CMOSTEK

AN132

CMT2180A Configuration Guideline

Introduction

The purpose of this document is to provide the guidelines for the users to configure the CMT2180A on the RFPDK. The part number covered by this document is shown in the table below.

Table 1. Part Number Covered in this Document

Part Number	Description
CMT2180A	Fully integrated, highly flexible, high performance, SoC OOK transmitter with an embedded RISC microcontroller for various 240 to 480 MHz wireless applications. It is part of the CMOSTEK NextGenRF™ family, which includes a complete line of transmitters, receivers and transceivers.

The RFPDK (Radio Frequency Products Development Kit) is a PC application developed by CMOSTEK for the NextGenRF™ product line. Differing from traditional RF chip configuration methods, which usually require complex software programming and register-based controlling, the RFPKD revolutionarily simplifies the NextGenRF™ product configurations. The user can easily complete the product configuration by just clicking and inputting a few parameters. After that, the product can be directly used in the RF system without performing any further configurations.

To help the user develop their application with CMT2180A easily, CMOSTEK provides **CMT2180A Development Kits** that enables the user to quickly evaluate the performance; demonstrate the features and develop the application. The Development Kits includes the below items.

- RFPDK
- USB Programmer
- CMT2180A-EM-D (CMT2180A evaluation module with differential PA output)
- CMT2180A-EM-S (CMT2180A evaluation module with single-ended PA output)

Table of Contents

1. Getting Started

Install the RFPDK on the PC. The details of the installation can be found in Section 7.1 of “AN103 CMT2110A/2210A One-Way RF Link Development Kits User’s Guide”.

Setup the Development Kits as shown in the figure below before configuring the CMT2180A. The application with CMT2180A can be CMT2180A-EM-S(-D) V1.0 provided by CMOSTEK, PCB designed by the user with CMT2180A.

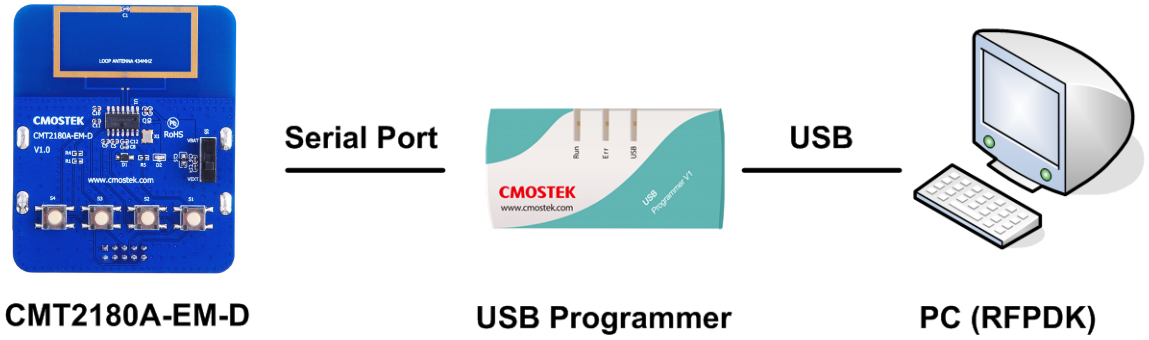

Figure 1. CMT2180A Configuration Setup

Please note that the USB programmer firmware update (Firmware version = 002) is required in order to programming the CMT2180A correctly.

Start the RFPDK from the computer’s desktop and select CMT2180A in the Device Selection Panel shown in the figure below. Once a device is selected, the Device Control Panel appears as shown in Figure 3. Because the Advanced Mode covers all the configurable features / parameters while the Basic Mode only contains a subset, the Advanced Mode is described in this document.

