



Gowin_EMPU_M1
Download Reference Guide

IPUG532-1.2E,08/18/2019

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Revision History

Date	Version	Description
02/19/2019	1.0E	Initial version published.
07/18/2019	1.1E	<ul style="list-style-type: none">● MCU supports the automated merging tool for hardware design and software programming design;● MCU supports off-chip SPI-Flash downloading and startup.
08/18/2019	1.2E	<ul style="list-style-type: none">● MCU hardware design and software programming design support extended peripheral: DDR3 Memory;● Known issues of ITCM, DTCM Size and IDE fixed.

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1 Download Methods

Gowin Gowin_EMPU_M1 provides three download methods of hardware design and software programming design:

1. Use the mapping file output by software programming design as the ITCM initiation value of hardware design.
 - a). A BIN format file generated by Gowin_EMPU_M1 software design;
 - b). In software design, convert the BIN format file to four hex format files with a "make_hex" tool: itcm0, itcm1, itcm2, and itcm3;
 - c). Use itcm0, itcm1, itcm2, and itcm3 as the ITCM initiation value to be read-in;
 - d). Synthesis, place&route, and output the bitstream files containing software design and hardware design;
 - e). Download the bitstream file using Gowin Programmer.
2. Merge the mapping files output by software programming designs and the bitstream files output by hardware designs.
 - a). Output a bitstream file by Gowin_EMPU_M1 hardware design.
 - b). Output a BIN format file generated by Gowin_EMPU_M1 software design;
 - c). Merge the BIN format file and the bitstream file using a merge_bit tool;
 - d). Output the new bitstream file after merging;
 - e). Download the new bitstream file using Gowin Programmer.
3. Download the BIN file output by software programming design using off-chip SPI-Flash.
 - a). Use bootload itcm0, itcm1, itcm2, and itcm3 as the ITCM initiation value to be read-in;
 - b). Gowin_EMPU_M1 hardware design outputs a bitstream file with the function of off-chip SPI-Flash downloading and startup;
 - c). Download the bitstream file output by hardware design using Gowin Programmer;
 - d). Output a BIN format file generated by Gowin_EMPU_M1 software design;
 - e). Download the BIN file output by software programming design using Gowin Programmer.

2 Software Programming Output Used as ITCM Initialization Value

2.1 Tools

- Linux:
Gowin_EMPU_M1\script\make_hex_script\linux\make_hex\bin\make_hex
- Windows:
Gowin_EMPU_M1\script\make_hex_script\windows\make_hex\bin\make_hex.exe

