文档编号 ： **FlashToolCLI** 说明

EigenCOMM Wireless Microcontroller

产品综述

本文档描述移芯通信 FlashToolCLI 命令行接口使用说明。

功能概述

【文档描述产品的主要功能、主要特性】

● 【功能描述】

● 【功能描述】

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● 【功能描述】

产品图片

【添加产品照片，通常包括产品正反面两张，主要针对有关硬件的文档，软件文档可删减】

Figure 1. *产品名称*

目录

1. 概述

FlashToolCLI 是命令行接口的版本烧录工具，本文介绍如何在 Windows 系统上使用 FlashToolCLI 通过 UART1 串口实现固件版本的烧录和升级。

2. 使用说明

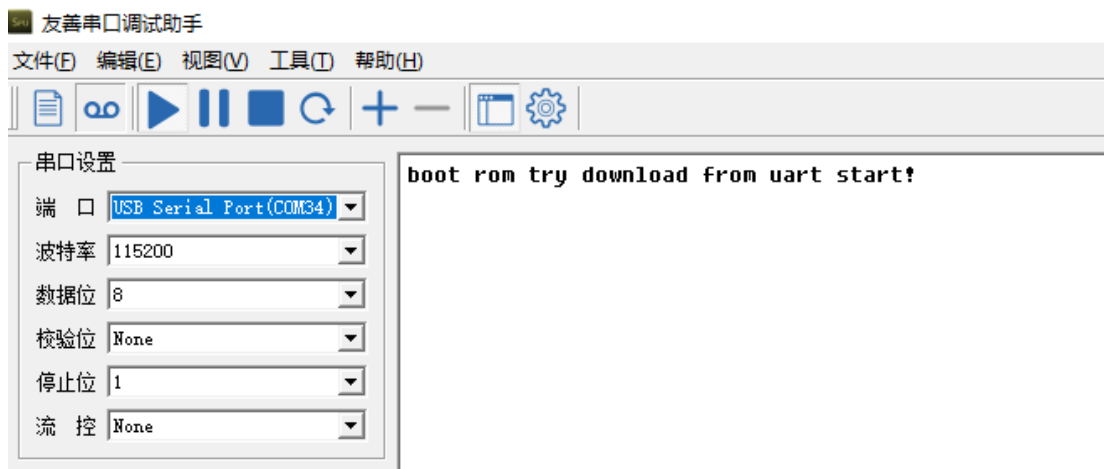打开命令行界面，进入 FlashToolCLI 所在的目录，运行 FlashToolCLI.exe。

```
C:\Users\ivan\Documents\others\test\FlashToolCLI>FlashToolCLI.exe
2019-10-24 16:07:44,631 INFO      [FlashTop]      init
usage: FlashToolCLI [-h] [--port PORT] [--baud BAUD] [--verbose VERBOSE]
                    [--cfgfile CFGFILE] [--skipconnect SKIPCONNECT]
                    [--lineid LINEID]
                    {list_com,burn,burnone,probe,flasherase} ...

FlashToolCLI

positional arguments:
  {list_com,burn,burnone,probe,flasherase}
                        Run flash -h for additional help
    list_com            list all useful com ports.
    burn                burn the binary file "bootloader" and "system" to
                        flash memory
    burnone             burn one binary file "flexfile" to flash memory
    probe               download the agentboot file and connect
    flasherase          erase flash data

optional arguments:
  -h, --help            show this help message and exit
  --port PORT, -p PORT  Serial port device
  --baud BAUD, -b BAUD  Serial port baud rate used when flashing/reading
  --verbose VERBOSE, -v VERBOSE
                        verbose mode
  --cfgfile CFGFILE     the file set as cfg file
  --skipconnect SKIPCONNECT
                        skip agentboot download, forward to command
  --lineid LINEID       specify line number to download
```

