HOPERF

HopeRF Sub-1G Products Introduction

Qingyu Ruan

Manufacturer of IoT Key Components

RF IC
射频芯片

IoT Module
无线

Signal Chain
信号链产品

Customized Solutions -
RF Modules & Wireless Networking
& More IoT Products

Agenda

- Sub-GHz Product Portfolio
- OOK Transmitter & Receiver
- Transmitter with encoder
- Transmitter SoC – 8051 Core
- FSK Transmitter & Receiver
- FSK Transceiver
- Wireless SoC - ARM Core

Sub-GHz Product Portfolio (partial)

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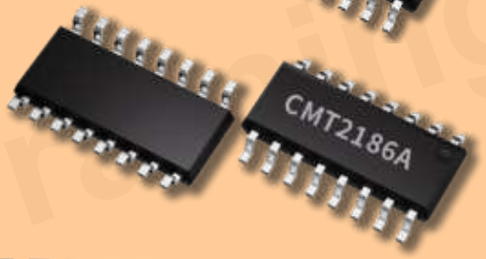
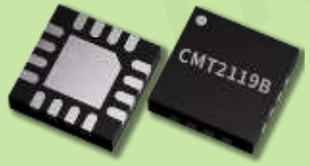
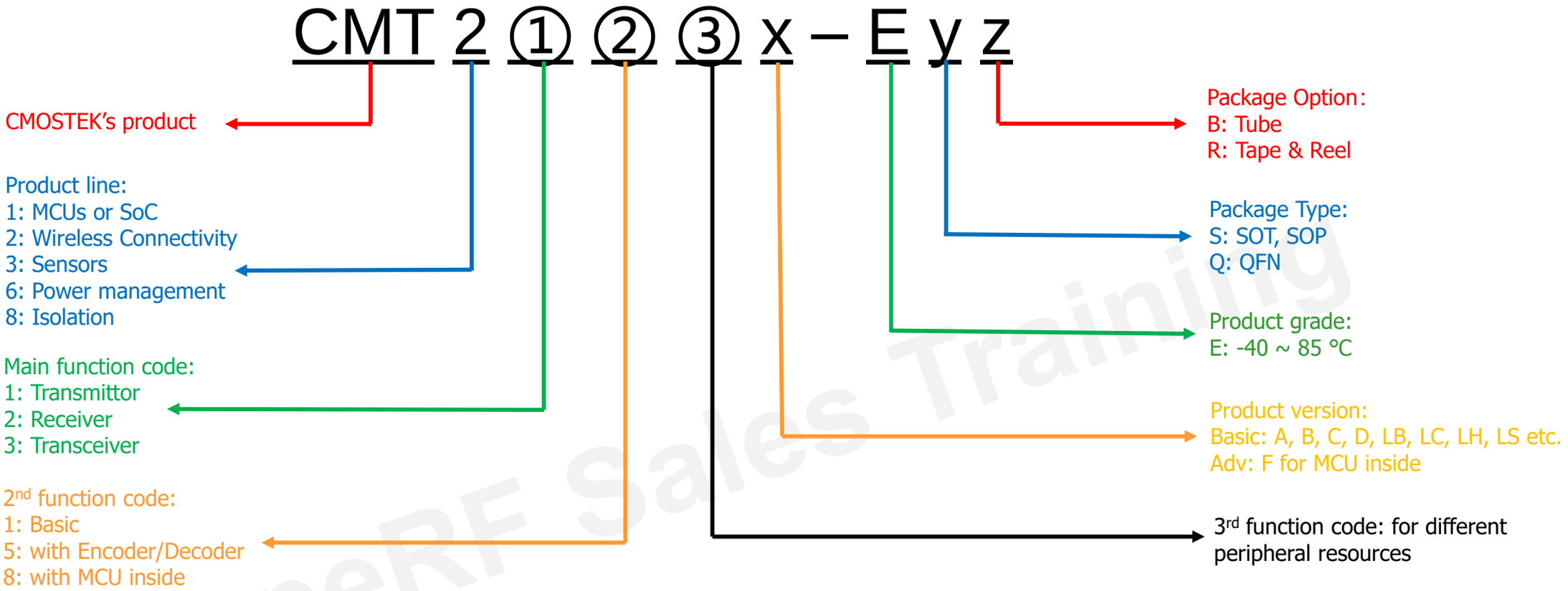
	Tx	Rx	TRx	TxEncoder/SoC	TRxSoC
OOK		 		 	
FSK	 	 	 	 	 

Naming convention



For example:

1. CMT2110A-ESR, Low cost 240-480MHz OOK transmitter, rev A, -40℃ ~ +85℃, SOT23-6, Tape & Reel
2. CMT2119A-ESR, Low cost 240-960MHz OOK/FSK transmitter, rev A, -40℃ ~ +85℃, SOT23-6, Tape & Reel
3. CMT2210LB-ESR, Low cost 300-480MHz OOK receiver, rev LB, -40℃ ~ +85℃, SOP-8, Tape & Reel
4. CMT2300A-EQR, Ultra low power Sub-1GHz Transceiver, rev A, -40℃ ~ +85℃, QFN-16, Tape & Reel
5. CMT2310A-EQR, High performance Sub-1GHz Transceiver, rev A, -40℃ ~ +85℃, QFN-24, Tape & Reel
6. CMT2157B-ESR, Sub-1GHz OOK transmitter with encoder, rev B, -40℃ ~ +85℃, SOP-14, Tape & Reel
7. CMT2189D-EQR, Sub-1GHz OOK/FSK transmitter SoC, rev D, -40℃ ~ +85℃, QFN-20, Tape & Reel
8. CMT2390F64-EQR, Ultra low power Sub-1GHz Wireless Transceiver, with Cotrex-M0, 64kB Flash, -40℃ ~ +85℃, QFN-48, Tape & Reel
9. CMT2391F128-EQR, Ultra low power Sub-1GHz Wireless Transceiver, with Cotrex-M4, 128kB Flash, -40℃ ~ +85℃, QFN-68, Tape & Reel

Product series

Differentiate by function:

- **Transmitter (Tx by short),** *just as CMT211xA and CMT211xB, for example CMT2110A and CMT2119A are both belong to CMT211xA series transmitter.*
- **Receiver (Rx by short),** *just as CMT221xA, CMT221xB and CMT221xLx, for example CMT2210LB, CMT2210LC, CMT2210LH, CMT2219A, CMT2219B, etc. are belong to receiver series. And we have much more receiver part number than transmitter.*
- **Transmitter with encoder**, *mainly as CMT215x, for example CMT2150A, CMT2150L, CMT2157A, CMT2157B, etc.*
- **Transmitter with microcontroller (TxSoC by short),** *mainly as CMT218x and CMT216x, for example CMT2189D, CMT2168A, etc.*
- **Transceiver (TRx by short),** *mainly two part number CMT2300A and CMT2310A*.
- **Transceiver with microcontroller (TRxSoC by short),** *mainly as CMT238xFxx and CMT239xFxxx, for example CMT2380F64, CMT2390F64, CMT2391F128, etc.*

Product series

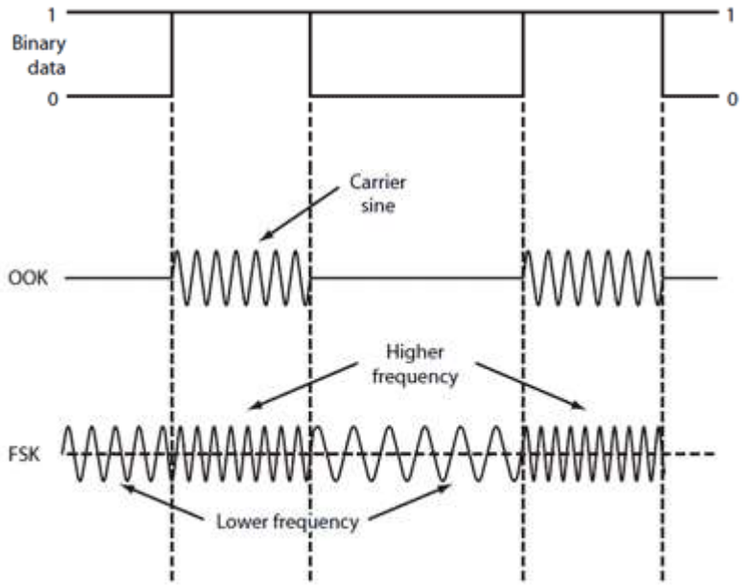
Differentiate by modulation:

- **OOK modulation,** *for example CMT2110A(Tx) and CMT2210LB(Rx) are a pair of products which are using OOK modulation, suitable to be used for low cost project.*
- **FSK modulation,** *for example CMT2119A(Tx) and CMT2219B(Rx) are a pair of products which are using FSK modulation, suitable to be used for the projects which need high quality and reliability.*

Notice:

1. The majority of chips that support FSK modulation also support OOK modulation, but the opposite is not. Because OOK modulation suitable for low cost application. It's also mean, FSK modulation's chips are expensive compare to OOK modulation's chips.
2. Considering communication reliability and quality, FSK modulation is much better than OOK modulation, although FSK modulation's chip more expensive, because FSK modulation/demodulation is more complex.

Modu.	Advantage	Disadvantage
OOK	Less power More simple Less cost	Less reliability Less range
FSK	More reliability More quality More range	More power More complex More cost



Product list (for OOK, partial)

OOK Tx/Rx main product list

Part Number	Func.	Freq(MHz)	Link budget	Package	Remark	Pairing PN
CMT2110A-ESR	Tx	240-480	+13 dBm	SOT23-6	Standalone+Burn CFG or TWI	CMT221x's e.g. CMT2210LB/LH
CMT2110B-ESR	Tx	240-480	+13 dBm	SOT23-6	Standalone	CMT221x's e.g. CMT2210LB/LH
CMT2210LB-ESR	Rx	300-480	-113 dBm	SOP-8	Standalone+Burn CFG	CMT21xx's e.g. CMT2110A
CMT2210LH-ESR	Rx	300-480	-109 dBm	SOP-8	Standalone+Burn CFG	CMT21xx's e.g. CMT2150L
CMT2217B-EQR	Rx	300-920	-113 dBm	QFN-16	Standalone+Burn CFG	CMT21xx's e.g. CMT2186A

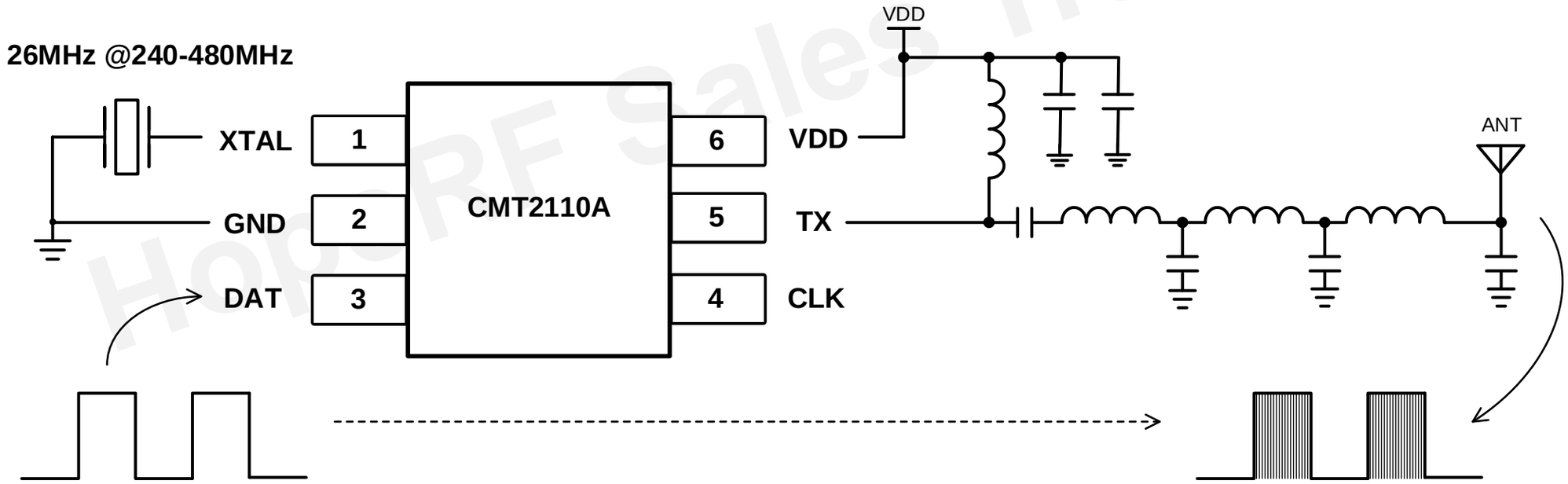
Notice:

1. *TWI, two wire interface, using SDA & SCL pins to configurate.*
2. *Standalone for Tx's chip, working as 'Data in, Antenna out'. Standalone for Rx's chip, working as 'Antenna in, Data out'.*
3. *Burn CFG, means that working parameters are burned through CMT's USB Programmer*

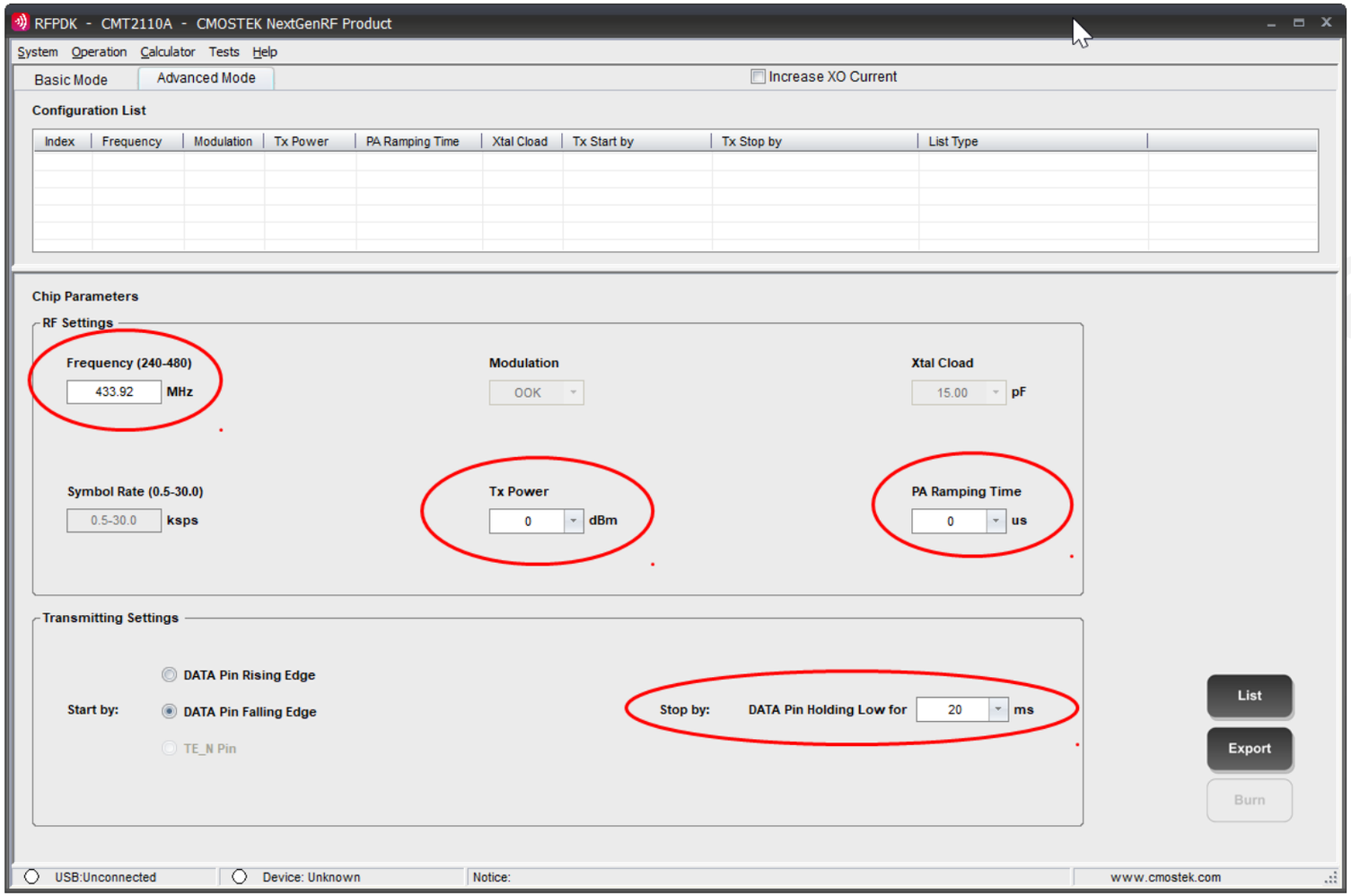
CMT2110A OOK Transmitter

SOT23-6

1. Easy to use, data in antenna out
2. Fractional-N frequency synthesizer, just one 26MHz crystal support 240-480MHz
3. Parameters programmable by RFPDK



