



Gowin_EMPU_M1 Quick Design Reference Manual

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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 hardware design and software programming design support extended peripherals: CAN, Ethernet, SPI-Flash, RTC, DualTimer, TRNG, I2C, SPI, SD-Card.● MCU supports off-chip SPI-Flash downloading startup.
08/18/2019	1.2E	<ul style="list-style-type: none">● MCU hardware design and software programming design support extended peripheral: DDR3;● Known issues of ITCM, DTCM Size and IDE fixed.
09/27/2019	1.3E	<ul style="list-style-type: none">● MCU hardware design and software programming design support read, write and erasure of SPI-Flash peripheral;● MCU software programming design supports a continuous multi-byte read and write of I2C peripheral;● Fixed known issues of address mapping of AHB2 and APB2 extended interface in MCU software programming design;● Fixed known issues of continuous read and write of DDR3 Memory in MCU software programming design.
12/06/2019	1.4E	<ul style="list-style-type: none">● MCU hardware design and software programming design supports PSRAM peripheral;● MCU compiling software GMD V1.0 updated;● RTOS reference design updated;● Hardware and software reference design of AHB2 and APB2 extension bus interface added.

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1 Reference Design

1.1 Gowin_EMPU_M1 Software Reference Design

Gowin_EMPU_M1 provides software reference designs in ARM Keil MDK and GOWIN MCU Designer software environment:
Gowin_EMPU_M1\ref_design\MCU_RefDesign\Keil_RefDesign and GMD_RefDesign.

1.2 Gowin_EMPU_M1 Hardware Reference Design

Gowin_EMPU_M1 offers hardware reference designs:

Gowin_EMPU_M1\ref_design\FPGA_RefDesign\Debug_RefDesign and NoDebug_RefDesign

The reference design includes two parts:

- Cortex-M1 core
- AHB-Lite interface, extension AHB, and APB peripheral interface

1.2.1 Cortex-M1

Take DK-START-GW2A18 V2.0 reference design gowin_empu_m1 as an example, the configured functions of Cortex-M1 are shown in Table 1-1.

Table 1-1 Cortex-M1 Functions of the Reference Design

Function Mode	Configuration
Number of external interrupts	32
Extended operation system	Supported
Data storage format	Little-endian format
MULT	Standard mode
Debugger	<ul style="list-style-type: none"> ● Integrated mode, four break points and two observation points ● Debugger disabled
Debug interface	Support JTAG and Serial Wire interfaces
ITCM size	32KB by default
ITCM Initial value	Enable
ITCM Initial value path	Off-chip SPI-Flash downloading: gowin_empu_m1\boot

Function Mode	Configuration
ITCM alias	Lower alias
DTCM size	32KB by default

1.2.2 AHB-Lite

Take DK-START-GW2A18 V2.0 reference design gowin_empu_m1 as an example, the configured peripheral interfaces of AHB-Lite is shown in Table 1-2.

Table 1-2 Reference Design of AHB-Lite Peripheral Interface Configuration

Peripheral Interface	Configuration
UART0	Supported
UART1	Supported
GPIO	Supported
Timer0	Supported
Timer1	Supported
WatchDog	Supported
Real-time Clock	Supported
True Random Number Generator	Supported
Dual Timer	Supported
Internal integrated circuit	Supported
SPI	Supported
SD-Card	Supported
Ethernet	Supported
SPI-Flash	Supported

Note!

Due to the FPGA logic resources of GW2A-18 devices, DK-START-GW2A18 V2.0 reference design Gowin_EMPU_M1 does not support enable the peripherals: CAN, DDR3 Memory and PSRAM.