在进行烧录等命令时需要通过先按键 RESET +按键 GPIO1，再释放 RESET 按键的顺序使硬件进入下载模式，下载模式下的 UART0 打印。

2.1 烧录 bootloader 和 system 镜像

烧录镜像 bootloader 和 system，在工具目录下输入 FlashToolCLI.exe --port="COM39" burn, 烧录时需要用—port 指定烧录的 COM 端口号。

```
C:\Users\ivan\Documents\others\test\FlashToolCLI>FlashToolCLI.exe --port="COM39" burn
2019-10-24 16:47:04,691 INFO    [FlashTop]    init
[FlashTop]    do_main: cmd loadpara
[Para]    update digest file :C:\Users\ivan\Documents\others\test\FlashToolCLI\cfg.digest, digest:b'\xc4\xf5\x64\xd9\x8f\xa8\x95\xd4\x4d\xd5\x86\x62\x50\x33\xc6\x7b\xca\x55\x15\xfe\xbc\xb8\xcc\x08\x19\x3
[Para]    LoadPara from cfgfile(C:\Users\ivan\Documents\others\test\FlashToolCLI\config.ini)
[FlashTop]    do_main: cmd burn, Thread0[21612]
[Thread0]    ProcessStart[21612]
[Thread0]    Download totalsize = 1670196
[Thread0]    ResetBoard finish
[Image]    SetBaud 921600
[Image]    GenHeadBin bodypath C:\Users\ivan\Documents\others\test\FlashToolCLI\.\agentboot.bin
[Image]    GenHeadBin C:\Users\ivan\Documents\others\test\FlashToolCLI\.\agentboot_head.bin success
[Thread0]    TryDownload C:\Users\ivan\Documents\others\test\FlashToolCLI\.\agentboot.bin start
[Thread0]    image size=26732, hdsize=272
[Thread0]    Preamble Send
[Thread0]    Preamble Received Rsp
[Thread0]    Preamble Send
[Thread0]    Preamble Received Rsp
[Thread0]    TryDownload agentboot success
[Thread0]    agbaud: 921600
[Thread0]    agbaud: 921600
[Thread0]    LPC Preamble Send
[Thread0]    LPC Preamble Received Rsp
[Image]    SetBaud 921600
[Image]    GenHeadBin bodypath C:\Users\ivan\Documents\others\test\FlashToolCLI\.\image\bootloader.bin
[Image]    GenHeadBin C:\Users\ivan\Documents\others\test\FlashToolCLI\.\image\bootloader_head.bin success
[Thread0]    TryDownload:headpath=C:\Users\ivan\Documents\others\test\FlashToolCLI\.\image\bootloader_head.bin, bodypath=C:\Users\ivan\Documents\others\test\FlashToolCLI\.\image\bootloader.bin
[Thread0]    LPCBurnOneTrig start                      ******
[Thread0]    LPCBurnOneTrig success
[Thread0]    DLDPreSync Preamble Send
[Thread0]    DLDPreSync Preamble Received Rsp
[Thread0]    image size=20124, hdsize=272
[Thread0]    Preamble Send
[Thread0]    Preamble Received Rsp
[Thread0]    imginfo.size=20124, RemainLen=19852, Offset=272
[Thread0]    Preamble Send
[Thread0]    Preamble Received Rsp
[Thread0]    imginfo.size=20124, RemainLen=0, Offset=272
[Thread0]    TryDownload finish
[Thread0]    TryDownload success:headpath=C:\Users\ivan\Documents\others\test\FlashToolCLI\.\image\bootloader_head.bin, bodypath=C:\Users\ivan\Documents\others\test\FlashToolCLI\.\image\bootloader.bin
[Image]    GenHeadBin bodypath C:\Users\ivan\Documents\others\test\FlashToolCLI\.\image\app-demo-flash.bin
[Image]    GenHeadBin C:\Users\ivan\Documents\others\test\FlashToolCLI\.\image\app-demo-flash_head.bin success
[Thread0]    TryDownload:headpath=C:\Users\ivan\Documents\others\test\FlashToolCLI\.\image\app-demo-flash_head.bin, bodypath=C:\Users\ivan\Documents\others\test\FlashToolCLI\.\image\app-demo-flash.bin
[Thread0]    LPCBurnOneTrig start                      ******
[Thread0]    LPCBurnOneTrig success
[Thread0]    DLDPreSync Preamble Send
[Thread0]    DLDPreSync Preamble Received Rsp
[Thread0]    image size=1650072, hdsize=272
[Thread0]    Preamble Send
[Thread0]    Preamble Received Rsp
[Thread0]    imginfo.size=1650072, RemainLen=1649800, Offset=272
[Thread0]    Preamble Send
[Thread0]    Preamble Received Rsp
[Thread0]    imginfo.size=1650072, RemainLen=1584264, Offset=65808
[Thread0]    imginfo.size=1650072, RemainLen=1584264, Offset=65808
[Thread0]    Preamble Send
[Thread0]    Preamble Received Rsp
[Thread0]    imginfo.size=1650072, RemainLen=1518728, Offset=131344
```

如有打印 Burn OK 则表明烧录成功

```
[Thread0]    Preamble Send
[Thread0]    Preamble Received Rsp
[Thread0]    imginfo.size=1650072, RemainLen=11400, Offset=1638672
[Thread0]    imginfo.size=1650072, RemainLen=11400, Offset=1638672
[Thread0]    Preamble Send
[Thread0]    Preamble Received Rsp
[Thread0]    imginfo.size=1650072, RemainLen=0, Offset=1638672
[Thread0]    TryDownload finish
[Thread0]    TryDownload success:headpath=C:\Users\ivan\Documents\others\test\FlashToolCLI\.\image\app-demo-flash_head.bin, bodypath=C:\Users\ivan\Documents\others\test\FlashToolCLI\.\image\app-demo-flash.bin
[Thread0]    Burn OK!
[Thread0]    ProcessEnd[21612]
```

