LSI3188

Application Specific
Quadrature Encoder / Linear Scale
Counter Card

Software Manual (V1.0)

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Correction record

Version	Record
1.0	firmware v1.0 up

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1. How to install the software of LSI3188

1.1 Install the PCI driver

The PCI card is a plug and play card, once you add a new card on the 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)

--Make sure the power is off

--Plug in the interface card

--Power on

--A hardware install wizard will appear and tell you it finds a new PCI card
Do not response to the wizard, just Install the file
(..\LSI3188\Software\WinXP_7\ or if you download from website please execute the file
LSI3188_Install.exe to get the file)

--After installation, power off

--Power on, it's ready to use

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.

2. Where to find the file you need

WinXP/7 and up

The directory will be located at

.. \ JS Automation \LSI3188\API\   (header files and lib files for VB,VC,BCB,C#)

.. \ JS Automation \LSI3188\Driver\   (backup copy of LSI3188 drivers)

.. \ JS Automation \LSI3188\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.

3. About the LSI3188 software

LSI3188 software includes a set of dynamic link library (DLL) and system driver that you can utilize to control the interface card's functions.

Your LSI3188 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 LSI3188 functions within Windows' operation system environment.

3.1 What you need to get started

To set up and use your LSI3188 software, you need the following:

- LSI3188 software
- LSI3188 hardware
  Main board
  Wiring board (Option)

3.2 Software programming choices

You have several options to choose from when you are programming LSI3188 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 LSI3188 software.

4. LSI3188 Language support

The LSI3188 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.

4.1 Building applications with the LSI3188 software library

The LSI3188 function reference topic contains general information about building LSI3188 applications, describes the nature of the LSI3188 files used in building LSI3188 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.

4.2 LSI3188 Windows Libraries

The LSI3188 for Windows function library is a DLL called **LSI3188.dll**. Since a DLL is used, LSI3188 functions are not linked into the executable files of applications. Only the information about the LSI3188 functions in the LSI3188 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 LSI3188 functions in LSI3188.dll.

Header Files and Import Libraries for Different Development Environments		
Language	**Header File**	**Import Library**
Microsoft Visual C/C++	LSI3188.h	LSI3188VC.lib
Borland C/C++	LSI3188.h	LSI3188BC.lib
Microsoft Visual C#	LSI3188.cs	
Microsoft Visual Basic	LSI3188.bas	
Microsoft VB.net	LSI3188.vb	

Table 1

5. Basic concepts of digital I/O control

The digital I/O control is the most common type of PC based application. For example, on the main board, printer port is the TTL level digital I/O.

5.1 Types of I/O classified by isolation

If the system and I/O are not electrically connected, we call it is isolated. There are many kinds of isolation: by transformer, by photo-coupler, by magnetic coupler,… Any kind of device, they can break the electrical connection without breaking the signal is suitable for the purpose.

Currently, photo-coupler isolation is the most popular selection, isolation voltage up to 2000V or over is common. But the photo-coupler is limited by the response time, the high frequency type cost a lot. The new selection is magnetic coupler, it is design to focus on high speed application.

The merit of isolation is to avoid the noise from outside world to enter the PC system, if the noise comes into PC system without elimination, the system maybe get “crazy” by the noise disturbance. Of course the isolation also limits the versatile of programming as input or output at the same pin as the TTL does. The inter-connection of add-on card and wiring board maybe extend to several meters without any problem.

The non-isolated type is generally the TTL level input/output. The ground and power source of the input/output port come from the system. Generally you can program as input or output at the same pin as you wish. **The connection of wiring board and the add-on board is limited to 50cm or shorter** (depends on the environmental noise condition).

5.2 Types of Output classified by driver device

There are several devices used as output driver, the relay, transistor or MOS FET, SCR and SSR.

Relay is electric- mechanical device, it life time is about 1,000,000 times of switching. But on the other hand it has many selections such as high voltage or high current. It can also be used to switch DC load or AC load.

Transistor and MOS FET are basically semi-permanent devices. If you have selected the right ratings, it can work without switching life limit. But the transistor or MOS FET can only work in DC load condition.

The transistor or MOS FET also have another option is source or sink. For PMOS or PNP transistor is source type device, the load is one terminal connects to output and another connects to common ground, but NPN or NMOS is one terminal connects to output and the other connects to VCC+. **If you are concerned about hazard from high DC voltage while the load is floating, please choose the source type driver device.**

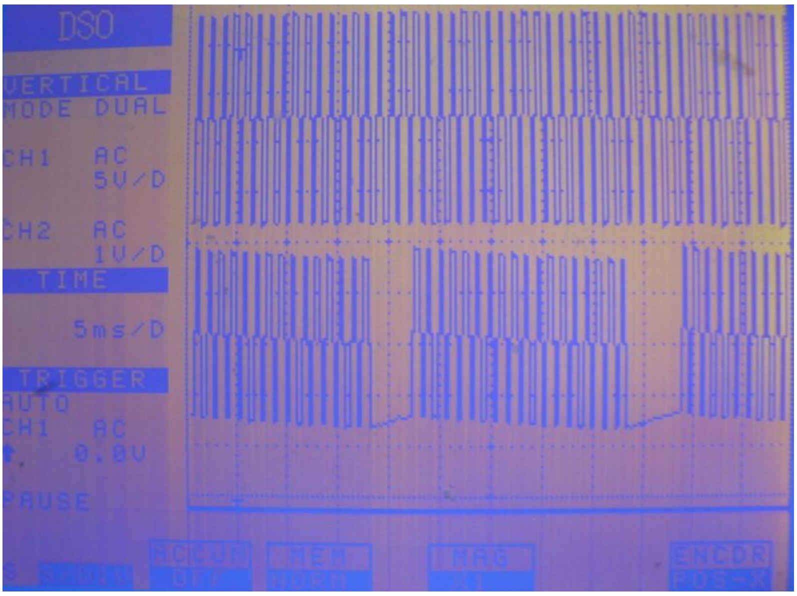
SCR (or triac) is seldom direct connect to digital output, but his relative SSR is the most often selection. In fact, SSR is a compact package of trigger circuit and triac. You can choose zero cross trigger (output command only turn on the output at power phase near zero to eliminate surge) or direct turn on type. SSR is working in AC load condition.

5.3 Input debounce

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, the output will generate a beat frequency.

<table>
<tr><td>
</td><td><- Input frequency at 835Hz
<- Output of digital filter,
Please note the beat frequency.</td></tr>
<tr><td colspan="2">Digital debounce circuit work at 1KHZ sample rate and observe the output of filter from 835Hz input</td></tr>
</table>

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

5.4 Input interrupt

You can scan the input by polling, but the CPU will spend a lot of time to do null task. Another way is use a timer to sample the input at adequate time (remind the Nyquist–Shannon sampling theorem, at least double of the input frequency). The third one is directly allows the input to generate interrupt to CPU. To use direct interrupt from input, the noise coupled from input must take special care not to mal-trigger the interrupt. LSI3188 card has 8 bit isolated digital input and 8 bit isolated digital output. Each input can be configured as external interrupt source.

5.5 Read back of Output status

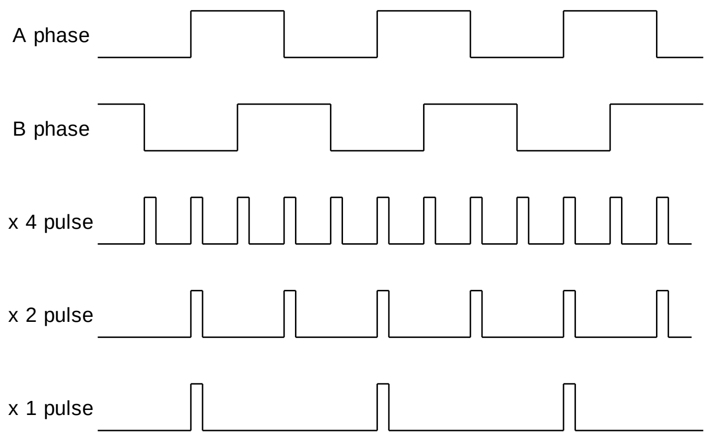
Some applications need to read back the output status, if the card do not provide output status read back, you can use a variable to store the status of output before you really command it output. Some cards provide the read back function but please note that **the read back status is come from the output register, not from the real physical output.**

6. Basic concepts of quadrature encoder counter

6.1 Signal input type

In LSI3188 card, there are 3 major signal types can be count.

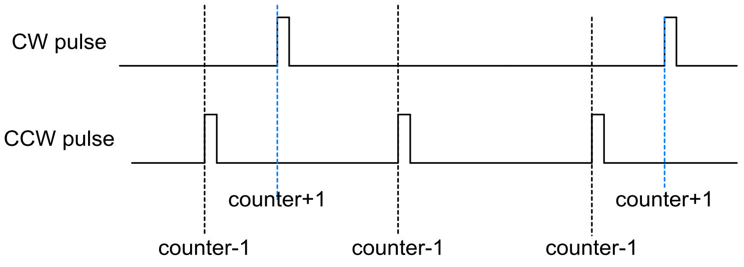
Quadrature input type



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.