2.2 Command Parameters

- Linux: make_hex bin-file
- Windows: make_hex.exe bin-file

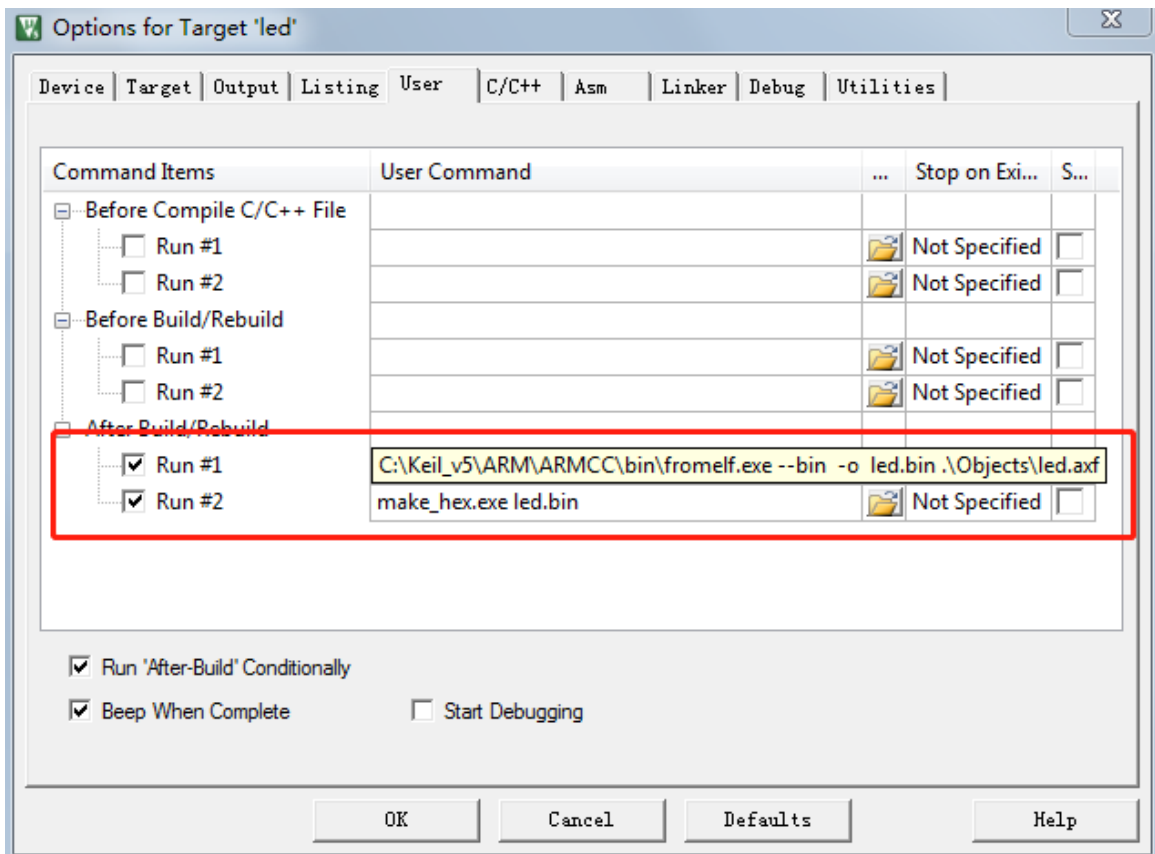
2.3 Software Configuration

Software programming design outputs a BIN format file. Convert the BIN format file to four hex format files with a "make_hex" tool: itcm0, itcm1, itcm2, and itcm3.

External script can be configured in ARM Keil Microcontroller Tool. make_hex.exe can be called automatically to generate hex format files during project compiling, as shown in Figure 2-1.

