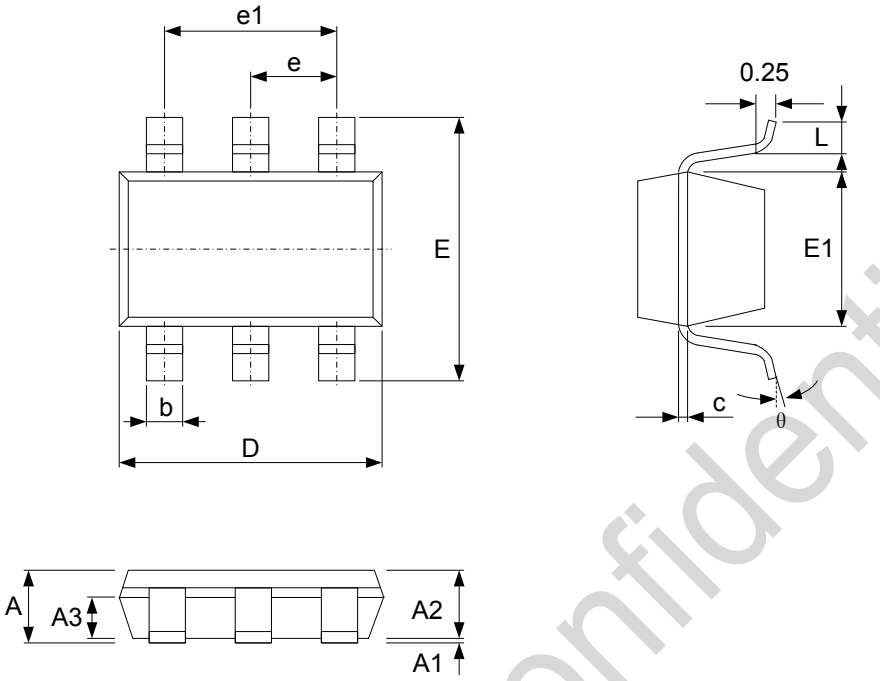


Figure 4. 6-Pin SOT23-6

Table 12. 6-Pin SOT23-6 Package Dimensions

Symbol	Size (millimeters)		
	Min	Typ	Max
A	—	—	1.35
A1	0.04	—	0.15
A2	1.00	1.10	1.20
A3	0.55	0.65	0.75
b	0.38	—	0.48
C	0.08	—	0.20
D	2.72	2.92	3.12
E	2.60	2.80	3.00
E1	1.40	1.60	1.80
e	0.95BSC		
e1	1.90BSC		
L	0.30	—	0.60
θ	0	—	8°

9. Top Marking

9.1 CMT2110/17B Top Marking

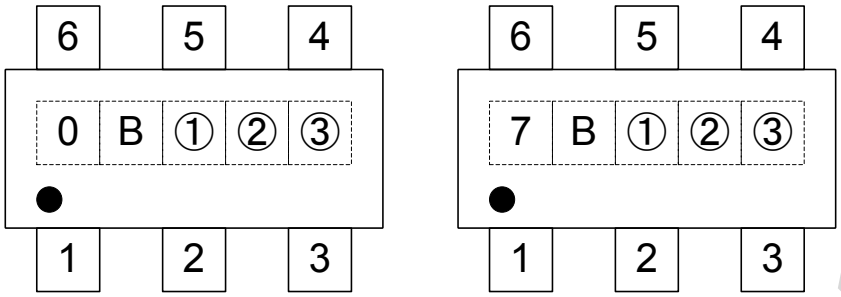


Figure 5. CMT2110B (Left) and CMT2117B (Right) Top Marking

Table 13. CMT2110/17B Top Marking Explanation

Top Mark:	0B①②③/7B①②③
Mark Method:	Laser
Font Size:	0.6 mm, right-justified
1st letter:	0, represents CMT2110B 7, represents CMT2117B
2nd letter:	B: represents revision B
3rd – 5th letter:	①②③: Internal reference for data code tracking,assigned by the assembly house

10. Other Documentations

Table 14. Other Documentations for CMT2110/17B

Brief	Name	Descriptions
AN170	CMT2110/17B Schematic and PCB Layout Design Guideline	Details of CMT2110/17B PCB schematic and layout design rules, RF matching network and other application layout design related issues.

11. Document Change List

Table 15. Document Change List

Rev. No.	Chapter	Description of Changes	Date
Preliminary	All	Initial released version	2017-09-07

12. Contact Information

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