



Gowin CIC Filter IP

User Guide

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Revision History

Date	Version	Description
07/28/2022	1.0E	Initial version published.

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1 About This Guide

1.1 Purpose

The purpose of Gowin CIC Filter IP User Guide is to help you learn the features and usage of this product by providing the descriptions of functions, ports, timing, GUI, and reference design, etc.

1.2 Related Documents

You can find the related documents at GOWINSEMI website 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](#)
- [DS891, GW1NRF series of Bluetooth FPGA Products Data Sheet](#)
- [DS881, GW1NSER series of FPGA Products Data Sheet](#)
- [DS861, GW1NSR series of FPGA Products Data Sheet](#)
- [DS102, GW2A series of FPGA Products Data Sheet](#)
- [DS226, GW2AR series of FPGA Products Data Sheet](#)
- [DS971, GW2AN series of FPGA Products Data Sheet](#)
- [DS961, GW2ANR series of FPGA Products 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
FPGA	Field Programmable Gate Array
ALU	Arithmetic Logical Unit
LUT	Look-up Table
CIC Filter	Cascade Integrator Comb Filter

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

2Overview

2.1 Gowin CIC Filter IP Overview

Gowin CIC Filter IP is a basic-structure FIR filter implemented directly by accumulative computation.

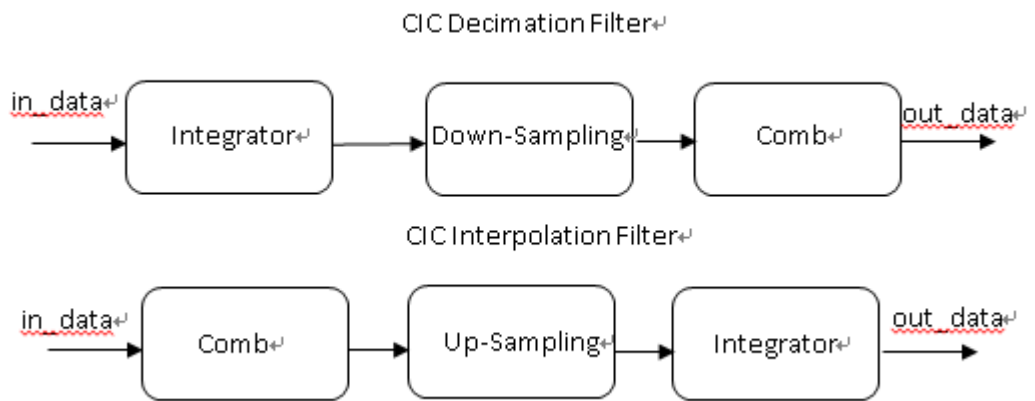
Table Gowin CIC Filter IP Overview

Gowin CIC Filter IP	
IP Core Application	
Supported Devices	● GW1N series: GW1N-4, GW1N-4B, GW1N-4D, GW1N-9, GW1N-9C ● GW1NR series: GW1NR-4, GW1NR-4B, GW1NR-4D, GW1NR-9, GW1NR-9C ● GW1NS series: GW1NS-4, GW1NS-4C ● GW1NSR series: GW1NSR-4, GW1NSR-4C ● GW1NRF series: GW1NRF-4B ● GW1NSER series: GW1NSER-4C ● GW2A series ● GW2AR series ● GW2ANR series ● GW2AN series
Logic Resource	Please refer to Table 3-1.
Delivered Doc.	
Design Files	Verilog
Reference Design	Verilog
TestBench	Verilog
Test and Design Flow	
Synthesis Software	GowinSynthesis
Application Software	Gowin Software (V1.9.8.07 and above)

2.2 CIC Filter Introduction

The CIC Filter is a FIR filter consisting of cascaded integrator comb filters. And it supports the decimation and interpolation of digital signals. The structure diagram is shown as Figure 2-1.

Figure 2-1 CIC Filter Structure Diagram



The overall structure of FPGA is shown in the figure and it consists of the following modules:

- Integrator module: The output data is the integration of the input data over time.
- Down/Up-Sampling module: Down-sampling or up-sampling
- Comb module: The input data is subtracted from its delay data

3 Features and Performance

3.1 Features

- Supports input data width 1-32 bits
- Supports cascade stages 1-8
- Supports differential delay 1-4
- Supports up-sampling /down-sampling rates 2-16384

3.2 Max. Frequency

The max. frequency of Gowin CIC Filter IP is mainly determined by speed grade of the selected devices.

3.3 Latency

The latency of Gowin CIC Filter IP is determined by the configuration parameters.