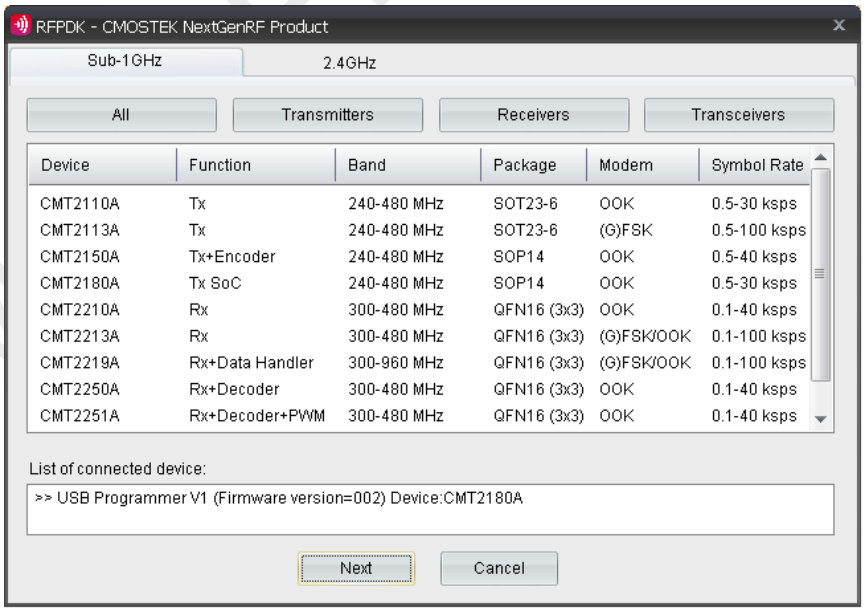

Figure 2. Device Selection Panel

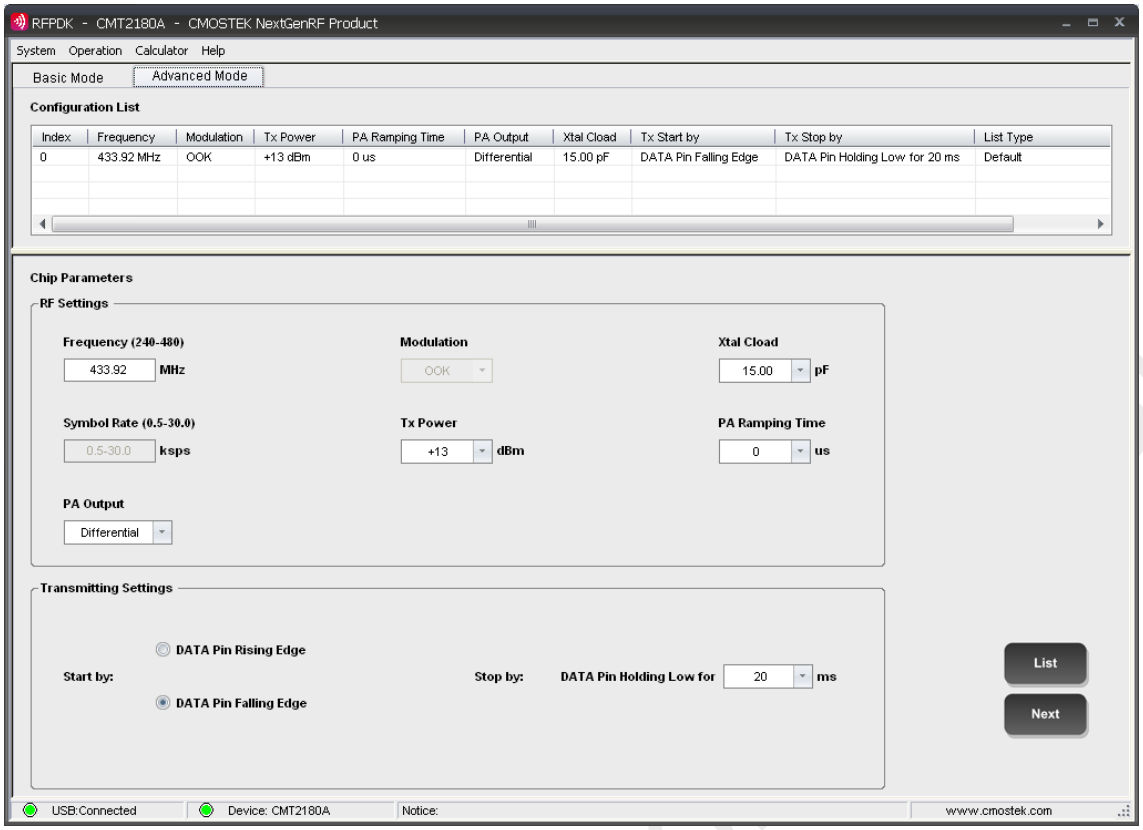

Figure 3. Advanced Mode of Device Control Panel

Table 2. Configurable Parameters of the RF Section

Category	Parameters	Descriptions	Default	Mode
RF Settings	Frequency	To input a desired transmitting radio frequency in the range from 240 to 480 MHz.	433.92 MHz	Basic Advanced
	Tx Power	To select a proper transmitting output power from -10 dBm to +14 dBm, 1 dB margin is given above +13 dBm.	+13 dBm	Basic Advanced
	Xtal Cload	On-chip XOSC load capacitance options: from 10 to 22 pF.	15 pF	Basic Advanced
	PA Ramping	To control PA output power ramp up/down time, options are 0 and 2^n us (n from 0 to 10).	0 us	Advanced
	PA Output	To select the PA output mode, the option is Single-ended or Differential.	Differential	Basic Advanced
Transmitting Settings	Start by	Start condition of a transmitting cycle, by Data Pin Rising/Falling Edge.	Data Pin Falling Edge	Advanced
	Stop by	Stop condition of a transmitting cycle, by Data Pin Holding Low for 20 to 90 ms.	Data Pin Holding Low for 20 ms	Advanced

Please note that the figure above shows the configurable parameter of the CMT2180A RF section, after finish the setting of the RF section, the user can click the Next Button on the bottom right corner to enter the microcontroller setting panel, as shown in the figure below.

