Gowin PicoRV32 Quick Design

Reference Manual

IPUG915-1.7E, 06/14/2024

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Revision History

Date	Version	Description
01/16/2020	1.0E	Initial version published.
03/13/2020	1.1E	● MCU supports GPIO of Wishbone bus interface. ● MCU supports extension AHB bus interface. ● MCU supports off-chip SPI-Flash download and startup. ● MCU supports the read, write and erasure SPI-Flash. ● MCU supports Hardware Stack Protection and Trap Stack Overflow.
06/01/2020	1.2E	● MCU on-line debug function supported. ● MCU core interrupt handler function enhanced. ● MCU core instruction optimized.
07/16/2021	1.3E	● The synthesis tool, SynplifyPro, deleted. ● The version of FPGA software updated.
02/14/2022	1.4E	● The register address mapping of the peripheral Simple UART updated. ● The register definitions of the peripheral I2C Master and GPIO updated. ● The driver function definition of the peripheral SPI-Flash updated. ● The interrupt handler enhanced. ● MCU software reference design updated. ● IDE software options configuration optimized. ● IDE software on-line debug process improved. ● The range of ITCM and DTCM Size for GW2AN-9X/GW2AN-18X modified. ● The reference design of makehex and mergebin added.
08/18/2023	1.5E	Arora V FPGA products supported.
03/29/2024	1.6E	● GW5AT-60 Version A FPGA products supported. ● mergebin tool updated to support GW2AN-18X/9X FPGA products. ● Reference designs for software programming and hardware updated.
06/14/2024	1.7E	Reference designs for software programming and hardware updated.

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1 About This Manual

1.1 Purpose

This manual describes the quick design of Gowin_PicoRV32 hardware design and software programming by taking DK-START-GW5A25 V1.1 development board reference design in software development kit as an example, aiming at helping users to quickly develop Gowin_PicoRV32 hardware design and software programming design.

1.2 Develop Environment

1.2.1 Hardware Target

- DK-START-GW5A25 V1.1

  GW5A-LV25UG324ES

  GW5A-25 (Version A)

1.2.2 Software Version

- Tested software version: Gowin_V1.9.9.03 (64-bit)
- GMD (tested software version: (V1.2)

1.3 Reference Design

1.3.1 Software Reference Design

Gowin_PicoRV32 provides software programming reference design for GMD software (tested software version: V1.2), and you can get the following reference design through the link:

...\ref_design\MCU_RefDesign\picorv32_demo

1.3.2 Hardware Reference Design

Gowin_PicoRV32 provides hardware reference design, and you can get the following reference design through the link:

…\ref_design\FPGA_RefDesign\DK_START_GW5A25_V1.1\gowin_picorv32

2 Software Programming Reference Design

2.1 Software Reference Design

Double click to open MCU software, and select "File > Import > General > Existing Projects into Workspace" in the menu bar to import the software programming reference design picorv32_demo, as shown in Figure 2-1 and Figure 2-2.

