RFGate NFU-TL021 NFC Temperature LoggerApplication

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1 Datasheet

Same as this document

2 Development Resources

1）Mobile APP and Reference Source（Android phones, IOS13 above APP and reference source）

2）Cell phone APP download connection

Android phones：

（Please contact RFGate web site ）

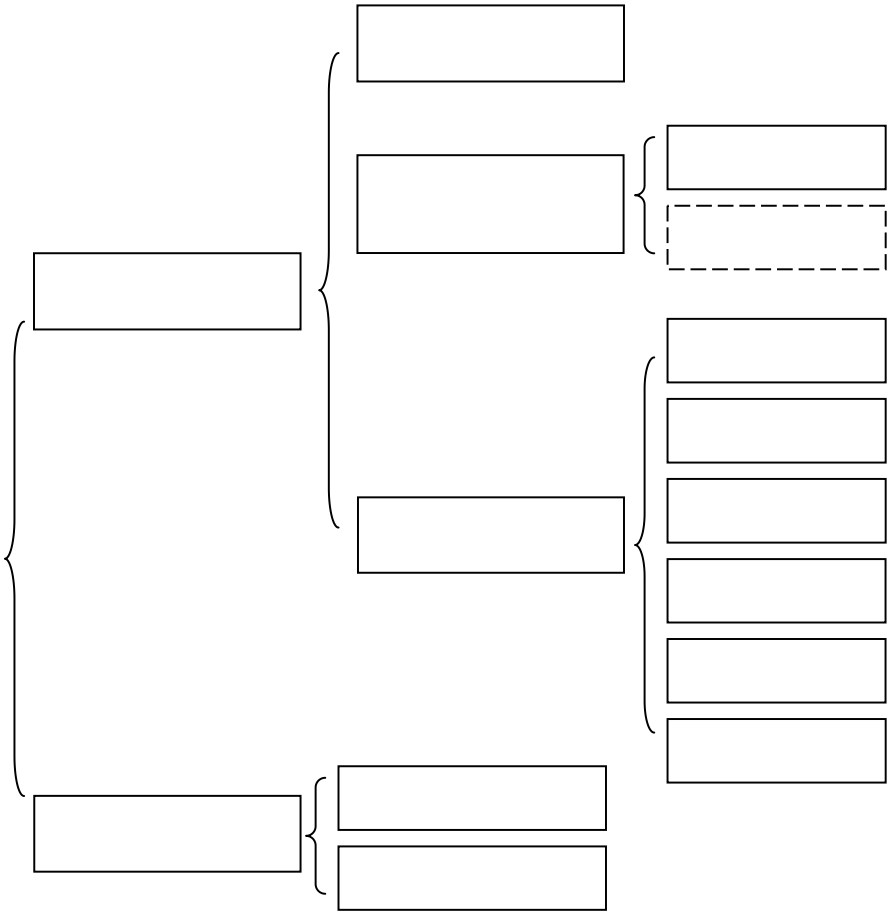
IOS：

（Note: above IOS13 of the Apple Phone software）

Test application can be gathered from RFGate

3 Functional Description

3.1 Memory



3.2 Memory Default Configuration

User area： 1k(1024)bytes ， address 0x0000h~0x03FFh

Data0： 19kbytes ， address 0x1000h~0x5BFFh

Data1 ： 0kbytes 。

Register： Contains registers under battery domain and registers under VCC domain.the register under the battery domain needs the chip to quit the PD mode before reading and writing operation.

Configuration Area： The user configuration area mainly includes 6,

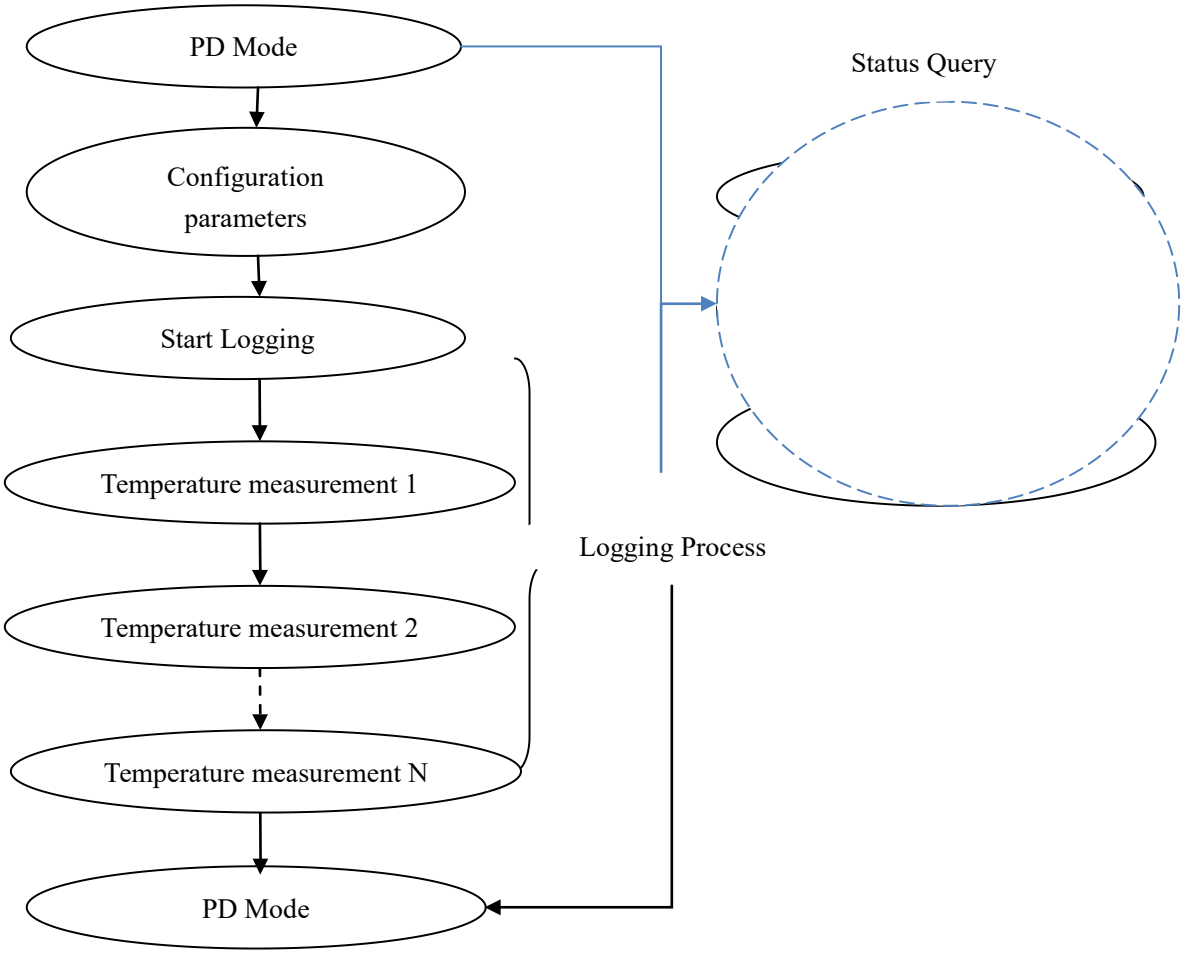
Sector1/Sector2/Sector3:Related to temperature measurement parameters, support password protection locking function.