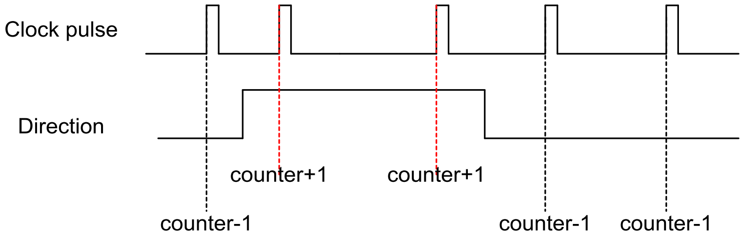
On the other hand, if B phase leads A phase, the counter will be down count.

CW and CCW input type (Dual pulse mode)



The left diagram shown that CW and CCW pulses. Any CW pulse input will increase counter by 1 and any CCW pulse input will decrease counter by 1.

Clock and direction input type (Single pulse mode)



The left diagram shown that Clock and Direction pulses. Any Clock pulse input will increase counter by 1 while the Direction signal is make and any Clock pulse input will decrease counter by 1 while Direction signal is break.

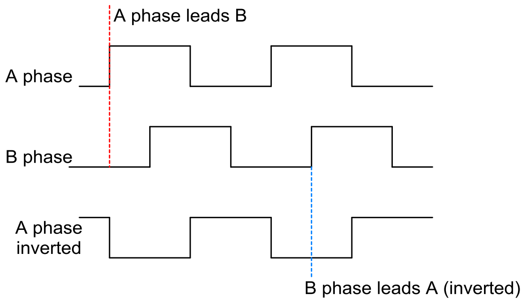
6.2 Input debounce time

If the counter input signal comes from the noisy environment, the input needs to filter out the unwanted signal and keep the meaningful signals to go through to counter. A programmable debounce digital filter put in the way of input signal to drop out the unwanted signal is a good choice.

Users can use the default debounce time constant or change depending on the signal speed and environment noise. A noisy environment normally needs large time constant to drop out the unwanted signal and high pulse rate limits the time constant you can choose. At default, the debounce function will drop the pulse duration less than 1us (debounce frequency 1M). You can choose one from 512K, 1M, 2M, 4M, 8M, 16M to meet your requirement.

6.3 Input polarity

For the maximum flexibility, the polarity function will change the input signal to meet the requirements of the following function blocks. Say A phase leads B in your external signal input, you can invert the A phase to change to B phase leads A phase without actually change the wiring.

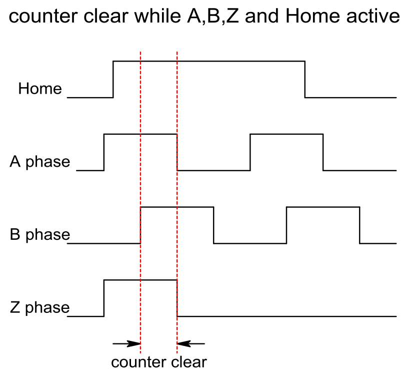


From left diagram, you can see A phase change polarity is equivalent to change A phase from lead state to lag state.

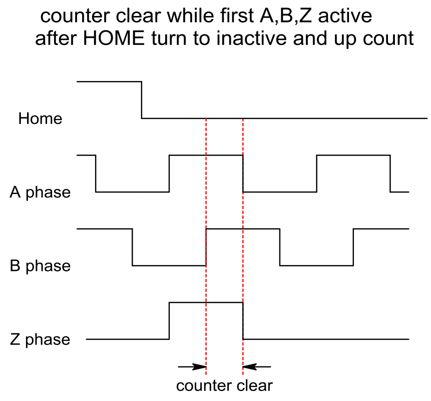
6.4 Homing (counter clear mode)

Normal counters use external asynchronous reset to clear counter but the quadrature counter generally provides more versatile functions to fit the need of different applications. In most quadrature counter applications the counter clear function also called as counter “HOMING”.

There are several modes to do homing:

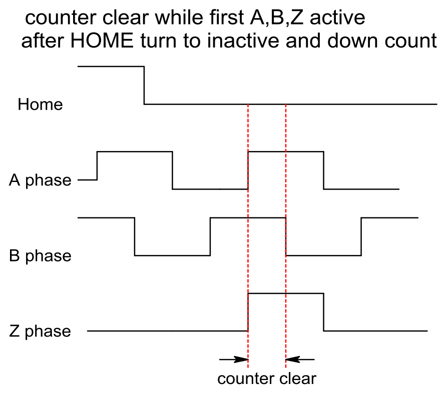


The counter will be cleared while A,B Z and Home are all “make”.


counter clear while first A,B,Z active
after HOME turn to inactive and up count
Home
A phase
B phase
Z phase
counter clear

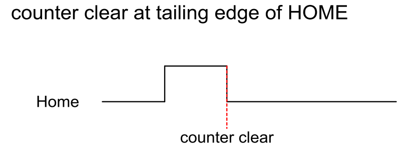
The counter will be cleared while the following conditions meet:

1. HOME switch turns into “BREAK” state.
2. first A,B Z are all “MAKE” and counter up counts (suppose A phase leads B phase).

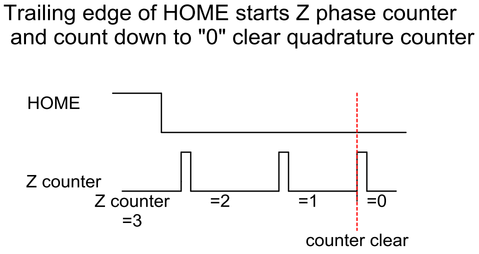

counter clear while first A,B,Z active
after HOME turn to inactive and down count
Home
A phase
B phase
Z phase
counter clear

The counter will be cleared while the following conditions meet:

1. the HOME switch turns into “BREAK” state.
2.first A,B Z are all “MAKE” and counter down counts (suppose B phase leads A phase).



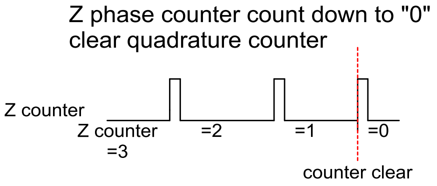
The counter will be cleared at the tailing edge of the HOME switch.


Trailing edge of HOME starts Z phase counter
and count down to "0" clear quadrature counter
HOME
Z counter
Z counter
=3
=2
=1
=0
counter clear

The counter will be cleared the following conditions meet:

1. the HOME switch turns into “BREAK” state.

2. Since the HOME tailing edge, Z phase counter counts down to “0”



The counter will be cleared while Z phase counter counts down to “0”.

7. Basic concepts of counter compare function

The most powerful function of LSI3188 card is the high speed comparison function. You can use this function to trigger external devices such as CCD camera to catch vision data.

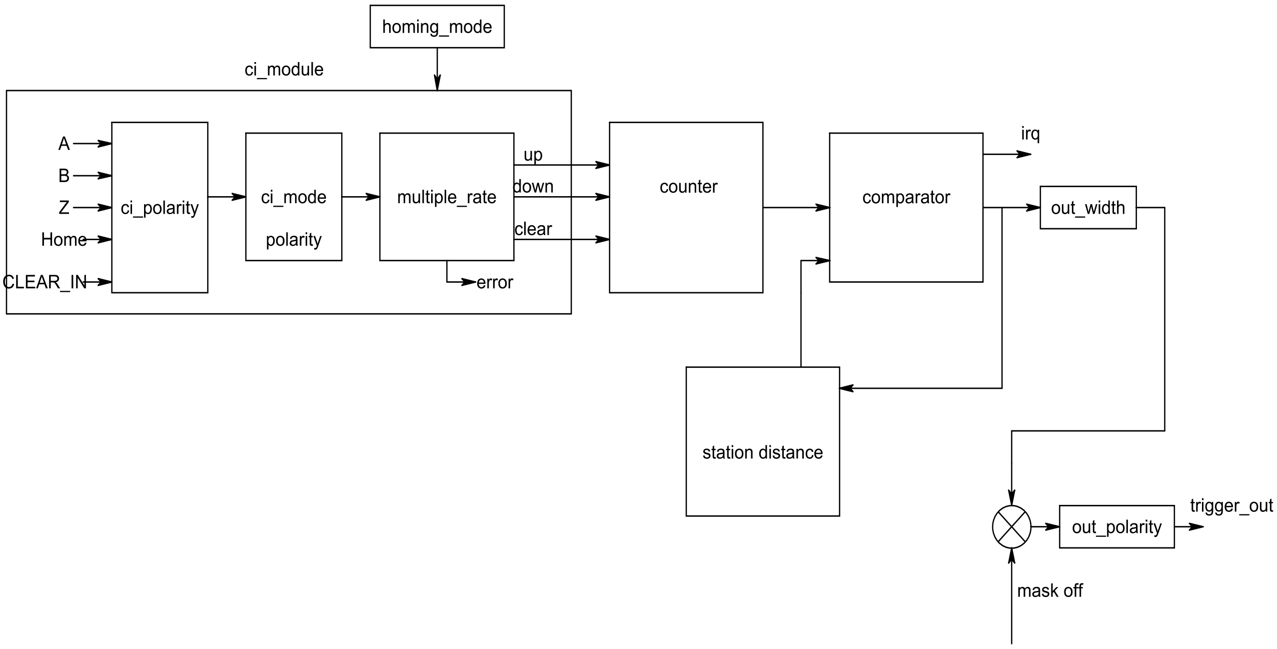


fig. 7.1 Function block of encoder counter card

From the above diagram, while the comparator compares equal, it will generate a trigger output and maintain the pulse at out_width duration. For more detailed application specific compare function, please refer Chapt. 11 Application specific counter function

8. Function format and language difference

Every LSI3188 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 LSI3188 function is the parameter **CardID** which is located the driver of LSI3188 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 set the hardware and pass the appropriate **CardID** to each function.
Note: **CardID** is set by DIP/ROTARY SW (**0x0-0xF**)

8.1 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 1

8.2 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 LSI3188 API. Read the following sections that apply to your programming language.

