

Gowin Background goConfig IP Options Usage Note

Overview

This document primarily describes the options involved when using Gowin Background goConfig IPs, including functions, usage, and application. Generally, these options are universal. This document covers the following options, including GoConfig and GoConfig Mode1, and GoConfig is the recommended option for most goConfig IPs.

Typically, when the "Use JTAG as regular IO" option is checked, GoConfig Mode1 is used; when "Use JTAG as regular IO" is not checked, GoConfig is used. Note that when using the goConfig JTAG IP, the "Use JTAG as regular IO" option must be checked, and GoConfig must be used.

Note!

- goConfig IP refers to IPs under "Soft IP Core > Background Configuration". The general format is goConfig xxx, where xxx represents the interface name, such as I2C, JTAG, etc. For simplicity, this document refers to the goConfig xxx as goConfig IP or IP.
- This document does not provide detailed descriptions of specific timing for the Flash interface.
- Unless otherwise specified, this document only applies to GW1N(R)-2C or GW1N-1P5C devices.

Option Table

This section lists the IPs currently released and provides reference options. This description only applies to GW1N(R)-2C or GW1N-1P5C devices.

Table 1 Reference Option Table

IP Name	Use JTAG as regular IO	Option
goConfig I2C	Checked	GoConfig Mode1

IP Name	Use JTAG as regular IO	Option
	Unchecked	I2C
goConfig JTAG	Checked	GoConfig
	Unchecked	-
goConfig SPI	Checked	GoConfig Mode1
	Unchecked	GoConfig

Note!

- For the I2C option usage, you can see [IPUG795, Gowin goConfig I2C IP User Guide](#).
- "-" indicates that this usage is either not recommended or not supported.

GoConfig

The GoConfig is generally used as a common background configuration option and the recommended use by the IP. Below is the description of the GoConfig option, covering functions, usage, and application.

Note!

The GoConfig option description currently only applies to GW1N(R)-2C or GW1N-1P5C devices.

Function Description

The purpose of the GoConfig option is to serve as a general option, theoretically allowing any goConfig IP to complete background programming. This option provides a channel for goConfig IP to connect to Flash. So when this option or this type of option is selected, goConfig IP can complete the background programming.

Usage Description

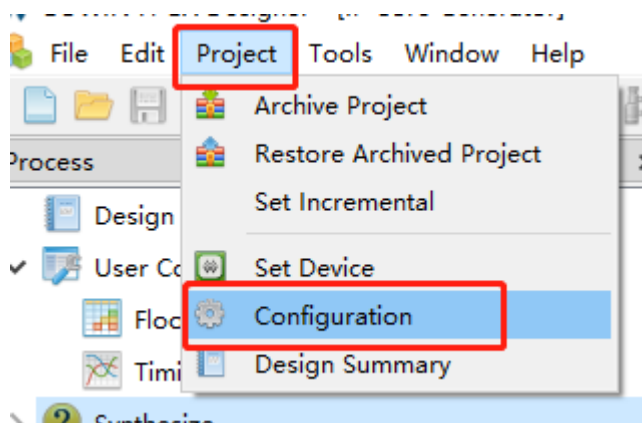
Using Gowin goConfig SPI IP reference design as an example, this section explains the usage of the GoConfig option in conjunction with the IP.

Select GoConfig

After selecting the device, GoConfig option can be accessed as follows; click "Project > Configuration > BitStream > sysControl > Background Programming > GoConfig".

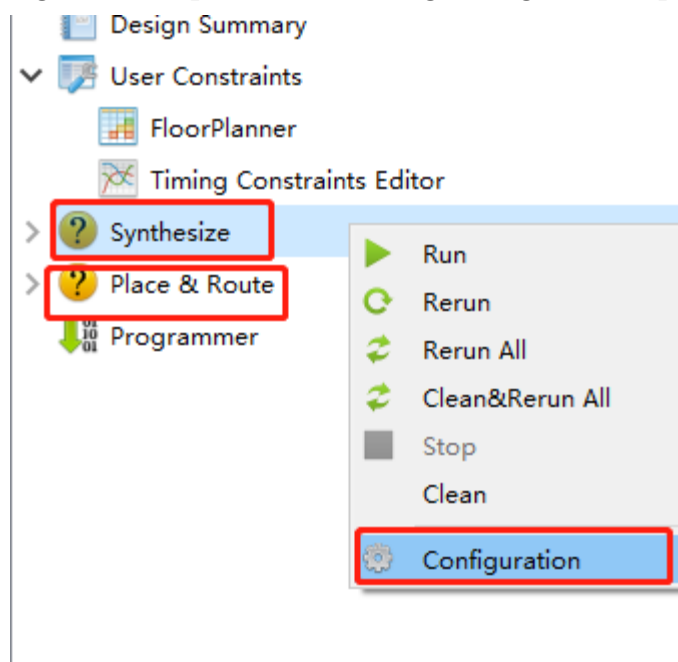
Method 1 for starting the "Configuration" option is as shown in Figure 1.

