Gowin APB Timer IP

User Guide

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Revision History

Date	Version	Description
2025/08/08	1.0E	Initial version published.
2026/11/13	1.0.1E	● Updated the software programming library. ● Updated the hardware and software programming reference designs.

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1 About This Guide

1.1 Purpose

The purpose of the Gowin APB Timer IP User Guide is to help you understand the features and operation of the Gowin APB Timer IP by describing its functions, signals, parameters, interface configuration, programming model, and reference design. The software screenshots and the supported products listed in this manual are based on Gowin Software 1.9.12.04(64-bit). As the software is subject to change without notice, some information may become outdated and should be interpreted according to the software version in use.

1.2 Related Documents

The latest user guides are available on the GOWINSEMI Website. You can download and view the following 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
- DS861, GW1NSR series of FPGA Products Data Sheet
- DS841, GW1NZ series of FPGA Products Data Sheet
- DS961, GW2ANR series of FPGA Products Data Sheet
- DS102, GW2A series of FPGA Products Data Sheet
- DS226, GW2AR series of FPGA Products Data Sheet
- DS971, GW2AN-18X & 9X Data Sheet
- DS976, GW2AN-55 Data Sheet
- DS981, GW5AT series of FPGA Products Data Sheet
- DS1103, GW5A series of FPGA Products Data Sheet
- DS1239, GW5AST series of FPGA Products Data Sheet
- DS1105, GW5AS series of FPGA Products Data Sheet

- DS1108, GW5AR series of FPGA Products Data Sheet
- DS1118, GW5ART series of FPGA Products Data Sheet
- SUG100, Gowin Software User Guide
- SUG549, GMD(GOWIN MCU Designer) User Guide

1.3 Terminology and Abbreviations

Table 1-1 shows the abbreviations and terminology used in this manual.

Table 1-1 Terminology and Abbreviations

Terminology and Abbreviations	Meaning
APB	Advanced Peripheral Bus
FPGA	Field Programmable Gate Array
IP	Intellectual Property

1.4 Support and Feedback

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

Website: www.gowinsemi.com

E-mail: support@gowinsemi.com

2 Overview

2.1 Introduction

Gowin APB Timer IP is a 32-bit down counter.

Table 2-1 Gowin APB Timer IP Overview

Gowin APB Timer IP	
Logic Resource	See 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 (V1.9.11.02 and above)

Note!

For a list of the supported devices, click here.

2.2 Features

Gowin APB Timer IP includes the following features:

- Interrupt request signal (TIMERINT): The timer generates an interrupt request signal, TIMERINT, when the counter value decrements to zero. The interrupt request continues to be valid until it is cleared by writing data to the INTCLEAR register.
- External input signal (EXTIN): The 0-to-1 transition of the EXTIN signal can be used as the enable signal for the timer.
- Interrupt status and software clear: If the counter of timer reaches 0 and the previous interrupt status is cleared by software at that moment, the interrupt status will be set to 1 again.
- External clock signal (EXTIN) frequency requirement: When EXTIN is used as the clock source for the timer, its frequency must be less than half of the peripheral clock frequency. This is because EXTIN, after being sampled by a double flip-flop synchronizer, must also be

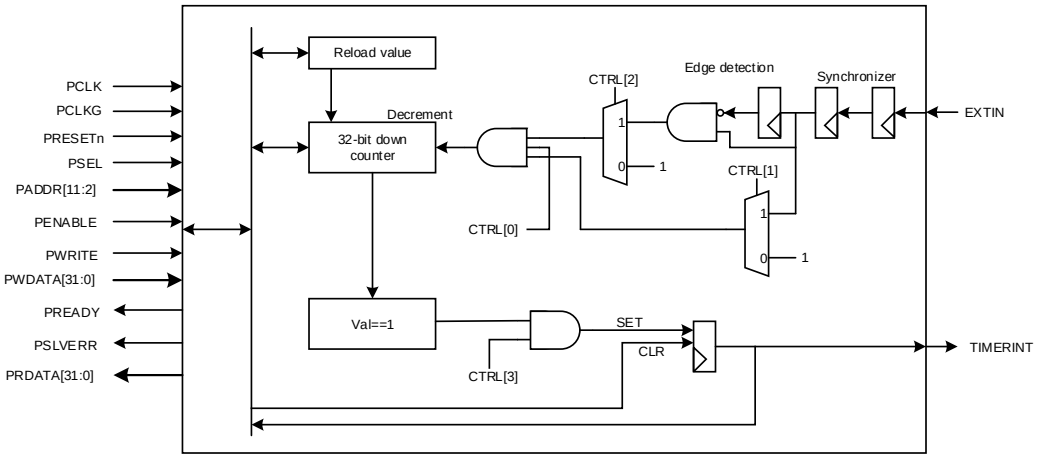
processed by edge detection logic.