Figure 2-1 Select Projects

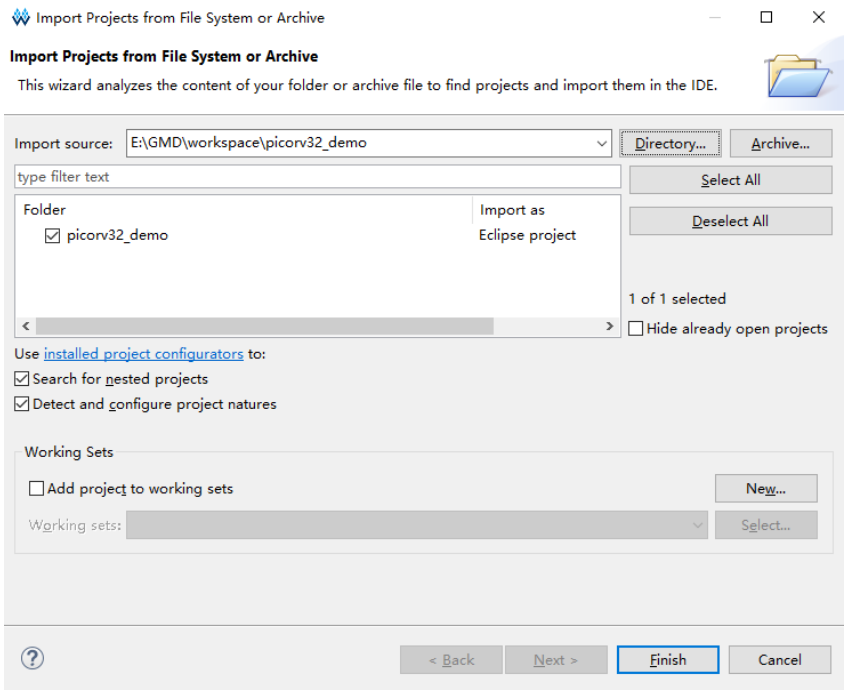
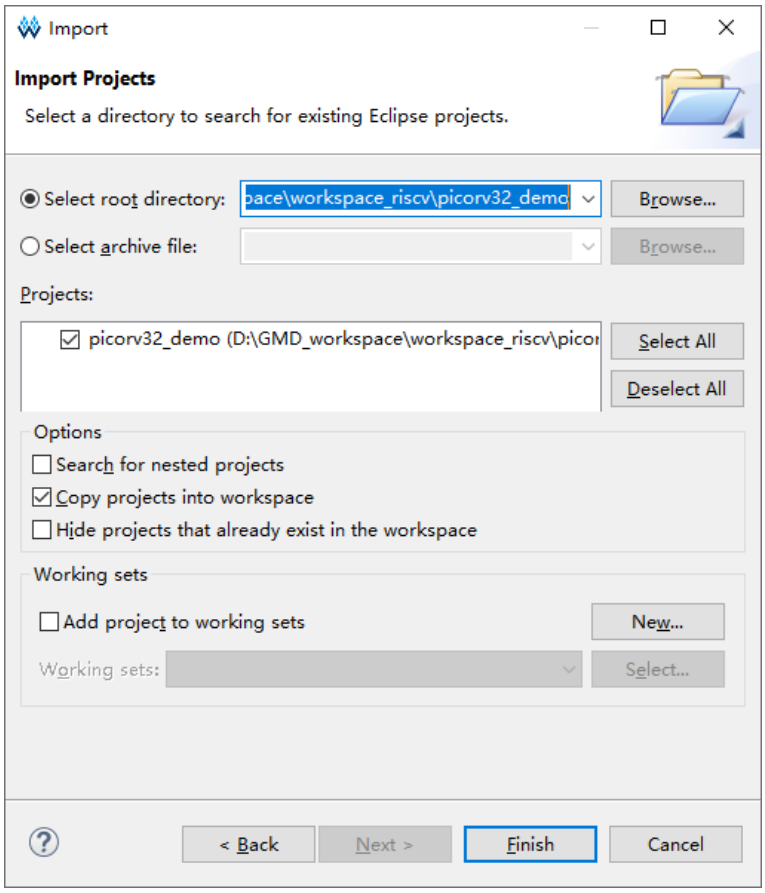