2 Gowin_EMPU_M1 Software Design

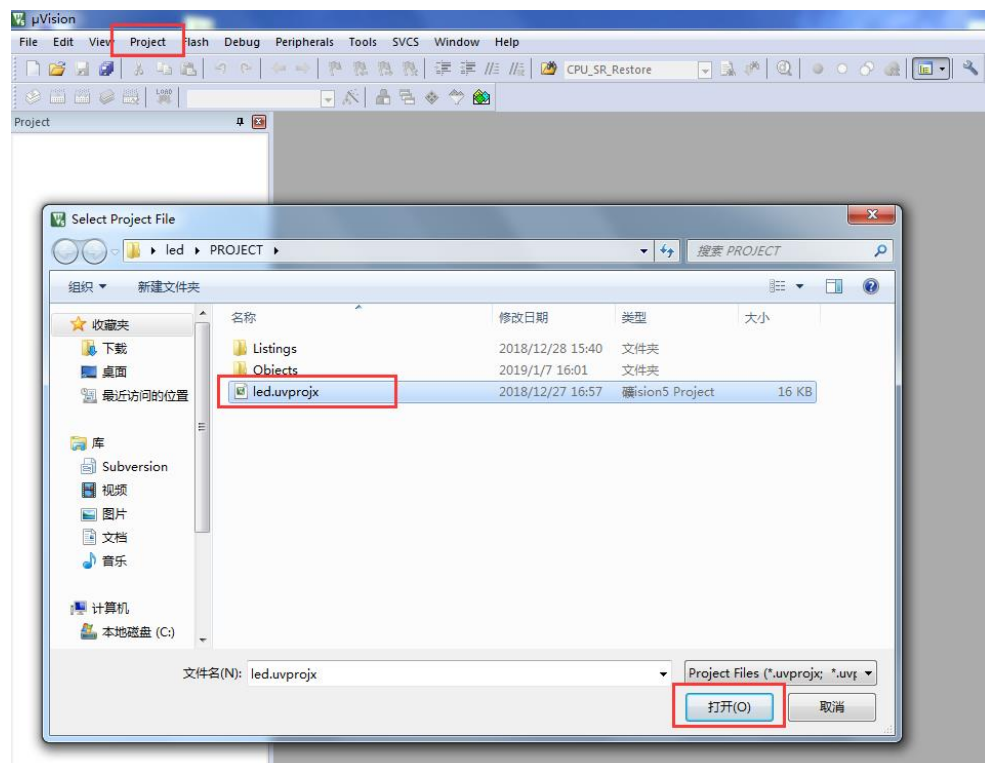
2.1 Software Environment

- ARM Keil MDK (V5.24.2.0 and above)
- GOWIN MCU Designer V1.0

2.2 Import Software Reference Design

Double click ARM KEIL MDK Tool and select "Project > Open Project..." to import the reference design of led, as shown in Figure 2-1.