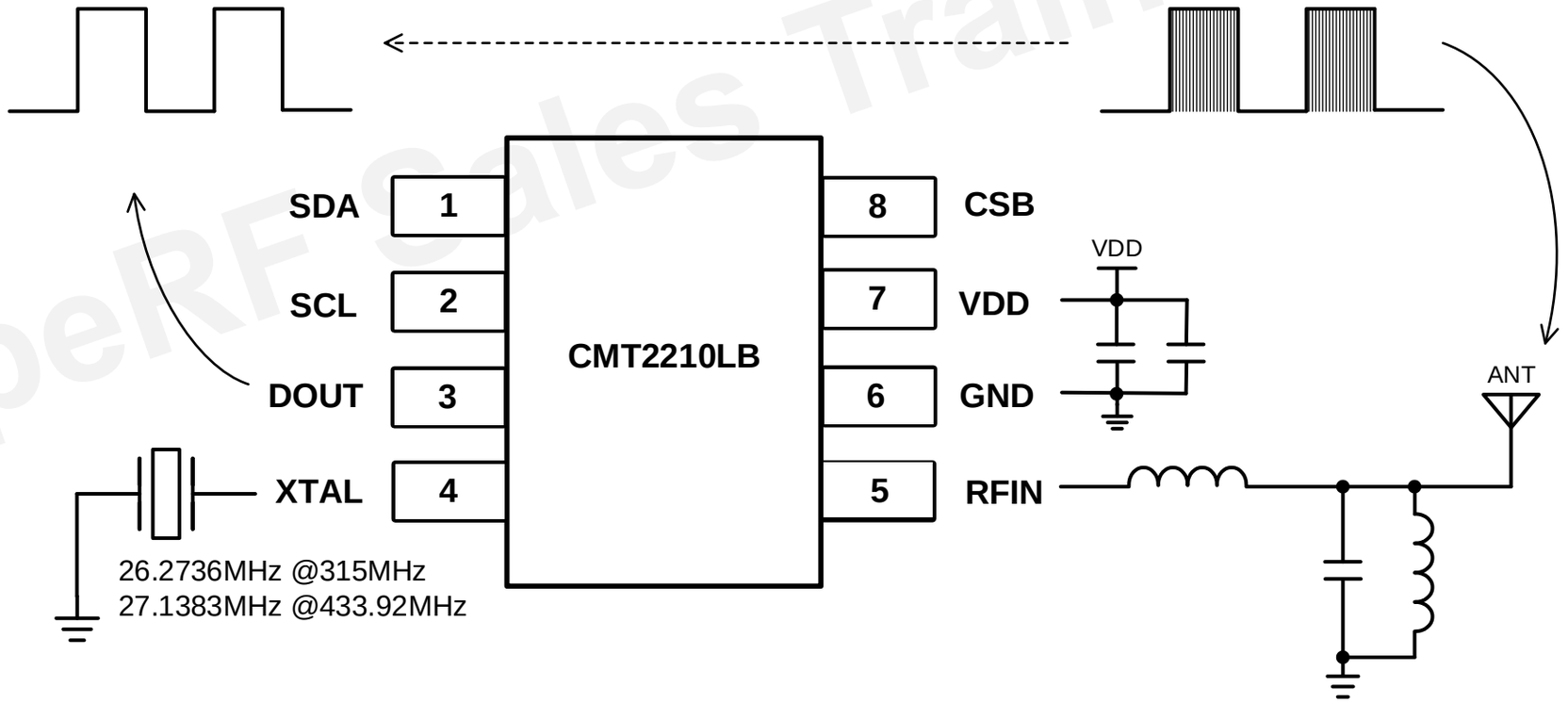
RFPDK for CMT2110A



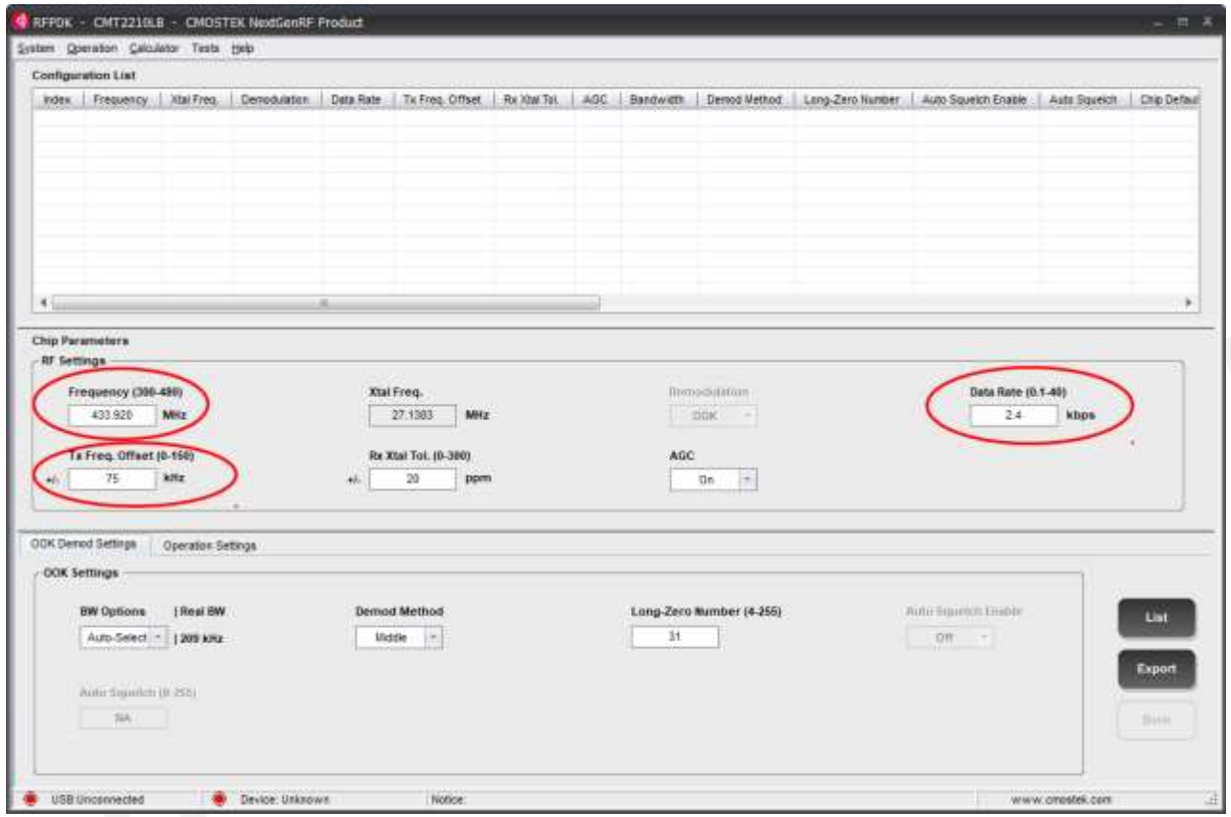
CMT2210LB/LH OOK Receiver

SOP-8

1. Easy to use, antenna in data out
2. Low Cost, CMT2210LB for 1.8V-3.6V, and CMT2210LH for 3.0V-5.5V
3. Support Duty-Cycle work mode, and parameters programmable by RFPDK

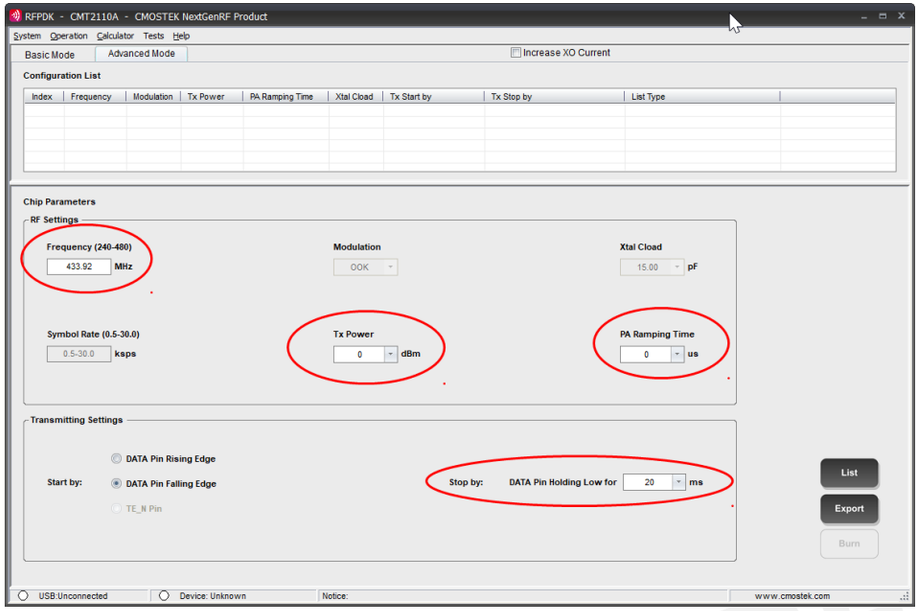


RFPDK for CMT2210LB



Mass Production

RFPDK

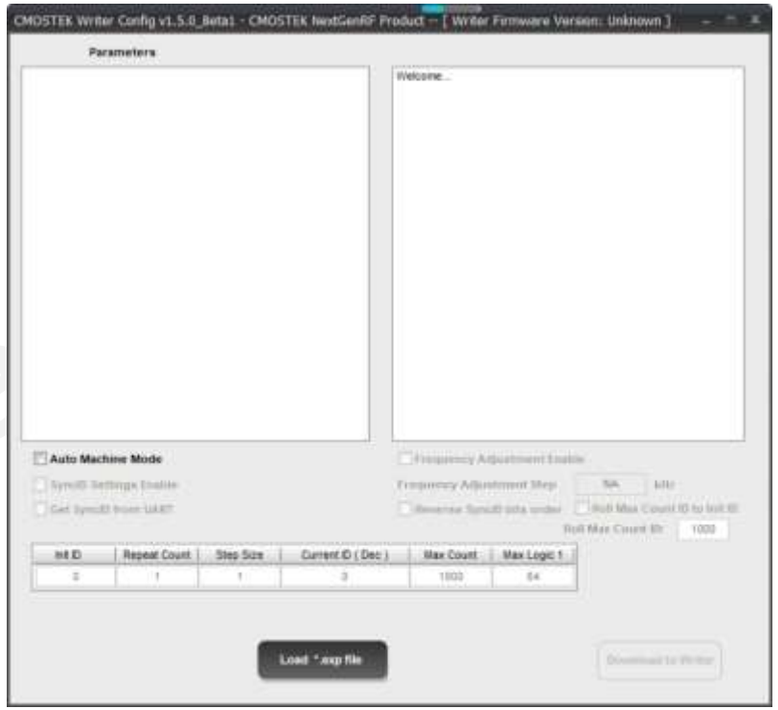


export

*.exp

load

Off-line Writer Config



download

Off-line Writer

Burn

CMT2110A，CMT2210LB，etc.

OOK Transmitter & Receiver Application

Car Alarm System

Remote Control

Product list (for Tx with encoder, partial)

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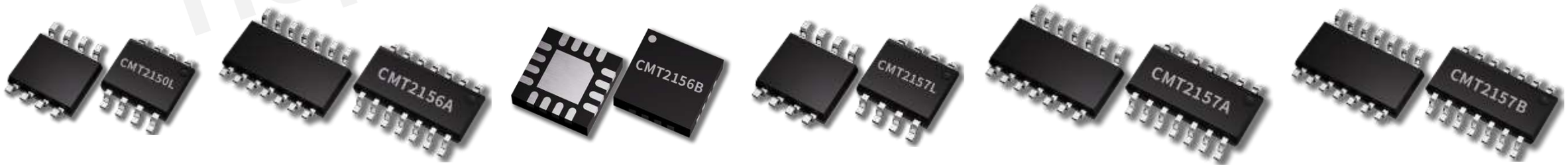
Tx with Encoder main product list

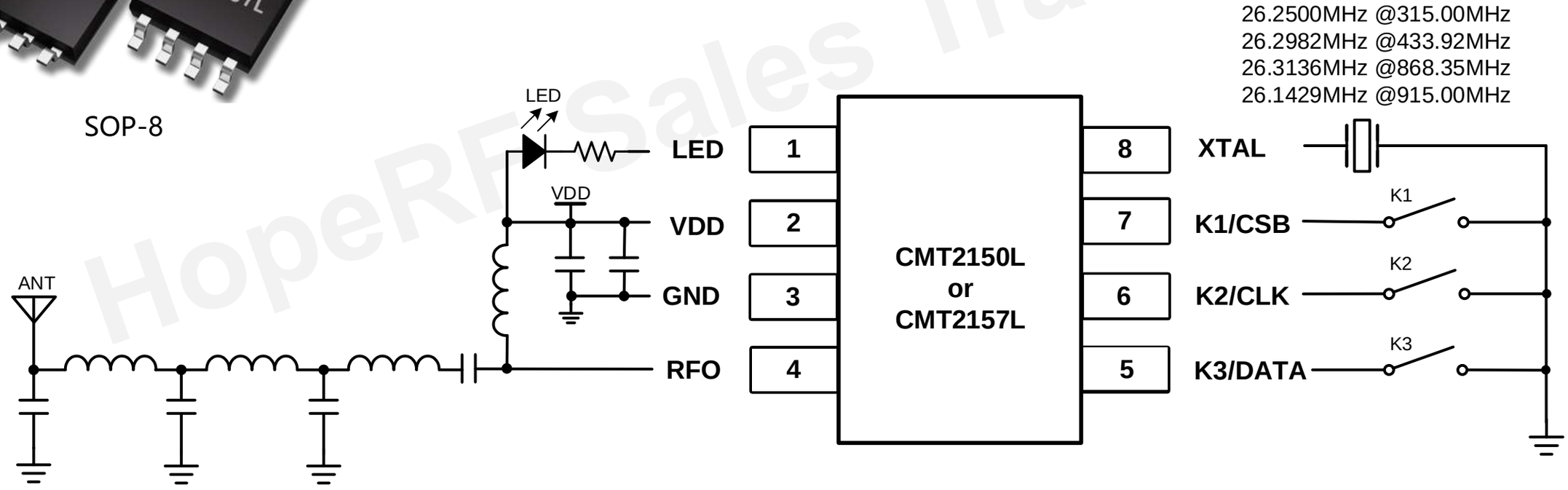
Part Number	Modem	Freq(MHz)	Link budget	Package	Remark	Pairing PN
CMT2150L-ESR	OOK	240-480	+13 dBm	SOP-8	up to 6 Keys	CMT221x's e.g. CMT2210LB/LH
CMT2156A-ESR	OOK	240-480	+13 dBm	SOP-14	built with PMU for battery less application	CMT2210LB/LH
CMT2156B-EQR	OOK	240-960	+13 dBm	QFN-16	built with PMU for battery less application	CMT2210LB/LH
CMT2157L-ESR	OOK	240-960	+13 dBm	SOP-8	up to 6 Keys	CMT221x's e.g. CMT2210LB/LH
CMT2157A-ESR	(G)FSK/OOK	240-960	+13 dBm	SOP-14	up to 7 Keys	CMT221x's e.g. CMT2218B
CMT2157B-ESR	OOK	240-960	+13 dBm	SOP-14	up to 10 Keys	CMT221x's e.g. CMT2210LB/LH