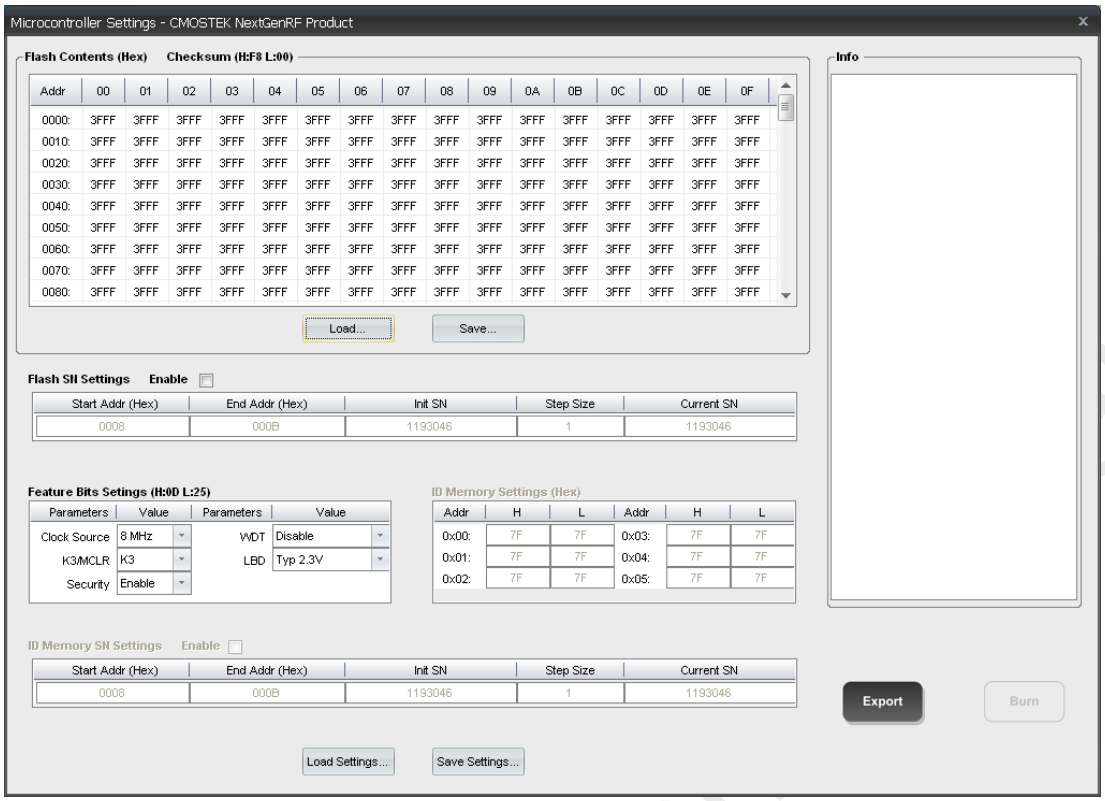

Figure 4. CMT2180A Microcontroller Settings Panel

Table 3. Configurable Parameters of the Microcontroller Section

Category	Parameters	Descriptions	Default
Flash SN Settings	Start Addr (Hex)	Defines the starting address of a consecutive address space in the Flash to store the series number.	0008
	End Addr (Hex)	Defines the ending address to store the series number to the Flash.	000B
	Init SN	Defines the initial SN value (in Dec), this value will be stored in the Flash with address defined from Start Addr (Hex) to End Addr (Hex).	1193046
	Step Size	Defines the incremental step size of the SN value, it can be a positive integer or zero.	1
	Current SN	Displays the next SN value to be burned into the device in the next burning operation.	1193046
Feature Bits	Clock Source	To select the internal clock source for the microcontroller, the options are: Blank, 8 MHz and 32 kHz.	8 MHz
	WDT	To enable or disable the watchdog timer, the options are Blank, Enable or Disable.	Disable
	K3/MCLR	To configure the K3 pin as Master Clear (MCLR) or push button key.	K3
	LBD	Defines the battery low threshold, the options are: Blank, Disable and Typ 2.3V.	Typ 2.3V
	Security	To enable or disable the code protection. When it is enabled, the readouts of bit11-7, bit4-0 in each word are fixed at 1. The options are Disable or Enable.	Enable
ID Memory Settings	-	This is a 12 x 7-bit ID area in the microcontroller section that allows the user to store any data.	-

Besides the configurable parameter shown in the table above, there are also a few read only information area in the panel, including the flash contents, checksum result and the Info zone. See Chapter 4 for the detail of the read only information.

After both settings for RF and Microcontroller sections are properly configured, the user can click the Burn button to program the configuration application to the CMT2180A.

