AIO3310A/3311A/3312A

Analog Input and Multi-Function Digital I/O Card

Software Manual (V2.0)

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Correction record

Version	Record
1.0	
V1.0->V1.1	Modify the order of the contents (flow chart)
V1.1->V2.0	disable the software key function with return value always true

Contents

1. Difference between AIO3310 and AIO3310A

Although AIO3310A is a recommended replacement of AIO3310 but it exist some differences. The driver package has provided the same function name leading with AIO3310 for the new AIO3310A card. The instructions in red color are the instructions not fully compatible with AIO3310 card; the black color instructions are fully compatible. (Detailed instruction description please refer the AIO3310 software manual)

	Function Name	Description
1	AIO3310_initial( )	AIO3310 Initial
2	AIO3310_initial_calibration( )	Initialized the factory calibrated data
3	AIO3310_close( )	AIO3310 Close
4	AIO3310_info( )	Read the I/O address of specific card
5	AIO3310_smart_AtoD( )	Read A/D in smart mode (converted and calibrated)
6	AIO3310_write_AD_command( )	write command to AD chip
7	AIO3310_read_AD_status( )	Read AD status
8	AIO3310_read_AD_data( )	read AD conversion data
9	AIO3310_AD_calibration( )	Calibration AD value
10	AIO3310_smart_AtoD_no_calibr( )	Read A/D value and convert to scale.
11	AIO3310_set_port_dir( )	Set port direction (input or output)
12	AIO3310_read_port_dir( )	Read port direction
13	AIO3310_read_port( )	Read port data
14	AIO3310_read_point( )	Read data of a specific point
15	AIO3310_set_port( )	Write data to port
16	AIO3310_set_point( )	Write bit of data to port
17	AIO3310_set_dedicate_IO( )	Set DIO10,DIO11 as dedicate or general out
18	AIO3310_set_timer( )	To set timer / counter at timer mode
19	AIO3310_set_counter( )	To set timer / counter at counter mode
20	AIO3310_set_pwm( )	Set timer/counter at PWM mode
21	AIO3310_load_GPT( )	Write data to GPT(general purpose timer/counter register)
22	AIO3310_GPT_enable( )	Enable/disable timer/counter function
23	AIO3310_read_GPT( )	Read GPT(general purpose timer/counter register) data
24	AIO3310_one_shot_command( )	Generate an one shot
25	AIO3310_set_gate_CNTR( )	Gated counter function
26	AIO3310_read_parameter( )	Read parameter
27	AIO3310_enable_IRQ( )	Enable interrupt of timer/counter
28	AIO3310_link_IRQ_process( )	Link IRQ process
29	AIO3310_disable_IRQ( )	Disable interrupt of timer/counter
30	AIO3310_read_IRQ_status( )	Read back IRQ status

31	AIO3310_set_password( )	Set password
32	AIO3310_change_password( )	Change password
33	AIO3310_clear_password( )	Clear password
34	AIO3310_unlock_security( )	Unlock security function
35	AIO3310_read_security_status( )	Read security status

- **AIO3310_set_timer**

Format : u32 status = AIO3310_set_timer(u8 CardID,u8 TimerID,u8 To_mode)

Purpose: To set timer / counter at timer mode and configure its timer output function.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
TimerID	u8	timer/counter designation 0: timer/counter0 1: timer/counter1
To_mode	u8	designation of timer output mode: 0: To will pulse low for 1us when terminal count is reached 1: To will pulse low for 2us when terminal count is reached 2: To will toggle whenever terminal count is reached 3: no output function

- **AIO3310_set_counter**

Format : u32 status = AIO3310_set_counter(u8 CardID,u8 TimerID,u8 To_mode, u8 Ti_mode)

Purpose: To set timer / counter at counter mode and configure its counter input and counter output function.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
TimerID	u8	timer/counter designation 0: timer/counter0 1: timer/counter1
To_mode	u8	counter output mode designation: 0: To will pulse low for 1us when terminal count is reached 1: To will pulse low for 2us when terminal count is reached 2: To will toggle whenever terminal count is reached 3: no output function
Ti_mode	u8	counter input mode designation: 0: not available 1: not available 2: Counter decrease 1 while Ti is high to low transition 3: Counter decrease 1 while Ti is low to high transition

Notes:

1. Counter/Timer0 input is at DIO00, Counter/Timer1 input is at DIO01, and before using this function, port0 should be configured as input port.
2. Counter/Timer0 output is at DIO10, Counter/Timer1 output is at DIO11, and before using this function, port1 should be configured as output port by AIO3310_set_dedicate_IO( ).

- **AIO3310_set_pwm**

Format : **u32 status = AIO3310_set_pwm(u8 CardID,u8 TimerID)**

Purpose: To set timer/counter at PWM mode and map the PWM output to port1 bit n for timer/counter n.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
TimerID	u8	timer/counter designation 0: timer/counter0 1: timer/counter1

Note:

Each timer/counter has 32 bit register length, if you program as PWM mode, the register is divided as 2 16 bit width, the lower 16 bit work as the PWM width and the upper 16 bit work as PWM frequency register.

- **AIO3310_one_shot_command**

Format : **status=AIO3310_one_shot_command (u8 CardID,u8 TimerID,u16 duration_time)**

Purpose: **To generate an one shot output from timer0/1 at programmed duration**

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
TimerID	u8	timer/counter designation 0: timer/counter 0 , output at DIO10 1: timer/counter 1 , output at DIO11
duration_time	u16	the duration time constant of one shot. Duration time = time constant *1us

Notes:

Counter/Timer0 output is at DIO10, Counter/Timer1 output is at DIO11, and before using this function, port1 should be configured as output port by AIO3310_set_dedicate_IO( ).

- **AIO3310_set_gate_CNTR**

Format : u32 status = AIO3310_set_gate_CNTR(u8 CardID,u8 TimerID,u8 enable)

Purpose: To enable/disable gated timer/counter function and the gated input for timer0/timer1.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
TimerID	u8	port designation 0: timer/counter0 1: timer/counter1
enable	u8	0: disable gated timer/counter function 1: enable or resume timer/counter function for Counter/Timer0, the gate input : DIO00: counter input DIO02: gate input, high enables counting for Counter/Timer1, the gate input : DIO01: counter input DIO03: gate input, high enables counting

2. How to install the software of AIO3310A

2.1 Install the PCI driver

The PCI card is a plug and play card, once you add a new card the on window system will detect while it is booting. Please follow the following steps to install your new card.

In WinXP/7 and up system you should: (take Win XP as example)

1. Make sure the power is off
2. Plug in the interface card
3. Power on
4. A hardware install wizard will appear and tell you it finds a new PCI card
5. Do not response to the wizard, just Install the file (..\AIO3310A\Software\WinXP_7\ or if you download from website please execute the file AIO3310A_Install.exe to get the file)
6. After installation, power off
7. Power on, it's ready to use

Note: AIO3310A, AIO3311A, AIO3312A use the same driver and dll.

For more detail of step by step installation guide, please refer the file "installation.pdf " on the CD come with the product or register as a member of our user's club at:

http://automation.com.tw/

to download the complementary documents.

3. Where to find the file you need

WinXP/7 and up

The directory will be located at

.. \ JS Automation \AIO3310A\API (header files and lib files for VB,VC,BCB,C#)

.. \ JS Automation \AIO3310A\Driver (backup copy of AIO3310A drivers)

.. \ JS Automation \AIO3310A\exe (demo program and source code)

The system driver is located at **..\system32\Drivers** and the DLL is located at **..\system**.

For your easy startup, the demo program with source code demonstrates the card functions and help file.

4. About the AIO3310A software

AIO3310A software includes a set of dynamic link library (DLL) and system driver that you can utilize to control the I/O card's ports and points separately.

Your AIO3310A software package includes setup driver, tutorial example and test program that help you how to setup and run appropriately, as well as an executable file which you can use to test each of the AIO3310A functions within Windows' operation system environment.

4.1 What you need to get started

To set up and use your AIO3310A software, you need the following:

- AIO3310A software
- AIO3310A hardware
  Main board
  Wiring board (Option)

4.2 Software programming choices

You have several options to choose from when you are programming AIO3310A software. You can use Borland C/C++, Microsoft Visual C/C++, Microsoft Visual Basic, or any other Windows-based compiler that can call into Windows dynamic link libraries (DLLs) for use with the AIO3310A software.

5. AIO3310A Language support

The AIO3310A software library is a DLL used with WinXP/7 and up. You can use these DLL with any Windows integrating development environment that can call Windows DLLs.

5.1 Building applications with the AIO3310A software library

The AIO3310A function reference topic contains general information about building AIO3310A applications, describes the nature of the AIO3310A files used in building AIO3310A applications, and explains the basics of making applications using the following tools:

Applications tools

- Microsoft Visual C/C++
- Borland C/C++
- Microsoft Visual C#
- Microsoft Visual Basic
- Microsoft VB.net

If you are not using one of the tools listed, consult your development tool reference manual for details on creating applications that call DLLs.

5.2 AIO3310A Windows libraries

The AIO3310A for Windows function library is a DLL called **AIO3310A.dll**. Since a DLL is used, AIO3310A functions are not linked into the executable files of applications. Only the information about the AIO3310A functions in the AIO3310A import libraries is stored in the executable files.

Import libraries contain information about their DLL-exported functions. They indicate the presence and location of the DLL routines. Depending on the development tools you are using, you can make your compiler and linker aware of the DLL functions through import libraries or through function declarations.

Refer to **Table 1** to determine to which files you need to link and which to include in your development to use the AIO3310A functions in AIO3310A.dll.

Header Files and Import Libraries for Different Development Environments		
Language	**Header File**	**Import Library**
Microsoft Visual C/C++	AIO3310A.h	AIO3310AVC.lib
Borland C/C++	AIO3310A.h	AIO3310ABC.lib
Microsoft Visual C#	AIO3310A.cs	
Microsoft Visual Basic	AIO3310A.bas	
Microsoft VB.net	AIO3310A.vb	

Table 1

6. Function format and language difference

6.1 Function format

Every AIO3310A function is consist of the following format:

Status = function_name (parameter 1, parameter 2, … parameter n)

Each function returns a value in the **Status** global variable that indicates the success or failure of the function. A returned **Status** equal to zero that indicates the function executed successfully. A non-zero status indicates failure that the function did not execute successfully because of an error, or executed with an error.

Note : **Status** is a 32-bit unsigned integer.

The first parameter to almost every AIO3310A function is the parameter **CardID** which is located the driver of AIO3310A board you want to use those given operation. The **CardID** is assigned by DIP/ROTARY SW. You can utilize multiple devices with different card CardID within one application; to do so, simply pass the appropriate **CardID** to each function.

Note: **CardID** is set by DIP/ROTARY SW (**0x0-0xF**)

6.2 Variable data types

Every function description has a parameter table that lists the data types for each parameter. The following sections describe the notation used in those parameter tables and throughout the manual for variable data types.