- Run #1
fromelf.exe --bin -o bin-file axf-file
- Run #2
make_hex.exe bin-file

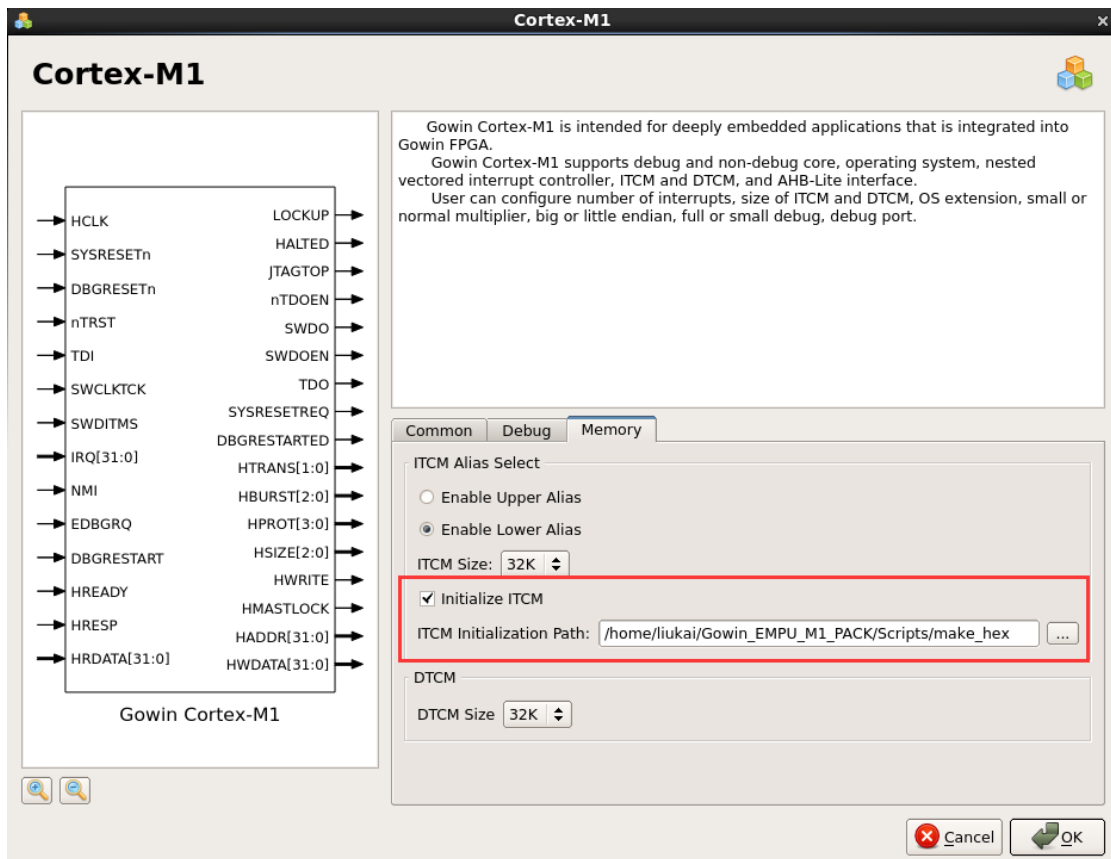
Figure 2-1 External Script Call



2.4 Hardware Configuration

When you configure Cortex-M1 in IP Core Generator, select "Initialize ITCM" and import the path of the four hex format files of itcm0, itcm1, itcm2, and itcm3 as the initial value of "ITCM Initialization Path", as shown in Figure 2-2.

Figure 2-2 Configure ITCM Initialization



2.5 Design Flow

1. Use the mapping files of itcm0, itcm1, itcm2, and itcm3 output by software design as the ITCM initiation value to be read-in;
2. Use Synplify_Pro or GowinSynthesis to synthesize;
3. Use Place & Route to place, route, and output bit stream files;
4. Download the bitstream file using Gowin Programmer.

2.6 Devices Supported

- GW1N-9
- GW1NR-9
- GW2A-18
- GW2AR-18
- GW2A-55

2.7 Reference Design

- Linux:
Gowin_EMPU_M1\script\make_hex_script\linux\make_hex\example
- Windows:
Gowin_EMPU_M1\script\make_hex_script\windows\make_hex\example
-le

3 Merge Results of Software Design and Hardware Design

3.1 Tools

- Linux:
Gowin_EMPU_M1\script\merge_bit_script\linux\merge_bit\bin\merge_bit.sh
- Windows:
Gowin_EMPU_M1\script\merge_bit_script\windows\merge_bit\bin\merge_bit.bat

3.2 Command Parameters

- Linux: bash merge_bit.sh
- Windows: merge_bit.bat

Take merge_bit.bat for instance, the software commands and parameters are as follows:

```
call make_loc.exe -i posp-file -s itcm's size [-d]
call merge_bit.exe bin-file itcm.loc fs-file
```

For the description of commands and parameters, please refer to Table 3-1.

Table3-1 merge_bit Commands and Parameters

Parameter	Description
make_loc.exe	Input posp-file and generate the ITCM layout information file: itcm.loc
-i	.posp file generated by Gowin_EMPU_M1 hardware design
-s	Set by the ITCM Size in Gowin_EMPU_M1 hardware design
-d	Optional If Enable Debug is configured, -d is enabled; If Disable Debug is configured, -d is disabled
merge_bit.exe	Merge Gowin_EMPU_M1 software design and hardware design
bin-file	The BIN mapping file output by Gowin_EMPU_M1 software design;

Parameter	Description
itcm.loc	Use make_loc.exe to generate the ITCM layout information file: itcm.loc
fs-file	The bitstream file output by Gowin_EMPU_M1 hardware design.

