



Gowin USB1.1 IP

User Guide

IPUG950-1.1E, 03/29/2022

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Revision History

Date	Version	Description
03/30/2020	1.0E	Initial version published.
04/21/2021	1.01E	Minor linguistic errors corrected.
05/07/2021	1.02E	Supported devices added.
03/29/2022	1.1E	The description of resource utilization added.

Contents

Contents	i
List of Figures	ii
List of Tables	iii
1 About This Guide	1
1.1 Purpose	1
1.2 Related Documents	1
1.3 Terminology and Abbreviations	1
1.4 Support and Feedback	2
2 Overview	3
2.1 Features	4
2.2 Resource Utilization	4
3 Functional Description	5
3.1 Gowin USB1.1 Block Diagram	5
3.2 USB Controller	6
3.3 USB Physical	6
3.4 UART Controller	6
4 Signal Description	7
4.1 Signal Description	7
4.2 Parameter Configuration Options	8
5 Interface Configuration	9

List of Figures

Figure 3-1 Block Diagram of USB1.1 When UART Disabled	5
Figure 3-2 Block Diagram of USB1.1 When UART Enabled	6
Figure 5-1 IP Core Generator	9
Figure 5-2 Open USB 1.1 IP Core	10
Figure 5-3 Configuration Interface	11
Figure 5-4 Help	11

List of Tables

Table 1-1 Terminology and Abbreviations 2

Table 2-1 Gowin USB 1.1 IP Overview 3

Table 2-2 Resource Utilization 4

Table 4-1 Signals Description 7

Table 4-2 Configuration Options 8

1 About This Guide

1.1 Purpose

The purpose of Gowin USB1.1 IP User Guide is to help you learn the features and usage of Gowin USB1.1 IP by providing the descriptions of functions, signals, and GUI.

1.2 Related Documents

The latest user guides are available on the GOWINSEMI Website. You can find the related documents at www.gowinsemi.com:

- [DS100, GW1N series of FPGA Products Data Sheet](#)
- [DS117, GW1NR series of FPGA Products Data Sheet](#)
- [DS821, GW1NS series of FPGA Products Data Sheet](#)
- [DS841, GW1NZ series of FPGA Products Data Sheet](#)
- [DS871, GW1NSE series of FPGA Products Data Sheet](#)
- [DS861, GW1NSR series of FPGA Products Data Sheet](#)
- [DS891, GW1NRF series of FPGA Products Data Sheet](#)
- [DS881, GW1NSER series of Bluetooth FPGA Products Data Sheet](#)
- [DS102, GW2A series of FPGA Products Data Sheet](#)
- [DS226, GW2AR series of FPGA Products Data Sheet](#)
- [DS961, GW2ANR series of FPGA Products Data Sheet](#)
- [DS976, GW2AN-55 Data Sheet](#)
- [DS971, GW2AN-18X & 9X Data Sheet](#)
- [SUG100, Gowin Software User Guide](#)

1.3 Terminology and Abbreviations

The terminology and abbreviations used in this manual are as shown in Table 1-1.

Table 1-1 Terminology and Abbreviations

Terminology and Abbreviations	Meaning
IP	Intellectual Property
USB	Universal Serial Bus
UART	Universal Asynchronous Receiver/Transmitter
CDC	Communication Device Class

1.4 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 by the following ways.

Website: www.gowinsemi.com

E-mail: support@gowinsemi.com

2 Overview

Universal Serial Bus, commonly known as USB, standardizes the connection and communication between computers and external devices.

Gowin USB1.1 IP is based on USB1.1 protocol and USB Device Class only supports Communications Device Class (CDC) at present.

One end of the Gowin USB1.1 IP is the USB interface (I/O position is fixed, and you can see [Package](#) for details) and the other end is data of other format.

If UART is enabled, the communication between USB and UART can be realized. Otherwise, the other end is 8bit data in parallel and it communicates by handshake signal. IP supports the configuration of the receive and transmit buffers size.

Table 2-1 Gowin USB 1.1 IP Overview

Gowin USB 1.1 IP	
IP Core Application	
Supported Devices	Gowin all devices.
Logic Resource	Please refer to Table 2-2
Delivered Doc.	
Design Files	Verilog (encrypted)
Reference Design	Verilog
TestBench	Verilog
Test and Design Flow	
Synthesis Software	GowinSynthesis
Application Software	Gowin Software (V1.9.8.03 and above)

2.1 Features

The features are as follows:

- Supports USB to UART;
- The size of USB receive and transmit buffers can be configured;
- UART baud rate can be configured;
- UART parity mode can be configured.