Sector4: lock and password configuration

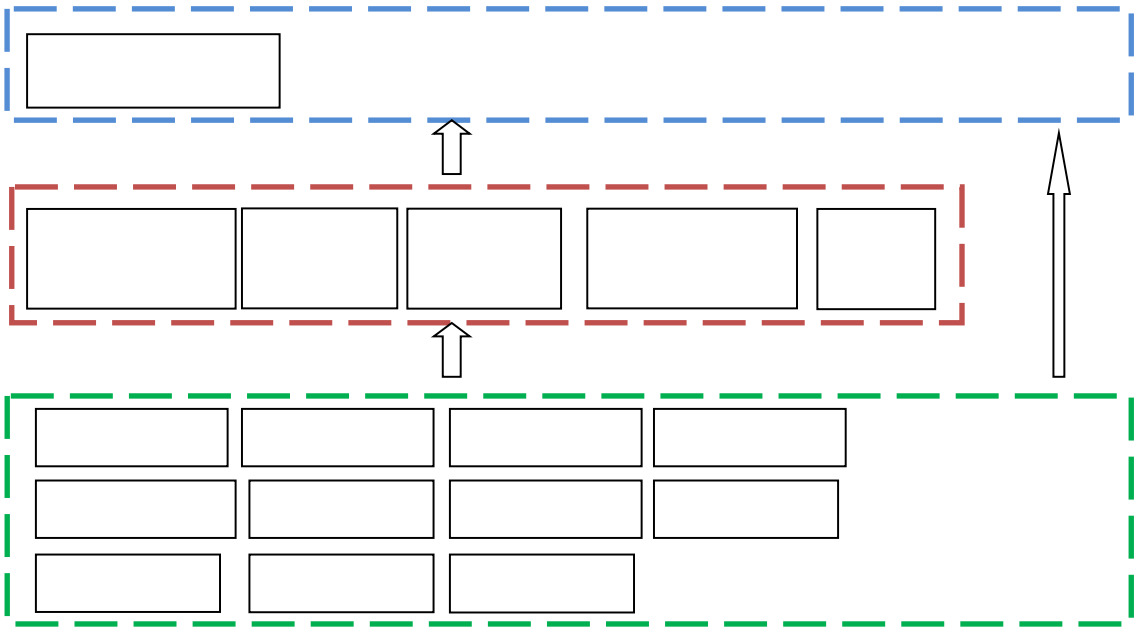
Sector5:UHF interface configuration

Sector6: indication for temperature recording.

3.3 Flow Chart of Chip Working Mode

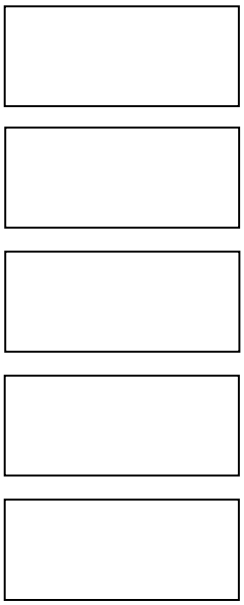


3.4 Development Model



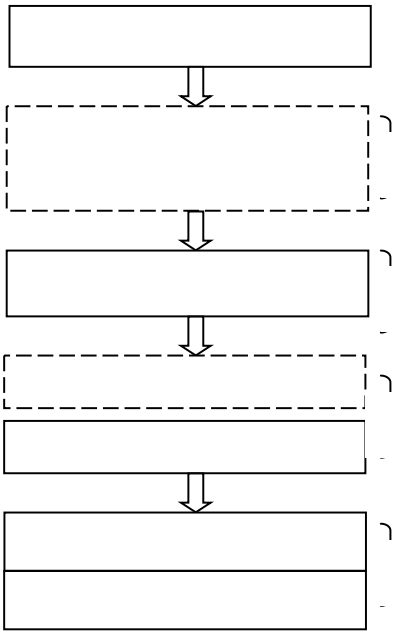
4 Logging Process

4.1 Functional Modules



4.2 Init Configuration

4.2.1 Label Initialization Reference Process



4.2.2 Label Initialization Reference Instruction Flow

1、User area Operations

According to the needs, they need to write personalized data information, such as URL and other NDEF data formats.

2、Parameter Configuration Operation

Set temperature data storage format and other related data, set Sector1/2/3 related parameters (Default temperature data standard storage mode ,2 decimal points, 0.25 Precision).

1）Write Memory command,Set the parameters in the address 0xb040 user_cfg0=0x4D,user_cfg1 =0x29

Send：40 B3 E 03 00 00 4

Recv：00 00 00

2）Write Memory command ,Set the parameters in the address 0xb044 user_cfg2=0x80， user_cfg3 =0x02

Send：40 B3 E 03 00 00 8

Recv：00 00 00

3、Stop Logging Password Setting

1）Write Memory command ,Set the parameters in the address 0xb138auth_rb_cfg=0x55

Send：40 B3 E 00 00 00 5

Recv：00 00 00

Note: parameter auth_rb_cfg can not be read after setting, default 00,(this parameter is optional settings)

2）Write Memory command ,Set the parameters in the address 0xb130

Stop logging password=0x44332211

Send：40 B3 E 03 00 00 1

Recv：00 00 00

Stop logging password is used Stop logging password.

Note: after setting up, you can read to confirm that the setting is correct; after setting the parameter is not all 0, once the chip is re-powered, it needs authentication before resetting and reading

Read Memory command reads check

Send：40 B1 E 00 00 00

Recv：11 22 33 44

4、Lock Password Setting

1）Write Memory command ,Set the parameters in the address 0xb12 Cunlock password =0x44332211

Send：40 B3 E 03 00 00 1

Recv：00 00 00

Read Memory command reads check

Send：40 B1 E 00 00 00

Recv：11 22 33 44

2）lock the user configuration area (sector1_lock/Sector2_lock /Sector3_lock)with Write Memory instructions