Figure 2-1 Import the Reference Design of Led

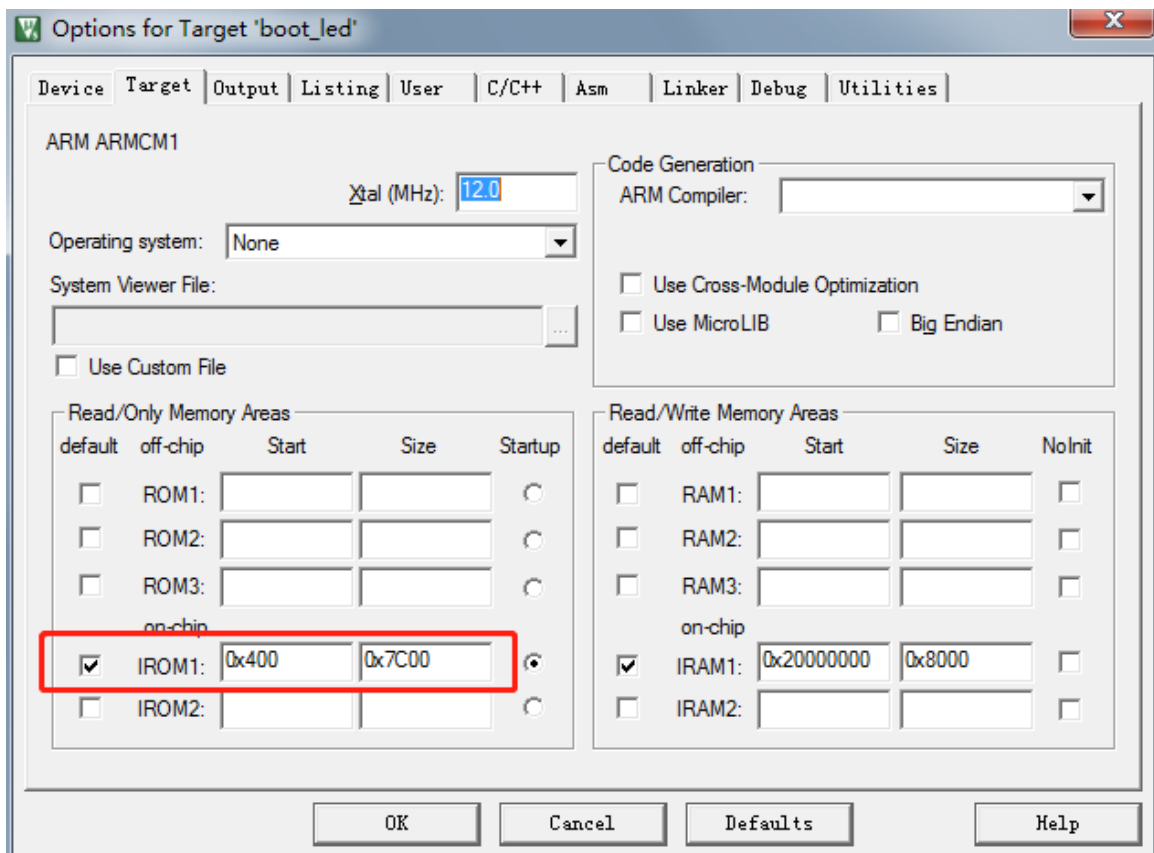


2.3 ROM Configuration

Take DK-START-GW2A18 V2.0 reference design gowin_empu_m1 as an example, you can use Gowin_EMPU_M1 off-chip SPI-Flash

downloading, set the ROM start address as 0x400 and the ROM size as 0x7C00, as shown in Figure 2-2.

Figure 2-2 ROM Start Address and Capacity



2.4 Compile


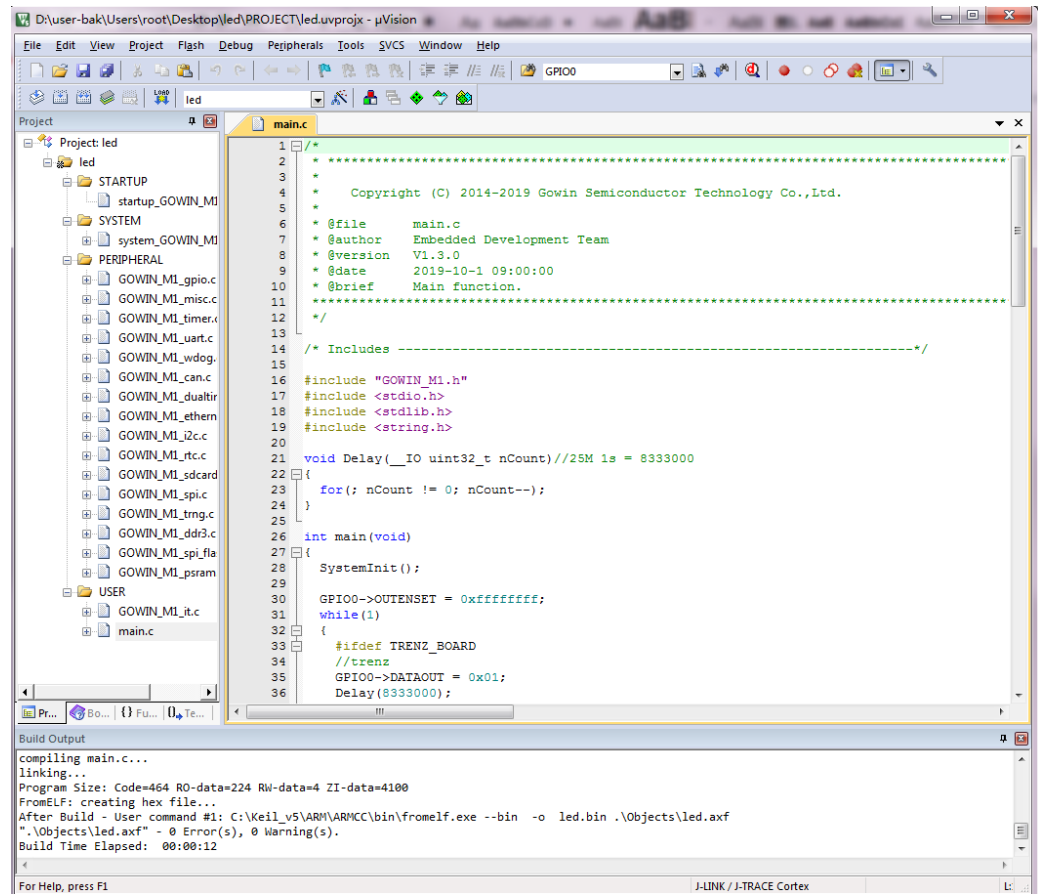
Click the compile button  on the tool bar to compile the reference design and output BIN file, as shown in Figure 2-3.