2.2 Resource Utilization

Gowin USB 1.1 IP can be implemented by Verilog. Its resource utilization may vary when the design is employed in different devices, or at different densities, speeds, or grades. Taking Gowin GW1N-2 series of FPGA as an instance, the resource utilization is as shown in Table 2-2.

Table 2-2 Resource Utilization

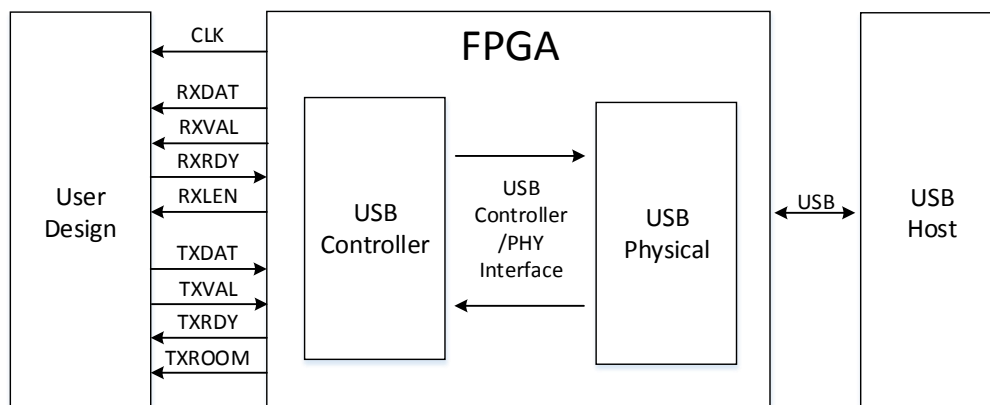
Device	Speed Grade	Resource	Utilization	Notes
GW1N-2	-5	LUT	133	-
		REG	47	
		ALU	0	
		BSRAM	0	
		IO	2	

3 Functional Description

3.1 Gowin USB1.1 Block Diagram

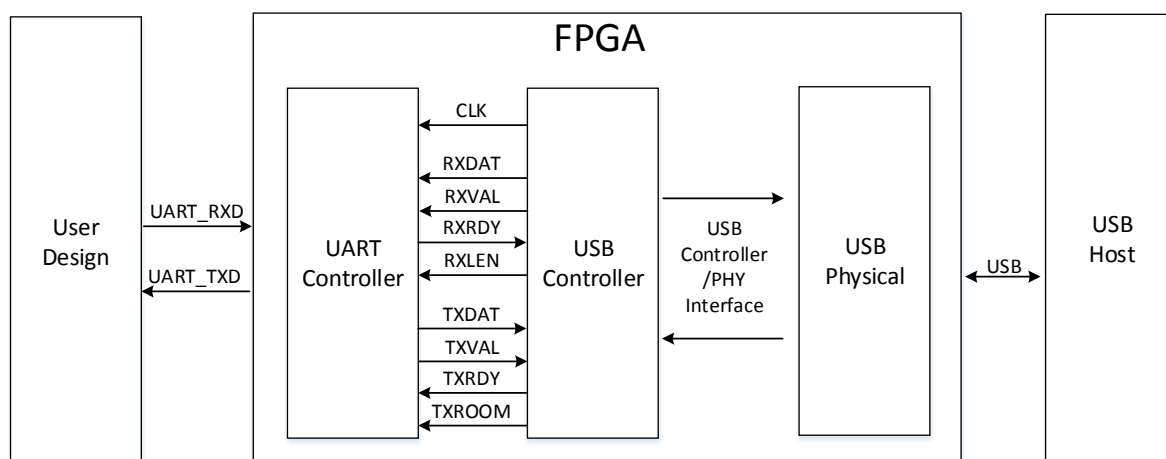
When UART is disabled, the block diagram of USB1.1 IP is as shown in Figure 3-1, including USB Controller and USB Physical modules.

Figure 3-1 Block Diagram of USB1.1 When UART Disabled



When UART is enabled, a UART module is generated and the output of USB Controller will be converted to UART output. The block diagram of USB1.1 is shown in Figure 3-2.