Lock sector1：

Send：40 B3 03 00 00

Recv：00 00 00

Lock sector2：

Send：40 B3 03 00 00

Recv：00 00 00

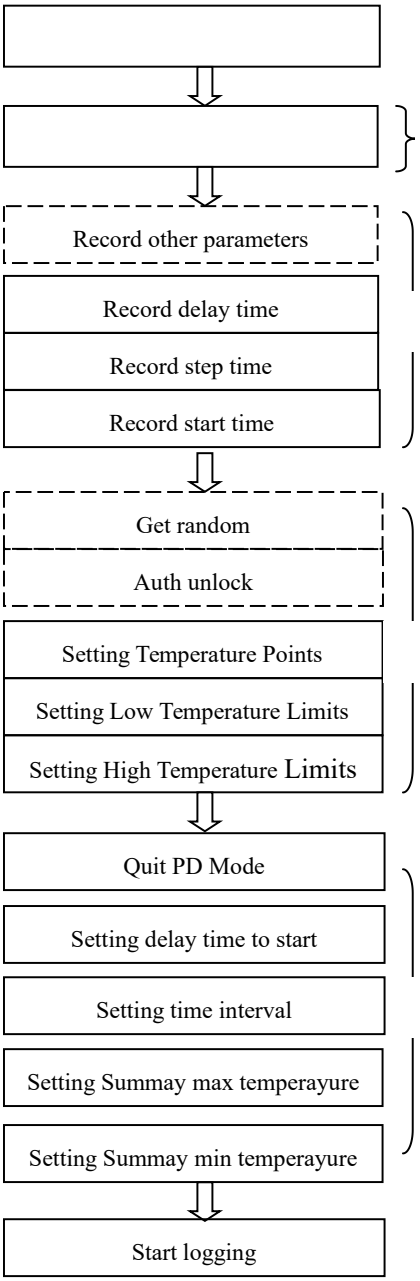
Lock sector3：

Send：40 B3 03 00 00

Recv：00 00 00

4.3 Start Logging

4.3.1 Start Logging Process Reference Flow



4.3.2 Start Logging Temperature Reference Instruction Flow

1、Status check

Op_Mode_Chk command is sent to check the current working mode of the chip to confirm that the current chip is in a non-logging process

Send：40 CF 01 00 00 00 00

Recv：00 01 21

Recv：00 01 31

Respond data：0x2101：

Bit12：0-not in logging process，RTC_logging _flag =0

Bit8：1-the voltage of battery is higher than 0.9V.

Respond data：0x3101：

Bit12：1- indicates that the current chip is in the temperature measurement process and can not start the timing temperature measurement (if you need to continue to start, you need to send RTC STOP Command to clear the temperature measurement flag)

Bit8：1-the voltage of battery is higher than 0.9V.

2、User area operations

In one of the user areas, it is used to record some information when plan Start logging process , and to query and display information when it is convenient to read. Demonstration DEMO mainly records three parameters, customers can add other information records according to their own needs, select the address of the user area.

Record parameters	First address	Description	Note
Delay time Map user area	0x0110-0x0111	Byte0 data high Byte1 data low	Consistent with data setting delay registers C084
interval time Map user area	0x0114-0x0115	Byte0 data high Byte1 data low	Consistent with data setting delay registers C085
Start Time Map user area	0x0140	Byte0 data high	19 bytes of time data converted to 4 bytes of hexadecimal data

1）Record Delay time0x0201=513m

Send：40 B3 0)1 00 00 0

Recv：00 00 00

2）Record interval time 0x0201=513s

Send：40 B3 0)1 00 00 0

Recv：00 00 00

3）RecordStart Time

Current time :2021/1/27 9:03:37 converted to 4 bytes of hexadecimal display data 0x6010BBE9,

Send：40 B3 0)3 00 00 6

Recv：00 00 00

3、Sector2 Operation

Setting parameters	Address	Description	Note
Temperature points	0xB094	Rtc_cnt_limit 2Bytes	The maximum number of times supported by different temperature formats is different
Minlimit0	0xB080	When the storage format of temperature data is in normal standard mode, the lower threshold value temperature is -35° in the temperature range	Note: Define the upper and lower thresholds of temperature data when the temperature data storage format is Limit mode.
Maxlimit0	0xB082	When the storage format of temperature data is in normal standard mode, the high threshold value temperature is 50° in the temperature range	
Minlimit1-Maxlimit1	0xB084-0xB087	Standard model ignored	
Minlimit2-Maxlimit2	0xB088-0xB08b	Standard model ignored	

Note: if there is a lock operation in the previous initialization process, Sector2 need to authenticate before rewriting the relevant parameters

1） Write Memory command to write temperature parameters Temperature points

Send：40 B3 [redacted] 01 00 00 [redacted]

Recv：00 00 00

in sector2, rtc_cnt_limit data ,2 bytes, address 0xb094, 0x0201=513 points

2） Write Memory command to write high Temperature Limit

Send：40 B3 E[redacted]01 00 00 8[redacted]

Recv：00 00 00

in normal standard mode ,0xb082 max_limit0,2 bytes,0x008C=35℃

3） Write Memory command to write Low Temperature Limit

Send：40 B3 E[redacted]01 00 00 8[redacted]

Recv：00 00 00

in normal standard mode, 0xb080min_limit 0x0388= -30℃

4、Register Operation

1）Send Wake up command To configure parameters used in the RTC logging process, the chip should quit the PD mode

Send：40 C4 00 00 00 00 00

Recv：00 00 00

Note：the Wake up command is sent only under the NFC instruction, after sending the instruction, the UHF instruction operation is not supported before start logging command

2）Check that the chip is out of PD mode

Send：40 C4 80 00 00 00 00

Recv：00 55 55

5555:the chip has quited PD mode successfully

FFFF:the chip has not quited PD mode

3）Setting delay time to start Register (vdet_delay_start_cfg)

Send： 40 C5 C0 84 [redacted] 00

Recv：00 00 00

Unit is minute. the actual time is the decimal value converted from the binary [15:0].

For example: If the value is 0000 0001 1110, the delay time is 30m.

Parameter:

00 00：0 minute. Indicates immediate start, recommended for use when testing.

02 01：513minute. Delay 513minutes to start

4）Setting time interval Register (vdet_step_cfg)

Send：40 C5 C0 85 0[redacted]0

Recv：00 00 00

Configuration of the time interval when logging. Unit is second.

Parameter:

00 00: No support

02 01: 513s. time interval is 513s.

5）Set RTC maximum temperature comparison register 0xC098(optional)

Write -100℃data to C098 register （0x0270）

Send：40 C5 C[redacted]02 70 00

Recv：00 00 00

Read to confirm that the written data is correct

Send：40 C6 C[redacted]00 00 00

Recv：00 70 02

6）Set RTC minimum temperature comparison register 0xC099(optional)

Write 100℃of data to C099 registers （0x0190）

Send：40 C5 C[redacted]01 90 00

Recv：00 00 00

Read to confirm that the written data is correct

Send：40 C6 C0 99 00 00 00

Recv：00 90 00

5、Start Logging

1） Start logging command used to start a temperature logging process

Send：40 C2 00 00 00 00 00

Recv：00 00 00

After sending, delay 10ms RF power off

4.4 Stop Logging

4.4.1 Address of User Configuration Area: RTC stop Instruction

sector	block	Addr	BYTE			
			3	2	1	0
4	12	0xB130				
	14	0xB138				

4.4.2 Setting stop password

RTC stop password default all 00000000, the authority does not take effect; once modified, re-power the password to take effect

1）Power on

2）Read Memory command reads the data RTC stop password in 0xB130 address

Send：40 B1 B1 30 00 00 00

Recv：00 00 00 00(LSB) default all 00000000

3）Write Memory command set the data RTC stop password in the user configuration area address 0xB130(reference data :0x44332211)

Send：40 B3 B1 30 03 00 00 11 22 33 44

Recv：00 00 00

4）Read Memory command reads the data RTC stop password in the 0xB130 to determine if it is set correctly

Send：40 B1 B1 30 00 00 00

Recv：11 22 33 44(LSB)

5）Write Memory command settings auth_rb_cfg configuration data (reference settings data 0x55) optional