Figure 2-2 Import Projects



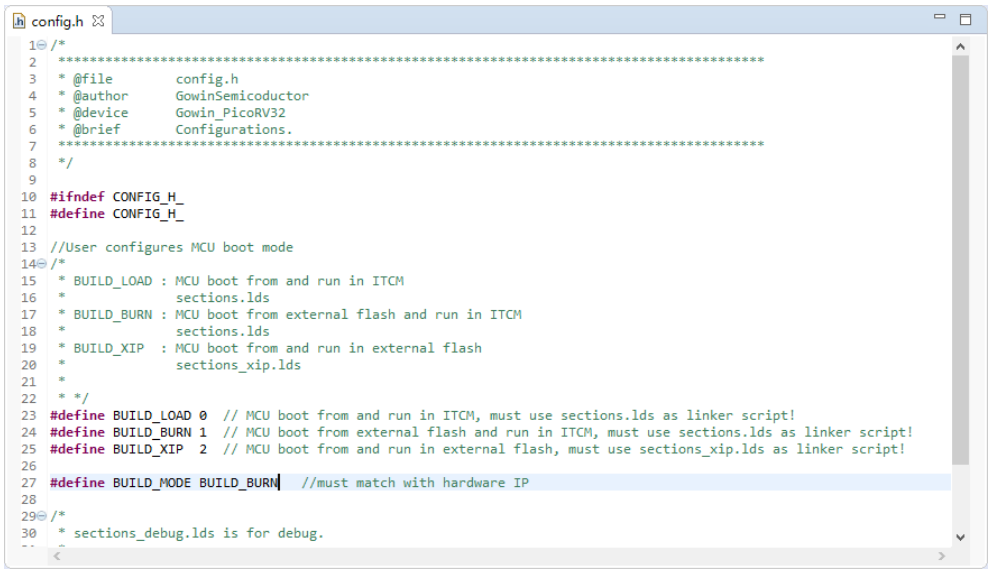
2.2 Software Configuration

Select "ITCM > Boot Mode > MCU boot from external Flash and run in ITCM" in the gowin_picorv32 hardware reference design.

2.2.1 Boot Mode Configuration

The software programming reference design picorv32_demo defines the macro definition for config.h as BUILD_BURN (#define BUILD_MODE BUILD_BURN), as shown in Figure 2-3.