Note: Be sure to include the declaration functions of LSI3188 prototypes by including the appropriate LSI3188 header file in your source code. Refer to 4.2 LSI3188 Windows Libraries for the header file appropriate to your compiler.

8.2.1 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 = LSI3188_port_read(u8 CardID, u8 port, u8*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 = LSI3188_port_read (CardID, port, &data);
```

8.2.2 Visual basic

The file LSI3188.bas contains definitions for constants required for obtaining LSI3188 Card information and declared functions and variable as global variables. You should use these constants symbols in the LSI3188.bas, do not use the numerical values.

In Visual Basic, you can add the entire LSI3188.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 LSI3188.bas file for your project in Visual Basic 4.0, go to the **File** menu and select the **Add File... option**. Select LSI3188.bas, which is browsed in the LSI3188 \ API directory. Then, select **Open** to add the file to the project.

To add the LSI3188.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** LSI3188.bas, which is in the LSI3188 \ API directory. Then, select **Open** to add the file to the project.

8.2.3 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 LSI3188BC.lib LSI3188.dll
```

Then add the **LSI3188BC.lib** to your project and add

#include “LSI3188.h” to main program.

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

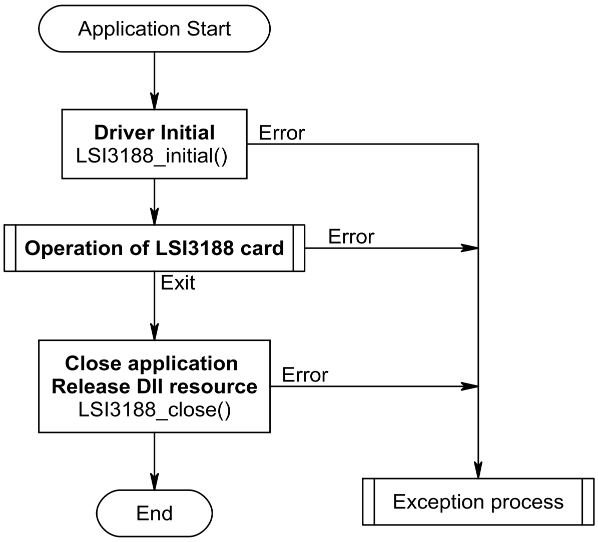
Status = LSI3188_port_read(u8 CardID, u8 port, u8*data);

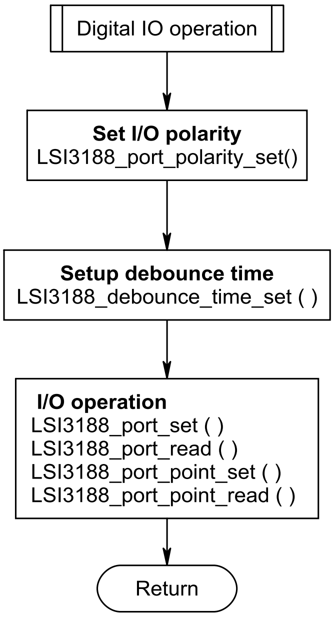
where **CardID** and **port** are input parameters, and **data** is an output parameter. Consider the following example:

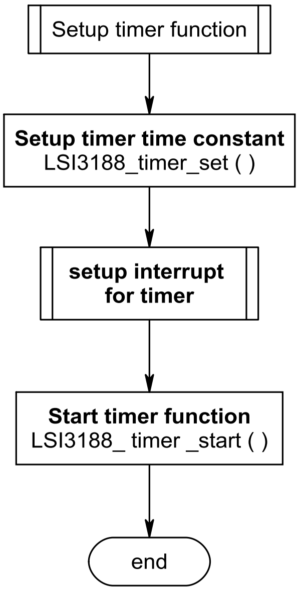
u8 CardID, port;
u8 data;
u32 Status;
Status = LSI3188_port_read(CardID, port, &data);

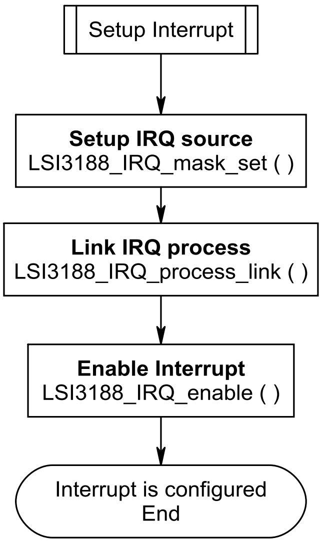
9. Flow chart of application implementation

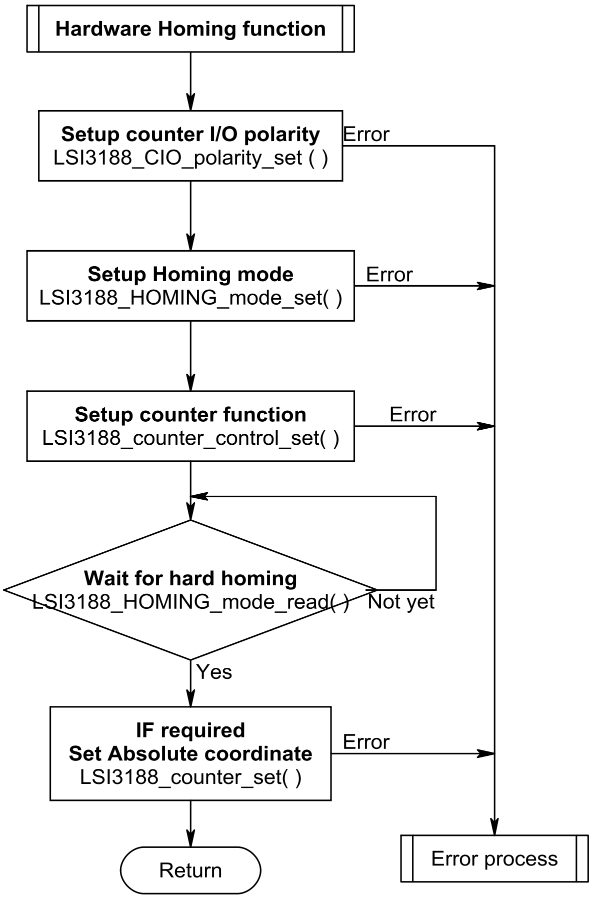
9.1 LSI3188 Flow chart of application implementation