CMT2150L/57L OOK Transmitter with encoder

SOP-8

1. Single chip solution for 1527 coding emitter
2. Easy to used and low Cost
3. Parameters programmable by RFPDK

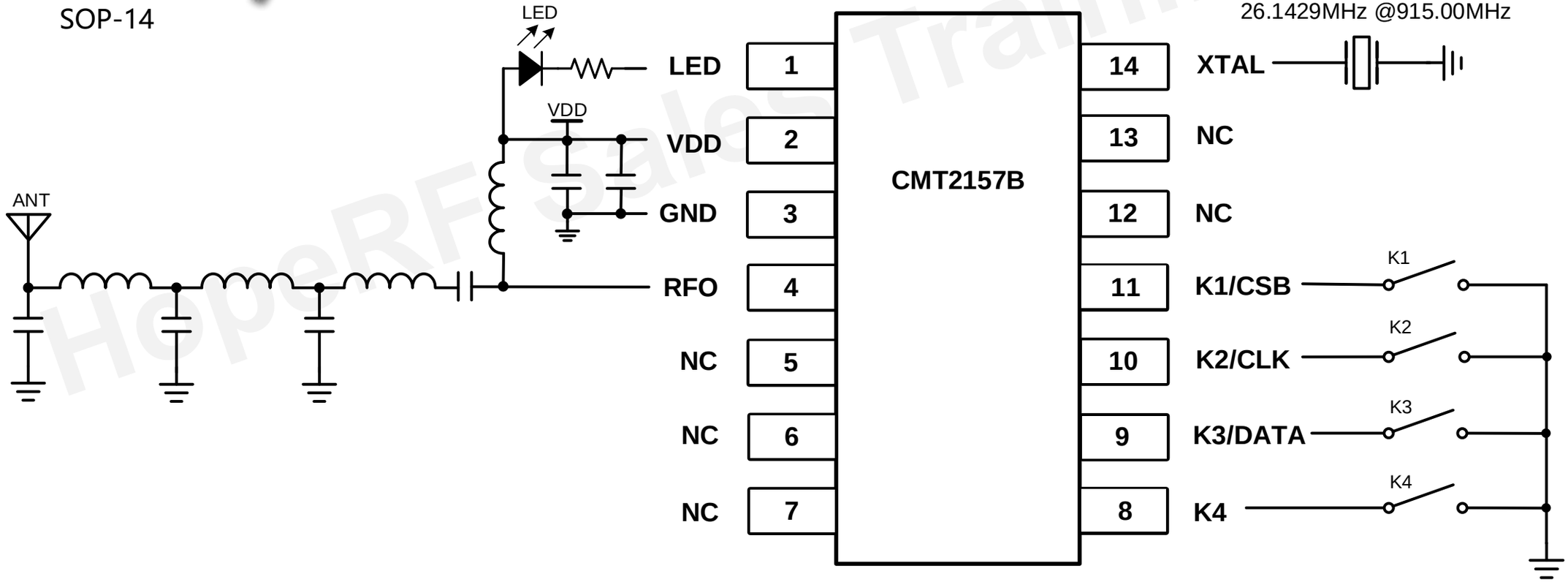


CMT2157B OOK Transmitter with encoder

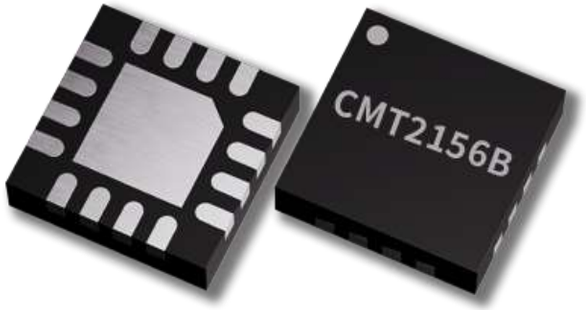
SOP-14

1. Single chip solution for custom encoder emitter
2. Easy to used, flexible for encoding and low cost
3. Parameters programmable by RFPDK

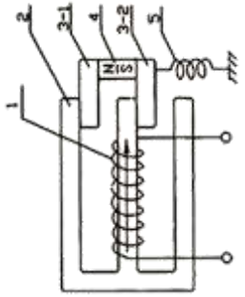
26.2500MHz @315.00MHz
26.2982MHz @433.92MHz
26.3136MHz @868.35MHz
26.1429MHz @915.00MHz



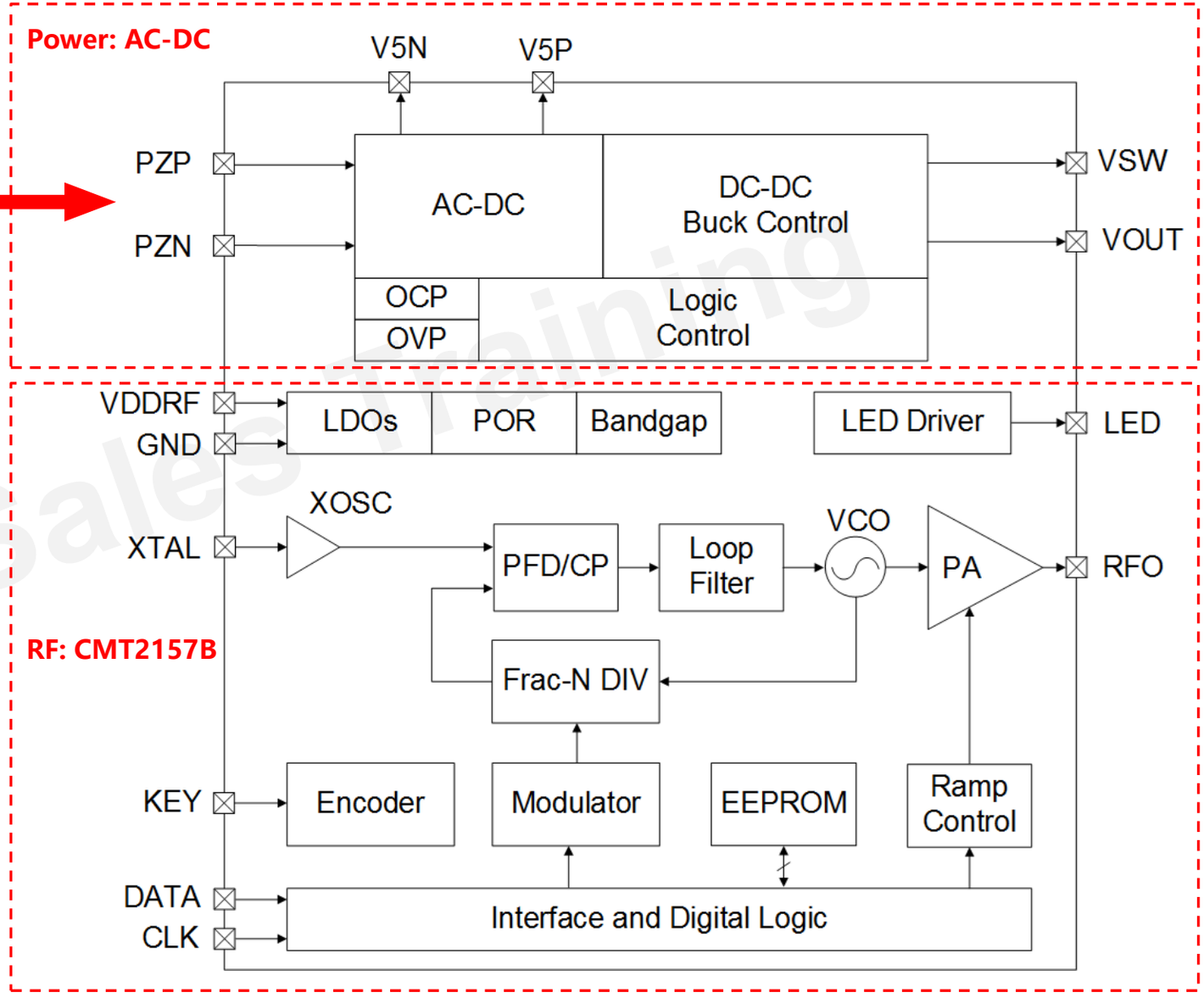
CMT2156B Emitter for Battery-less



QFN-16



Power Generator



1. Single chip solution for battery-less encoder emitter
2. Easy to used, flexible for encoding and low cost
3. Parameters programmable by RFPDK

OOK Transmitter with encoder Application

Low Cost Alarm System

CMT2210LH inside

CMT2150L inside

Pager

CMT2210LB inside

CMT2157L inside

Wireless Door Bell (Battery-less)

CMT2156B inside

CMT2210LB inside

Product list (for TxSoC, partial)

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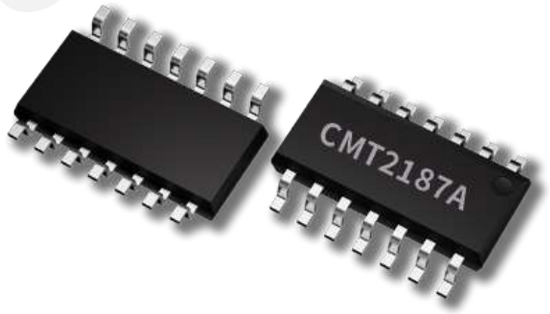
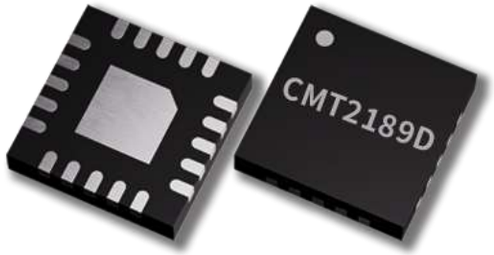
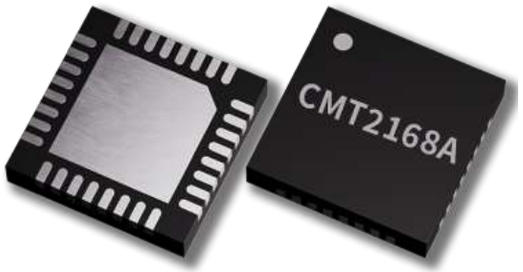
TxSoC main product list

Part Number	Modem	Freq(MHz)	Link budget	Package	Remark	Pairing PN
CMT2186A-ESR/16	OOK	210-960	+13 dBm	SOP-14 SOP-16	1T-8051, 4kB MTP up to 9 GPIOs / 11 GPIOs	CMT221x's e.g. CMT2210LB/LH
CMT2187A-ESR	(G)FSK/OOK	210-960	+13 dBm	SOP-14	1T-8051, 4kB MTP up to 9 GPIOs	CMT221x's e.g. CMT2218B CMT2219B
CMT2189D-EQR	(G)FSK/OOK	27-960	+13 dBm	QFN-20	1T-8051, 8kB OTP, ADC up to 14 GPIOs	
CMT2165A-EQR	(G)FSK/OOK	27-960	+13 dBm	QFN-32	1T-8051, 8kB OTP, ADC up to 17 GPIOs	
CMT2168A-EQR	(G)FSK/OOK	27-960	+13 dBm	QFN-32	1T-8051, 8kB OTP, ADC, LF_Rx up to 17 GPIOs	







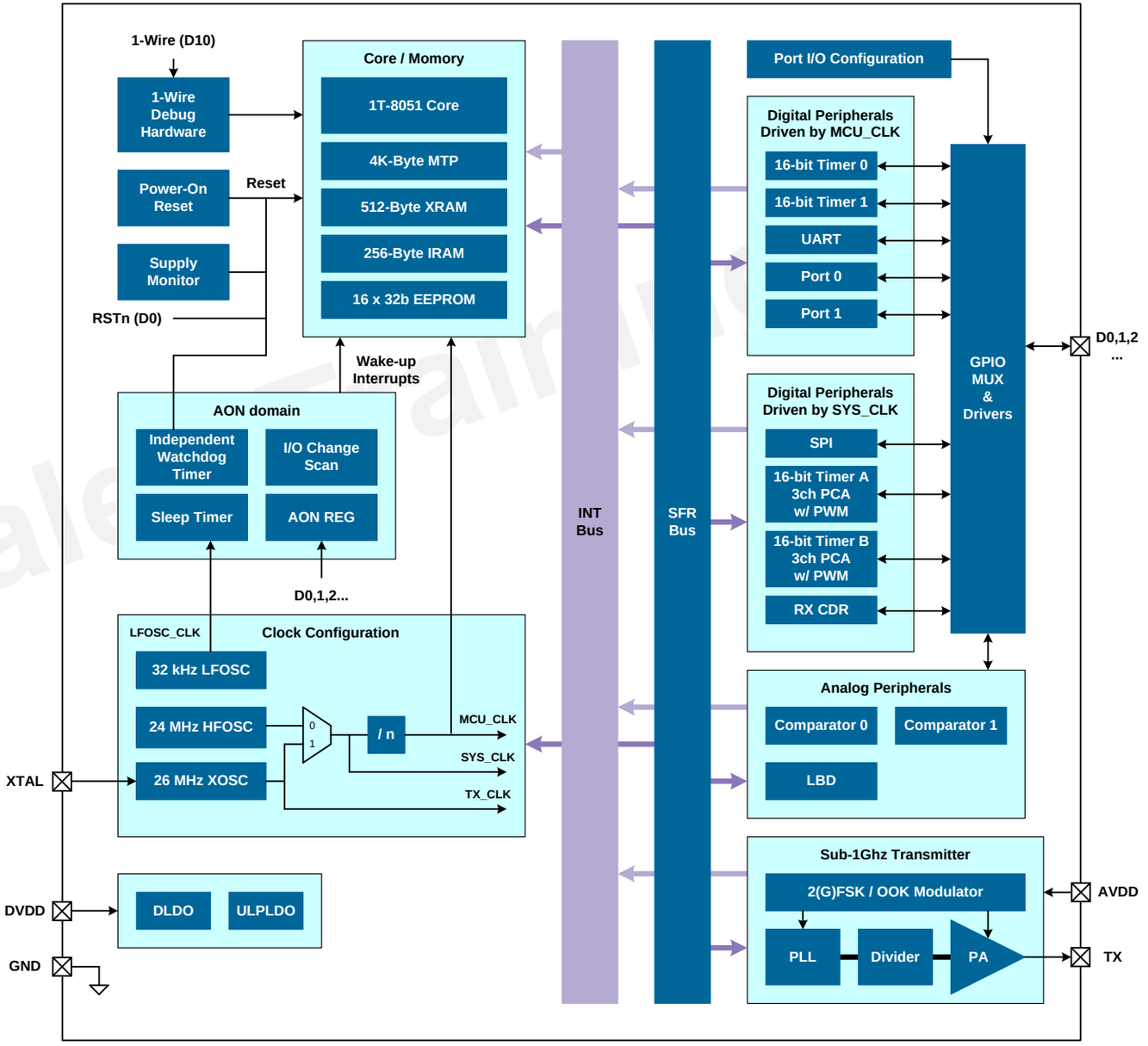
Introduction to CMT2186A/CMT2187A

Microcontroller

- Powerful 1T-8051 Core
- Built-in 24MHz RC，up to 20MIPs，running power 111uA/MHz
- 4 kB MTP , up to 10k endure
- 512-Byte XRAM and 256-Byte IRAM
- Built-in 512-Bit EEPROM
- Built-in 32 kHz low power internal RC oscillator (LPOSC)
- CMT2186A-ESR16 up to 11 GPIOs (SOP-16)
- CMT2186A-ESR up to 9 GPIOs (SOP-14)
- CMT2187A-ESR up to 6 GPIOs (SOP-14)
- All GPIO support input change interrupt
- Double 16-Bit Timer with Three Capture/Compare (Timer A & Timer B)
- UART x1, SPI x1, WDT x1
- 1-Wire on-chip debugging
- 1.8V ~ 3.6 V & -40 ~ +85°C

RF Section

- 210 MHz ~ 960 MHz
- Modulation mode
  - OOK 0.5 – 40 kbps @ CMT2186A / CMT2187A
  - FSK / GFSK 0.5 – 200 kbps @ CMT2187A
- Up to +13 dBm output power
- Tx Current：24 mA @ +13 dBm
- Class-E single-ended PA