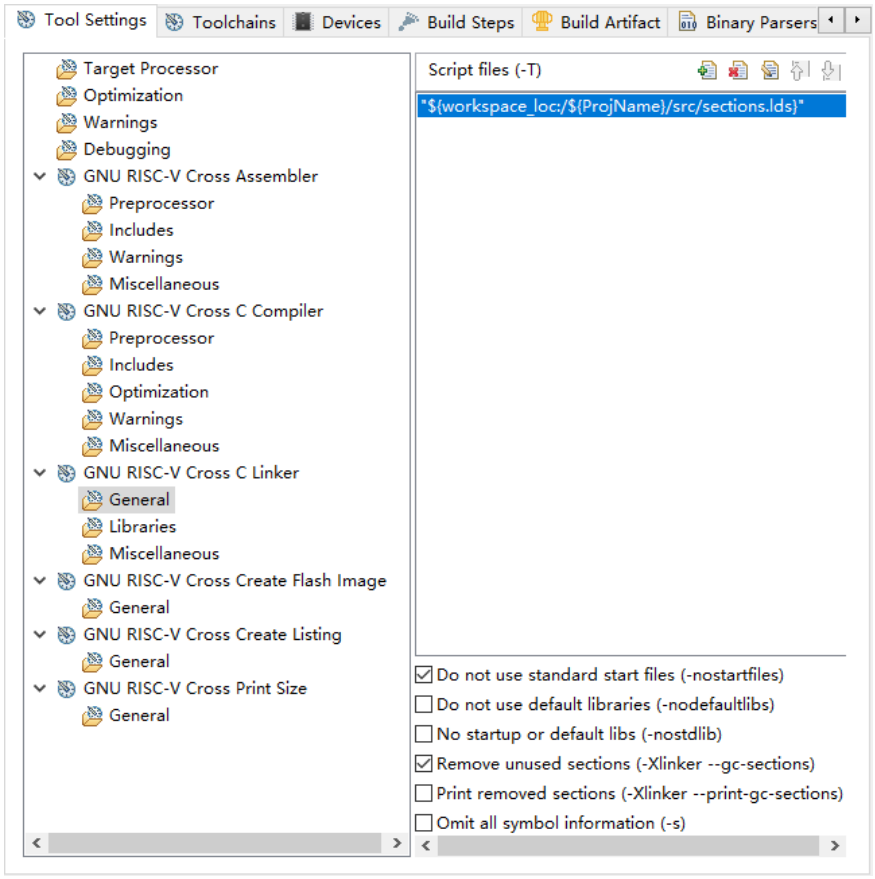
Figure 2-3 Boot Mode Configuration



2.2.2 Flash linker Configuration

Click "Properties > C/C++ Build > Settings > Tool Settings > GNU RISC-V Cross C Linker > General", and select "sections.lds" as the Flash linker, as shown in Figure 2-4.

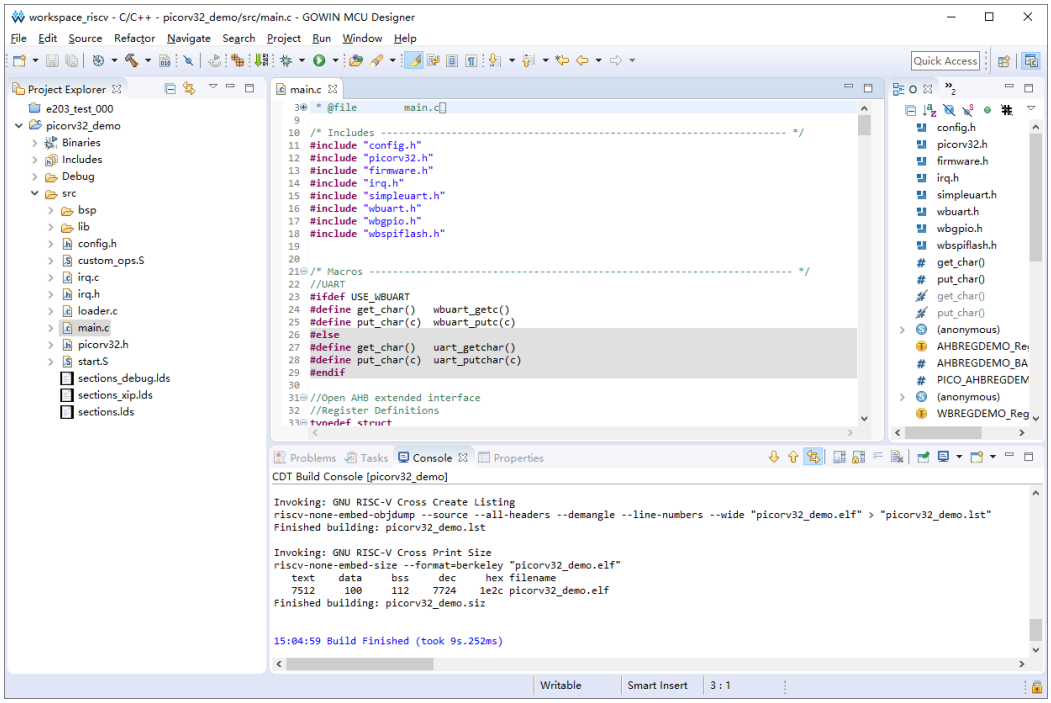
Figure 2-4 Flash Linker Configuration



2.3 Build Software Project

Click the Build "" button on the tool bar to build the software programming reference design and generate the BIN file of the software design, as shown in Figure 2-5.

