思澈方案外发 NAND 烧录

1.nand flash BBM(坏块管理策略)

(1)坏块跳过策略:遇到坏块跳过，存放进好块里。
(2)坏块替换策略:替换之后，FTL 会将坏块地址重新映射到好块地址，
基于 NAND Flash 来讲，用 SA 区中的好块替换坏块。SpareArea(SA 区)一般用来标记坏块，和保存对 main 区数据的 ECC 校验码。是基于 NAND Flash 的概念。

思澈方案保留给 BBM(坏块管理)的大小为 flash 总大小的 1/32，

例：

512Mb flash 烧录包大小为 490Mb，最后 16Mb 是没有固件的。需要烧录厂按照思澈的坏块管理策略写入相应坏块地址跟映射地址。

512Mb ： 0x400 0000

固件烧录地址：从 0x0 开始到 0x3E0 0000

BBM(坏块管理地址)：0x3E0 0000 到 0x400 0000 结束

```
#define BBM_MAGIC_NUM                (0x5366424d)

typedef struct
{
    uint16_t logic_blk;     // logic block number
    uint16_t physical_blk;  // physical block number
} Sifli_MapTbl;

typedef struct
{
    uint32_t magic;// magic number to decalare bbm talbe, 0x5366424d
    uint32_t version: 31;
    uint32_t tbl_idx: 1; // 0:TBL1, 1:TBL2
    uint16_t bbk_num; // bad block number
    uint16_t free_blk_num;// free block number
    uint16_t free_blk_start; // free block start addr, it will be used for next map.
    uint16_t reserv_blk_start; // start block number for reverved spare
    uint32_t hdr_crc; // crc for this table before this member
    uint32_t tbl_crc; // map table crc
    Sifli_MapTbl stru_tbl[64 - 4]; // max support 64 block backup
} Sifli_NandBBM; //Nand Flash Bad block management
```

