CMOSTEK AN163

CMT2219B RF Parameter Configuration Guide

Overview

This document provides RFPDK RF and FSK demodulation parameter configuration guide.

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

Table 1. Product Models Covered in This Document

Product Model	Frequency Range	Modulation Method	Chip Function	Configuration Method	Package
CMT2219B	127 - 1020 MHz	(G)FSK	Receiving	EEPROM	QFN16

Before reading this document, it is recommended to read the *AN161-CMT2219B Quick Start Guide* to understand the basic information of the product.

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1 Rx Parameter Configuration

1.1 Basic Parameter Configuration

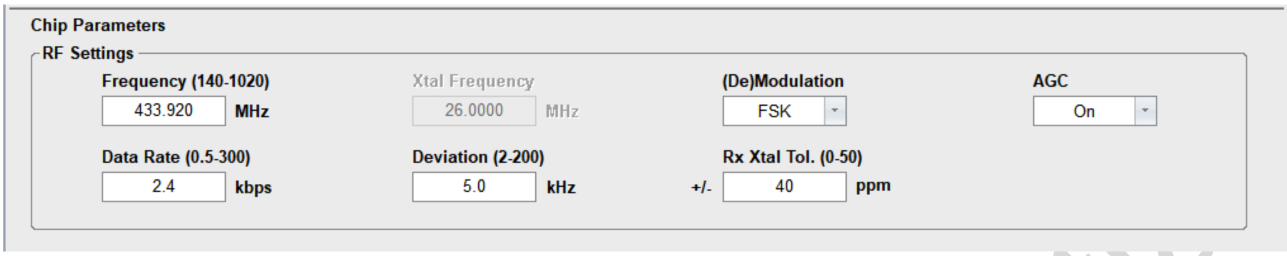

Figure 1. Parameter Configuration

Table 2. RF Parameter Description

Parameter	Description
Frequency	RF frequency
Xtal Frequency	Fixed to 26 MHz
Demodulation	Demodulation mode. Configure as FSK or GFSK.
AGC	Automatic gain control
Data rate	Baud rate
Deviation	(G)FSK single-side frequency deviation
Rx XtalTol	Crystal tolerance

- **Deviation configuration principles**

In general, It is recommended that the configured deviation meets the below 3 requirements.

1. 4 kHz < deviation < 200 kHz, and data rate * 0.5 + deviation <= 250 kHz.
2. Data rate * 0.25 <= deviation, meaning that the modulation index cannot be less than 0.5 (MSK).
3. If item 1 and 2 are satisfied, the best sensitivity can be achieved if it meets data rate * 0.5 <= deviation <= data rate * 2.

- **Crystal PPM configuration principles**

Users are required to input the crystal tolerance values of Tx and Rx respectively. Inputting +/- 20 ppm means that, between the transmitter and receiver, the crystal frequencies differ by 40 ppm in the worst case. Users should take account of this worst case when setting the two tolerance values, which will affect various bandwidth settings inside the receiver.

- **AGC configuration principles**

Usually, it is recommended to open the AGC. If in some applications, the amplitude change significantly during data transmission, users need to turn off the AGC in the case.

1.2 OOK Demodulation Configuration

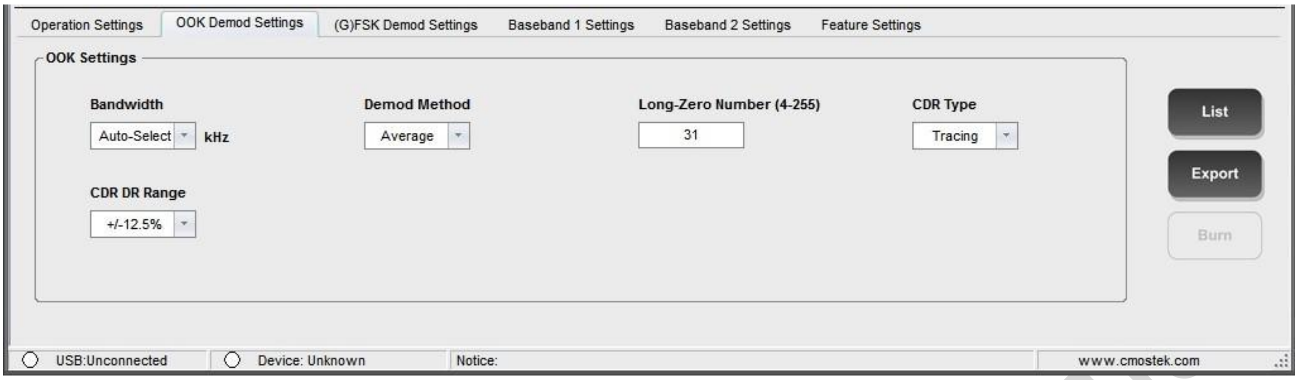

Figure 2. OOK Demodulation Configuration

The configuration guidelines are listed in the below table.