2.2   烧录 flexfile

烧录镜像 flexfile0 (flexfile0~flexfile19)文件，在工具目录下输入 FlashToolCLI.exe --port="COM39" burnone flexfile0，烧录时需要用—port 指定烧录的 COM 端口号。

```
C:\Users\ivan\Documents\others\test\FlashToolCLI>FlashToolCLI.exe --port="COM39" burnone flexfile0
2019-10-24 17:16:10,803 INFO    [FlashTop]    init
[FlashTop]    do_main: cmd loadpara
[Para]    update digest file :C:\Users\ivan\Documents\others\test\FlashToolCLI\cfg.digest, digest:b'\xc4\xf5\x64\xd9\x8f\xa8\x95\xd4\x4d\xd5\x86\x
[Para]    LoadPara from cfgfile(C:\Users\ivan\Documents\others\test\FlashToolCLI\config.ini)
[FlashTop]    do_main: cmd burnone, Thread0[18188]
[Thread0]    ProcessStart[18188]
[Thread0]    Download totalsize = 1672304
[Thread0]    ResetBoard finish
[Image]    SetBaud 921600
[Image]    GenHeadBin bodypath C:\Users\ivan\Documents\others\test\FlashToolCLI\.\agentboot.bin
[Image]    GenHeadBin C:\Users\ivan\Documents\others\test\FlashToolCLI\.\agentboot_head.bin success
[Thread0]    TryDownload C:\Users\ivan\Documents\others\test\FlashToolCLI\.\agentboot.bin start
[Thread0]    image size=26732, hdsize=272
[Thread0]    Preamble Send
[Thread0]    Preamble Received Rsp
[Thread0]    Preamble Send
[Thread0]    Preamble Received Rsp
[Thread0]    TryDownload agentboot success
[Thread0]    agbaud: 921600
[Thread0]    agbaud: 921600
[Thread0]    LPC Preamble Send
[Thread0]    LPC Preamble Received Rsp
[Thread0]    DownloadBurnOne imgtype(flexfile0)
[Thread0]    DownloadBurnOne imgtype(flexfile0), burnaddr(0x3a4000), imgid(0x464c5849)
[Thread0]    DownloadBurnOne file C:\Users\ivan\Documents\others\test\FlashToolCLI\.\rfCaliTb\Rf_Calibration_file_mt_normal.bin, GenImgHd
[Thread0]    TryDownload C:\Users\ivan\Documents\others\test\FlashToolCLI\.\rfCaliTb\Rf_Calibration_file_mt_normal.bin start
[Thread0]    LPCBurnOneTrig start                          ******
[Thread0]    LPCBurnOneTrig success
[Thread0]    DLDPreSync Preamble Send
[Thread0]    DLDPreSync Preamble Received Rsp
[Thread0]    image size=2108, hdsize=272
[Thread0]    Preamble Send
[Thread0]    Preamble Received Rsp
[Thread0]    imginfo.size=2108, RemainLen=1836, Offset=272
[Thread0]    Preamble Send
[Thread0]    Preamble Received Rsp
[Thread0]    imginfo.size=2108, RemainLen=0, Offset=272
[Thread0]    TryDownload success
[Thread0]    Burn OK!
[Thread0]    ProcessEnd[18188]
```

2.3   Flash 擦除

擦除 flash 的命令格式如下，FlashToolCLI.exe --port="COM39" flasherase memaddr memlen。

在工具目录下输入 FlashToolCLI.exe --port="COM39" flasherase 0x0 0x400000，因为长度超过 FLASH 大小，所以将进行 Flash 全擦。烧录时需要用—port 指定烧录的 COM 端口号，根据 flash 的状态，一般擦除 flash 需要等待一段时间才能完成。

如果需要进行部分擦除，修改 flasherase 命令参数 memaddr memlen 为实际需要擦除的地址和长度，如擦除文件系统区域，FlashToolCLI.exe --port COM39 flasherase 0x350000 0x54000

```
C:\Users\ivan\Documents\others\test\FlashToolCLI>FlashToolCLI.exe --skipconnect 1 --port COM39 flasherase 0x350000 0x540
00
2019-12-11 16:09:11,713 INFO    [FlashTop]    init
[Process-20412] [FlashTop]    do_main: cmd loadpara
[Process-20412] [Para]    update digest file :C:\Users\ivan\Documents\others\test\FlashToolCLI\cfg.digest, digest:b'\x7e
\x73\xe5\xfb\x8a\xf2\x5b\x06\xc1\x2a\x99\x5f\xcc\x90\x54\xb6\x21\xf8\x5e\x36\xc9\xfd\x71\xd2\x50\x14\x7e\x33\xda\x23\x82
\x4b'
[Process-20412] [Para]    LoadPara from cfgfile(C:\Users\ivan\Documents\others\test\FlashToolCLI\config.ini)
[Process-20412] [Para]    CfgGetOpt except:section[agentboot] and option[agloadskip]
[Process-20412] [FlashTop]    do_main: cmd flasherase, Thread0[20180]
[Process-20412] [Thread0]    ProcessStart[20180]
[Process-20412] [Thread0]    ResetBoard skip for straight download
[Process-20412] [Thread0]    args.ser.port :COM39
[Process-20412] [Board0]    args.trace :0 invalid hex , trace will be set to 0
[Process-20412] args.trace :0 invalid hex , trace will be set to 0
[Process-20412] [Thread0]    TryDownload agentboot skip
[Process-20412] [Thread0]    agbaud: 921600
[Process-20412] [Thread0]    LPC Preamble Send
[Process-20412] [Thread0]    LPC Preamble Received Rsp
[Process-20412] [Thread0]    Erase start, mem addr:0x0, mem len:0x400000
[Process-20412] [Thread0]    Erase success, mem addr:0x0, mem len:0x400000
[Process-20412] [FlashTop]    flasherase finish, Thread0[20180]
[Process-20412] [Thread0]    ProcessEnd[20180]
```