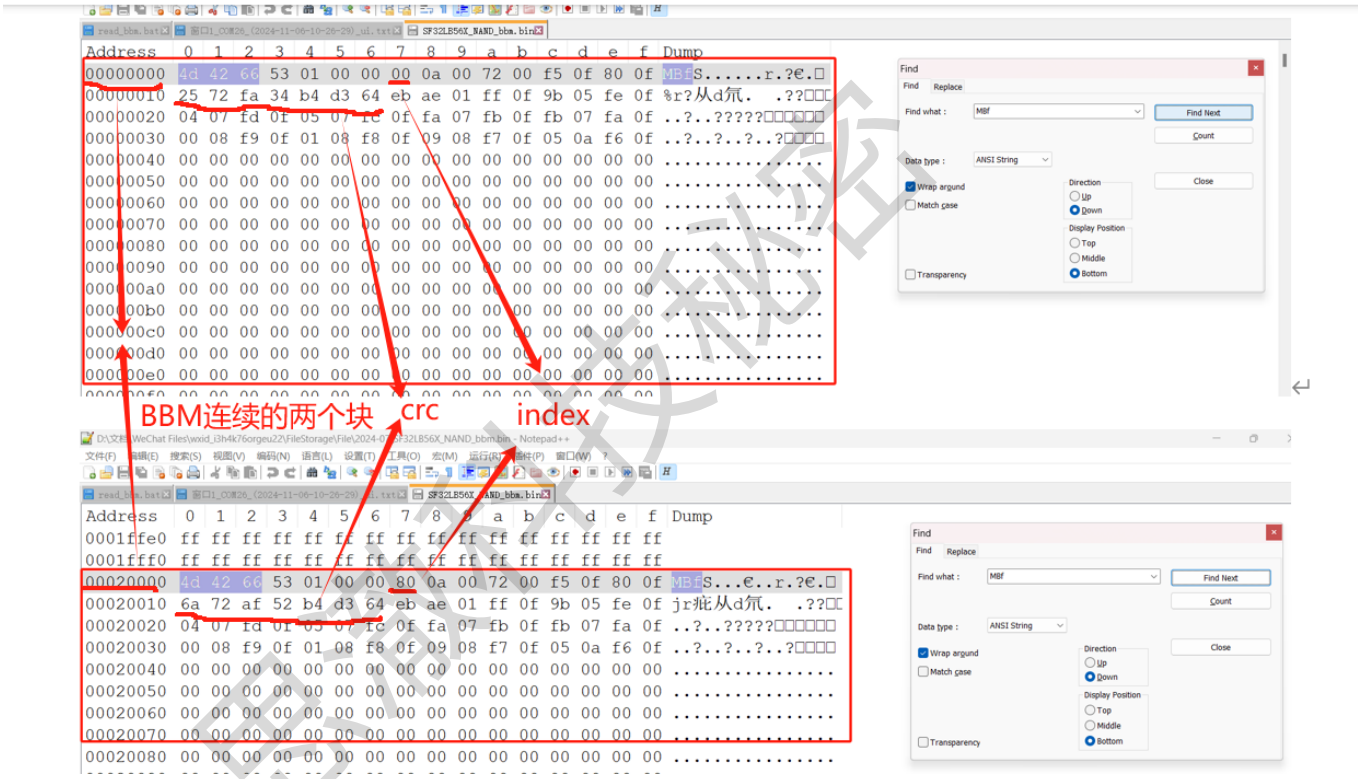
（映射表的数据结构）

2.BBM(坏块管理)规则

2.1.从 0x3e0 0000 开始连续两个块，除了 index 和 CRC 值其他的内容都应该相同

保留区从前往后数，在遇到的第一个 good block 创建映射表格，第二个 good block 创建备份映射表格

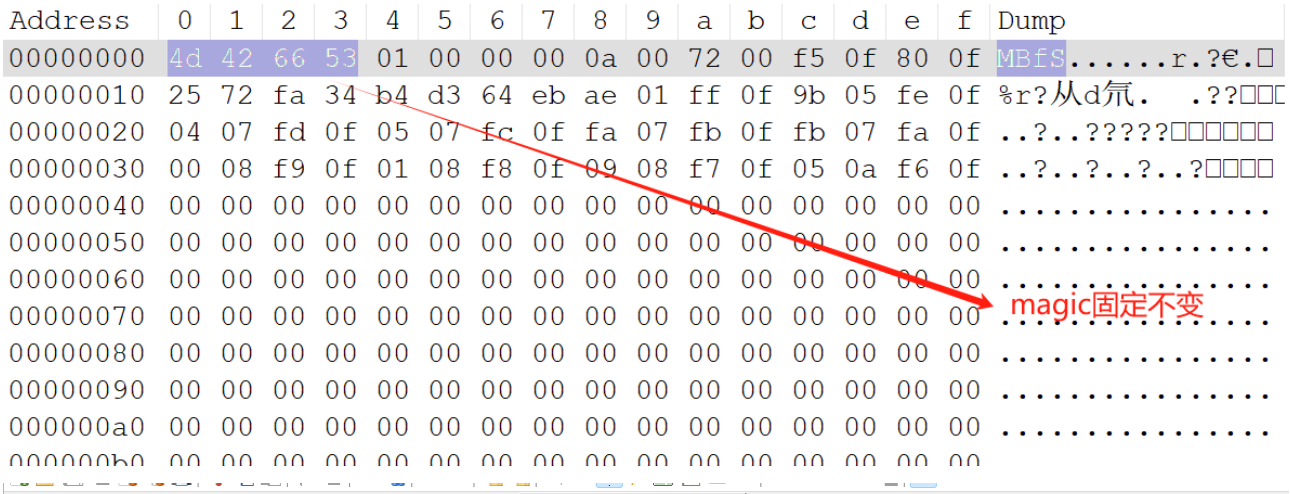
如图数据是从 BBM(坏块管理区域)读取的数据

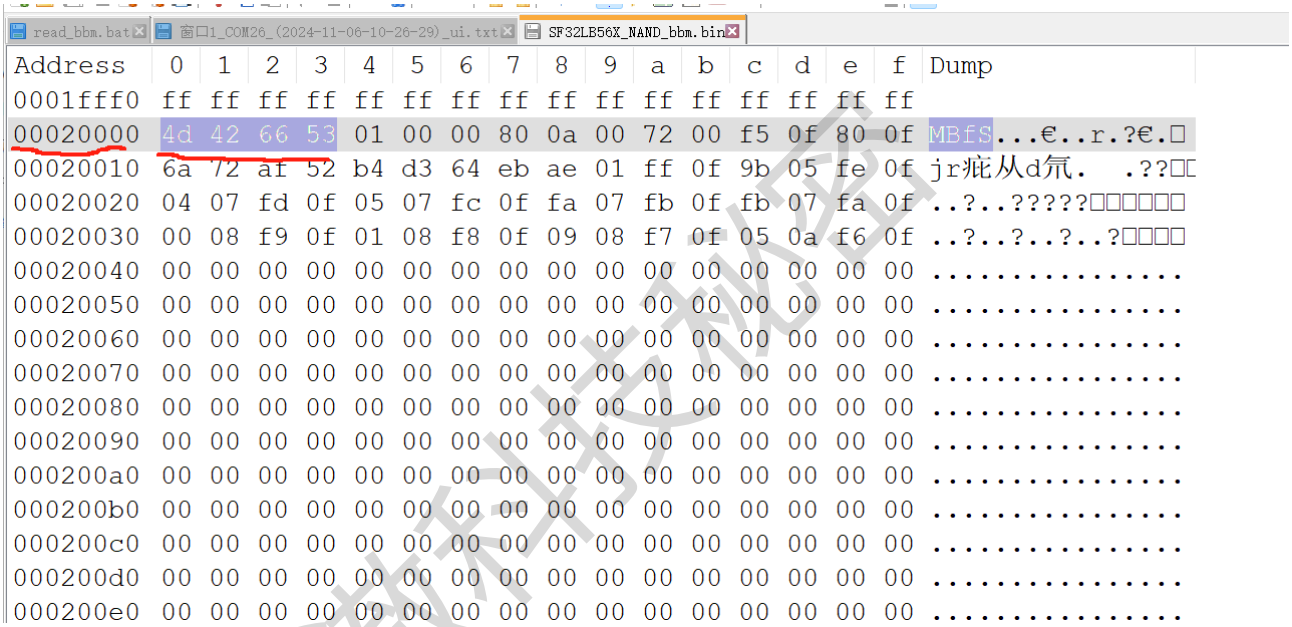


2.2.BBM(坏块管理)数据

1. magic 固定不变，前后两个块都是一样的。

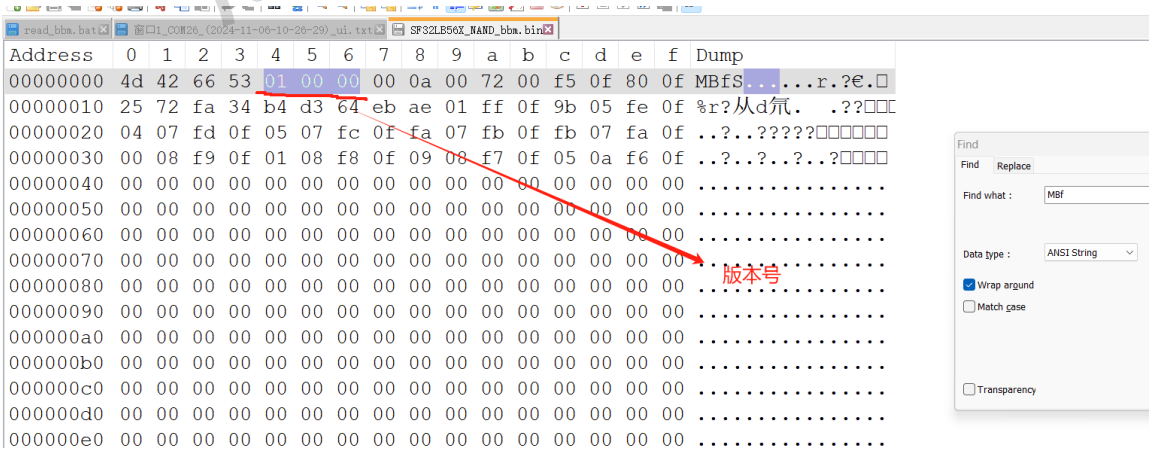
Magic: 坏块管理表的 magic number, 固定为 0x5366424D