Figure 1 Example One of Starting Configuration Option



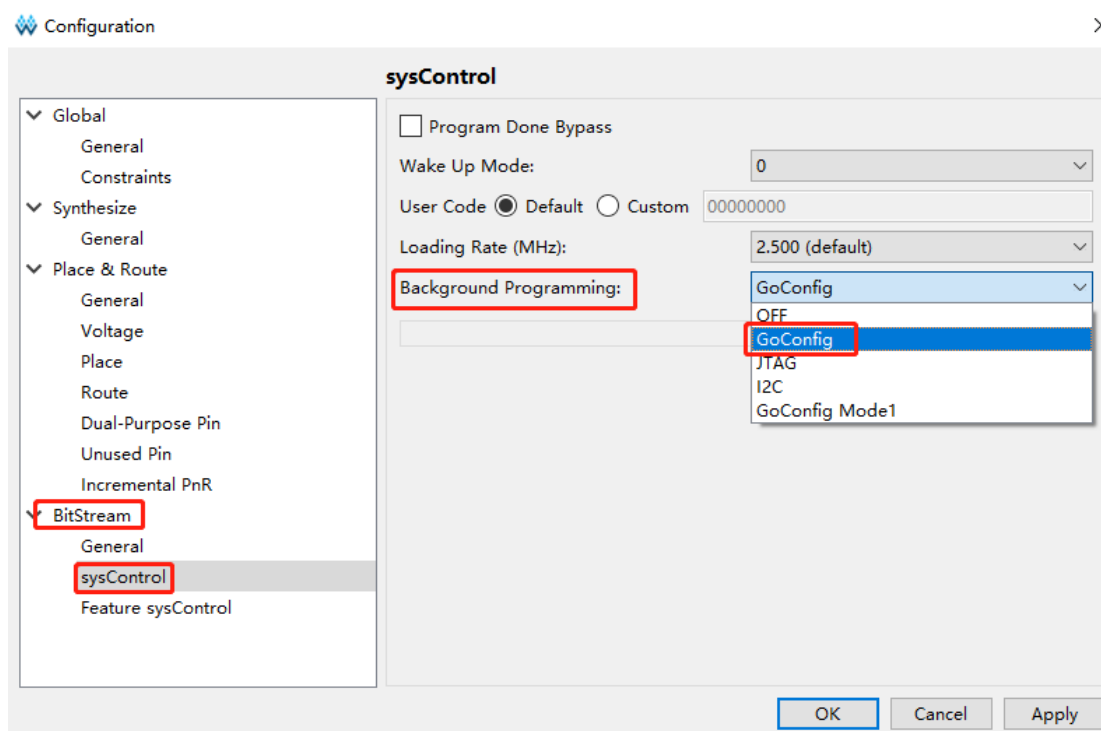
Method 2 for starting the "Configuration" option is as shown in Figure 2. Right-click "Synthesize" or "Place & Route", then select "Configuration".

Figure 2 Example Two of Starting Configuration Option



Select the "GoConfig" on the Configuration page, as shown in Figure 3.

Figure 3 Select GoConfig



Flash IO Constraints

The GoConfig option determines the connection with Flash by constraining the Flash IO.