Figure 2-3 Compiling



2.5 Downloading

Take DK-START-GW2A18 V2.0 reference design gowin_empu_m1 as an example, Download Gowin_EMPU_M1 BIN file using Programmer.


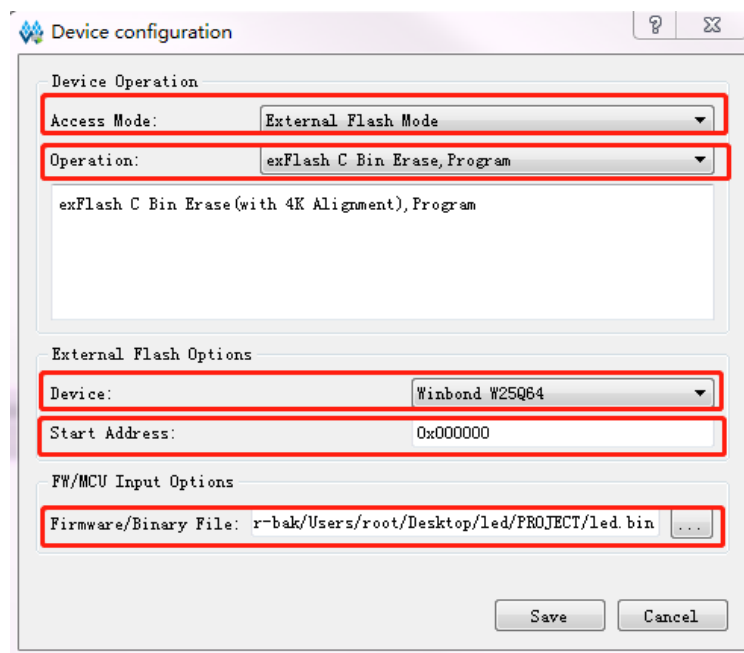

Click "Tools > Programmer > Edit > Configure Device" or click "  " to open Device configuration dialog box. Select "External Flash Mode" from "Access Mode", select "exFlash Erase, Program" from "Operation", import required BIN file in "Firmware/Binary File", select "Device" based on the Flash on board in "External Flash Options", select "0x400000" in "Start Address" and click "Save", as shown in Figure 2-4.

Figure 2-4 Device Configuration

After device configuration, click "Program/Configure" in the Programmer toolbar or "  " to complete BIN file downloading.

2.6 Reference Manual

For Gowin_EMPU_M1 Software Design method, please refer to the following two manuals:

- IPUG533, Gowin_EMPU_M1 Software Programming Reference Manual
- IPUG536, Gowin_EMPU_M1 IDE Software Reference Manual
- IPUG532, Gowin_EMPU_M1 Downlaod Reference Manual
- IPUG535, Gowin_EMPU_M1 Serial Debug Reference Manual
- [SUG502](#), Gowin Programmer User Guide