- Register Clock (PCLKG): PCLKG is an independent clock pin used for the APB register read and write logic. When there is no APB activity, PCLKG allows the clock distribution to peripheral register logic to be stopped.

2.3 Structure Diagram

The structure diagram of Gowin APB Timer IP is shown in Figure 2-1.

Figure 2-1 Structure Diagram



2.4 Functional Description

In Gowin APB Timer IP, the peripheral bus clock (PCLKG) used for register access can be disabled when there is no APB access.

The timer operations are driven by a free-running clock (PCLK), which must operate at the same frequency as the PCLKG signal and remain synchronized with it.

This allows power savings when there is no APB access, as PCLKG can be turned off. However, PCLK must remain active to ensure proper timer operation. Therefore, PCLK and PCLKG should operate at the same frequency and stay synchronized to ensure reliable timer functionality.

2.5 Resource Utilization

Gowin APB Timer IP is implemented in Verilog. Its performance and resource utilization may vary when the design is employed in different devices, or at different densities, speeds, or grades. Taking Gowin GW5AT series of FPGA as an instance, the resource utilization of the Gowin APB IP is shown in Table 2-2.

Table 2-2 Resource Utilization

Device	Resource	Resource Utilization	Configuration
GW5AT	Logic	205	-
	Register	80	
	BSRAM	0	

3 Signal Description

The port descriptions of Gowin APB Timer IP are shown in Table 3-1.

Table 3-1 Signal Description

Signal Name	I/O	Width	Description
PCLK	input	1	APB clock signal
PCLKG	input	1	APB clock gated signal
PRESETn	input	1	APB reset signal (Active-Low)
PSEL	input	1	APB select signal
PADDR	input	[11:2]	APB address bus
PENABLE	input	1	APB enable signal
PWRITE	input	1	APB transfer direction signal
PWDATA	input	[31:0]	APB write data bus
PRDATA	output	[31:0]	APB read data bus
PREADY	output	1	APB ready signal
PSLVERR	output	1	APB slave error signal
EXTIN	input	1	External input signal, which is synchronized by double flip-flops before the time logic uses it
TIMERINT	output	1	Timer interrupt output

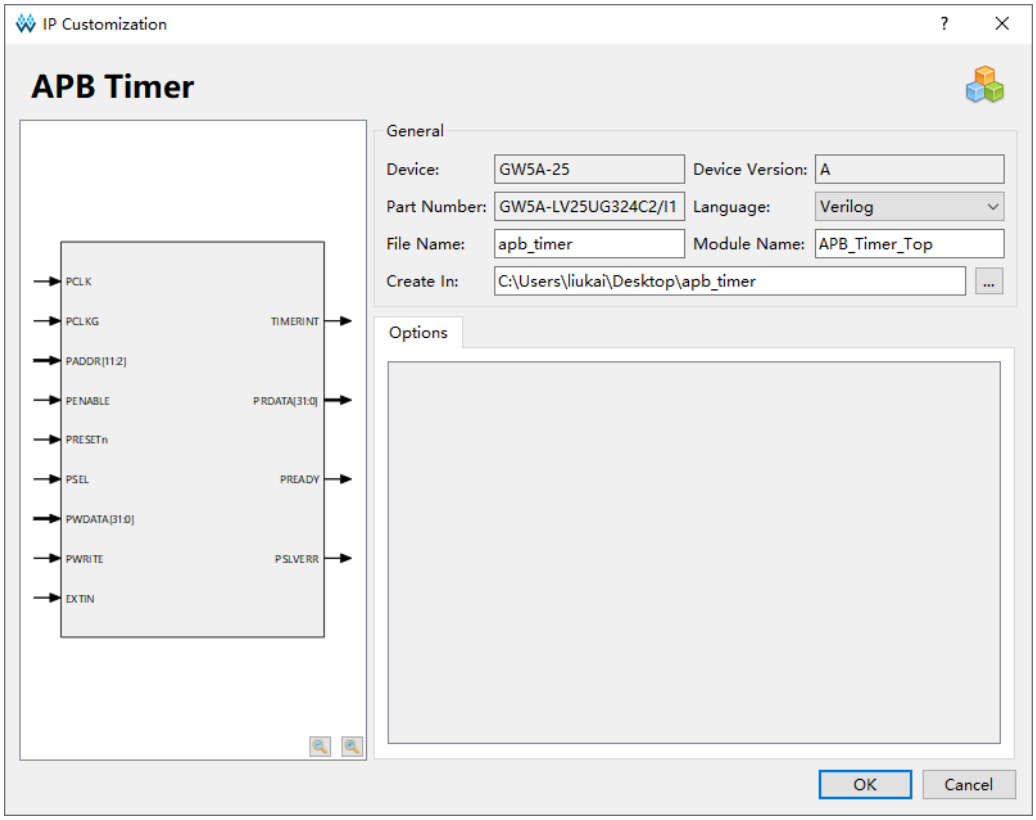
4 Interface Configuration

You can select IP Core Generator Tool in Gowin Software to call and configure Gowin APB Timer IP.