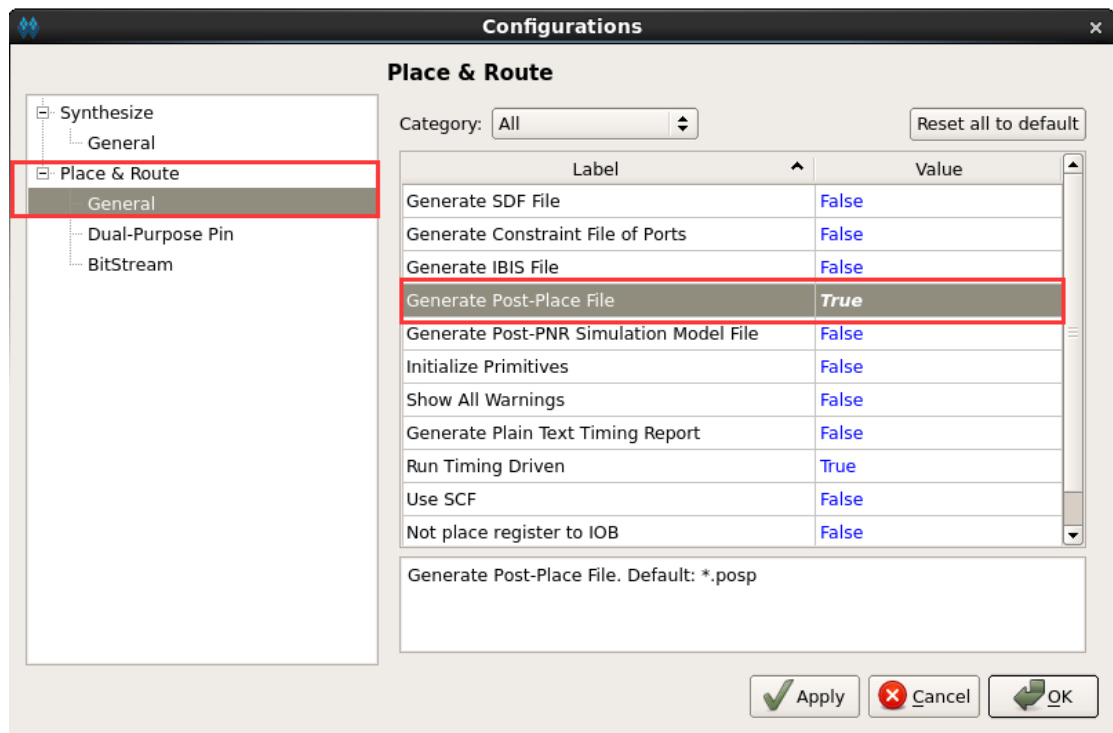
Merge the mapping files output by software programming designs and the bitstream files output by hardware designs and then output a new bitstream file.

You can modify the parameters, such as -i posp-file, -s itcm's size, -d, bin-file, fs-file, according to your requirements.

3.3 Hardware Configuration

A posp file, as the input file of make_loc.exe -i, will be generated when the value of "Generate Post-Place File" under "Place & Route" is True, as shown in Figure 3-1.

Figure 3-1 posp Configuration



3.4 Design Flow

3.4.1 Merge

1. Gowin_EMPU_M1 hardware design outputs a bitstream file and a posp file;
2. Gowin_EMPU_M1 software design outputs a BIN format file;
3. Use the merge_bit.sh or merge_bit.bat to merge the bitstream file and the BIN file and then output a new bitstream file, as shown in Figure 3-2.

Figure 3-2 Merge the Results of Software Design and Hardware Design

```
----- GOWIN Bin2FS -----
Read bit stream file gowin_empu_m1.fs ...
Build bsram init value fusemap...
Location file location.txt reading...
Bsram R28[9] init value convert to fusemap success.
Bsram R28[8] init value convert to fusemap success.
Bsram R28[7] init value convert to fusemap success.
Bsram R28[6] init value convert to fusemap success.
Bsram R46[4] init value convert to fusemap success.
Bsram R10[4] init value convert to fusemap success.
Bsram R28[5] init value convert to fusemap success.
Bsram R46[3] init value convert to fusemap success.
Bsram R10[3] init value convert to fusemap success.
Bsram R28[4] init value convert to fusemap success.
Bsram R46[2] init value convert to fusemap success.
Bsram R10[2] init value convert to fusemap success.
Bsram R28[3] init value convert to fusemap success.
Bsram R28[2] init value convert to fusemap success.
Bsram R28[1] init value convert to fusemap success.
Bsram R28[0] init value convert to fusemap success.
Replace new bsram init value map to file new_gowin_empu_m1.fs...
Build bsram init value replace completed.
```

3.4.2 Download

Download the new bitstream file using Gowin Programmer after the bitstream file and the BIN file are merged.