3 Gowin_EMPU_M1 Hardware Design

3.1 Hardware Environment

DK-START-GW2A18 V2.0: GW2A-LV18PG256C8/I7

3.2 Software Environment

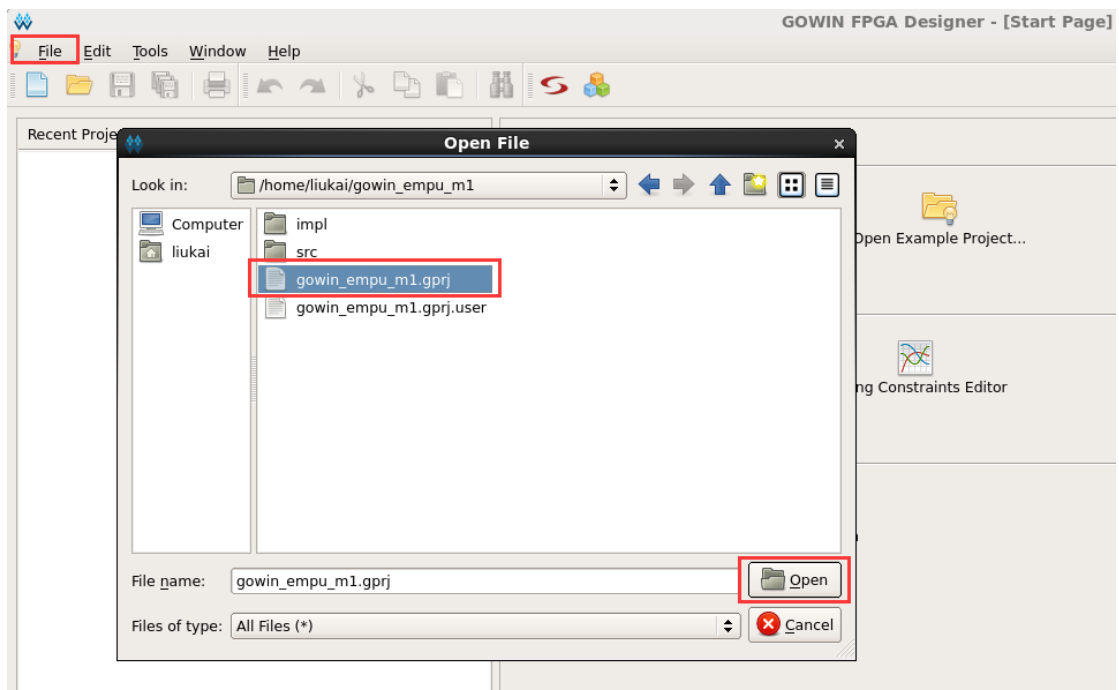
Gowin_V1.9.3.01 Beta

3.3 Import Hardware Reference Design

Double click Gowin Yun Yuan software, select "File > Open", and select Gowin_EMPU_M1 hardware reference design gowin_empu_m1, as shown in Figure 3-1.

Or you can open the IP Core Generator and reconfigure and generate Gowin_EMPU_M1 hardware design according to your requirements.

Figure 3-1 Import Gowin_EMPU_M1 Hardware Reference Design



The main project files of the hardware reference design are as shown in Table 3-1.

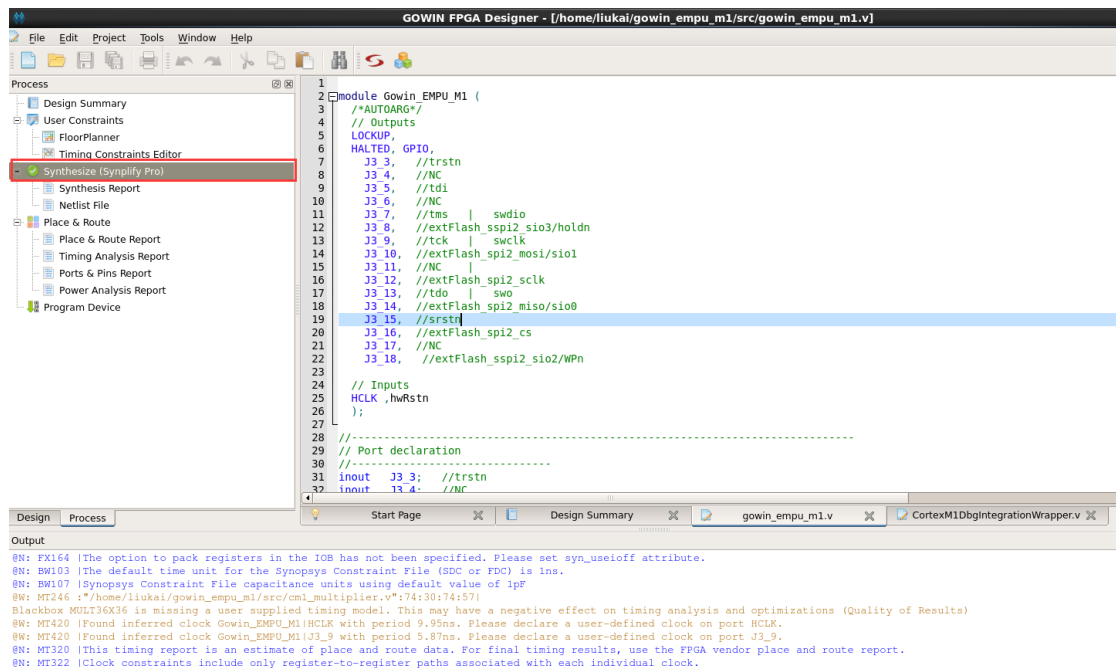
Table 3-1 Hardware Reference Design Examples