Send：40 B3 B1 38 03 00 00 55 00 00 00（0x00000055）

Recv：00 00 00

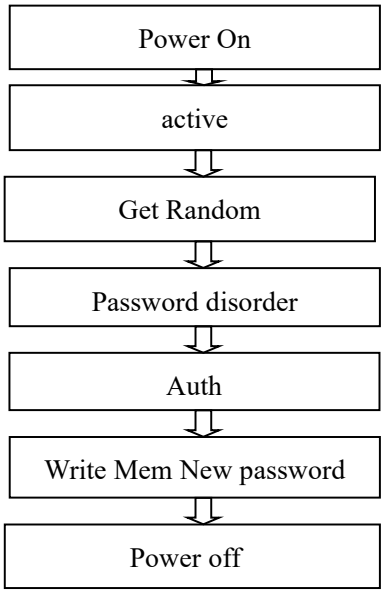
Be aware that auth_rb_cfg data can not be read

6）Power Off

Example:

sector	block	Addr	BYTE			
			3	2	1	0
4	12	0xB130				
	14	0xB138				

4.4.3 Update RTC stop password

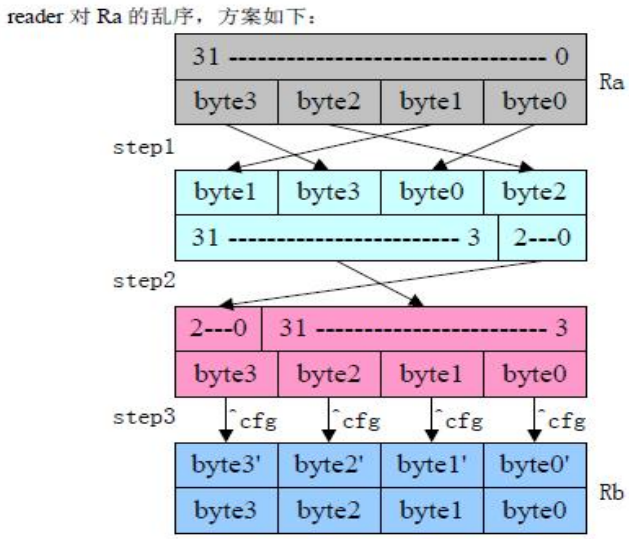


1）Get Random

Send：40 B2 00 00 00 00 00

Recv：00 E9 5E 1B 22 (Ra = 0x221B5EE9)

2）Disorder Principle：



There are 3 steps

Step1：Change the bytes' position；**Step1=0x5E22E91B**

Step2：The all 32bits data is shifted 3 bits to the right position consecutively；**Step2=0x6BC45D23**

Step3：These 32bits data will XOR one byte in the configuration area which named auth_rf_cfg. This byte of data is written into the corresponding configuration area when the tag is initialized. It is suggested to use different data for different chips which can be calculated based on the UID.

Rb=Step3=0x6BC45D23^0x55555555=0x3E910876

Generate a new password:

PW^Rb=0x44332211^0x3E910876=**0x7AA22A67**

3）Auth command (cmd cfg=0x04，Select the type of the password)

Send：40 B4 04 67 2A A2 7A

Recv：00 84 00(passed the password verification)

result=0x0084

Bit7 =1 passed the password verification

Bit[2:0]=100 stop logging password

4）**Write Memory**

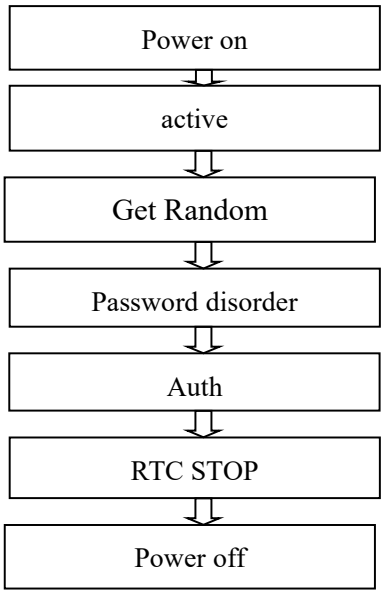
Set the data RTC stop password in the address 0xB130 of the user configuration area (reference data :0x44332211)

Send：40 B3 B1 30 03 00 00 11 22 33 44

Recv：00 00 00

4.4.4 RTC stop Logging

RTC STOP instruction flow is referenced as follows:



ISO14443 Flow:

1）**Get Random**

Send：40 b2 00 00 00 00 00

Recv：00 E9 5E 1B 22 (Ra = 0x221B5EE9)

2）**Disorder Principle：**

There are 3 steps

Step1：Change the bytes' position；**Step1=0x5E22E91B**

Step2：The all 32bits data is shifted 3 bits to the right position consecutively；**Step2=0x6BC45D23**

Step3：These 32bits data will XOR one byte in the configuration area which named auth_rf_cfg. This byte of data is written into the corresponding configuration area when the tag is initialized. It is suggested to use different data for different chips which can be calculated based on the UID.

Rb =0x6BC45D23^0x55555555=0x3E910876

Generate a new password:

PW^Rb=0x44332211^0x3E910876=**0x7AA22A67**

3）**Auth Command** (cmd cfg=0x04，Select the type of the password)

Send：40 B4 04 67 2A A2 7A

Recv：00 84 00(passed the password verification)

result=0x0084

Bit7 =1 passed the password verification

Bit6 =1 means that the password is 0.

Bit[2:0]=100 stop logging password

4）**RTC STOP**

Send：40 C2 80 67 2A A2 7A

Recv：00 00 00

result[1]：1 password verification not passed，high active.

result[0]：1 the value of Stop logging password is 0，high active

Note：

1）RTC STOP Command supports Authority management control, the chip PW default configuration is: 00000000, if modified to non-0, effective.

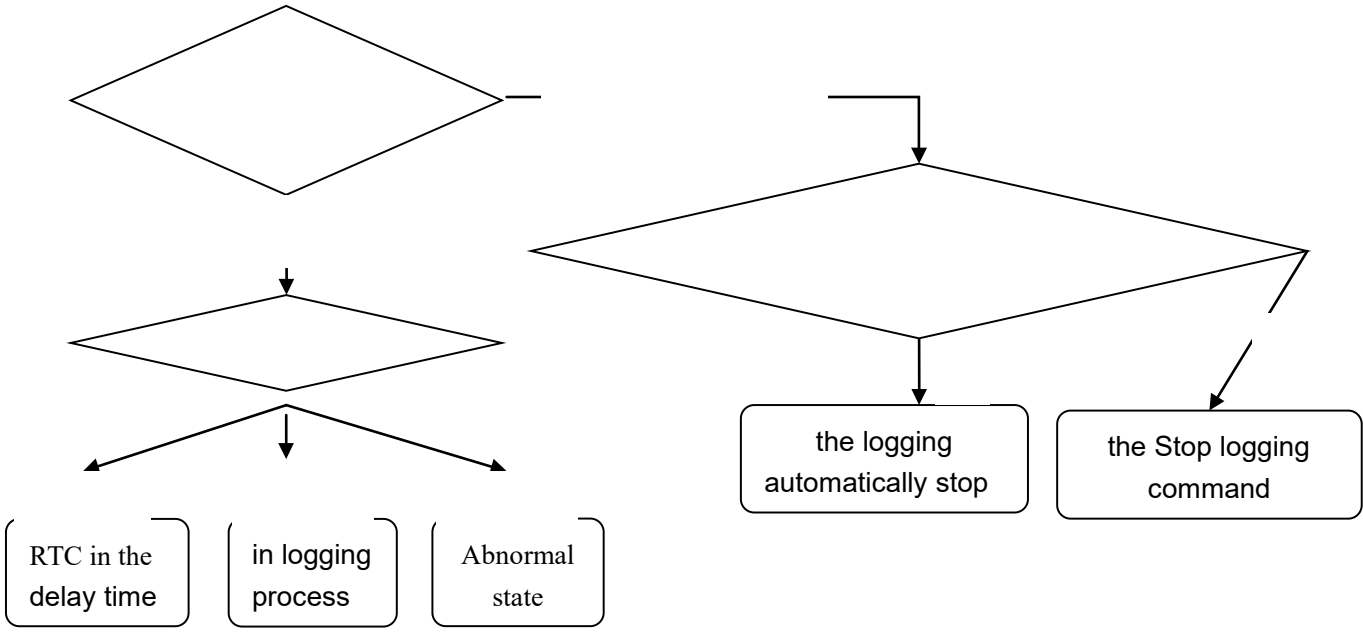
2）A temperature logging process interval time greater than 10 S is recommended

