User Manual

IC-M29

Digital Monochrome 29Megapixel

CCD Camera with Camera Link Interface

Revision History

Revision	Descriptions
0.1	Draft
0.2	Added Serial Communication specification
0.3	Added Camera control tool(GUI) Fixed Minor errors
0.4	Fixed Minor errors
0.5	Fixed Minor errors
0.6	Updated function information Updated Serial Communication Command Updated Camera Control Tool(GUI) Added Grabber(Matrox DCF File) Setting Added Firmware Writing Fixed Minor errors
0.7	Updated Camera Control Tool(GUI)
0.8	Fixed Minor errors
0.9	Updated Camera Control Tool(GUI) Rev 1.1D Added M72 Mount Camera
1.0	Fixed Minor errors

- Table of Contents -

1. Precautions

1-1. General

- Do not drop or damage the device
- Do not disassemble, repair or alter the device
- Keep the machine not to be stained with the alien substances
- Contact your nearest distributor in case of trouble or problem.

1-2. Precautions in Use

- Do not expose the camera's image-pickup-plane to sunlight or other intense light directly. Its inner CCD sensor might be damaged.
- In clearing, do not splash water on the device but wipe it out with smooth cloth or towel.
- Do not place magnets near the product.
- Be careful not to let liquid like water, drinks or chemicals leak inside the device.
- Clean the device often to remove dust on it.
- If the camera is not in use, attach the lens cap to the camera to protect the Image Pickup surface.

1-3. Maintenance

Turn off power to the equipment and wipe it with a dry cloth.
If it becomes severely contaminated, gently wipe the affected areas with a soft Cloth dampened with diluted neutral detergent. Never use alcohol, benzene, thinner, or other chemicals because such chemicals may damage or discolor the paint and indications. If the image pickup surface becomes dusty, contaminated, or scratched, consult your sales representative.

2. Overview

IC-M29 is a mono area scan CCD camera.

IC-M29 has 29 million pixels resolution.

These Cameras are suitable for a wide range of application within factory Automation, an also for application outside the factory floor, such as AOI(Automatic Optical Inspection), High-end surveillance and medical.

Main Function

1) ROI(Region of interest)
2) DPC(Defective Pixel Correction)
3) FFC(Flat Field Correction)
4) Binning
5) VGA(Variable gain amplifier) Gain Control
6) Black Clamp Level Control
7) Gamma Control
8) Mode : Trigger Master Mode / Trigger Slave Mode / Free Run Mode
9) Image Data Output & Speed Selectable
10) Exposure Time Control
11) Test Pattern
12) External Trigger Support / External Strobe Output Support
13) Temperature Monitoring

3. Specification

3.1 Electrical specification

- Image Sensor : Truesense KAI-29050 29M CCD image Sensor(Global Shutter)
- Number of active pixels : 6576(H) x 4384(V)
- full resolution in continuous operation : 5 frames/second [2Tap Base]
- Pixel size : 5.5μm (H) × 5.5μm (V)
- Optical size : 35mm Optical Format
- Active Sensor Size : 36.17mm(H) x 24.11mm(V)
- Number of Output : Quad
- Sensitivity : 34uV / e-
- ADC resolution : 8bit / 10bit / 12bit Raw Bayer Pattern Output
- S/N Ratio : 55dB Over

- Dynamic Range : 64dB
- Full Well Capacity : 20000 e-
- Operating Temp : 0℃ ~ +40℃(Performance assurance)
- Humidity : 20% ~ 90% RH(Non Condensing)
- Camera Link Configuration : 2Tap Camera Link Base Mode
- Built in LUT (Look Up Table)
- Defective Correction Circuit built in
- Pre-select and pulse width trigger modes
- Power supply voltage : DC12 V ± 10%(ripple 50 mV or less) / MAX 15W
- LVAL-synchronous / A-synchronous operation (auto-detect)
- Setup by Windows XP / VISTA / WIN7 serial communication

3.2 Electrical shutter specification

- Shutter Speed :
  - -. Exposure Time is 100μsec to 7000msec
  - -. Factory default : 10ms
- Random Trigger Shutter (Factory default : Fixed Mode)
  - -. Fixed mode : The exposure time depends on the shutter speed setting
  - -. Pulse width mode : The exposure time depends on the pulse width.
  - -. Minimum pulse width : 100μsec(Minimum exposure time: 100μsec)

3.3 Mechanical spec

- Lens mount : F Mount / M72 Mount
- Dimensions : F Mount 97mm(L) * 97mm(W) * 86mm(H)
  M72 Mount 97mm(L) * 97mm(W) * 77mm(H)
- Weight : Approx 1.0kg
- Camera body grounding : Conductive between circuit GND and camera body

3.4 Input signal specification

- TRIG : Camera Link I/F(CC1) and External Control connector input
  - -. Signal level : TTL level
  - -. Polarity : High/Low switching (Factory default: Active-High)
  - -. Pulse width : 100μsec or more

3.5 Operating ambient conditions

■ Performance assurance

-. Temperature : 0℃ to +40℃

-. Humidity : 20% ~ 90% RH(Non Condensing)

■ Operation Temperature(Image & Life cycle cannot guarantee)

-. Temperature : 0℃ to +70℃

-. Humidity : 10% to 90%(No dew formation)

■ Storage Temperature

-.Temperature : -20℃ to +70℃

-. Humidity : 90% or less (No dew formation)

3.6 Various safety standards

■ Performance assurance

-.CE(AoC)

Test Standard(2004/108/EC) : EN55022:2006 +A1:2007 [Class A Equipment]

EN 55024 : 1998 +A1:2001, +A2:2003

-.FCC(Verification)

Test Standard : Section 15.107, Section 15.109 (Class A Equipment)

NOTE : This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

3.7 Sensor Spectral Response(Quantum Efficiency) Information

3.7.1 Spectral response Mono

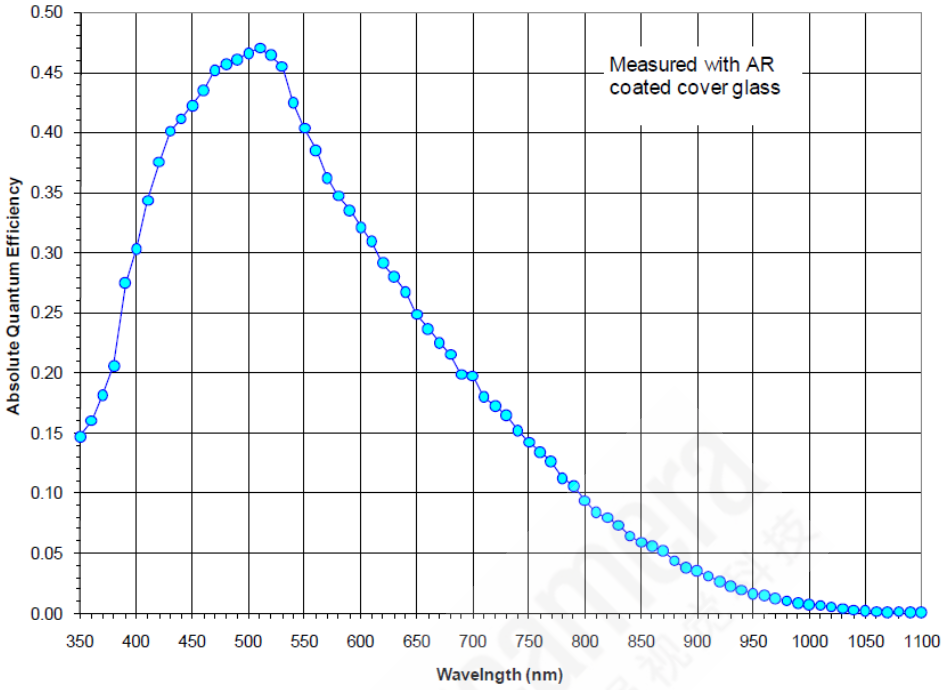


Fig 3.1 Spectral response

4. Camera Interface

4.1 General Description

As shown in the following figure, 3 types of connectors and status indicator LED Are located on the back of the camera and have the functions as follows :

(1) Power Connector : 6 pin Power Input

▷ Camera Power Input(DC-12V/15W)

(2) Control Connector : 12 pin Control Connector

▷ External Trigger Signal Input(2 Pin) and Strobe Output(1 Pin)

▷ Firmware Download Input(9 Pin)

(3) 26 pin Camera-Link Connector

▷ Video Data Transmission, Camera Control

(4) Status LED

▷ Initial Status Red LED Sequence

1) Red LED on 0.7 second : Camera operates in power on
2) Red LED off 8.3 second : Initial Status
3) Red LED flashing at 0.5 second intervals : Camera Freerun operation

▷ Operation Mode Red LED Status

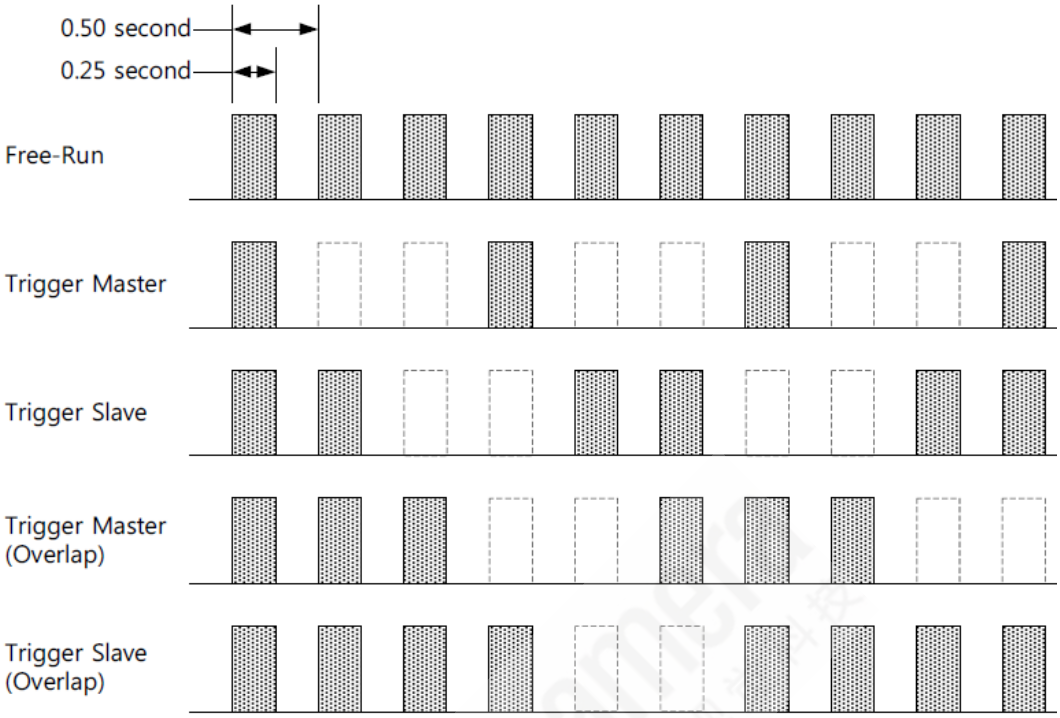


Fig 4.1 Operation Red LED Status(Gray Tone timing is LED on status)

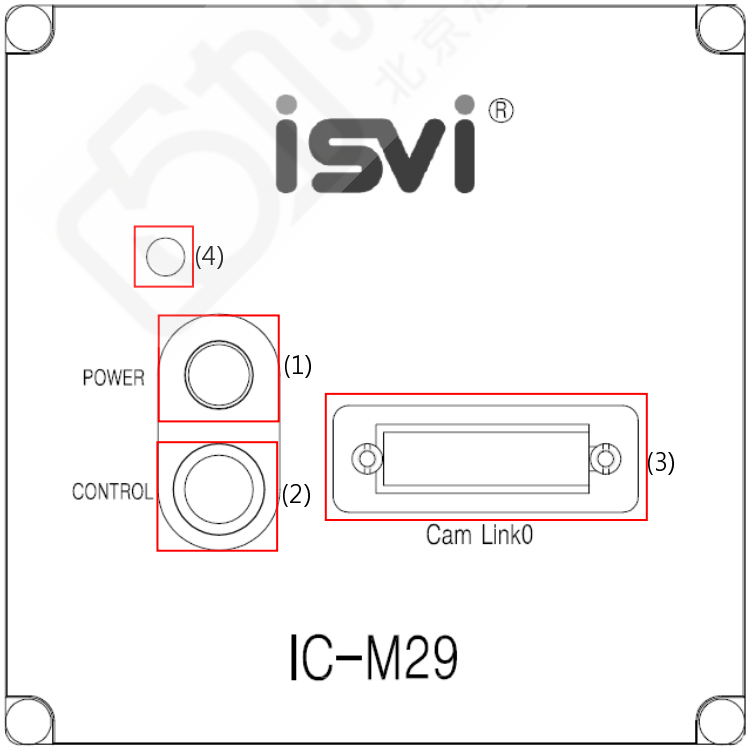


Fig 4.2 IC-M29 CONNECTOR

4.2 Camera Link Connector

(1) Video output/controlling (Camera Link Base Configuration) : CAMERA LINK0

▷ Connector type: MDR 26-PIN connector 10226-52A2PL (Manufactured by 3M)

▷ Camera output complies with Camera Link Standard and following list shows the pin configuration of connector.