Introduction to CMT216xA/CMT2189D

Microcontroller

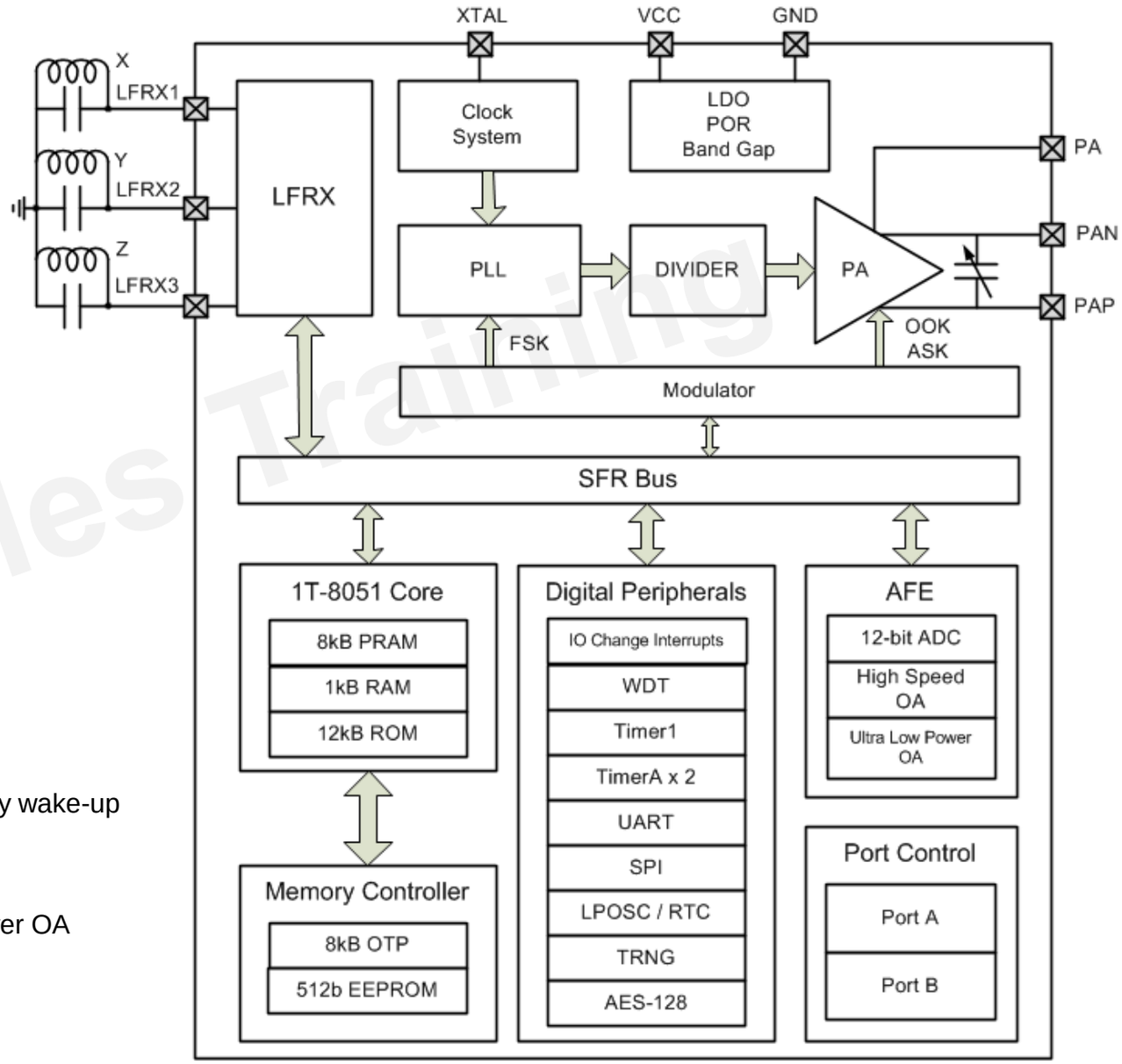
- Powerful 1T-8051 Core
- Up to 24 MIPs @ 24MHz
- 8 kB NVM (OTP) / 8 kB PRAM for code
- 1 kB of internal data RAM
- 12 kB ROM for API embedded functions
- Built-in 512 bits EEPROM
- Built-in AES-128 accelerator
- Built-in true random number generator (TRNG)
- Built-in 8/12/24 MHz high speed internal RC oscillator
- Built-in 32 kHz low power internal RC oscillator (LPOSC)
- Support external 32768 Hz crystal
- I/O change interrupt: PA0 - PA7 & PB0 - PB7
- Double 16-Bit Timer with Three Capture/Compare (Timer A & Timer B)
- UART x1, SPI x1, WDT x1
- 1-Wire on-chip debugging
- 2.0 – 3.6 V & -40 to +85°C

RF Section

- 27 MHz – 960 MHz
- Modulation mode
  - OOK / ASK 0.5 – 40 kbps
  - FSK / GFSK 0.5 – 200 kbps
- Up to +13 dBm
- Tx current: 18 mA @ +13 dBm
- Class-E single-ended PA

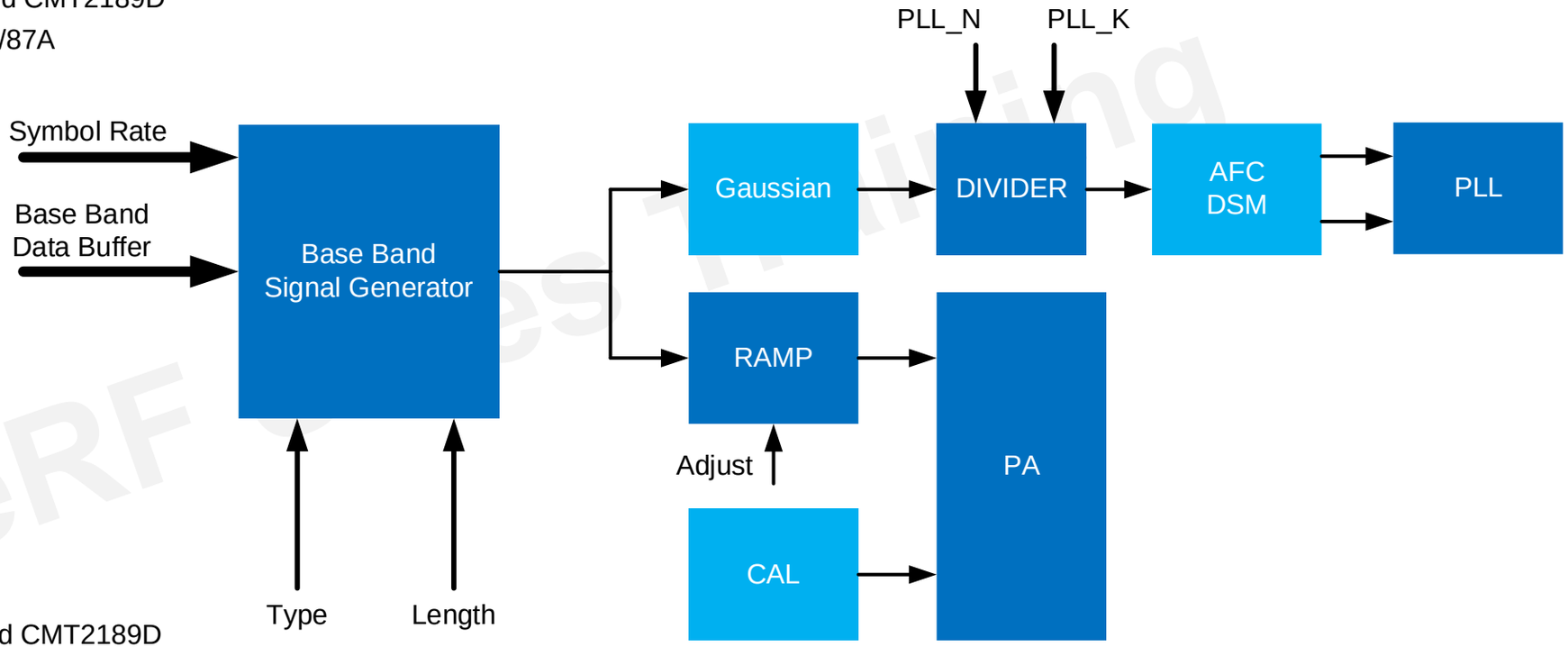
AFE Section

- Built-in 125 kHz low frequency wake-up receiver
- Built-in 12-Bit ADC
- Built-in high speed & low power OA
- Built-in ultra low power OA



Sub-1G Transmitter

- Frequency Range
  - 27 MHz – 960 MHz for CMT216x and CMT2189D
  - 210 MHz – 960 MHz for CMT2186A/87A
- Modulation mode
  - OOK / ASK 0.5 – 40 kbps
  - FSK / GFSK 0.5 – 200 kbps
- Output Power
  - Up to +13 dBm
- Output Mode
  - Class-E Single-ended PA
- Tx current
  - 18 mA @ +13 dBm for CMT216x and CMT2189D
  - 24 mA @ +13 dBm for CMT2186A/87A



Tools Chain for TxSoC

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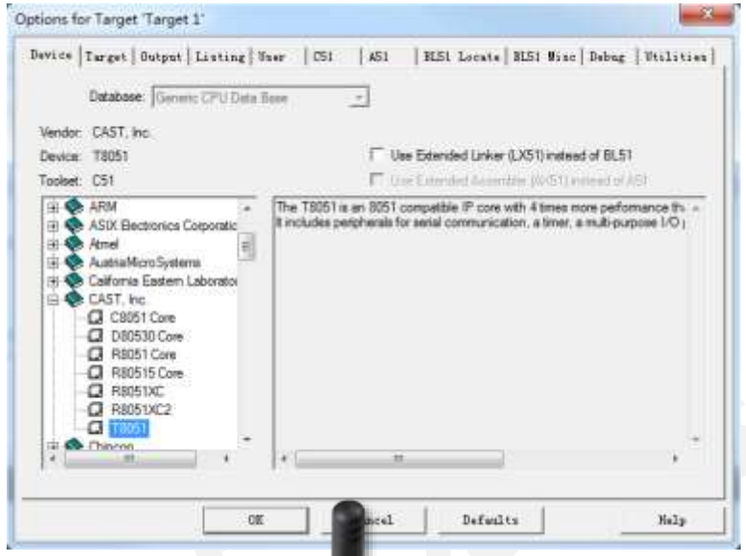
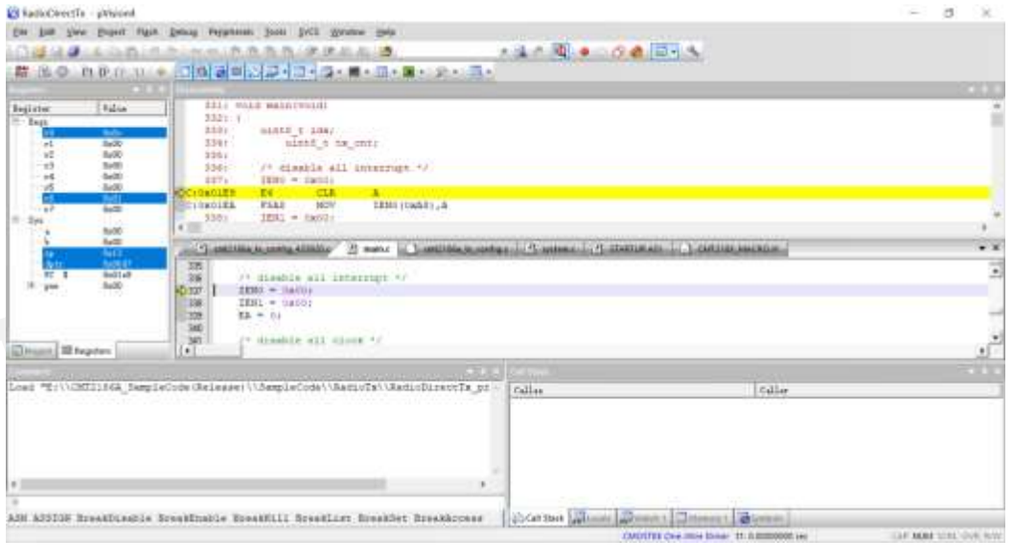
IDE: Keil C51, Keil2 or Keil4





Simulator for CMT2186A/87A

CMT2186A/87A

CMT2186A-EB

Simulator for CMT216xA/89D

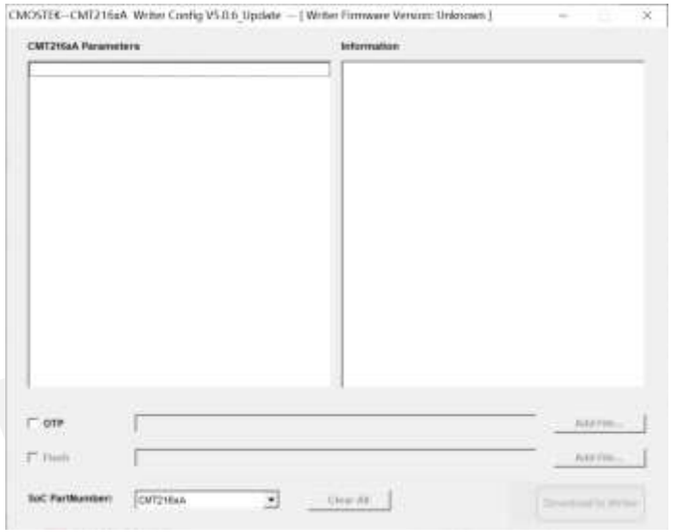
CMT2168A-EB

CMT2186A/87A

Tools Chain for TxSoC

TxSoC RFPDK

TxSoC Writer Config



TxSoC USB Programmer

DM Board, such as CMT2186A-DM

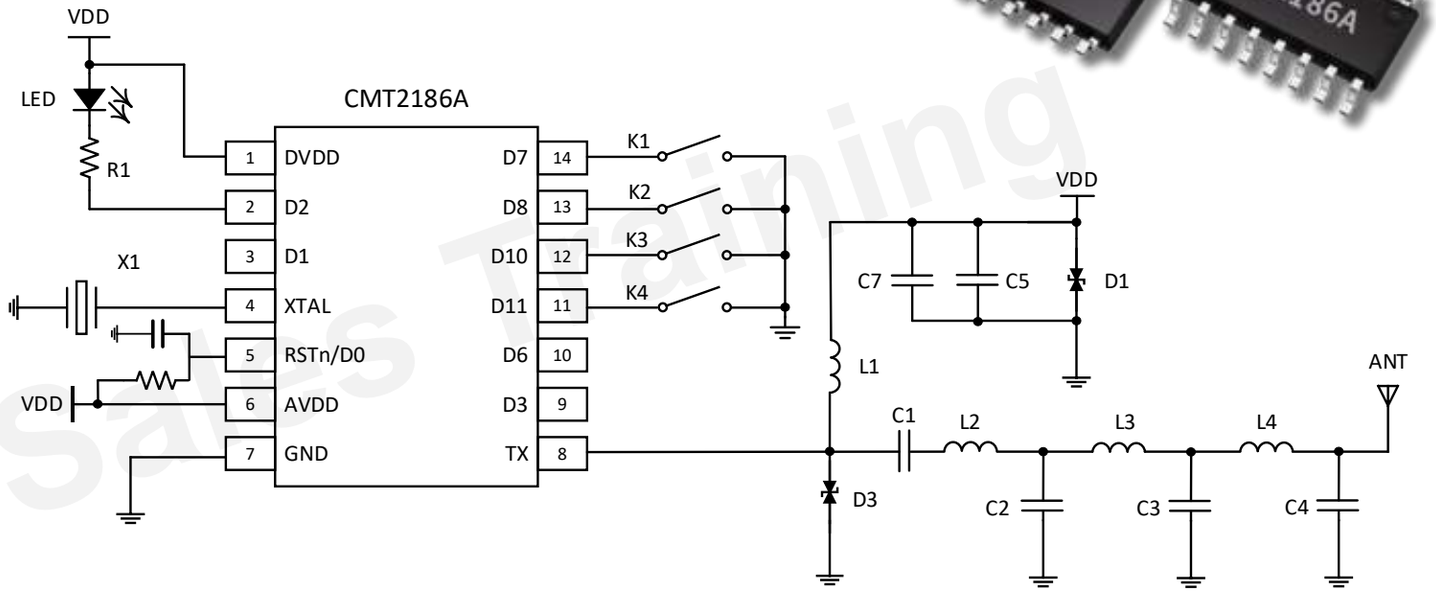
TxSoC Writer Config

Notice：TxSoC RFPDK、TxSoC Writer Config、TxSoC USB Programmer、 TxSoC Writer Config, all these tools are suitable for CMT2186A/87A, CMT216x & CMT2189D, but just not simulator.