Figure 2-5 Build



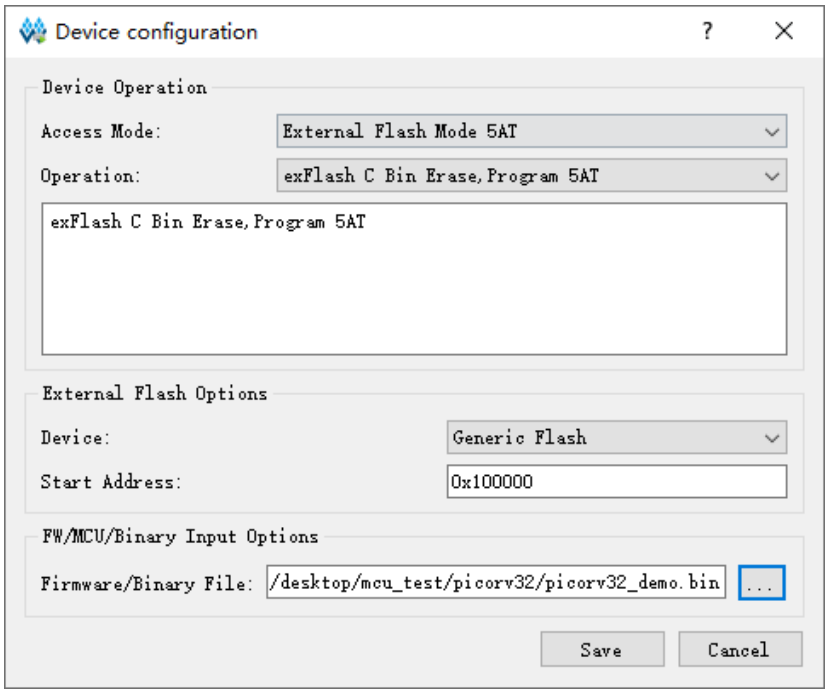
2.4 Download

Click "Run > Programmer" in the menu bar or "Programmer" "" in the tool bar to open the download tool "Programmer".

Click "Edit > Configure Device" on the Programmer menu bar or "Configure Device" () on the tool bar to open "Device configuration", as shown in Figure 2-6.

- Select "External Flash Mode 5AT" option in "Access Mode" drop-down list.
- Select "exFlash C Bin Erase, Program 5AT" or "exFlash C Bin Erase, Program, Verify 5AT" option in "Operation" drop-down list.
- Click "FW/MCU/Binary Input Options > Firmware/Binary File" option to import the BIN files of the software programming design to download.
- Select "Generic Flash" from "External Flash Options > Device" option.
- Configure the start address as "0x100000" in "External Flash Options > Start Address" option.
- Click "Save" to complete the configuration.

Figure 2-6 Device Configuration



After device configuration, click "Program/Configure" ( ) on the Programmer tool bar to complete the the download of BIN files of software programming design.

2.5 Reference Manual

For Gowin_PicoRV32 software programming design method, please refer to the following manuals:

- IPUG911, Gowin_PicoRV32 Software Programming Reference Manual
- IPUG910, Gowin_PicoRV32 IDE Software Reference Manual
- IPUG913, Gowin_PicoRV32 Software Download Reference Manual
- SUG502, Gowin Programmer User Guide

3 Hardware Reference Design

3.1 Hardware Environment

Double click to open Gowin Software, select "File > Open..." in the menu bar to import gowin_picorv32 hardware reference design. Gowin_PicoRV32 can be reconfigured to generate Gowin_PicoRV32 based on application requirements.

The description of the hardware reference design is as shown in Table 3-1.