Table 3. Parameter Configuration Guidelines

RFPDK Input Parameter	Configuration Guidelines
Bandwidth	Suggest as *Auto-Select*
Demod method	When *middle* is selected, the quick demodulation response brings the advantage of immediate correct demodulation when each communication starts, however the disadvantage is the impact on the further demodulation if a spike appears in the packet (the amplitude suddenly becomes too large). When *average* is selected, the slow demodulation response causes the disadvantage of a long time (10 - 20 symbols in general) spent to get correct demodulation when each communication starts, however the advantage is no impact on demodulate if a spike appears in the packet (the amplitude suddenly becomes too large). According to general experience, spikes occur only in some special applications, thus *middle* is recommended to speed up demodulation then reduce receiving time.
Long-Zero number	Users need to input this value to tell the receiver how many consecutive zeros exist in the packet, thus the receiver modulates the related parameters to ensure the best demodulation effect.
CDR type	In the packet mode, or in the cases when detecting preamble or sync is needed, the data rate clock recovery function must be turned on. Refer to the following chapters for how to use CDR.
CDR range	When *tracing* is selected in CDR type, users need to input this parameter. Refer to the following chapters for how to use CDR.

1.3 FSK Demodulation Configuration

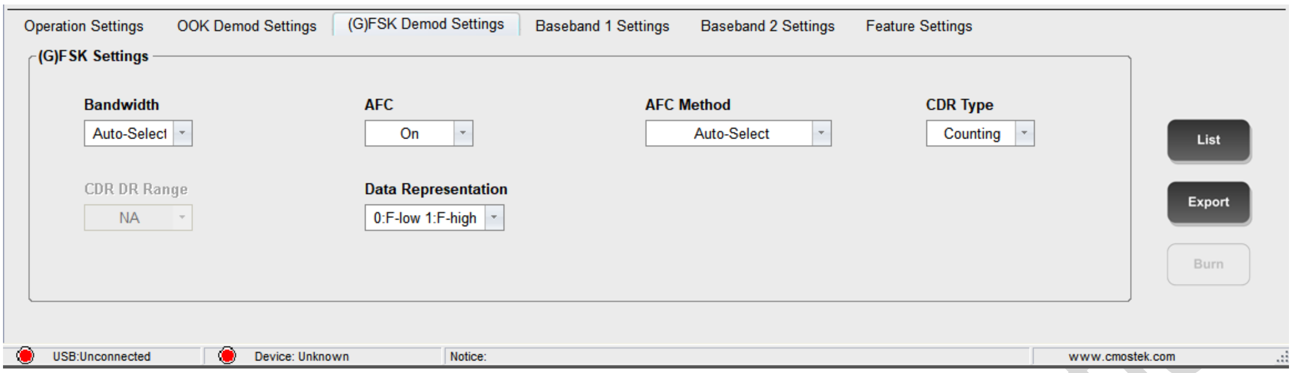

Figure 3. FSK Parameter Configuration

Table 4. FSK Parameter Configuration Guidelines

Parameter	Description
Bandwidth	Suggest as *Auto-Select.*
AFC	AFC on/off control, suggest as *on*.
AFC Method	AFC method, suggest as *on*
Data Representation	This parameter specifies, which one represents *0* and which one represents *1* within the 2 FSK frequency points. Use default value in general.

1.4 CDR Parameter and Mode Selection

The corresponding RFPDK screen and parameters are shown in the below figure.

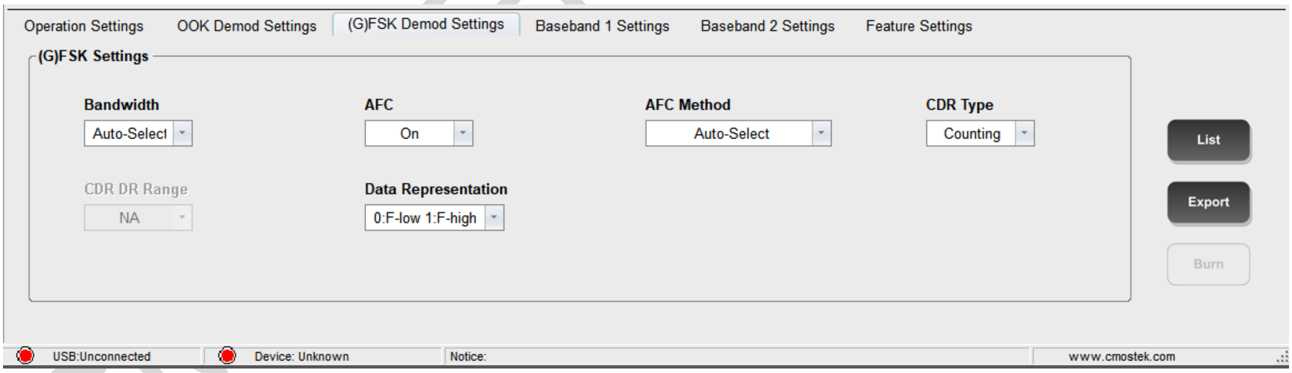

Figure 4. CDR Parameter Configuration

Table 5. CDR Parameter Configuration

Parameter	Description
CDR type	CDR refers to data rate clock recovery. Refer to the following chapters for more details.
CDR range	It represents the maximum deviation range of the traceable data rate. Users need to input this parameter when CDR type is *Tracing*.