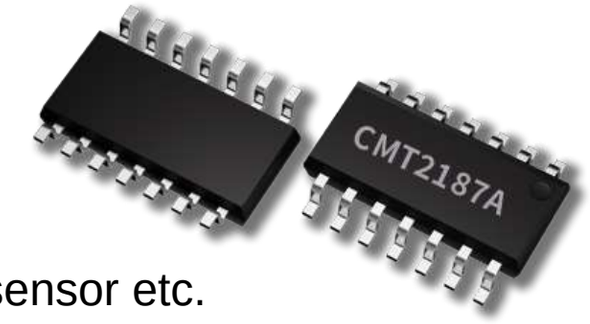
TxSoC Application

All kinds of remoter / opener / emitter

- 1527 Encoding Emitter
- Custom Encoding Emitter
- Remote Keyless Entry
- Garage Door Opener
- Security Alarm Emitter (SOS)
- Door / Window Contactor
- Curtain Motor Emitter
- Parking Lock Opener
- Pager Emitter
- Active RFID



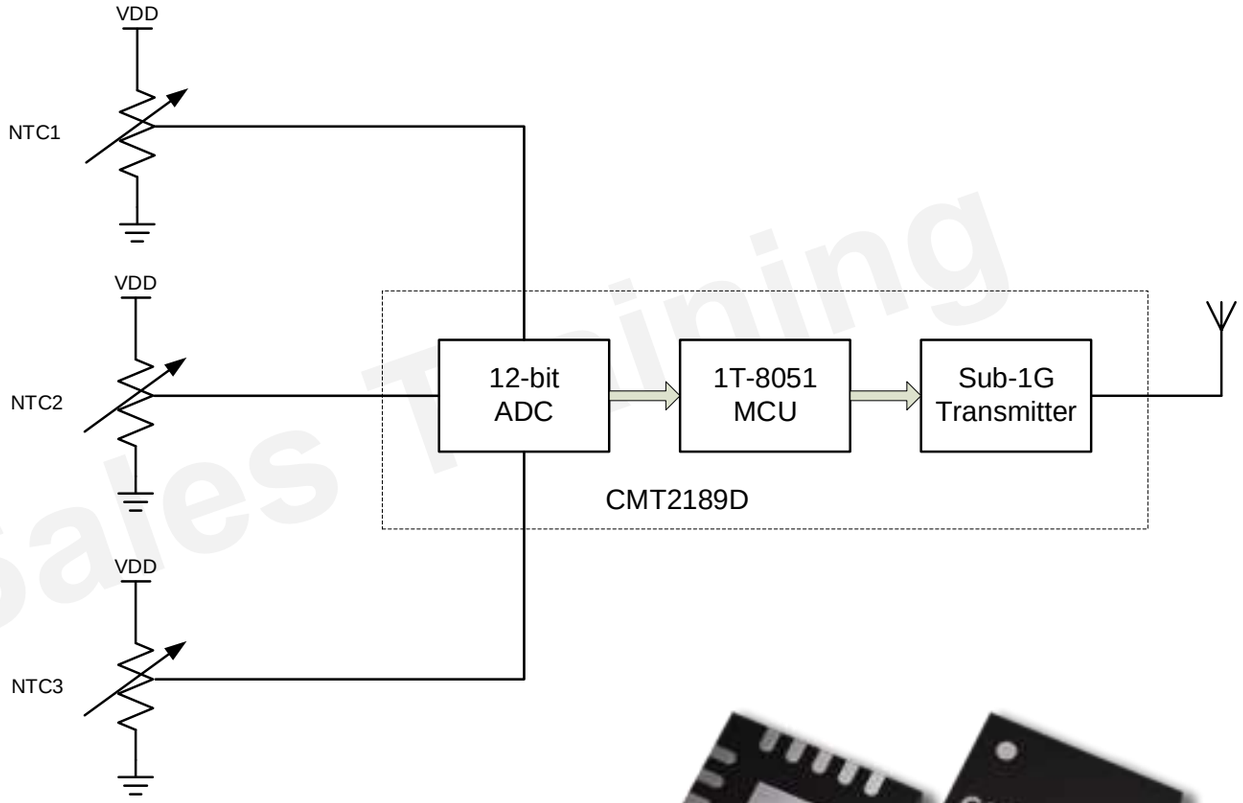
Recommended



- CMT2186A-ESR, suitable for OOK low cost application.
- CMT2187A-ESR, suitable for FSK low cost application, and simple request.
- CMT2189D-EQR, suitable for all kinds case, such as rolling code, work with sensor etc.

TxSoC Application

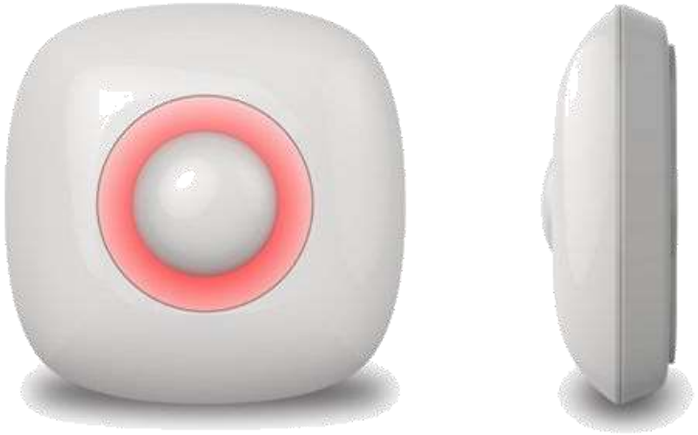
Wireless Meat Thermometer

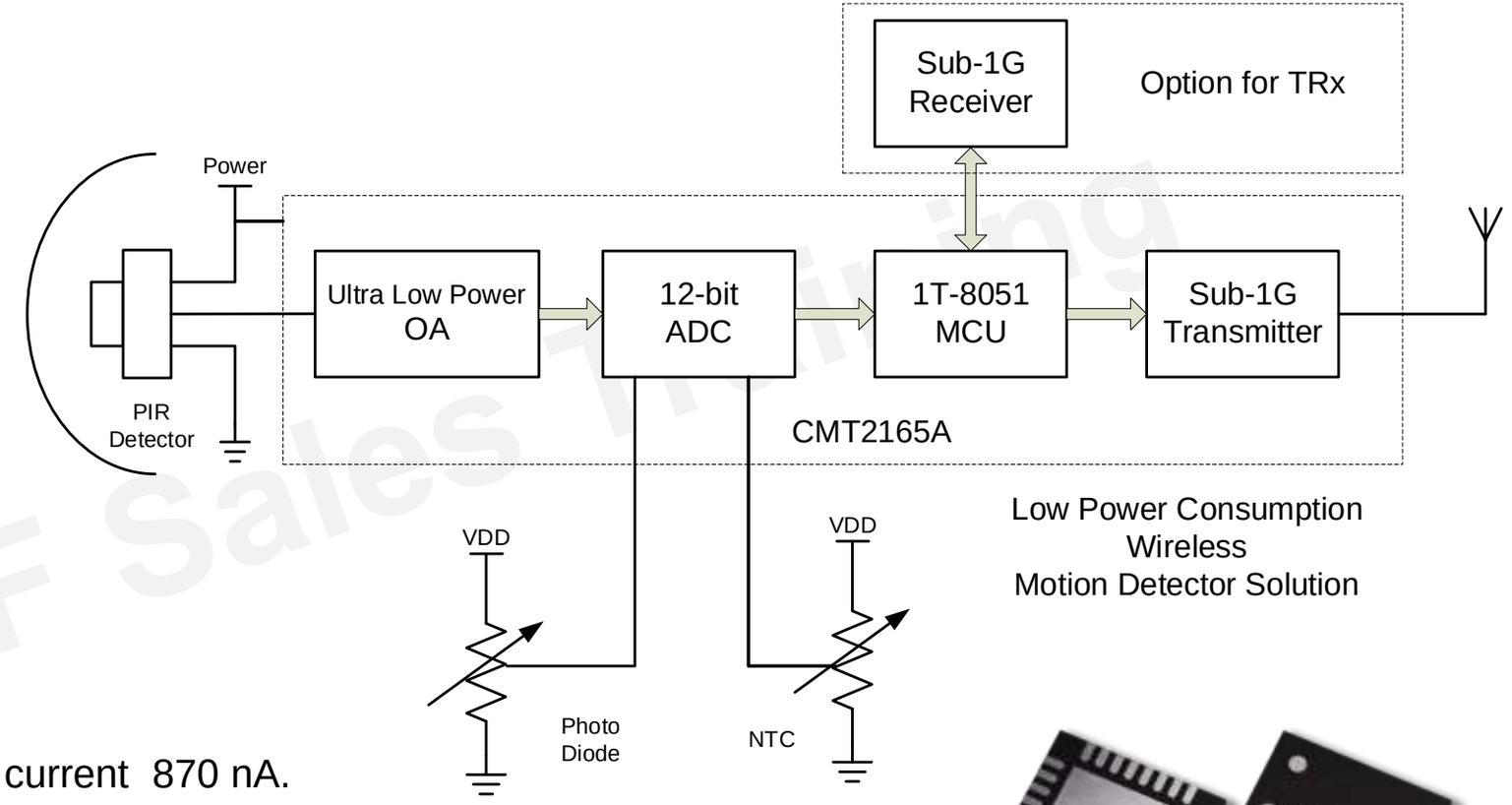


Recommended CMT2189D-EQR

- Transmitter SoC, with 1T-8051 core
- Built-in 12-bit ADC, with multi-channels
- Class-E High efficiency PA, +13dBm @ 20mA FSK
- Support auto-running for window detect (SNOOZE mode)
- Small size package, QFN20, 4x4mm

Motion Detector



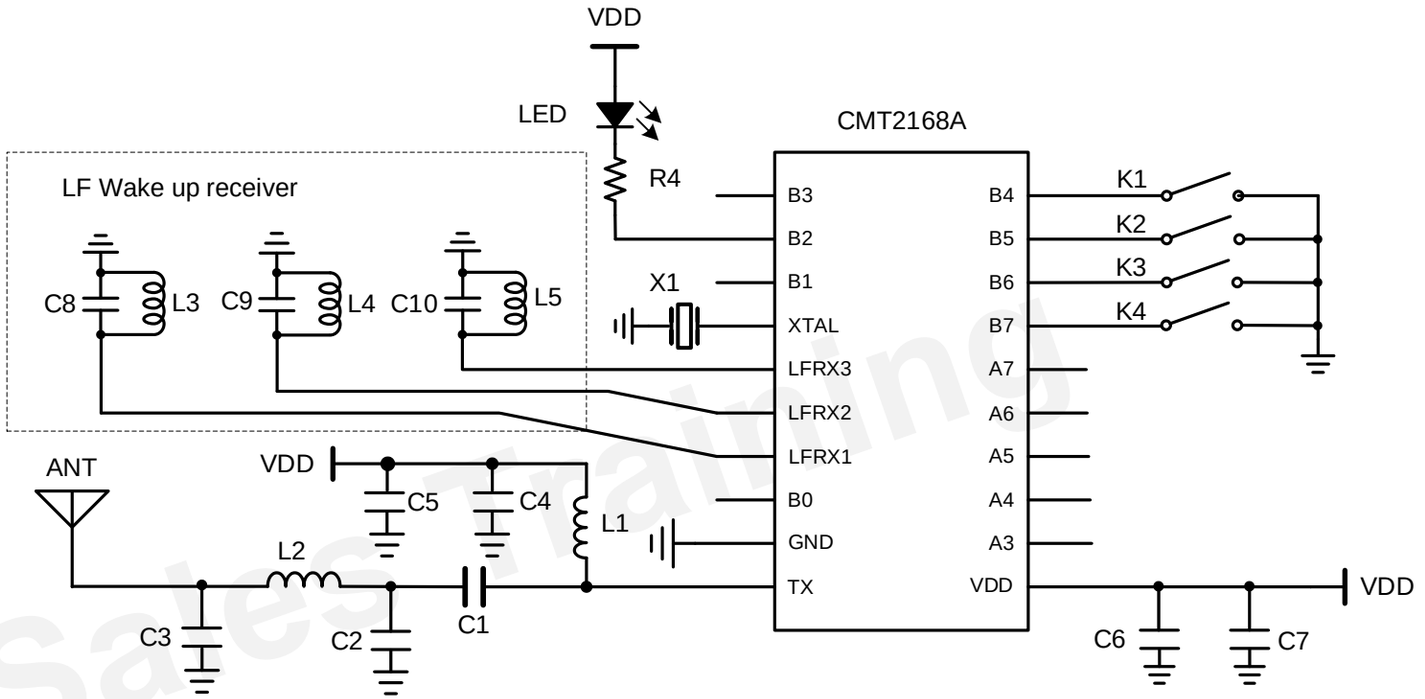


Recommended CMT2165A-EQR

- Built-in ultra low power OA, quiescent current 870 nA.
- Built-in 12-bit ADC.
- Support auto-running for window detect (SNOOZE mode)

TxSoC Application

Passive Keyless Entry



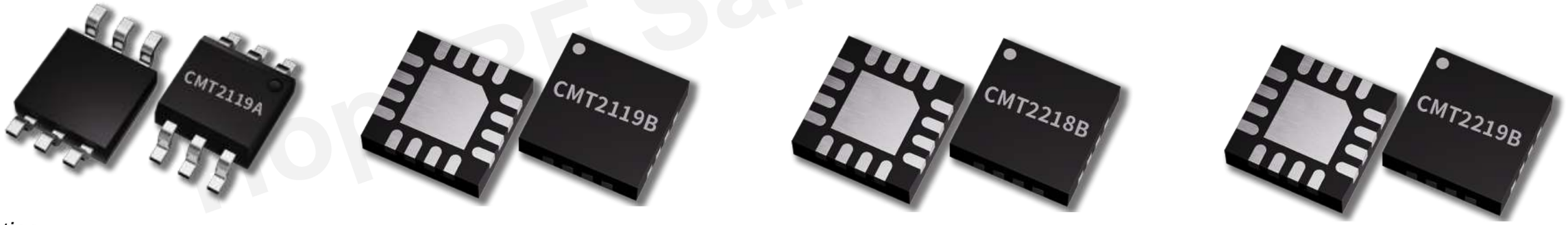
Recommended CMT2168A-EQR

- Built-in 125 kHz low frequency wake-up receiver
- Single chip solution for PKE (not include transponder)
- Low power for LF Wake-up mode : 5-6 uA with Duty-Cycle off
- When Duty-Cycle on in LF Wake-up mode : 2.0 to 4.6 uA
- Output power up to +13 dBm
- Frequency range covers 27 to 960 MHz

Main product list (for FSK Transmitter & Receiver, partial)

FSK Tx/Rx main product list

Part Number	Func.	Freq(MHz)	Link budget	Package	Remark	Pairing PN
CMT2119A-ESR	Tx	240-960	+13 dBm	SOT23-6	Standalone+Burn CFG Or TWI	CMT221x's e.g. CMT2218B CMT2219B
CMT2119B-EQR	Tx	127-1020	+20 dBm	QFN-16	3-wire SPI	
CMT2218B-EQR	Rx	127-1020	-120 dBm	QFN-16	Standalone+Burn CFG	CMT21xx's e.g. CMT2119A/B
CMT2219B-EQR	Rx	127-1020	-120 dBm	QFN-16	3-wire SPI	



Notice:

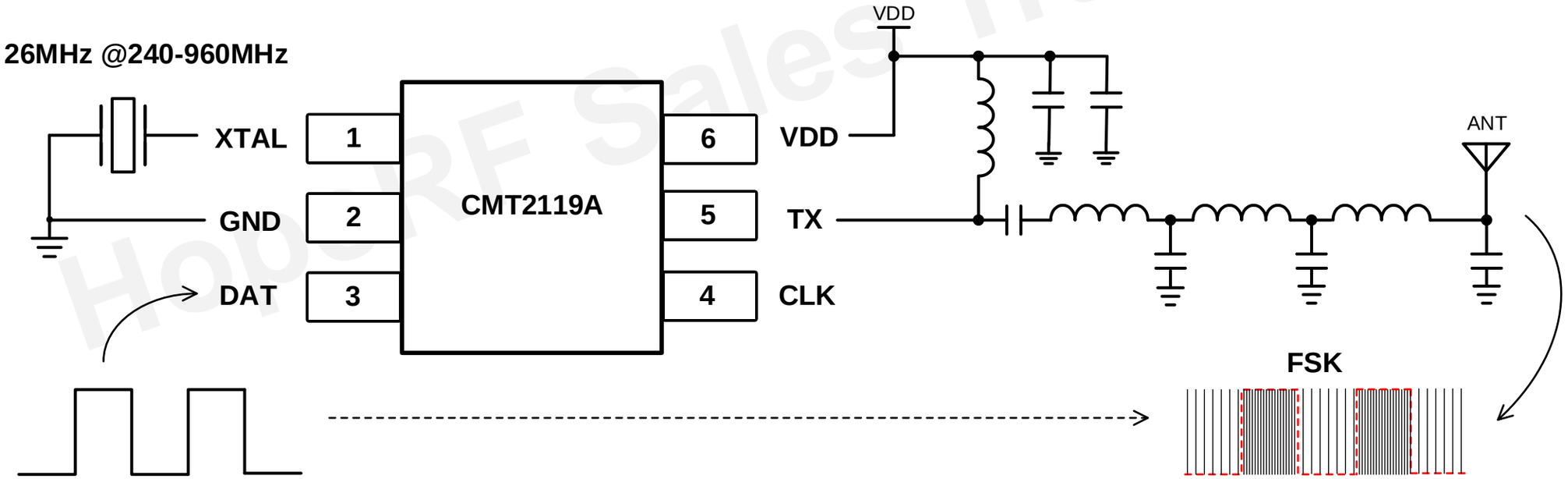
1. *TWI, two wire interface, using SDA & SCL pins to configurate.*
2. *Standalone for Rx's chip, working as 'Antenna in, Data out'.*
3. *Burn CFG, means that working parameters are burned through CMT's USB Programmer.*
4. *3-Wire SPI means that using CSB, SCL(serial data clock), and SDA(serial data in & out) for configuration. But when reading or wirting FIFO, it need to use FCSB, not CSB.*