Figure 3-2 Block Diagram of USB1.1 When UART Enabled



3.2 USB Controller

The USB Controller is the main logic module of the Gowin USB1.1 IP, which is between the User Design and the PHY. USB Controller connects user design with PHY in series, receives commands from USB and realizes data transaction between user design and USB.

3.3 USB Physical

USB Physical has been embedded in FPGA, so it is unnecessary for you to connect and configure. It only needs to connect to the external USB device through the related interface.

The position of external signal pins (such as DP, DM, etc.) varies with the device package. Please see the related package for confirmation.

3.4 UART Controller

UART Controller is an option provided by Gowin USB1.1 IP and it can automatically generate the module when UART Enable is selected. The module processes the signals from USB Controller and communicates with User Design via serial ports.

4 Signal Description

4.1 Signal Description

The description of signals is as shown in Table 4-1.

Table 4-1 Signals Description

No.	Signal	I/O	Data Width	Description	Remarks
1	CLK	O	1	Output clock, synchronized with other output signals. When UART is disabled, it can be used as the clock for the other designs; 60MHz by default;	Only exists when UART is disabled
2	TXDAT	I	8	IP transmits this data through the USB interface	
3	TXVAL	I	1	Transmit data valid signal, active-high	
4	TXRDY	O	1	Transmit ready signal, it can receive TXDAT at high level	
5	TXROOM	O	1-11	The remaining bytes in transmit buffer	
6	RXDAT	O	8	IP will output the data received from the USB interface	
7	RXVAL	O	1	Receive data valid signal, active-high	
8	RXRDY	I	1	Receive ready signal, it can receive RXDAT at high level	
10	RXLEN	O	1-11	The remaining bytes in receive buffer	

No.	Signal	I/O	Data Width	Description	Remarks
11	UART_TXD	O	1	UART transmit data signal	Only exists when UART is enabled
12	UART_RXD	I	1	UART receive data signal	
13	DP	Bidir	1	USB data pin Data+	USB PHY pin fixed
14	DM	Bidir	1	USB data pin Data-	
15	VBUSPAD	Bidir	1	USB VBus pin	
16	IDPAD	I	1	USB ID pin	
17	XIN	I	1	USB PHY crystal oscillator input signal, 12MHz recommended.	
18	XOUT	O	1	USB PHY crystal oscillator output signal	
19	REXT	I	1	Connected with 12.7K high-precision resistance	

4.2 Parameter Configuration Options

Gowin USB1.1 IP parameter configuration options are shown in Table 4-2

Table 4-2 Configuration Options

Options	Description
VENDORID	ID of vendor
PRODUCTID	ID of product
VERSIONBCD	Version (BCD)
Receive Buffer Size	The size of USB receive buffer
Transmit Buffer Size	The size of USB transmit buffer
CLK Frequency	System clock of UART Controller
Baud Rate	Baud rate of UART Controller
Parity	UART parity mode: none, even, odd, mark and space.