▷Base : 2tap(8bit /10bit /12bit) : Camera link 0 connector

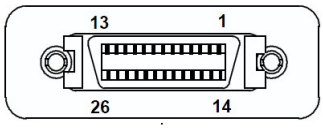


Fig 4.3 Camera Link0 Connector

Pin No	I/O	Signal Name	Pin No	I/O	Signal Name
1	Ground	Inner shield	14	Ground	Inner shield
2	OUT	X0-	15	OUT	X0+
3	OUT	X1-	16	OUT	X1+
4	OUT	X2-	17	OUT	X2+
5	OUT	XCLKOUT-	18	OUT	XCLKOUT+
6	OUT	X3-	19	OUT	X3+
7	INPUT	RX+_SERTC+	20	INPUT	RX-_SERTC-
8	OUT	TX-_SERTFG-	21	OUT	TX+_SERTFG+
9	INPUT	CC1-(Trigger-)	22	INPUT	CC1+(Trigger+)
10	INPUT	CC2+	23	INPUT	CC2-
11	INPUT	CC3-	24	INPUT	CC3+
12	INPUT	CC4+	25	INPUT	CC4-
13	Ground	Inner shield	26	Ground	Inner shield

Fig 4.4 Camera Link 0 Pin Assignments

4.3 Camera Link Interface

The video output is Camera Link, where the 8 channels with 8bit video are placed in a base configuration. The digital output signals follow the Camera Link standardized multiplexed signal output interface.

The output driver is NS type DS90CR287, and the receiver is NS type DS90CR288. The data bits from the digital video, FVAL, LVAL and DVAL are multiplexed into the twisted pairs, which are a part of the Camera Link. Trigger signals and the serial camera control are feed directly through its own pairs.

The 26 pin connector pin assignment follows the Camera Link base configuration. For a detailed description of Camera Link specifications, please refer to the Camera Link standard specifications found on http://www.machinevisiononline.org

4.4 Power Input Connector

Power input connector of camera is Hirose 6 pin connector(part # HR10A-7R-6PB).

Pin arrangement and configuration are as follows:

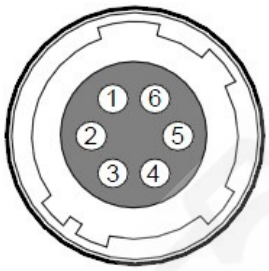


Fig 4.5 Power Input Connector

Pin No	I/O	Signal Name
1	INPUT	+12V
2	INPUT	+12V
3	INPUT	+12V
4	GND	GROUND
5	GND	GROUND
6	GND	GROUND

Power plug can be configured using the Hirose 6 pin plug (part # HR10A-7R-6PB) or compatible parts enclosed in the camera box. For power supply, it is recommended to use the power adapter with over 2A current output at 12VDC ±10% voltage output.

4.5 Control Connector

The control connector used is Hirose 12 pin connector(part # HR10A-10R-12SB) and consists of external trigger signal input and strobe output port.

Pin arrangement and configuration are as follows:

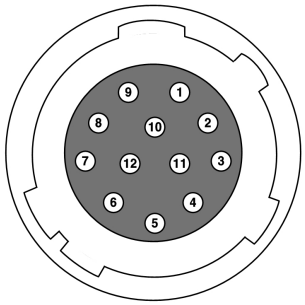


Fig 4.6 I/O Control Connector

Pin	I/O	Signal Name	Pin	I/O	Signal Name
1	INPUT	Trigger +	7	OUTPUT	Reserved
2	INPUT	Trigger -	8	INPUT	Reserved
3	OUTPUT	Strobe Output	9	INPUT	Reserved
4	INPUT	Reserved	10	OUTPUT	Reserved
5	GND	GROUND	11	INPUT	Reserved
6	INPUT	Reserved	12	INPUT	Reserved

▷ Camera firmware upgrade

Camera firmware upgrade is available through the ISVI firmware cable.

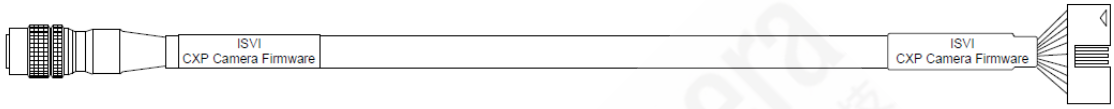
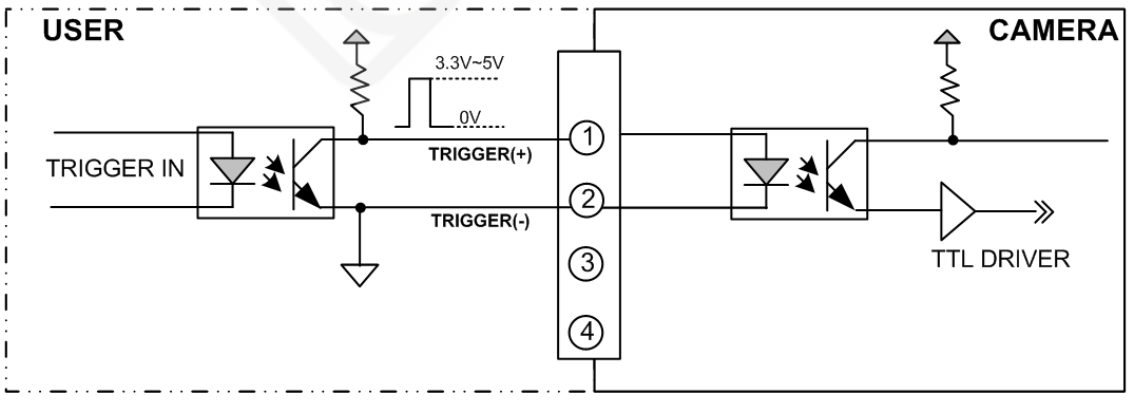


Fig 4.7 ISVI Firmware cable

4.6 Trigger Input Circuit

Following figure shows trigger signal input circuit of 12 pin connector. Trigger signal entered is delivered to internal circuit through photo coupler. Minimum trigger width that can be recognized at camera is 100us. If trigger signal entered is less than 100us, trigger signal is ignored in camera. External trigger signal can approve signals to the circuits in the 2 methods shown below.



[HR10A-10R-12SB]

Fig 4.8 Trigger Input Schematic

4.7 Strobe Output Circuit

Strobe output signal is output through TTL Driver IC of 3.3 V output level and pulse width of signal is output in synchronization with exposure of camera.

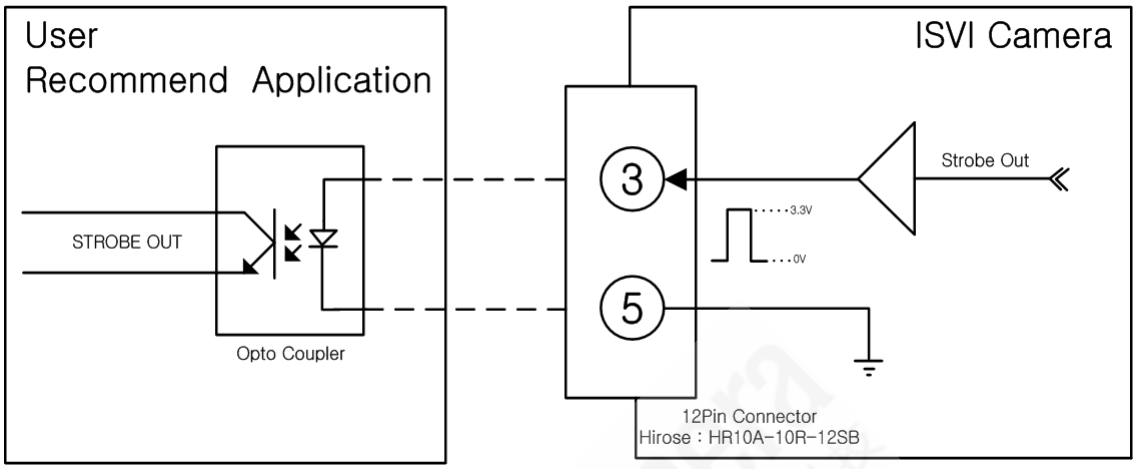


Fig 4.9 Strobe Output Schematic

5. Functions and Operations

5.1 Basic Functions

The IC-M29 cameras is a interline transfer CCD camera with 29 Mega pixels monochrome. The interface to the host PC is via digital Camera Link. Output video as 8,10,12bits. The camera also features several pre-processing functions. There are two trigger modes in addition to continuous operation. The Pre-Select and Pulse Width trigger modes are available with a unique Automatic LVAL sync or a-sync selection function. Below the functions are described in detail below.

5.2 Trigger operation

Trigger mode of camera is divided into Free-Run mode where image is synchronized to Internal Trigger signal created inside camera, and External Sync mode where image is synchronized to the trigger signal entered in external port.

5.2.1 Free Run Mode

In FreeRun mode, the cycle of internal trigger signal is determined by Transfer Time (1 Frame data transmission time) and Exposure setting value, and image is obtained with such periodic signal. FreeRun mode is always operating in overlap mode(Exposure time should be within 1 frame transfer time-224.7ms)

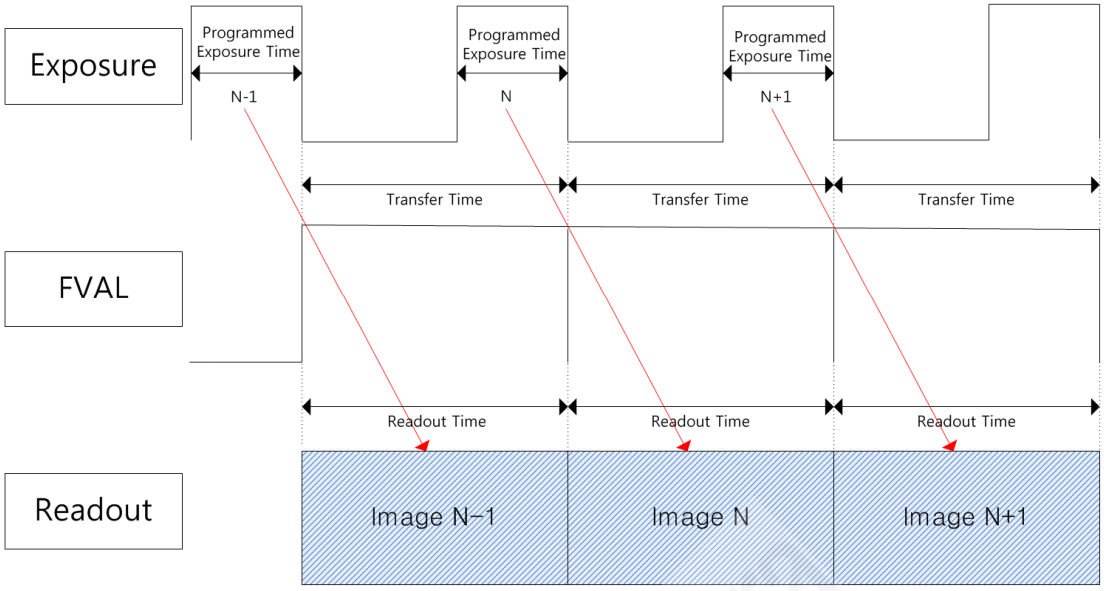


Fig 5.1 Freerun Mode Normal Operation

5.2.2 Trigger Mode/Master/Slave

In Trigger Mode, camera keeps standby status until trigger signal is entered, and when trigger input occurs, Readout start after Exposure process set earlier. After Readout is completed, and returns to trigger standby status again. In Trigger mode, if a new trigger input occurs during readout, the new trigger input is ignored.

In Trigger mode, it is required to set Trigger Source regarding which input, CC1 input port(Camera Link) or External Trigger port, will be used for trigger signal, as well as Polarity and Exposure source of signal entered.

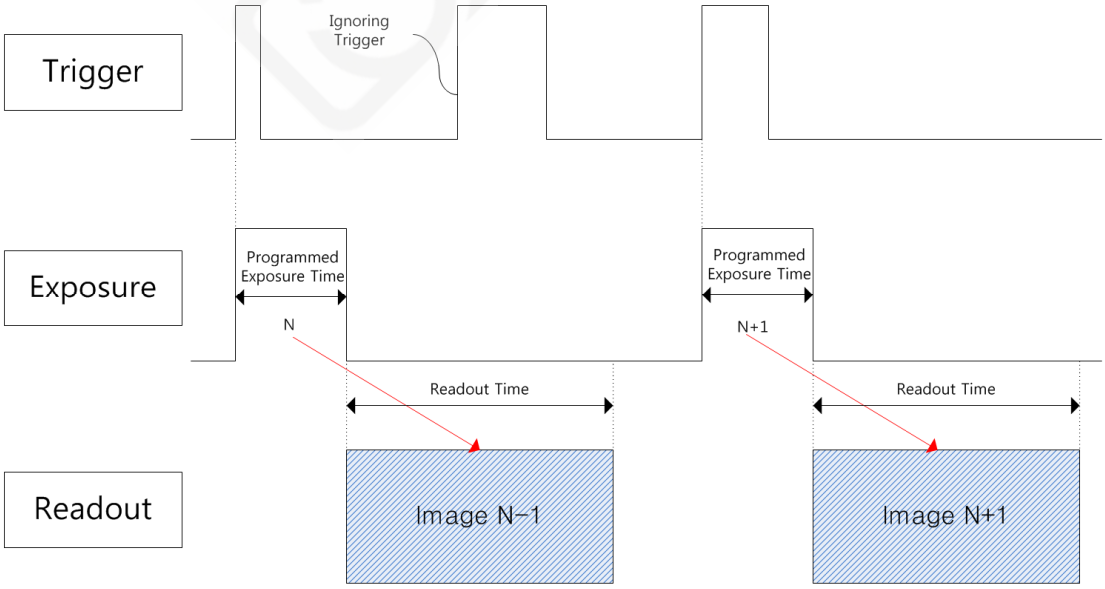


Fig 5.2 Trigger Mode / Master

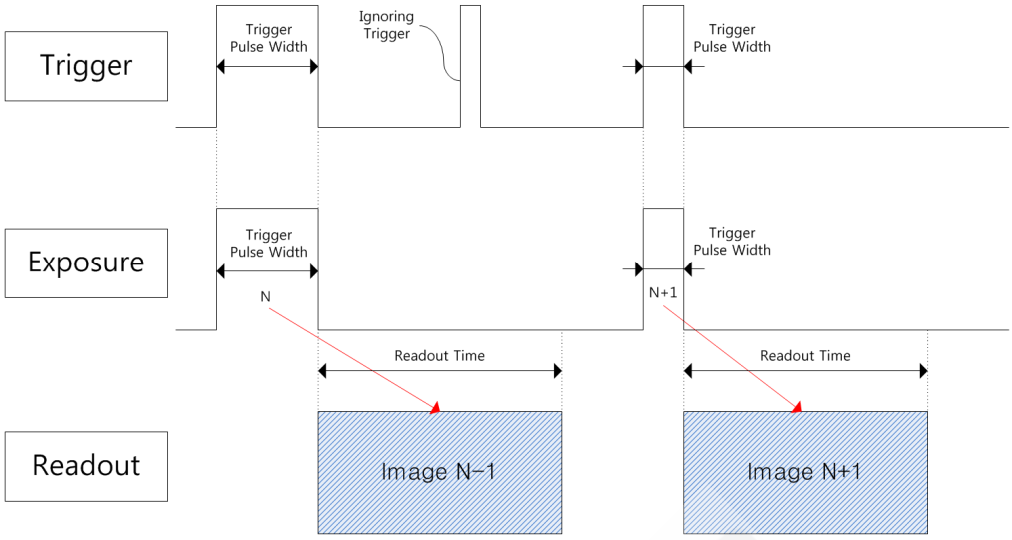


Fig 5.3 Trigger Mode / Slave

5.2.3 Overlap mode

Camera keeps standby status until trigger signal is entered and Readout starts after exposure process set earlier if trigger input occurs. When new trigger input occurs during Readout of First image, it keeps Readout and pass exposure process of new trigger input. Provided, however, that when trigger input occurs during Exposure since Exposure Time is longer than trigger interval, that trigger signal is ignored. To obtain the image as maximum frame for trigger input, Exposure Time should not be longer than Readout time, trigger time should not be shorter than Readout time. Readout time for the IC-M29 is 224.7ms.(Quad Output) Overlap mode operates ideally when trigger signal interval or exposure time is constantly kept. Overlap mode only operating in the Trigger mode.