For further details about how to use Programmer, please refer to [Gowin Programmer User Guide](#).

3.5 Devices Supported

- GW2A-18
- GW2AR-18
- GW2A-55

3.6 Reference Design

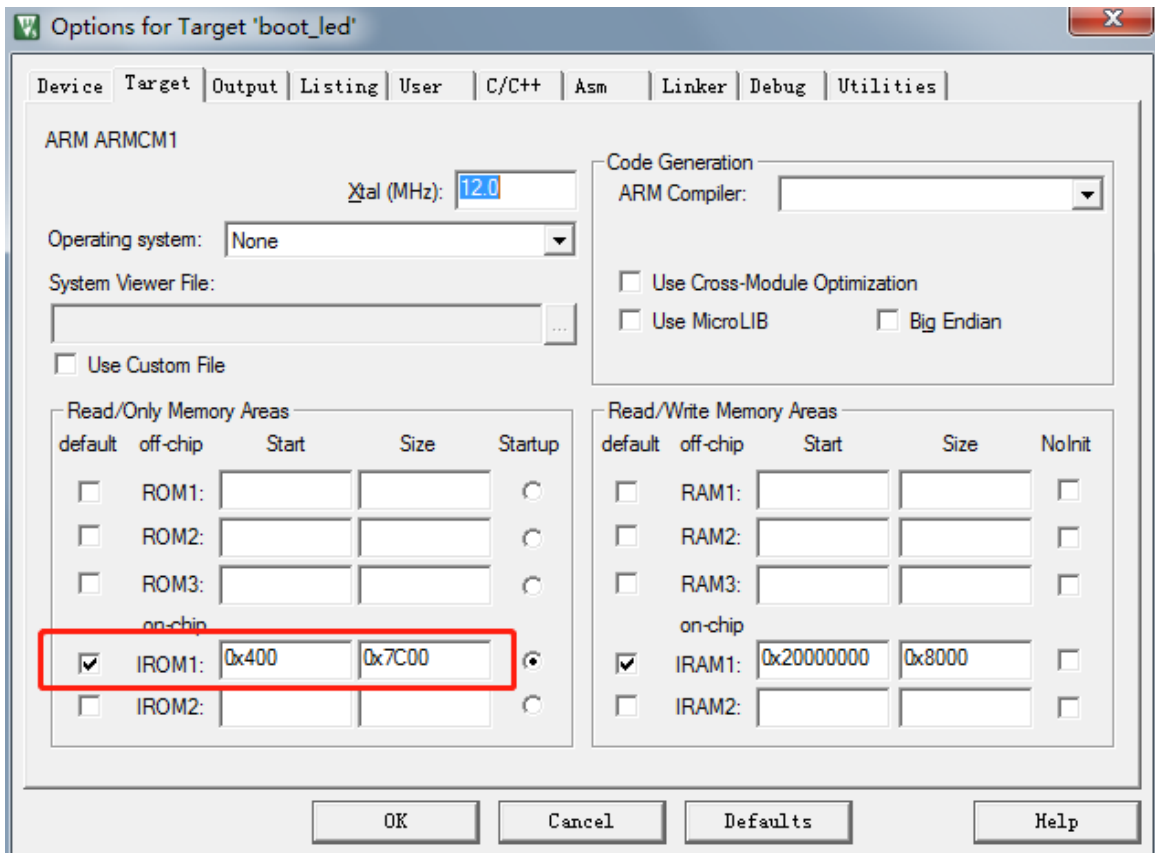
- Linux:
Gowin_EMPU_M1\script\merge_bit_script\linux\merge_bit\example
- Windows:
Gowin_EMPU_M1\script\merge_bit_script\windows\merge_bit\example

4 Off-chip SPI-Flash Download and Startup

4.1 Software Configuration

In the software programming design of Gowin_EMPU_M1, the ROM start address is 0x400 and the ROM capacity is 0x7C00, as shown in Figure 4-1.