Table 2 Flash IO Constraints

Signal Name	I/O	Description
GW_BACKGROUND_INT_CLK	Output	IP-Flash interface clock
GW_BACKGROUND_INT_DO	Output	IP-Flash interface data output
GW_BACKGROUND_INT_MODEL	Output	IP-Flash interface mode selection
GW_BACKGROUND_INT_SEL	Output	IP-Flash background programming enable
GW_BACKGROUND_INT_DI	Input	IP-Flash interface data input
GW_BACKGROUND_INT_DI_EN	Input	IP-Flash interface data input valid

The Flash IO signals in the table have the following characteristics:

- The I/O direction take the IP as reference.
- Flash IO must exist at the top level, and the I/O directions must be consistent with those defined in the table.

- The top-level I/O names need to be exactly the same as those defined in the table; and there is no need to constrain their locations, Gowin Software will automatically constrain the locations.

Note!

IP-Flash indicates that the signals go from the IP to Flash.

IP Using Example

In the top-level module of the project, the Flash IO names must be consistent with those defined by the IP. Using the goConfig SPI reference design as an example, an instance of calling the IP is as shown in Figure 4.

Figure 4 Example of Calling IP IO Names

```
goConfig_SPI_Top inst_SPI_JTAG(  
  //SPI IO  
  .GW_BACKGROUND_EXT_SCLK(GW_BACKGROUND_EXT_SCLK),  
  .GW_BACKGROUND_EXT_CS_N(GW_BACKGROUND_EXT_CS_N),  
  .GW_BACKGROUND_EXT_MOSI(GW_BACKGROUND_EXT_MOSI),  
  .GW_BACKGROUND_EXT_MISO(GW_BACKGROUND_EXT_MISO),  
  //flash IO  
  .GW_BACKGROUND_INT_CLK(GW_BACKGROUND_INT_CLK),  
  .GW_BACKGROUND_INT_DO(GW_BACKGROUND_INT_DO),  
  .GW_BACKGROUND_INT_MODEL(GW_BACKGROUND_INT_MODEL),  
  .GW_BACKGROUND_INT_DI(GW_BACKGROUND_INT_DI),  
  .GW_BACKGROUND_INT_DI_EN(GW_BACKGROUND_INT_DI_EN),  
  .GW_BACKGROUND_INT_SEL(GW_BACKGROUND_INT_SEL),  
  //  
  .GW_BACKGROUND_RECONFIG_N(GW_BACKGROUND_RECONFIG_N),  
  .GW_BACKGROUND_EXT_SEL(GW_BACKGROUND_EXT_SEL),  
  .GW_OSC_CLK(GW_OSC_CLK)  
);
```

The top-level IO definitions are as shown in Figure 5, and the names of the Flash IO are consistent with those defined by the IP.

Figure 5 Example of Calling Top-level IO Definitions

```
//SPI IO
input  GW_BACKGROUND_EXT_SCLK,
input  GW_BACKGROUND_EXT_CS_N,
input  GW_BACKGROUND_EXT_MOSI,
output GW_BACKGROUND_EXT_MISO,

//Flash IO
output  GW_BACKGROUND_INT_CLK,
output  GW_BACKGROUND_INT_DO,
output  GW_BACKGROUND_INT_MODEL,
output  GW_BACKGROUND_INT_SEL,
input   GW_BACKGROUND_INT_DI,
input   GW_BACKGROUND_INT_DI_EN,

// Others
output  GW_BACKGROUND_RECONFIG_N,
input   GW_BACKGROUND_EXT_SEL,
output  [3:0] test_iol,
output  GW_OSC_CLK,
output  Test_LED
)
;
```

Scope of Application

Except for Gowin goConfig JTAG IP, when the GoConfig option is selected, other goConfig IPs cannot choose "Use JTAG as regular IO" option, which is generally used as the default for goConfig IPs.

GoConfig Mode1

The GoConfig Mode1 option can be used as a background programming option. This section will provide relevant descriptions of the GoConfig Mode1, including function, usage, and application. Generally, the usage of GoConfig Mode1 is similar to that of GoConfig, but the scope of application for GoConfig Mode1 is slightly broader, although it is not the recommended option.

Note!

- The GoConfig Mode1 option description currently only applies to GW1N(R)-2C or GW1N-1P5C devices.
- The GoConfig Mode1 option is supported in Gowin Software V1.9.10.01 and above.

Function Description

The purpose of the GoConfig Mode1 is to serve as a general option, theoretically allowing any goConfig IP to complete background programming. This option provides a channel for goConfig IP to connect to Flash. So when this option or this type of option is selected, goConfig IP

can complete the background programming.