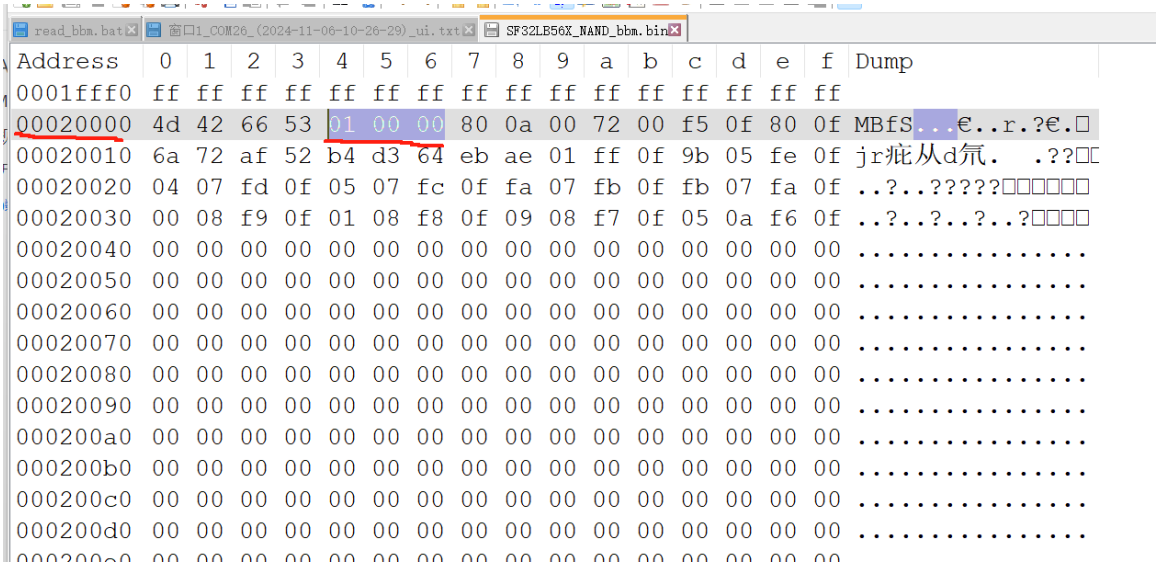




2.version 版本号从 1 开始，前后两个块都是一样的，烧录厂烧录默认写

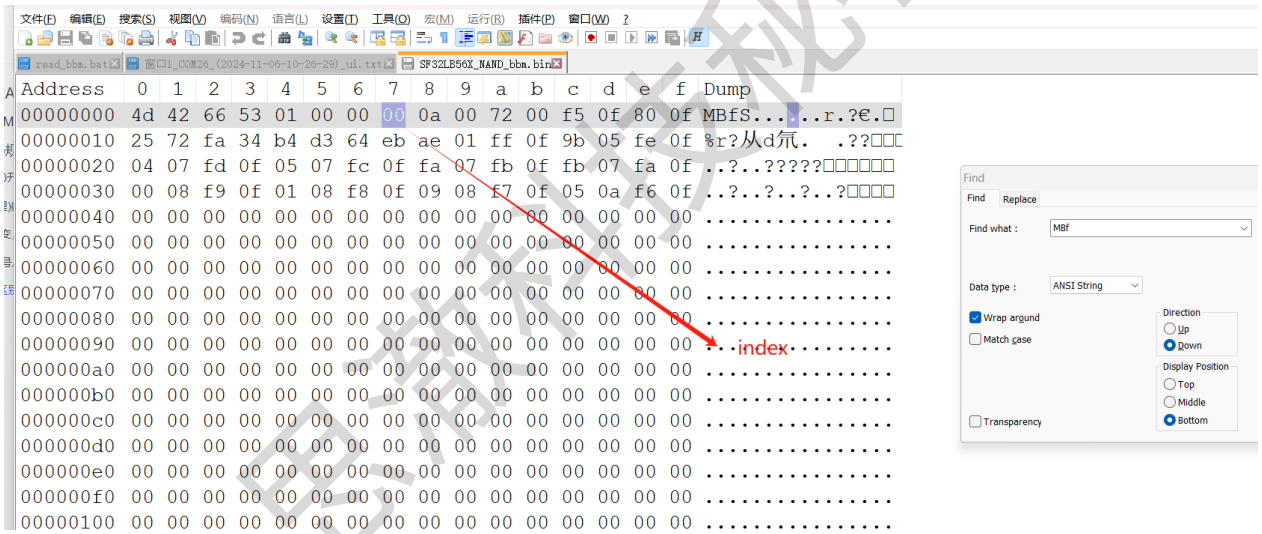
1 就行





Address	0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f	Dump
0001fff0	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	
00020000	4d	42	66	53	01	00	00	80	0a	00	72	00	f5	0f	80	0f	MBfS...€..r.?€.□
00020010	6a	72	af	52	b4	d3	64	eb	ae	01	ff	0f	9b	05	fe	0f	jr疵从d氖. .??□□
00020020	04	07	fd	0f	05	07	fc	0f	fa	07	fb	0f	fb	07	fa	0f	..?..?????□□□□□□
00020030	00	08	f9	0f	01	08	f8	0f	09	08	f7	0f	05	0a	f6	0f	..?..?..?..?□□□□
00020040	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00020050	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00020060	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00020070	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00020080	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00020090	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000200a0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000200b0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000200c0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000200d0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....

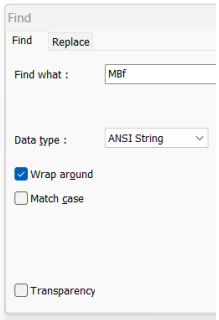
3. index 这里有区别，前面的块区里固定是 0x0.后面一个块区固定为 0x80



Address	0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f	Dump
00000000	4d	42	66	53	01	00	00	00	0a	00	72	00	f5	0f	80	0f	MBfS...r.?€.□
00000010	25	72	fa	34	b4	d3	64	eb	ae	01	ff	0f	9b	05	fe	0f	%r?从d氖. .??□□□
00000020	04	07	fd	0f	05	07	fc	0f	fa	07	fb	0f	fb	07	fa	0f	..?..?????□□□□□□
00000030	00	08	f9	0f	01	08	f8	0f	09	08	f7	0f	05	0a	f6	0f	..?..?..?..?□□□□
00000040	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000050	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000060	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000070	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000080	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000090	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000000a0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000000b0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000000c0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000000d0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000000e0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000000f0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000100	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....

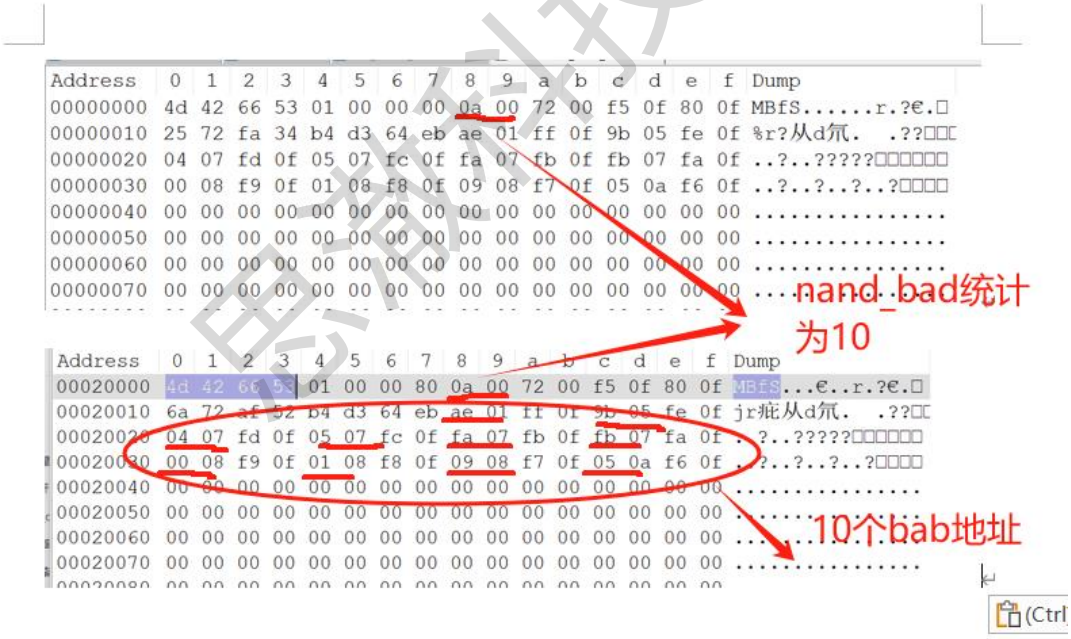
read_bbm.bat | 窗口1_COM26_(2024-11-06-10-26-29)_ui.txt | SF32LB56X_NAND_bbm.bin

Address	0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f	Dump
0001fff0	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	ff	
00020000	4d	42	66	53	01	00	00	80	0a	00	72	00	f5	0f	80	0f	MBfS...€..r.?€.□
00020010	6a	72	af	52	b4	d3	64	eb	ae	01	ff	0f	9b	05	fe	0f	jr疵从d氖. .??□□
00020020	04	07	fd	0f	05	07	fc	0f	fa	07	fb	0f	fb	07	fa	0f	..?..?????□□□□□□
00020030	00	08	f9	0f	01	08	f8	0f	09	08	f7	0f	05	0a	f6	0f	..?..?..?..?□□□□
00020040	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00020050	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00020060	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00020070	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00020080	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00020090	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000200a0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000200b0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000200c0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000200d0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000200e0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
000200f0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00020100	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00020110	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....