Primary Type Names					
Name	**Description**	**Range**	**C/C++**	**Visual BASIC**	**Pascal (Borland Delphi)**
u8	8-bit ASCII character	0 to 255	char	Not supported by BASIC. For functions that require character arrays, use string types instead.	Byte
i16	16-bit signed integer	-32,768 to 32,767	short	Integer (for example: deviceNum%)	SmallInt
u16	16-bit unsigned integer	0 to 65,535	unsigned short for 32-bit compilers	Not supported by BASIC. For functions that require unsigned integers, use the signed integer type instead. See the i16 description.	Word
i32	32-bit signed integer	-2,147,483,648 to 2,147,483,647	long	Long (for example: count&)	LongInt
u32	32-bit unsigned integer	0 to 4,294,967,295	unsigned long	Not supported by BASIC. For functions that require unsigned long integers, use the signed long integer type instead. See the i32 description.	Cardinal (in 32-bit operating systems). Refer to the i32 description.
f32	32-bit single-precision floating-point value	-3.402823E+38 to 3.402823E+38	float	Single (for example: num!)	Single
f64	64-bit double-precision floating-point value	-1.797683134862315E+308 to 1.797683134862315E+308	double	Double (for example: voltage Number)	Double

Table 2

6.3 Programming language considerations

Apart from the data type differences, there are a few language-dependent considerations you need to be aware of when you use the AIO3310A API. Read the following sections that apply to your programming language.

Note: Be sure to include the declaration functions of AIO3310A prototypes by including the appropriate AIO3310A header file in your source code. Refer to Building Applications with the AIO3310A Software Library for the header file appropriate to your compiler.

6.3.1 C/C++

For C or C++ programmers, parameters listed as Input/Output parameters or Output parameters are pass-by-reference parameters, which means a pointer points to the destination variable should be passed into the function. For example, the Read Port function has the following format:

```
Status = AIO3310A_TTL_IO_port_read(CardID, port, *data);
```

where **CardID** and **port** are input parameters, and **data** is an output parameter. Consider the following example:

```
u8 CardID, port;
u8 data,
u32 Status;
Status = AIO3310A_TTL_IO_port_read (CardID, port, data);
```

6.3.2 Visual basic

The file AIO3310A.bas contains definitions for constants required for obtaining AIO Card information and declared functions and variable as global variables. You should use these constants symbols in the AIO3310A.bas, do not use the numerical values.

In Visual Basic, you can add the entire AIO3310A.bas file into your project. Then you can use any of the constants defined in this file and call these constants in any module of your program. To add the AIO3310A.bas file for your project in Visual Basic 4.0, go to the **File** menu and select the **Add File... option**. Select AIO3310A.bas, which is browsed in the AIO3310A \ API directory. Then, select **Open** to add the file to the project.

To add the AIO3310A.bas file to your project in Visual Basic 5.0 and 6.0, go to the **Project** menu and select **Add Module**. Click on the Existing tab page. **Select** AIO3310A.bas, which is in the AIO3310A \ API directory. Then, select **Open** to add the file to the project.

6.3.3 Borland C++ builder

To use Borland C++ builder as development tool, you should generate a .lib file from the .dll file by implib.exe.

implib AIO3310ABC.lib AIO3310A.dll

Then add the **AIO3310ABC.lib** to your project and add

#include “AIO3310A.h” to main program.

Now you may use the dll functions in your program. For example, the Read Port function has the following format:

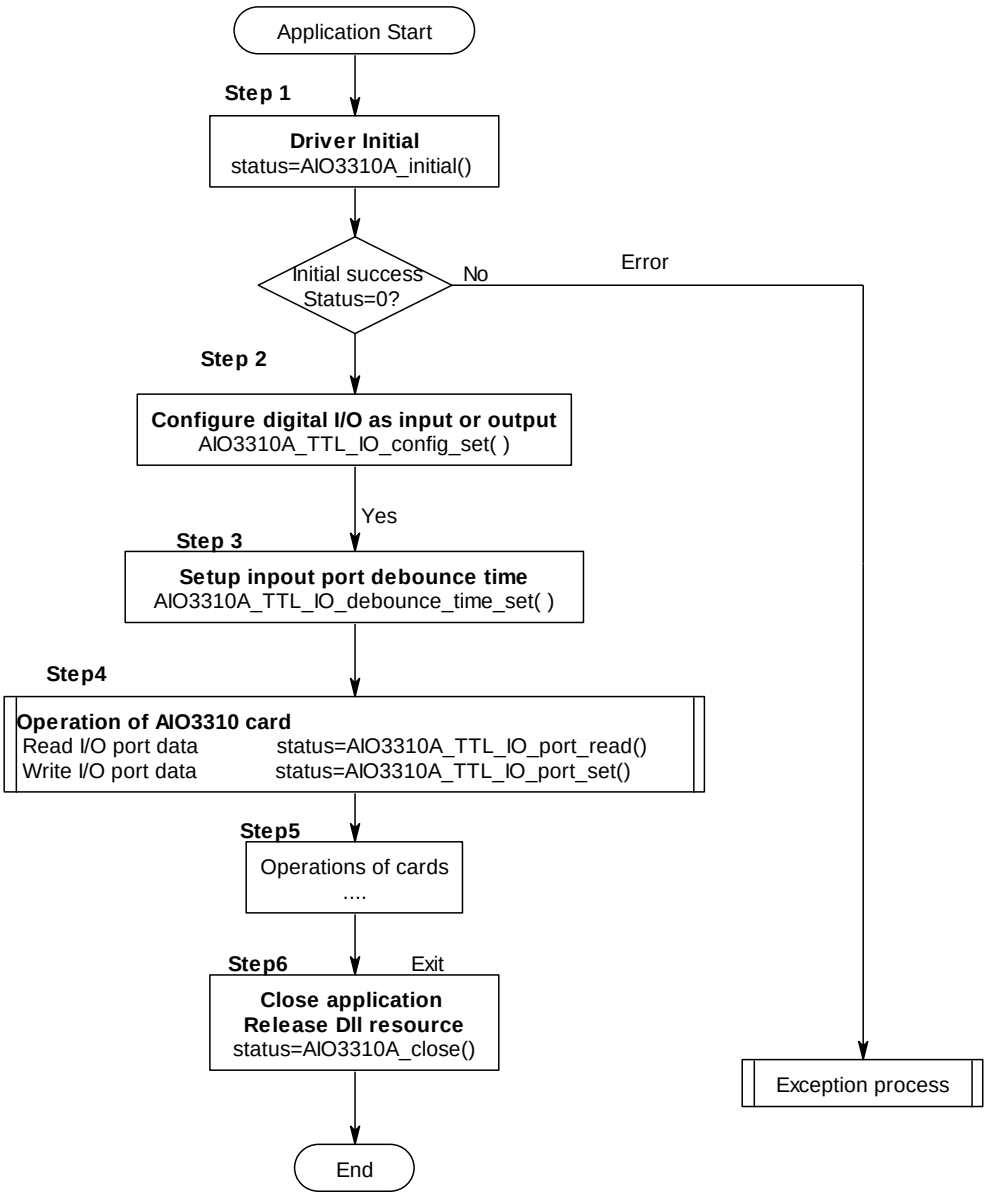
```
Status = AIO3310A_TTL_IO_port_read(CardID, port, *data);
```

where **CardID** and **port** are input parameters, and **data** is an output parameter. Consider the following example:

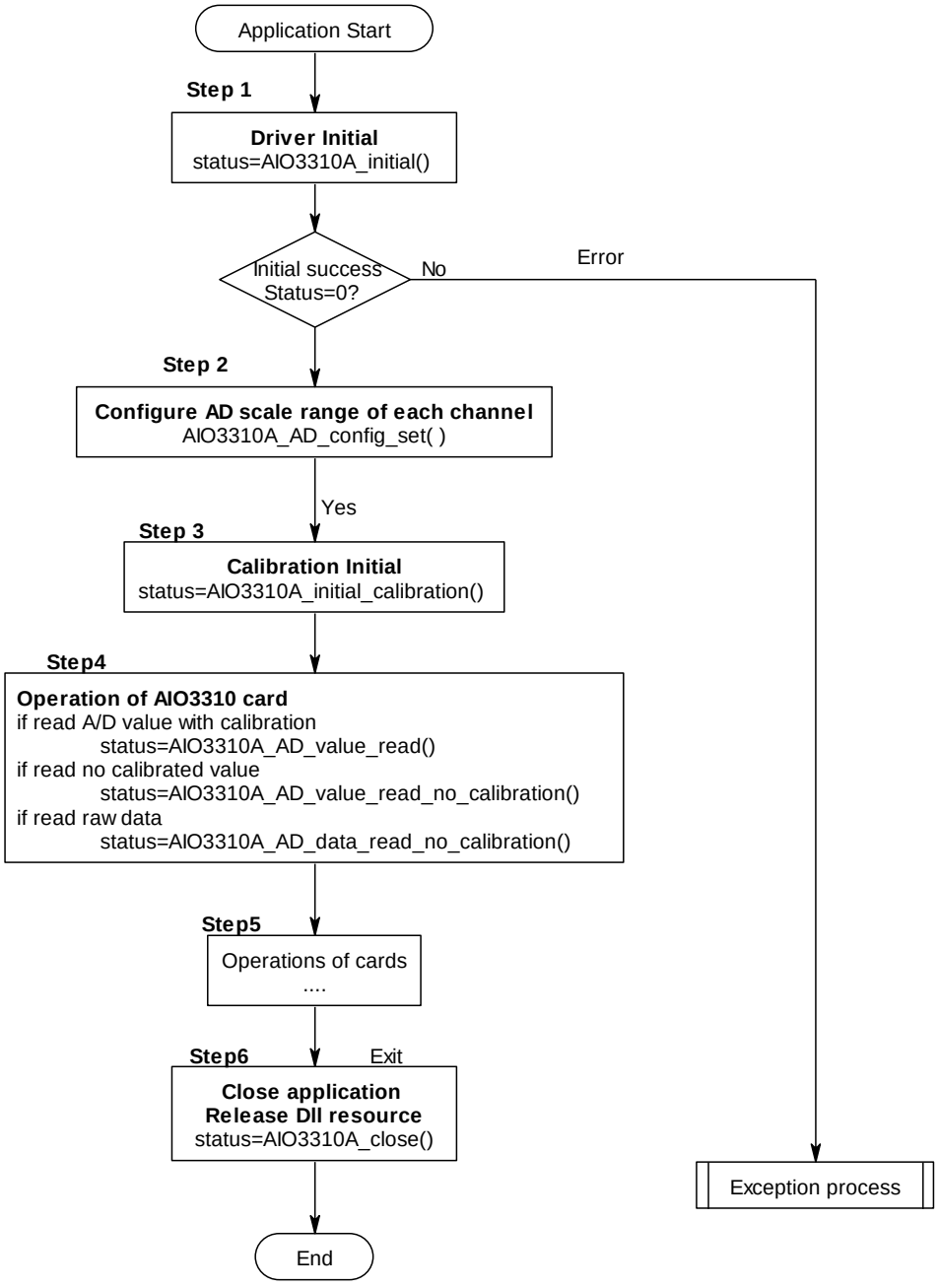
```
u8 CardID, port;
u8 data;
u32 Status;
Status =AIO3310A_TTL_IO_port_read (CardID, port, data);
```