Usage Description

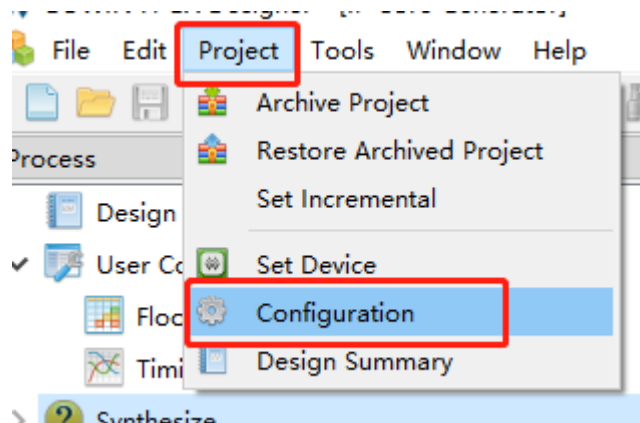
Software Configuration

After selecting the device, GoConfig option can be accessed as follows; click "Project > Configuration > BitStream > sysControl > Background Programming > GoConfig Mode1".

You can select "Project > Configuration > Place & Route > Dual-Purpose Pin", and then check "Use JTAG as regular IO" to set JTAG as a regular IO.

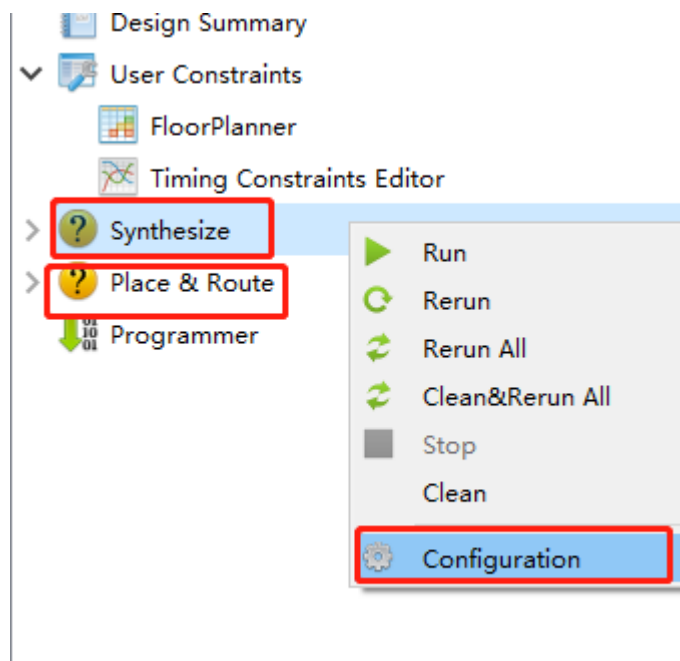
Method 1 for starting the "Configuration" option is as shown in Figure 6.