4. bbk_num（坏块数量），烧录时记录的坏块数量。前后两个块都是一样的

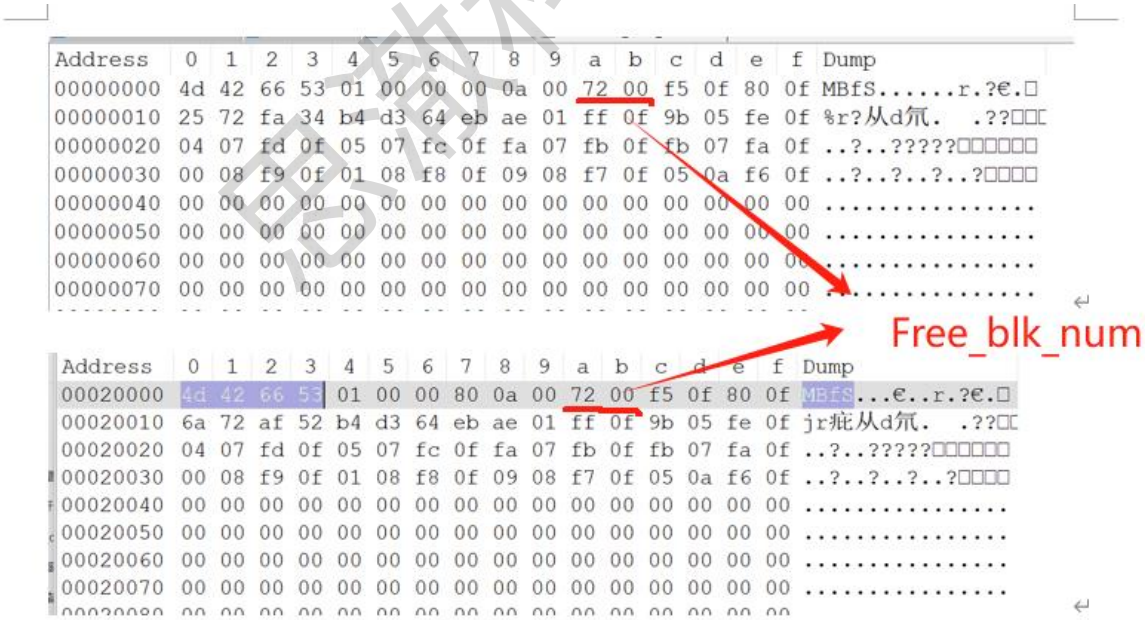
Bbk_num: 当前统计到的坏块数量，当未发现坏块时为 0.



5. Free_blk_num：目前空闲的可以用来做替换的块的数量，当未发生过映射处理时数据应该为总保留块数减 4（保留 4 个块用来保存管理表信息）

如下图：0x72（Free_blk_num）+ 0x0a（bbk_num）+ 0x04（保留 4 个块）= 128 个块

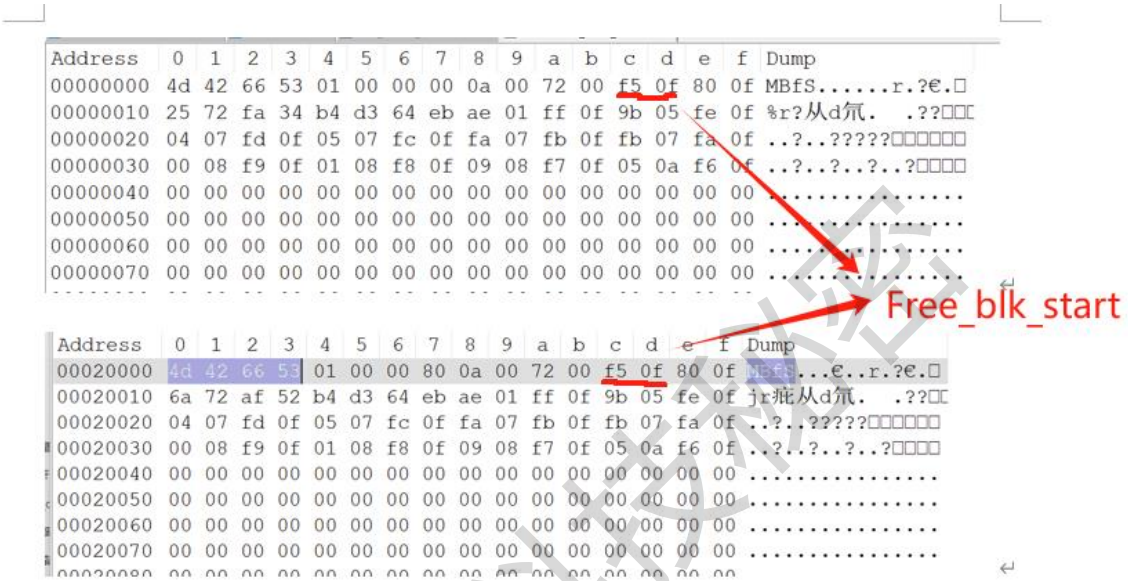
512M flash 有 4096 个块，128 个块是 1/32.



6. Free_blk_start: 可用来做替换的表的块号，这是个递减的数据，替换块从后往前找（如果未发生过替换，则应该为总块数减 1， 比如 1024 个块的颗粒，初始值应该为 1023）

如下图：0x0ff5(Free_blk_start) + 1 + 0x0a（bbk_num）= 4096 个块

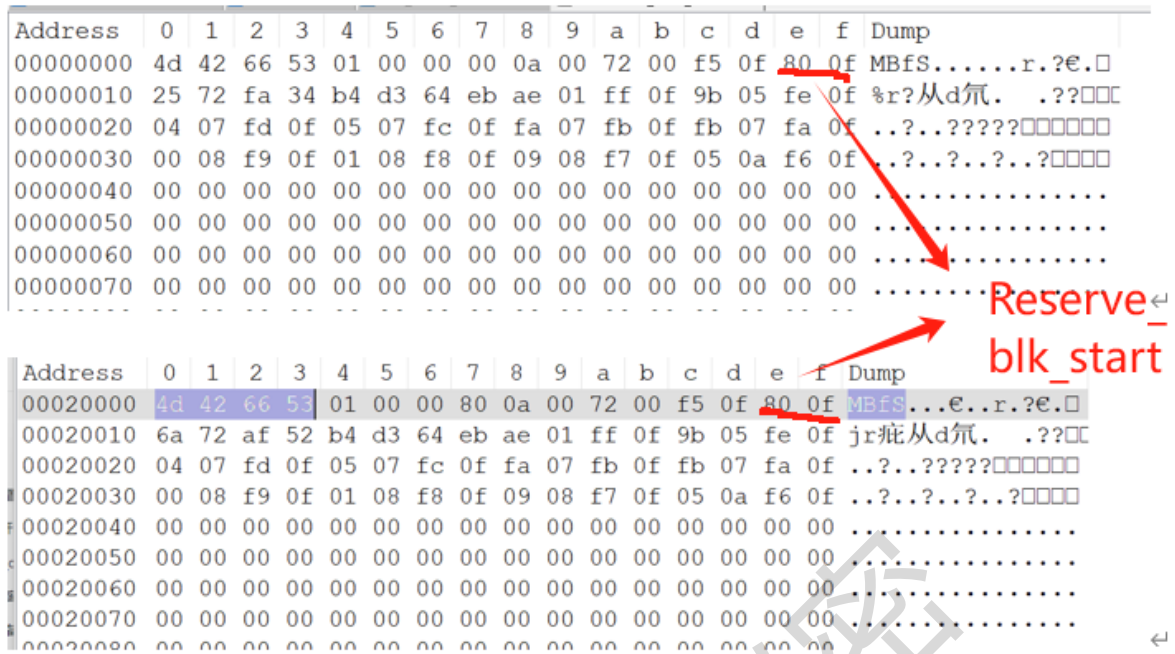
512M flash 有 4096 个块，128 个块是 1/32.



7. Reserve_blk_start: 保留块的第一个块号，比如 1024 个块，最后 32 个块保留的话，则此数据为 992， 这个数据不会更新。

如下图：4096 - 128 = 0x0f80(Reserve_blk_start)

512M flash 有 4096 个块，128 个块是 1/32.