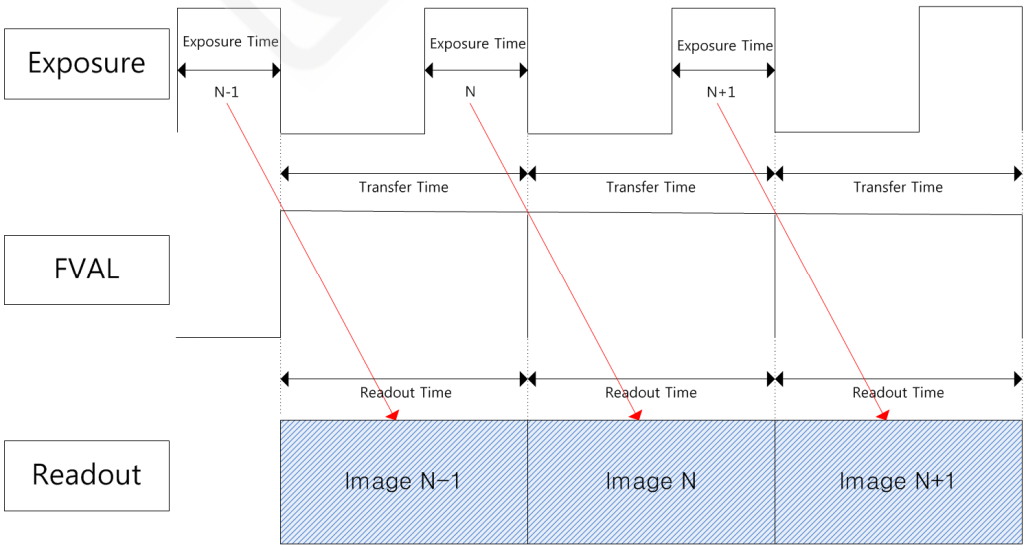


Fig 5.4 Overlap Mode Operation(Transfer Time > Exposure Time)

5.3 Gamma Correction - LUT(Look Up Table)

LUT (Lookup Table) enables the conversion of the original image value into an ad-hoc level value. Since one-on-one mapping is performed for each level value, you can connect the ad-hoc 12-bit input to the ad-hoc 12-bit output. LUT has a programmable look-up table (LUT) that lets the user adjust the transfer function of the video output. Selectable settings include multiple-point LUT and Gamma 0.45. The look up table has 4096 setting points by which the full range of input signal is divided. On each of the point, the gain can be set to get a required transfer function. Gamma 0.45 or programmable LUT can be selected by software control. If the LUT is not configured, Gamma is set at 1.0(off).

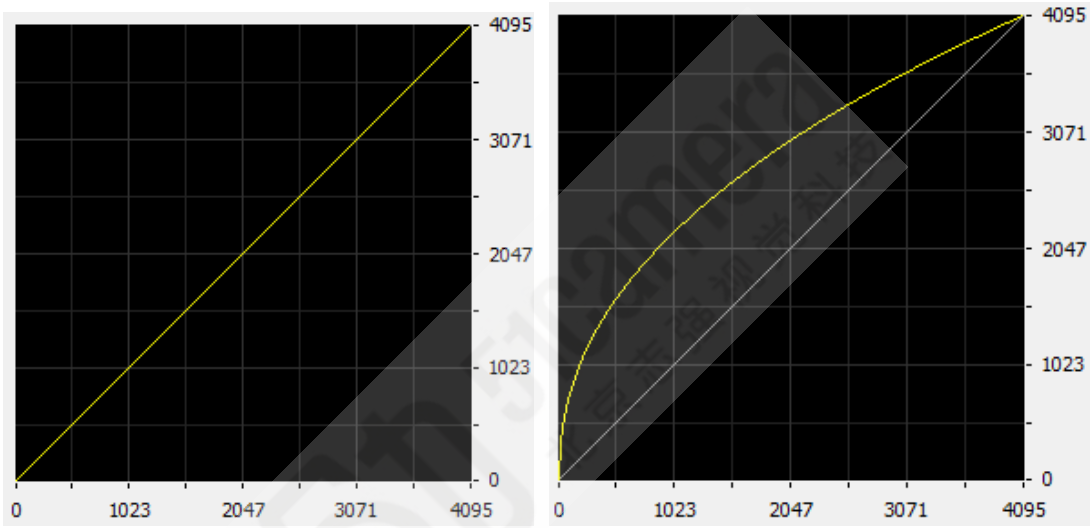


Fig 5.5 Gamma Correction(Left Image : 1.0, Right Image : 0.45)

5.4 Defective Pixel Correction

There could be incidence of light-malfunctioning defective pixel in the CCD. In this case, additional correction is required to enhance the degraded quality of output images. For each camera, defective pixel information of CCD is encoded during the shipping process. If a user demands an addition of defective pixel information, a new coordinate of defective pixel must be entered into the camera.

5.5 Flat Field Correction

Flat Field Correction is a function which corrects a non-uniform pixel response across a CCD and makes the response as uniform as possible (flat), assuming the offsets are non-varying (fixed) patterns.

5.6 Test Pattern Image

It can be set to output test image created inside instead of image data output from image sensor, in order to check normal operation of camera. 2 types of test image are available.(Test Pattern 1 : Fixed Image, Test Pattern 2 : Moving Image)

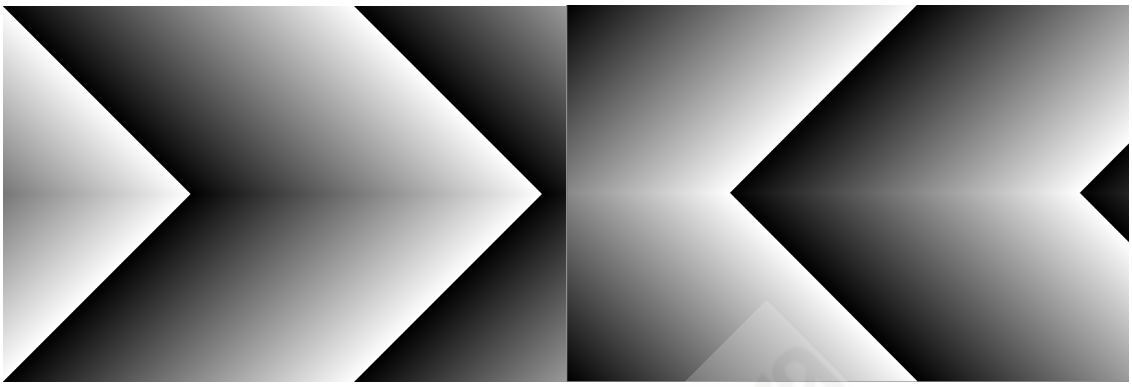


Fig 5.6 Test Pattern Image 1(Left Image-Fixed) or 2(Right Image-Moving)

5.7 Region Of Interest

ROI is the area containing the data required by the user within the entire image. The user can obtain the image faster than obtaining overall areas by designating the area as ROI while keeping the same high quality.

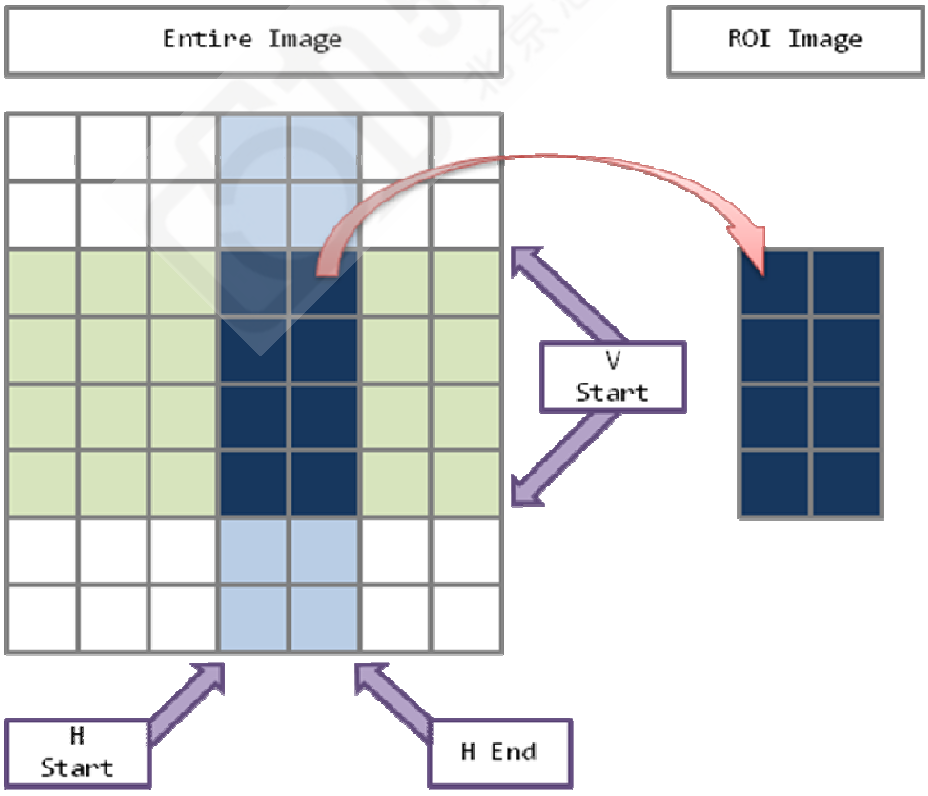


Fig 5.7 ROI(Region Of Interest)

5.8 Binning

CCD Binning (or Pixel Binning) is the process of combining neighboring pixels on an image sensor (CCD sensor) into a "super pixel". This super pixel represents the area of all the individual pixels contributing to the charge. For example, in 2 x 2 CCD binning, the charge from a square of 4 adjacent pixels is combined into 1, and in 4 x 4 CCD binning, the charge from a square of 16 adjacent pixels is combined into 1.

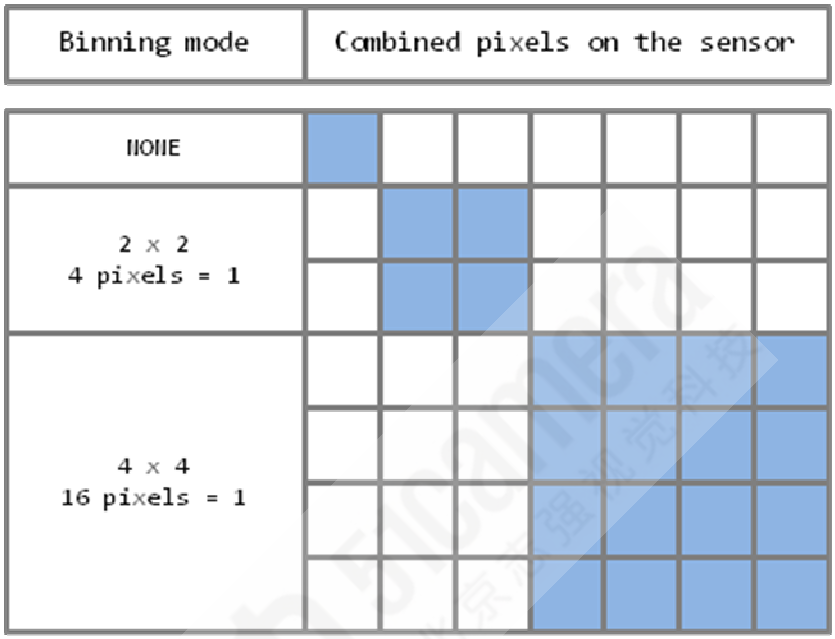


Fig 5.8 Binning

Binning provides several beneficial results:

1) An increase in signal equal to the number of pixels binned.
   This allows the camera to detect fainter signals and reduce exposure time.
2) An increase in frame rate due to the reduction in exposure time and a reduction in the number of pixels to be measured
3) An increase in the signal to noise ratio resulting from a single read error being applied to the charge of the binned pixels rather than the addition of multiple read errors if the pixels were read individually.
4) An increase in the dynamic range of the sensor resulting from the larger charge capacity of the summing node (typically 1.65-2 times increase in well depth).