参数约束：

memaddr (取值范围[0,0x400000]，且按照 4KB 对齐)，

memlen (取值范围 [0, 0x400000])， memaddr 不为 0 时[0，0x400000],

memaddr 为 0 时，[0，0xffffffff]

2.4 Flash 读取

读取 flash 的命令格式如下，FlashToolCLI.exe --port="COM39" flashread memaddr memlen --memrbf flash_addr_len.bin

在工具目录下输入 FlashToolCLI.exe --port="COM39" flashread 0x0 0x400000 --memrbf flash_0x0_0x400000.bin

0x0 为 flash 内的偏移地址; 0x400000 为需要读取的 flash 数据长度。

参数约束：

memaddr (取值范围[0,0x400000])，

memlen (取值范围 [0, 0x400000])， memaddr 不为 0 时[0，0x400000],

memaddr 为 0 时，[0，0xffffffff]

2.5 设备复位

设备复位的命令格式如下，FlashToolCLI.exe --skipconnect 1 --port="COM39" sysreset，一般用于烧录完成，重新启动板子。(一般在复位前，板子已经处于下载连接状态，不再需要重新连接，所以加上参数--skipconnect 1)。

```
C:\Users\ivan\Documents\others\test\FlashToolCLI>FlashToolCLI.exe --skipconnect 1 --port COM12 sysreset
2019-12-31 10:29:32,539 INFO      [FlashTop]    init
[Process-2516] [FlashTop]    do_main: cmd loadpara
[Process-2516] [Para]     exe path: C:\Users\ivan\Documents\others\test\FlashToolCLI
[Process-2516] [Para]     update digest file :C:\Users\ivan\Documents\others\test\FlashToolCLI\cfg.digest, digest:b'\x6
xc9\x63\x61\xef\xf1\x84\x56\x8a\xd8\x24\x1e\xb3\x37\xea\xb8\xa8\x18\x8b\x2f\x31\x2b\x92\x6b\x70\x08\xb9\x5d\xd8\x09\xa
xa3'
[Process-2516] [Para]     LoadPara from cfgfile(C:\Users\ivan\Documents\others\test\FlashToolCLI\config.ini)
[Process-2516] [FlashTop]    do_main: cmd sysreset, Thread0[13524]
[Process-2516] [Thread0]     ProcessStart[13524]
[Process-2516] [Thread0]     ResetBoard skip for straight download
[Process-2516] [Thread0]     args.ser.port :COM12
[Process-2516] [Thread0]     TryDownload agentboot skip
[Process-2516] [Thread0]     agbaud: 921600
[Process-2516] [Thread0]     LPC Preamble Send
[Process-2516] [Thread0]     LPC Preamble Received Rsp
[Process-2516] [FlashTop]    sysreset finish, Thread0[13524]
[Process-2516] [Thread0]     ProcessEnd[13524]
```

2.6 探测连接

探测连接，用于检测下载通道能否正常连接，在工具目录下输入 FlashToolCLI.exe --port="COM39" probe，该命令通过下载 agentboot 检测下载通信是否通畅，当该命令完成下载 agentboot 或者 agentboot 同步成功时，可以认为连接正常。

```
C:\Users\ivan\Documents\others\test\FlashToolCLI>FlashToolCLI.exe --port="COM39" probe
2019-10-24 17:22:51,181 INFO      [FlashTop]    init
[FlashTop]    do_main: cmd loadpara
[Para]      update digest file :C:\Users\ivan\Documents\others\test\FlashToolCLI\cfg.digest, digest:b'\xc4\xf5
[Para]      LoadPara from cfgfile(C:\Users\ivan\Documents\others\test\FlashToolCLI\config.ini)
[FlashTop]    do_main: cmd burnag, Thread0[8684]
[Thread0]    ProcessStart[8684]
[Thread0]    ResetBoard finish
[Image]    SetBaud 921600
[Image]    GenHeadBin bodypath C:\Users\ivan\Documents\others\test\FlashToolCLI\.\agentboot.bin
[Image]    GenHeadBin C:\Users\ivan\Documents\others\test\FlashToolCLI\.\agentboot_head.bin success
[Thread0]    TryDownload C:\Users\ivan\Documents\others\test\FlashToolCLI\.\agentboot.bin start
[Thread0]    image size=26732, hdsize=272
[Thread0]    Preamble Send
[Thread0]    Preamble Received Rsp
[Thread0]    Preamble Send
[Thread0]    Preamble Received Rsp
[Thread0]    TryDownload agentboot success
[Thread0]    agbaud: 921600
[Thread0]    Burn OK!
[Thread0]    ProcessEnd[8684]
```

2.7 列举 COM 端口

列举 COM 端口，用于所有的 COM 端口，在工具目录下输入 FlashToolCLI.exe --port="COM39" list_com。

```
C:\Users\ivan\Documents\others\test\FlashToolCLI>FlashToolCLI.exe list_com
2019-10-24 14:49:51,939 INFO      [FlashTop]    init
list_com
2019-10-24 14:49:51,943 INFO      [FlashTop]        ----- useful serial port list -----------------------
2019-10-24 14:49:51,962 INFO      [FlashTop]    - Port : COM41
2019-10-24 14:49:52,084 INFO      [FlashTop]    - Port : COM59
2019-10-24 14:49:52,086 INFO      [FlashTop]    - Port : COM7, busy
2019-10-24 14:49:52,103 INFO      [FlashTop]    - Port : COM38
2019-10-24 14:49:52,239 INFO      [FlashTop]    - Port : COM39
2019-10-24 14:49:52,368 INFO      [FlashTop]    - Port : COM40
2019-10-24 14:49:52,484 INFO      [FlashTop]
```

