GigaDevice Semiconductor Inc.

Arm® Cortex®-M3/4/23/33 32-bit MCU

应用笔记

AN038

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1. 介绍

在IEC60730自检测试中，要求对mcu片上flash进行自检，为了实现CRC值的自动计算和添加，需要在IDE中添加CRC校验步骤，为此，本应用笔记讲述如何在Keil环境中添加CRC校验批处理方法，过程描述如下。

2. CRC 校验批处理添加

Keil 环境中没有直接计算 CRC 值的功能，因此需要借助开源工具计算 CRC 值，并在编译过程中通过批处理将其自动添加到.hex 文件的末尾，以便于 flash 自检程序的正常运行。

2.1. 添加 CRC 值所需文件

1. 首先下载 Srecord 工具，在工程目录下新建 bin 文件夹，将 srec_cat.exe、srec_cmp.exe 和 srec_info.exe 拷贝到该文件夹下。

2. 在工程目录下添加 gen_crc.bat、IEC_TEST_BOOT_FLASH.sct 和 CRC_LOAD.ini 文件。gen_crc.bat 文件用于调用 Srecord 工具计算 CRC 值，并将该值存储到.hex 文件的末尾以便于对整个 flash 进行自检测试，并在 build 窗口打印通过 Srecord 工具计算得到的 CRC 值。该文件的命令代码如下所示：

```
SET MAP_FILE=Listings\Project.map

::-----------------get CRC address information line
SET TMP_FILE=crc_temp.txt
FINDSTR /R /C:"^    *CHECKSUM" %MAP_FILE%>%TMP_FILE%
SET /p crc_search=<%TMP_FILE%
DEL %TMP_FILE%
::-----------------CRC address
for /f "tokens=1 delims=(" %%a in ("%crc_search%") do set crc_search=%%a
SET crc_search=%crc_search:CHECKSUM=%
for /f "tokens=1 delims= " %%a in ("%crc_search%") do set CRC_ADDR=%%a


SET /a CRC_ADDR_END=%CRC_ADDR%+4
::-----------------choose CRC32 or CRC16
FINDSTR /R /C:"^      *crc_block_data_calculate" %MAP_FILE% > nul && call :OK||call :NO


goto :eof
:OK
::-------------------CRC32
bin\srec_cat.exe Objects\Project.hex -intel -crop 0x08000000 %CRC_ADDR% -fill 0xff 0x08000000 %CRC_ADDR% -stm32-l-e %CRC_ADDR% -o Objects\Project_checked.hex -intel
bin\srec_cat.exe Objects\Project.hex -intel -crop 0x08000000 %CRC_ADDR% Objects\Project_checked.hex -intel -crop %CRC_ADDR% %CRC_ADDR_END% -o
```

```
Objects\Project.hex -intel
bin\srec_cat.exe Objects\Project.hex -intel -crop %CRC_ADDR% %CRC_ADDR_END% -o -hex-dump
goto :eof

:NO
::--------------------CRC16
bin\srec_cat.exe Objects\Project.hex -intel -crop 0x08000000 %CRC_ADDR% -fill 0xff 0x08000000 %CRC_ADDR% -crc16-l-e %CRC_ADDR% -POLYnomial ccitt -XMODEM -o Objects\Project_checked.hex -intel
bin\srec_cat.exe Objects\Project.hex -intel -crop 0x08000000 %CRC_ADDR% Objects\Project_checked.hex -intel -crop %CRC_ADDR% %CRC_ADDR_END% -o Objects\Project.hex -intel
bin\srec_cat.exe Objects\Project.hex -intel -crop %CRC_ADDR% %CRC_ADDR_END% -o -hex-dump
goto :eof

exit
```

IEC_TEST_BOOT_FLASH.sct 是分散加载文件，其定义各个程序段和变量的加载地址，通过如下所示的代码，将 CRC 值（CHECKSUM）固定在 FLASH 空间的末尾位置。

```
; *************************************************************
; *** Scatter-Loading Description File generated by uVision ***
; *************************************************************

LR_IROM1 0x08000000 0x0001FFF8 {
    ER_IROM1 0x08000000 0x0001FFF8 {
        *.o (RESET, +First)
        *(InRoot$$Sections)
        .ANY (+RO)
    }

    ; RAM test during run time
    RAM_BUF 0x20000004
    {
        gd32e10x_test_prerun.o (RAM_RUN_BUF)
    }

    ; RAM pointer during run time
    RAM_PTR 0x20000030
    {
        gd32e10x_test_prerun.o (RAM_RUN_PTR)
    }
```

```
    ; variables of IEC test
    IEC_TEST_VAR 0x20000040 UNINIT 0x0000070
    {
        gd32e10x_test_prerun.o (IEC_TEST_RAM)
    }

    ; RW data
    RW_IRAM1 0x200000B0 UNINIT 0x00005000
    {
        .ANY (+RW +ZI)
    }

    ; stack overflow test
    STACK_IRAM2 0x200050B0 UNINIT 0x00002F40
    {
        gd32e10x_test_prerun.o (STACK_OV_TEST)
        startup_gd32e10x.o (STACK, +Last)
    }
}

LR_IROM2 0x0801FFFC 0x0000004 {
    ER_IROM2 0x0801FFFC 0x0000004
    {
        *.o (CHECKSUM, +Last)
    }
}
```