Figure 6 Example One of Starting Configuration Option



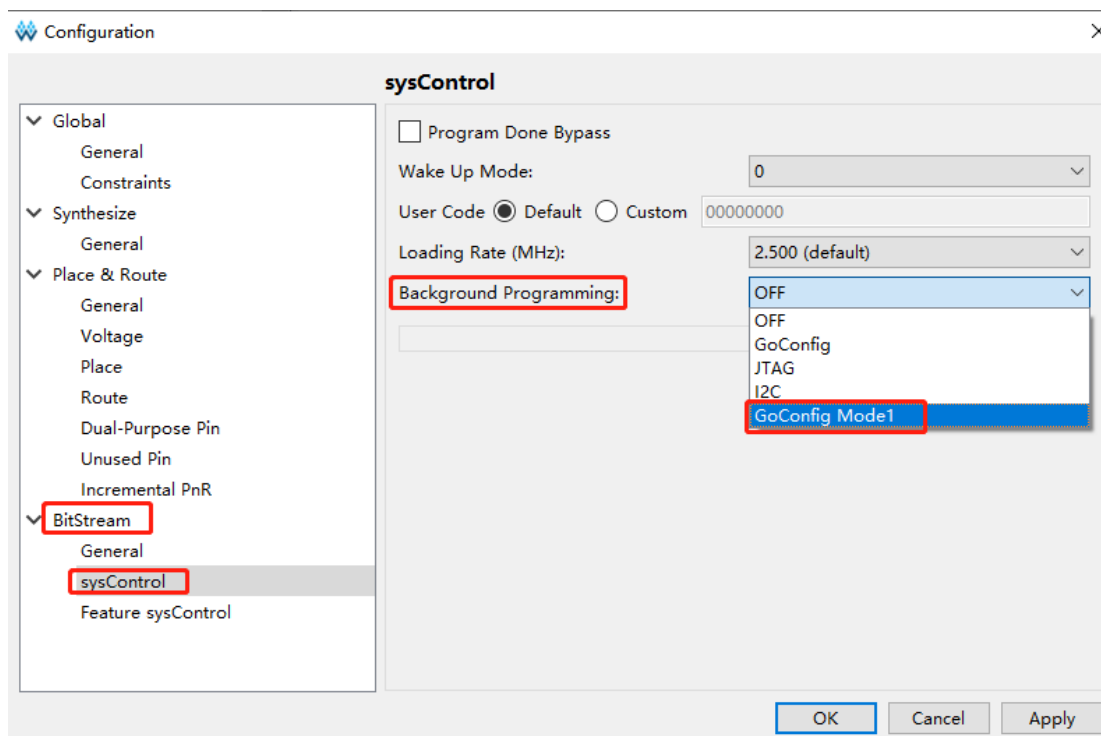
Method 2 for starting the "Configuration" option is as shown in Figure 7. Right-click "Synthesize" or "Place & Route", then select "Configuration".

Figure 7 Example Two of Starting Configuration Option



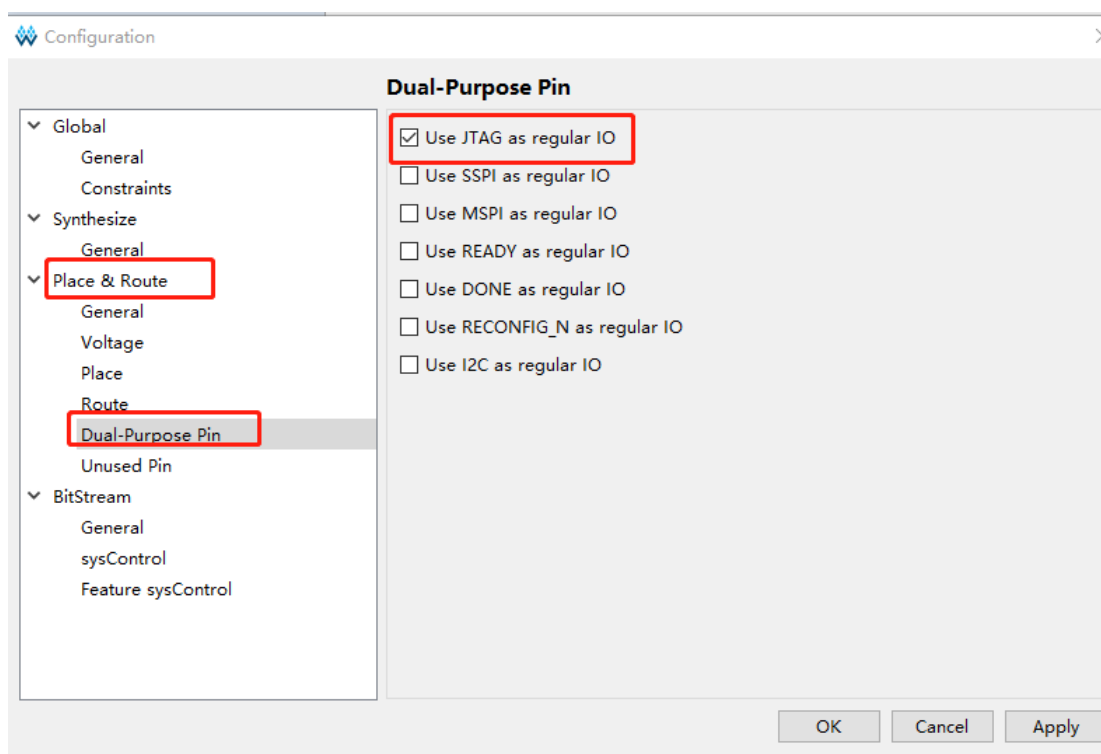
Select the "GoConfig" on the Configuration page, as shown in Figure 8.