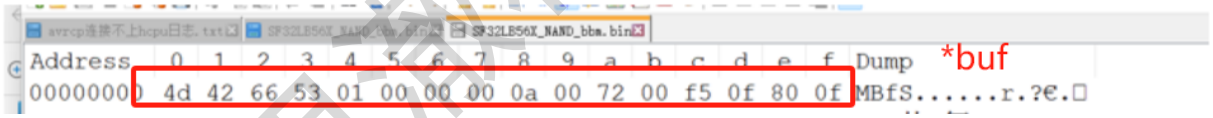


8. Hdr_crc: 保存此字段之前的数据的 CRC 校验值（从 magic 开始的 16 个字节）

算法 api：Static uint32_t bbm_crc_check(const uint8_t *buf, uint32_t size)

代码公式：bbm_local[0].hdr_crc = bbm_crc_check((const uint8_t *)(&bbm_local[0]), 16);

实际值：const uint8_t *buf = 0x4d426653010000000a007100f50f800f



uint32_t size = 16

9. Tbl_crc: 后面 stru_tbl 字段的 CRC 校验值（长度为 4 *（保留块数-4））

注意 stru_tbl 有新老驱动区别，老的是 64-4.新的是 128-4

算法 api：Static uint32_t bbm_crc_check(const uint8_t *buf, uint32_t size)

代码公式：bbm_local[0].tbl_crc = bbm_crc_check((const uint8_t *)(&(bbm_local[0].stru_tbl)), sizeof(Sifli_MapTbl) * (bkup_blk - 4));

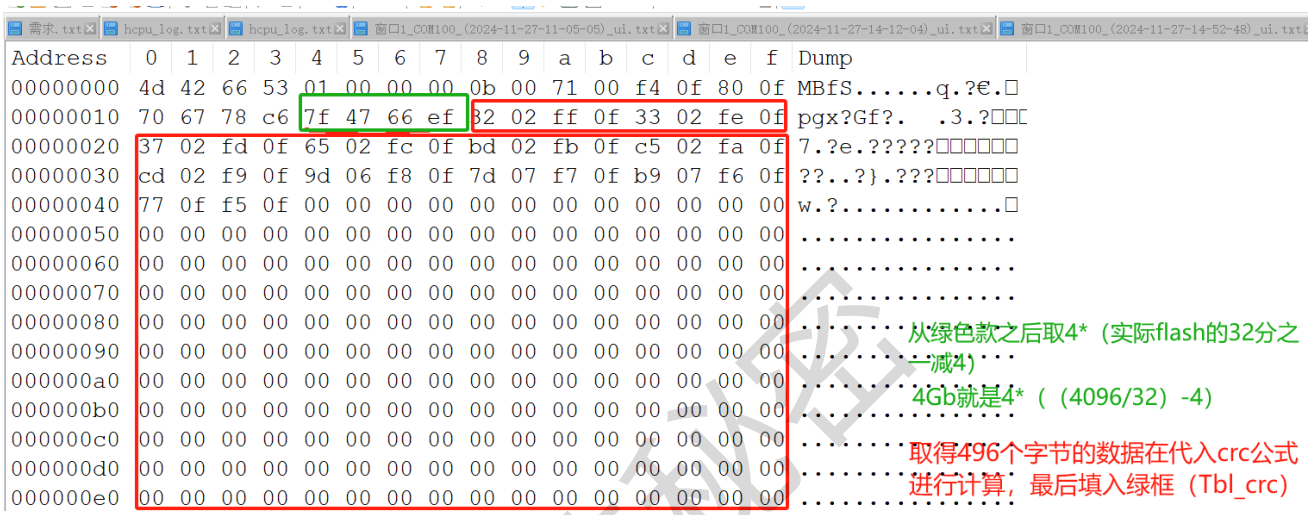
实际值：const uint8_t *buf = bbm_local[0].stru_tbl[cnt].logic_blk = bblk; //目前字段的逻辑块编号，对烧录来说就是最后 32/1 开始的这块号。4096 -128 = 3968

bbm_local[0].stru_tbl[cnt].physical_blk = bbm_local[0].free_blk_start + 1 ; //可用来做替换的表的块号+1

bkup_blk = //保留的用来做映射的块，老代码最大支持 2Gb 所以是 2048/32=64，新代码最大支持 4Gb 所有是 4096/32=128

uint32_t size = 4*（128-4）//新驱动代码最大支持 4G

uint32_t size = 4*（64-4）//旧驱动代码最大支持 2G



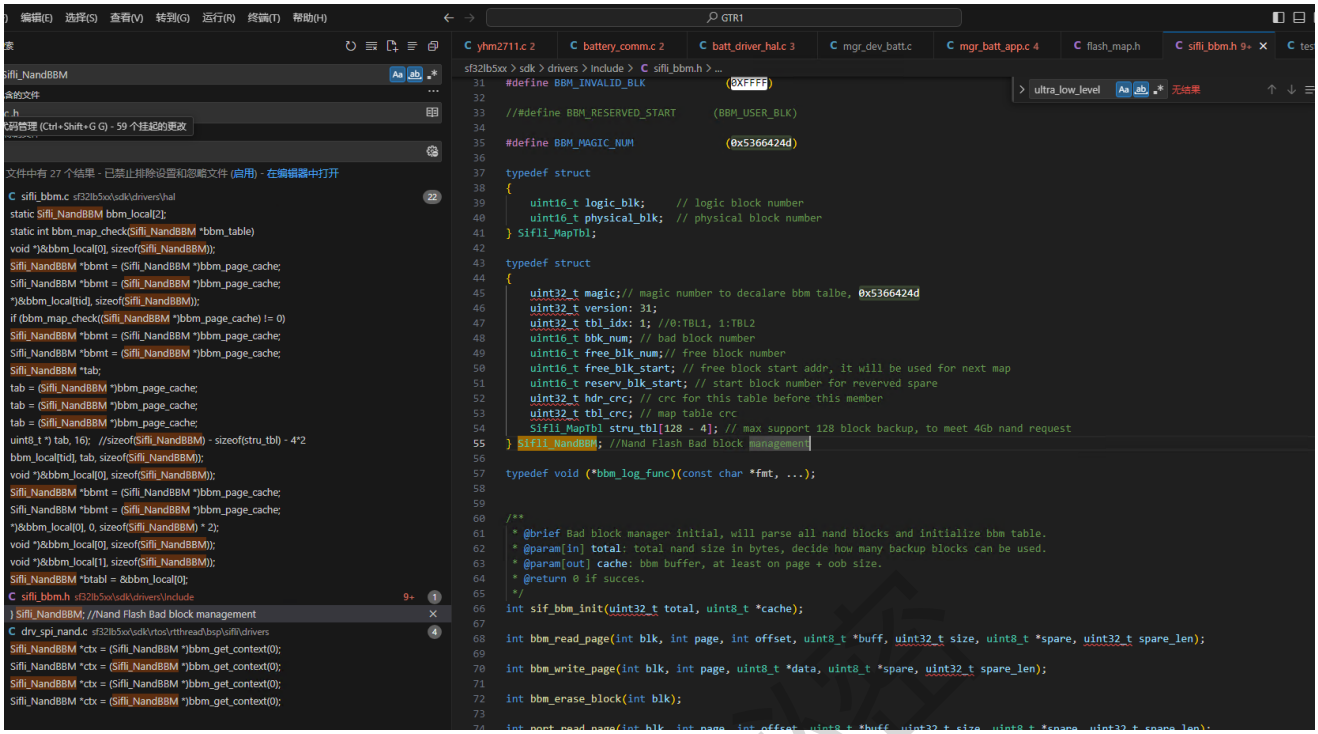
Address	0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f	Dump
00000000	4d	42	66	53	01	00	00	00	0b	00	71	00	f4	0f	80	0f	MBfS......q.?€.□
00000010	70	67	78	c6	7f	47	66	ef	32	02	ff	0f	33	02	fe	0f	pgx?Gf?. .3.?□□□
00000020	37	02	fd	0f	65	02	fc	0f	bd	02	fb	0f	c5	02	fa	0f	7.?e.?????□□□□□□
00000030	cd	02	f9	0f	9d	06	f8	0f	7d	07	f7	0f	b9	07	f6	0f	??..?}.???□□□□□□
00000040	77	0f	f5	0f	00	00	00	00	00	00	00	00	00	00	00	00	w.?.............□
00000050	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
00000060	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
00000070	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
00000080	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
00000090	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
000000a0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
000000b0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
000000c0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
000000d0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
000000e0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....