Select "Tool > IP Core Generator" on the menu bar or click the “ ” on the tool bar to open IP Core Generator; then select "Soft IP Core > Microprocessor System > Peripheral > AHB Timer 1.0".

Gowin APB Timer IP interface configuration is shown in Figure 4-1.

Figure 4-1 Interface Configuration



5 Programming Model

5.1 Register

5.1.1 Register Overview

The definition of Gowin APB Timer IP register is shown in Table 5-1. The APB Timer register definition is located in …\library\lib\apb_timer.h.

Table 5-1 Register Definition

Address Offset	Name	Description
0x00	CTRL	Control register
0x04	VALUE	Value register
0x08	RELOAD	Reload register
0x0C	INTSTATUS/INTCLEAR	Interrupt status/Interrupt clear register

The following sections provide a detailed description of the Gowin APB Timer IP register definitions.

The abbreviations for register types are summarized as follows:

- RO: Read-only
- WO: Write-only (read as zero)
- R/W: Readable and writable

5.1.2 Control Register (0x00)

The definition of control register is shown in Table 5-2.

Table 5-2 Control Register

Name	Bit	Type	Description	Reset
IntEn	3	R/W	APB Timer interrupt enable	0x0
ExtInClk	2	R/W	Select external input as clock	0x0
ExtInEn	1	R/W	Select external input as enable	0x0
En	0	R/W	Enable	0x0

5.1.3 Value Register (0x04)

The definition of value register is shown in Table 5-3.

Table 5-3 Value Register

Name	Bit	Type	Description	Reset
Val	31:0	R/W	Current value	0x0

5.1.4 Reload Register (0x08)

The definition of reload register is shown in Table 5-4.

Table 5-4 Reload Register

Name	Bit	Type	Description	Reset
ReloadVal	31:0	R/W	Reload value. A write to this register sets the current value	0x0

5.1.5 Interrupt Status/Interrupt Clear Register (0x0C)

The definition of interrupt status and interrupt clear register are shown in Table 5-5.

Table 5-5 Interrupt Status/Interrupt Clear Register

Name	Bit	Type	Description	Reset
IntStatus	0	RO	Timer interrupt status	0x0
IntClr	0	WO	Timer interrupt clear, write one to clear	

5.2 Driver Function

5.2.1 Driver Function Overview

The definition of Gowin APB Timer IP Driver Function is shown in Table 5-6. The definition of Gowin APB Timer IP driver function is located in …\library\lib\apb_timer.h and apb_timer.c.

Table 5-6 Driver Function Definition

Driver Function	Description
apb_timer_initialize	Initialize APB Timer
apb_timer_start	Start APB Timer
apb_timer_stop	Stop APB Timer
apb_timer_get_irq_status	Get the interrupt status of APB Timer
apb_timer_clear_irq	Clear the interrupt for APB Timer
apb_timer_get_reload	Get the reload value of APB Timer
apb_timer_set_reload	Set the reload value for APB Timer
apb_timer_get_value	Get the current value of APB Timer
apb_timer_set_value	Set the current value for APB Timer
apb_timer_enable_irq	Enable the interrupt of APB Timer
apb_timer_disable_irq	Disable the interrupt of APB Timer
apb_timer_enable_select_ext	Select external input as the enable
apb_timer_select_ext_clock	Select external input as the clock

The following sections provide a detailed description of the Gowin APB Timer driver function definitions.

5.2.2 apb_timer_initialize

The definition of apb_timer_initialize function is shown in Table 5-7.

Table 5-7 apb_timer_initialize Function Definition

Prototype	void apb_timer_initialize(APB_TIMER_RegDef* TIMERx, APB_TIMER_InitTypeDef* TIMER_InitStruct)
Description	Initialize APB Timer
Parameter	TIMERx: Pointer to APB_TIMER_RegDef structure TIMER_InitStruct: Pointer to APB_TIMER_InitTypeDef structure
Return value	None

5.2.3 apb_timer_start

The definition of apb_timer_start function is shown in Table 5-8.

Table 5-8 apb_timer_start Function Definition

Prototype	void apb_timer_start(APB_TIMER_RegDef* TIMERx)
Description	Start APB Timer
Parameter	TIMERx: Pointer to APB_TIMER_RegDef structure
Return value	None

5.2.4 apb_timer_stop

The definition of apb_timer_stop function is shown in Table 5-9.