4.6 Read Temperature Data

4.6.1 Read Temperature Measurement State

1）Query user area data

2）Query summury Information



1、Check temperature status

Op_Mode_Chk command is sent to check the current working mode of the chip to confirm that the current chip is in a non-temperature measurement logging process

Send：40 CF 01 00 00 00 00

Recv：00 01 21

Recv：00 01 31

Respond data：0x2101：

Bit12：0-not in logging process，RTC_logging _flag =0

Respond data：0x3101：

Bit12：1- in logging process，RTC_logging _flag =1

2、The chip is in a non-logging process

RTC_logging _flag =0，Indicates that the chip is not in the process of temperature measurement,

Case 1: the logging automatically stop(In standard data storage mode)

query data_area_block_pointer data：

Send：40 B1 B1 88 00 00 00

Recv：63 00 00 14

data_area_block_pointer=0x0063=99

query rtc_cnt_limit data：
Send：40 B1 B0 94 00 00 00
Recv：64 00 00 00
rtc_cnt_limit==0x0064=100

data_area_block_pointer+1= rtc_cnt_limit Indicates the end of temperature measurement

Case 2: the stop logging command (In standard data storage mode)
query data_area_block_pointer data：
Send：40 B1 B1 88 00 00 00
Recv：53 00 00 14
data_area_block_pointer=0x0053=83

query rtc_cnt_limit data：
Send：40 B1 B0 94 00 00 00
Recv：64 00 00 00
rtc_cnt_limit==0x0064=100

Represents 83/100 for a total of 100 times of temperature measurement ,83 times of testing stopped the temperature measurement.

Note: when data_area_block_pointer=0x0063(data_area_block_pointer=99）, the Stop Command is sent, this time because the chip automatically stops in the same state. If you need to distinguish, it is recommended to record a flag in the user area when sending a stop instruction.

3、the chip in the logging process

1）Query reg C094 to check the current temperature state
Send：40 C6 C0 94 00 00 00
Recv：00 00 00 (abnormal state, battery power down during temperature logging process)
Recv：00 20 00 (in logging process)
Recv：00 10 00 (in logging delay process)

2）Query regC091 to record the number of the current logging process
Send：40 C6 C0 91 00 00 00
Recv：00 (logging 0x0053=83 times)

or query data_area_block_pointer data:
Send：40 B1 B1 88 00 00 00
Recv：53 00 00 14
data_area_block_pointer=0x0053=83 (logging 0x0053=83 times)

4.6.2 Query record Information

1、Query startup time

Send：40 B1 01 40 00 00 00

Recv：6

0x60 10 BB E9：2021/01/27 09:03:37

2、Query setting interval time

Send：40 B1 01 14 00 00 00

Recv：0)0 00

0x0201 =513s

3、Query setting delay time

Send：40 B1 01 10 00 00 00

Recv：0)0 00

0x0201 =513m

4.6.3 Read Temperature Measurement Data

DT160 default configuration user zone 1 Kbits, temperature data zone 19 Kbits. DT160 supports up to 8 temperature storage formats, users need to choose which data format to store temperature data before the temperature measurement process begins. The temperature storage data format corresponding to different temperature measurement modes is different, so it is necessary to analyze the temperature data according to the specific situation. By default, standard storage mode ,2 decimal points.

4.6.3.1Normal Mode

4864 temperature data due to actual test due to temperature zone 19K bits

<table>
<tr><th>Mode</th><th>Brief description</th><th>Potential Logging points</th><th>Actual Logging points</th></tr>
<tr><td>normal mode (default)</td><td>There is only one logging data saved in one block in this mode.
<table>
<tr><th>bit31</th><th>bit30-16</th><th>bit15-12</th><th>bit9-0</th></tr>
<tr><td>parity</td><td>time number</td><td>flag</td><td>10 bit temperature value</td></tr>
</table></td><td>Measure and Record point 5120</td><td>Measure and Record point 4864</td></tr>
</table>

Reference is made to the following:

For example: ISO14443 measure 5 times to save the address in the temperature data area

Send Read Memory Command：40 B1 10 00 00 10 00 (Start Address 0x1000，0x10+4=20 data)

Recv：74 40 00 80 74 40 01 00 73 60 02 00 73 C0 03 80 73 C0 04 00

Format stored in the label:

add	bit31-24	bit23-16	bit15-8	bit7-0
0x1000	0x80	0x00	0x40	0x74
0x1004	0x00	0x01	0x40	0x74
0x1008	0x00	0x02	0x60	0x73
0x100C	0x80	0x03	0xC0	0x73
0x1010	0x00	0x04	0xC0	0x73

2 decimal point temperature analysis:

Time 0	0x74	29℃
Time 1	0x74	29℃
Time 2	0x73	28.75℃
Time 3	0x73	28.75℃
Time 4	0x73	28.75℃

3 decimal point temperature analysis:

Time 0	0x74	14.5℃
Time 1	0x74	14.5℃
Time 2	0x73	14.375℃
Time 3	0x73	14.375℃
Time 4	0x73	14.375℃

4.6.3.2 Original data mode

1 、temperature data is stored in the label in the following format:

bit31	bit30	Bit28-16	bit15	bit14	bit12-0
parity	flag	13bit Temperature value1	parity	flag	13bit Temperature value0

Reference is following:

For example: ISO14443 measure 8 times to save the address in the temperature data area

Read Memory instruction to read temperature data:

Send：40 B1 10 00 00 0C 00 （Start Address 0x1000，length 0x000C，16 data ）

Recv：AB 4E AE 4E A6 CE A3 CE A3 CE A2 4E A2 4E A2 4E (LSB)