CMT2119A FSK Transmitter

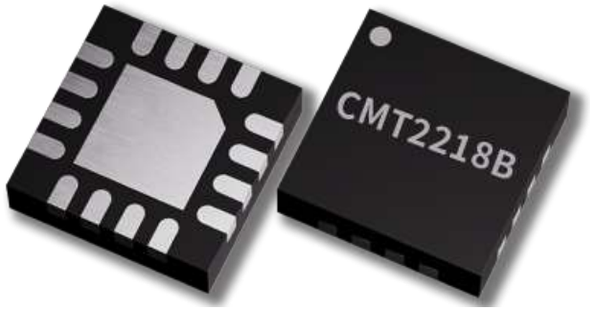
1. Easy to use, data in antenna out
2. Fractional-N frequency synthesizer, just one 26MHz crystal support 240-960MHz
3. Parameters programmable by RFPDK

Notice: pin to pin compatible to CMT2110A

SOT23-6

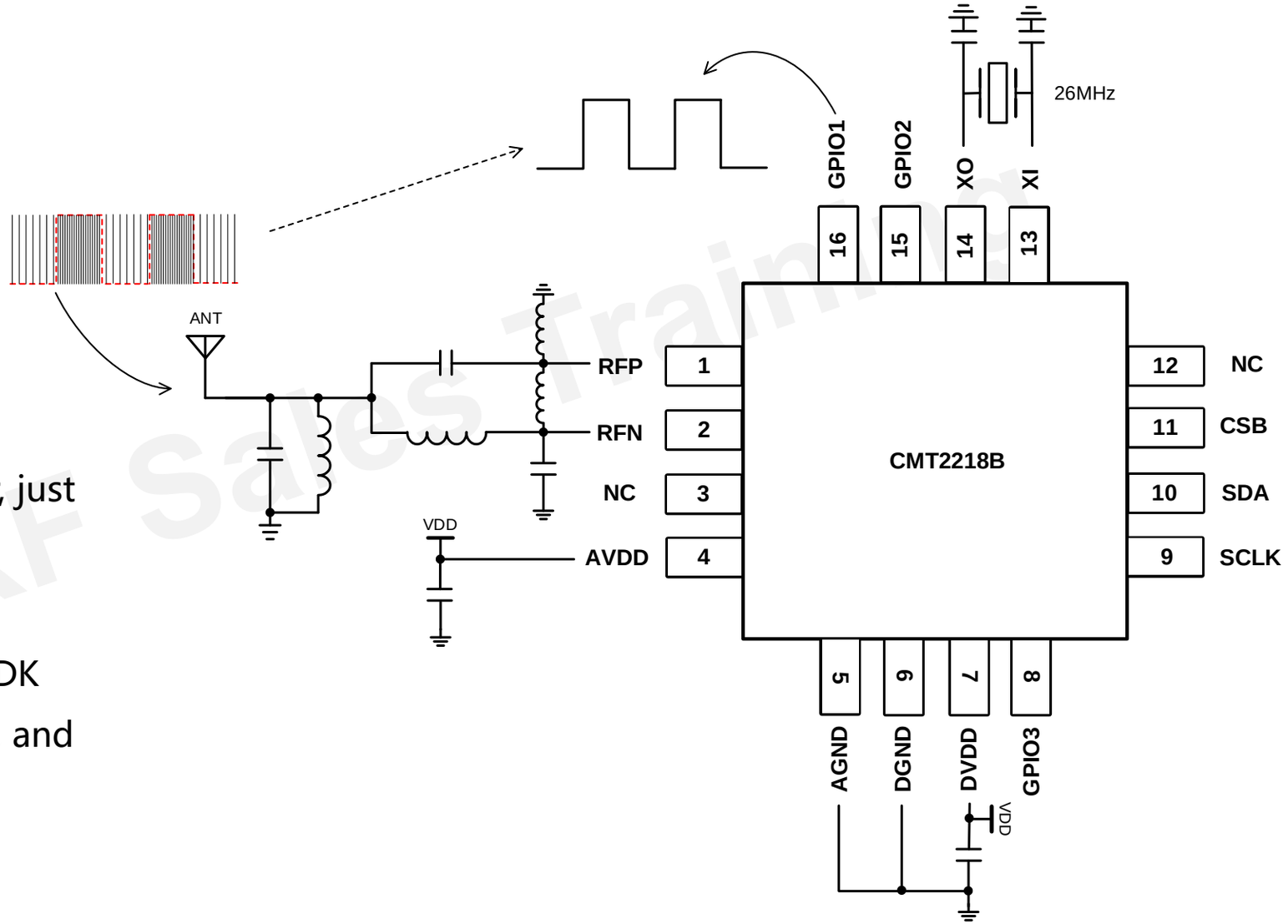


CMT2218B FSK Receiver



QFN-16

1. Easy to use, antenna in data out
2. Fractional-N frequency synthesizer, just one 26MHz crystal support 127-1020MHz
3. Parameters programmable by RFPDK
4. Support Duty-Cycle working mode, and auto-polling data out



FSK Transmitter & Receiver Application

Single-Way Car Alarm System

CMT2219B inside

Emitter CMT2119A inside

TPMS

Sensor CMT2119A inside

Displayer CMT2218B inside

Dog Training Collar

Collar CMT2219B inside

Emitter CMT2119B inside

Weather station

Displayer CMT2219B inside

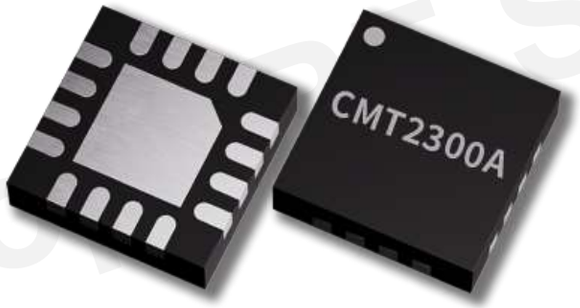
Sensor CMT2119B inside

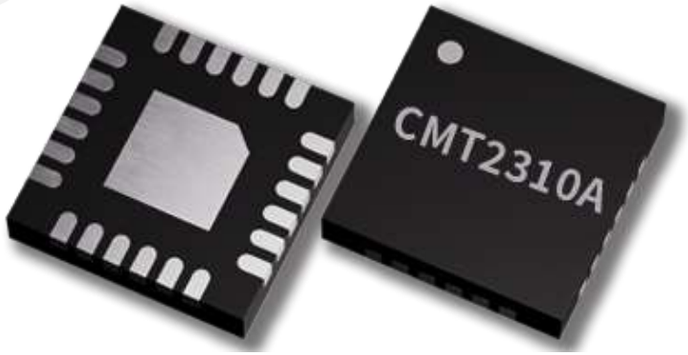
Main product list (partial)

HOPERF

TRx main product list

Part Number	Modem	Freq(MHz)	Link budget	Package	Remark	Pairing PN
CMT2300A-EQR	(G)FSK/OOK	127-1020	+20dBm / -120 dBm	QFN-16	3-wire SPI	Any
CMT2310A-EQR	(G)FSK/OOK	113-960	+20dBm / -122 dBm	QFN-24	4-wire SPI	

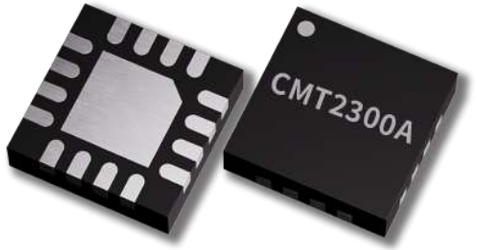




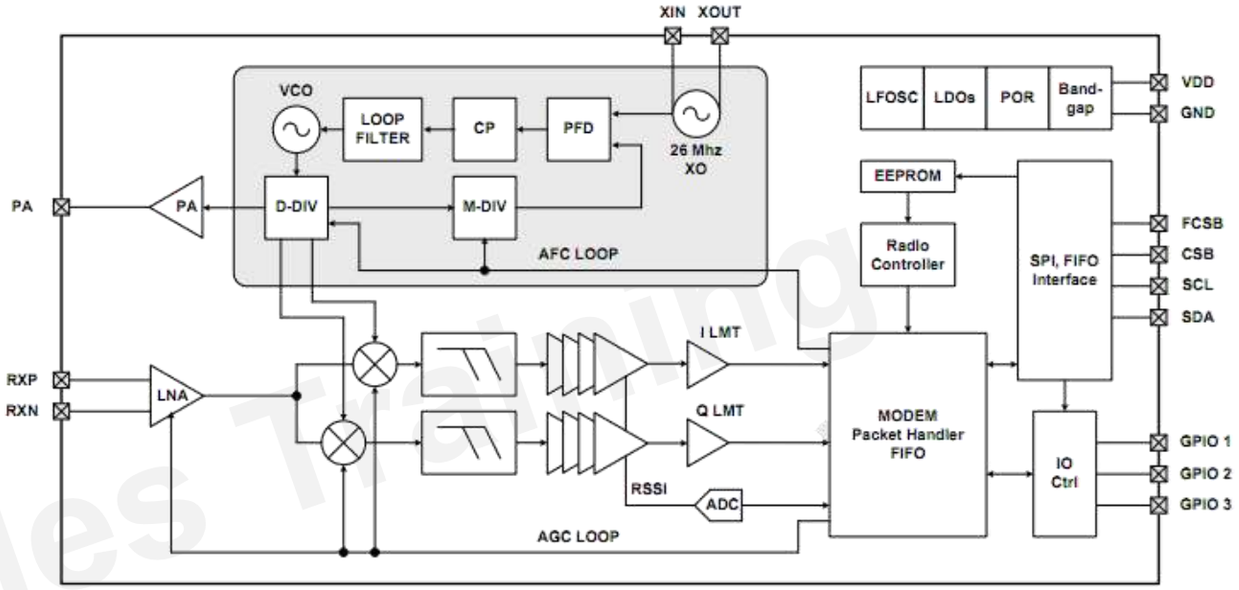
Notice:

1. *3-wire SPI means that using CSB, SCL(serial data clock), and SDA(serial data in & out) for configuration. But when reading or wirting FIFO, It need to use FCSB, not CSB.*
2. *4-wire SPI means that using CSB, SCLK(serial data clock), SDI(serial data input), SDO(serial data output) for configuration, both reading or writing FIFO.*

Introduction to CMT2300A



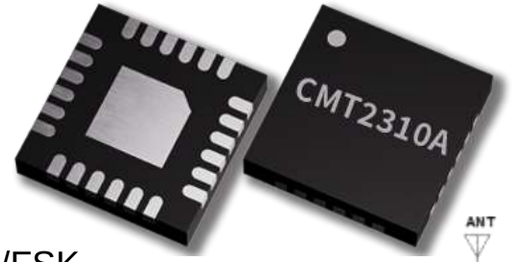
- Voltage: 1.8V ~ 3.6V
- Frequency: 127MHz ~ 1020MHz
- Modulation: OOK, G/FSK
- Symbol Rate: 0.5kbps ~ 300kbps @ G/FSK
- Sensitivity : -121dBm @2kbps, 433.92MHz, Dev=±10kHz
  -111dBm @50kbps, 433.92MHz, Dev=±25kHz
- ACR-I: 30dB, BW=100kHz, Channel space=200kHz
- Blocking: 70dB, ±1MHz offset, BW=100kHz
- Tx Current: 23mA @+13dBm, 433.92MHz, FSK
  72mA @+20dBm, 433.92MHz, FSK
- Rx Current: 8.5mA @433.92MHz, FSK,
- Sleep Current: 300nA @Deep Sleep
  800nA @Duty Cycle On
- FIFO Buffer Size: 64 Bytes
- Interface: 3-SPI with 2 select pin
- Package: QFN-16, 3 x 3 x 0.75mm



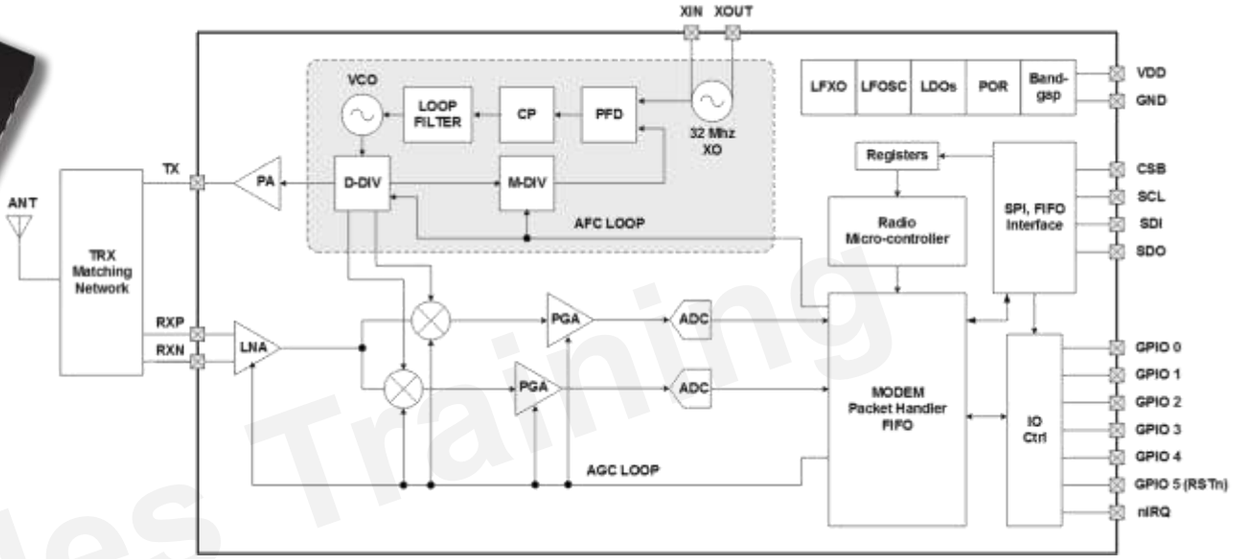
Application

- Wireless Metering and Wireless Smart Grid(AMR and AMI)
- Home and Building Automation
- Industrial Monitoring and Control
- Wireless Alarm and Security Systems
- Wireless Sensor Networks and Active RFID

Introduction to CMT2310A



- Voltage: 1.8V ~ 3.6V
- Frequency: 113MHz ~ 960MHz
- Modulation: OOK, 2-G/FSK, 4-G/FSK
- Symbol Rate: 0.5kbps ~ 500kbps @ 2-G/FSK
  1kbps ~ 1Mbps @4-G/FSK
- Sensitivity: -126dBm @500bps, 433.92MHz, Dev=±250Hz
  -120dBm @2.4kbps, 433.92MHz, Dev=±1.2kHz
  -97dBm @500kbps, 433.92MHz, Dev=±150kHz
- ACR-I: 60dB, BW=5.4kHz, Channel space=12.5kHz
- Blocking: 77dBc, ±1MHz offset, BW=5.4kHz
- Tx Current: 30mA @+13dBm, 433.92MHz, FSK
  82mA @+20dBm, 433.92MHz, FSK
- Rx Current: 9.6mA @433.92MHz, FSK, DC-DC mode
- Sleep Current: 400nA @Deep Sleep
  800nA @Duty Cycle On
- FIFO Buffer Size: 256 Bytes
- Interface: 4-SPI
- Package: QFN-24, 4x4x0.75mm