3.4 Resource Utilization

CIC Filter can be implemented by Verilog. Its performance and resource utilization may vary when the design is employed in different devices, or at different densities, speeds, or grades.

Take GW2A-18 FPGA as an example. See Table 3-1 for the resource utilization. For the applications on the other GOWINSEMI devices, please refer to the later release.

Table 3-1 CIC Filter Resource Utilization

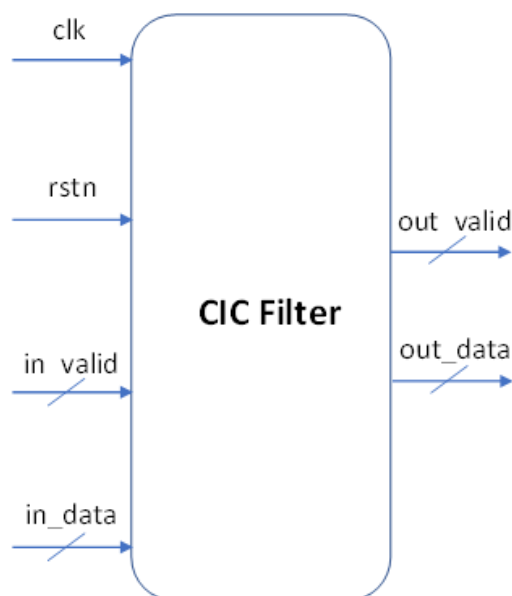
Device	Speed Grade	Resource Name	Resource Utilization
GW2A-18	C8/I7	Register	2811
		LUT	1355
		ALU	2577
		BSRAM	0
		SSRAM	320

4 Functional Description

4.1 CIC Filter Structure and Function

Gowin CIC Filter IP supports the decimation and interpolation of digital signals. And you can configure parameters as required when generating the module. The diagram is as shown in Figure 4-1.

Figure 4-1 CIC Filter Interface



4.2 Data Setting

The data width can be configured on the GUI; the maximum bit width is 32 bits, and the minimum bit width is 1 bit.

4.3 Filter Parameter Configuration

You can configure Stages, Differential Delay, and Up-Sampling /Down-Sampling Rates on the GUI.

5 Port Description

The details of Gowin CIC Filter IP I/O ports are shown in Table 5-1.

Table 5-1 CIC Filter I/O Ports

Signal	I/O	Description
clk	Input	Clock signal
rstn	Input	Reset signal, active-low.
in_valid	Input	data input valid signal
in_data	Input	Input sampling data
out_valid	Output	Data output valid signal
out_data	Output	Output sampling data

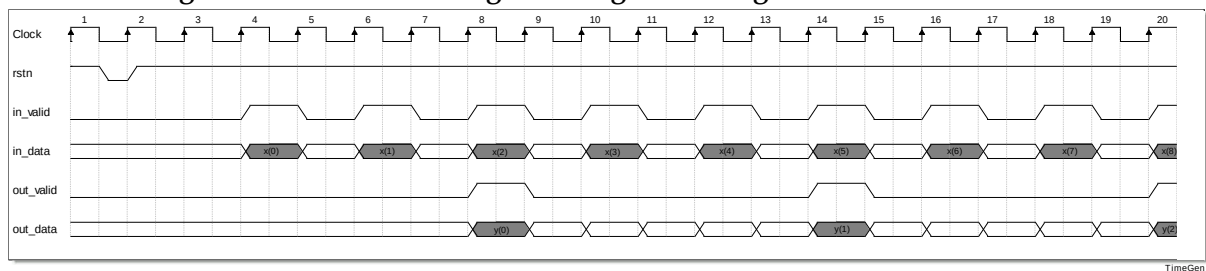
6 Timing Description

This chapter mainly introduces the timing of Gowin CIC Filter IP.

6.1 CIC Decimating Filter Signal Timing

The CIC decimating filter in the figure below has sampling rate of 2, differential delay M of 1, and stage N of 1.