7. Flow chart of application implementation

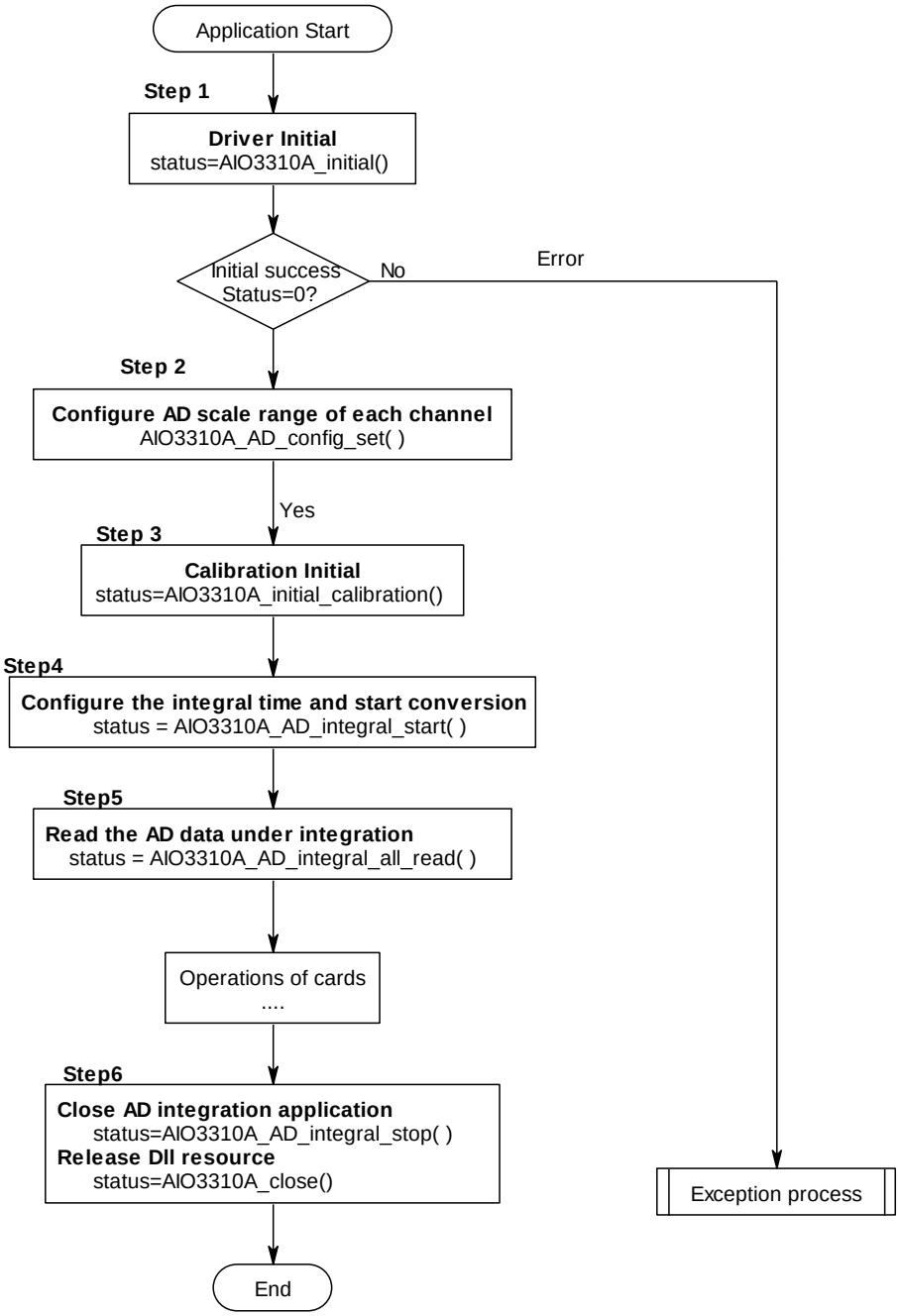
7.1 AIO3310A Flow chart of digital I/O application implementation



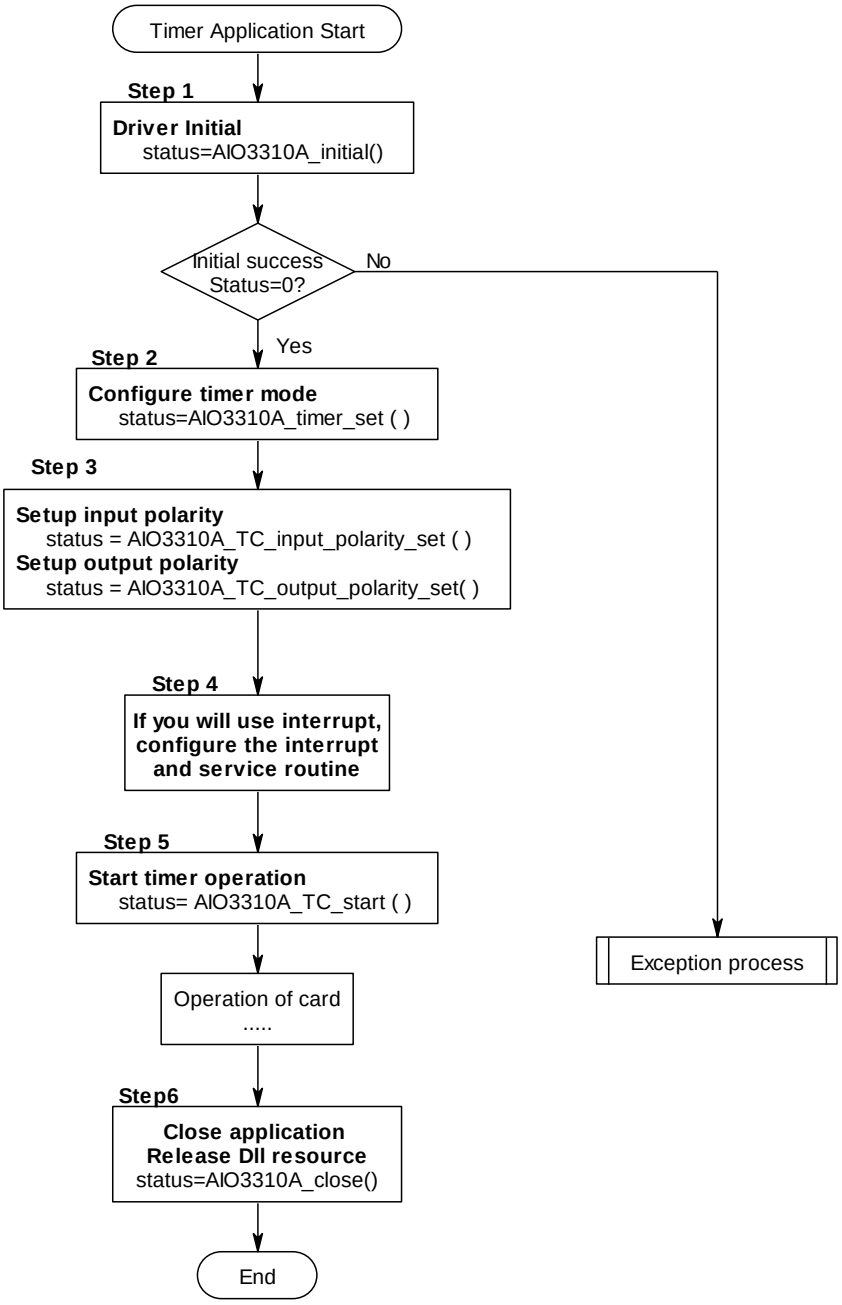
7.2 AIO3310A Flow chart of analog I/O application implementation



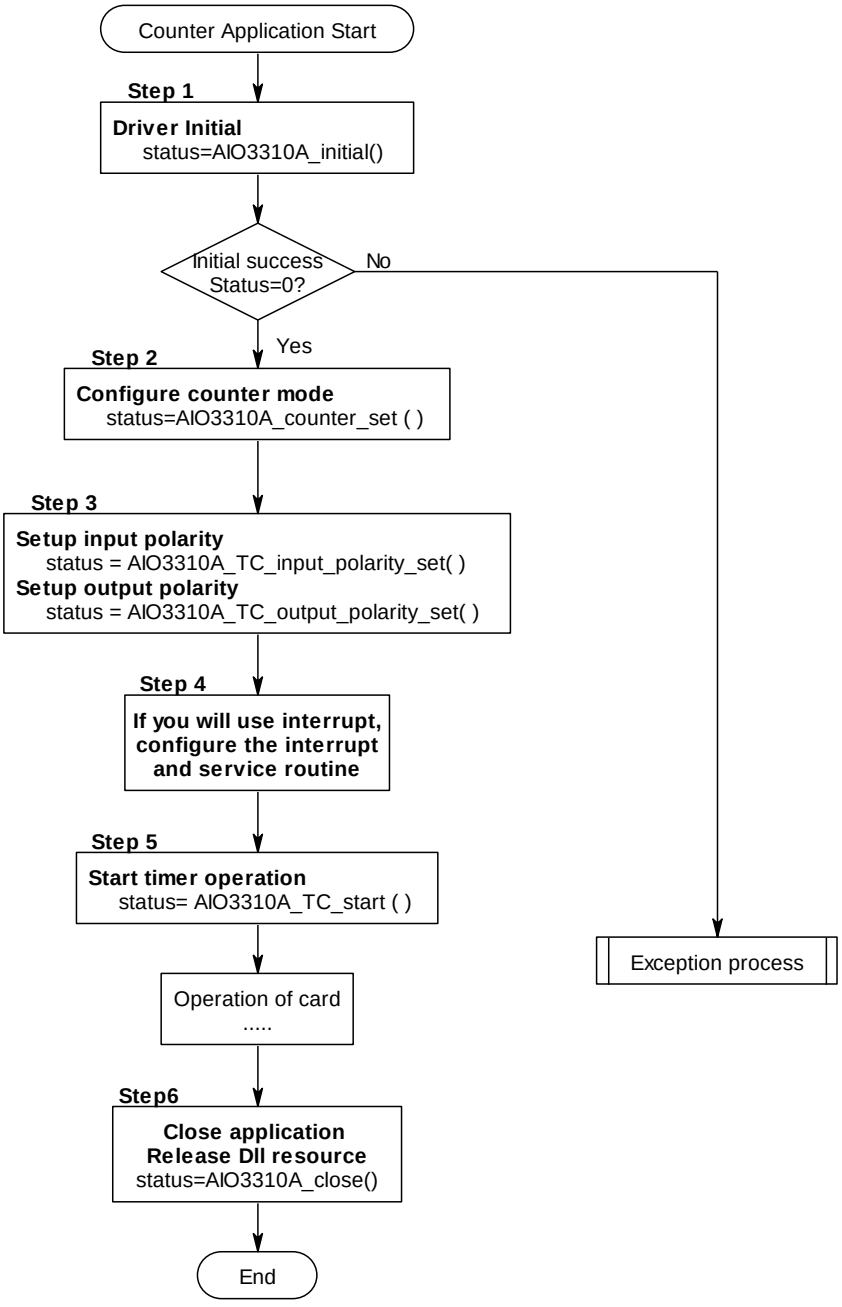
7.3 AIO3310A Flow chart of analog I/O application with embedded integration function