Figure 8 Select GoConfig Mode1



On the Configuration page, check "Use JTAG as regular IO" to set JTAG as a regular IO, as shown in Figure 9.

Figure 9 Check Use JTAG as regular IO



Flash IO Constraints

The GoConfig option determines the connection with Flash by constraining the Flash IO.

Table 3 Flash IO Constraints

Signal Name	I/O	Description
GW_BACKGROUND_INT_CLK	Output	IP-Flash interface clock
GW_BACKGROUND_INT_DO	Output	IP-Flash interface data output
GW_BACKGROUND_INT_MODEL	Output	IP-Flash interface mode selection
GW_BACKGROUND_INT_DI	Input	IP-Flash interface data input
GW_BACKGROUND_INT_DI_EN	Input	IP-Flash interface data input valid
GW_BACKGROUND_INT_SEL	Output	IP-Flash background programming enable

The Flash IO signals in the table have the following characteristics:

- The IO direction take the IP as reference.
- Flash IO must exist at the top level, and the I/O directions must be consistent with those defined in the table.

- The top-level IO names need to be exactly the same as those defined in the table; and there is no need to constrain their locations, Gowin Software will automatically constrain the locations.

Note!

- IP-Flash indicates that the signals go from the IP to Flash.
- The Flash IO of GoConfig Mode1 is consistent with the Flash IO of GoConfig.

IP Using Example

In the top-level module of the project, the Flash IO names must be consistent with those defined by the IP. Using the goConfig SPI reference design as an example, an instance of calling the IP is as shown in Figure 10.

Figure 10 Example of Calling IP IO Names

```
goConfig_SPI_Top inst_SPI_JTAG(  
  //SPI IO  
  .GW_BACKGROUND_EXT_SCLK(GW_BACKGROUND_EXT_SCLK),  
  .GW_BACKGROUND_EXT_CS_N(GW_BACKGROUND_EXT_CS_N),  
  .GW_BACKGROUND_EXT_MOSI(GW_BACKGROUND_EXT_MOSI),  
  .GW_BACKGROUND_EXT_MISO(GW_BACKGROUND_EXT_MISO),  
  //flash IO  
  .GW_BACKGROUND_INT_CLK(GW_BACKGROUND_INT_CLK),  
  .GW_BACKGROUND_INT_DO(GW_BACKGROUND_INT_DO),  
  .GW_BACKGROUND_INT_MODEL(GW_BACKGROUND_INT_MODEL),  
  .GW_BACKGROUND_INT_DI(GW_BACKGROUND_INT_DI),  
  .GW_BACKGROUND_INT_DI_EN(GW_BACKGROUND_INT_DI_EN),  
  .GW_BACKGROUND_INT_SEL(GW_BACKGROUND_INT_SEL),  
  //  
  .GW_BACKGROUND_RECONFIG_N(GW_BACKGROUND_RECONFIG_N),  
  .GW_BACKGROUND_EXT_SEL(GW_BACKGROUND_EXT_SEL),  
  .GW_OSC_CLK(GW_OSC_CLK)  
);
```

The top-level IO definitions are as shown in Figure 11, and the names of the Flash IO are consistent with those defined by the IP.

Figure 11 Example of Calling Top-level IO Definitions

```
//SPI IO
input  GW_BACKGROUND_EXT_SCLK,
input  GW_BACKGROUND_EXT_CS_N,
input  GW_BACKGROUND_EXT_MOSI,
output GW_BACKGROUND_EXT_MISO,

//Flash IO
output GW_BACKGROUND_INT_CLK,
output GW_BACKGROUND_INT_DO,
output GW_BACKGROUND_INT_MODEL,
output GW_BACKGROUND_INT_SEL,
input  GW_BACKGROUND_INT_DI,
input  GW_BACKGROUND_INT_DI_EN,

// Others
output GW_BACKGROUND_RECONFIG_N,
input  GW_BACKGROUND_EXT_SEL,
output [3:0] test_iol,
output GW_OSC_CLK,
output Test_LED
)
;
```

Scope of Application

Except for Gowin goConfig JTAG IP, when the GoConfig Mode1 option is selected, other goConfig IPs can select "Use JTAG as regular IO" option to use JTAG pins to complete other functions.