Figure 4-1 ROM Start Address and Capacity

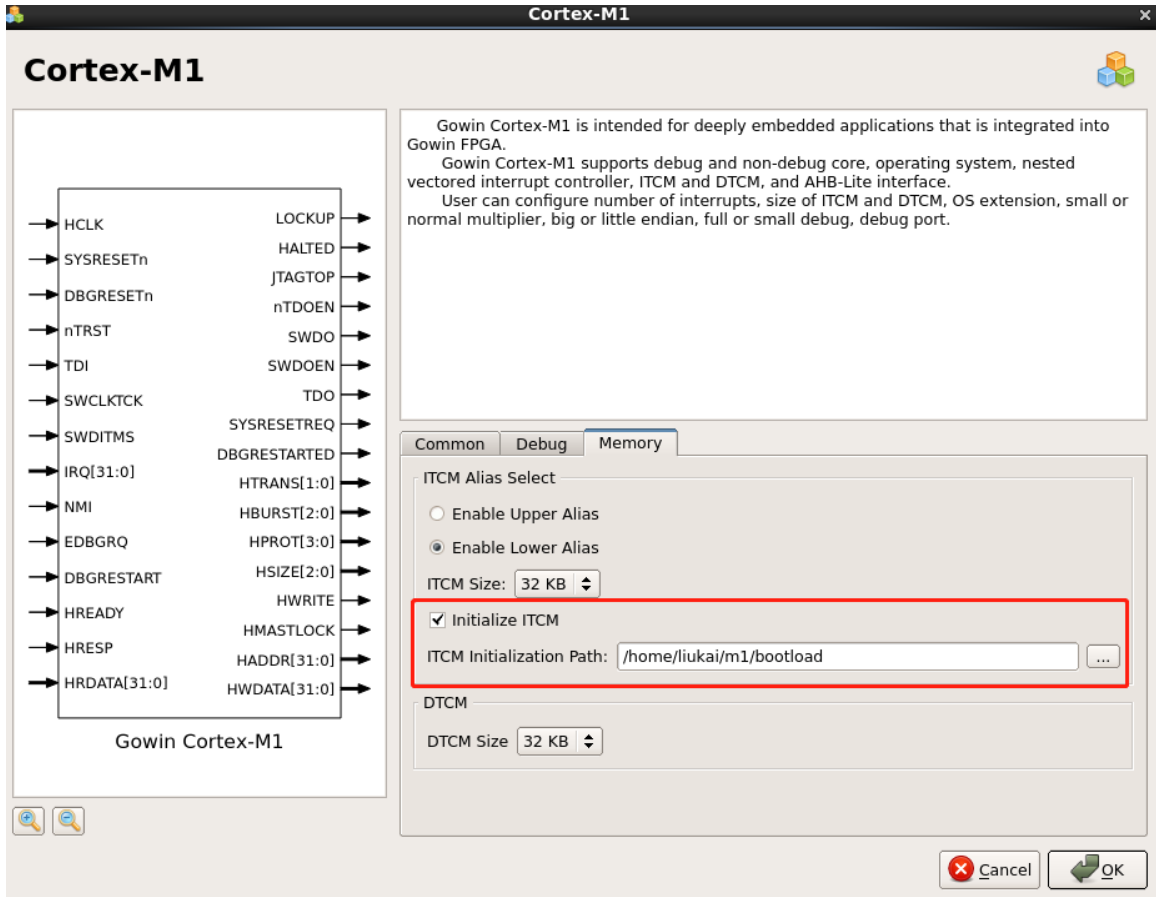


4.2 Hardware Configuration

4.2.1 ITCM Initialization Configuration

In Gowin_EMPU_M1 hardware design, configure the ITCM Initialization Path of Cortex-M1 as the bootload path. bootload itcm0, itcm1, itcm2, and itcm3 is read as the ITCM Initialization value, as shown in Figure 4-2.