The trade off for the gains due to binning are:

1) A loss of image resolution equal to the binning level.
2) An increase in dark current proportional to the number of pixels binned.

6. External Appearance and Dimensions

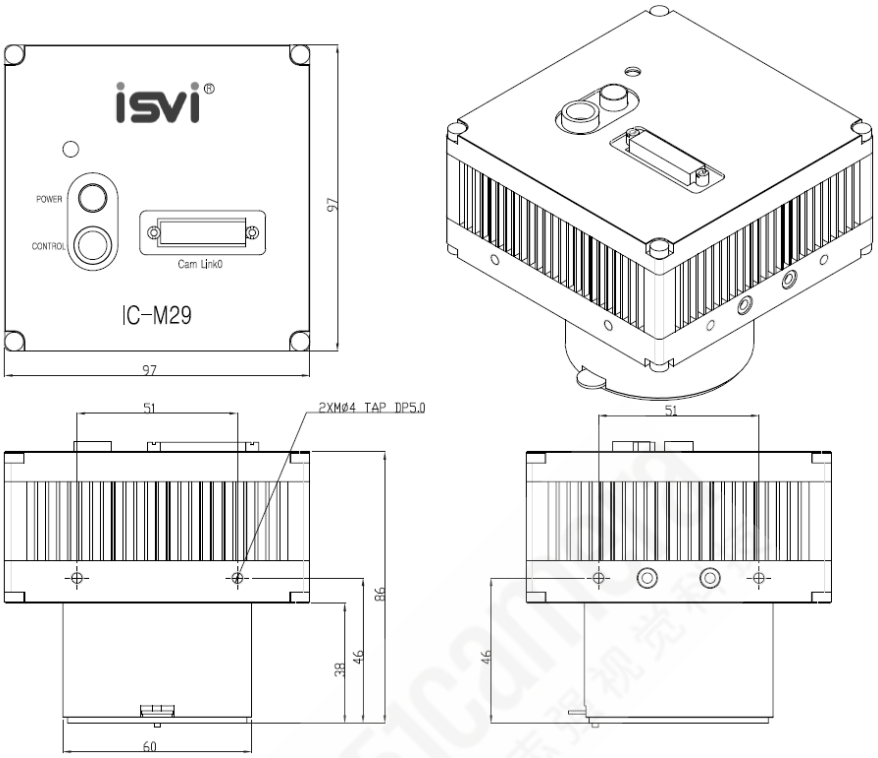


Fig. 6-1 F-mount Dimension

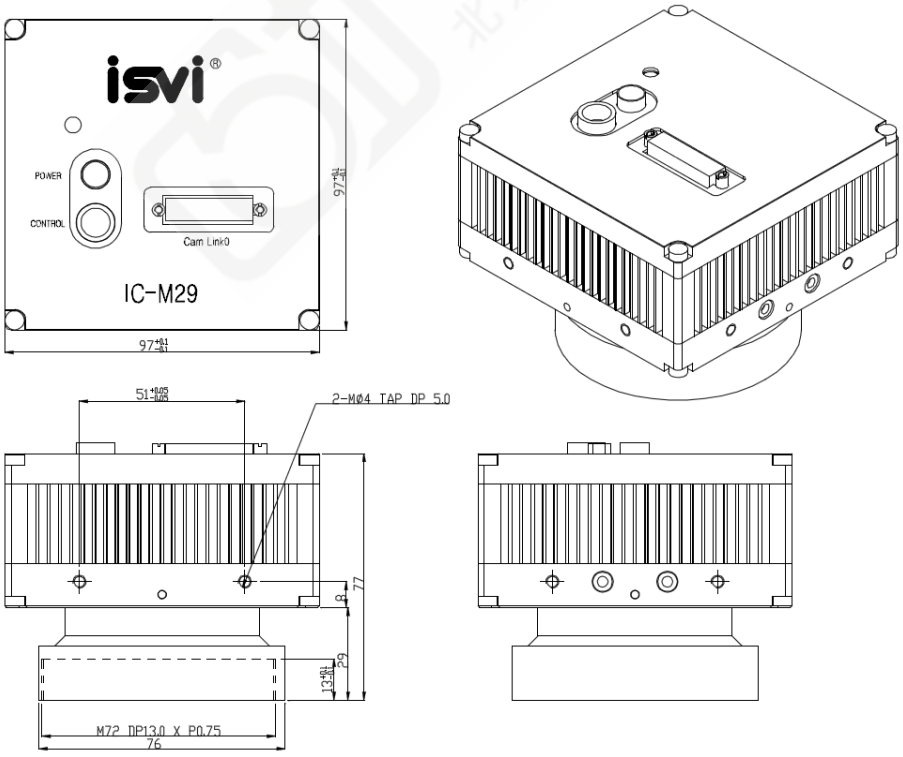


Fig. 6-2 M72-mount Dimension

7. Communication specification

All configuration of the 29M series camera is done via Camera Link.
All types of camera setting commands, requiring data transmission are delivered in Hex command type. The camera can be set up from a PC running terminal emulator software, or using iSVi camera control software.(IC-M29_Mon GUI)

7.1 Communication Setting:

- Baud Rate : 19,200 bps
- Data bit : 8 bit
- Parity : None
- Stop bit : 1 bit
- Flow Control : None

7.2 Command Format

<command> <parameter1> <parameter2> < \ r>
(0 ~ 2 Parameters follow the command.)

Example 1.

```
Command    : "set 10000<\r>"
             73 65 74 20 31 30 30 30 30 0D
Response   : "OK<\r><\n>"
             4F 4B 0D 0A
```

7.3 Command List

7.3.1 Readout Mode

Type	Command	Response	Description
Get	"grm<\r>"	"<0|1|2><\r><\n>"	0 = Normal Mode 1 = ROI Mode 2 = Binning(2 or 4) Mode
Set	"srm <0|1|2><\r>"	"OK<\r><\n>"	

7.3.2 ROI Horizontal Area

Type	Command	Response	Description
Get	“gha<\r>”	“<0~6574> <1~6575> <\r><\n>”	<0~6574> starting point <1~6575> Endpoint
Set	“sha <0~6574> <1~6575> <\r>”	“OK<\r><\n>”	

7.3.3 ROI Vertical Area

Type	Command	Response	Description
Get	“gva<\r>”	“<0~2190><\r><\n>”	<0 ~ 2190> starting point
Set	“sva <0~2190><\r>”	“OK<\r><\n>”	

7.3.4 Binning Mode

Type	Command	Response	Description
Get	“gbf<\r>”	“<0|1><\r><\n>”	0 = 2 by 2 binning 1 = 4 by 4 binning
Set	“sbf <0|1><\r>”	“OK<\r><\n>”	

7.3.5 Data Bits

Type	Command	Response	Description
Get	“gdb<\r>”	“<0|1|2><\r><\n>”	0 = 8-bit 1 = 10-bit 2 = 12-bit
Set	“sdb <0|1|2><\r>”	“OK<\r><\n>”	

7.3.6 Test Pattern Enable

Type	Command	Response	Description
Get	“gte<\r>”	“<0|1|2><\r><\n>”	0 = disable 1 = test image 1 2 = test image 2 <0~255> speed of moving test image
Set	“ste <0|1|2> <0~255> <\r>”	“OK<\r><\n>”	

7.3.7 LUT Mode

Type	Command	Response	Description
Get	“gls<\r>”	“<0|1|2><\r><\n>”	0 = Off 1 = LUT1 2 = LUT2
Set	“sls<0|1|2><\r>”	“OK<\r><\n>”	

7.3.8 Reset

Type	Command	Response	Description
Set	“rst <0|1><\r>”	“OK<\r><\n>”	0 = EPCS 1 = SDR

7.3.9 Defective Pixel Correction

Type	Command	Response	Description
Get	“gdc<\r>”	“<0|1><\r><\n>”	0 = disable 1 = enable
Set	“sdc <0|1><\r>”	“OK<\r><\n>”	

7.3.10 Flat Field Correction

Type	Command	Response	Description
Get	“gfc<\r>”	“<0|1><\r><\n>”	0 = disable 1 = enable
Set	“sfc <0|1><\r>”	“OK<\r><\n>”	

7.3.11 Flat Field Offset

Type	Command	Response	Description
Get	“gfo<\r>”	“<0~4095><\r><\n>”	<0~4095> Flat Field Target Level
Set	“sfo <0~4095><\r>”	“OK<\r><\n>”	

7.3.12 Generate Flat Field Data

Type	Command	Response	Description
Set	“ggd <1~16><\r>”	“OK<\r><\n>”	<1~16> Number of frames

7.3.13 Save Flat Field Data

Type	Command	Response	Description
Set	“sgf<\r>”	“OK<\r><\n>”	Save Flat Field Data to nonvolatile memory

7.3.14 Trigger Mode

Type	Command	Response	Description
Get	“gtm<\r>”	“<0|1|2><\r><\n>”	0 = Free-Run Mode 1 = Trigger-Master Mode 2 = Trigger-Slave Mode
Set	“stm <0|1|2><\r>”	“OK<\r><\n>”	

7.3.15 Overlap Enable

Type	Command	Response	Description
Get	“goe<\r>”	“<0|1><\r><\n>”	0 = disable 1 = enable
Set	“soe <0|1><\r>”	“OK<\r><\n>”	

7.3.16 Trigger Source

Type	Command	Response	Description
Get	“gts<\r>”	“<0|1><\r><\n>”	0 = Camera Link CC1 1 = External Trigger Input
Set	“sts <0|1><\r>”	“OK<\r><\n>”	

7.3.17 Trigger Polarity

Type	Command	Response	Description
Get	“gtp<\r>”	“<0|1><\r><\n>”	0 = Active-Low 1 = Active-High
Set	“stp <0|1><\r>”	“OK<\r><\n>”	

7.3.18 Exposure Time

Type	Command	Response	Description
Get	“get<\r>”	“<100~7000000><\r><\n>”	Min. Exposure Time 100 = 100 usec Max. Exposure Time 7000000 = 7 sec
Set	“set <100~7000000><\r>”	“OK<\r><\n>”	

7.3.19 Strobe Out Offset

Type	Command	Response	Description
Get	“gso<\r>”	“<0~10000><\r><\n>”	Min. 0 = 0 usec Max. 10000 = 10,000 usec
Set	“sso <0~10000><\r>”	“OK<\r><\n>”	

7.3.20 Strobe Out Polarity

Type	Command	Response	Description
Get	“gsp<\r>”	“<0|1><\r><\n>”	0 = Active-Low 1 = Active-High
Set	“ssp <0|1><\r>”	“OK<\r><\n>”	

7.3.21 VGA Gain

Type	Command	Response	Description
Get	“gvg<\r>”	“<0~700><\r><\n>”	Min. VGA Gain 0 = 0 dB Max. VGA Gain 700 = 25.06 dB
Set	“svg <0~700><\r>”	“OK<\r><\n>”	

7.3.22 VGA Gain Offset

Type	Command	Response	Description
Set	“sgo <0|1|2|3> <0 ~ 700><\r>”	“OK<\r><\n>”	<0|1|2|3> 0 = Channel A 1 = Channel B 2 = Channel C 3 = Channel D <0 ~ 700> 0 = 0 dB(Min.) 700 = 25.06 (Max.)

7.3.23 Optical Black Clamp Level

Type	Command	Response	Description
Get	“gcl<\r>”	“<0~700><\r><\n>”	0 = Min.Black Clamp Level 700 = Max.Black Clamp Level
Set	“scl <0~700><\r>”	“OK<\r><\n>”	

7.3.24 Optical Black Clamp Level Offset

Type	Command	Response	Description
Set	“sco <0|1|2|3> <0 ~ 700><\r>”	“OK<\r><\n>”	<0|1|2|3> 0 = Channel A 1 = Channel B 2 = Channel C 3 = Channel D <0 ~ 700> 0 = Min. 700 = Max.

7.3.25 Config Initialization

Type	Command	Response	Description
Get	“gci<\r>”	“<0|1|2><\r><\n>”	0 = Factory Default 1 = User 1 2 = User 2
Set	“sci <0|1|2><\r>”	“OK<\r><\n>”	

7.3.26 Load & Save Config

Type	Command	Response	Description
Load	“lcf <0|1|2><\r>”	“OK<\r><\n>”	0 = Factory Default 1 = User 1 2 = User 2
Save	“sct <1|2><\r>”	“OK<\r><\n>”	1 = User 1 2 = User 2

7.3.27 Current Temperature

Type	Command	Response	Description
Get	“gct<\r>”	“<s1> <s2><\r><\n>”	s1 = Fahrenheit's temperature scale s2 = Celsius temperature scale

7.3.28 MCU Version

Type	Command	Response	Description
Get	“gmv<\r>”	“<s><\r><\n>”	Displays MCU Version

7.3.29 Model Number

Type	Command	Response	Description
Get	“gmn<\r>”	“<s><\r><\n>”	Displays Model Number

7.3.30 FPGA Version

Type	Command	Response	Description
Get	“gfv<\r>”	“<s><\r><\n>”	Displays FPGA Version

7.4 Storage Area

The camera has 3 storage area.(Factory Area, User1 Area, User2 Area)

Storage area to store the camera setting value. User area can be read and written, but Factory area can be read only. At camera booting, setting value in one of 3 storage area is copied to camera according to config initialization value and value of the area is used for camera setting.

Default(Factory) Setting	
Trigger Mode	Freerun
Output Pixel Format	12 bit
Sensor Output Channel	Quad Output
Camera Link Output Channel	2 TAB
External Trigger Source	Camera Link CC1
Trigger Source Polarity	Active High
Strobe Out Polarity	Active High
Exposure Time	10ms
VGA Gain / Black Clamp Level	0 / 0
DPC / FFC	On / Off

7.5 Sensor Area Define

The camera is divided into four areas. Camera sensor area appears as shown in Fig 7-1.