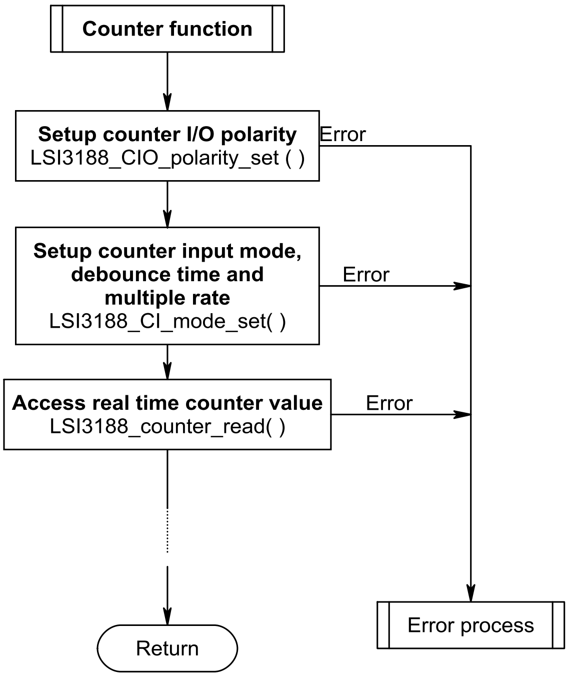


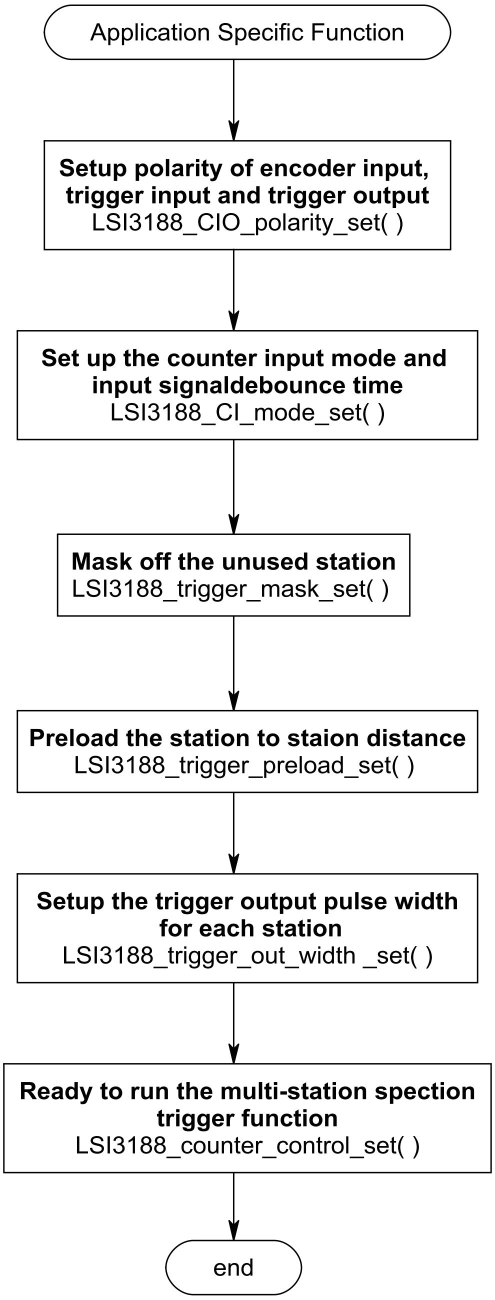







Hardware Homing function
Setup counter I/O polarity
LSI3188_CIO_polarity_set ( )
Error
Setup Homing mode
LSI3188_HOMING_mode_set( )
Error
Setup counter function
LSI3188_counter_control_set( )
Error
Wait for hard homing
LSI3188_HOMING_mode_read( )
Not yet
Yes
IF required
Set Absolute coordinate
LSI3188_counter_set( )
Error
Return
Error process


Counter function
Setup counter I/O polarity
LSI3188_CIO_polarity_set ( )
Error
Setup counter input mode,
debounce time and
multiple rate
LSI3188_CI_mode_set( )
Error
Access real time counter value
LSI3188_counter_read( )
Error
Return
Error process


Application Specific Function
Setup polarity of encoder input, trigger input and trigger output
LSI3188_CIO_polarity_set( )
Set up the counter input mode and input signaldebounce time
LSI3188_CI_mode_set( )
Mask off the unused station
LSI3188_trigger_mask_set( )
Preload the station to staion distance
LSI3188_trigger_preload_set( )
Setup the trigger output pulse width for each station
LSI3188_trigger_out_width _set( )
Ready to run the multi-station spection trigger function
LSI3188_counter_control_set( )
end

10. Software overview and dll function

10.1 Initialization and close

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

LSI3188_initial( ) will do.

Once you want to close your application, call

LSI3188_close( ) to release all the resource.

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

LSI3188_info( ) to get the address.

- **LSI3188_initial**

Format : **u32 status =LSI3188_initial (void)**

Purpose: Initial the LSI3188 resource when start the Windows applications.

- **LSI3188_close**

Format : **u32 status = LSI3188_close (void);**

Purpose: The LSI3188_close () function is corresponded with LSI3188_initial ( ) function to make LSI3188 card windows application program completely ended and memory fully be released.

- **LSI3188_info**

Format : **u32 status =LSI3188_info(u8 CardID, u16 *IO_address, u16 *TC_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
IO_address	u16	physical I/O address assigned by OS
TC_address	u16	physical timer/counter I/O address assigned by OS

10.2 Input/Output function

For the easy use of digital input / output or the signal and control input / output, the logic polarity configure as you need will release the complexity of your application. Use

LSI3188_port_polarity_set ( ) to set digital input/output port logic polarity.

LSI3188_port_polarity_read ( ) to read back the digital input/output port logic polarity.

To eliminate the input noise, debounce filter is a good solution. LSI3188 card provides software input debounce circuit, before using the digital input, selecting an adequate filter frequency by:

LSI3188_debounce_time_set( ) and read back setting by

LSI3188_debounce_time_read( ).

To output data

LSI3188_port_set( ) will do.

To read digital input /output status

LSI3188_port_read ( ) will do.

To set a dedicate digital output, use

LSI3188_point_set( ) and to read back the digital input/output status by

LSI3188_point_read( )

- **LSI3188_port_polarity_set**

Format : **u32 status = LSI3188_port_polarity_set (u8 CardID, u8 port, u8 polarity)**

Purpose: To set LSI3188 card's digital I/O port polarity.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
port	u8	0: input port 1: output port
polarity	u8	b7: IN07 for input port,OUT07 for output port 0: normal polarity (default) 1: inverse polarity …. b0: IN00for input port,OUT00 for output port 0: normal polarity (default) 1: inverse polarity

- **LSI3188_port_polarity_read**

Format : **u32 status = LSI3188_port_polarity_read (u8 CardID, u8 port, u8 *polarity)**

Purpose: To read back polarity of digital I/O port point.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
port	u8	0: input port 1: output port

Output:

Name	Type	Description
polarity	u8	b7: IN07 for input port,OUT07 for output port 0: normal polarity (default) 1: inverse polarity …. b0: IN00for input port,OUT00 for output port 0: normal polarity (default) 1: inverse polarity

- **LSI3188_debounce_time_set**

Format : **u32 status = LSI3188_debounce_time_set (u8 CardID, u8 debounce_time)**

Purpose: Set the input port debounce time

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW
debounce_time	u8	Debounce time selection: 0: no debounce 1: debounce frequency 100 Hz, filter out duration less than 10ms (default) 2: debounce frequency 200 Hz, filter out duration less than 5ms 3: debounce frequency 1K Hz, filter out duration less than 1ms

- **LSI3188_debounce_time_read**

Format : **u32 status = LSI3188_debounce_time_read (u8 CardID, u8 * debounce_time)**

Purpose: Read back the input port debounce time configuration

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW

Output:

Name	Type	Description
debounce_time	u8	Debounce time selection: 0: no debounce 1: debounce frequency 100 Hz, filter out duration less than 10ms (default) 2: debounce frequency 200 Hz, filter out duration less than 5ms 3: debounce frequency 1K Hz, filter out duration less than 1ms

- **LSI3188_port_set**

Format : **u32 status = LSI3188_port_set (u8 CardID, u8 port, u8 data)**

Purpose: To set LSI3188 card’s DIO output.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
port	u8	0: invalid 1: output port
data	u8	b7: OUT07 for output port …. b0: OUT00 for output port

- **LSI3188_port_read**

Format : **u32 status = LSI3188_port_read (u8 CardID, u8 port, u8 *data)**

Purpose: To read LSI3188 card’s DIO port status.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
port	u8	0: input port 1: output port

Output:

Name	Type	Description
data	u8	b7: state of IN07 for input port or OUT07 for output port …. b0: state of IN00 for input port or OUT00 for output port

- **LSI3188_point_set**

Format : **u32 status = LSI3188_point_set (u8 CardID, u8 port, u8 point, u8 state)**

Purpose: To set LSI3188 card’s digital input/output point.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
port	u8	0: invalid 1: output port
point	u8	Point designated 7~0 for OUT07~OUT00
state	u8	Data (0 or 1) will set the designated pint

- **LSI3188_point_read**

Format : **u32 status = LSI3188_point_read (u8 CardID, u8 port, u8 point, u8 *state)**

Purpose: To read LSI3188 card’s digital input/output point status.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
port	u8	0: input port 1: output port
point	u8	Point designated 7~0 for b7~b0

Output:

Name	Type	Description
state	u8	Returned status (0 or 1) of the designed bit

10.3 Timer function

The build in 32 bit timer based on 1 us time base can be used as system clock to generate interrupt for periodical task.

To setup timer or change time constant

LSI3188_timer_set( ) and start by

LSI3188_timer_start( ) and stop by

LSI3188_timer_stop( )

If you want to dedicated control the timer associated registers, use

LSI3188_TC_set( ) to set registers and use

LSI3188_TC_read( ) to read back settings.

- **LSI3188_timer_set**

Format : **u32 status = LSI3188_timer_set (u8 CardID, u32 time_constant)**

Purpose: To setup timer operation mode or update timer

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY switch
time_constant	u32	Timer constant based on 1us clock

Note:

1. Time constant is based on 1us clock, period T= (time_constant +1) * 1us
2. If you also enable the timer interrupt, the period T must at least longer than the system interrupt response time else the system will be hanged by excess interrupts.

- **LSI3188_timer_start**

Format : **u32 status = LSI3188_timer_start (u8 CardID)**

Purpose: To start timer operation mode

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY switch

- **LSI3188_timer_stop**

Format : **u32 status = LSI3188_timer_stop (u8 CardID)**

Purpose: To stop timer operation mode

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY switch

- **LSI3188_TC_set**

Format : **u32 status=LSI3188_TC_set (u8 CardID, u8 index, u32 data)**

Purpose: To load data to timer related registers

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
index	u8	0: TC_CONTROL 1: PRELOAD 2: TIMER
data	u32	For TC_CONTROL 0: stop timer operation 1: timer run For PRELOAD or TIMER Data is the constant to be load

Note: PRELOAD is the register for timer to re-load, the value will be valid while timer count to zero and reload the data.

- **LSI3188_TC_read**

Format : **u32 status=LSI3188_TC_read (u8 CardID, u8 index, u32 *data)**

Purpose: To read data from timer related registers

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
index	u8	0: TC_CONTROL 1: PRELOAD 2: TIMER

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	0~1	0:timer stops operation 1: timer runs
1	PRELOAD	1~0xffffffff (1~ 4294967295)	timer preload value
2	TIMER	1~0xffffffff (1~ 4294967295)	Timer value on the fly

Note:

For example, you want to watch the timer counting on the fly, use
LSI3188_TC_read (CardID,index, *data)   //CardID as you assign, index=2
to read back the timer value.

