HOPERF AN197

CMT2300A/CMT2119B/CMT2219B
Fast Manual Frequency Hopping

Summary

This article introduces the quick manual frequency hopping mechanism of the three products: CMT2300A, CMT2119B, and CMT2219B, to help users carry out design and application more conveniently.

The product models covered in this document are shown in the table below.

Table 1. Product Models Covered in this Document

Product Model	Operating Frequency	Modulation Mode	Main Functions	Configuration	Package
CMT2300A	126.33-1020MHz	(G) FSK/OOK	All-in-one transceiver	Register	QFN16
CMT2119B	126.33-1020MHz	(G) FSK/OOK	Transmitter	Register	QFN16
CMT2219B	126.33-1020MHz	(G) FSK/OOK	Receiver	Register	QFN16

Before reading this document, it is recommended to read *AN142 - CMT2300A Quick Start Guide, AN184 - CMT2119B Quick Start Guide*, and *AN161 - CNMT2219B Quick Start Guide* to understand the basic usage methods of the three products.

Catalogue

1. Fast Manual Frequency Hopping Mechanism

This article introduces the manual frequency hopping mechanism of the 3 products. Among them, some operations are only for the RX mode. For users who only use CMT2119B or CMT2300A TX for frequency hopping, the relevant descriptions can be ignored.

Manual frequency hopping means that based on the basic frequency obtained by configuring the RRPDK, such as 433.92MHz,
during the application process, the MCU can quickly switch to another frequency by simply setting 1 to 2 registers. Here are the relevant configuration registers.

Table 2. Fast Manual Frequency Hopping

Register name	Bit number	R/W	Bit name	Function description
CUS _ FREQ _ CHNL(0x63)	7:0	RW	FH CHANNEL< 7: 0 >	The number of channels for setting fast manual frequency hopping is 255.
CUS _ FREQ _ OFS (0x64)	7:0	RW	FH OFFSET< 7: 0 >	Set the channel width for fast manual frequency hopping. Each bit increases approximately 2.5 kHz and the largest channel width is 2.5 x255 = 637.5 kHz.

The effective working frequency bands of these products are:

Table 3. Effective Frequency Band

Target Frequency Band		FREQ _ DIVX _ CODE < 2: 0 >	DIVIDER
FREQ VCO BANK < 2: 0 > = 110	FREQ VCO BANK < 2: 0 > = 001		
758-840 MHz	840-1020 MHz	000	2
379-420 MHz	420-510 MHz	001	4
189.5-210 MHz	210-255 MHz	010	8
126.33-140 MHz	140-170 MHz	011	12
252.67-280 MHz	280-340 MHz	101	6

In the table above, we consider the frequency of using the same DIVIDER value to be within the same frequency band. For example, 758-1020MHz is the same frequency band.

The calculation formula of the target frequency point of manual frequency hopping is:

FREQ = Basic Frequency Point + 2.5 kHz x FH_OFFSET< 7: 0 > x FH_CHANNEL< 7: 0 >

Although the base frequencies of RX and TX are independent, there is only one set of frequency hopping mechanism. However, the chip will switch automatically: when entering TX mode, the frequency hopping mechanism operates on the base frequency of TX; when entering RX mode, it operates on the base frequency of RX. The basic frequency band refers to the frequency point configured on the RFPDK. This frequency point determines the current frequency band, and subsequent frequency hopping operations cannot exceed this band.

Generally speaking, users can first set FH OFFSET<7:0> during the power-on initialization configuration phase, and then switch channels by continuously changing FH_CHANNEL<7:0> in the application.

2. AFC Parameter Setting for RX Frequency Hopping

The content of this chapter can be ignored by users who only use CMT2119B or CMT2300A TX for frequency hopping.

When using manual frequency hopping in RX, the frequency hopping operation will affect the setting of an important parameter AFCOVFTH<7:0> of AFC (Automatic Frequency Control). If the setting is incorrect, it may result in failure to receive at the current frequency. Under normal circumstances, this parameter is automatically calculated by RFPDK based on the frequency points input by the user, and the user does not need to configure it specially. However, when users use fast frequency hopping or manually configure frequency points, the setting of frequency points is separated from RFPDK, so RFPDK cannot help users configure this parameter. CMOSTEK provides another tool for customers to automatically calculate this parameter, which is the "CMT2300A-CMT2219B Frequency Hopping Calculation Table". The usage method is as follows:

1. The user fills in 4 parameters respectively.

Xtal Frequency (MHz) - Crystal frequency, the default is 26MHz. If necessary, modify RX Xtal Tolerance (ppm) according to the actual frequency - The maximum error of the crystal used by the receiver
TX Xtal Tolerance (ppm) - Crystal error used by the transmitter RX Frequency Range (MHz) - Frequency hopping range of the receiver
Note that the crystal errors related to TX and RX refer to the crystal errors of the respective communication parties. For TRX products, one party can be assumed to be RX and the other to be TX.