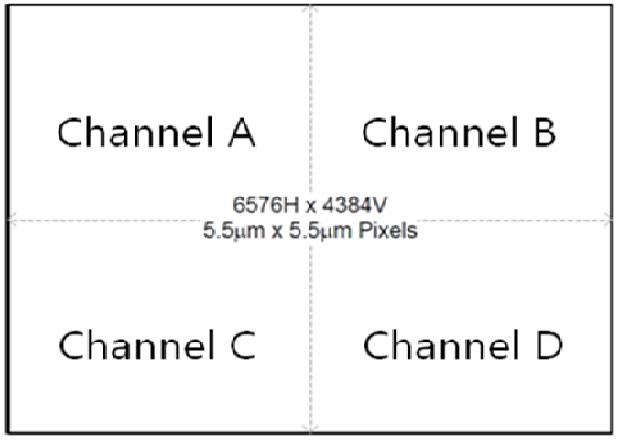


Fig. 7-1 29M CCD Sensor Area Define

8 Camera Control Tool(GUI)

8.1 Camera Connect

Camera configuration utility software, the IC-M29_Mon, is provided with change its settings and save the settings a file or in the camera.

1) ISVI Camera Scan.

- When you execute the program while the camera is turned on, Camera Scan window appears as shown in the figure below. At this time, the program checks serial port of computer and DLL provided by camera link to scan whether the camera is connected. If there is a camera connected, it displays Version information and model name on the screen. If the camera is not properly displayed on the screen check the connection of cable with power of camera and press Scan button If you found a camera, Configurations is executed and displays current setting value of camera connected.

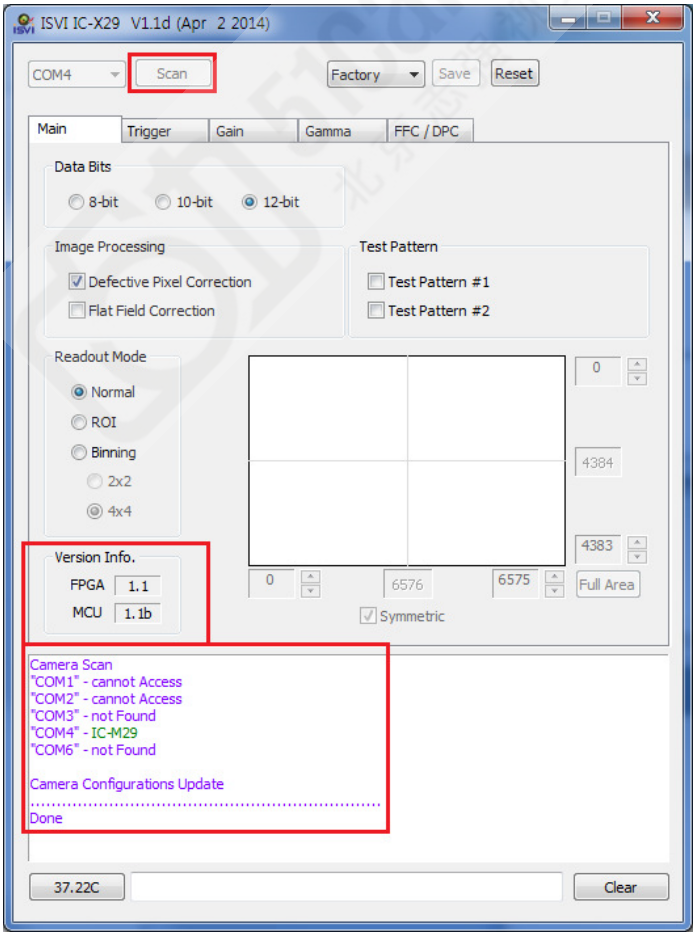


Fig. 8-1 ISVI Camera Scan

8.2 User work space

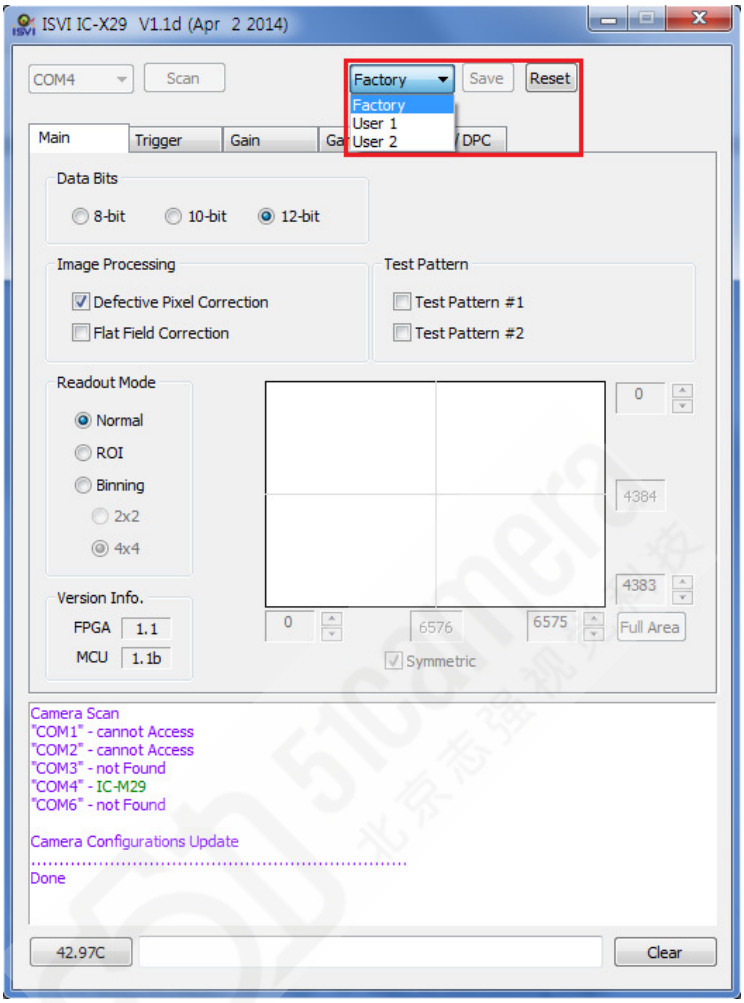


Fig. 8-2 User work space

1) User Work Space Selection window.
   - If you change the User Space is immediately stored in the camera and reset.
2) Save : Saves the camera setting values to the camera memory(User1,User2)
3) Reset : Camera Reset

8.3 Main Tab

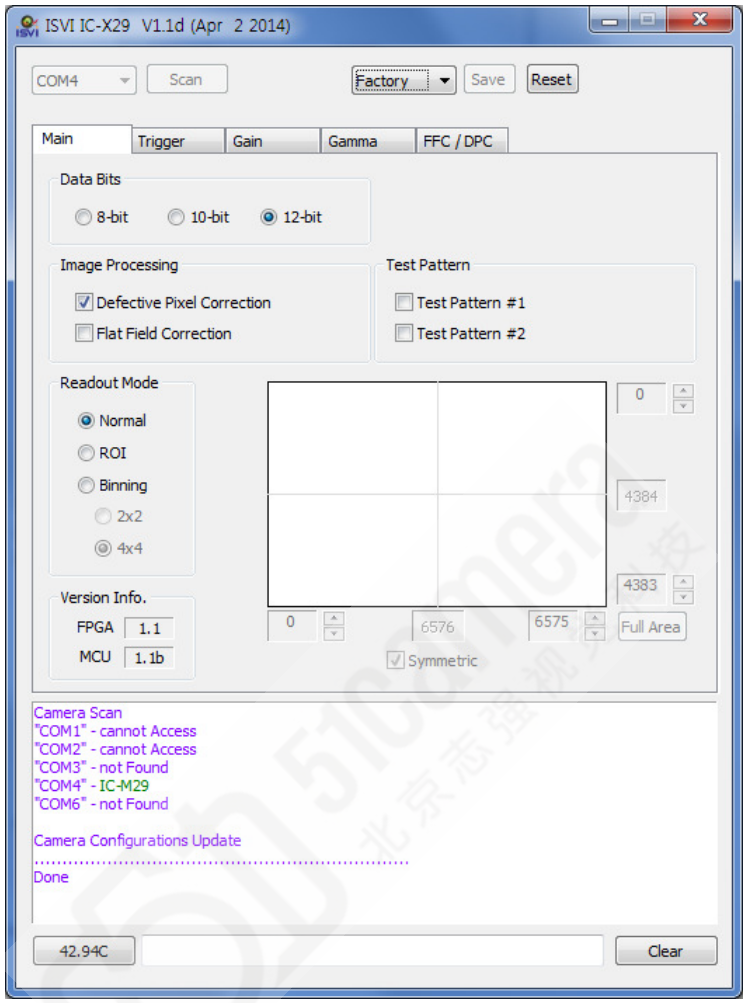


Fig. 8-3 Main Tab

1) Data Bits : Selects width of data output.
2) Image Processing : Defective Pixel Correction on/off, Flat Field Correction on/off
3) Test Pattern
   - Test Pattern #1 On/Off(Fixed Image), Test Pattern #2 On/Off(Moving Image)

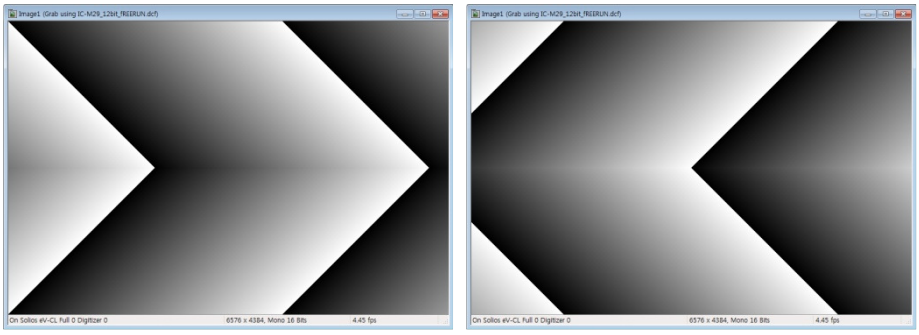


Fig. 8-4 Test Pattern(Left : Fixed Image, Right : Left Moving Image)

4) Readout Mode

- Normal : Normal Operation Mode
- ROI : Region Of Interest Mode

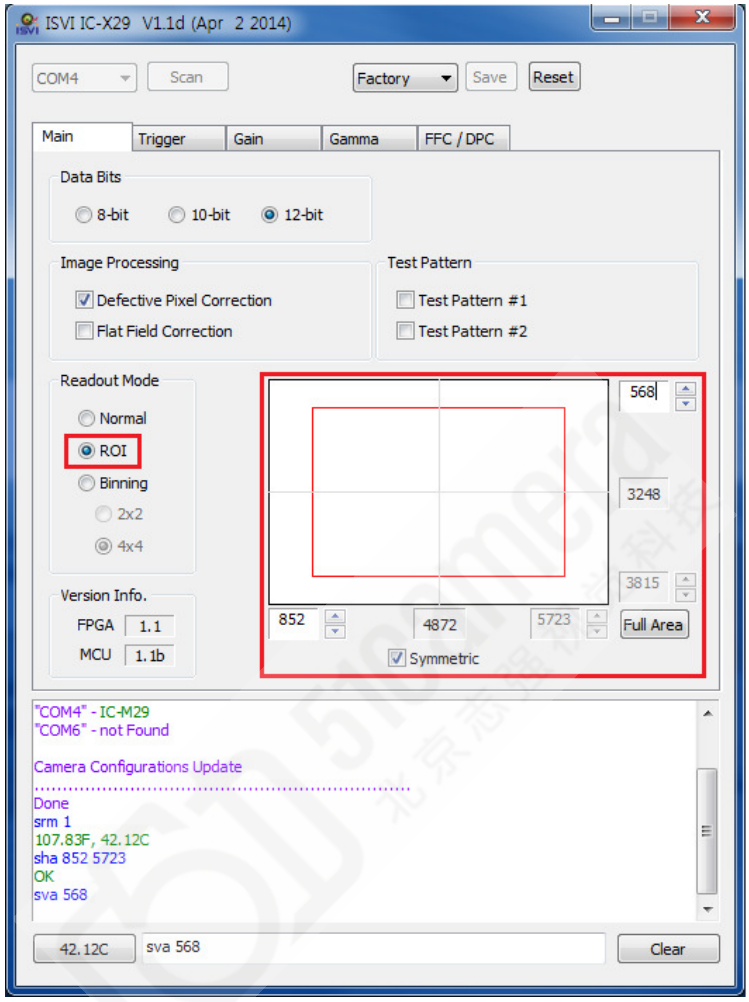


Fig. 8-5 ROI Mode Select & ROI Window

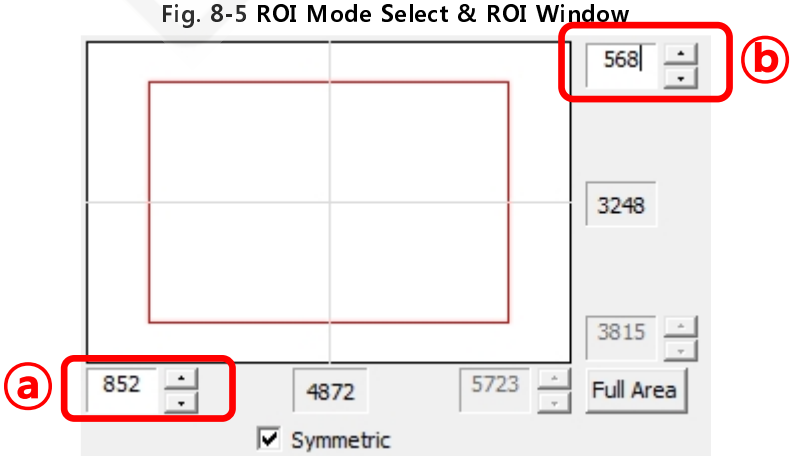


Fig. 8-6 ROI Window

ⓐ Set to the X area width of the symmetry

ⓑ Set to the Y area width of the symmetry

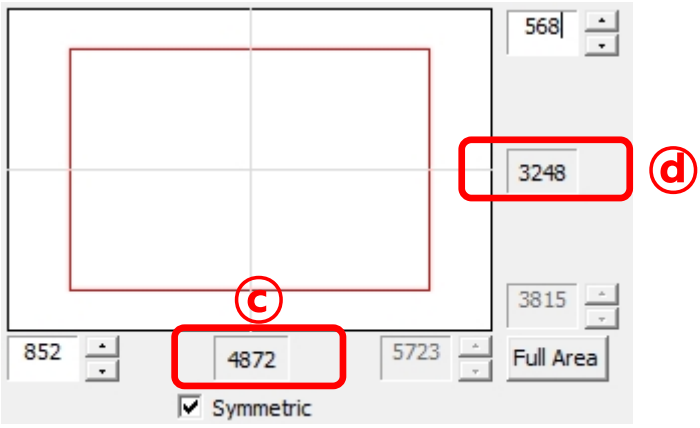


Fig. 8-7 ROI Window

ⓒ Width of the X area.