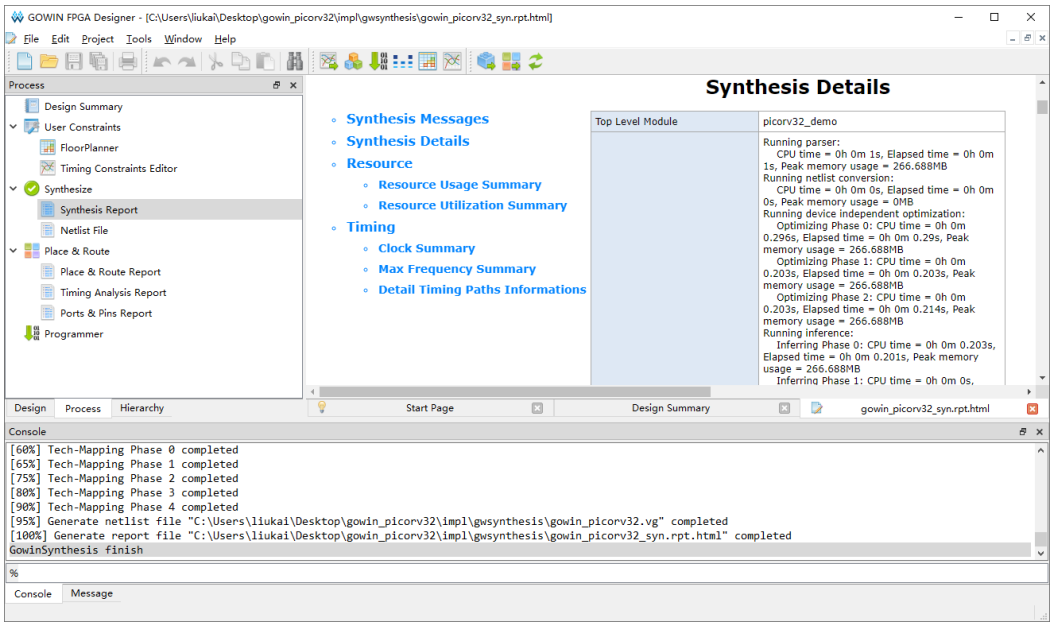
Table 3-1 Hardware Reference Design Examples

File	Description
gowin_picorv32.v	Gowin_PicoRV32 IP design generated by IP Core Generator
picorv32_demo.v	Gowin_PicoRV32 Top Module instantiation and user design
wbreg.v	The example of Open Wishbone bus extension external device
ahbreg.v	The example of Open AHB bus extension external device
button.v	The example of external interrupt
cnt.v	Counter delay
key_debounce.v	Reset key debounce
picorv32.cst	Physical constraint
picorv32.sdc	Timing Constraint

3.2 Synthesize

Run the synthesis tool GowinSynthesis to synthesize hardware reference design and generate the netlist file, as shown in Figure 3-1.

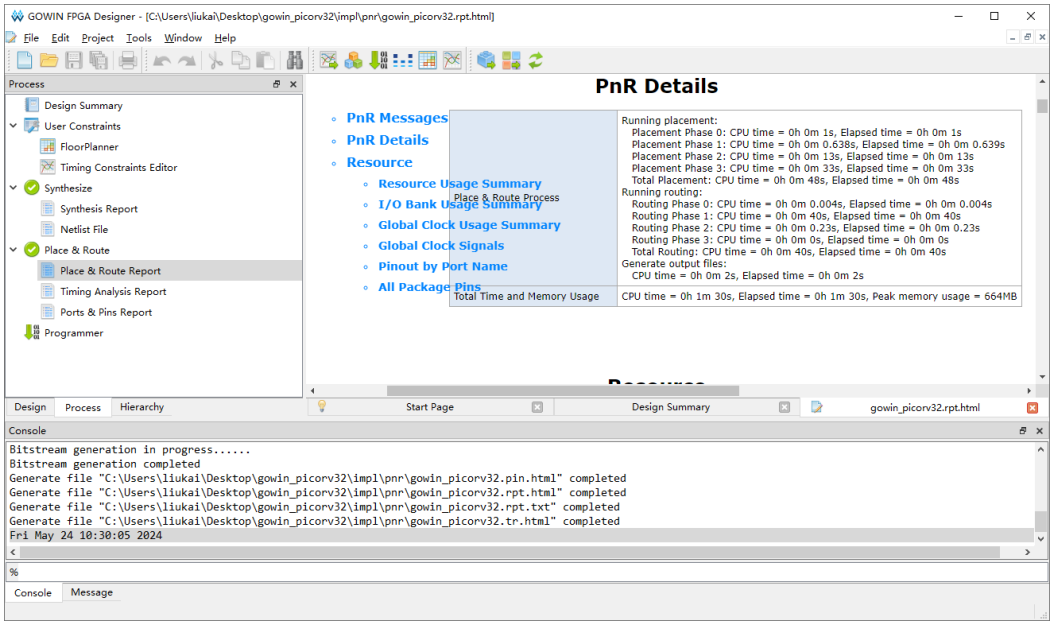
Figure 3-1 Synthesis



3.3 Place & Route

Run Place & Route tool to generate the bitstream files of hardware design, as shown in Figure 3-2.