Measure 8 times save address in temperature data area

add	bit31-24	bit23-16	bit15-8	bit7-0
0x1000	0x4E	0xAE	0x4E	0xAB
0x1004	0xCE	0xA3	0xCE	0xA6
0x1008	0x4E	0xA2	0xCE	0xA3
0x100C	0x4E	0xA2	0x4E	0xA2

For example: Data0 = 0x0EAB （bit0~bit12）data ： 3755

Data1 = 0x0EAE

2、Query current label vdet_a and vdet_b parameters

The vdet_a and vdet_b parameters are saved in the User Configuration Area sector1 add=0xb04C

add	3	2	1	0
0xb04c	vdet_B		vdet_A	

Send ： 40 B1 B0 4C 00 00 00

Recv ： 6E 2C 94 ED (LSB)

vdet_A =0x2C6E vdet_A data: 710.875

vdet_B =0xED94 vdet_B data : -294.75

(The highest bit represents the symbol bit, the high 12 bit is the integer part, the low 4 bit is the decimal part)

3、Query vdet_offset of current label compensation parameters

vdet_offset parameters are saved in the configuration area sector1 block3 in 0xb048

add	3	2	1	0
0xb048	**vdet_offset**		data_area_start_block_pointer	

Send：40 B1 B0 48 00 00 00

Recv：00 00 08 00 (LSB)

vdet_offset =0x0008 vdet_offset data =0.5

(The highest bit represents the symbol bit, the high 12 bit is the integer part, the low 4 bit is the decimal part)

4、Calculation of temperature data

Temperature calculation formula ： **T= vdet_a * cnt / 8192+vdet_b+offset**

1 ）Cnt Data collected and recorded in the bloc kdata0，data1，data2，data3 ，data4 ，，，

T0= vdet_a * cnt / 8192+vdet_b+offset

=710.875*3755/8192-294.75+0.5=31.597 ℃

4.6.4 Query summary data of temperature logging process

sector	block	Addr	BYTE			
			3	2	1	0
6	0	0xb180				
	1	0xb184				

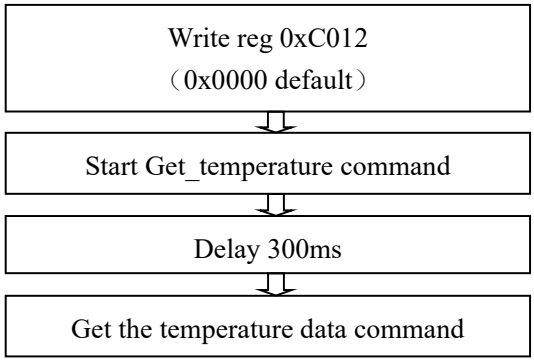
Name	byte size	Function Description
max_temperature[9:0]	2	The maximum temperature data in all of the logging data
min_temperature[9:0]	2	The minimum temperature data in all of the logging data
max_limit_cnt	2	The times of the logging data beyonds the limit threshold which is defined by Max_alarm_limit.
min_limit_cnt	2	The times of the logging data beyonds the limit threshold which is defined by Min_alarm_limit.

Note：This is Optional operation

4.7 Status Check

4.7. Single time temperature measurement

DT160 can measure the temperature by the Get_temperature command single timely. Get temperature command is used to fulfill a single time measurement of the temperature instantly. Two times of command are needed to complete one measurement. The first command is used to start the measuring process; the second command is used to send back the temperature data. The interval between two commands needs to be greater than 300ms to ensure enough measurement time.



Note:
1) single instant temperature measurement is greatly affected by the high frequency field
2) single instant temperature measurement supports active mode and passive mode

T2T Reference Instruction Flow:
1）wrire reg 0xC012 enter temperature measurement mode
Send: 40 C5 C0 12 00 00 00
Recv: 00 00 00

2）first command, start a temperature measurement
cmd cfg para config 0x06：
Bit2：send back the transformed data that represent the actual temperature
Bit1：the field energy check function will be enabled
Send: 40 C0 06 00 00 00 00
Recv: 00 FA FF

3）Delay 300ms

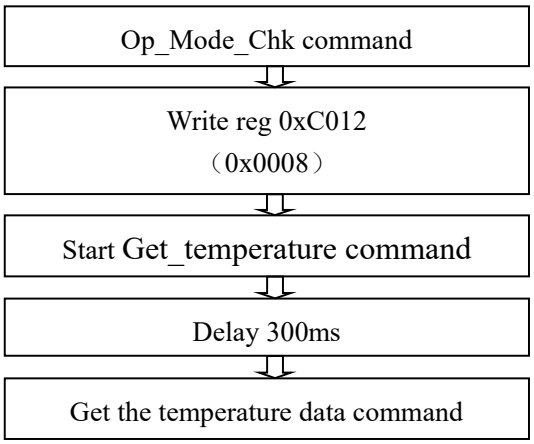
4）second command, get the measurement result
Send: 40 C0 86 00 00 00 00
Recv: 00 76 00 (LSB is sent first. result[9:0]: transformed data that represent the actual temperature)

The measurement result Calculation: 0x0076 /4 = 29.5 ℃ （2 decimal Conditions）

4.7.2 Single time battery voltage measurement

DT160 can complete the measurement of battery voltage by get_temprature instructions.

Battery voltage measurement steps:



T2T Reference Instruction Flow:

1）Op_Mode_Chk command:check the voltage of battery is higher than 0.9V.

Send: 40 CF 01 00 00 00 00

Recv: 00 01 21(LSB is sent first)

0x2101

bit8=1 means that the voltage of battery is higher than 0.9V

bit8=0 means that the battery is not connected

2）write ana_cfg1 reg 0xC012 enter other sensor mode（0xC012 value=0x0008）

Send: 40 C5 C0 12 00 08 00

Recv: 00 00 00

3）first command, start a measurement

cmd cfg para must set 0x12: Battery voltage must be in Original data mode

Send: 40 C0 12 00 00 00 00

Recv: 00 FA FF

4）delay 300ms

5）second command, get the measurement result（cmd cfg=0x92）

Send: 40 C0 92 00 00 00 00

Recv: 00 A9 13 (LSB is sent first)

Battery voltage calculation formula:

0x13A9 / 8192 * 2.5 = 1.53595V

5 Temperature Parameter Configuration

5.1 Temperature Mode Configuration

1. label temperature data storage supports 7 modes, different storage modes meet different Application requirements, storage temperature data format and temperature data quantity are also different. Concrete reference datasheet 3.2.3 data storage format chapter.

Configuration for mode user_cfg0 in the user configuration area, refer to the following:

	add	3	2	1	0
	0xb040	~user_cfg1	user_cfg1	~user_cfg0	user_cfg0
nomal mode		0xD6 **（ones-complement code）**	0x29	0xB3 **（ones-complement code）**	0x4C
Original data mode		0xD6 **（ones-complement code）**	**0x29**	0x23 **（ones-complement code）**	0xDC

Note: Don't write wrong code.