Application

- Wireless Metering and Wireless Smart Grid(AMR and AMI)
- LPWAN
- Home and Building Automation
- Industrial Monitoring and Control
- Wireless Alarm and Security Systems
- Wireless Sensor Networks and Active RFID
- IEEE 802.15.4g Systems @ Sub-1G
- Wi-SUN

TRx Evaluation Kit

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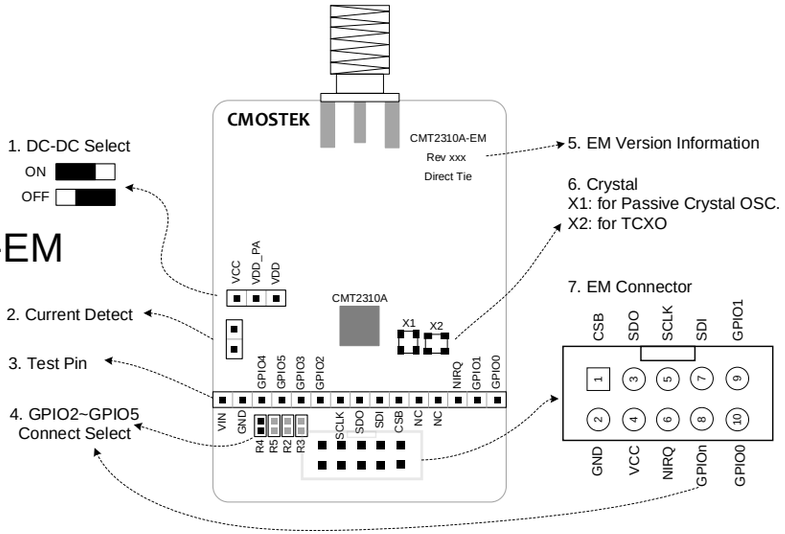
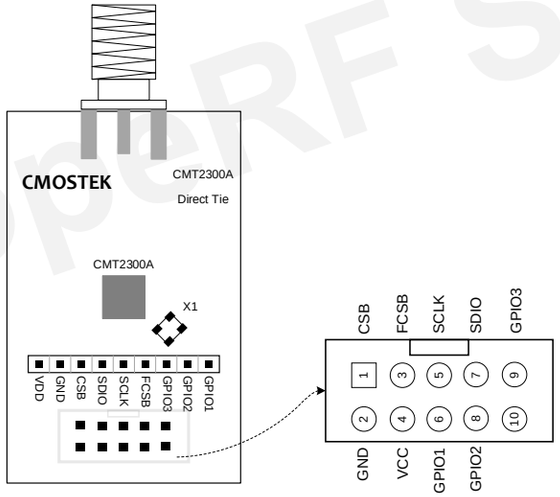
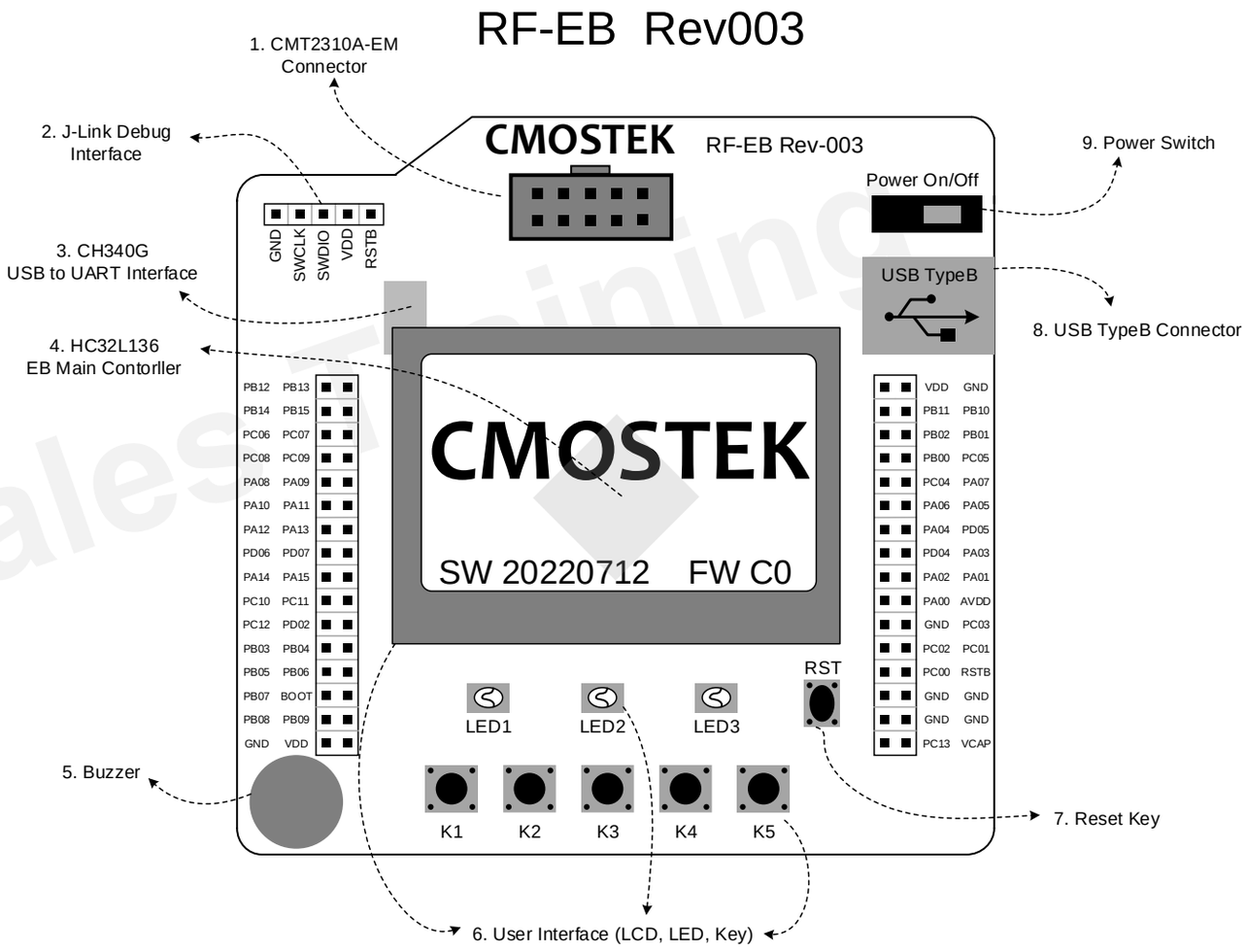
CMT2310A-EM



CMT2300A-EM

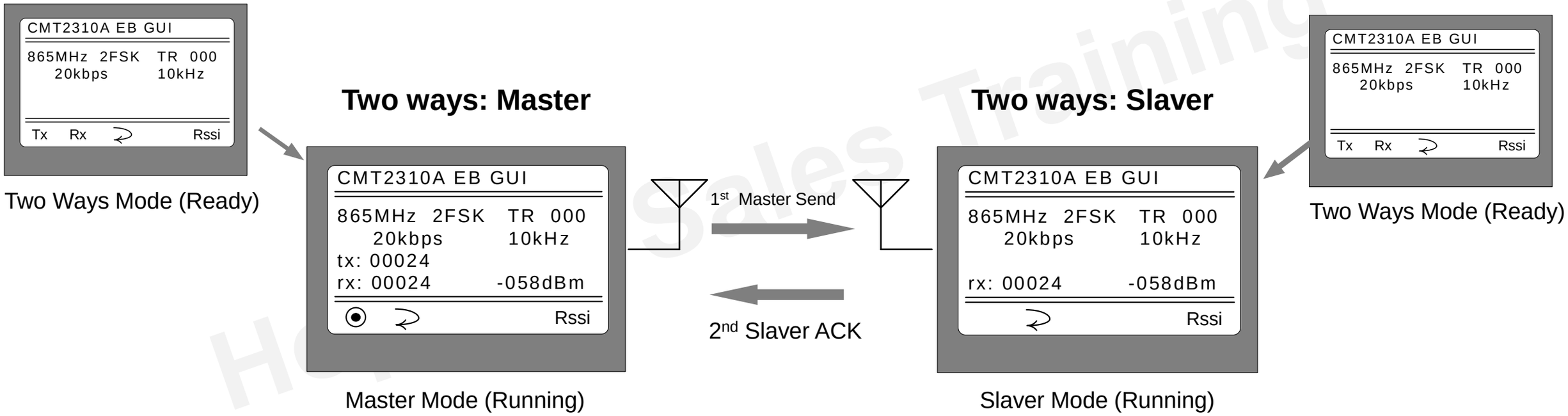


RF-EB Rev003



Note: For more detail, please refer to the AN241

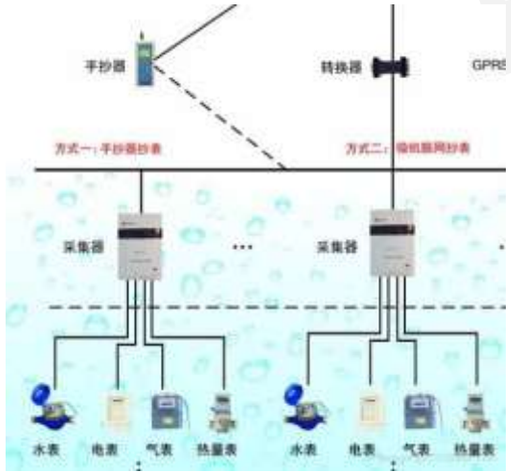
Two ways link budget test



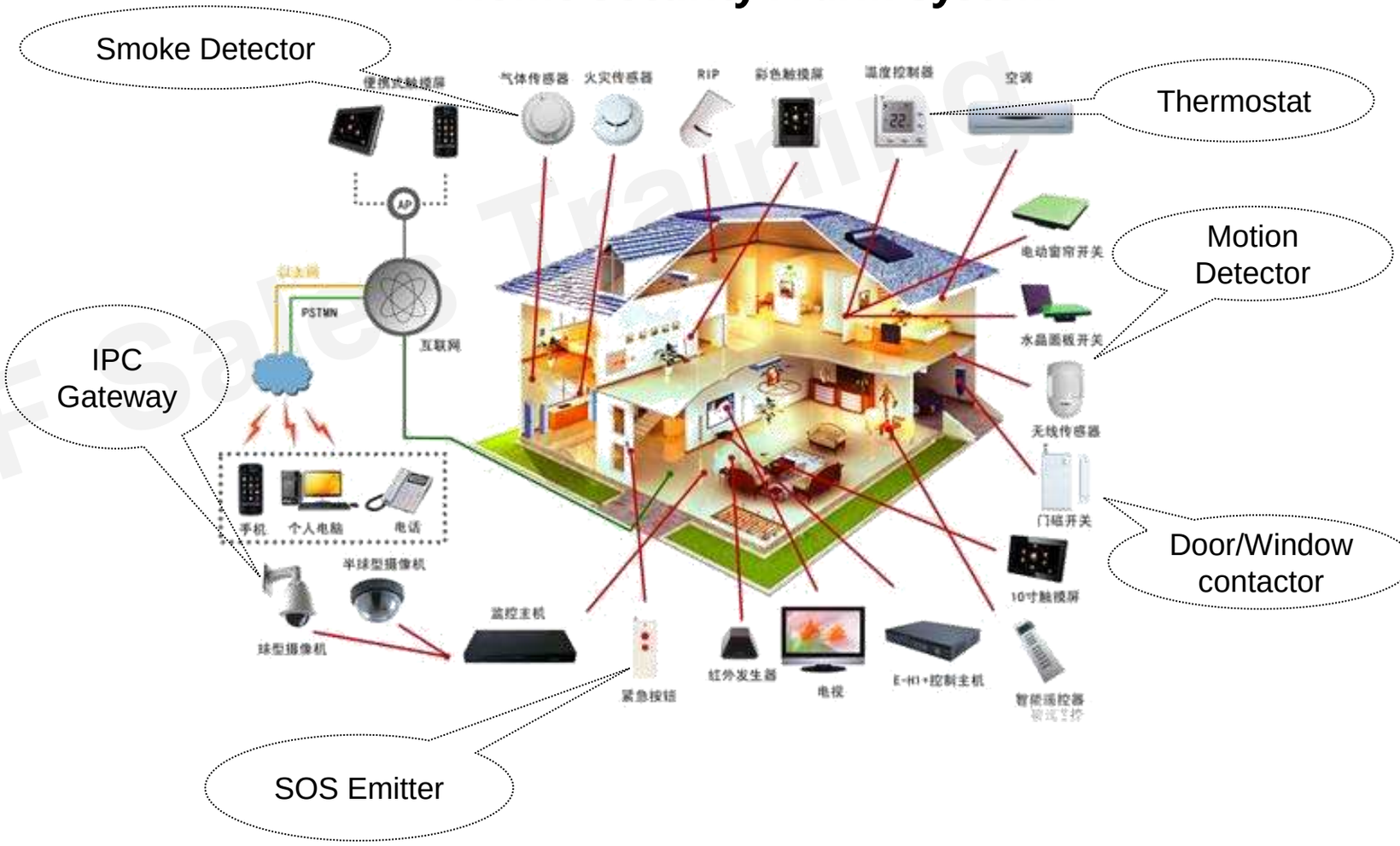
TRx Application

Two-Way Car Alarm System

Smart Grid



Home Security Alarm System

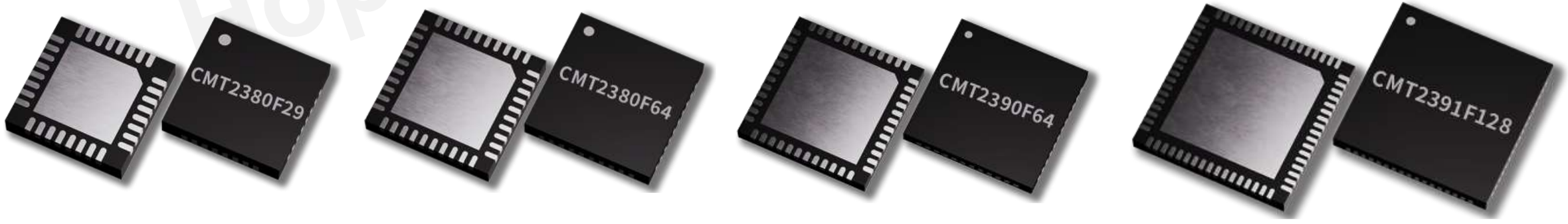


Main product list (partial)

HOPERF®

TRx SoC main product list

Part Number	RF Core	Freq(MHz)	Link budget	Package	Remark	Pairing PN
CMT2380F29-EQR	CMT2300A	127-1020	+20dBm / -122 dBm	QFN-32	Cortex M0, 29kB Flash, ADC up to 18 GPIOs	Any
CMT2380F64-EQR	CMT2300A	127-1020	+20dBm / -122 dBm	QFN-40/48	Cortex M0, 64kB Flash, ADC up to 23/29 GPIOs	
CMT2390F64-EQR	CMT2310A	113-960	+20dBm / -122 dBm	QFN-48	Cortex M0, 64kB Flash, ADC up to 23 GPIOs	
CMT2391F128-EQR	CMT2310A	113-960	+20dBm / -122 dBm	QFN-68	Cortex M4, 128kB Flash, ADC up to 44 GPIOs	
CMT2392F512-EQR	CMT2310A	113-960	+20dBm / -122 dBm	QFN-68	Cortex M4, 512kB Flash, ADC With up to 36 GPIOs	