3. 配置说明

默认文件为当前目录下的 config.ini，镜像文件 bootloader.bin 和 app-demo-flash.bin 放在 image 子目录下。

```ini
[config]
line_0_com = COM39
agbaud = 921600

;agentboot.bin file infomation
[agentboot]
agpath = .\agentboot.bin

;bootloader.bin file infomation
[bootloader]
blpath = .\image\bootloader.bin
blloadskip = 0

;system.bin file infomation
[system]
syspath = .\image\app-demo-flash.bin
sysloadskip = 0

[flexfile0]
filepath = .\rfCaliTb\Rf_Calibration_file_mt_normal.bin
burnaddr = 0x3A4000
```

3.1 配置置项[Config]

Line_0_Com:配置为下载串口连接的 USB 串口号，当串口命令中不指定"—port=COMn"时，使用该串口号。

Agbaud:配置为默认 921600

3.2 配置项[agentboot]

烧录时代理下载程序的配置

Agpath 配置为 agentboot.bin 文件路径，默认不用修改。如果 Agpath 项不配置，则认为 agentboot.bin 和 FlashToolCLI.exe 在同一层目录下。

3.3   配置项[bootloader]

烧录时 bootloader 的配置

blpath 配置为 bootloader.bin 文件路径

headpath 配置为 bootloader_head.bin 位置，安全启动使用时配置，默认可以不配。

blloadskip 默认为 0，配置为 1，烧录时跳过 bootloader 烧录。

3.4   配置项[system]

烧录时 system.bin(app-demo-flash.bin)的配置

syspath 配置为 system.bin(app-demo-flash.bin)文件路径

headpath 配置为 system_head.bin(app-demo-flash_head.bin)位置，安全启动使用时配置，默认可以不配。

sysloadskip 默认为 0，配置为 1，烧录时跳过 system 烧录。
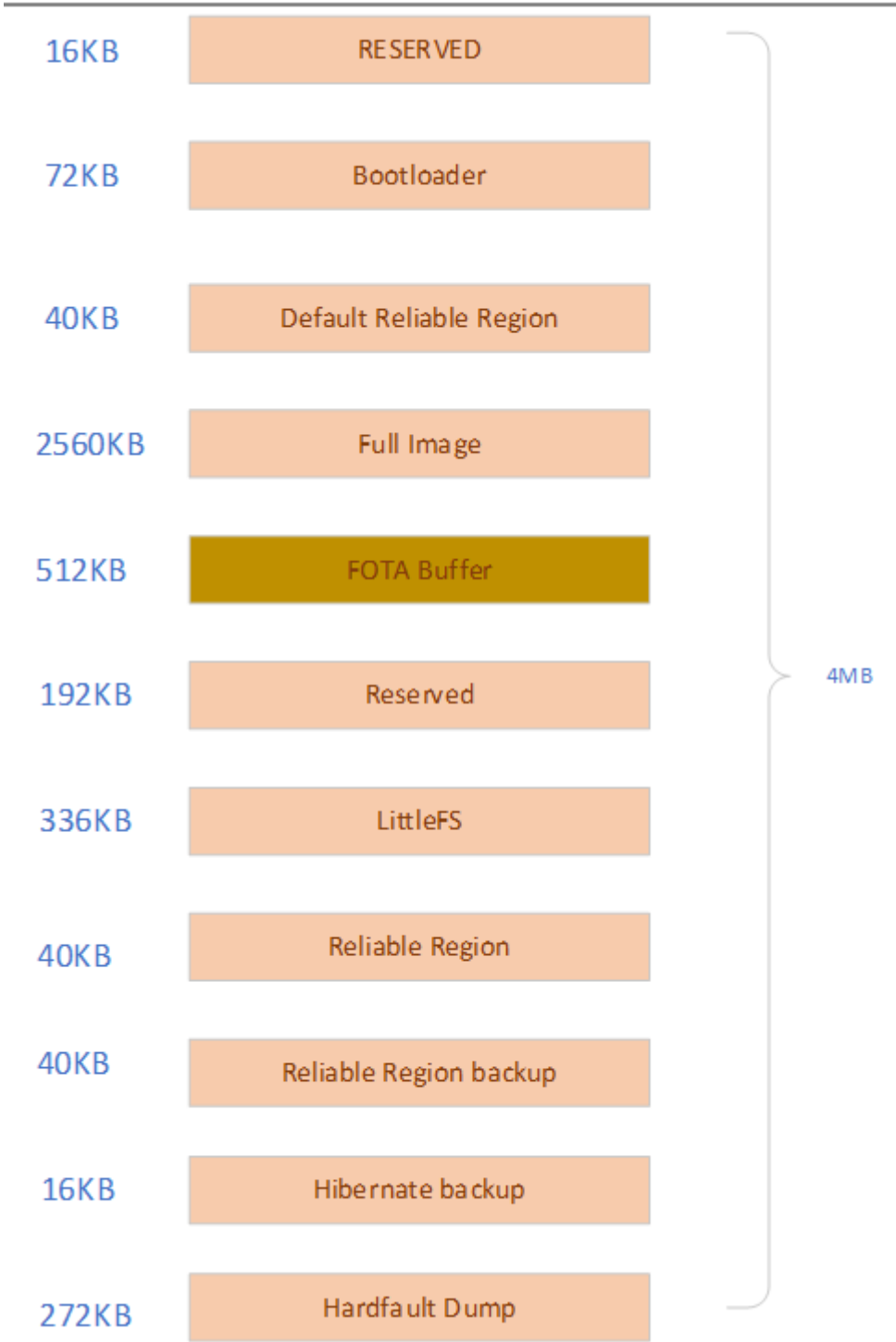
3.5   配置项[flexfile0]-[flexfile19]