10.4 Interrupt function

There are 3 interrupt sources for your quick response application,

Digital input: IN07~IN00 generate interrupt

Timer: time up interrupt

Counter: compare equal

can generate interrupt.

To use the interrupt service, the first step

LSI3188_IRQ_mask_set ( ) to mask off the undesired interrupt source.

LSI3188_IRQ_mask_read( ) to read back the mask.

After the mask set, you can link your service routine to interrupt by:

LSI3188_IRQ_process_link( ), then enable or disable by:

LSI3188_IRQ_enable( ) to enable, or

LSI3188_IRQ_disable( ) to disable the function.

If you want to check the interrupt status to identify which is the interrupt source,

LSI3188_IRQ_status_read( ) will do and it also clears the interrupt status.

- **LSI3188_IRQ_mask_set**

Format : **u32 status = LSI3188_IRQ_mask_set (u8 CardID,u8 source, u8 mask)**

Purpose: Mask off interrupt source of port0 IN07~IN00 or timer,counter

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW
source	u8	0: digital io block 1: timer /counter block 2: trigger output block
mask	u8	**Digital IO block:** Any bit set to 1 of b7~b0 means IN07~IN00 can generate interrupt **Timer /Counter block:** b0=1, enable timer cross zero to generate interrupt, else disable. **Trigger output block:** Any bit set to 1 of b7~b0 means Trigger07~ Trigger00 can generate interrupt

- **LSI3188_IRQ_mask_read**

Format : **u32 status = LSI3188_IRQ_mask_read (u8 CardID,u8 source,u8 *mask)**

Purpose: read back interrupt mask of port0 b7~b0 or timer/counter

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW
source	u8	0: digital io block 1: timer/counter block 2: trigger output block

Output:

Name	Type	Description
mask	u8	Digital block: Any bit set to 1 of b7~b0 means IN07~IN00 can generate interrupt **Timer /Counter block:** b0=1, enable timer cross zero to generate interrupt, else disable. **Trigger output block:** Any bit set to 1 of b7~b0 means Trigger07~Trigger00 can generate interrupt

- **LSI3188_IRQ_process_link**

Format : **u32 status = LSI3188_IRQ_process_link (u8 CardID,**
void (__stdcall *callbackAddr)(u8 CardID))

Purpose: Link irq service routine to driver

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW
callbackAddr	void	callback address of service routine

- **LSI3188_IRQ_enable**

Format : **u32 status = LSI3188_IRQ_enable (u8 CardID, HANDLE *phEvent)**

Purpose: Enable interrupt from selected source

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW

Output:

Name	Type	Description
phEvent	HANDLE	event handle

- **LSI3188_IRQ_disable**

Format : **u32 status = LSI3188_IRQ_disable (u8 CardID)**

Purpose: Disable interrupt from selected source

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW

- **LSI3188_IRQ_status_read**

Format : **u32 status = LSI3188_IRQ_status_read (u8 CardID,u8 source,**
u8 *Event_Status)

Purpose: To read back the interrupt status to identify the source

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by Rotary SW
source	u8	0: digital io block 1: timer block 2: trigger output block

Output:

Name	Type	Description
Event_Status	u8	Digital block: Any bit set to 1 of b7~b0 means port0 IN07~IN00 has generated interrupt **Timer /counter block:** b0:S_TIMER Timer cross 0 will set S_TIMER flag **Trigger output block:** Any bit set to 1 of b7~b0 means Trigger07~ Trigger 00 has generated interrupt

Note:

1. Status read back will also clear the on board status register.
2. The status will reflect the on board digital input or timer count up status are irrelevant to the IRQ_MASK

11. Application specific counter function

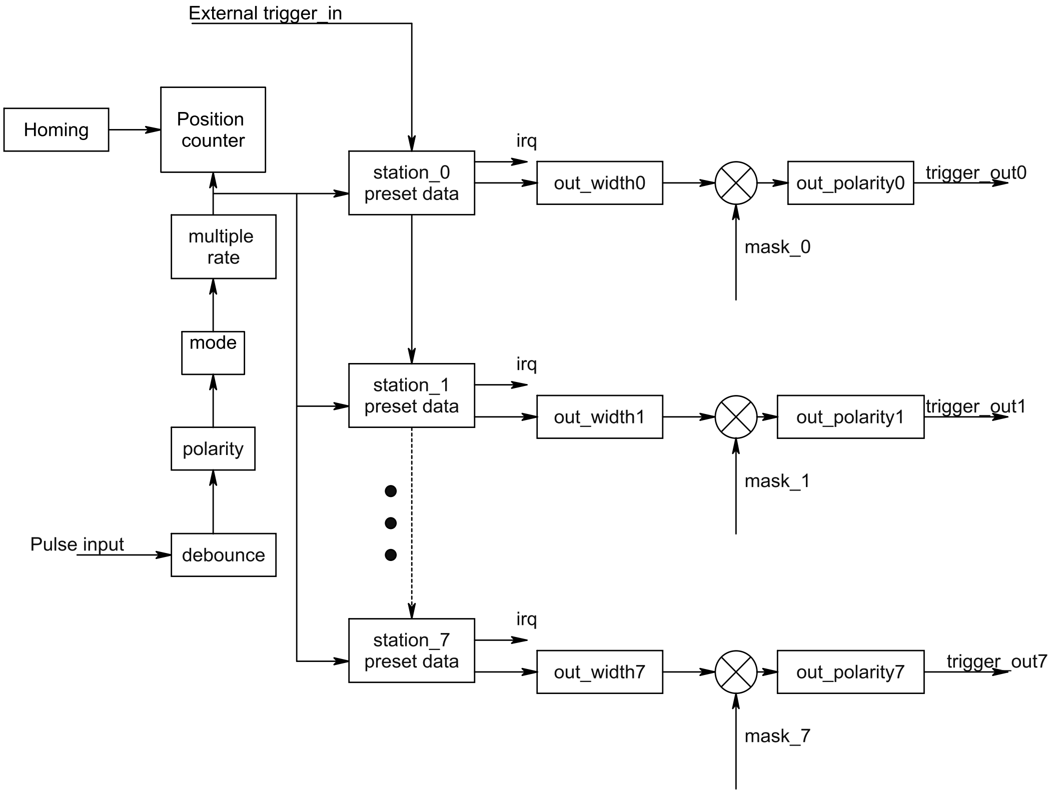


fig. 11.1 Application specific counter function block diagram

Function Overview

The highlight of the LSI3188 card is the application specific counter function. It is designed to provide the multiple trigger output to CCD's (but not limit to CCD inspection, any kind of device under test or inspection that randomly comes in but the test/inspection station is fixed can be used) for a production line or rotary table.

Now we take CCD inspection as example. Owing to the under inspect device comes in randomly (not at equal spacing). In the traditional solution, each CCD inspection station needs a sensor to confirm the under inspect product is in-position and trigger the CCD to inspect. For different process or product, you must align the mechanical displacement of the sensors to meet the requirement to generate the trigger signals.

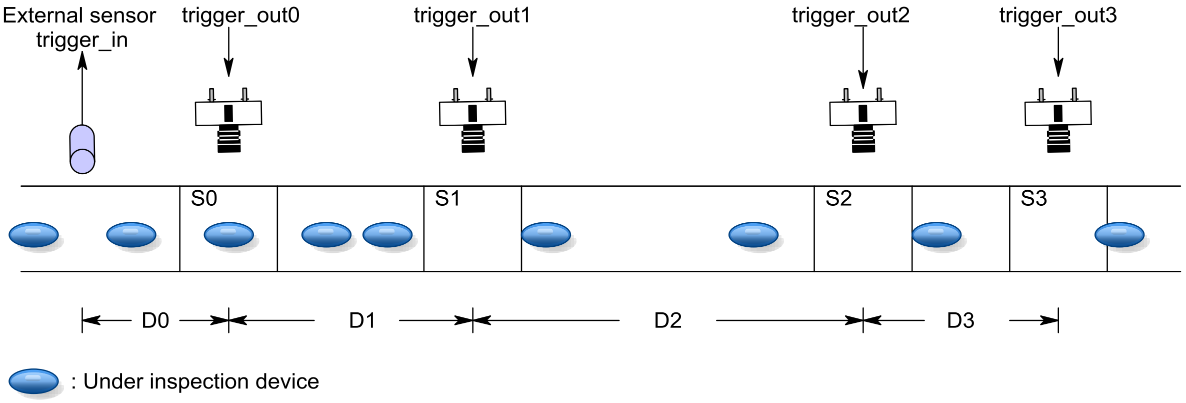


fig 11.2 Typical application of application specific counter function

The new approach provided by the LSI3188 is that you can use one sensor (trigger_in sensor) for confirmation of the under inspect product and one encoder for the position sensing. First, put the sensor at the convenient place then program the distance to the first station (D0) and then the distance from 0th station to the 1st station (D1), distance from 1st station to the 2nd station (D2) then 2nd to 3rd station (D3).... All is software programmable, it is flexible to change process, to change model or inspection station.