Once a write error occurs, the label can not be identified

2.example:user_cfg0

user_cfg0	[4:2]	temp_format_cfg[2:0] (default 011)	Define the store format of the temperature data: 000：compress mode 0 001：compress mode 1 010：compress mode 2 011：normal mode 100：limit mode 0 101：limit mode 1 110：limit mode 2 111：original data mode

5.2 Standard Data Format Decimal Setting

configuration of 2 decimals, temperature display resolution 0.25 degrees(default)

configuration of 3 decimals, temperature display resolution 0.125 degrees

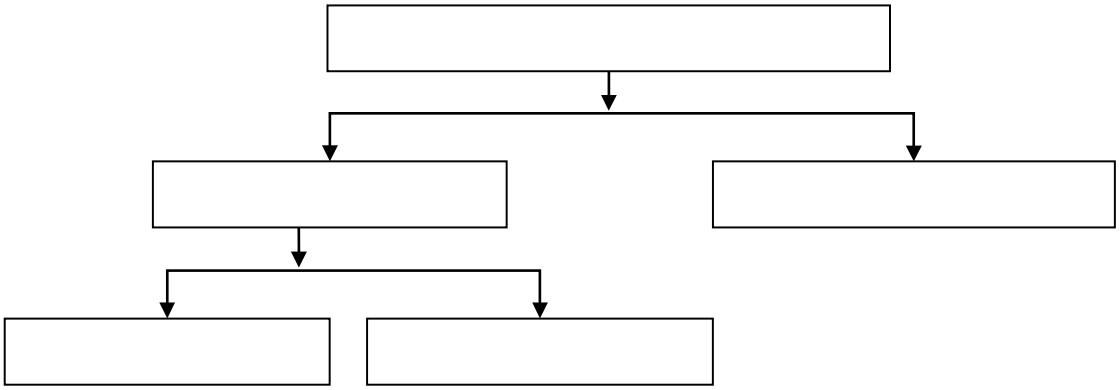
Configuration parameters	**EEPROM add**	**description**
user_cfg0.temp_format_high_preci_en	0xb040~0xb043	Configurate the accuracy of the temperature data when the storage format is in 10bits mode. The default value is "0". 0: The temperature data include 8bits integer and 2bits decimal. 1: The temperature data include 7bits integer and 3bits decimal.

5.3The start point of the address

data_area_start_block_pointer	0xb048 (2bytes)	These 2bytes defines the start point of the address when the temperature data need to be written to the data area in the temperature logging process. For example, if data_area_start_block_pointer=0， the data will be written from the block0 of data area.

Default 0, starting 0x1000 address at the temperature data area

5.4 Reference code flow



1）Query Label Current Mode Configuration

Send: 40 B1 B0 40 00 00 00

Recv: 4C B3 29 D6

2）2 decimal points (0.25℃ temperature display resolution)

The bit7 bit temp_format_high_preci_en in the modified user_cfg0 is 0 and the others remain the same

Send: 40 B3 B0 40 03 00 00 4C B3 29 D6

Recv: 00 00 00

2）3 decimal points (0.125℃ temperature display resolution)

The bit7 bit temp_format_high_preci_en in the modified user_cfg0 is 1 and the others remain the same

Send: 40 B3 B0 40 03 00 00 CC 33 29 D6

Recv: 00 00 00

6 Lock

sector1~sector3 supports the LOCK function, and the rewriting authority of the LOCK is controlled by the sector_lock. When the sector_lock is valid, the corresponding configuration area is locked to read-only, and the user can not modify the configuration data.

sector_lock control rewriting, need to pass the unlock password authentication, if passed the authentication, the power on process of sector_lock failure, users can rewrite the configuration information in the sector1~sector3.

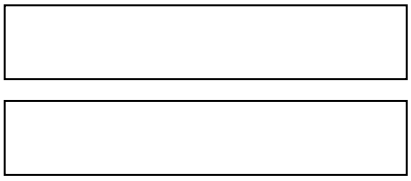
Sector	block	addr	3	2	1	0
Sector1	15	0xb07c	sector1_lock		RFU	RFU
Sector2	15	0xb0bc	Sector2_lock		RFU	RFU
Sector3	15	0xb0fc	Sector3_lock		RFU	RFU
Sector4	11	0xb12c	unlock password			

sector1_lock/ sector2_lock /sector3_lock：The lock byte of sector

8'h5a : The sector1 will be locked to be readonly.

other :The sector1 is not locked.

6.1 Lock Process reference



1、Effect Lock Fuction:Modify the unlock password of 0xb12c in the Sector4 to incomplete 0, such as :11223344

Send：40 B3 B1 2C 03 00 00 11 22 33 44

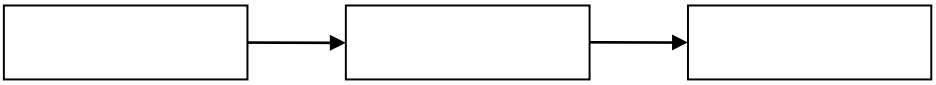
Recv：00 00 00

2、Lock the corresponding sector,such as sector1_lock,sector1_lockis 0x5A

Send：40 B3 B0 7C 03 00 00 00 00 00 5A

Recv：00 00 00

6.2 Unlock/update unlock password



1、Get Random

Send：40 B2 00 00 00 00 00

Recv：00

2、Auth unlock

Send：40 B4 03 (Disorder Xor operation Based on actual situation)

Recv：00 83 00

7 Other Function

7.1 Data conversion format reference

1、Offset data conversion 16bit data

Temperature calculation formula：

T=vdet_a*x(t)+vdet_b+offset

Offset address ： 0xb04A

Sector	Addr	BYTE			
		3	2	1	0
Sector1	0xB048	Vdet_offset			

The high 12bits is the integer part and the low 4bits is the decimal part. The MSB is the symbol bit.

Examples:

Negative:

data ： 0xFFEB

1111 1111 1110 1011 Conversion binary

000 0000 0001 0101 Not add 1

000 0000 0001 integer 1

0101 Decimal 0.5*0+0.25*1+0.125*0+0.0625*1=0.3125

Data ： -1.3

Positive:

Data ： 0x26aa

Conversion binary ： 0010 0110 1010 1010

010 0110 1010 integer 618

1010 Decimal 0.5*1+0.25*0+0.125*1+0.0625*0=0.625

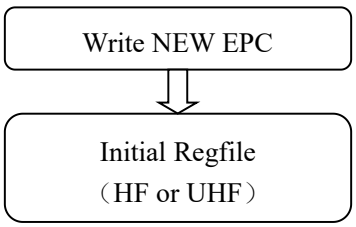
Data ： 618.625

Note: Standard temperature data storage mode 10 bit data

7.2 EPC Update

1、When the battery is reset, the Initial Regfile instruction must be executed, otherwise the UHF interface reading EPC is all 0.

2、Update EPC



7.1 LED Configuration Usage Note

Lighting LED has two functions (only for DFN10 packaging chips):

First, the LED will be lightened to give a message that logging process is running normally after a single step measurement has finished.

Second, overtemperature alarm, when the measured temperature over the limit, can let the LED flicker several times.

1、user_cfg0 IO_pad_cfg[1:0] Select 01: Light the off-chip LED

Cfg	bit	bit name	description
user_cfg0	[1:0]	io_pad_cfg [1:0] (default 00)	Define IO/IRQ pad's function： 00：RFU 01：Light the off-chip LED 10：Send an interrupt signal to the off-chip MCU 11：Analog signal input, used to receive the off chip sensor's measurement result.