2. RF Settings

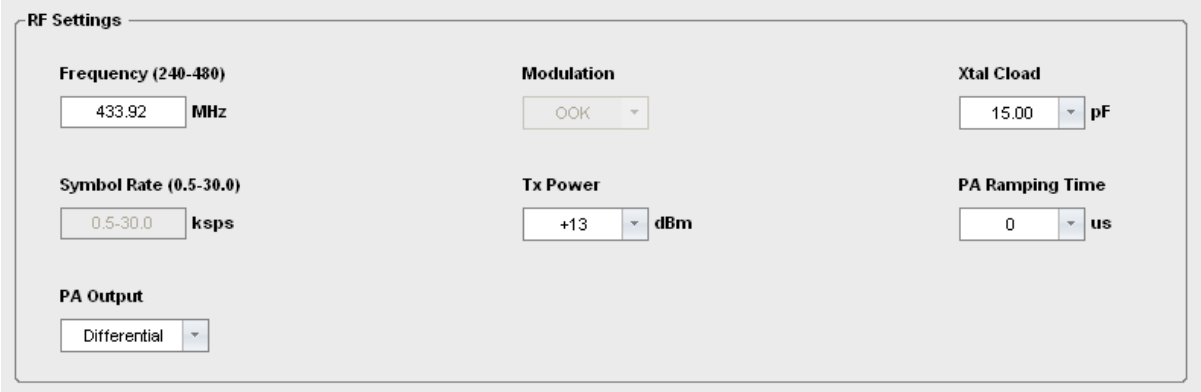

Figure 5. CMT2180A RF Settings

5 parameters can be configured for CMT2180A, as shown in the figure above. And the configuration range is shown in the table below.

Table 4. CMT2180A RF Settings

Parameters	Symbol	Min	Max	Step Size	Unit
Frequency[1]	F_{RF}	240	480	0.01	MHz
Tx Power[2]	P_{OUT}	-10	+14	1	dBm
PA Output	-	Single-ended or Differential		-	-
PA Ramping Time	-	0	1024	2^n	us
Xtal Load[3]	C_{LOAD}	10	22	0.33	pF

Notes:

[1]. CMT2180A RF frequency resolution is better than 198 Hz.

[2]. Proper PA matching network is required, see "AN131 CMT2180A Schematic and PCB Layout Design Guideline" for details of recommended matching network.

[3]. Recommended Xtal load capacitance is 12 to 20 pF. 2 pF margin is given in both ends in order to ensure the recommended load capacitance can be covered.

2.1 Frequency

The Frequency can be continuously configured from 240 to 480 MHz accurate to two decimal places.

2.2 PA Output and Tx Power

The CMT2180A supports single-ended or differential PA output. When the CMT2180A is configured in Single-ended output, it supports Tx Power from -10 to +14 dBm in 1 dBm step size with proper matching network designed. The actual output power could be slightly different due to the user's PCB layout and the components used for matching network differing from CMOSTEK's recommendations. Therefore, the user should select the proper value from the Tx Power pull down menu to meet the system output power requirement according the actual measurement result.

Please note that this Tx Power and step size is not applicable when the device is configured as Differential PA output. For more details of the single-ended or differential PA output networks design, please refer to "AN131 CMT2180A Schematic and PCB Layout Design Guideline".

2.3 PA Ramping Time

The PA can be configured with different ramping time by setting the PA Ramping Time. The available options for the ramping (up and down) time are 0, 1, 2, 4, 8, 16, 32, 64, 128, 256, 512 and 1024 us. When the option is set to 0, the PA output power will ramp up or down to its configured value in the shortest possible time. See the figure below for different PA ramping times.

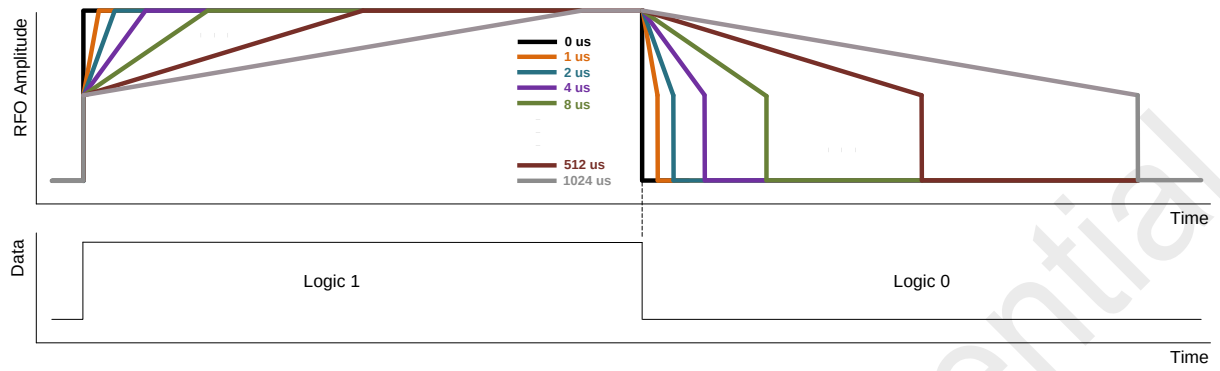

Figure 6. Different PA Ramping Time

2.4 Xtal Cload

The CMT2180A uses a 1-pin crystal oscillator circuit with the required crystal load capacitance integrated on the chip. The recommended specifications for the crystal are: 26 MHz with ±20 ppm frequency tolerance, ESR (Rm) < 60 Ω, load capacitance C_{LOAD} ranging from 12 to 20 pF. In order to cover the 12 to 20 pF load capacitance range, the parameter Xtal Cload pull down menu is intended to extend extra 2 pF margin in both ends. The recommended procedure to set the Xtal Cload is shown as the figure below.