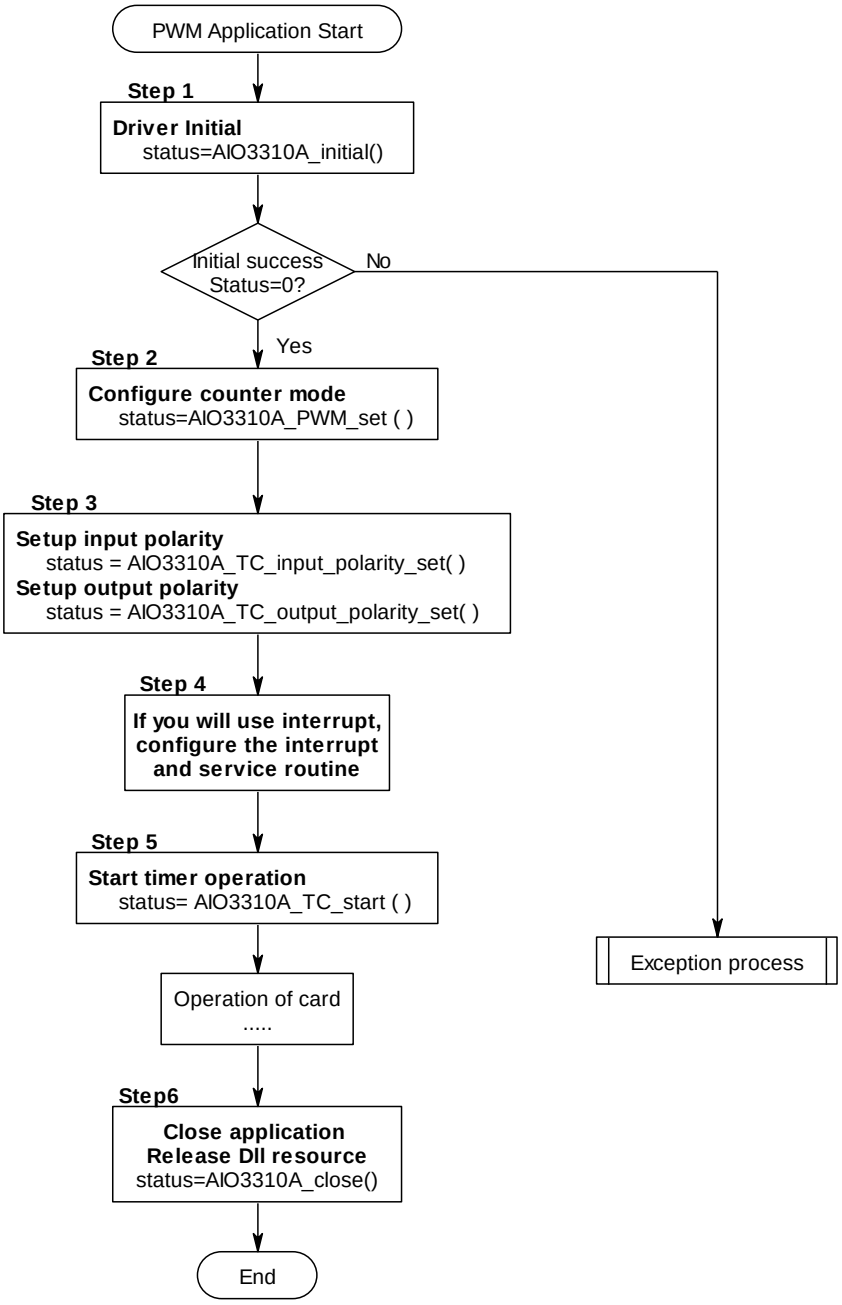
7.4 AIO3310A Flow chart of Timer application



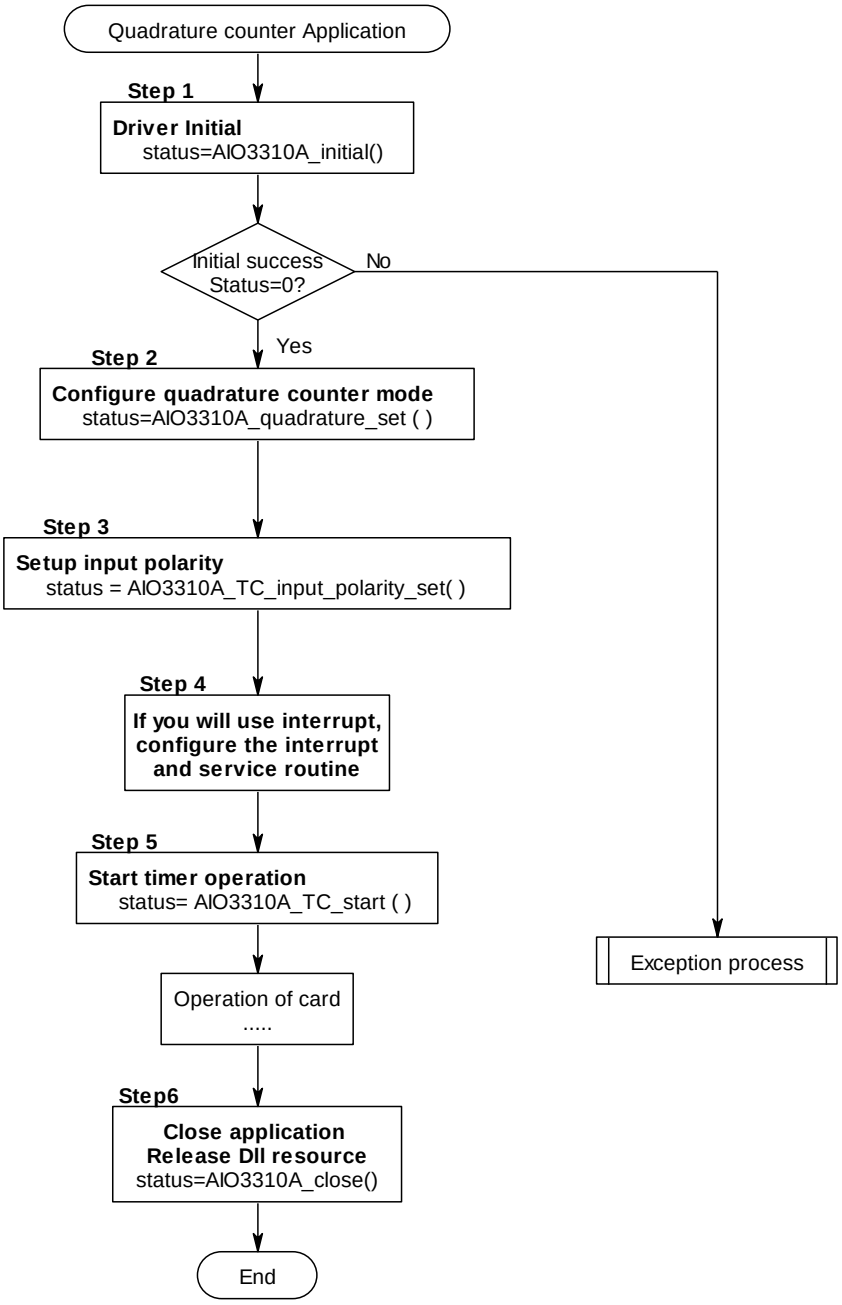
7.5 AIO3310A Flow chart of Counter application



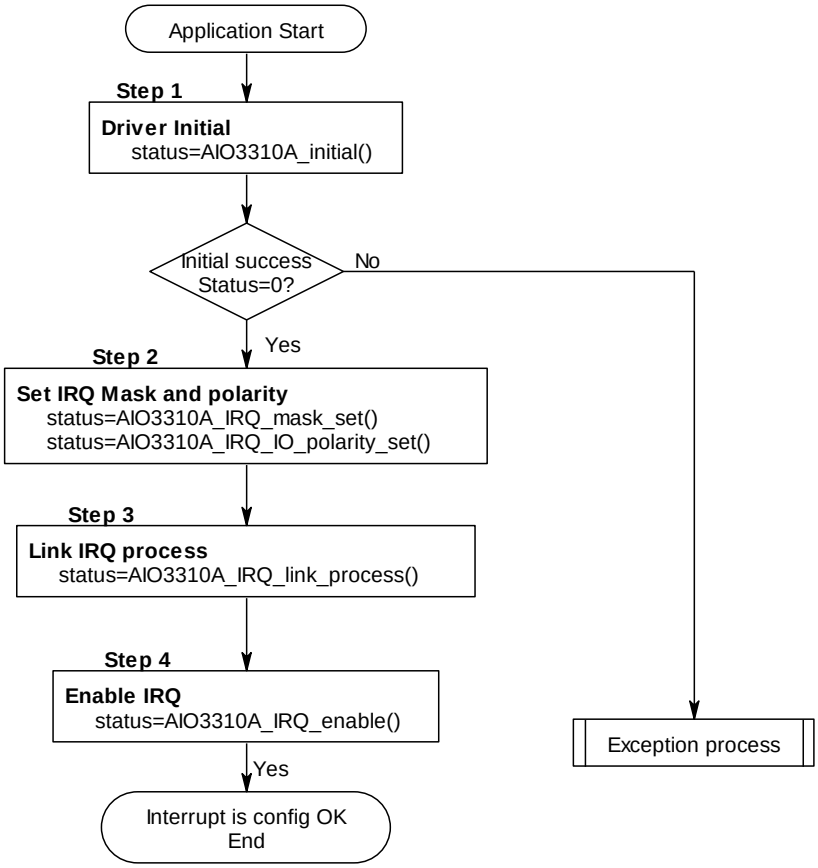
7.6 AIO3310A Flow chart of PWM application



7.7 AIO3310A Flow chart of quadrature counter application



7.8 AIO3310A Flow chart of interrupt setup



8. Software overview and dll function

These topics describe the features and functionality of the AIO3310A boards and briefly describes the AIO3310A functions.

8.1 Initialization and close

You need to initialize system resource each time you start to run your application.

AIO3310A_initial( ) will do.

Before you want to A/D conversion, the factory calibrated data should be initialized for A/D conversion.

AIO3310A_initial_calibration( ) will read factory calibrated data to working area.

Once you want to close your application, call

AIO3310A_close( ) to release all the resource.

If you want to know the physical address assigned by OS. use

AIO3310A_info( ) to get the address.

- **AIO3310A_initial**

Format : **u32 Status =AIO3310A_initial (void)**

Purpose: Initial the AIO3310A resource when start the Windows applications.

- **AIO3310A_initial_calibration**

Format : **u32 Status =AIO3310A_initial_calibration(u8 CardID)**

Purpose: Read the factory-calibrated data for the future calibration.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW

- **AIO3310A_close**

Format : **u32 Status =AIO3310A_close (void);**

Purpose: Release the AIO3310A resource when close the Windows applications.

- **AIO3310A_info**

Format : **u32 status =AIO3310A_info(u8 CardID,u16 *address)**

Purpose: Read the physical I/O address assigned by O.S..

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW

Output:

Name	Type	Description
address	u16	physical I/O address assigned by OS

8.2 Analog input

The AIO3310A / AIO3311A / AIO3312A now are 16 bit AD cards. There are different channel numbers on AIO3310A (8 channels), AIO3311A(16 channels) and AIO3312A(24 channels). You must configure the input range of the specific channel by:

AIO3310A_AD_config_set( ) and read back the configuration for verification by:

AIO3310A_AD_config_read( )

To read the input voltage value with the factory pre-calibrated data by:

AIO3310A_AD_value_read( ), it can be also read without the calibration by

AIO3310A_AD_value_read_no_calibration( )

If your application only need the raw AD data, you can read AD data by:

AIO3310A_AD_data_read_no_calibration( )

The AIO3310A hardware only provide the AD conversion data on the fly, in noisy environment the conversion result maybe contaminated by noise, to use the integral of signals will eliminate the high frequency noise. The dll has provide build in software integration functions; to start the function by:

AIO3310A_AD_integral_start( ) and read the integration data by

AIO3310A_AD_integral_all_read( ), if you want to stop the integration function don't forget to release the resource and stop integration by:

AIO3310A_AD_integral_stop( )

- **AIO3310A_AD_config_set**

Format : u32 status = AIO3310A_AD_config_set(u8 CardID,u8 channel,u8 mode)

Purpose: Set A/D config.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
channel	u8	A/D channel number 0~7: AIO3310A, 8 channels AD 0~15: AIO3311A, 16 channels AD 0~23: AIO3312A, 24 channels AD
mode	u8	scale range: 0: 0V ~ 5V 1: -5V ~ +5V 2: 0V ~ 10V 3: -10V ~ +10V 255 : AD stop operation.