Figure 4-2 Configure ITCM Initialization Path



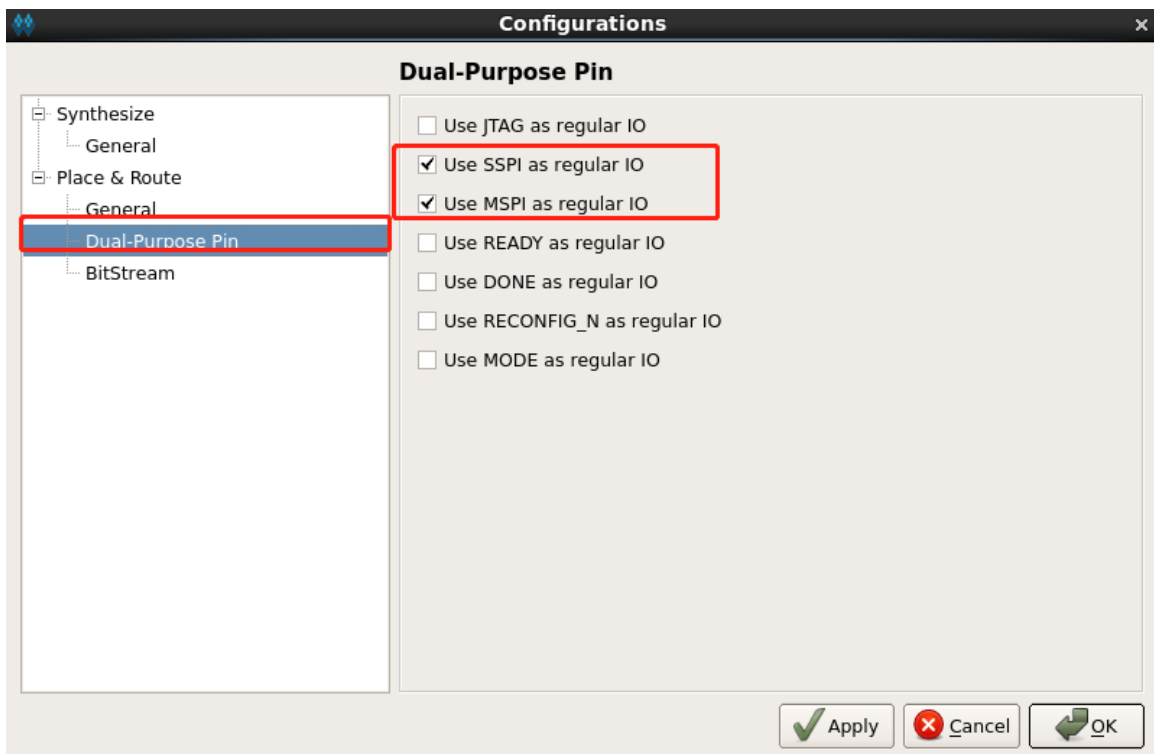
Gowin_EMPU_M1 offers Off-chip SPI-Flash downloading and startup of bootload:

bootload\boot\itcm0、 itcm1、 itcm2、 itcm3

4.2.2 Dual-Purpose Pin Configuration

In Gowin_EMPU_M1 hardware design, configure SSPI and MSPI as regular IO under Place & Route > Dual-Purpose Pin, as shown in Figure 4-3.

Figure 4-3 Configure Dual-Purpose Pin Configuration



4.3 Design Flow

1. Use bootloader itcm0, itcm1, itcm2, and itcm3 as the ITCM initiation value in Gowin_EMPU_M1 hardware design;
2. Gowin_EMPU_M1 hardware design outputs a bitstream file with the function of off-chip SPI-Flash downloading and startup;
3. Download the bitstream file using Gowin Programmer.
4. Gowin_EMPU_M1 software design outputs a BIN format file;
5. Download the BIN file using Gowin Programmer.