2、sector1 address= 0xb060，LED_mode_cfg1 Configure flicker time，example 0x03

sector	block	addr	BYTE			
			3	2	1	0
1	0	0xb060	filed_chk_cfg	led_mode_cfg1	led_mode_cfg2	RFU

Name	Size （byte）	Function Description		
led_mode_cfg	2	Used to set the flash mode of the LED in logging process.		
		led_mode_cfg 1	[7:4]	RFU
			[3:0]	vdet_flash_len_cfg[3:0] Definition of the duration time of LED lighting which starts after the single step measurement has just completed in the temperature logging process. t=(cfg+1)*100ms
		led_mode_cfg 2	[7:4]	vdet_limit_times_cfg[7:4] Definition of times of LED flash as a warning message when the logging temperature is over the limit threshold.
			[3:0]	vdet_limit_len_cfg[3:0] Definition of the pulse width of LED flash when the logging temperature is over the limit threshold. t=(cfg+1)*100ms

3、user_cfg1 Led_auto_flash_en (default 1) ：

Cfg	bit	bit name	description
user_cfg1	[5]	Led_auto_flash_en (default 1)	Define If the LED will be lightened to give a message that logging process is running normally after a single step measurement has finished. 0: disable 1: enable

Demo Reference Configuration

address 0xb040：4C b3 29 D6

update ：4D b2 29 D6

0xb060 ：00 00 00 00

update ：00 00 03 00

8 ISO14443 Commands

8.1 Overview

Code	Name	description
General command		
0x26	reqa	Refer to ISO/IEC 14443-3
0x52	wupa	Refer to ISO/IEC 14443-3
0x93	anti/select level1	Refer to ISO/IEC 14443-3
0x95	anti/select level2	Refer to ISO/IEC 14443-3
0x30	read	Refer to ISO/IEC 14443-3
0x3a	fast read	Refer to ISO/IEC 14443-3
0xa2	write	Refer to ISO/IEC 14443-3
0xa0	compatibility write	Refer to ISO/IEC 14443-3
0xc2	sector select	Refer to ISO/IEC 14443-3
0x50	halt	Refer to ISO/IEC 14443-3
0x40	selfdef_cmd	Customed commands
Customed commands		
40 b1	Read Memory	Customed read memory command is used to read the temperature data out of the EEPROM one time.
40 b2	Get Random	Get random command is used to get the 32bits random number from the chip.
40 b3	Write Memory	Customed write memory command is used to write data into all of the area of the EEPROM that has write authority.
40 b4	Auth	Auth command is used to verify the password.
40 C0	Get Temperature	Get temperature command is used to fulfill a single measurement of the temperature instantly.
40 C2	Start logging	Start logging command used to start a temperature logging process
40 C2	Stop logging	Stop logging command used to clear the RTC logging flag in the logging process.
40 C3	Deep Sleep	The chip will enter PD(power down) mode when Deep sleep command received.
40 C4	Wake up	To configure parameters used in the RTC logging process, the chip should quit the PD mode when received Wake up command from HF interface
40 C5	Write Reg	Write reg command is used to write information into the RTC relevant register.
40 C6	Read Reg	Read reg command is used to read the RTC relevant register's value.
40 C9	Led Ctrl	Led ctrl command is used to control the off chip LED's lighting or not.
40 CF	Op_Mode_Chk	Op_Mode_Chk is used to check the chip's current operation mode or refresh the temperature logging process's configuration.
40 D0	**F**ield_Strength_Chk	Field_strength_chk command is used to measure the HF field strength that helps to estimate if the field will affect the temperature measurement's accuracy.
40 CE	Initial Regfile	In the semi-active mode, this command is used to initialize the value of the register under the battery power domain including EPC code of UHF

8.2 Instruction reference

1、Write Reg（example:C012）

Send ： 40 C5 C0 12 22 11 00

Recv ： 00 00 00

Note:

1）Make sure the chip quit the PD mode before writing the Battery power domain reg

2）High bytes of data to be written 0x2211 the first

2、Read Reg（example:C012）

Send ： 40 C6 C0 12 00 00 00

Recv ： 00 11 22

Note:

A low byte returns when read, returning data 0x2211

3、Read Memory:

Send ： 40 B1 00 14 00 00 00（read address 0x0014 data, data length 4）

Recv ： 92 09 0A 64 (LSByte is sent firs)

Note:

1）Start Address and Read length must increment by blocks (4bytes per block).

2）The instruction response data does not contain flag

4、Write Memory:

Send ：40 B3 00 14 03 00 00 11 22 33 44（write address 0x0014 ,length 0x04 ,data 0x44332211）

Recv ： 00 00 00 （write success）

Recv ： 00 02 00 （lock ,no write permission）

Note：

1）Data Number is the length of the data that need to be written into EEPROM. The unit is byte. The maxium length is 4bytes.

5、Field_strength_chk

Send ： 40 D0 00 00 00 00 00

Recv ： 00 86 00

0x0086 Minimum 4 Bit Data(LSB) 6 indicates small field power for reference

6、Op_Mode_Chk

Send ： 40 CF 01 00 00 00 00

Recv ： 00 01 21 （LSB 0x2101）

7、init Regfile

Send ： 40 CE 00 00 00 00 00

Recv ： 00 00 00

8、Led ctrl

LED ON Send ： 40 C9 02 00 00 00 00

Recv ： 00 00 00

LED OFF Send ： 40 C9 00 00 00 00 00

Recv ： 00 00 00

9、Sleep

Send：40 C3 01 00 00 00 00

Recv：00 00 00

Parameter 0x01: the chip enters PD mode, note that this parameter is only valid during non-temperature measurement

10、Get Random

Send：40 B2 00 00 00 00 00

Recv：00 E9 5E 1B 22 （LSB Ra = 0x221B5EE9）

11、Auth

Send：40 B4 03 0

Recv：00 C3 00

Recv：00 03 00

1、When the relevant password is set, the Get Random instruction is required to send before the Auth instruction

2、When the relevant password is not set,

Parameter 03 ： unlock password

Respond 0x00C3 ：

Bit7 ： 1-auth success；0-auth fail

Bit6 ： 1-password all 0 ； 0-the password is not all 0.

Bit[2 ： 0]：011 ， 3-unlock password

Send：40 B4 04 0

Recv：00 C4 00

Parameter 04： stop logging password

Respond 0x00C4：

Bit7: 1-auth success；0-auth fail

Bit6: 1-password all 0 ； 0-the password is not all 0.

Bit[2：0]: 100，4-stop logging password

9 Attentions

1、update the data of the user configuration area(User_cfg), pay attention to the positive and ones-complement code do not write wrong.If wrong, the reader can not identify the UID of the label after the label is re-energized

	add	3	2	1	0
	0xb040	~user_cfg1	user_cfg1	~user_cfg0	user_cfg0
Normal mode		0xD6 （ones-complement）	0x29	0xB3 （ones-complement）	0x4C
Original data mode		**0xD6** （ones-complement）	**0x29**	**0x23** （ones-complement）	0xDC

2、when the battery voltage is below 0.9 V for dual-frequency chip ,the RF interface can not Identification the UID.