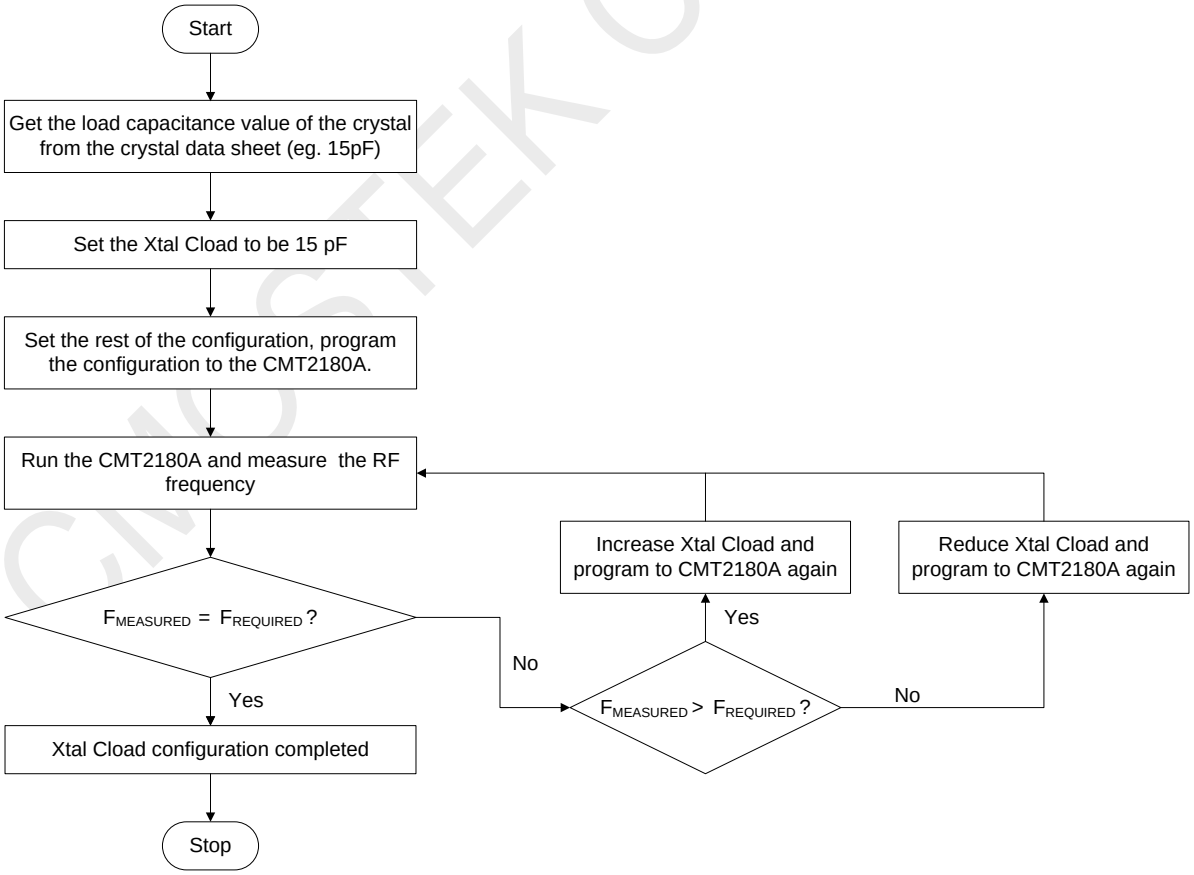

Figure 7. Procedure of Setting Xtal Cload

3. Transmitting Settings

Figure 8. CMT2180A Transmitting Settings

The data to be transmitted is generated by the microcontroller section of the CMT2180A, and this data signal is able to be observed on the DATA pin. The user can configure the start and stop condition of the transmitting according to the data observed on the DATA pin to control the transmission properly.

3.1 Start by

The transmission of CMT2180A can be started by either “DATA Pin Rising Edge” or “DATA Pin Falling Edge”, which should be chosen properly according to the microcontroller program. See the two figures for the 2 different Start by conditions and Table 5 for the timing requirements of the conditions.