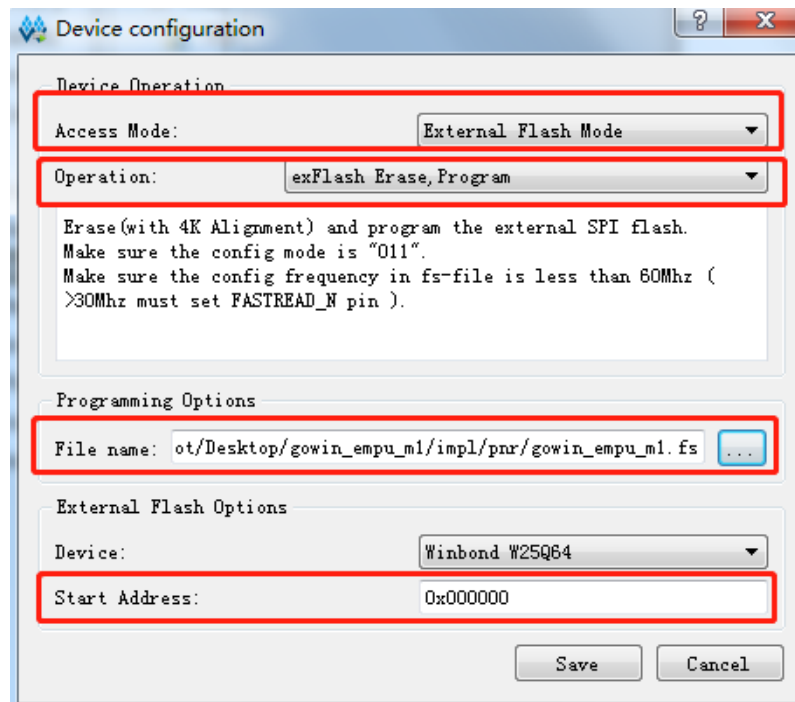
4.4 Download

For further details about how to use Programmer, please refer to SUG502, [Gowin Programmer User Guide](#).

4.4.1 Download Bitstream File

Gowin_EMPU_M1 hardware design outputs bootloader as ITCM initialization value and a bitstream file with the function of off-chip SPI-Flash downloading and startup. Download the bitstream file using Gowin Programmer.

As shown in Figure 4-4, configure "Access Mode" of Programmer as External Flash Mode, configure "Operation" of Programmer as exFlash Erase, Program, import the Gowin_EMPU_M1 hardware design bitstream file, and configure "Start Address" as 0x000000.

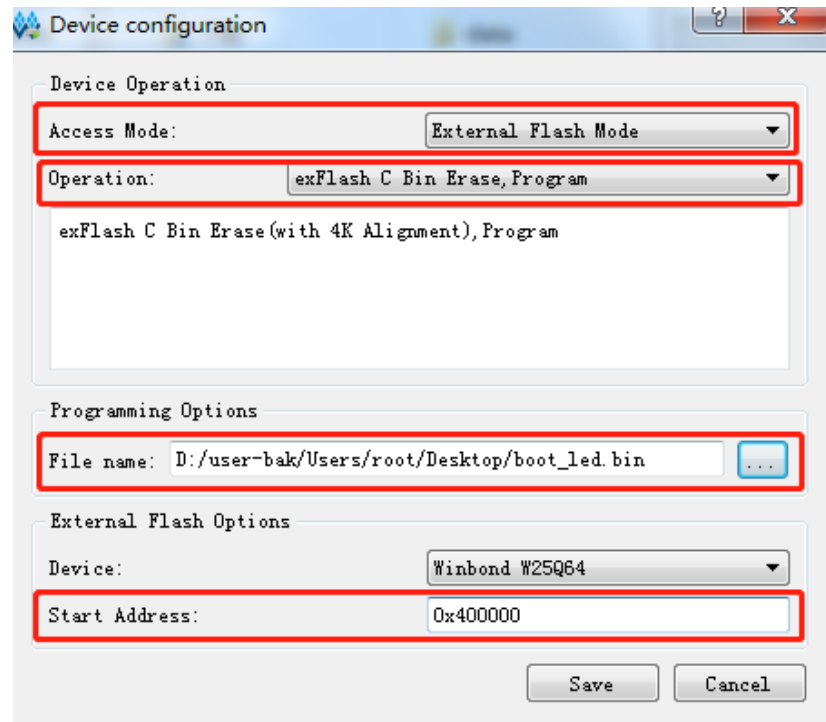
Figure 4-4 Configure Programmer Bitstream Download Mode

4.4.2 Download C-Bin File

After downloading the bitstream file output by Gowin_EMPU_M1 hardware design, download the BIN file output by Gowin_EMPU_M1 software design using Programmer.

As shown in Figure 4-5, configure "Access Mode" of Programmer as External Flash Mode, configure "Operation" of Programmer as exFlash Erase, Program, import the Gowin_EMPU_M1 software design C-Bin file, and configure "Start Address" as 0x400000.

Figure 4-5 Configure Programmer C-Bin Download Mode



4.5 Devices Supported

- GW2A-18
- GW2AR-18
- GW2A-55

4.6 Reference Design

Gowin_EMPU_M1\bootload\example