2. Then, in one column of the Index, fill in each frequency point of frequency hopping that needs to be used in order, with a maximum of 100 entries. If the user does not use that many frequency points, the remaining ones can be left blank.
3. After filling in all the frequency hopping points, the table will calculate the values (in decimal) of AFC_OVF_TH<7:0> corresponding to each frequency point. At the same time, the value of Initial AFC_OVF_TH<7:0> will be displayed in the left table.

- If all values of AFC_OVF_TH<7:0> are equivalent to Initial AFC_OVF_TH<7:0>, it indicates that there are no frequency points requiring special handling. In this case, the user only needs to write the value of Initial AFC_OVF_TH<7:0> into the 0x27 CUS_FSK4 register once during the chip initialization process, and there will be no need to make changes afterward.

- If in a certain frequency point, the value of AFC_OVF_ TH<7:0> is different from that of Initial AFC_OVF_TH<7:0>, then this value will be marked in red. The user needs to configure the value of Initial AFC_OVF_ TH<7:0> during the initialization process. Before hopping to this frequency point (in the STBY state), update the corresponding value of AFC_OVF_TH<7:0> to the 0x27 CUS_FSK4 register. Before jumping to the next frequency point, if the two values are the same, it is necessary to restore the register content to the value of Initial AFC_OVF_TH<7:0>.

In short, users need to ensure that before jumping to each frequency point, the value of the 0x27 CUS_FSK register must be the same as the corresponding AFC_OVF_TH<7:0> value in the table.

Regarding the initialization process, please refer to the quick start guide for the corresponding product.

3. The Overall Process of Rapid Manual Frequency Hopping

The following summarizes the overall process of fast manual frequency hopping:

1. Use the *CMT2300A-CMT2219B Frequency Hopping Calculation Table* to obtain the Initial AFC OVF TH<7:0>, and write this value into the 0x27 CUSFSK4 register during the chip initialization process. If only TX frequency hopping is used, this step can be ignored.

2. Send go_stby to make the chip return to the STBY state.

3. Set FH CHANNEL<7:0>. If it is necessary to reset FH_OFFSET<7:0>, handle it in this step as well. Refer to the operating frequency band division in Table 3 to limit the frequency hopping range. It should be kept in mind that the chip does not support cross-band frequency hopping operations, that is, the value of the FREQ_DIVX_CODE<2:0> register cannot be changed. Since the base frequency is determined by RFPDK, the parameter table generated by default by RFPDK includes the value of the FREQ_DIVX_CODE<2:0> register corresponding to this frequency band, which is configured during initialization, so users do not need to configure it every time they frequency hop. However, it should be noted that FREQ_VCO_BANK<2:0> will change within the same frequency band. When users set the frequency hopping points in this step, corresponding to the range marked in Table 3, if necessary, they should update the value of FREQ_VCO_BANK<2:0>.

4. If performing RX frequency hopping operation, according to the method introduced in Chapter 2, use the EXCEL tool sheet provided by CMOSTEK to ensure that the value of the 0x27 CUS_FSK4 register is equal to the value of AFC_OVF_TH<7:0> corresponding to the current frequency point to be hopped to. If it is a TX frequency hopping operation, this step can be ignored.

5. Send go_tx to enter TX for transmission, or go_rx to enter RX for reception.

If the user performs a frequency hopping operation on TX and then switches to RX state for receiving, they must set FH_CHANNEL<7:0> back to 0 before reception to return to the RX basic frequency point set by RFPDK. Conversely, after performing the frequency hopping operation of RX, FH_CHANNEL<7:0> must also be set back to 0 to using the TX basic frequency point for transmission, setting by RFPDK.

The advantage of manual frequency hopping is that the frequency point can be changed by setting only 1 to 2 registers. Without this mechanism, it would be necessary to write to the frequency region to change the frequency, which would significantly increase the content of the registers that need to be written, lengthen the time, and might fail to meet application requirements.

4. Document Revised Record

Table 4. Revised Record

Version No.	Chapter	Change Description	Date
0.8	All	Initial version release	2017/11/07 2025/9/5

5. Contact Information

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