File	Description
gowin_empu_m1.v	Gowin_EMPU_M1 Hardware Design
gowin_empu_m1_template.v	Gowin_EMPU_M1 instantiation and user design
gowin_empu_m1.cst	Physical Constraints

3.4 Synthesize

Run the "Synplify_Pro" synthesis tool to generate the netlist file, as shown in Figure 3-2.

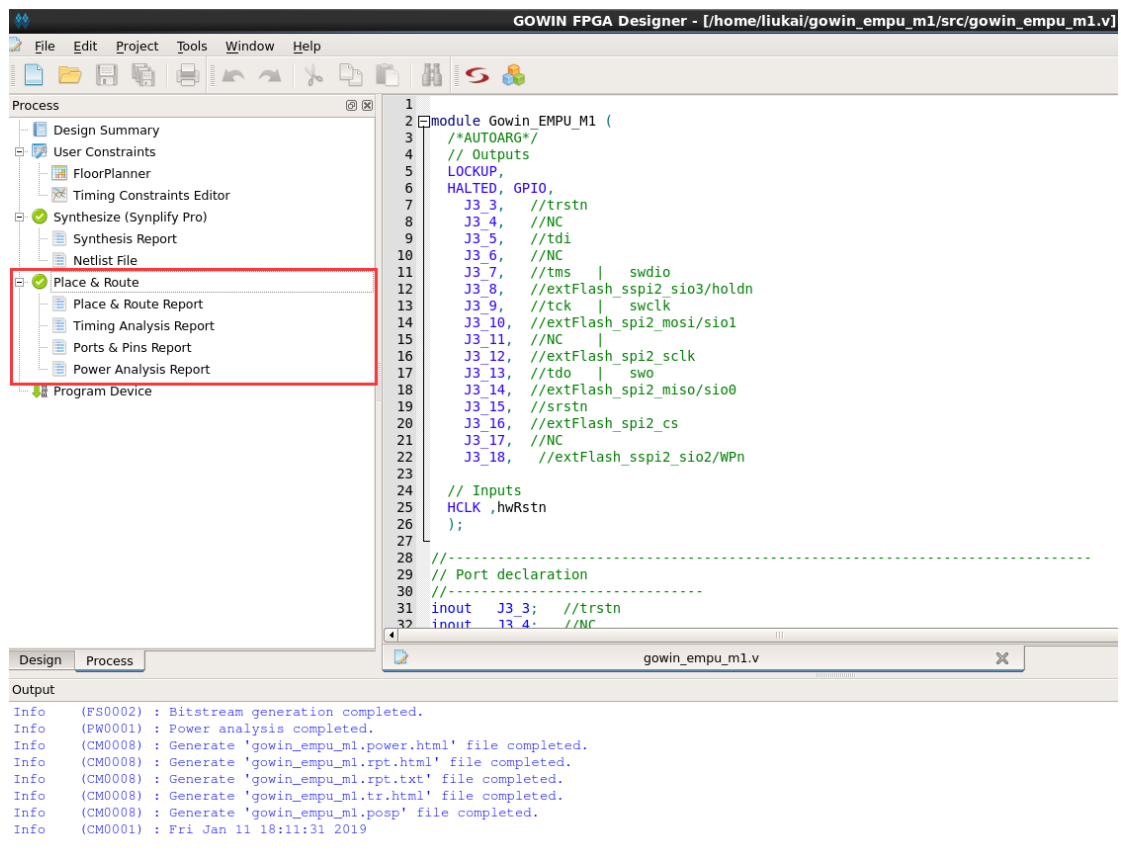
Figure 3-2 Reference Design Synthesis



3.5 Place & Route

After synthesis, run the place & route tool to generate the bitstream files containing software design output and hardware design output, as shown in Figure 3-3.