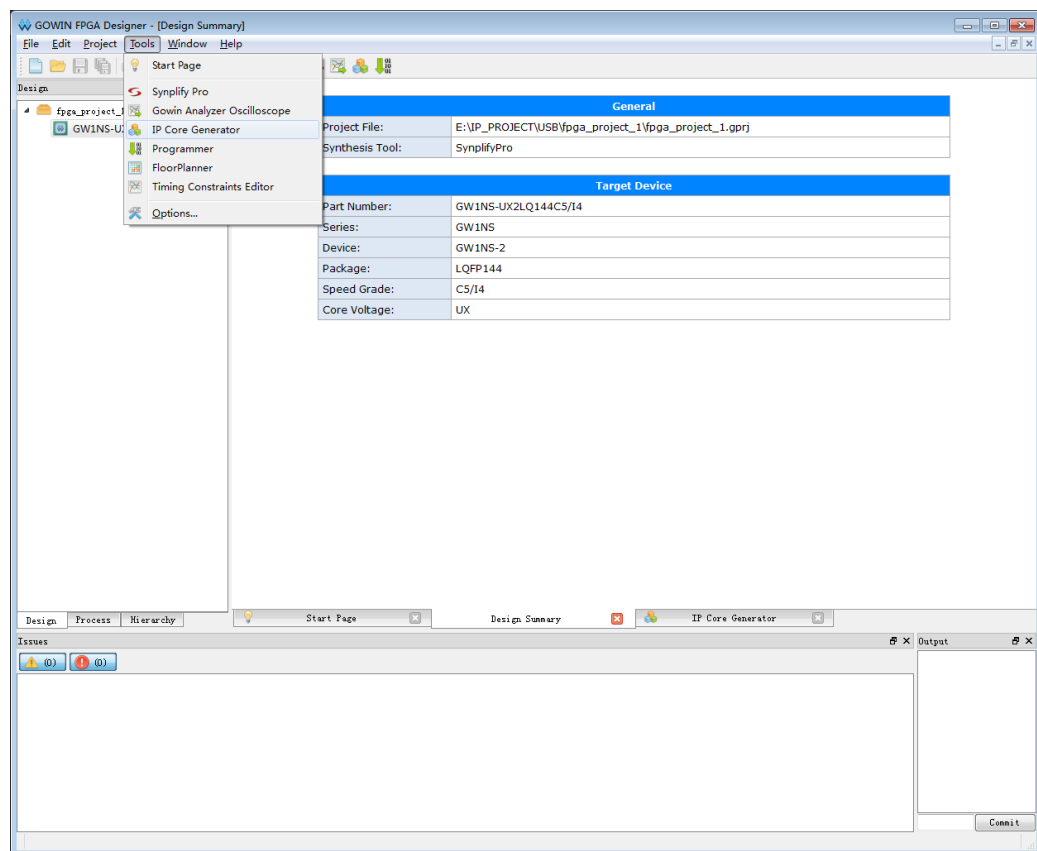
5 Interface Configuration

You can start the IP Core Generator by Tools menu bar, invoke and configure USB1.1.

1. Open IP Core Generator

After creating the project, you can click the "Tools" tab in the upper left, select and open the IP Core Generator via the drop-down list, as shown in Figure 5-1.

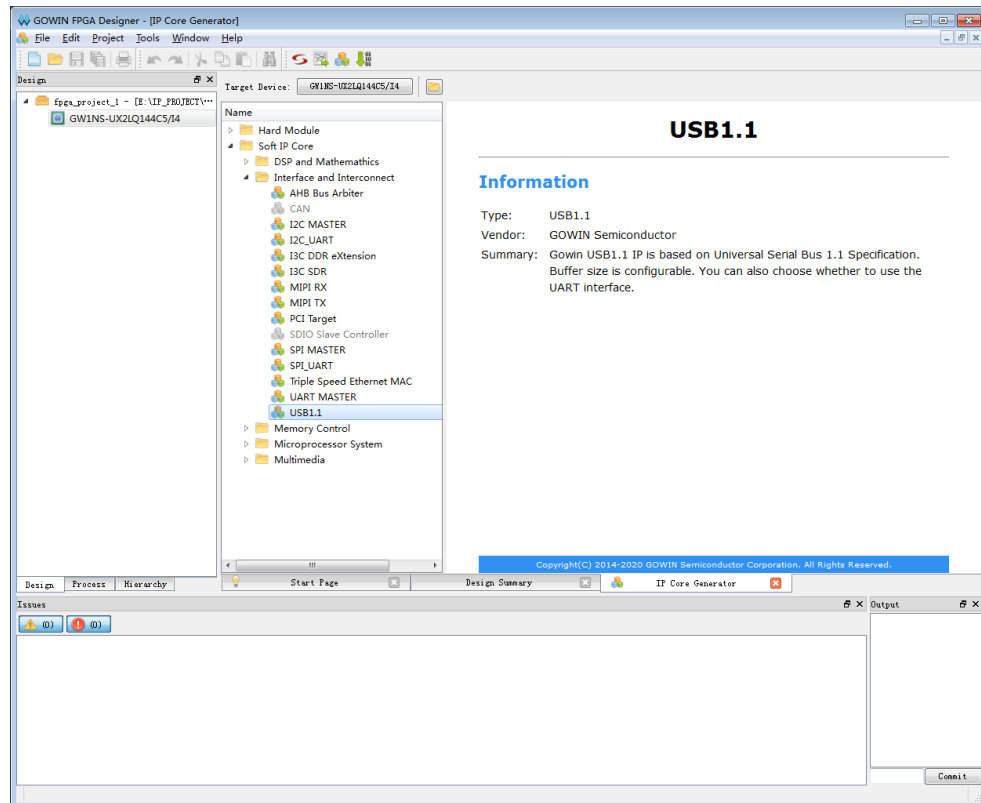
Figure 5-1 IP Core Generator



2. Open USB1.1 IP Core

Click "Soft IP Core > Interface and Interconnect > USB1.1 IP" to open USB1.1 IP GUI, as shown in Figure 5-2.