- **AIO3310A_AD_config_read**

Format : **u32 status = AIO3310A_AD_config_read(u8 CardID,u8 channel,u8 *mode)**

Purpose: Read A/D configuration.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
channel	u8	A/D channel number 0~7: AIO3310A, 8 channels AD 0~15: AIO3311A, 16 channels AD 0~23: AIO3312A, 24 channels AD

Output:

Name	Type	Description
mode	u8	scale range: 0: 0V ~ 5V 1: -5V ~ +5V (Default) 2: 0V ~ 10V 3: -10V ~ +10V 255 : AD stop operation.

- **AIO3310A_AD_value_read**

Format : **u32 status = AIO3310A_AD_value_read(u8 CardID,u8 channel, f32 *value)**

Purpose: Read voltage value with pre-calibration data.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
channel	u8	A/D channel number 0~7: AIO3310A, 8 channels AD 0~15: AIO3311A, 16 channels AD 0~23: AIO3312A, 24 channels AD

Output:

Name	Type	Description
value	f32	Voltage value based on the AD converted and calibrated data. Say if the AD scale range is set at 0~5V then the voltage value returned will be in the 0~5 range.

Note:

Use *AIO3310A_initial_calibration( )* to load calibration data first then the further calibration will be effective.

- **AIO3310A_AD_value_read_no_calibration**

Format : **u32 status = AIO3310A_AD_value_read_no_calibration (u8 CardID, u8 channel, f32 *value)**

Purpose: Read voltage value.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
channel	u8	A/D channel number 0~7: AIO3310A, 8 channels AD 0~15: AIO3311A, 16 channels AD 0~23: AIO3312A, 24 channels AD

Output:

Name	Type	Description
value	f32	Voltage value based on the AD converted data only. Say if the AD scale range is set at 0~10V then the voltage value returned will be in the 0~10 range.

- **AIO3310A_AD_data_read_no_calibration**

Format : **u32 status = AIO3310A_AD_data_read_no_calibration (u8 CardID, u8 channel, u16 *data)**

Purpose: Read A/D data.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
channel	u8	A/D channel number 0~7: AIO3310A, 8 channels AD 0~15: AIO3311A, 16 channels AD 0~23: AIO3312A, 24 channels AD

Output:

Name	Type	Description
data	u16	AD 16 bit data, 0~65535: if unipolar AD mode, 0~5V or 0~10V range 0~32767: if bipolar AD mode, in 0~5V or 0~10V range 65535~32768: if bipolar AD mode, in 0~ -5V or 0 ~ -10V range

- **AIO3310A_AD_integral_start**

Format : **u32 status = AIO3310A_AD_integral_start(u8 CardID,u8 mode)**

Purpose: start AD conversion with integral constant.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by jumper setting
mode	u8	0: immediately access, no integration 1: integration time 100ms 2: integration time 200ms 3: integration time 300ms 4: integration time 400ms 5: integration time 500ms 6: integration time 600ms 7: integration time 700ms 8: integration time 800ms 9: integration time 900ms 10: integration time 1s

- **AIO3310A_AD_integral_all_read**

Format : **u32 status = AIO3310A_AD_integral_all_read(u8 CardID,u16 data[24])**

Purpose: read one port integral result of AD conversion data.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by jumper setting

Output:

Name	Type	Description
data[24]	u16	data[0]: Channel 0 AD data … data[23]: Channel 23 AD data

Note:

To read all channels in integral

Start integral mode by AIO3310A_AD_integral_start.

Read all channels by **AIO3310A_AD_integral**_all_**read**.

Stop AD integration function by **AIO3310A_AD_integral_stop.**

- **AIO3310A_AD_integral_stop**

Format : **u32 status = AIO3310A_AD_integral_stop(u8 CardID)**

Purpose: stop AD integral conversion.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by jumper setting

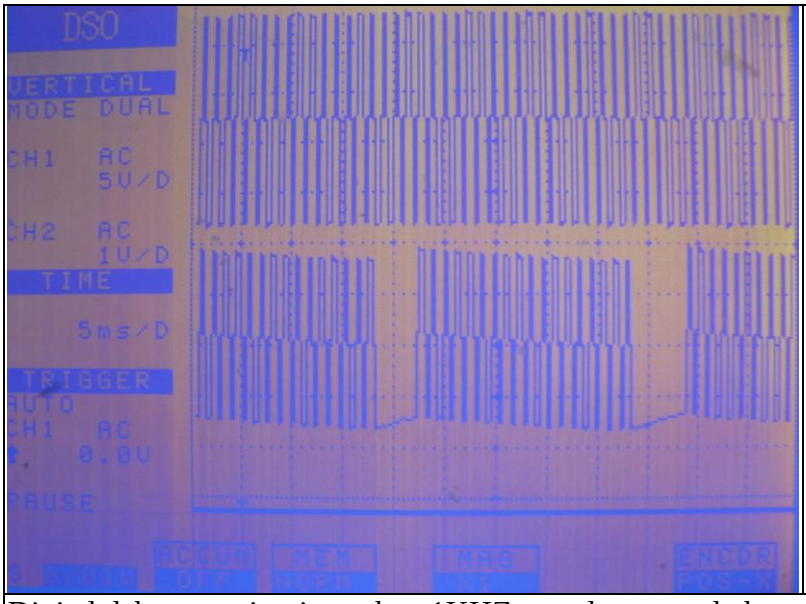
8.3 TTL I/O Port R/W

In general, TTL I/O port can be input or output as configured. To work as input, the AIO3310A series cards provide input digital debounce function.

Debounce is the function to filter the input jitters. From the microscope view of a switch input, you will see the contact does not come to close or release to open clearly. In most cases, it will contact-release-contact-release… for many times then go to steady state (ON or OFF). If you do not have the debounce function, you will read the input at high state and then next read will get low state, this maybe an error data for your decision of contact input.

Debounce can be implemented by hardware or software. Analog hardware debounce circuit will have fixed time constant to filter out the significant input signal, if you want to change the response time; the only way is to change the circuit device.

If digital debounce is implemented, maybe several filter frequency you can choose. To choose the filter frequency, please keep the Nyquist–Shannon sampling theorem in mind: **filter sample frequency must at least twice of the input frequency.** The following sample is a bad selection of debounce filter, the input frequency is not as low as les than half of the sample frequency and the output will generate a beat frequency.



<- Input frequency at 835Hz

<- Output of digital filter,
Please note the beat frequency.

Digital debounce circuit work at 1KHZ sample rate and observe the output of filter from 835Hz input.

Software debounce will consumes the CPU time a lot, we do not recommend to use except for you really know you want.

To configure the port as input or output by:

AIO3310A_TTL_IO_config_set ( ) and read back the configuration by:

AIO3310A_TTL_IO_config_read ( ).

The TTL I/O port can use:

AIO3310A_TTL_IO_port_set ( ) to output data and input data by:

AIO3310A_TTL_IO_port_read( ).

For the point output, use:

AIO3310A_TTL_IO_point_set ( ) and point input by:

AIO3310A_TTL_IO_point_read ( ).

At noisy environment to debounce the signal or to debounce the mechanical contact input, use:

AIO3310A_TTL_IO_debounce_time_set ( ) to set the adequate time constant to drop out the noise and read back to check the setting by:

AIO3310A_TTL_IO_debounce_time_read( ).

- **AIO3310A_TTL_IO_config_set**

Format : u32 status =AIO3310A_TTL_IO_config_set (u8 CardID, u8 port, u8 configuration)

Purpose: Sets port configuration.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW
port	u8	port number 0: port0 (DIO0x) 1: port1 (DIO1x)
configuration	u8	0: input port (default) 1: output port

- **AIO3310A_TTL_IO_config_read**

Format : u32 status =AIO3310A_TTL_IO_config_read (u8 CardID, u8 port, u8 *configuration)

Purpose: read port configuration.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW
port	u8	port number 0: port0 (DIO0x) 1: port1 (DIO1x)

Output:

Name	Type	Description
configuration	u8	0: input port (default) 1: output port

- **AIO3310A_TTL_IO_port_set**

Format : **u32 status = AIO3310A_TTL_IO_port_set (u8 CardID,u8 port, u8 data)**

Purpose: Sets the port data.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW
port	u8	port number 0: port0 (DIO0x) 1: port1 (DIO1x)
data	u8	bitmap of output values bit0: DIOn0 … bit7: DIOn7

- **AIO3310A_TTL_IO_port_read**

Format : **u32 status = AIO3310A_TTL_IO_port_read (u8 CardID , u8 port , u8 *data)**

Purpose: Read the port data.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW
port	u8	port number 0: port0 (DIO0x) 1: port1 (DIO1x)

Output:

Name	Type	Description
data	u8	bitmap of output/input values bit0: DIOn0 … bit7: DIOn7

- **AIO3310A_TTL_IO_point_set**

Format : **u32 status =AIO3310A_TTL_IO_point_set (u8 CardID, u8 port, u8 point, u8 state)**

Purpose: Sets the bit data of output port.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW
port	u8	port number 0: port0 (DIO0x) 1: port1 (DIO1x)
point	u8	point number 0~7 for bit0~bit7 (DIOn0 ~ DIOn7)
state	u8	point of output state

- **AIO3310A_TTL_IO_point_read**

Format : **u32 status = AIO3310A_TTL_IO_point_read (u8 CardID, u8 port, u8 point, u8 *state)**

Purpose: Read the output port state .

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW
port	u8	port number 0: port0 (DIO0x) 1: port1 (DIO1x)
point	u8	point number of input 0~7 for bit0~bit7 (DIOn0 ~ DIOn7)

Output:

Name	Type	Description
state	u8	point of output/input state

- **AIO3310A_TTL_IO_debounce_time_set**

Format : u32 status = AIO3310A_TTL_IO_debounce_time_set (u8 CardID,u8 port , u8 debounce_time)

Purpose: debounce time of the TTL I/O port signal

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW
port	u8	port number 0: port0 (DIO0x) 1: port1 (DIO1x)
debounce_time	u8	Debounce time selection: 0: no debounce 1: filter out duration less than 10ms (100Hz, default) 2: filter out duration less than 5ms (200Hz) 3: filter out duration less than 1ms (1KHZ)

Note:

only valid for port configured as input

- **AIO3310A_TTL_IO_debounce_time_read**

Format : u32 status = AIO3310A_TTL_IO_debounce_time_read (u8 CardID,u8 port , u8 *debounce_time)

Purpose: To read back configuration of debounce mode

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW
port	u8	port number 0: port0 (DIO0x) 1: port1 (DIO1x)

Output:

Name	Type	Description
debounce_time	u8	Debounce time selection: 0: no debounce 1: filter out duration less than 10ms (default) 2: filter out duration less than 5ms 3: filter out duration less than 1ms

8.4 Counter / Timer / PWM function

Many control applications need timer as time base for digital sampled data control systems. The timer consists a counter to count the time base clock on the fly and generate interrupt on a periodic time interval. If the counter do not count the time base but count the signals from external world, we call it "counter".