TRx SoC

HOPERF

CMT2380F64-EQR, QFN40

CMT2380F64-EQR48, QFN48

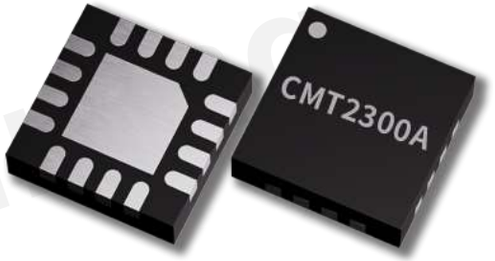
MCU Core

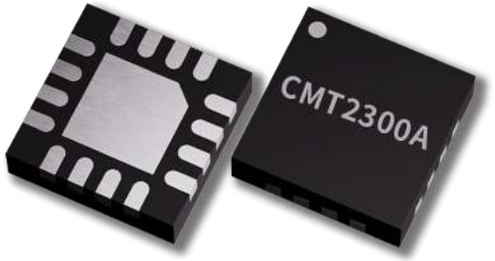
Cortex M0

64kB Flash

Up to 48MHz

RF Core





TRx SoC

HOPERF

CMT2390F64-EQR, QFN48

CMT2391F128-EQR, QFN68

MCU Core

Cortex M0

64kB Flash

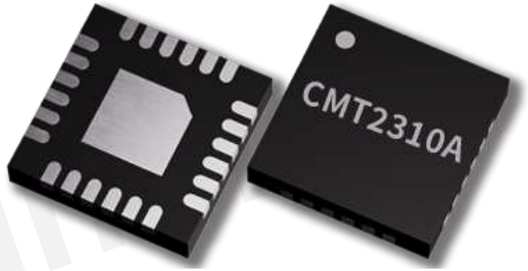
Up to 48MHz

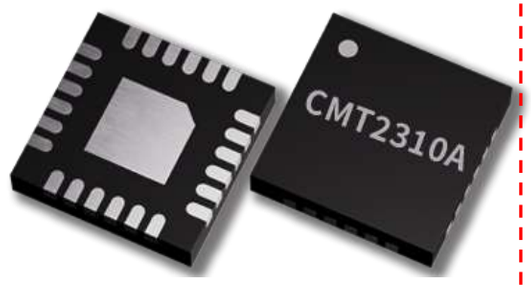
Cortex M4F

128kB Flash

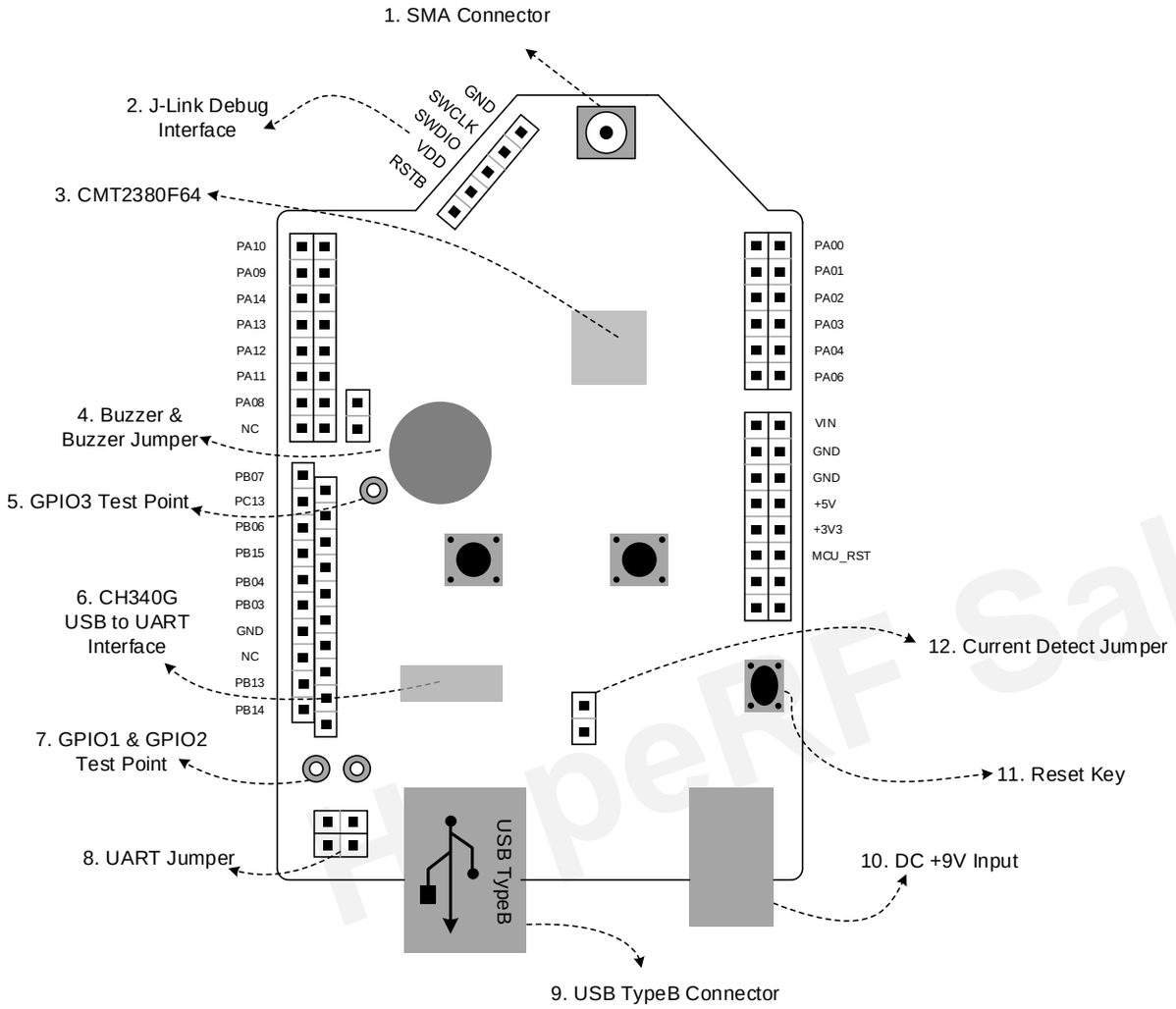
Up to 48MHz

RF Core

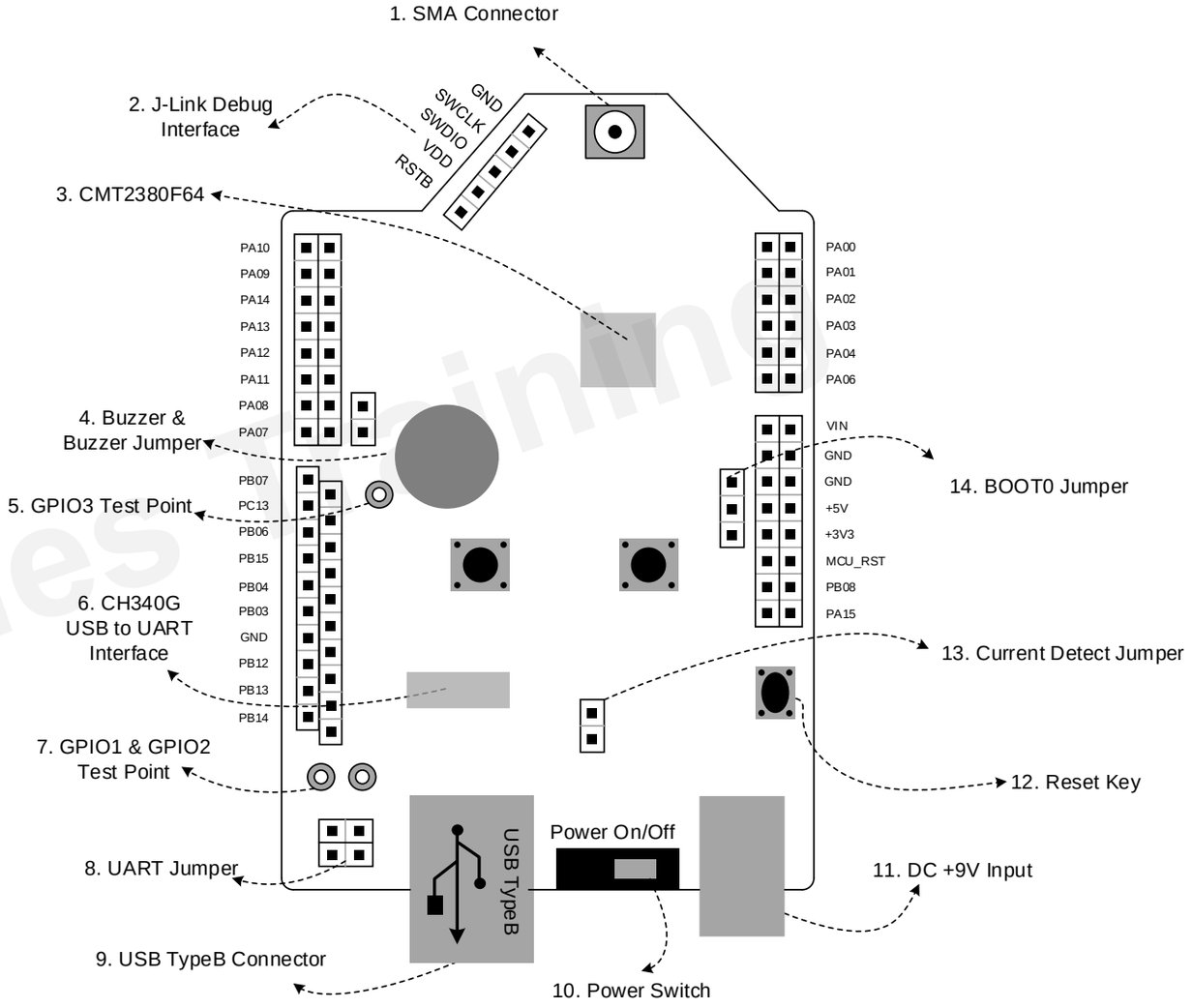




TRx SoC Evaluation Kit



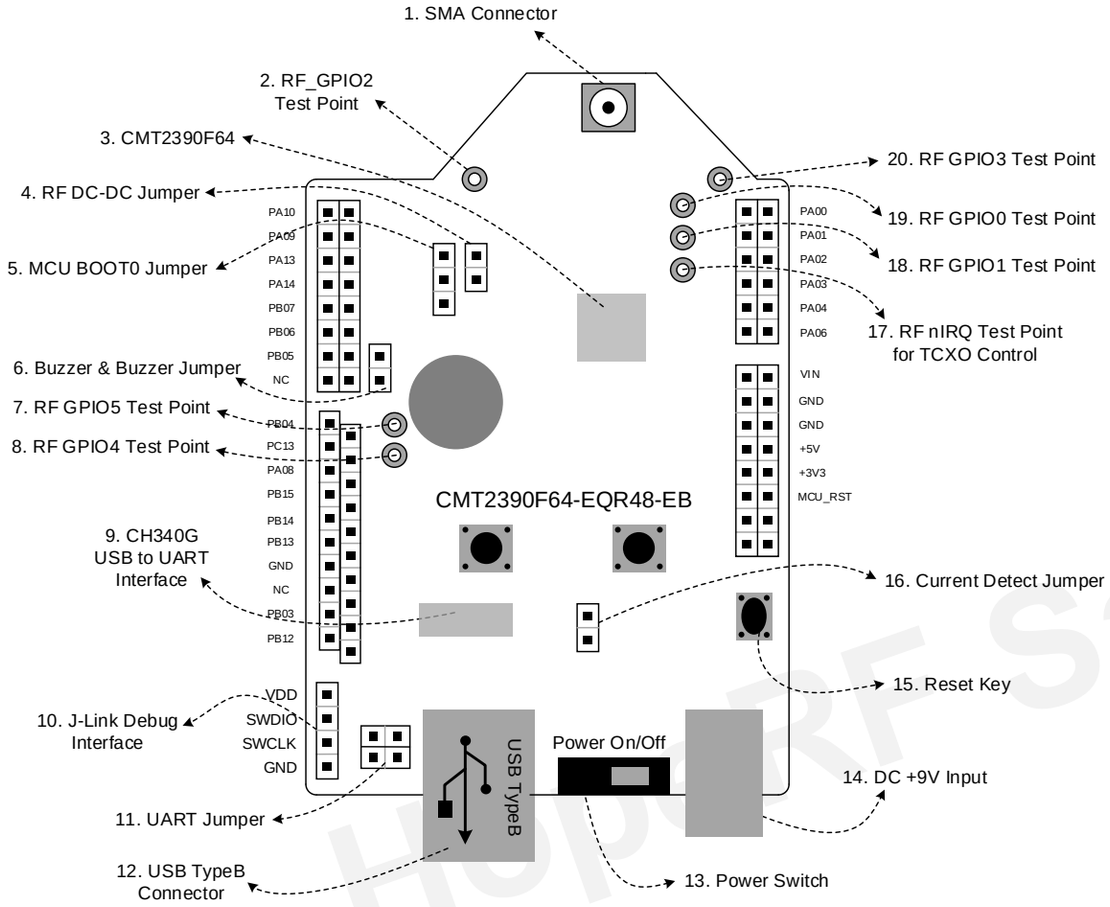
CMT2380F64-EQR-EB



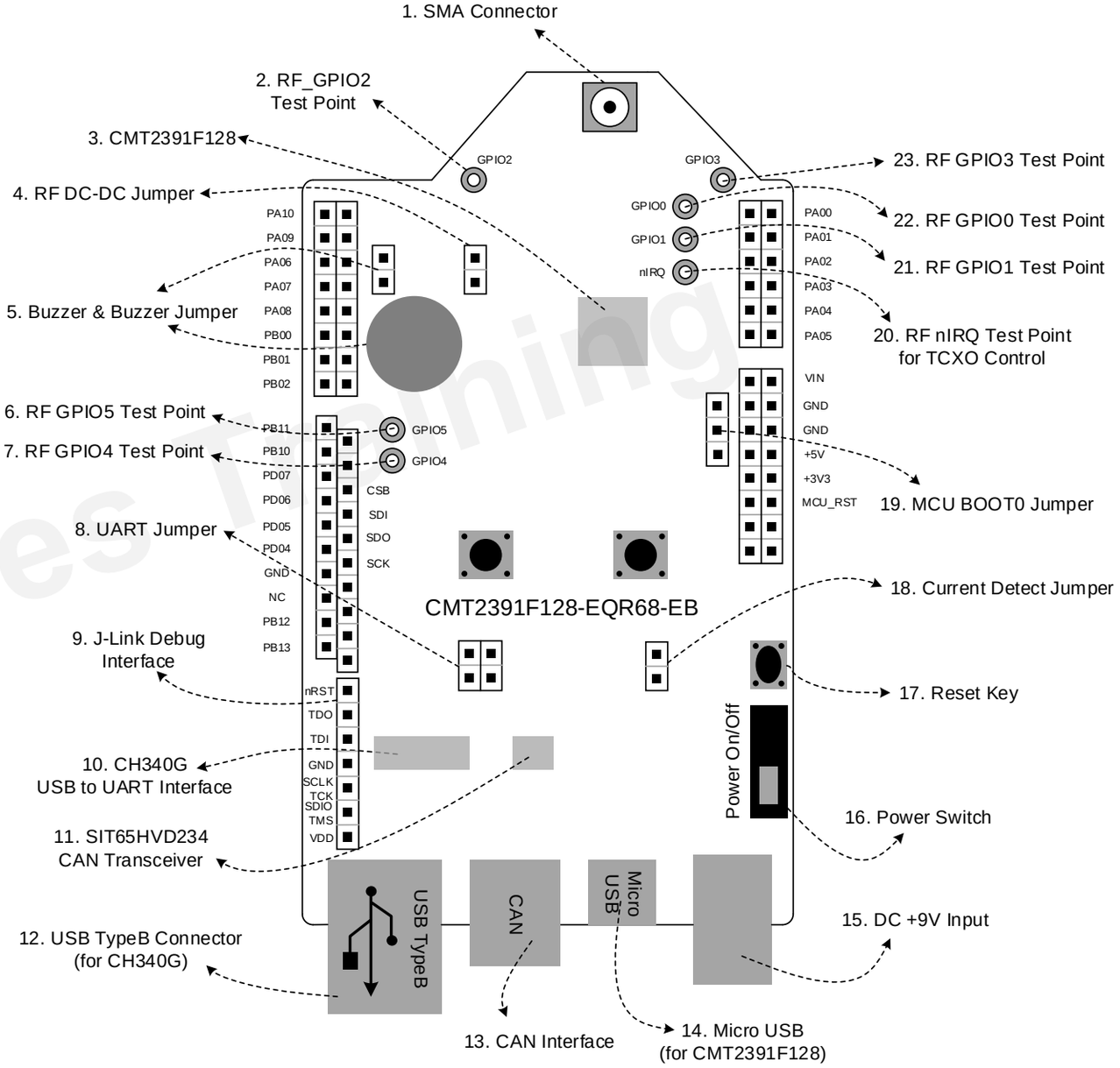
CMT2380F64-EQR48-EB

Note: For more detail, please refer to the AN191

TRx SoC Evaluation Kit



CMT2390F64-EB



CMT2391F128-EB

Note: For more detail, please refer to the AN247

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