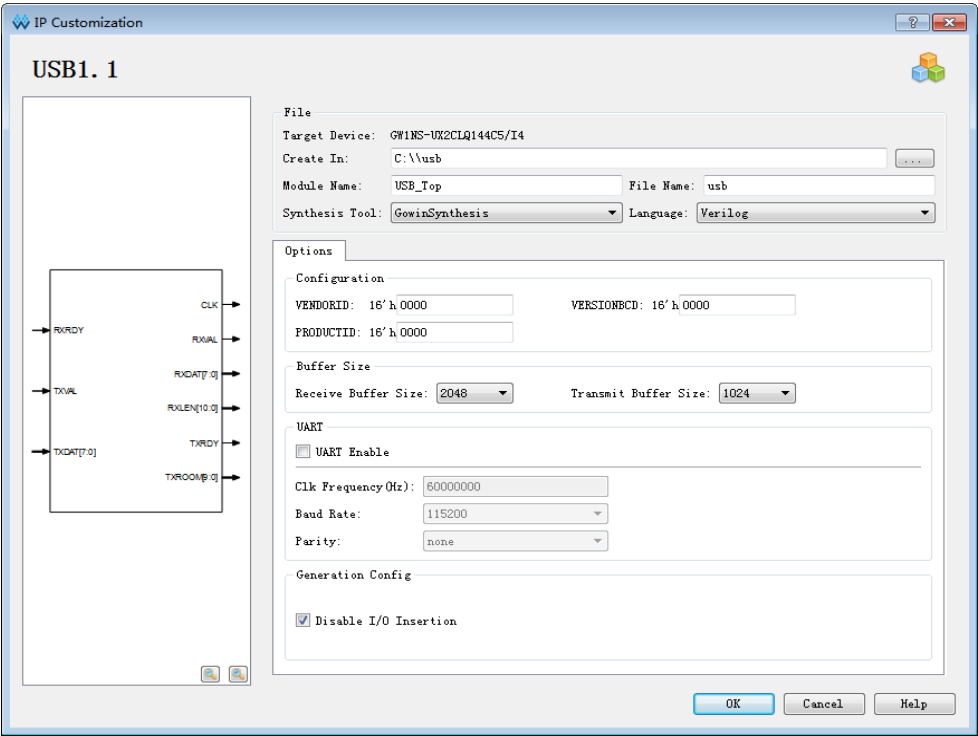
Figure 5-2 Open USB 1.1 IP Core



3. Configuration Interface

Figure 5-3 shows the USB1.1 IP core configuration interface. The interface diagram is on the left. Options are on the right. You can modify the name of the generated file in File Name, modify the module name in Module Name and configure VENDORID in Options.

Figure 5-3 Configuration Interface



4. Open Help
- As shown in Figure 5-3, click the "Help" button in the lower right corner to see a brief introduction to the options. The Help interface is as shown in Figure 5-4.

Figure 5-4 Help

USB1.1	
Information	
Type:	USB1.1
Vendor:	GOWIN Semiconductor
Summary:	Gowin USB1.1 IP is based on Universal Serial Bus 1.1 Specification. Buffer size is configurable. You can also choose whether to use the UART interface.
Options	
Option	Description
Configuration	
VENDORID	Vendor ID to report in device descriptor.
PRODUCTID	Product ID to report in device descriptor.
VERSIONBCD	Product version to report in device descriptor.
Buffer Size	
Receive Buffer Size(Bytes)	Size of receive buffer.
Transmit Buffer Size(Bytes)	Size of transmit buffer.
UART	
UART Enable	Whether to use UART or not.
Clk Frequency	System clock frequency of UART.
Baud Rate	Baud rate value of UART.
Parity	Five options are valid: none, even, odd, mark, space.