ⓓ Width of the Y area.

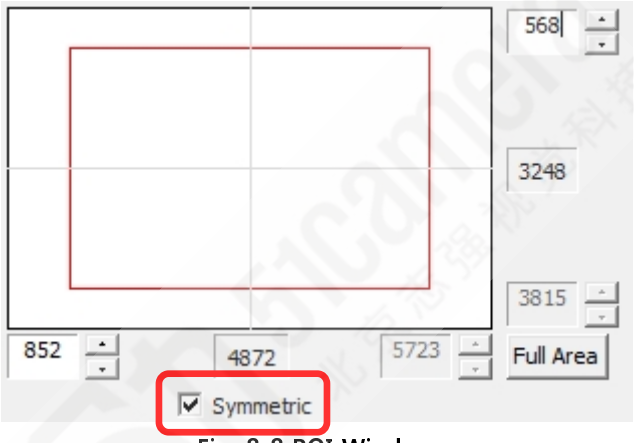


Fig. 8-8 ROI Window

Symmetric On : X area change symmetrically.

Symmetric Off : X area change asymmetrically.

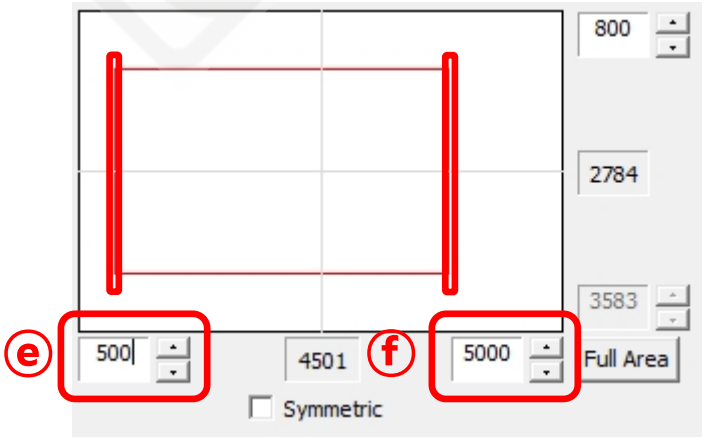


Fig. 8-9 ROI Window

ⓔ Adjust X area to the Left position.

ⓕ Adjust X area to the Right position.

- Binning : Binning Mode(2*2, 4*4)

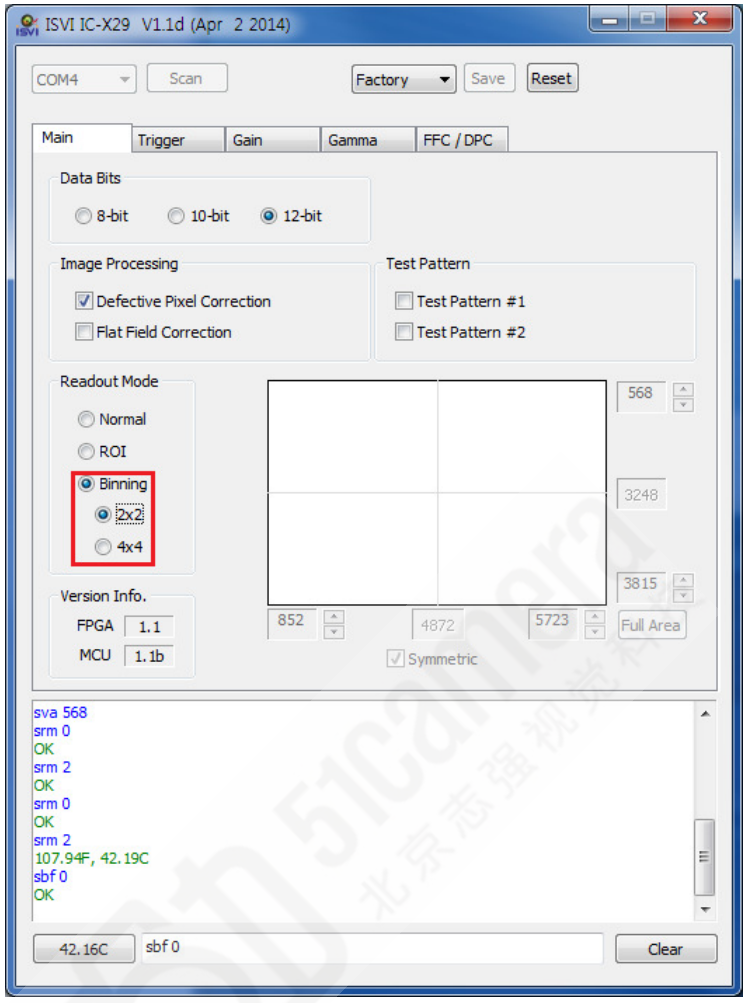


Fig. 8-10 Binning Mode

8.4 Trigger Tab

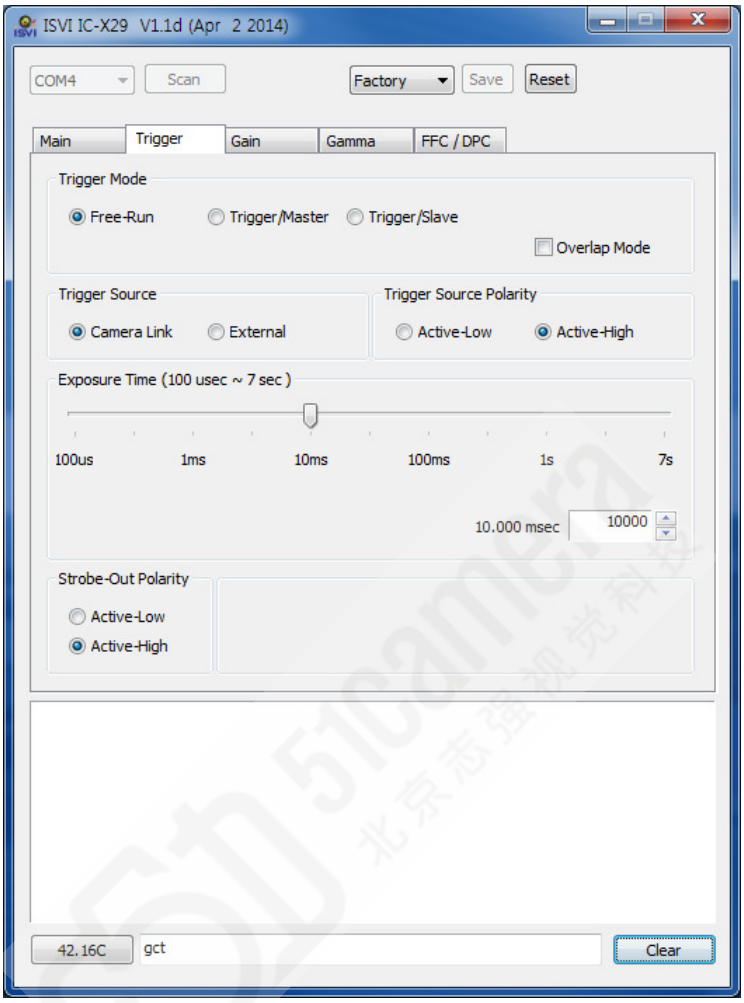


Fig. 8-11 Trigger Tab

1) Trigger Mode : Selects trigger mode. Once a mode has been selected, related selections will be activated.
   - ▶ Free-run Mode : Regardless external trigger, it's output image based on designated exposure time.
   - ▶ Trigger/Master : It's output an image through designated exposure time by Source Trigger (Camera Link & External)
   - ▶ Trigger/Slave : It's output an image through designated Trig Width by Source Trigger (Camera Link & External)
2) Trigger Source
   - ▶ Camera Link : The source setting of trigger to Camera link(CC1).
   - ▶ External : The source setting of trigger Camera to External.(12Pin Connector)
3) Trigger Source Polarity

- Active low : It's for setting active mode in the Trigger
- Active High : It's for setting active mode in the Trigger

4) Exposure Time
   - It's for setting exposure time of Camera internal register.
     It's available to set from 100us to 7000msec
   - It's able to use this function on the Mode of Free Run & Trigger/Master
   - After changing the value of one should press the enter key.

5) Strobe-out Polarity
   - Output strobe signal by Camera Exposure Time.
   - It's available to use for light and shutter control
   - Active low : It's for setting active mode in the Strobe Trigger
   - Active High : It's for setting active mode in the Strobe Trigger

8.5 Gain Tab

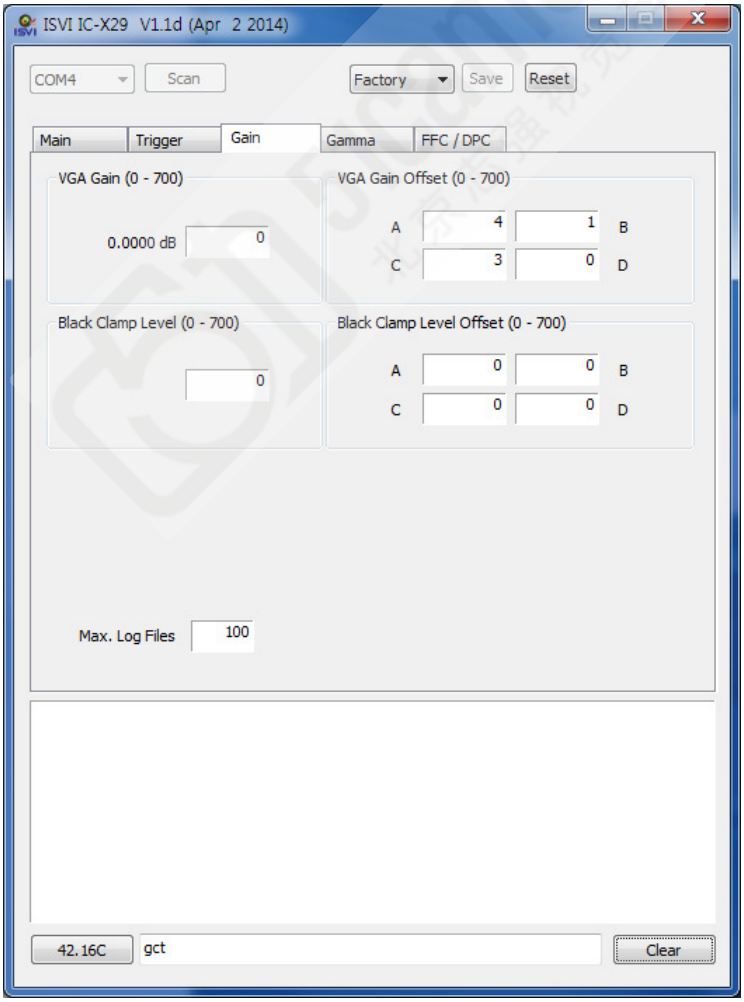


Fig. 8-12 Gain Tab

1) VGA Gain
   - VGA Gain allows the user to set gain settings of the image.
   - It's available to set Camera Gain Value from "0" to "700".
   - After changing the value of one should press the enter key.
2) VGA Gain Offset
   - Sets gain value of each channel(Sensor Area).
   - It's available to set Camera Gain Value from "0" to "700".
   - After changing the value of one should press the enter key.

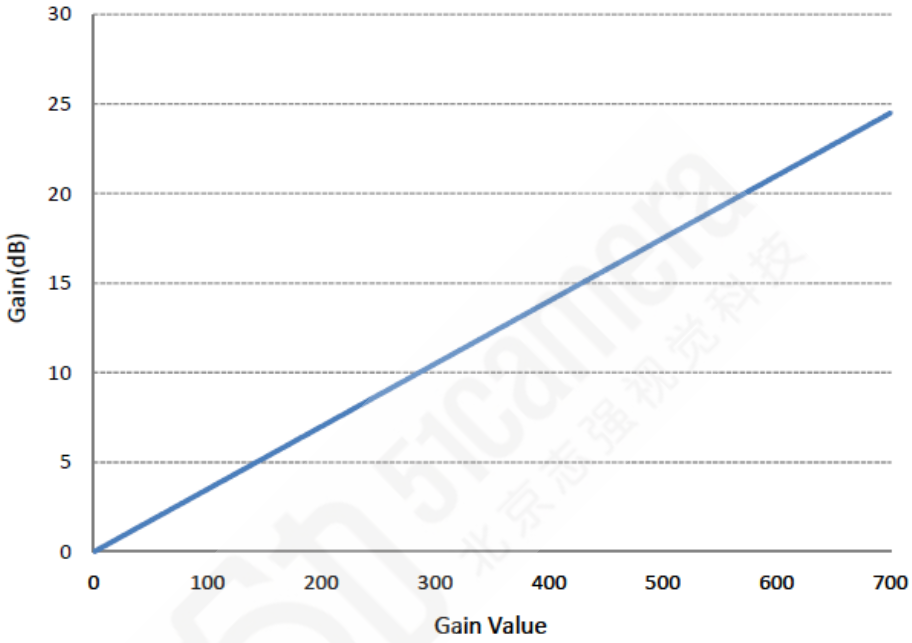


Fig. 8-13 VGA Gain Curve(Value 1 : 0.035dB)

3) Black Clamp Level
   - The black clamp level is used to remove residual offsets in the signal chain and to track low frequency variations in the black level of the CCD.
   - It's available to set Camera Black Clamp Level from "0" to "700".
   - After changing the value of one should press the enter key.
4) Black Clamp Level Offset
   - Sets level value of each channel(Sensor Area).
   - It's available to set Camera Black Clamp Level Offset Value from "0" to "700".
   - After changing the value of one should press the enter key.