This section primarily describes the usage and considerations of GoConfig Mode1 when reusing JTAG. In practical applications, this usage is not recommended. While this usage has a broader range of applications than GoConfig, it involves more operation requirements and may lead to more derived phenomena, making it more difficult for users to understand these phenomena.

Background Description

When JTAG is reused, the JTAG pins are set as general IO, so they can no longer perform configuration-related functions. To restore the JTAG pins to configuration mode, the JTAGSEL_N pin must be set to low.

An example of configuration-related functions is as follows; the JTAG pins perform operations such as reading codes (ID Code, Status, User Code), configuring SRAM, and programming Flash. For details, you can see the JTAG section in [UG290, Gowin FPGA Products Programming and Configuration Guide](#).

Each background programming IP has a "Background Programming Enable" IO that can enable or disable the IP background programming

function.

The background programming enable IO, assigned as an input pin, may have different signal names in various IPs (for simplicity, it will be referred to as IP_SEL hereafter), but the function it performs is the same. For instance, in goConfig SPI, it is GW_BACKGROUND_EXT_SEL, and in goConfig I2C, it is GW_BACKGROUND_SEL_INR.

The background programming function of the IP is incompatible with the configuration function of the JTAG pins. For example, when the background programming function is in use, the JTAG pins cannot be used for configuration. Similarly, when the JTAG pins are used for configuration, the background programming function of the IP cannot be used.

Special Phenomenon

When using the Background Programming IP in a project, it may be necessary to use the JTAG pins as regular I/O for other functions. The following conditions must be met:

1. When JTAGSEL_N=IP_SEL=1, the background programming function is enabled, and the JTAG pins are used as regular I/O.
2. When JTAGSEL_N=IP_SEL=0, the background programming function is disabled, and the JTAG pins are used as configuration pins.

Note!

When JTAGSEL_N != IP_SEL, neither the background programming nor the JTAG configuration can be used normally, and other phenomena are not clear, so this use is prohibited.

Additional Explanation

The possible application scenario for the simultaneous use of JTAG multiplexing and background programming IP mentioned in this section, and switching back and forth between the JTAG configuration function and the background programming, is during debugging. In most cases, only the background programming function is enabled in actual application, and switching back to JTAG is no longer required.

Special Case Explanation

This section describes how Gowin goConfig I2C IP uses this option to accomplish the function of multiplexing JTAG. Since the Flash port names in the goConfig I2C IP differ from those in the GoConfig Mode1 option, a naming conversion is required, which will be described in the followings.

Project Setup Procedure

When setting up a project with the goConfig I2C IP or inserting the

goConfig I2C IP into an existing project, follow the steps below.

- Configure and generate Gowin goConfig I2C IP. Detailed steps can be found in the configuration chapter of [IPUG795, Gowin goConfig I2C IP User Guide](#).
- Call the IP at the top level
- Configure "Background Programming > GoConfig Mode1" in Gowin Software, and set the JTAG as regular I/O.

The preliminary setting up of the project, as well as other operations after completing the above steps, are consistent with the operations of normal project, so it will not be detailed in this document.

If issues arise during the IP project setting up, you can also follow this procedure to troubleshoot and determine if it is a possible IP using issue.

Configure and Generate IP

Select Gowin goConfig I2C IP for the background programming IP, configure and generate it. For steps, see the configuration chapter of [IPUG795, Gowin goConfig I2C IP User Guide](#).

Top-Level IP Invocation

When using GoConfig Mode1 to implement the background programming, the Flash I/O constraint rules of GoConfig Mode1 must be followed.

When Gowin goConfig I2C IP operates in GoConfig Mode1, you can see Table 4 for the Flash I/O mapping relationships.