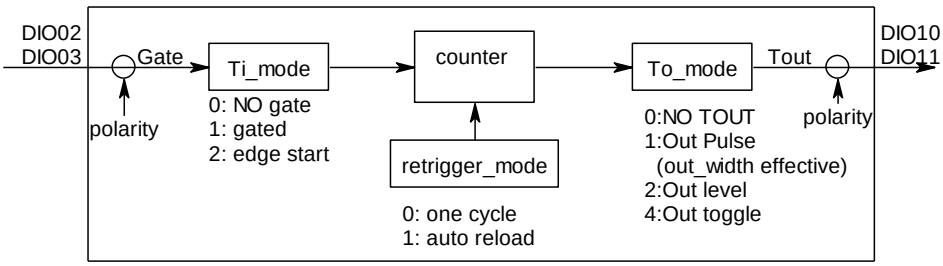
A timer/counter may be multi-functions, if the input signal and control mode and the output can be programmed as various kind of working mode.

Input signal debounce

The timer / counter input comes from DIO00 ~ DIO03 the signal maybe occasionally contaminated by noise. AIO3310A series card provides wide range of filter frequency from 100Hz up to 1KHz (to drop out noise pulse less than 1ms), even the quadrature signals comes from mechanical contacts the counter can still operate very nice. If you will use faster signals, you can program the debounce as **no debounce** to pass the signal directly to counter. But take care of the noise induced by the environment and wiring, we recommended you to use a high speed isolation type encoder counter card such as LSI3101 (up to 8M counter speed) or LSI3101A (up to 16M counter speed) of JS Automation Corp to get better performance.

Timer function

The timer model used in AIO3310A series is as follows:



In this model, the timer can work in one cycle mode and auto reload mode.

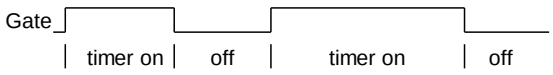
one cycle mode: the timer will stop when the timer time up.

auto reload mode (sometimes called continuous mode): the time will reload the time constant while time up.

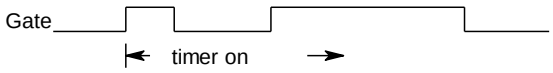
In the timer input control block:

NO gate: the timer do not control by any input.

gated : the timer only working on the gate input active and stops counting while gate is inactive.



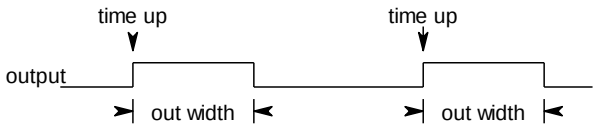
Edge start: the timer will start timing while the gate input transition from inactive to active.



In the timer output block:

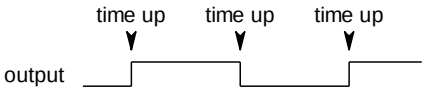
NO TOUT: the timer has no output to control (but timer time up interrupt is available).

Out_pulse: while the timer time up, it will trigger an output pulse and pulse width is controlled by out_width register at 1us time base.



Out_level: while the timer time up, it will trigger the output active.

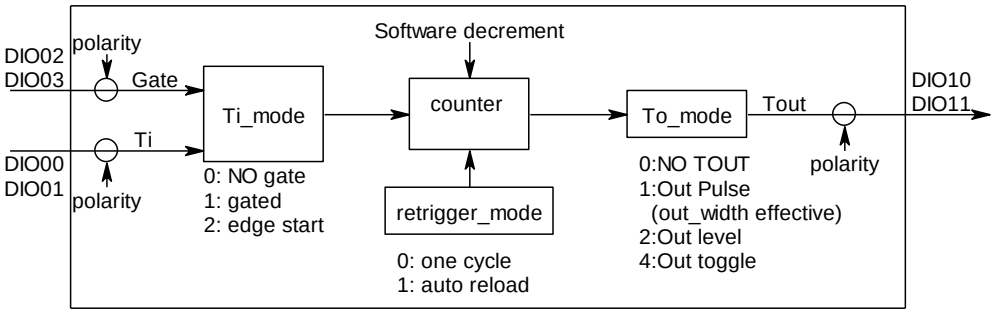
Out_toggle: while the timer time up, it will trigger the output toggled.



polarity: set the input/output active high or active low

Counter function

The counter model used in AIO3310A series is as follows:



In this model, the counter can work in one cycle mode and auto reload mode.

one cycle mode: the counter will stop when the counter cross zero.

auto reload mode (sometimes called continuous mode): the counter will reload the counter constant while time up.

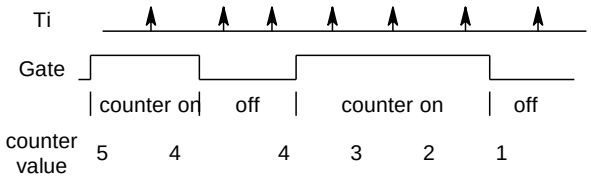
Software decrement: the counter value will decrement by software trigger.

In the counter input control block:

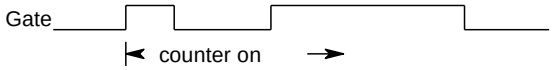
NO gate: the counter do not control by any input.

gated : while gate input is active and the counter signal input also active the counter will decrement by 1 and stops counting while gate is inactive.

Take the following diagram as example, the counter is initialized at 5 and working in gated mode, while the Ti (counter signal input) is active and gate is also active, the counter will decrease by one.



Edge start: the counter will start counting function while the gate input transition from inactive to active.



In the counter output block: (refer the timer function)

NO TOUT: the counter has no output to control (but counter cross zero interrupt is available).

Out_pulse: while the counter cross zero, it will trigger a output pulse and pulse width is controlled by out_width register at 1us time base.

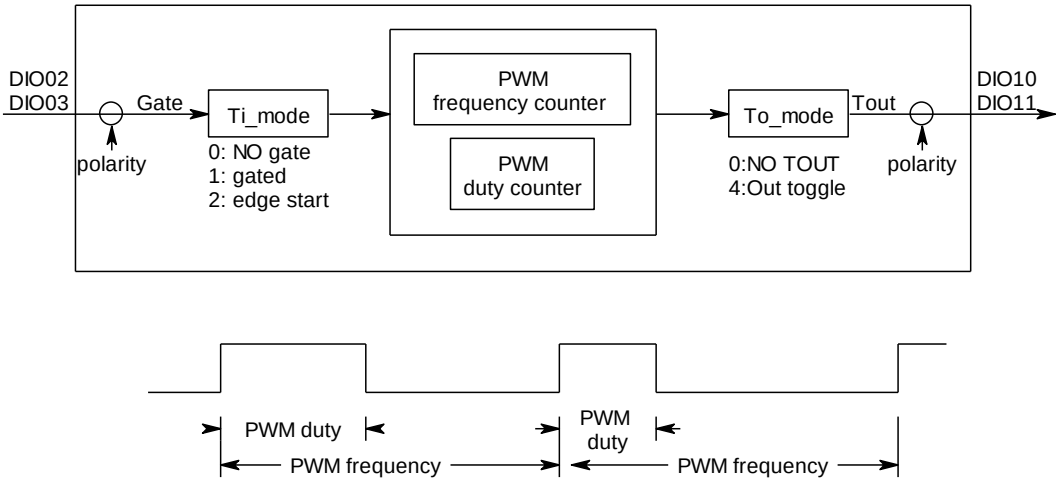
Out_level: while the counter cross zero, it will trigger the output active.

Out_toggle: while the counter cross zero, it will trigger the output toggled.

polarity: set the input/output active high or active low

PWM function

The PWM model used in AIO3310A series is as follows:



In this model, the PWM counter can only work in auto reload mode.

auto reload mode (sometimes called continuous mode): the time will reload the time constant while time up.

In the PWM counter input control block: (refer the counter function)

NO gate: the PWM counter do not control by any input.

gated : while gate input is active the PWM counter will start working and stops while gate is inactive.

Edge start: the PWM counter will start counting function while the gate input transition from inactive to active.

In the PWM counter output block: (refer the timer function)

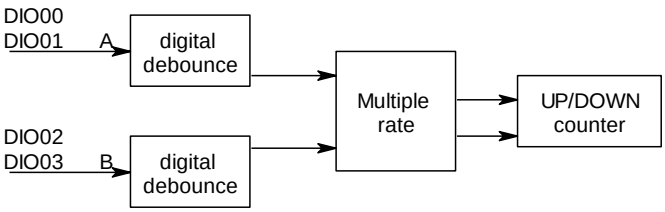
NO TOUT: the PWM counter has no output to control.

Out_toggle: while the PWM counter cross zero, it will trigger the output toggled.

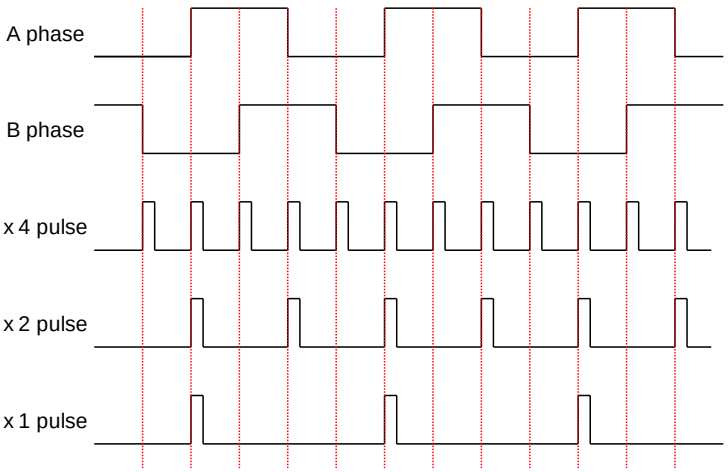
polarity: set the input/output active high or active low

Quadrature encoder counter

In spite of the flexible multi-function timer/counter, the quadrature encoder counter is another type of application. The AIO3310A series also has the build in function for quadrature encoder input counting.



On the above diagram, you can see the digital debounce function filter out the unwanted high frequency then pass the signal to the multiple rate circuit to determine the pulse and direction, finally the counter counts the pulses.



The left diagram shown that A phase leads B, if we take A leads B as up count and the counting pulse of up count will depends on the multiple rate.

DLL functions of timer / counter

Timer/counter function can work in general mode: as timer, as counter or as PWM generator and in special mode: quadrature counter mode.

In the general timer/counter mode, DIO00, DIO02 and DIO10 can be configured as dedicated I/O for timer1 / counter1 and DIO01, DIO03 and DIO11 can be configured as dedicated I/O for timer2 / counter2.

To configure the working mode use

AIO3310A_timer_set( ) to configure as timer and its output mode

AIO3310A_counter_set( ) to configure as counter and its input and output mode

AIO3310A_PWM_set( ) to configure as PWM generator.

AIO3310A_quadrature_set( ) to configure as quadrature counter.