从绿色款之后取4*（实际flash的32分之一减4）

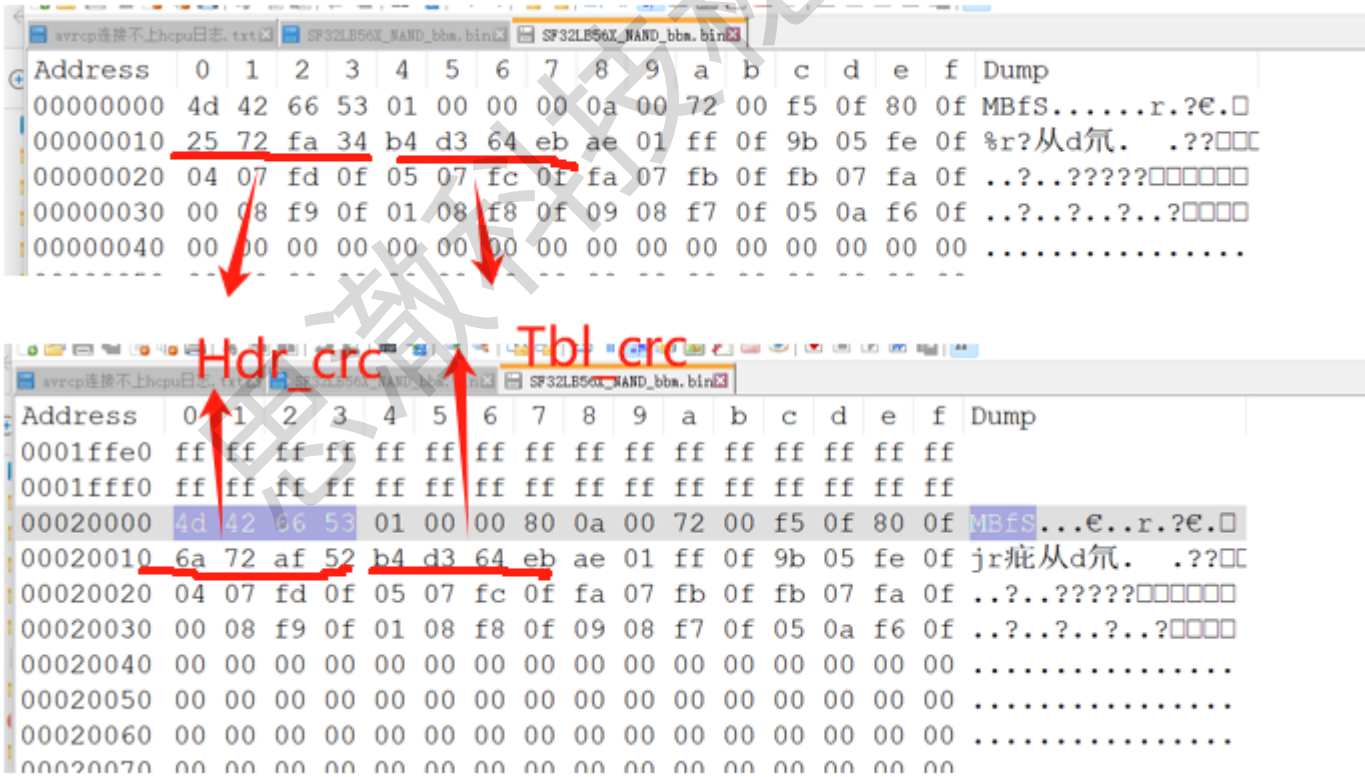
4Gb就是4*（（4096/32）-4）

取得496个字节的数据在代入crc公式进行计算，最后填入绿框（Tbl_crc）

```
#define BBM_MAGIC_NUM               (0x5366424d)

typedef struct
{
    uint16_t logic_blk;     // logic block number
    uint16_t physical_blk;  // physical block number
} Sifli_MapTbl;

typedef struct
{
    uint32_t magic;// magic number to decalare bbm talbe, 0x5366424d
    uint32_t version: 31;
    uint32_t tbl_idx: 1; // 0:TBL1, 1:TBL2
    uint16_t bbk_num; // bad block number
    uint16_t free_blk_num;// free block number
    uint16_t free_blk_start; // free block start addr, it will be used for next map.
    uint16_t reserv_blk_start; // start block number for reverved spare
    uint32_t hdr_crc; // crc for this table before this member
    uint32_t tbl_crc; // map table crc
    Sifli_MapTbl stru_tbl[64 - 4]; // max support 64 block backup
} Sifli_NandBBM; //Nand Flash Bad block management
```



```
#define BBM_INVALID_BLK             (0XFFFF)

//#define BBM_RESERVED_START      (BBM_USER_BLK)

#define BBM_MAGIC_NUM               (0x5366424d)

typedef struct
{
    uint16_t logic_blk;     // logic block number
    uint16_t physical_blk;  // physical block number
} Sifli_MapTbl;

typedef struct
{
    uint32_t magic;// magic number to decalare bbm talbe, 0x5366424d
    uint32_t version: 31;
    uint32_t tbl_idx: 1; //0:TBL1, 1:TBL2
    uint16_t bbk_num; // bad block number
    uint16_t free_blk_num;// free block number
    uint16_t free_blk_start; // free block start addr, it will be used for next map
    uint16_t reserv_blk_start; // start block number for reverved spare
    uint32_t hdr_crc; // crc for this table before this member
    uint32_t tbl_crc; // map table crc
    Sifli_MapTbl stru_tbl[128 - 4]; // max support 128 block backup, to meet 4Gb nand request
} Sifli_NandBBM; //Nand Flash Bad block management

typedef void (*bbm_log_func)(const char *fmt, ...);


/**
 * @brief Bad block manager initial, will parse all nand blocks and initialize bbm table.
 * @param[in] total: total nand size in bytes, decide how many backup blocks can be used.
 * @param[out] cache: bbm buffer, at least on page + oob size.
 * @return 0 if succes.
 */
int sif_bbm_init(uint32_t total, uint8_t *cache);

int bbm_read_page(int blk, int page, int offset, uint8_t *buff, uint32_t size, uint8_t *spare, uint32_t spare_len);

int bbm_write_page(int blk, int page, uint8_t *data, uint8_t *spare, uint32_t spare_len);

int bbm_erase_block(int blk);
```