Figure 3-2 Place & Route



3.4 Download

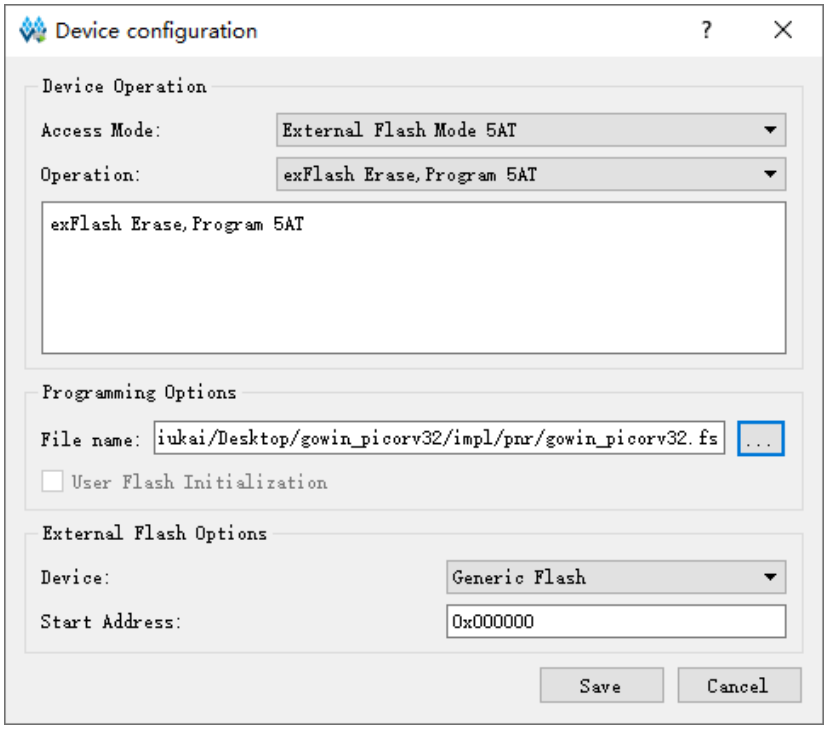
Run Programmer, the download tool of Gowin Software, to download hardware design the bitstream file.

Click "Edit > Configure Device" on the menu bar or "Configure Device" ( ) on the tool bar to open the "Device configuration", as shown in Figure 3-3.

- Select "External Flash Mode 5AT" in "Access Mode" drop-down list.

- Select "exFlash Erase, Program 5AT" or "exFlash Erase, Program, Verify 5AT" in "Operation" drop-down list.
- Import the hardware design bitstream file that is required to download in "Programming Options > File name" option.
- Select "Generic Flash" from "External Flash Options > Device" option.
- Configure the start address as "0x000000" in "External Flash Options > Start Address" option.
- Click "Save" to complete the configruation.

Figure 3-3 Device Configuration



After device configuration, click "Program/Configure" ( ) on the Programmer tool bar to complete the download of the bitstream files for hardware design.

3.5 Reference Manual

For Gowin_PicoRV32 hardware design, please refer to the following manuals:

- IPUG914, Gowin_PicoRV32 Hardware Design Reference Manual
- SUG100, Gowin Software User Guide
- SUG935，Gowin Design Physical Constraints User Guide,
- SUG1018，Arora V Design Physical Constraints User Guide
- SUG502, Gowin Programmer User Guide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