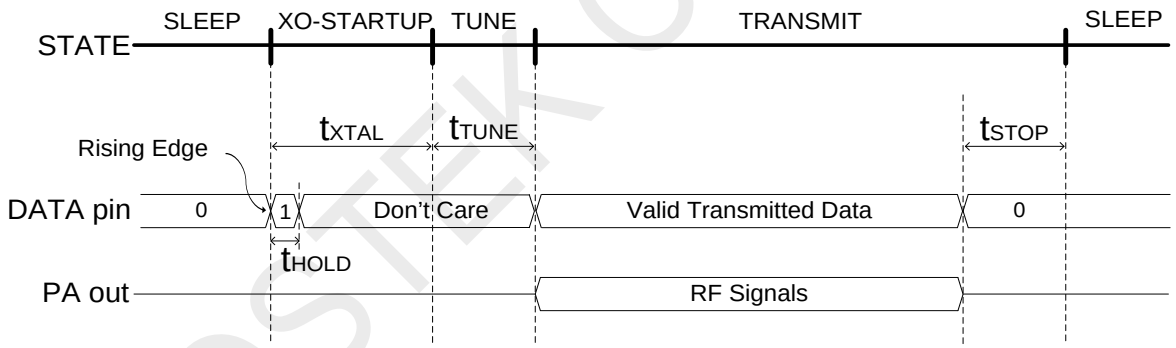

Figure 9. Transmission Enabled by DATA Pin Rising Edge

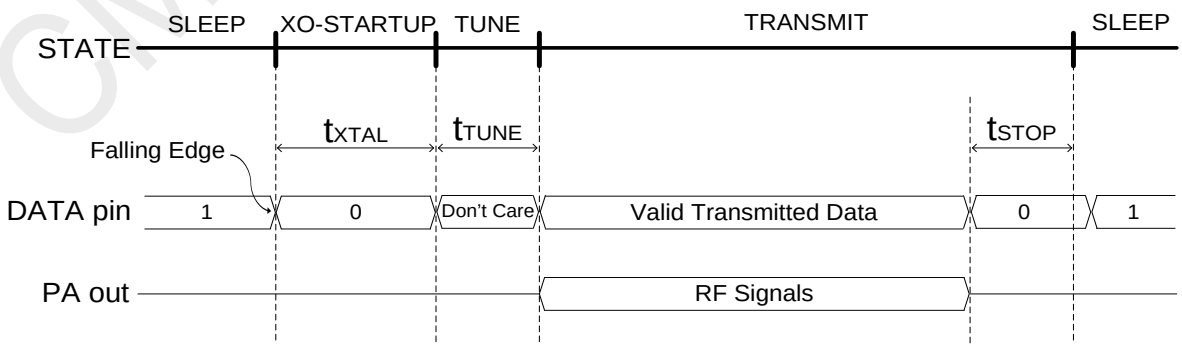

Figure 10. Transmission Enabled by DATA Pin Falling Edge

Table 5.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[2]	t_{STOP}	20		90	ms
Notes: [1]. This parameter is to a large degree crystal dependent. [2]. Configurable from 20 to 90 ms in 10 ms step size.					

3.2 Stop by

When the CMT2180A DATA pin is driven to low (logical zero) for the time t_{STOP} (can be selected from 20 to 90 ms in 10 ms step size), the transmission is ended and the CMT2180A goes back to the SLEEP state, waiting for the next transmit cycle. Please note that the selected stop time and the actual symbol rate limits the number of consecutive zeros that can be transmitted. If the number of zeros transmitted is larger than N, which is calculated as below, the transmission is ended.

$$N = \text{Integer}[\frac{t_{STOP}}{1/SR}]$$

Note:

1. SR represents the actual symbol rate of the transmitted data.
2. The unit for t_{STOP} is ms, and for SR is ksps.
3. The function **Integer [ ]** is rounding down to the nearest integer. E.g. Integer [1.4] = 1; Integer [10.6] = 10.

Example 1

If the t_{STOP} is 20 ms and the actual SR is 0.5 ksps, the maximum number of consecutive zeros that can be transmitted is Integer [20 * 0.5] = 10.

Example 2

If the t_{STOP} is 20 ms and the actual SR is 1.03 ksps, the maximum number of consecutive zeros can be transmitted is Integer [20 * 1.03] = 20.

4. Microcontroller Settings

After finish the settings of the RF section, the user can click the Next button on the bottom right corner to enter the microcontroller settings panel, as shown in the figure below. Please note that this is a programming interface but not an application development platform.