10.附 CRC 算法

```
Static uint32_t bbm_crc_check(const uint8_t *buf, uint32_t size)
{
    unsigned int i, crc;
    crc = 0xFFFFFFFF;

    for (i = 0; i < size; i++)
        crc = crc32tab[(crc ^ buf[i]) & 0xff] ^ (crc >> 8);
```

```
    return crc ^ 0xFFFFFFFF;
}

static const unsigned int crc32tab[] =
{
    0x00000000L, 0x77073096L, 0xee0e612cL, 0x990951baL,
    0x076dc419L, 0x706af48fL, 0xe963a535L, 0x9e6495a3L,
    0x0edb8832L, 0x79dcb8a4L, 0xe0d5e91eL, 0x97d2d988L,
    0x09b64c2bL, 0x7eb17cbdL, 0xe7b82d07L, 0x90bf1d91L,
    0x1db71064L, 0x6ab020f2L, 0xf3b97148L, 0x84be41deL,
    0x1adad47dL, 0x6ddde4ebL, 0xf4d4b551L, 0x83d385c7L,
    0x136c9856L, 0x646ba8c0L, 0xfd62f97aL, 0x8a65c9ecL,
    0x14015c4fL, 0x63066cd9L, 0xfa0f3d63L, 0x8d080df5L,
    0x3b6e20c8L, 0x4c69105eL, 0xd56041e4L, 0xa2677172L,
    0x3c03e4d1L, 0x4b04d447L, 0xd20d85fdL, 0xa50ab56bL,
    0x35b5a8faL, 0x42b2986cL, 0xdbbbc9d6L, 0xacbcf940L,
    0x32d86ce3L, 0x45df5c75L, 0xdcd60dcfL, 0xabd13d59L,
    0x26d930acL, 0x51de003aL, 0xc8d75180L, 0xbfd06116L,
    0x21b4f4b5L, 0x56b3c423L, 0xcfba9599L, 0xb8bda50fL,
    0x2802b89eL, 0x5f058808L, 0xc60cd9b2L, 0xb10be924L,
    0x2f6f7c87L, 0x58684c11L, 0xc1611dabL, 0xb6662d3dL,
    0x76dc4190L, 0x01db7106L, 0x98d220bcL, 0xefd5102aL,
    0x71b18589L, 0x06b6b51fL, 0x9fbfe4a5L, 0xe8b8d433L,
    0x7807c9a2L, 0x0f00f934L, 0x9609a88eL, 0xe10e9818L,
    0x7f6a0dbbL, 0x086d3d2dL, 0x91646c97L, 0xe6635c01L,
    0x6b6b51f4L, 0x1c6c6162L, 0x856530d8L, 0xf262004eL,
    0x6c0695edL, 0x1b01a57bL, 0x8208f4c1L, 0xf50fc457L,
    0x65b0d9c6L, 0x12b7e950L, 0x8bbeb8eaL, 0xfcb9887cL,
    0x62dd1ddfL, 0x15da2d49L, 0x8cd37cf3L, 0xfbd44c65L,
    0x4db26158L, 0x3ab551ceL, 0xa3bc0074L, 0xd4bb30e2L,
    0x4adfa541L, 0x3dd895d7L, 0xa4d1c46dL, 0xd3d6f4fbL,
    0x4369e96aL, 0x346ed9fcL, 0xad678846L, 0xda60b8d0L,
    0x44042d73L, 0x33031de5L, 0xaa0a4c5fL, 0xdd0d7cc9L,
    0x5005713cL, 0x270241aaL, 0xbe0b1010L, 0xc90c2086L,
    0x5768b525L, 0x206f85b3L, 0xb966d409L, 0xce61e49fL,
    0x5edef90eL, 0x29d9c998L, 0xb0d09822L, 0xc7d7a8b4L,
    0x59b33d17L, 0x2eb40d81L, 0xb7bd5c3bL, 0xc0ba6cadL,
    0xedb88320L, 0x9abfb3b6L, 0x03b6e20cL, 0x74b1d29aL,
    0xead54739L, 0x9dd277afL, 0x04db2615L, 0x73dc1683L,
    0xe3630b12L, 0x94643b84L, 0x0d6d6a3eL, 0x7a6a5aa8L,
    0xe40ecf0bL, 0x9309ff9dL, 0x0a00ae27L, 0x7d079eb1L,
    0xf00f9344L, 0x8708a3d2L, 0x1e01f268L, 0x6906c2feL,
    0xf762575dL, 0x806567cbL, 0x196c3671L, 0x6e6b06e7L,
    0xfed41b76L, 0x89d32be0L, 0x10da7a5aL, 0x67dd4accL,
    0xf9b9df6fL, 0x8ebeeff9L, 0x17b7be43L, 0x60b08ed5L,
    0xd6d6a3e8L, 0xa1d1937eL, 0x38d8c2c4L, 0x4fdff252L,
    0xd1bb67f1L, 0xa6bc5767L, 0x3fb506ddL, 0x48b2364bL,
    0xd80d2bdaL, 0xaf0a1b4cL, 0x36034af6L, 0x41047a60L,
    0xdf60efc3L, 0xa867df55L, 0x316e8eefL, 0x4669be79L,
    0xcb61b38cL, 0xbc66831aL, 0x256fd2a0L, 0x5268e236L,
    0xcc0c7795L, 0xbb0b4703L, 0x220216b9L, 0x5505262fL,
    0xc5ba3bbeL, 0xb2bd0b28L, 0x2bb45a92L, 0x5cb36a04L,
    0xc2d7ffa7L, 0xb5d0cf31L, 0x2cd99e8bL, 0x5bdeae1dL,
    0x9b64c2b0L, 0xec63f226L, 0x756aa39cL, 0x026d930aL,
    0x9c0906a9L, 0xeb0e363fL, 0x72076785L, 0x05005713L,
    0x95bf4a82L, 0xe2b87a14L, 0x7bb12baeL, 0x0cb61b38L,
    0x92d28e9bL, 0xe5d5be0dL, 0x7cdcefb7L, 0x0bdbdf21L,
    0x86d3d2d4L, 0xf1d4e242L, 0x68ddb3f8L, 0x1fda836eL,
    0x81be16cdL, 0xf6b9265bL, 0x6fb077e1L, 0x18b74777L,
    0x88085ae6L, 0xff0f6a70L, 0x66063bcaL, 0x11010b5cL,
    0x8f659effL, 0xf862ae69L, 0x616bffd3L, 0x166ccf45L,
    0xa00ae278L, 0xd70dd2eeL, 0x4e048354L, 0x3903b3c2L,
    0xa7672661L, 0xd06016f7L, 0x4969474dL, 0x3e6e77dbL,
    0xaed16a4aL, 0xd9d65adcL, 0x40df0b66L, 0x37d83bf0L,
    0xa9bcae53L, 0xdebb9ec5L, 0x47b2cf7fL, 0x30b5ffe9L,
    0xbdbdf21cL, 0xcabac28aL, 0x53b39330L, 0x24b4a3a6L,
    0xbad03605L, 0xcdd70693L, 0x54de5729L, 0x23d967bfL,
    0xb3667a2eL, 0xc4614ab8L, 0x5d681b02L, 0x2a6f2b94L,
```