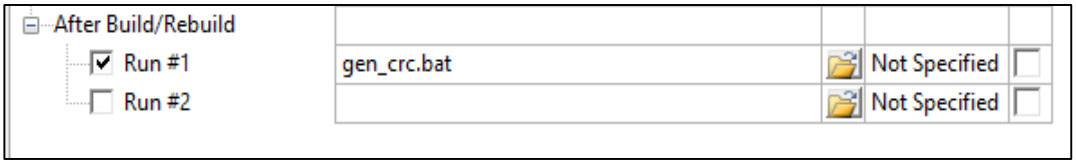
CRC_LOAD.ini 文件用于将添加 CRC 值之后的.hex 文件下载到被测 MCU 中，以实现 CRC 值自动添加到自检程序中，无需手动添加，其代码如下：

```
LOAD "Objects\\Project.hex"
```

2.2. 配置批处理

1. 在工程目录中添加了上述三个文件之后，打开工程，在 Options for Target->user->After Build/Rebuild 中选择 gen_crc.bat 文件，如*图 2-1. 选择 gen_crc.bat 文件*所示。

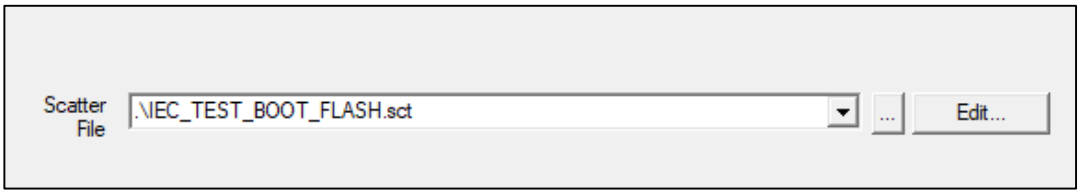
图 2-1. 选择 gen_crc.bat 文件



2. 在 Options for Targe->Linker 的 Scatter File 选项中选择 IEC_TEST_BOOT_FLASH.sct

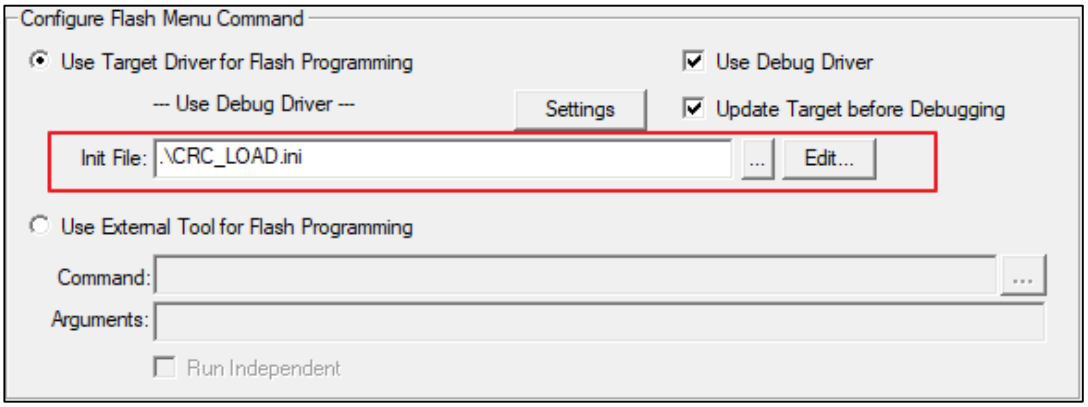
文件，如*图 2-2. 选择 IEC_TEST_BOOT_FLASH.sct 文件* 所示。

图 2-2. 选择 IEC_TEST_BOOT_FLASH.sct 文件



3. 在 Options for Targe->Utilities 的 Init File 选项中选择 CRC_LOAD.ini 文件,如*图 2-3. 选择 CRC_LOAD.ini 文件*所示。

图 2-3. 选择 CRC_LOAD.ini 文件



3. 结果

配置完成后，点击编译，可以在 Build Output 窗口观察 build 信息，如*图 3-1. Build 信息*所示，build 信息显示 CRC 值已存储在 0x0801FFF0 之后的位置；点击调试，并在 memory 观察窗口查询 0x0801FFF0 地址，如*图 3-2. 0x0801FFF0 地址*所示，可以看出 memory 中的值与 Build Output 窗口显示的 CRC 值一致，CRC 值计算批处理添加成功。

图 3-1. Build 信息

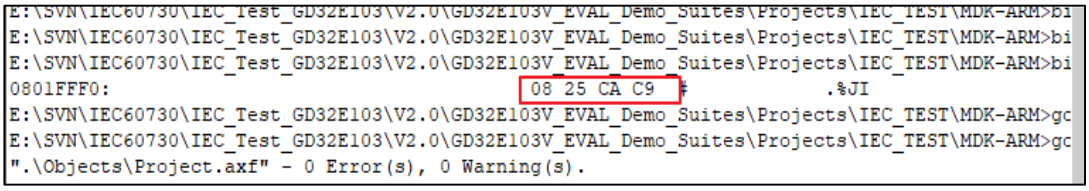
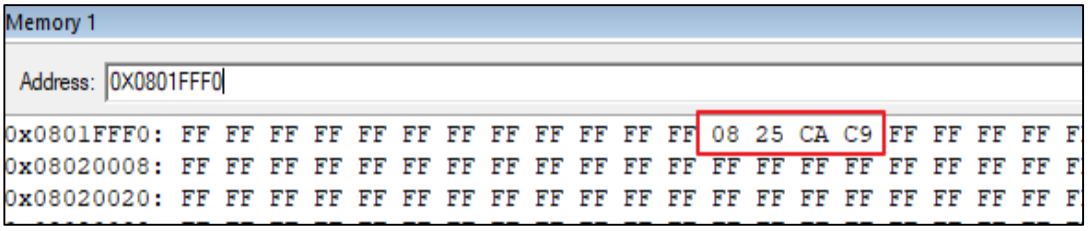


图 3-2. 0x0801FFF0 地址



4. 版本历史

表 4-1. 版本历史

版本号.	描述	日期
1.0	首次发布	2021 年 10 月 19 日

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