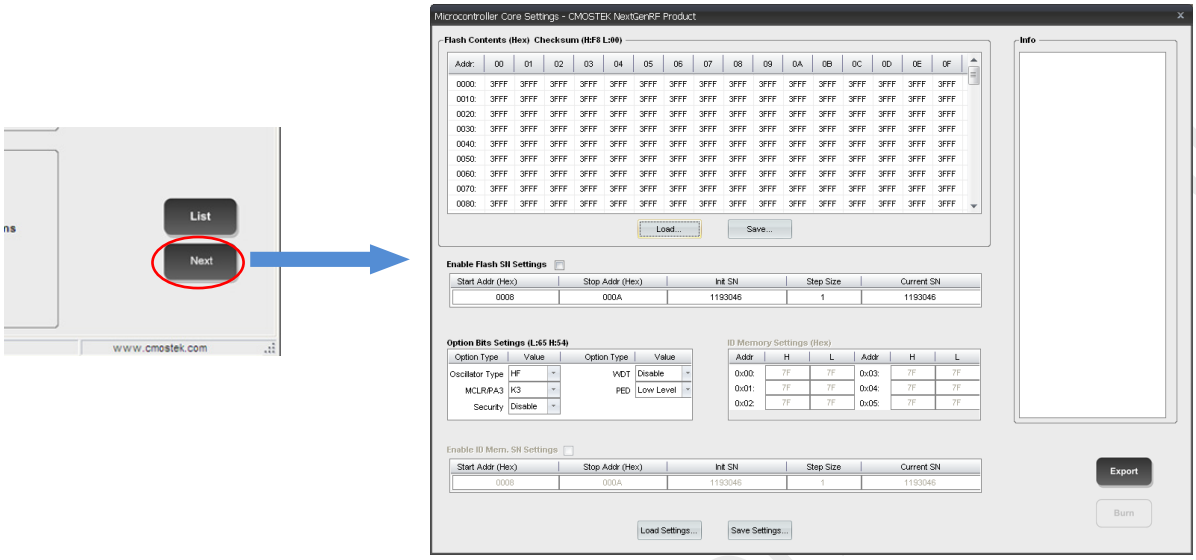

Figure 11. Click Next Button to Enter the Microcontroller Settings Panel

In the Microcontroller Settings Panel, there are 7 parts listed as follow: Flash Contents, Flash SN Settings, Feature Bits Settings, ID Memory Settings, ID Memory SN Settings, Info and Functional Buttons.

4.1 Flash Contents

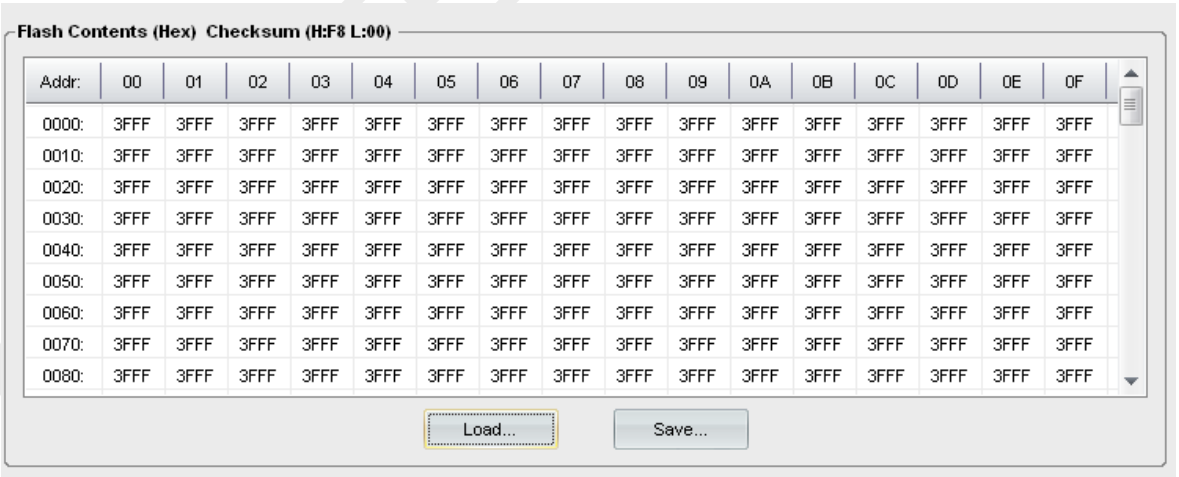

Figure 12. Flash Contents

The user can click the Load button to load the compiled program file into the RFPDK. The compiled program file is in Hex format which was generated by the compilation tool. After finish the program loading, the value of each word address will be displayed in the area as shown in the figure above. The user can also save the flash content into a file by clicking the Save button. The checksum result of the flash contents is shown on top of the Flash Contents.

4.2 Flash SN Settings

If the user has defined certain addresses to store a Serial Number in the microcontroller program, the “Flash SN Settings” section allows the user to locate the addresses of the SN in the compiled Hex file and let the RFPDK to automatically change the SN prior to each burning operation. As a result, the SN will be unique in each device.

Table 6. Flash SN Settings

Parameter	Descriptions	Default
Start Addr (Hex)	Defines the starting address of a consecutive address space in the Flash to store the series number.	0008
End Addr (Hex)	Defines the ending address to store the series number to the Flash.	000B
Init SN	Defines the initial SN value (in Dec), this value will be stored in the Flash with address defined from Start Addr (Hex) to End Addr (Hex).	1193046
Step Size	Defines the incremental step size of the SN value, it can be a positive integer or zero.	1
Current SN	Displays the next SN value to be burned into the device in the next burning operation.	1193046

Start Addr (Hex), End Addr (Hex)

These two parameters allow the user to locate the SN in the HEX file. The user shall remember the exact addresses which have been defined to store the SN in the compiled program (usually written in C and assembly language). Below gives an example of that Start Addr (Hex) is set to 0x32 and End Addr (Hex) is set to 0x35. Please note that according to the instruction format of the microcontroller, only the lower 7 bits in each of these 14-bit words are used to store the SN. The maximum allowed number of bytes is 4, which means a maximum 28 bits can be used to store the SN.