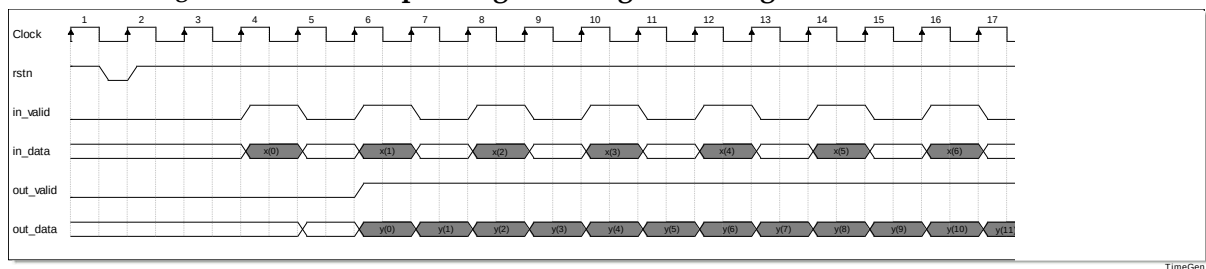
Figure 6-1 CIC Decimating Filter Signal Timing



6.2 CIC Interpolating Filter Signal Timing

The CIC interpolating filter in the figure below has sampling rate of 2, differential delay M of 1, and stage N of 1.

Figure 6-2 CIC Interpolating Filter Signal Timing

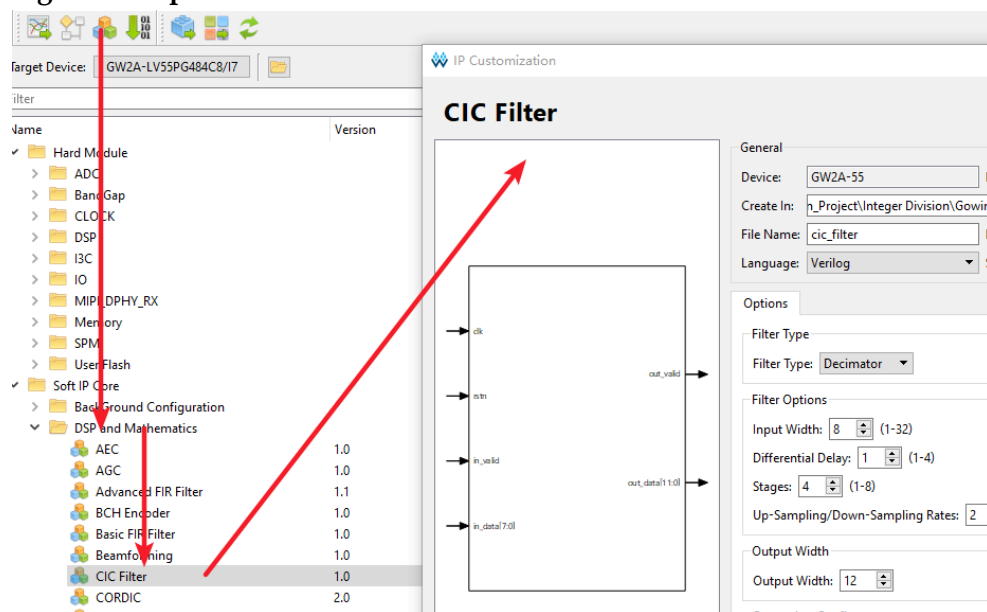


7 GUI Configuration

7.1 IP Generation

Click "Tools > IP Core Generator > DSP and Mathematics" to call and configure CIC Filter; toolbar icon is also available as shown in Figure 7-1.

Figure 7-1 Open GUI Via Icon



7.2 Configuration Interface

CIC Filter configuration interface is shown in Figure 7-2.

Figure 7-2 Gowin CIC Filter IP Configuration Interface

CIC Filter

General

Device: GW2A-55 Part Number: GW2A-LV55PG484C8/I7

Create In: h_Project\Integer Division\Gowin Integer Division RefDesign\src\cic_filter

File Name: cic_filter Module Name: CIC_Filter_Top

Language: Verilog Synthesis Tool: GowinSynthesis

Options

Filter Type

Filter Type: Decimator

Filter Options

Input Width: 8 (1-32)

Differential Delay: 1 (1-4)

Stages: 4 (1-8)

Up-Sampling/Down-Sampling Rates: 2 (2-16384)

Output Width

Output Width: 12

Generation Config

☒ Disable I/O Insertion

OK Cancel

- In the "Create In" field, you can select the path of generated IP core folder.
- In the "File Name" field, you can enter the generated IP file name.
- In the "Module Name" field, you can enter the generated IP module name.

8 Reference Design

Please refer to the related test cases in [RefDesign](#).

9 Doc. Delivered

The delivery doc. of CIC Filter IP includes documentation and reference design.

Table 9-1 Documentation List

Name	Description
IPUG797, Gowin CIC Filter IP User Guide	Gowin IP User Guide, namely this one
RN797, Gowin CIC Filter IP Release Note	Gowin IP Release Note