烧录单独的二进制数据文件时使用

Filepath 配置为二进制文件的路径

Burnaddr 配置为二进制文件需要烧录的 FLASH 地址

4. 量产烧录

4.1 Flash Map 及烧录区域

EC616 Flash Map 如下：

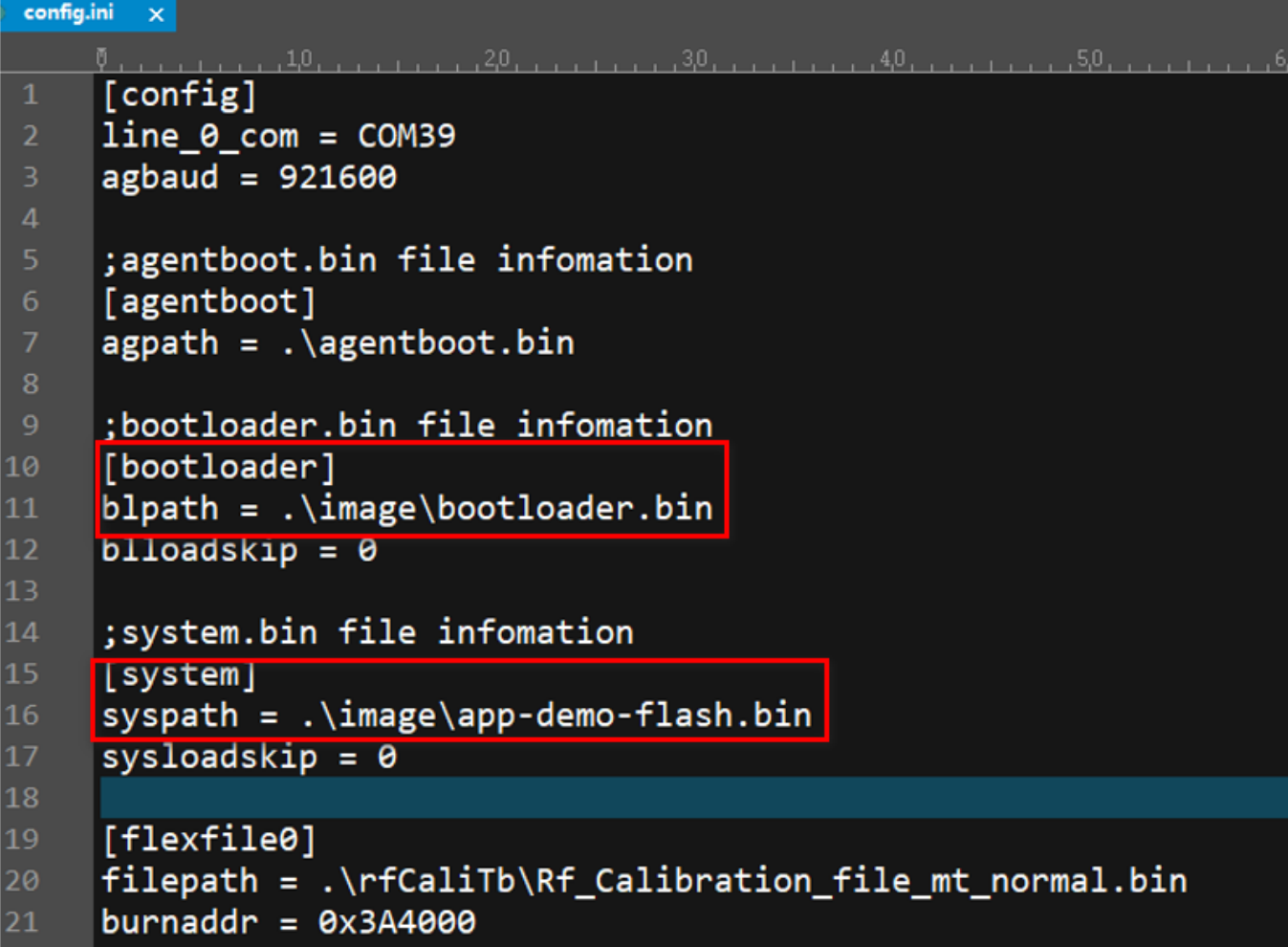|		
16KB	RESERVED	
72KB	Bootloader	
40KB	Default Reliable Region	
2560KB	Full Image	
512KB	FOTA Buffer	4MB
192KB	Reserved	
336KB	LittleFS	
40KB	Reliable Region	
40KB	Reliable Region backup	
16KB	Hibernate backup	
272KB	Hardfault Dump	