To support the function, we will describe the detail functions step by step:

11.1 Position signal and position counter

- input signal modes, multiple rate
- input signal polarity
- input signal debounce
- trigger_in and trigger_out polarity
- operation of position counter

11.2 Homing (to clear counter)

- homing mode
- operation of homing function

11.3 Compare function

- configuration of station to station distance counter
- configuration of output pulse
- control of compare function

11.1 Position signal and position counter

The position signal generally comes from a encoder or linear scale but sometimes from other source that gives the information of the position information. There are 3 signal modes can be processed by LSI3188 card,

0: QUADRATURE_MODE
A, B phase quadrature signal input

1: DUAL_PULSE_MODE
CW and CCW signal input

2: SINGLE_PULSE_MODE
Clock and Direction signal input

You can choose the appropriate working mode to meet your signal source.

The signal debounce is another issue of system stability. External noise can disturb the counter if you do not have adequate filtering. You can choose the debounce frequency from 512K up to 16M. To configure the input mode and debounce for the input signal by using:

LSI3188_CI_mode_set( ) and read back to verify by

LSI3188_CI_mode_read( )

If the counting direction is not as you need after wiring the input signal, you can change the counting direction by changing the input polarity. You can also change the polarity to meet the device you use to get a convenient logic (such as positive logic at program coding and don’t care the physical device logic).

LSI3188_CIO_polarity_set( ) will do.

LSI3188_CIO_polarity_read( ) to read back for verification.

To read the real time status of counter related input or output,

LSI3188_CIO_read( ) will do.

The position counter is 32bit width, you can enabled / disabled by:

LSI3188_counter_control_set( ) and read back by:

LSI3188_counter_control_read( )

If you want to set counter value, for example, after homing the counter value =0 but you want the homing point has the coordinate value at 1000, then you can set the counter by:

LSI3188_counter_set( ) to load the counter.

To read the counter value (get counter data on the fly) at any time, use

LSI3188_counter_read( )

- **LSI3188_CI_mode_set**

Format : **u32 status = LSI3188_CI_mode_set (u8 CardID, u8 in_mode, u8 debounce_time, u8 multiple_rate)**

Purpose: To set LSI3188 card's position counter input mode.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
in_mode	u8	0: QUADRATURE_MODE A, B phase quadrature signal at A and B input pin 1:DUAL_PULSE_MODE CW and CCW signal at A and B input pin 2:SINGLE_PULSE_MODE Clock and Direction signal at A and B input pin
debounce_time	u8	0: filter out duration less than 1.95us signal, counter bandwidth less than 512K. 1: filter out duration less than 1us signal (default), counter bandwidth less than 1M. 2: filter out duration less than 0.5us signal, counter bandwidth less than 2M. 3: filter out duration less than 0.25us signal, counter bandwidth less than 4M. 4: filter out duration less than 0.125us signal, counter bandwidth less than 8M. 5: filter out duration less than 0.1us signal, counter bandwidth less than 10M. (only valid for LSI3188A) 6: filter out duration less than 0.0625us signal, counter bandwidth less than 16M. (only valid for LSI3188A)
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: The counter input mode will also apply to the distance counter.

- **LSI3188_CI_mode_read**

Format : **u32 status = LSI3188_CI_mode_read (u8 CardID, u8 *in_mode, u8 *debounce_time, u8 *multiple_rate)**

Purpose: To read back the LSI3188 card's counter input mode.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW

Output:

Name	Type	Description
in_mode	u8	0: QUADRATURE_MODE A, B phase quadrature signal at A and B input pin 1:DUAL_PULSE_MODE CW and CCW signal at A and B input pin 2:SINGLE_PULSE_MODE Clock and Direction signal at A and B input pin
debounce_time	u8	0: filter out duration less than 1.95us signal, counter bandwidth less than 512K. 1: filter out duration less than 1us signal (default), counter bandwidth less than 1M. 2: filter out duration less than 0.5us signal, counter bandwidth less than 2M. 3: filter out duration less than 0.25us signal, counter bandwidth less than 4M. 4: filter out duration less than 0.0125us signal, counter bandwidth less than 8M. 5: filter out duration less than 0.1us signal, counter bandwidth less than 10M. (only valid for LSI3188A) 6: filter out duration less than 0.0625us signal, counter bandwidth less than 16M. (only valid for LSI3188A)
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

- **LSI3188_CIO_polarity_set**

Format : **u32 status = LSI3188_CIO_polarity_set (u8 CardID, u16 polarity)**

Purpose: To set LSI3188 card's high speed counter related input and output polarity.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
polarity	u16	b7: TRIGGER_OUT polarity (CMP_OUT)* b6: null b5: null b4: TRIGGER_IN polarity (CLEAR_IN)* b3: HOME input polarity b2: Z_phase input polarity b1: B_phase input polarity b0: A_phase input polarity A bit set to 0 mean the corresponding input or output normal polarity (default). A bit set to 1 means the corresponding input or output is inverse polarity

*TRIGGER_IN, TRIGGER_OUT please refer 11.3 Compare function.

- **LSI3188_CIO_polarity_read**

Format : **u32 status = LSI3188_CIO_polarity_read (u8 CardID, u16 *polarity)**

Purpose: To read back the LSI3188 card's high speed counter related input and output polarity.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW

Output:

Name	Type	Description
polarity	u16	b7: TRIGGER_OUT polarity (CMP_OUT) b6: null b5: null b4: TRIGGER_IN polarity (CLEAR_IN) b3: HOME input polarity b2: Z_phase input polarity b1: B_phase input polarity b0: A_phase input polarity A bit set to 0 mean the corresponding input or output normal polarity (default). A bit set to 1 means the corresponding input or output is inverse polarity

- **LSI3188_CIO_read**

Format : **u32 status = LSI3188_CIO_read(u8 CardID, u8 *CIO_state)**

Purpose: To read back the LSI3188 card's high speed counter related input and output status.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW

Output:

Name	Type	Description
CIO_state	u8	b0: A phase input state b1: B phase input state b2: Z phase input state b3: HOME input state b4: TRIGGER_IN input state b5: Z phase toggled flag (first Z input trigger to MAKE, 2nd trigger to BREAK, 3rd MAKE …)

Note: The Z phase input is very difficult to watch even by a scope but you can verify the "Z phase trigger toggled flag" to proof its occurrence.

- **LSI3188_counter_control_set**

Format : **u32 status = LSI3188_counter_control_set (u8 CardID, u8 mode)**

Purpose: To set up position counter operation mode.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY switch
mode	u8	0: STOP_COUNTER counter stops. 1: NORMAL_COUNTER operation in counter mode (including HOMING). (default)

- **LSI3188_counter_control_read**

Format : **u32 status = LSI3188_counter_control_read (u8 CardID, u8 *mode)**

Purpose: To read back position counter operation mode.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY switch

Output:

Name	Type	Description
mode	u8	0: STOP_COUNTER counter stopped. 1: NORMAL_COUNTER operation in counter mode (including HOMING). (default)

- **LSI3188_counter_set**

Format : **u32 status = LSI3188_counter_set (u8 CardID, i32 counter_value)**

Purpose: To set value to position counter.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
counter_value	i32	-2147483648 ~ 2147483647

Note: If you set the position counter, it means you give the counter a basic value, the next counting will based on this value.

- **LSI3188_counter_read**

Format : **u32 status = LSI3188_counter_read (u8 CardID, i32* counter_value)**

Purpose: To read back position counter the on the fly.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW

Output:

Name	Type	Description
counter_value	i32	-2147483648 ~ +2147483647, counter value on the fly

11.2 Homing (to clear counter)

At the beginning of an application, the position of encoder / linear scale needs a reference point of coordinate, to do homing make the coordinate reference to a special point to ensure the accuracy of each operation. The LSI3188 card provides several kinds of homing; if the absolute reference point is the HOME switch, you can have homing by using:

LSI3188_HOMING_mode_set ( ) to setup the homing mode (clear counter) while the special condition meet.

To check if hardware homing occurred, use

LSI3188_HOMING_mode_read( ) to read back homing mode.