8.6 Gamma Tab

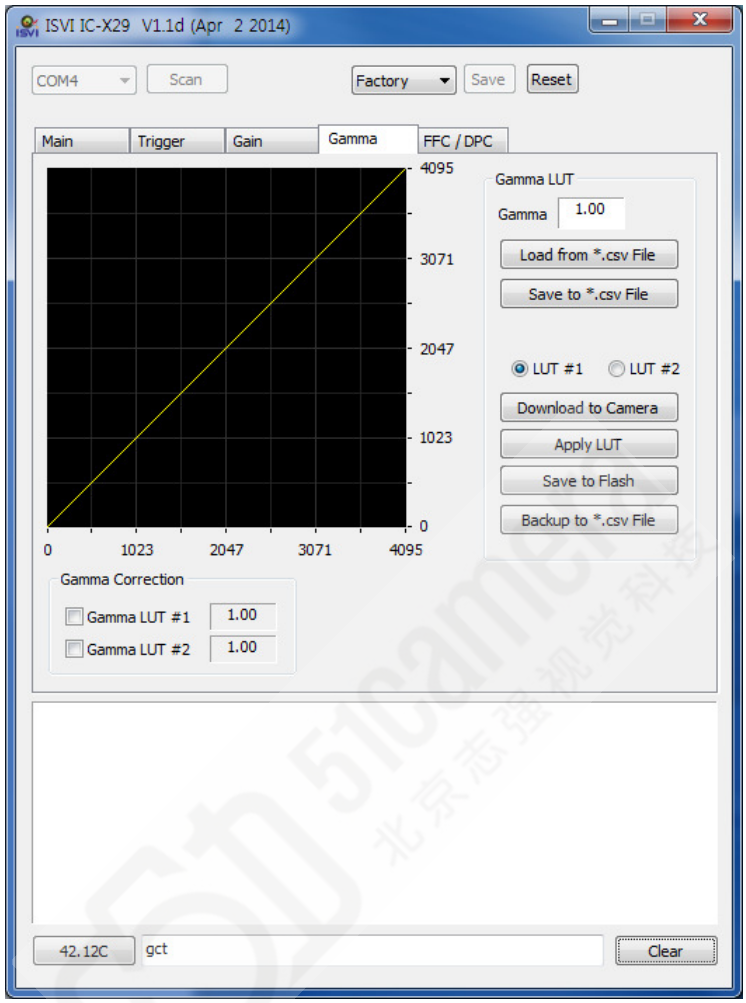


Fig. 8-14 FFC Tab

1) Provides 2 non-volatile spaces for LUT data storage.(LUT #1, LUT #2)
2) Gamma : Gamma Curve value setting.
3) Load & Save
   Load : LUT data import to GUI from the user computer.(CSV File)
   Save : LUT data export to GUI to the user computer.(CSV File)
4) LUT#1, LUT#2 : Spaces Select.
5) Download to Camera : Created by gamma value is sent to the camera.
6) Apply LUT : LUT Curve applied.
7) Save to Flash : Gamma data is saved in the camera.
8) Backup : Camera of the Gamma value is saved in the User Computer.(CSV File).
9) Gamma Correction : Gamma LUT #1/Gamma LUT #2 On/Off.

8.7 FFC/DPC Tab

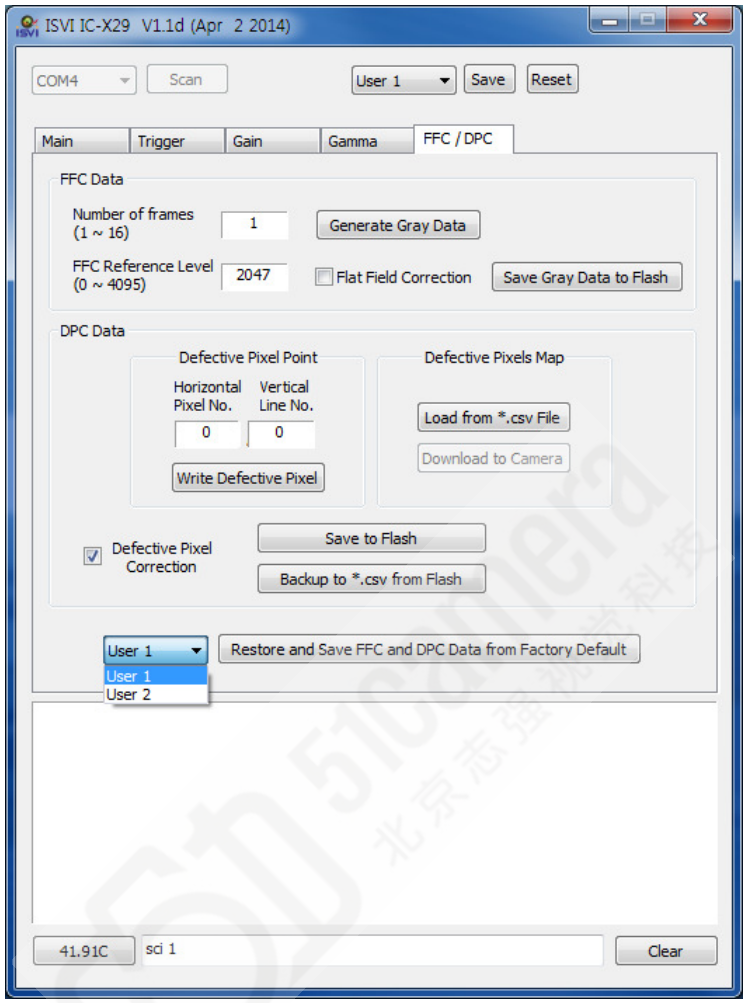


Fig. 8-15 FFC Tab

1) Number of Frames
   - ▶ Sets how many images will be used for the generation.
   - ▶ It's available to set Value from "1" to "16".
   - ▶ After changing the value of one should press the enter key.
2) Generate Gray Data : Generates the flat field data to be used for correction.
3) Save Gray Data to Flash : Saves the generated flat field data to flash in order to reuse in the future or retrieves the saved flat field data
4) FFC Offset
   - ▶ Sets the offset value of the image after Flat Field Correction is applied..
   - ▶ It's available to set Value from "0" to "4095".(Default Value : 2047)
   - ▶ After changing the value of one should press the enter key.
5) If you use the FFC is produces by gray card.(Gray Level 50%(0x7FF))

6) Write Defective Pixel : Add to defect pixel point in DPC data(Not Save to Camera)
7) Load frome*.csv File : DPC data import to GUI from the user computer.(CSV File)
8) Download to Camera : Created by DPC data is sent to the camera.
10) Save to Flash : DPC data is saved in the camera.
11) Backup to*.csv from Flash : Camera of the DPC data is saved in the use computer.
Total time ≒ about 85sec(Data generation: 40sec, PC Transfer: 30sec ~60sec
Depending on the number of DPC)
12) Restore and Save FFC and DPC Data from Factory Default : Recover function for FFC and DPC data

※ FFC/DPC TAB will become valid only USER1, USER2 mode.

8.8 Temperature Monitor

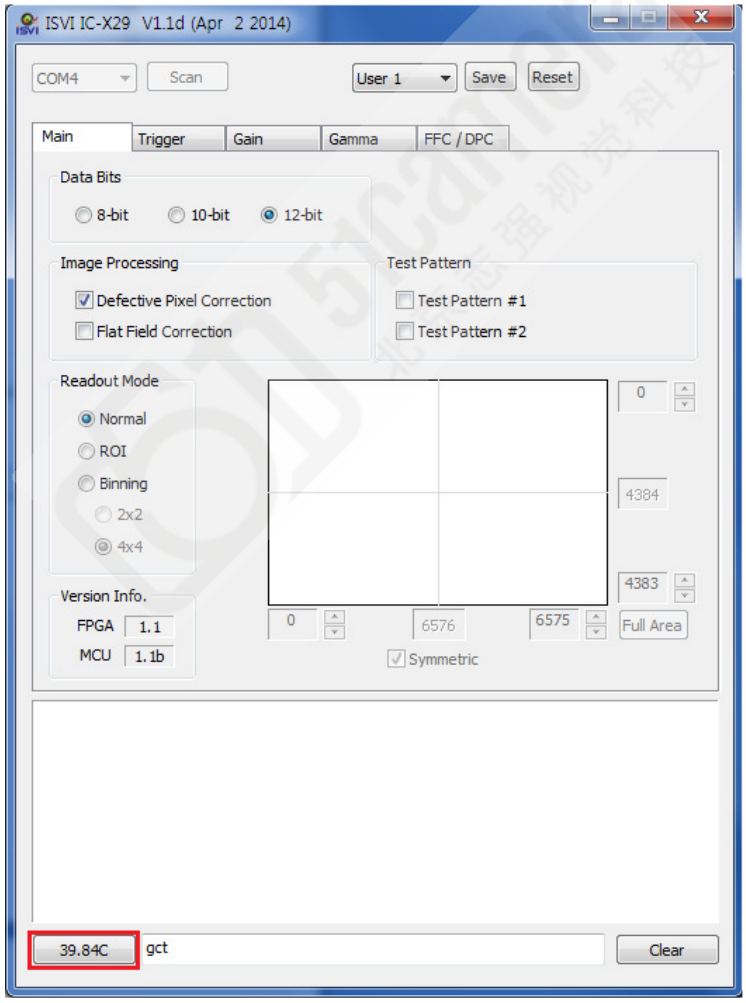


Fig. 8-16 Temperature Monitor

1) IC-M29 is embedded in the camera to monitor the internal temperature.
▶ Temperature is displayed in real time.

9 Grabber(Matrox DCF File) Setting

9.1 Overview Tab

▶ Show the General Information.(DCF File)

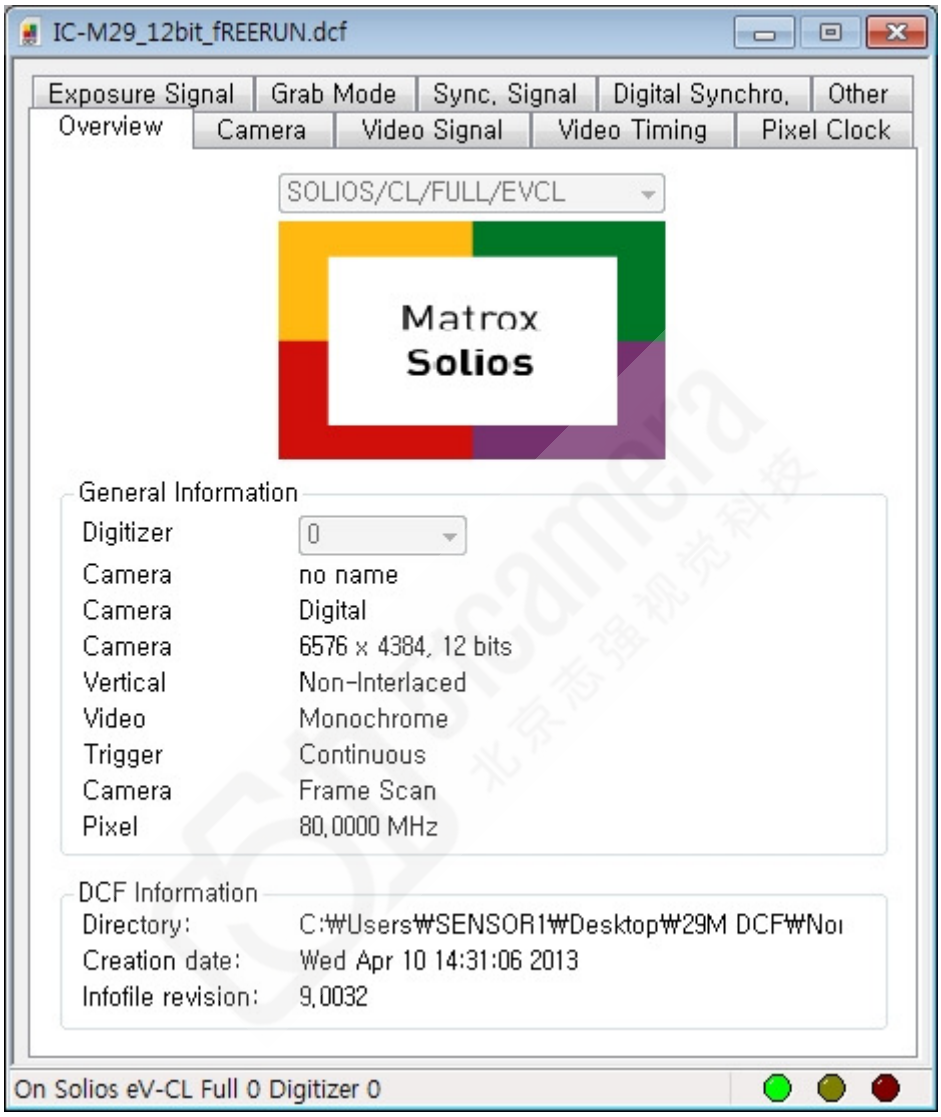


Fig. 9-1 Overview Tab – Freerun Mode

9.2 Camera Tab

1) Camera Tab

▶ IC-M29 use the 2 Tab Base Camera Link configuration.