4.2 量产需要烧录的区域

　　量产需要烧录 bootloader 和 system (full image)以及校准文件，将需要量产的 bootloader、system 镜像及校准文件等更新到工具目录中，默认路径在 config.ini 有对应的文件路径配置，如果路径或者文件名发生变化，需要重新配置。

4.2.1　bootloader 和 system (full image)

bootloader 和 system(full image)的烧录命令如下，

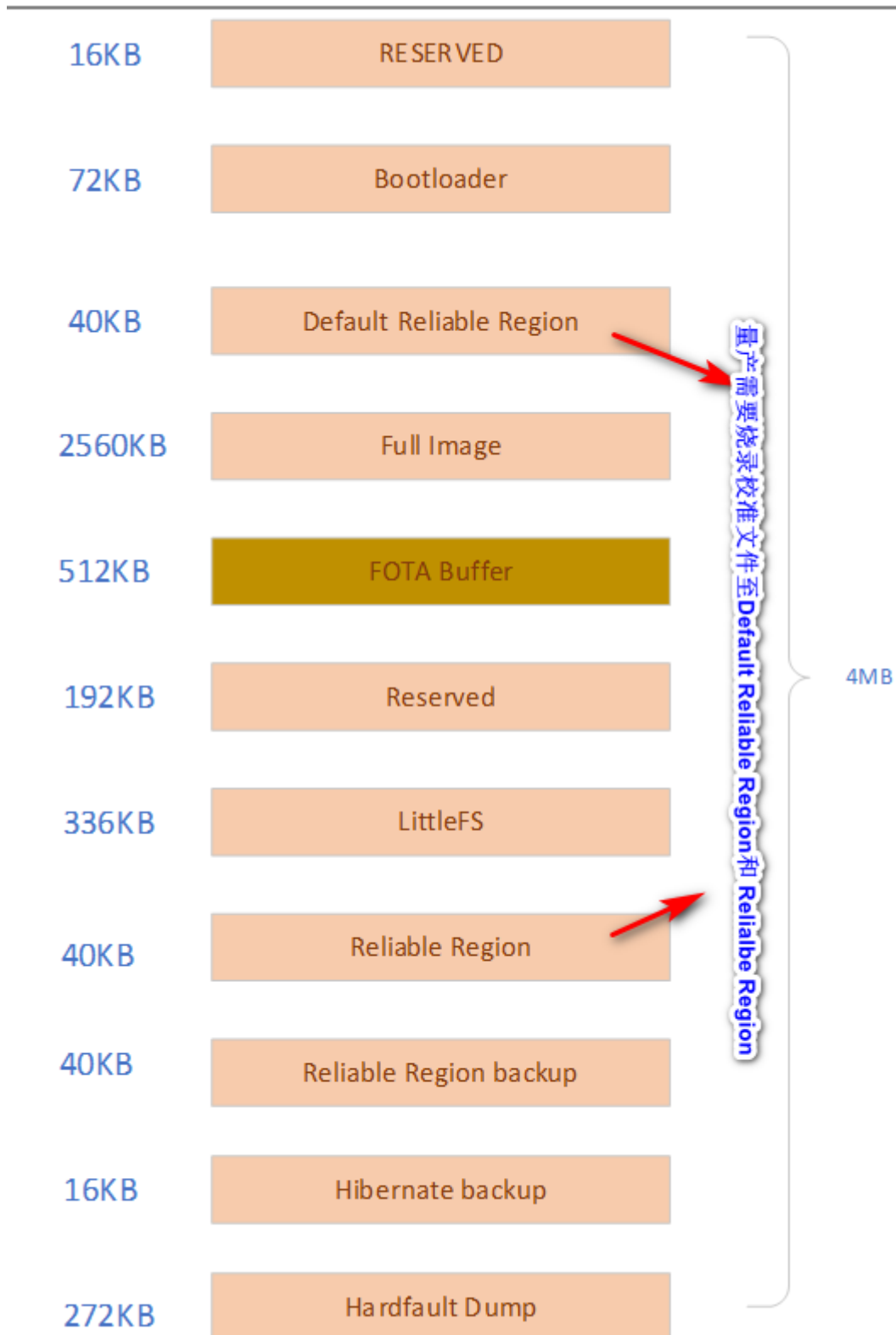FlashToolCLI.exe --port="COM39" burn

Bootloader 和 system(full image)的配置如下：

```
config.ini    ×

1    [config]
2    line_0_com = COM39
3    agbaud = 921600
4
5    ;agentboot.bin file infomation
6    [agentboot]
7    agpath = .\agentboot.bin
8
9    ;bootloader.bin file infomation
10   [bootloader]
11   blpath = .\image\bootloader.bin
12   blloadskip = 0
13
14   ;system.bin file infomation
15   [system]
16   syspath = .\image\app-demo-flash.bin
17   sysloadskip = 0
18
19   [flexfile0]
20   filepath = .\rfCaliTb\Rf_Calibration_file_mt_normal.bin
21   burnaddr = 0x3A4000
```