To start/stop the operation by:

AIO3310A_TC_start( )

AIO3310A_TC_stop( )

To read or load dedicated timer/counter registers, use

AIO3310A_TC_set( ) set TC dedicated registers

AIO3310A_TC_read( ) read TC dedicated registers

If you want to change the input polarity, using

AIO3310A_TC_input_polarity_set( ) and read back to verify by:

AIO3310A_TC_input_polarity_read( )

If you want to change the output polarity, using

AIO3310A_TC_output_polarity_set( ) and read back to verify by:

AIO3310A_TC_output_polarity_read( )

- **AIO3310A_timer_set**

Format : u32 status = AIO3310A_timer_set (u8 CardID, u8 TimerID, Timer_struct *TC_struct)

Purpose: To setup timer operation mode or update timer

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY switch
TimerID	u8	0: timer/counter0 1: timer/counter1

TC_struct	struct	struct TC_struct
		{
		u8 TiGate_MODE,
		// 0: NO_GATE
		//Always count without gate function,
		//DIO02 / DIO03 is digital input.
		// 1:GATED
		//DIO02 / DIO03 is gate input,
		//after command start_TC,
		//if internal logic active high will start timer and //low will halt the timer counting.
		// 2: EDGE_START
		//DIO02 / DIO03 is gate input,
		//after command start_TC,
		//if internal logic active high will start timer
		
		u32 time_constant,
		// Timer constant based on 1us clock
		
		u8 Tout_mode,
		// 0: NO_TOUT ,
		// DIO10 / DIO11: use as general digital output
		// 1: OUT_PULSE
		//DIO10 / DIO11: timer cross zero output pulse.
		//(out_width effective)
		// 2: OUT_LEVEL
		//DIO10 / DIO11: timer cross zero output will //make.
		// 4:OUT_TOGGLE
		//DIO10 / DIO11: timer cross zero toggles output
		
		u16 Tout_width,
		// Output pulse width based on 1us clock, only
		//valid in Tout_mode is OUT_PULSE
		
		u8 cont_single,
		// 0: SINGLE_CYCLE
		//single cycle mode, timer will stop operation
		//when time constant count down to zero.
		// 1: ALWAYS_RUN
		//continuous operation mode, timer will reload
		//time constant and continue operation when
		//time constant count down to zero.

		}

- **AIO3310A_counter_set**

Format : u32 status = AIO3310A_counter_set (u8 CardID, u8 TimerID, Counter_struct *TC_struct)

Purpose: To setup counter operation mode or update counter

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY switch
TimerID	u8	0: timer/counter0 1: timer/counter1

TC_struct	struct	struct TC_struct
		{
		u8 TiGate_MODE,
		// 0: NO_GATE
		//Always count without gate function,
		//Timer/counter0, Timer/counter1:
		//DIO00, DIO01 is counter pulse input
		//DIO02, DIO03 is digital input.
		
		// 1:GATED
		//DIO00, DIO01 is counter pulse input (Ti)
		//DIO02, DIO03 is gate input, internal logic active //high will pass the counter Ti pulse to counter //after command start_TC
		
		// 2: EDGE_START
		//DIO00, DIO01 is counter pulse input (Ti)
		//DIO02, DIO03 is gate input, internal logic active //high will start topass the counter Ti pulse to //counter after command start_TC
		
		u32 counter_constant,
		// Counter constant
		
		u8 Tout_mode,
		// 0: NO_TOUT
		// Timer/counter0, Timer/counter1:
		// DIO10, DIO11 use as general digital output
		
		// 1: OUT_PULSE
		//DIO10, DIO11: timer cross zero output pulse.
		//(out_width effective)
		
		// 2: OUT_LEVEL
		//DIO10, DIO11: timer cross zero output will //make.
		// 4:OUT_TOGGLE
		//DIO10, DIO11: timer cross zero toggles output
		
		u16 Tout_width,

		// Output pulse width based on 1us clock, only
		//valid in Tout_mode is OUT_PULSE
		
		u8 cont_single
		// 0: SINGLE_CYCLE
		//single cycle mode, counter will stop operation //when time constant count down to zero.
		// 1: ALWAYS_RUN
		// continuous operation mode, counter will reload //time constant and continue operation when time //constant count down to zero.
		}

- **AIO3310A_PWM_set**

Format : u32 status = AIO3310A_PWM_set(u8 CardID, u8 TimerID,
PWM_struct *PWM_struct)

Purpose: To setup PWM operation mode or update PWM.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY switch
TimerID	u8	0: timer/counter0 1: timer/counter1

PWM_struct	struct	PWM_struct
		{
		u8 TiGate_MODE,
		// 0: NO_GATE
		//Always count without gate function,
		//Timer/counter0, Timer/counter1:
		//DIO00, DIO01 is counter pulse input
		//DIO02, DIO03 is digital input.
		
		// 1:GATED
		//DIO00, DIO01 is counter pulse input (Ti)
		//DIO02, DIO03 is gate input, internal logic active
		//high will pass the counter Ti pulse to counter
		//after command start_TC
		
		u16 PWM_freq;
		// PWM frequency clock count based on 33MHz
		// clock
		
		u16 PWM_duty;
		//PWM duty clock count based on 33MHz clock
		
		//DIO10, DIO11 use as PWM output
		}

Note:

1. PWM base clock is based on33MHz, say if you want your PWM frequency is 20KHz, please put the PWM_freq = (33MHz/20KHz) = 1650
2. PWM duty must less than PWM_freq for proper operation, from the example above, the PWM_duty value can be 1 ~ 1649. For 50% duty, the PWM_duty will be 1650/2 = 825

- **AIO3310A_quadrature_set**

Format : u32 status = AIO3310A_quadrature_set (u8 CardID,u8 TimerID, u8 Multiple_rate)

Purpose: To setup quadrature counter operation mode

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY switch
TimerID	u8	0: timer/counter0 1: timer/counter1
Multiple_rate	u8	Only valid for quadrature mode, in other mode, this parameter is ignored. 0: MULTIPLE_4 (default) A,B phase input multiple rate is 4 1: MULTIPLE_2 A,B phase input multiple rate is 2 2: MULTIPLE_1 A,B phase input multiple rate is 1

Note:

1. Port0 is forced to be input.
2. DIO00 is A phase input and DIO02 is B phase input for counter0.
3. DIO01 is A phase input and DIO03 is B phase input for counter1.

- **AIO3310A_TC_start**

Format : u32 status = AIO3310A_TC_start (u8 CardID,u8 TimerID)

Purpose: To start timer/counter/PWM/quadrature counter operation mode

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY switch
TimerID	u8	0: timer/counter0 1: timer/counter1

- **AIO3310A_TC_stop**

Format : u32 status = AIO3310A_TC_stop (u8 CardID, u8 TimerID)

Purpose: To stop timer/counter/PWM/quadrature counter operation mode

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY switch
TimerID	u8	0: timer/counter0 1: timer/counter1

- **AIO3310A_TC_set**

Format : u32 status=AIO3310A_TC_set (u8 CardID, u8 TimerID, u8 index,u32 data)

Purpose: To set data to counter/timer register

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
TimerID	u8	0: timer/counter0 1: timer/counter1
index	u8	0: TC_CONTROL 1: TC_MODE 2: TiGate_MODE 3: To_MODE 4: RETRIGGER_MODE 5: PRELOAD 6: COUNTER 7: OUT_WIDTH 8: MULTIPLE_RATE
data	u32	register data to be set

Note:

1. please refer the next segment "Note: Meaning of setting or return value of different index"
2. Write to IRQ_STATUS will reset the corresponding bit. Say, if write with bit0=1, the status bit0 will reset but other bit will not effect.

- **AIO3310A_TC_read**

Format : u32 status=AIO3310A_TC_read (u8 CardID, u8 TimerID, u8 index,u32 *data)

Purpose: To read data from counter/timer

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
TimerID	u8	0: timer/counter0 1: timer/counter1
index	u8	0: TC_CONTROL 1: TC_MODE 2: TiGate_MODE 3: Tout_MODE 4: RETRIGGER_MODE 5: PRELOAD 6: COUNTER 7: OUT_WIDTH 8: MULTIPLE_RATE

Output:

Name	Type	Description
data	u32	Data read back

Note:

Meaning of setting or return value of different index

index	register	value	meaning
0	TC_CONTROL	0	STOP, stop operation of TC
		1	START, start operation of TC
1	TC_MODE	0	TIMER_MODE
		1	COUNTER_MODE
		3	SW_DEC (a write will software decrease counter by 1 and return to COUNTER_MODE.)
		4	PWM_MODE
		8	QUADRATURE_MODE
2	TiGate_MODE	0	NO_GATE
		1	GATED
		2	EDGE_START
3	Tout_MODE	0	NO_TOUT
		1	OUT_PULSE
		2	OUT_LEVEL
		4	OUT_TOGGLE
4	RETRIGGER_MODE	0	SINGLE_CYCLE
		1	ALWAYS_RUN
5	PRELOAD	1~0xffffffff	Counter or timer or PWM preload value
6	COUNTER	1~0xffffffff	Set (write): will write preload and counter Read : will read counter on the fly
7	OUT_WIDTH	1~0xffff	Output pulse width based on 1us
8	MULTIPLE_RATE	0	0: MULTIPLE_4 (default) A,B phase input multiple rate is 4
		1	1: MULTIPLE_2 A,B phase input multiple rate is 2
		2	2: MULTIPLE_1 A,B phase input multiple rate is 1

- **AIO3310A_TC_input_polarity_set**

Format : **u32 status = AIO3310A_TC_input_polarity_set (u8 CardID,u8 TimerID, u8 input,u8 polarity)**

Purpose: Set TC input polarity.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
TimerID	u8	timer/counter designation 0: timer/counter0 1: timer/counter1
input	u8	input: 0: Gate. 1: Ti (clock input).
polarity	u8	polarity values: 0: means normal. 1: means invert.

Note:

timer/counter0, DIO00 clock input , DIO02 gate input.

timer/counter1, DIO01 clock input , DIO03 gate input.

- **AIO3310A_TC_input_polarity_read**

Format : **u32 status = AIO3310A_TC_input_polarity_read (u8 CardID,u8 TimerID, u8 input,u8 *polarity)**

Purpose: Read TC input polarity.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
TimerID	u8	timer/counter designation 0: timer/counter0 1: timer/counter1
input	u8	input: 0: Gate. 1: Ti (clock input).

Output:

Name	Type	Description
polarity	u8	polarity values: 0: means normal. 1: means invert.

- **AIO3310A_TC_output_polarity_set**

Format : **u32 status = AIO3310A_TC_output_polarity_set (u8 CardID,u8 TimerID, u8 polarity)**

Purpose: Set TC output polarity

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
TimerID	u8	timer/counter designation 0: timer/counter0 1: timer/counter1
polarity	u8	TC output polarity: 0: means normal 1: means invert

Note:

timer/counter0, DIO10 Signal output.

timer/counter1, DIO11 Signal output.

- **AIO3310A_TC_output_polarity_read**

Format : **u32 status = AIO3310A_TC_output_polarity_read (u8 CardID,u8 TimerID, u8 * polarity)**

Purpose: Read TC output polarity

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
TimerID	u8	timer/counter designation 0: timer/counter0 1: timer/counter1

Output:

Name	Type	Description
polarity	u8	TC output polarity: 0: means normal 1: means invert

8.5 Interrupt function

Interrupt is an efficient method to quick response without occupy too much system resource. AIO3310A provide timer/counter and TTL port0 as interrupt source, to use interrupt function use

AIO3310A_IRQ_link_process( ) to link your irq service routine,

AIO3310A_IRQ_enable( ) to enable it and

AIO3310A_IRQ_disable( ) to disable it.

AIO3310A_IRQ_mask_set( ) to mask off the undesired source;

AIO3310A_IRQ_mask_read( ) to read back for verify the mask setting

AIO3310A_IRQ_IO_polarity_set( ) to set the polarity of port0 IRQ generation.

AIO3310A_IRQ_IO_polarity_read( ) to read back for verifying.