Table 4 Flash IO Mapping

Flash IO (I2C) Name	Flash IO (GoConfig Mode1) Name	I/O	Description
GW_BACKGROUND_CLK	GW_BACKGROUND_INT_CLK	Output	IP-Flash interface clock
GW_BACKGROUND_DATA_OUT	GW_BACKGROUND_INT_DO	Output	IP-Flash interface data output
GW_BACKGROUND_MODEL	GW_BACKGROUND_INT_MODE_L	Output	IP-Flash interface mode selection
GW_BACKGROUND_SELECT_EXR	GW_BACKGROUND_INT_SEL	Output	IP-Flash background programming enable
GW_BACKGROUND_DATA_IN	GW_BACKGROUND_INT_DI	Input	IP-Flash interface data input
GW_BACKGROUND_DATA_IN_EN	GW_BACKGROUND_INT_DI_EN	Input	IP-Flash interface data input valid
GW_BACKGROUND_RESET	-	Output	-

Flash IO (I2C) Name	Flash IO (GoConfig Mode1) Name	I/O	Description
CONFIG_N			

Compared to the Flash IO of Gowin goConfig I2C IP, the Flash IO in GoConfig Mode1 does not include "GW_BACKGROUND_RECONFIG_N" signal. If you need to use this signal, it can be implemented by constraining the location in the CST file.

Figure 12 shows an example of calling Gowin goConfig I2C IP in Top.v in the reference design.

Figure 12 Example of Calling IP IO Names

```
// =====//
//  Goconfig I2C IP (goConfig_I2C_Top)
// =====//
goConfig_I2C_Top u_GW_BACKGROUND_I2C(
// I2C IO :
    .GW_BACKGROUND_SCL_INR    (GW_BACKGROUND_SCL_INR)    ,
    .GW_BACKGROUND_SDA_INR    (GW_BACKGROUND_SDA_INR)    ,
// Flash IO :
    .GW_BACKGROUND_CLK         (GW_BACKGROUND_INT_CLK)    ,
    .GW_BACKGROUND_DATA_OUT    (GW_BACKGROUND_INT_DO)    ,
    .GW_BACKGROUND_MODEL       (GW_BACKGROUND_INT_MODEL)  ,
    .GW_BACKGROUND_DATA_IN     (GW_BACKGROUND_INT_DI)    ,
    .GW_BACKGROUND_SEL_EXR     (GW_BACKGROUND_INT_SEL)    ,
    .GW_BACKGROUND_DATA_IN_EN  (GW_BACKGROUND_INT_DI_EN) ,
// Function pin
    .GW_BACKGROUND_RECONFIG_N (GW_BACKGROUND_RECONFIG_N) ,
    .GW_BACKGROUND_SEL_INR    (GW_BACKGROUND_EXT_SEL) ,
// General pin
    .GW_OSC_CLK                (GW_OSC_CLK)
);
```

Figure 13 shows the correct using of IP IO definitions in Top.v in the reference design. Since the function is implemented through GoConfig Mode1, so it must be Flash IO of GoConfig Mode1.

Figure 13 Example of Top-level I/O Definition

```

module Top
(
    .....input.....rstn,
    .....output.....Test_LED,
    .....output.....[3:0]Test_pin,
    //I2C IO
    .....input.....GW_BACKGROUND_SCL_INR.....,
    .....inout.....GW_BACKGROUND_SDA_INR.....,
    //Flash IO
    .....output.....GW_BACKGROUND_INT_CLK,
    .....output.....GW_BACKGROUND_INT_DO,
    .....output.....GW_BACKGROUND_INT_MODEL,
    .....output.....GW_BACKGROUND_INT_SEL,
    .....input.....GW_BACKGROUND_INT_DI,
    .....input.....GW_BACKGROUND_INT_DI_EN,
    //
    .....input.....GW_BACKGROUND_EXT_SEL,
    .....output.....GW_BACKGROUND_RECONFIG_N,
    .....output.....GW_OSC_CLK
);
//.....

```

If the "GW_BACKGROUND_RECONFIG_N" pin must be used in the project, the "GW_BACKGROUND_RECONFIG_N" signal needs to be constrained to the "RECONFIG_N" of the current device in the CST file.

Figure 14 CST Constraint Example

```
IO_LOC "GW_BACKGROUND_RECONFIG_N" 119;//reconfig_n
```

Software Configuration

Configure "Background Programming > GoConfig Mode1" and "Use JTAG as regular IO" in Gowin Software. For details, you can see [Software Configuration](#).

Support and Feedback

Gowin Semiconductor provides customers with comprehensive technical support. If you have any questions, comments, or suggestions, please feel free to contact us directly using the information provided below.

Website: www.gowinsemi.com

E-mail: support@gowinsemi.com

Revision History

Date	Version	Description
11/08/2024	1.0E	Initial version published.

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