Table 5-9 apb_timer_stop Function Definition

Prototype	void apb_timer_stop(APB_TIMER_RegDef* TIMERx)
Description	Stop APB Timer
Parameter	TIMERx: Pointer to APB_TIMER_RegDef structure
Return value	None

5.2.5 apb_timer_get_irq_status

The definition of apb_timer_get_irq_status function is shown in Table 5-10.

Table 5-10 apb_timer_get_irq_status Function Definition

Prototype	ITStatus apb_timer_get_irq_status(APB_TIMER_RegDef* TIMERx)
Description	Get the interrupt status of APB Timer
Parameter	TIMERx: Pointer to APB_TIMER_RegDef structure
Return value	The interrupt status of APB Timer

5.2.6 apb_timer_clear_irq

The definition of apb_timer_clear_irq function is shown in Table 5-11.

Table 5-11 apb_timer_clear_irq Function Definition

Prototype	void apb_timer_clear_irq(APB_TIMER_RegDef* TIMERx)
Description	Clear the interrupt for APB Timer
Parameter	TIMERx: Pointer to APB_TIMER_RegDef structure
Return value	None

5.2.7 apb_timer_get_reload

The definition of apb_timer_get_reload function is shown in Table 5-12.

Table 5-12 apb_timer_get_reload Function Definition

Prototype	unsigned int apb_timer_get_reload(APB_TIMER_RegDef* TIMERx)
Description	Get the reload value for APB Timer
Parameter	TIMERx: Pointer to APB_TIMER_RegDef structure
Return value	Reload value of APB Timer

5.2.8 apb_timer_set_reload

The definition of apb_timer_set_reload function is shown in Table 5-13.

Table 5-13 apb_timer_set_reload Function Definition

Prototype	void apb_timer_set_reload(APB_TIMER_RegDef* TIMERx, unsigned int value)
Description	Set the reload value for APB Timer
Parameter	TIMERx: Pointer to APB_TIMER_RegDef structure Value: Reload value
Return value	None

5.2.9 apb_timer_get_value

The definition of apb_timer_get_value function is shown in Table 5-14.

Table 5-14 apb_timer_get_value Function Definition

Prototype	unsigned int apb_timer_get_value(APB_TIMER_RegDef* TIMERx)
Description	Get the current value of APB Timer
Parameter	TIMERx: Pointer to APB_TIMER_RegDef structure
Return value	The current value of APB Timer

5.2.10 apb_timer_set_value

The definition of apb_timer_set_value function is shown in Table 5-15.

Table 5-15 apb_timer_set_value Function Definition

Prototype	void apb_timer_set_value(APB_TIMER_RegDef* TIMERx, unsigned int value)
Description	Set the current value for APB Timer
Parameter	TIMERx: Pointer to APB_TIMER_RegDef structure Value: Current value
Return value	None

5.2.11 apb_timer_enable_irq

The definition of apb_timer_enable_irq function is shown in Table 5-16.

Table 5-16 apb_timer_enable_irq Function Definition

Prototype	void apb_timer_enable_irq(APB_TIMER_RegDef* TIMERx)
Description	Enable the interrupt of APB Timer
Parameter	TIMERx: Pointer to APB_TIMER_RegDef structure
Return value	None

5.2.12 apb_timer_disable_irq

The definition of apb_timer_disable_irq function is shown in Table 5-17.

Table 5-17 apb_timer_disable_irq Function Definition

Prototype	void apb_timer_disable_irq(APB_TIMER_RegDef* TIMERx)
Description	Disable the interrupt of APB Timer
Parameter	TIMERx: Pointer to APB_TIMER_RegDef structure
Return value	None

5.2.13 apb_timer_enable_selec_ext

The definition of apb_timer_enable_selec_ext function is shown in Table 5-18.

Table 5-18 apb_timer_enable_selec_ext Function Definition

Prototype	void apb_timer_enable_select_ext(APB_TIMER_RegDef* TIMERx)
Description	Select the external input as the enable for APB Timer
Parameter	TIMERx: Pointer to APB_TIMER_RegDef structure
Return value	None

5.2.14 apb_timer_select_ext_clk

The definition of apb_timer_select_ext_clk function is shown in Table 5-19.

Table 5-19 apb_timer_select_ext_clk Function Definition

Prototype	void apb_timer_select_ext_clk(APB_TIMER_RegDef* TIMERx)
Description	Select the external input as the clock for APB Timer
Parameter	TIMERx: Pointer to APB_TIMER_RegDef structure
Return value	None

6 Reference Design

Please refer to the Gowin APB Timer IP Reference Design for details at Gowinsemi website.

- Hardware Reference Design:

  ...

  \ref_design\FPGA_RefDesign\DK_START_GW5A25_V2.0\apb_timer

- Software Reference Design:

  …\ref_design\MCU_RefDesign\apb_timer


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