Figure 3-3 Place & Route



3.6 Download

Download Gowin_EMPU_M1 bitstream file using Programmer.


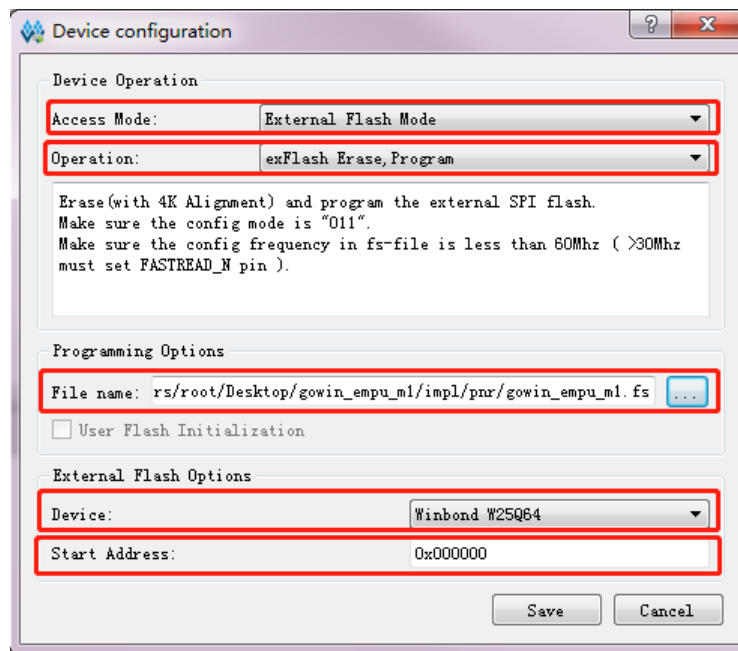
Click "Tools > Programmer > Edit > Configure Device" or click "  " to open Device configuration dialog box. Select "External Flash Mode" from "Access Mode", select "exFlash Erase, Program" from "Operation", import required bitstream file in "Programming Options", select "Device" based on the Flash on board in "External Flash Options", select "0x000000" in "Start Address" and click "Save", as shown in Figure 3-4.

Figure 3-4 Device Configuration

After device configuration, click "Program/Configure" in the Programmer toolbar or "📁" to complete bitstream file downloading.

3.7 Reference Manual

Please refer to the following manuals for Gowin_EMPU_M1 hardware design:

- IPUG531, Gowin_EMPU_M1 Hardware Design Reference Guide
- [SUG100](#), Gowin YunYuan Software User Guide
- [SUG101](#), Gowin Design Constraints Guide
- [SUG502](#), Gowin Programmer User Guide

4 Debug

4.1 Gowin_EMPU_M1 Hardware Debug

Use Gowin Analyzer Oscilloscope (GAO) to debug the Gowin_EMPU_M1 FPGA hardware design.

4.2 Gowin_EMPU_M1 Software Debug

Two Gowin_EMPU_M1 software debugging methods are supported:

- Emulator Debugging
- Serial Debugging

4.2.1 Emulator Debug

Emulator Type

Gowin_EMPU_M1 supports the following emulator to set break points for single-step debugging:

- JLINK emulator
- ULINK emulator

Debug interface

Gowin_EMPU_M1 supports the following debugging interfaces:

- JTAG
- Serial Wire

4.2.2 Serial Debug

Use serial and serial debugging assistant to print the running status.

4.2.3 Reference Manual

- [SUG114](#), Gowin Analyzer Oscilloscope User Guide
- IPUG536, MCU IDE Software Reference Manual
- IPUG535, Gowin_EMPU_M1 Serial Debugging Reference Manual