To enable homing, you must have the counter in RUN state by

LSI3188_counter_control_set( ) (refer 11.1 Position signal and position counter)

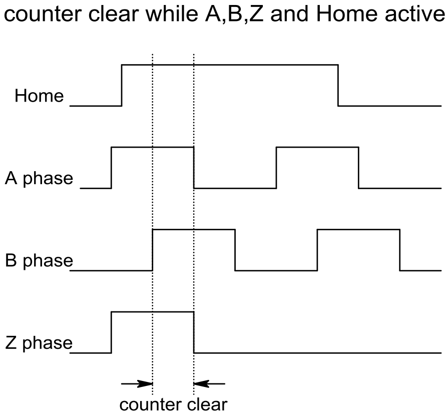
- **LSI3188_HOMING_mode_set**

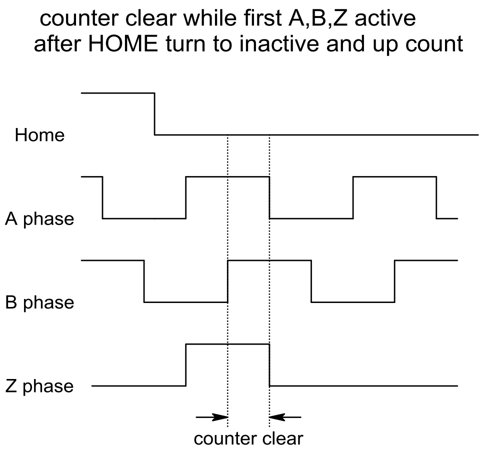
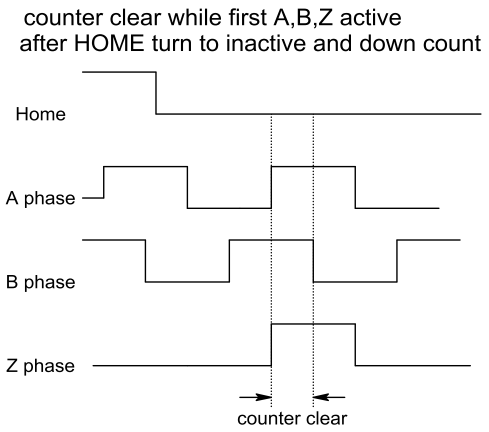
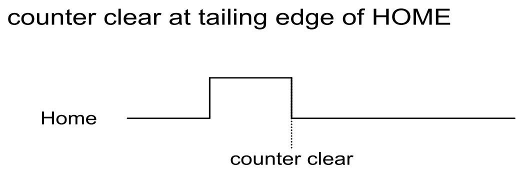
Format : **u32 status = LSI3188_HOMING_mode_set (u8 CardID, u8 homing_mode, u16 z_count,u8 single_cont)**

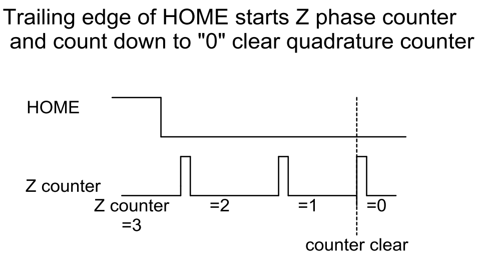
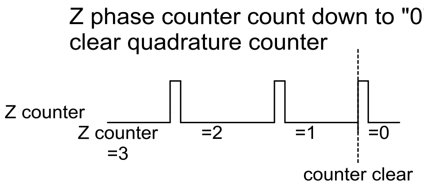
Purpose: To set LSI3188 card's homing mode of high speed counter.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
homing_mode	u8	0: NORMAL (default) NORMAL is used for counting or compare. While the homing mode completes, the homing mode will reset to NORMAL. 1: HOME_ABZ Clear counter while A,B,Z and HOME signals are MAKE simultaneously.  counter clear while A,B,Z and Home active Home A phase B phase Z phase counter clear

		2: HOME_ABZ_UP Clear counter at first A,B,Z are MAKE after HOME signal turned to BREAK and counter up-count.  counter clear while first A,B,Z active after HOME turn to inactive and up count Home A phase B phase Z phase counter clear 3: HOME_ABZ_DOWN Clear counter at first A,B,Z are MAKE after HOME signal turned to BREAK and counter down-count.  counter clear while first A,B,Z active after HOME turn to inactive and down count Home A phase B phase Z phase counter clear 4: HOME_ Clear counter at the tailing edge of HOME input.  counter clear at tailing edge of HOME Home counter clear 5: not available

		6: HOME_ZN Clear counter while HOME active to enactive and Z phase counts z-count pulses.  Trailing edge of HOME starts Z phase counter and count down to "0" clear quadrature counter HOME Z counter Z counter =3 =2 =1 =0 counter clear 7:H_ZN Clear counter while Z phase counts z-count pulses.  Z phase counter count down to "0" clear quadrature counter Z counter Z counter =3 =2 =1 =0 counter clear
z_count	u16	Z phase count pulses at HOME_ZN and H_ZN homing mode.
single_cont	u8	0: SINGLE, once counter clears, homing mode reset to NORMAL. 1: CONT, continuous mode, always doing HOMING function while condition meet.

- **LSI3188_HOMING_mode_read**

Format : **u32 status = LSI3188_HOMING_mode_read (u8 CardID, u8 *homing_mode, u16 *z_count,u8 *single_cont)**

Purpose: To read back the LSI3188 card's high speed counter homing mode.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW

Output:

Name	Type	Description
homing_mode	u8	Refer explanation of **LSI3188_HOMING_mode_set**
z_count	u16	
single_cont	u8	

11.3 Compare function

For the product line, the inspection stations may be not in equal distance and the in-coming under inspect devices can also randomly come in, as figure 11.2 shown.

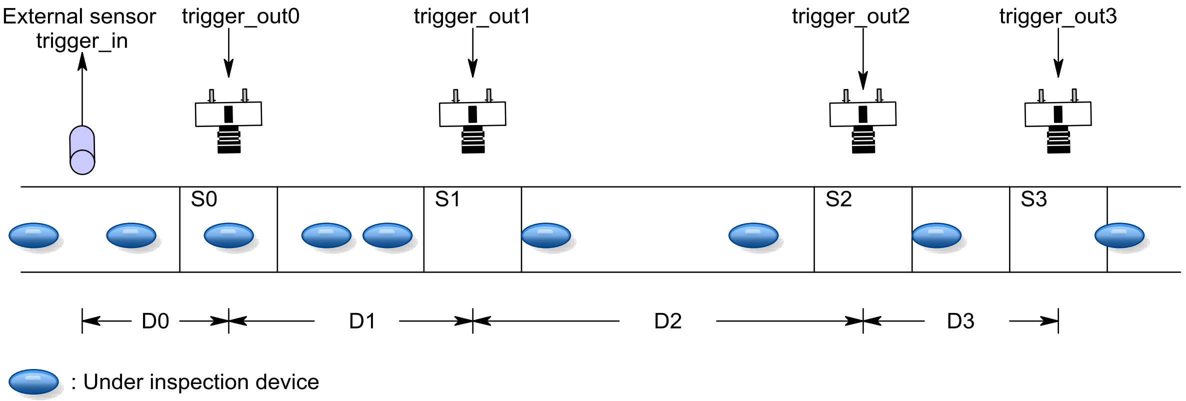


fig. 11.2 Typical application of application specific counter function-1

Let us take the CCD inspection as example. There is a sensor to detect the presence of under inspect device and give the trigger signal to TRIGER_IN input to the application specific counter function. At each inspection station there has one camera to take inspection. Each station is fixed but the station to station distance may be different.

Now we want to inspect each under inspect device at the inspection station (S0, S1, S2...) while the device go to the inspection point. From the fig.11.2, you can see the under inspect device is not equally spaced on the line.

What we must do first is to program the distance D0 (from trigger_in sensor to S0), D1 (S0 to S1), D2 (S1 to S2).... and the trigger out pulse of each station. Now the under inspect device will triggered to inspect while it go to the inspection point.

Another example is the round table type production line. There can be maximum 8 stations for inspection application (fig. 11.3). The table turns clockwise continuously or run-stop-run and stop at inspection station, the loader loads the device under inspect to Sin station. A sensor next to Sin will sense the presence of the device under inspect to trigger the application specific counter function. Same as the linear production line, the device under inspect will pass he S0, S1, S2, ...S5 for inspection then go to Sout to make pass/ no-pass decision. Please note that the distance between the station is equal distance only the sensor to S0 distance is different.

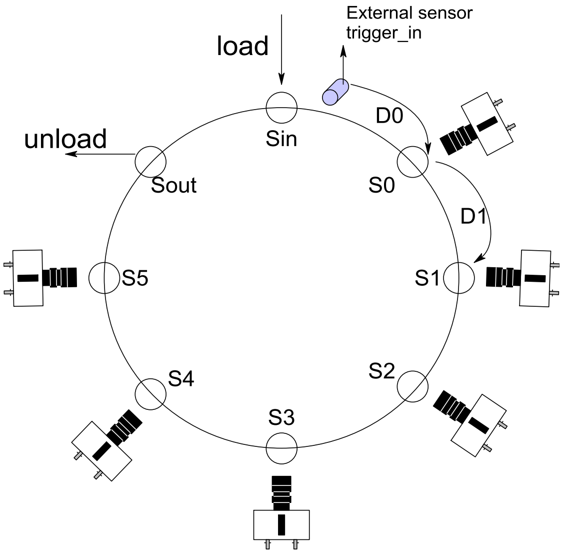


fig 11.3 Typical application of application specific counter function-2

You can fill the preset data to each station counter. After you start the application specific function, the device under inspect reach the station a trigger pulse will be generated to trigger the CCD camera to check.

Some variation of the example such as:

-- if we skip some stations in purpose, we can have the software to mask off the trigger function.

-- if the device under inspect is more than one piece between two stations, what to do with that?

The LSI3188 card can queue up to 7 devices.

To implement the compare function, you must first decide the polarity of position sensor (i.e. encoder) input signal and trigger_in, trigger_out signal by:

LSI3188_CIO_polarity_set( ) (refer 11.1 Position signal and position counter) and debounce time and input mode by:

LSI3188_CI_mode_set( ) (refer 11.1 Position signal and position counter).