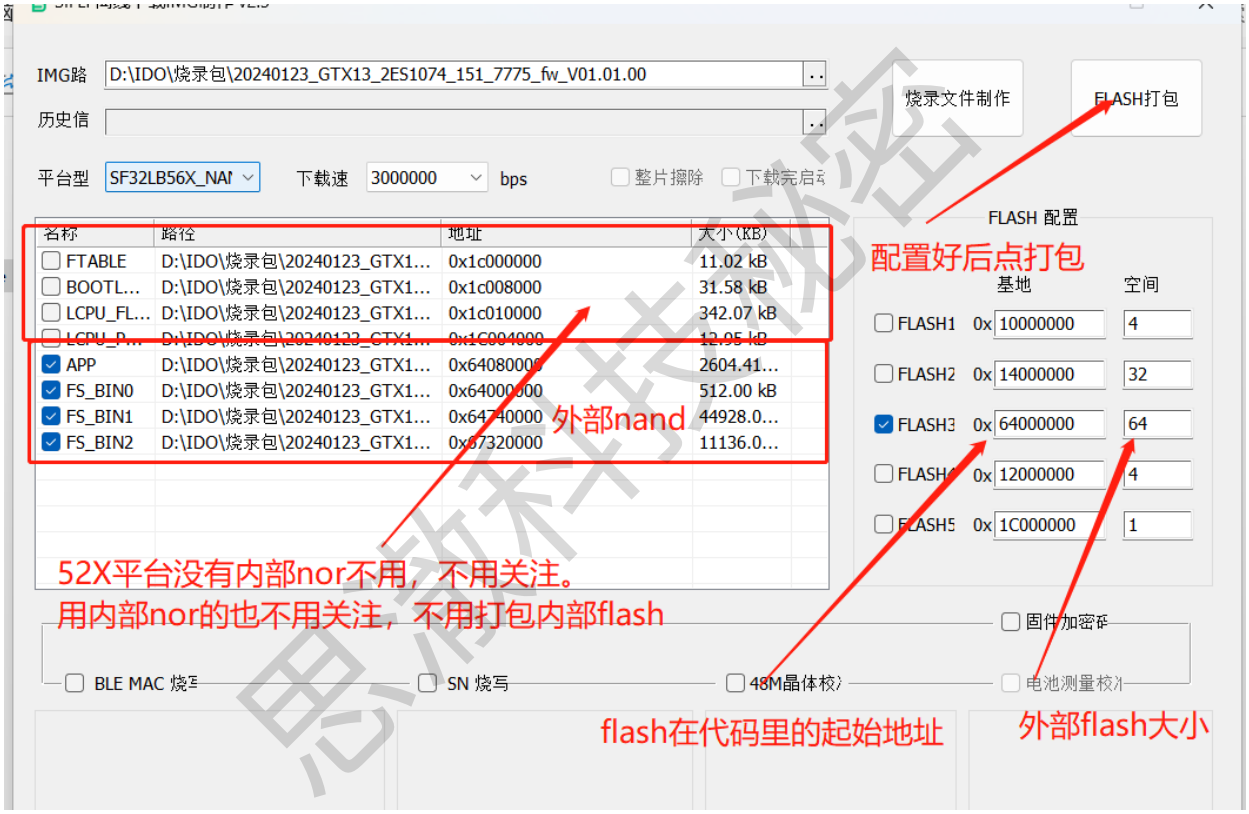
0xb40bbe37L, 0xc30c8ea1L, 0x5a05df1bL, 0x2d02ef8dL
};

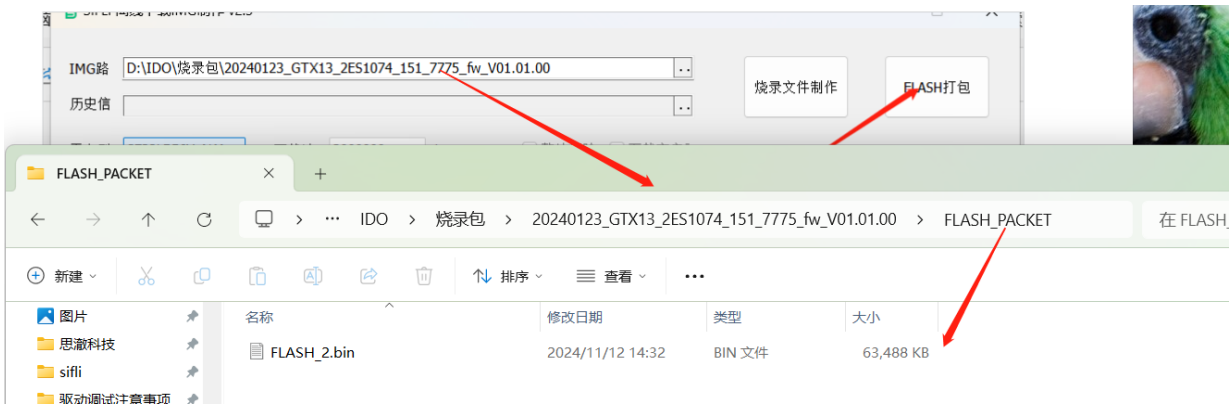
3.外部 flash 打包

打包外部 flash 只用关注:

1. 选对 bin 文件
2. flash 起始地址配对
3. flash 大小填写实际大小。注意 nand 跟 nor 都是是填写实际大小。nand 打包后 bin 大小比填写的值小 1/32 是对的。 nand 有坏块管理

其他参数配置并不影响。



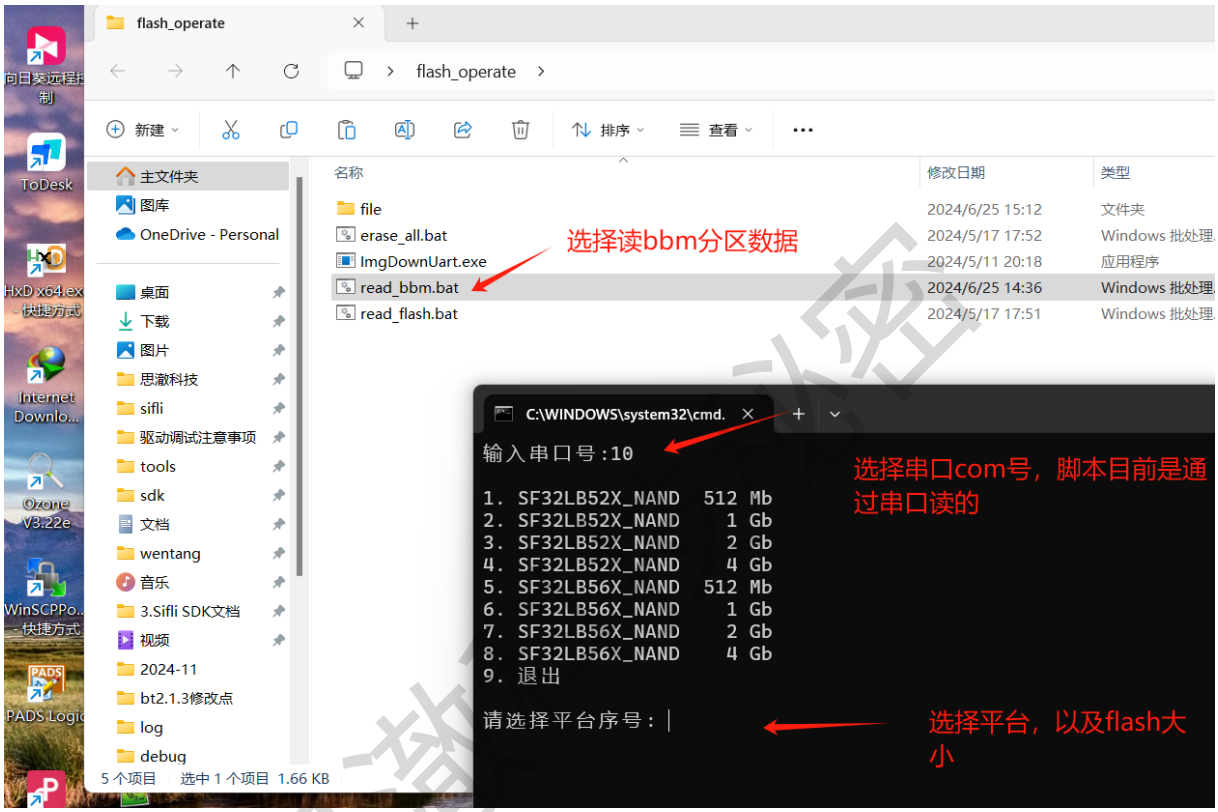


4.nand 读 bbm 分区验证，看是否正常

读出来的数据跟前面 2.2BBM(坏块管理)数据比较。看是否计算的跟烧录的一致。

也可以用要外发烧录的 nand，先用思澈工具烧录。再用脚本读出 bbm 分区数据，可以省掉除 #4 #5 #6 #7 #8 及坏块替换的计算。

同一块 flash 烧录时 flash：#1 #2 #3 是不变的



5.附件

ImgStamp_v2.3.7zflash_operate.zip