After you enable and link interrupt, you can enable/disable timer/counter function or enable/disable interrupt function as you need.

To check the IRQ status

AIO3310A_IRQ_status_read( ) will do.

- **AIO3310A_IRQ_link_process**

Format : u32 status = AIO3310A_IRQ_link_process(u8 CardID,
void (__stdcall *callbackAddr(u8 CardID))

Purpose: To link the interrupt source with the callback function.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
callbackAddr	void	the address of your callback function

- **AIO3310A_IRQ_enable**

Format : u32 status = AIO3310A_IRQ_enable (u8 CardID,HANDLE *phEvent)

Purpose: Enable interrupt.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW

Output:

Name	Type	Description
phEvent	HANDLE	The returned handle of event

- **AIO3310A_IRQ_disable**

Format : u32 status = AIO3310A_IRQ_disable (u8 CardID)

Purpose: To disable interrupt.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW

- **AIO3310A_IRQ_mask_set**

Format : u32 status = AIO3310A_IRQ_mask_set(u8 CardID,u16 mask)

Purpose: Set IRQ mask.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
mask	u16	b0: 0, disable DIO00 as interrupt source 1, enable DIO00 as interrupt source … b6: 0, disable DIO06 as interrupt source 1, enable DIO06 as interrupt source b7: 0, disable DIO07 as interrupt source 1, enable DIO07 as interrupt source b8: 0, disable TC0 counter counts to zero as interrupt source 1, enable TC0 counter counts to zero as interrupt source b9: 0, disable TC1 counter counts to zero as interrupt source 1, enable TC1 counter counts to zero as interrupt source

- **AIO3310A_IRQ_mask_read**

Format : **u32 status = AIO3310A_IRQ_mask_read(u8 CardID,u16 *mask)**

Purpose: Read IRQ mask.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW

Output:

Name	Type	Description
mask	u16	b0: 0, disable DIO00 as interrupt source 1, enable DIO00 as interrupt source … b6: 0, disable DIO06 as interrupt source 1, enable DIO06 as interrupt source b7: 0, disable DIO07 as interrupt source 1, enable DIO07 as interrupt source b8: 0, disable TC0 counter counts to zero as interrupt source 1, enable TC0 counter counts to zero as interrupt source b9: 0, disable TC1 counter counts to zero as interrupt source 1, enable TC1 counter counts to zero as interrupt source

- **AIO3310A_IRQ_IO_polarity_set**

Format : u32 status =AIO3310A_IRQ_IO_polarity_set (u8 CardID, u8 polarity)

Purpose: Sets the interrupt polarity of TTL port0

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW
polarity	u8	port0 polarity values: 0: any bit of port0 form low to high (default) can generate IRQ 1: any bit of port0 from high to low can generate IRQ

- **AIO3310A_IRQ_IO_polarity_read**

Format : u32 status = AIO3310A_IRQ_IO_polarity_read (u8 CardID, u8 * polarity)

Purpose: Read the I/O IRQ polarity of the TTL port0.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW

Output:

Name	Type	Description
polarity	u8	port0 polarity values: 0: any bit of port0 form low to high(default) can generate IRQ 1: any bit of port0 from high to low can generate IRQ

- **AIO3310A_IRQ_status_read**

Format : **u32 status = AIO3310A_IRQ_status_read(u8 CardID,u16 * status)**

Purpose: To read IRQ state

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW

Output:

Name	Type	Description
status	u16	Bit 0: DIO00 generate IRQ. … Bit 7: DIO07 generate IRQ. Bit 8: timer/counter0 generate IRQ. Bit 9: timer/counter1 generate IRQ.

Note:

This command will also clear the on board IRQ_status register, the second read will not be correct.

8.6 Security function

From the dll version 2.0 and later, we remove the software key function owing to some customers complained about the card locked on some unknown occasion. We only remain the functions to comply with the existing programs but the returned value always true.

Since AIO3310A is a general purpose card, anyone who can buy from JS automation corp. or her distributors. Your program is the fruit of your intelligence, un-authorized copy maybe prevent by the security function enabled.

You can use

AIO3310A_password_set( ) to set password and start the security function. Use ***AIO3310A_password_change( )*** to change it.

If you don't want to use security function after the password being setup,

AIO3310A_password_clear( ) will reset to the virgin state.

Once the password is set, any function call of the dll's (except for the security functions) will be blocked until the

AIO3310A_security_unlock( ) unlock the security.

You can also use

AIO3310A_security_status_read( ) to check the current status of security.

- **AIO3310A_password_set**

Format : **u32 status = AIO3310A_password_set(u8 CardID,u16 password[5])**

Purpose: To set password and if the password is not all "0", security function will be enabled.

Note: If the password is all "0", the security function is disabled.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
password[5]	u16	Password, 5 words

- **AIO3310A_password_change**

Format : **u32 status = AIO3310A_password_change(u8 CardID,u16 Oldpassword[5], u16 password[5])**

Purpose: To replace old password with new password.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
Oldpassword [5]	u16	The previous password
password[5]	u16	The new password to be set

- **AIO3310A_password_clear**

Format : **u32 status = AIO3310A_password_clear(u8 CardID,u16 password[5])**

Purpose: To clear password, to set password to all "0", i.e. disable security function.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
password[5]	u16	The password previous set

- **AIO3310A_security_unlock**

Format : **u32 status = AIO3310A_security_unlock(u8 CardID,u16 password[5])**

Purpose: To unlock security function and enable the further operation of this card

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
password[5]	u16	The password previous set

- **AIO3310A_security_status_read**

Format : **u32 status = AIO3310A_security_status_read(u8 CardID,u8 *lock_status, u8 *security_enable)**

Purpose: To read security status for checking if the card security function is unlocked.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW

Output:

Name	Type	Description
lock_status	u8	0: security unlocked 1: locked 2: dead lock (must return to original maker to unlock)
security_enable	u8	0: security function disabled 1: security function enabled

8.7 Error conditions

These error types may indicate an internal hardware problem on the board. Error Codes summary contains a detailed listing of the error status returned by AIO3310A functions.

9. Dll list

	Function Name	Description
1.	AIO3310A_initial( )	Card initial.
2.	AIO3310A_initial_calibration( )	AD calibration initial.
3.	AIO3310A_close( )	Card Close.
4.	AIO3310A_info( )	Read Card Address.
5.	AIO3310A_AD_config_set( )	Set AD config.
6.	AIO3310A_AD_config_read( )	Read AD config.
7.	AIO3310A_AD_value_read( )	Read AD calibration value.
8.	AIO3310A_AD_value_read_no_calibration( )	Read AD value.
9.	AIO3310A_AD_data_read_no_calibration( )	Read AD data.
10.	AIO3310A_AD_integral_start( )	start AD conversion with integral constant
11.	AIO3310A_AD_integral_all_read( )	read port integral result of AD conversion data
12.	AIO3310A_AD_integral_stop( )	stop AD integral conversion
13.	AIO3310A_TTL_IO_config_set( )	Set port config (input or output)
14.	AIO3310A_TTL_IO_config_read( )	Read port config (input or output)
15.	AIO3310A_TTL_IO_port_set( )	Write data to port
16.	AIO3310A_TTL_IO_port_read( )	Read port data
17.	AIO3310A_TTL_IO_point_set( )	Write bit of data to port
18.	AIO3310A_TTL_IO_point_read( )	Read data of a specific point
19.	AIO3310A_TTL_IO_debounce_time_set( )	Write Ti point debounce time.
20.	AIO3310A_TTL_IO_debounce_time_read( )	Read debounce time.
21.	AIO3310A_timer_set( )	setup timer operation mode or update timer
22.	AIO3310A_counter_set( )	setup counter operation modeor update counter
23.	AIO3310A_PWM_set( )	setup PWM operation mode or update PWM
24.	AIO3310A_quadrature_set( )	setup quadrature counter operation mode
25.	AIO3310A_TC_start( )	start timer/counter/PWM/quadrature counter operation mode
26.	AIO3310A_TC_stop( )	stop timer/counter/PWM/quadrature counter operation mode
27.	AIO3310A_TC_set( )	set data to counter/timer register
28.	AIO3310A_TC_read( )	read data from counter/timer register
29.	AIO3310A_TC_input_polarity_set( )	Set TC input polarity
30.	AIO3310A_TC_input_polarity_read( )	Read back TC input polarity setting
31.	AIO3310A_TC_output_polarity_set( )	Set TC output polarity
32.	AIO3310A_TC_output_polarity_read( )	Read back TC output polarity setting
33.	AIO3310A_IRQ_link_process( )	Link process IRQ.
34.	AIO3310A_IRQ_enable( )	Enable IRQ.
35.	AIO3310A_IRQ_disable( )	Disable IRQ.
36.	AIO3310A_IRQ_mask_set( )	Set mask.
37.	AIO3310A_IRQ_mask_read( )	Read mask.
38.	AIO3310A_IRQ_IO_polarity_set( )	Set IO polarity.
39.	AIO3310A_IRQ_IO_polarity_read( )	Read IO polarity.
40.	AIO3310A_IRQ_status_read ( )	Read IRQ status.

41.	AIO3310A_password_set( )	Set password
42.	AIO3310A_password_change( )	Change password
43.	AIO3310A_password_clear( )	Clear password
44.	AIO3310A_security_unlock( )	Unlock security function
45.	AIO3310A_security_status_read( )	Read security status

10. AIO3310A Error codes summary

10.1 AIO3310A Error codes table

Error Code	Symbolic Name	Description
0	JSDRV_NO_ERROR	Success, No error.
2	JSDRV_INIT_ERROR	Driver initial error
3	JSDRV_UNLOCK_ERROR	Security unclock failure
4	JSDRV_LOCK_COUNTER_ERROR	Dead lock, unclock failure more than 10 times
5	SDRV_SET_SECURITY_ERROR	Password overwrite error
100	DEVICE_RW_ERROR	Device Read/Write error
101	JSDRV_NO_CARD	No AIO3310A card on the system.
102	JSDRV_DUPLICATE_ID	AIO3310A CardID duplicate error.
104	JSDRV_PAR_ERROR	Bad parameter or illegal parameter
300	JSDIO_ID_ERROR	Function input parameter error. CardID setting error, CardID doesn't match the DIP/ROTARY SW setting
301	JSAIO_MODE_ERROR	Mode parameter error. Parameter out of range.
302	JSAIO_CHANNEL_ERROR	Channel parameter error. Parameter out of range.
305	JSAIO_CONVERSION_ERROR	Conversion time over. Maybe no hardware or bad hardware.
306	JSAIO_CONVERSION_BUSY	A/D is busy in conversion
400	JSAIO_PORT_ERROR	Port parameter error. Parameter out of range.
401	JSAIO_STATE_ERROR	State parameter error. Parameter out of range.
402	JSAIO_POINT_ERROR	Point parameter error. Parameter out of range.
403	JSAIO_EEPROM_RW_ERROR	Eeprom R/W error
405	JSAIO_CALIBRATION_ERROR	Calibration error. Maybe out of range.
406	JSAIO_TIMERID_ERROR	TimerID parameter error. Parameter out of range.
407	JSAIO_TO_MODE_ERROR	To_mode parameter error. Parameter out of range.
408	JSAIO_TI_MODE_ERROR	Ti_mode parameter error. Parameter out of range.
409	JSAIO_PARAMETER_ERROR	Parameter error. Parameter out of range.
500	JSAIO_EVENT_ERROR	Event error. Maybe no event created.