The followings will discuss the Designed parameters for clock data recovery (hereinafter referred to as CDR) and CDR mode selection.

The basic task of a CDR system is to recover the clock signal synchronized with the data rate while receiving data, which is used either inside the chip to remove the glitch of the demodulated data, or output to GPIO for users to perform data sampling. The task of the CDR is simple but important. If the recovered clock frequency is inaccurate compared with the actual transmitted data rate, it will cause data acquisition failure during receiving, resulting in code error.

- **2 application environment scenarios**

In practice, application environment is not ideal. The system may work in the below 2 scenarios In general.

1. The data rates configured for TX and RX are aligned, or with an error as small enough as a few thousandths or ten thousandth. Generally relatively advanced configuration and calculation mechanisms are used in both TX and RX side in this case.
2. A large data rate deviation exists between the actual RX and the configured RX value, such as from a few hundredths to a few tenths.

- **3 key indicators for CDR**

The following 3 indicators are key to CDR.

1. The maximum collected data length when there's no inverse in the received data (receiving 0 or 1 continuously).
2. The maximum tolerate data rate deviation between TX and RX.
3. The capability to improve sensitivity and reduce errors.

- **3 internal CDR systems**

Based on an overall consideration of these 2 application scenarios and 3 indicators, the CMT2219B offers 3 internal CDR systems as follows.

1. COUNTING system - this system is designed corresponding to the scenario where the data rate is relatively accurate. If ata rate is 100% aligned, users can even receive unlimited length of 0 with no error occurring. However, if there is a deviation, the deviation will have a cumulative effect if there's no data reverse. For example, if a symbol is deviated by 5%, after 10 consecutive symbols without reverse, the deviation accumulates to more than 50% resulting in sampling errors, similar to the UART transfer. Once a signal reverses, the deviation is cleared and it starts the accumulation again. Therefore, when the deviation is very small, such as 1/5000, users may not encounter error if continuously receiving 2500 symbols without data reverse, with quite good performance gained.

2. TRACING system - this system is designed corresponding to the scenario with relatively large data rate deviation. It has a tracking function, which can automatically detect the data rate transmitted by TX, and quickly adjust the RX local data rate to minimize the deviation between them. This product can support up to 15.6% data rate deviation, leading the industry in this aspect. On the other hand, the effectiveness of this system depends on the accuracy of the local data rate adjustment. Since the crystal frequency is fixed at 26 MHz, the higher the data rate, the lower the adjustment accuracy. As generally known that the accuracy will be higher when crystal frequency is below 50 kHz, that is, longer data with no reverse can be collected without error occurring. In short, the lower the data rate, the longer the correct sampled data is collected (the actual number of symbols depends on the actual measurement). When the crystal frequency exceeds 50 kHz, the non-reverse data that can be correctly sampled will become less and less, for instance, at 250 kHz, as the accuracy is very low it maybe can only correctly sample 2-3 bytes data with no reverse.

3. MANCHESTER system - this system comes from the COUNTER system and inherits its basic characteristics. The MANCHESTER system is different in its dedicated design for Manchester codec with special treatment on handling sudden changes in TX data rate. A general sudden change case is that 2 consecutive 0 or 1 patterns appear in the Manchester encoded TX data. If one of the two consecutive 0 or 1 symbols suddenly becomes 50%+ longer, the RX may sample three 0 or 1. If it suddenly becomes 50%+ shorter, only one 0 or 1 will be sampled. To handle such special cases, in this clock recovery system, if 3 or more symbols are detected in the received data without reverse, the sampling stops to avoid code error occurring if a symbol suddenly becomes longer. As for the case when symbols suddenly become shorter, a quite common case in practical applications, in general users can increase the data rate at RX side to make sure correct data collecting even when a symbol becomes 50%+ shorter.

- **CDR type selection principles**

If data rate deviation between TX and RX is uncertain or unknown, do not use CDR and select *None*.

If data rate deviation between TX and RX is small and there's no long consecutive 0/1 existing in the data packet, select *counting*.

If data rate deviation between TX and RX is less than 15.6% with long consecutive 0/1 existing, select *tracing*.

If all packets sent in TX are Manchester coded, select *Manchester*.

No matter which CDR system is used, it will increase the sensitivity by 1-2 dB comparing to that of receiving RAW data. In addition, most of parameters in *tracing* are automatically calculated by RFPDK internally. If for special needs, please consult CMOSTEK technical support.

2 Revise History

Table 6. Revise History Records

Version No.	Chapter	Description	Date
1.0	All	Initial version	2017-11-21

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