4.2.2 Default Reliable Region, Reliable Region
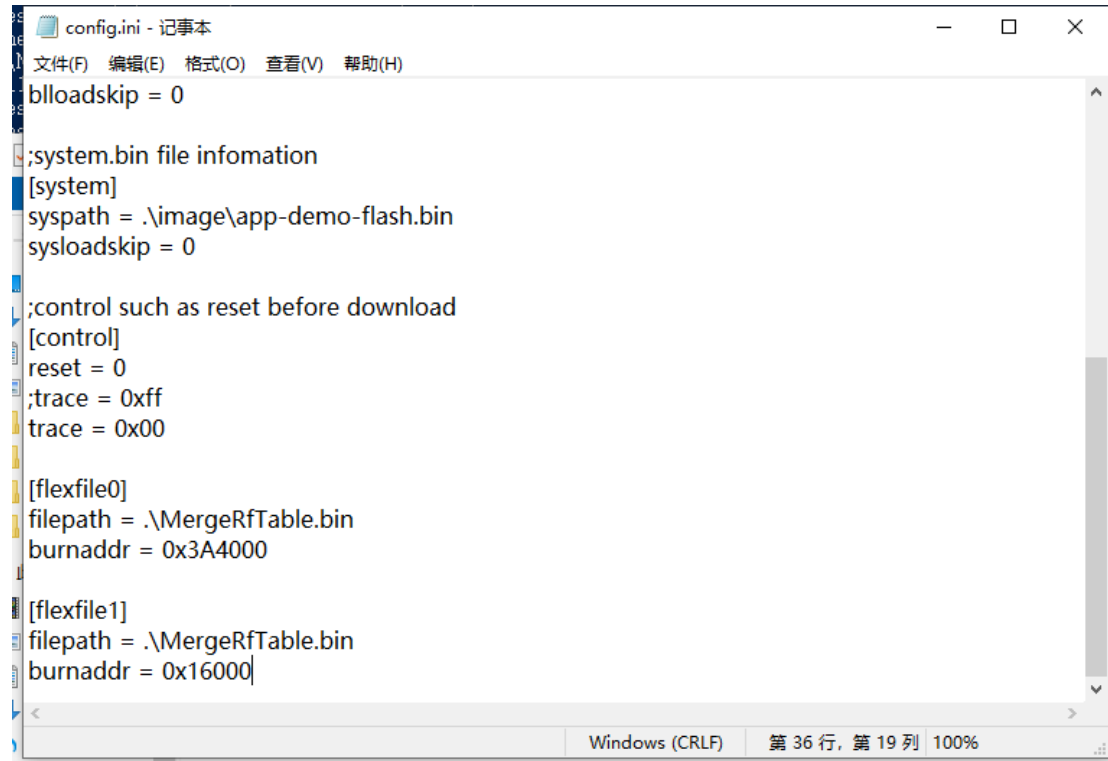
Default Reliable Region 和 Reliable Region 区域如下，

16KB	RESERVED
72KB	Bootloader
40KB	Default Reliable Region
2560KB	Full Image
512KB	FOTA Buffer
192KB	Reserved
336KB	LittleFS
40KB	Reliable Region
40KB	Reliable Region backup
16KB	Hibernate backup
272KB	Hardfault Dump

量产需要烧录校准文件至 Default Reliable Region 和 Relialbe Region

4MB

烧录命令如下

FlashToolCLI.exe --port="COM39" burnone flexfile0

FlashToolCLI.exe --port="COM39" burnone flexfile1

并且 flexfile0 和 flexfile1 需要配置为校准文件，并且指定烧录地址。

4.3   Skipconnect 参数说明

Skipconnect 参数说明：如果执行烧录过程中有多个烧录步骤，如果那么经过第一个烧录命令以后，agentboot 已经进入下载连接状态，"—skipconnect 1" 表示后续的命令不需要重复下载 agentboot 过程，可以减少后续烧录命令的同步时间，直接进入下载。

举个例子，burn 命令烧录完后，后面的两个 flexfile0,flexfile1 烧录的命令前加入--skipconnect 1

FlashToolCLI.exe --port="COM39" burn

FlashToolCLI.exe --skipconnect 1   --port="COM39" burnone flexfile0

FlashToolCLI.exe --skipconnect 1   --port="COM39" burnone flexfile1

5. 附录

5.1 参考文档

Table 5-1. 参考文档

序号	文档名称	注释
【1】		
【2】		

5.2　术语和解释

Table 5-2.　术语和解释

术语	解释

5.3 安全和警告

6. 版本

版本	日期	备注
Draft	2019-04-08	

文档类型【输入文档类型，居中】 文档名称_版本号_MM/YY
【版本号按字母顺序使用，草稿版本用字符 DRF 表示】

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上海移芯通信科技有限公司（www.eigencomm.com）坐落于中国·上海张江硅谷，公司于 2017 年 2 月成立，致力于蜂窝物联网芯片的研发和销售，公司创始人及开发团队大部分来自于知名手机芯片厂商 Marvell，团队完整，阵容强大。其中，20%为知名高校博士，80%为知名高校硕士，平均工作年限 10 年以上。团队所开发的手机芯片已累计出货数亿片。开发团队在蜂窝终端芯片上积累了丰富的实战经验，从算法，协议栈，射频到基带 SOC 以及系统软硬件和方案，从低功耗设计经验到射频模拟开发能力具有完整而强大的研发能力。

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