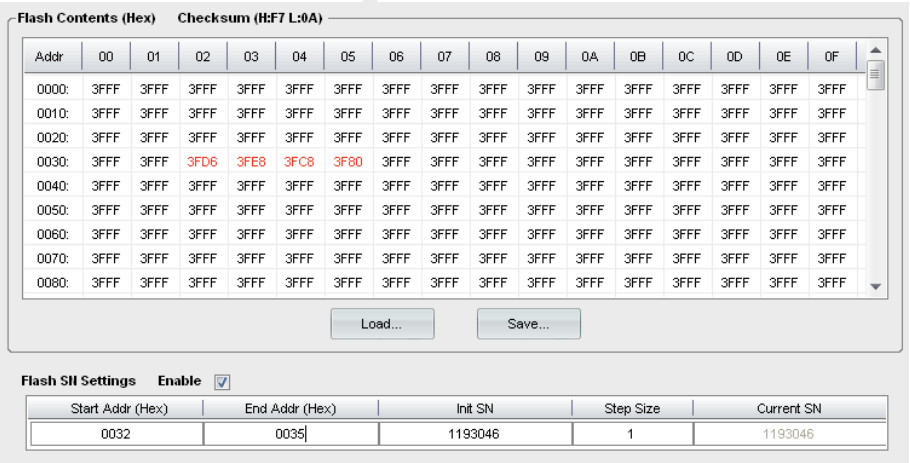

Figure 13. Data Section Supposed to Be Changed

Init SN, Step Size, Current SN

These parameters define how the SN is changed prior to each burning operation. The formula is given below.

$$SN\ (2^{nd}\ \text{device}) = \text{Init SN}\ (1^{st}\ \text{device}) + \text{Step Size}$$

$$\text{Current SN (current device)} = \text{Last SN (previous device)} + \text{Step Size}$$

Notes:

1. The Init SN is the initial SN specified by the user. The value must be within the range which can be presented by the configured SN address.

2. The Step Size can be a positive integer or zero. Setting it to zero means to remain the SN unchanged.
3. The Current SN is the SN value, which is automatically calculated by the RFPDK, to be burned into the device in the next burning operation.

4.3 Feature Bits Settings

These options allow the user to define a few features of the microcontroller, as shown in the table below.

Table 7. Feature Bits Settings

Parameter	Descriptions	Default
Clock Source	To select the internal clock source for the microcontroller, the options are: Blank, 8 MHz and 32 kHz.	8 MHz
WDT	To enable or disable the watchdog timer, the options are Blank, Enable or Disable.	Disable
K3/MCLR	To configure the K3 pin as Master Clear (MCLR) or push button key	K3
LBD	Defines the battery low threshold, the options are: Blank, Disable and Typ 2.3V.	Typ 2.3V
Security	To enable or disable the code protection. When it is enabled, the readouts of bit11-7, bit4-0 in each word are fixed at 1. The options are Disable or Enable.	Enable

Clock Source

This option is to select the clock source of the microcontroller. There are two internal RC oscillators available to generate the microcontroller system clock, one is 8 MHz and another is 32 kHz.

WDT

This option is to enable or disable the watchdog timer. The watchdog timer is base on the 32 kHz (@3V) internal RC oscillator.

K3/MCLR

This option is to select whether the K3 pin is used as Master Clear (MCLR) reset input or K3 push button key.

LBD

This option is to enable the Low Battery Detection voltage level. When it is enabled by selecting Typ 2.3V, the LBD voltage level is set to around 2.3V.

Security

This option is to enable or disable the code protection. When it is enabled, in a 14-bit word, the readout values of bit13/12/6/5 are correct; the readout values for the rest bits (bit 11-7, bit 4-0) are all fixed to 1.

4.4 ID Memory Settings, ID Memory SN Settings

In the Microcontroller section, there are 12 bytes available for the user to store any data. If these data are used as the SN, they can be changed on each burning operation according to the rule defined in the ID Memory SN Settings, which is similar to the Flash SN Settings introduced in Section 4.2.

4.5 Info

The Info section is a read-only area where the user can obtain the burning log.

4.6 Functional Buttons

Besides the Load/Save buttons, the Export and Burn button is available for the user to save the RF configuration, the microcontroller program and the microcontroller features to an image file or burn these configurations into the connected device.

Export

The user can click the Export button to export the current configurations, including the RF and the microcontroller sections, to an image file suffixed by ".exp". This file can be loaded by the manufacturing programmer to program the CMOSTEK NextGenRF™ products in mass production phase.

Burn

Once all the parameters are configured and all the hardware is properly connected, the user can click the Burn button to burn all the configurations and microcontroller program into the chip. A message will pop up to confirm whether the programming is done successfully or not. If the programming is failed, the user should double check the setup or the USB Programmer version and try again.

5. Document Change List

Table 8. Document Change List

Rev. No.	Chapter	Description of Changes	Date
0.8	All	Initial released version	2014-09-22

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