You can define the working inspect stations at that station you want to trigger the instrument, by software mask off the unused station:

LSI3188_trigger_mask_set( ) and you can read back for verification by

LSI3188_trigger_mask_read( )

After the basic environment setup, you need to setup the distance between stations by

LSI3188_trigger_preload_set( ) and you can verify by read back using:

LSI3188_trigger_preload_read( )

You also need to decide how long the trigger pulse width you need to trigger the CCD camera (or the inspection device)

LSI3188_trigger_out_width_set( ) and read back for verification by

LSI3188_trigger_out_width_read( )

The position information input (say, quadrature encoder signal) to the counter may be up count or down count depends on the physical alignment, you can invert the input signal (change polarity of one phase) to revert the counting direction or you can directly assign the counting direction of the counter by:

LSI3188_trigger_direction_set( ) and read back for verification by

LSI3188_trigger_direction_read( )

In spite of the trigger output of each working station, there is a composed output which generate 5us pulse while nay of the station trigger has output. It can be used as monitoring or trigger source of special application. You can setup the polarity by

LSI3188_CIO_polarity_set( )(refer 11.1 Position signal and position counter)

To start or stop the operation of the counter you can use:

LSI3188_counter_control_set( ) (refer 11.1 Position signal and position counter)

Any working station that generate the trigger output can also generate an interrupt, you can mask off by

LSI3188_IRQ_mask_set( ) (refer 10.4 Interrupt function) and link the service routine to the interrupt and enable or disable to control the function (refer 10.4 Interrupt function ***LSI3188_IRQ_process_link***, ***LSI3188_IRQ_enable, LSI3188_IRQ_disable***).

- **LSI3188_trigger_mask_set**

Format : **u32 status = LSI3188_trigger_mask_set (u8 CardID , u8 station , u8 control)**

Purpose: Mask off of un-used station

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
station	u8	0: station S0 … 7: station S7
control	u8	0: mask off (station not used) 1: station used

- **LSI3188_trigger_mask_read**

Format : **u32 status = LSI3188_trigger_mask_read (u8 CardID , u8 station ,**
u8 * control)

Purpose: read back of mask

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
station	u8	0: trigger_0 … 7: trigger_7

Output:

Name	Type	Description
control	u8	Trigger mask.

- **LSI3188_trigger_preload_set**

Format : **u32 status = LSI3188_trigger_preload_set (u8 CardID , u8 station ,
u16 preload)**

Purpose: to setup the distance between stations.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
station	u8	0: distance between S0 to S1 for trigger_out0 … 7: distance between S6 to S7 for trigger_out7
preload	u16	distance between stations

Note: The preload data defines the distance between stations, normally it is a constant once the machine is fixed.

- **LSI3188_trigger_preload_read**

Format : **u32 status = LSI3188_trigger_preload_read (u8 CardID , u8 station ,
u16 *preload)**

Purpose: to read back setting of distance between stations

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
station	u8	0: distance between S0 to S1 for trigger_out0 … 7: distance between S6 to S7 for trigger_out7

Output:

Name	Type	Description
preload	u16	distance between stations

- **LSI3188_trigger_out_width_set**

Format : **u32 status = LSI3188_trigger_out_width_set (u8 CardID , u8 station , u16 width)**

Purpose: setup trigger pulse width

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
station	u8	0: trigger_out0 … 7: trigger_out7
width	u16	Trigger_out pulse width @1us time base

- **LSI3188_trigger_out_width_read**

Format : **u32 status = LSI3188_trigger_out_width_read (u8 CardID , u8 station , u16 *width)**

Purpose: read back the setting of trigger out pulse.

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
station	u8	0: trigger_out0 … 7: trigger_out7

Output:

Name	Type	Description
width	u16	Trigger width out @1us time base.

- **LSI3188_trigger_direction_set**

Format : **u32 status = LSI3188_trigger_direction_set (u8 CardID , u8 direction)**

Purpose: setup the counting direction

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW
direction	u8	0: normal 1: reverse

Note: Normally user define quadrature signal A lead B as up counting, you can change polarity to make the counter as down counting or use **LSI3188_trigger_direction_set** to change the direction.

- **LSI3188_trigger_direction_read**

Format : **u32 status = LSI3188_trigger_direction_read(u8 CardID , u8 * direction)**

Purpose: read back the setup of counting direction

Parameters:

Input:

Name	Type	Description
CardID	u8	assigned by DIP/ROTARY SW

Output:

Name	Type	Description
direction	u8	0: normal 1: reverse

12. Dll list

	Function Name	Description
1.	LSI3188_initial( )	LSI3188 initial
2.	LSI3188_close( )	LSI3188 close
3.	LSI3188_info( )	Read the I/O address of the specific card
4.	LSI3188_port_polarity_set( )	Set Input/output port polarity
5.	LSI3188_port_polarity_read( )	Read back the Input/output port polarity
6.	LSI3188_debounce_time_set( )	Set input port digital debounce time
7.	LSI3188_debounce_time_read( )	Read back input port digital debounce time
8.	LSI3188_port_set( )	Output data to digital output
9.	LSI3188_port_read( )	Read back the input or output port
10.	LSI3188_point_set( )	point output to digital output
11.	LSI3188_point_read( )	point read back of digital input or output
12.	LSI3188_timer_set( )	Setup or update timer
13.	LSI3188_timer_start( )	Start timer operation
14.	LSI3188_timer_stop( )	Stop timer operation
15.	LSI3188_TC_set( )	Set TC registers
16.	LSI3188_TC_read( )	Read TC registers
17.	LSI3188_IRQ_mask_set( )	Setup interrupt source mask
18.	LSI3188_IRQ_mask_read( )	Read back interrupt source mask
19.	LSI3188_IRQ_process_link( )	Link interrupt service routine to driver
20.	LSI3188_IRQ_enable( )	Enable interrupt function
21.	LSI3188_IRQ_disable( )	Disable interrupt function
22.	LSI3188_IRQ_status_read( )	Read back irq status
23.	LSI3188_CI_mode_set( )	Counter input mode setup
24.	LSI3188_CI_mode_read( )	Read back counter input mode
25.	LSI3188_CIO_polarity_set( )	Setup counter specific I/O polarity
26.	LSI3188_CIO_polarity_read( )	Read back counter specific I/O polarity
27.	LSI3188_CIO_read( )	Read the current status of counter specific I/O
28.	LSI3188_counter_control_set( )	Set up position counter operation mode
29.	LSI3188_counter_control_read( )	Read back position counter operation mode
30.	LSI3188_counter_set( )	Set up data to position counter
31.	LSI3188_counter_read( )	Read back position counter the on the fly
32.	LSI3188_HOMING_mode_set( )	Setup Homing mode
33.	LSI3188_HOMING_mode_read( )	Read back homing mode
34.	LSI3188_trigger_mask_set( )	mask off un-used station

35.	LSI3188_trigger_mask_read( )	read back of mask
36.	LSI3188_trigger_preload_set( )	setup the distance between stations
37.	LSI3188_trigger_preload_read( )	read back setting of distance between stations
38.	LSI3188_trigger_out_width_set( )	setup trigger pulse width
39.	LSI3188_trigger_out_width_read( )	read back the setting of trigger out pulse
40.	LSI3188_trigger_direction_set( )	setup the counting direction
41.	LSI3188_trigger_direction_read( )	read back the setup of counting direction

13. LSI3188 Error codes summary

13.1 LSI3188 Error codes table

Error Code	Symbolic Name	Description
0	DRV_NO_ERROR	No error.
2	DRV_INIT_ERROR	Initial error
3	DRV_UNLOCK_ERROR	Security unclock failure
4	DRV_LOCK_COUNTER_ERROR	Dead lock, unclock failure more than 10 times
5	DRV_SET_SECURITY_ERROR	Password overwrite error
100	DEVICE_IO_ERROR	Device drive error
101	DRV_NO_CARD	No card find error
102	DRV_DUPLICATE_ID	Card duplicate error
300	LSI_ID_ERROR	CardID setting error, CardID doesn’t match the DIP SW setting
301	LSI_COUNTER_MODE_ERROR	LSI3188_set_counter_mode(),"mode" parameter out of range.
302	LSI_TIMER_CONSTANT_ERROR	LSI3188_timer_set(),"time" parameter out of range.
303	LSI_CI_MODE_ERROR	LSI3188_CI_mode_set(),"control" parameter out of range.
304	LSI_MULTIPLE_RATE_ERROR	LSI3188_CI_mode_set (),"mode" parameter out of range.
306	LSI_CO_ERROR	LSI3188_CO_mode_set (),"mode" parameter out of range.
307	LSI_HOME_MODE_ERROR	LSI3188_HOMING_mode_set(),"mode" parameter out of range.
308	LSI_COMPARE_MODE_ERROR	LSI3188_compare_mode_set(),"mode" parameter out of range.
309	LSI_POLARITY_ERROR	"polarity" parameter out of range.
316	LSI_COUNTER_ERROR	LSI3188_counter_start (),"control" parameter out of range.
317	LSI_IRQ_MASK_ERROR	LSI3188_IRQ_mask_set (),"control" parameter out of range.
400	LSI_DRIVER_NOT_SUPPORT	driver not support interrupt function
500	PORT_ERROR	Function input parameter error. Parameter out of range.
501	DEBOUNCE_MODE_ERROR	LSI3188_debounce (),"control" parameter out of range.

502	INDEX_ERROR	TC register index error
503	SOURCE_ERROR	IRQ source parameter out of range.
504	CHANNEL_ERROR	Trigger command channel out of range
505	CONTROL_ERROR	Trigger command control out of range