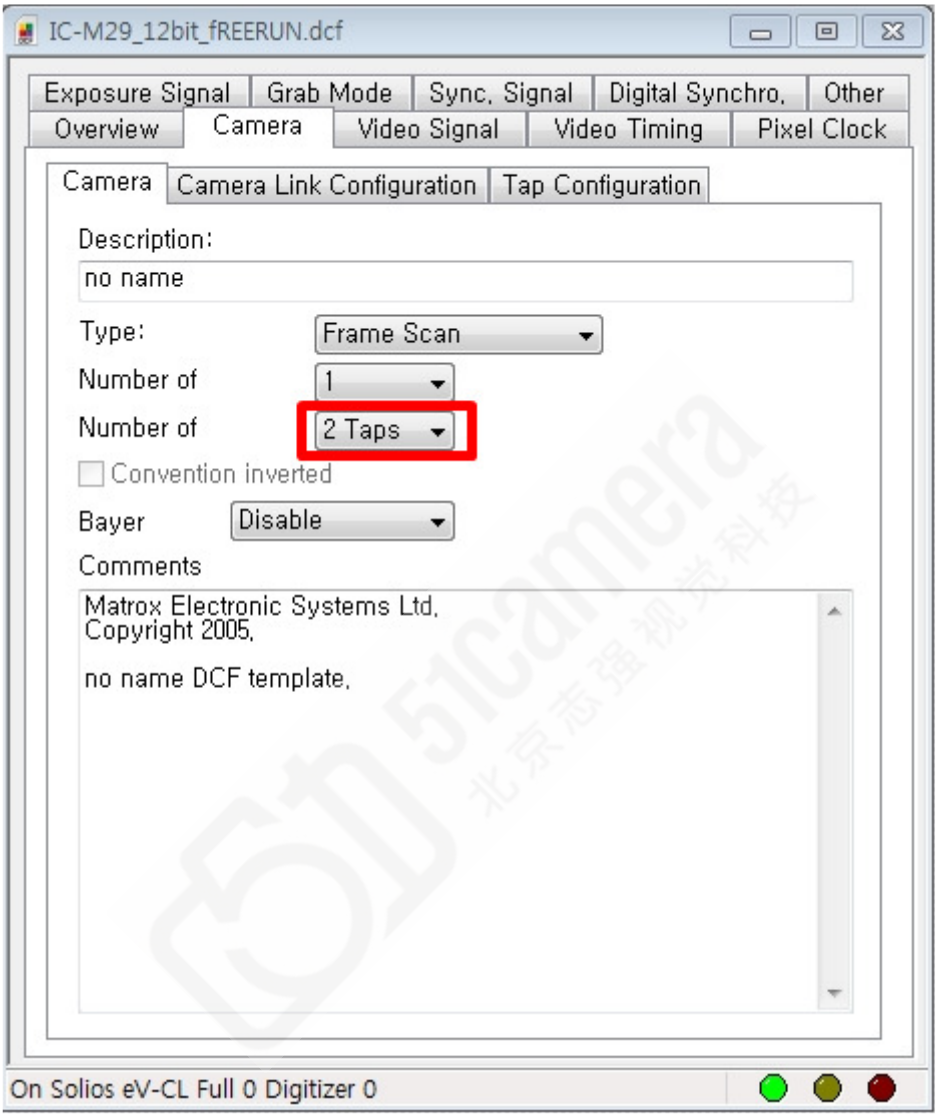


Fig. 9-2 Camera Tab

2) Camera Link Configuration Tab

▶ IC-M29 use the 2 Tab Base Camera Link configuration.

▶ Camera Mode Setting

- Data Bit 10 bit or 12bit : 2 Tabs 10/12bits
- Data Bit 8 bit : 2 Tabs 8bits

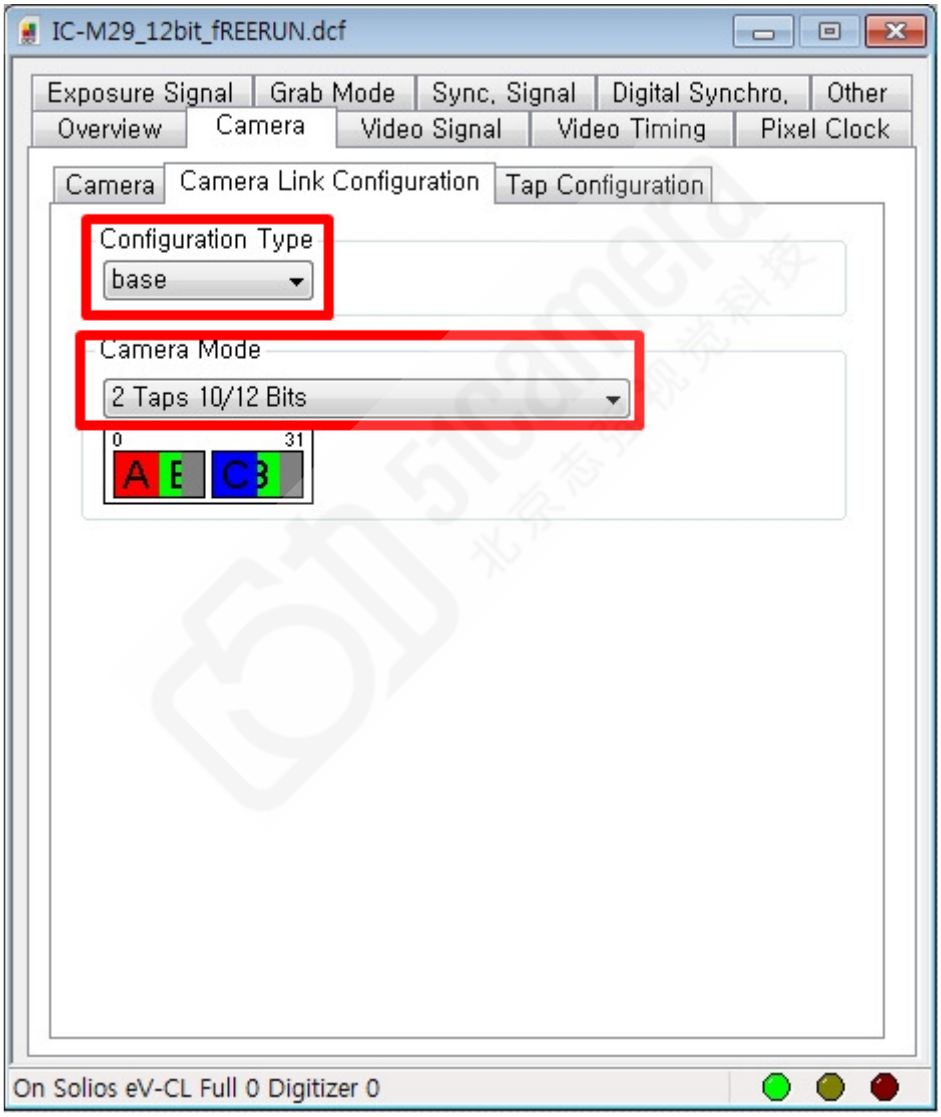


Fig. 9-3 Camera Link Configuration Tab

3) Tab Configuration Tab

▶ As shown in the following figure, data regions and tab orders and directions.

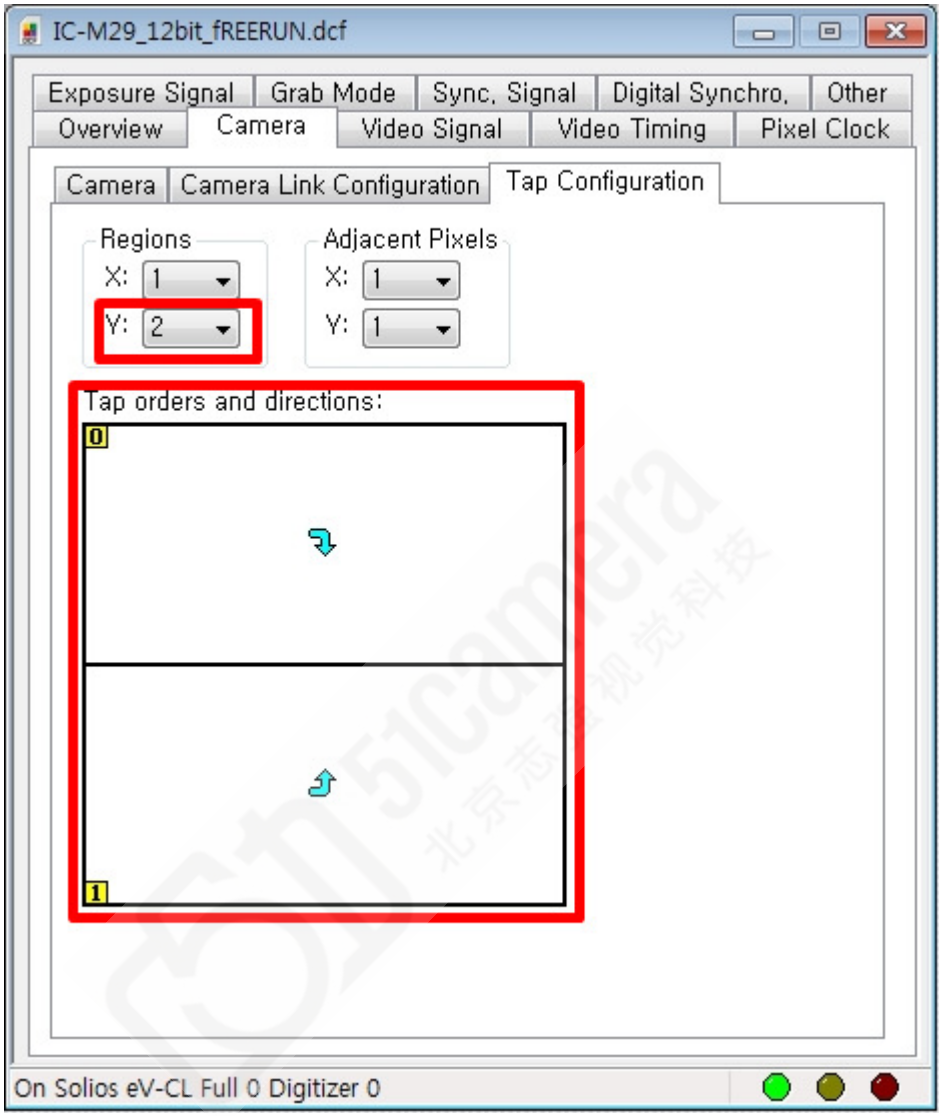


Fig. 9-4 Tap Configuration Tab

9.3 Video Signal Tab

▶ Data bus width Setting

- Camera Data Bit 12 bit : 12bit
- Camera Data Bit 10 bit : 10bits
- Camera Data Bit 8 bit : 8bits

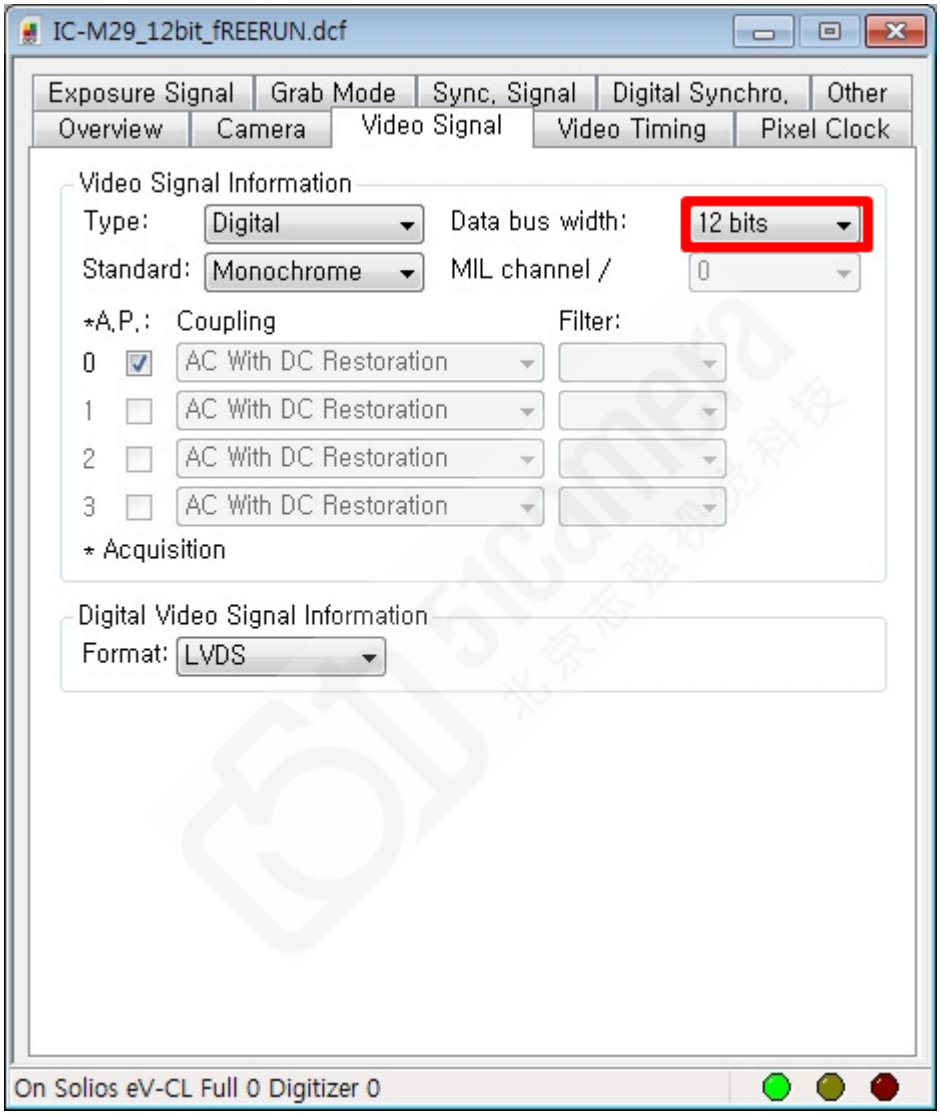


Fig. 9-5 Video Signal Tab

9.4 Video Timing Tab

- Pixel Clock Frequency : 80MHz
- Image Size : X 6576 * Y 2192

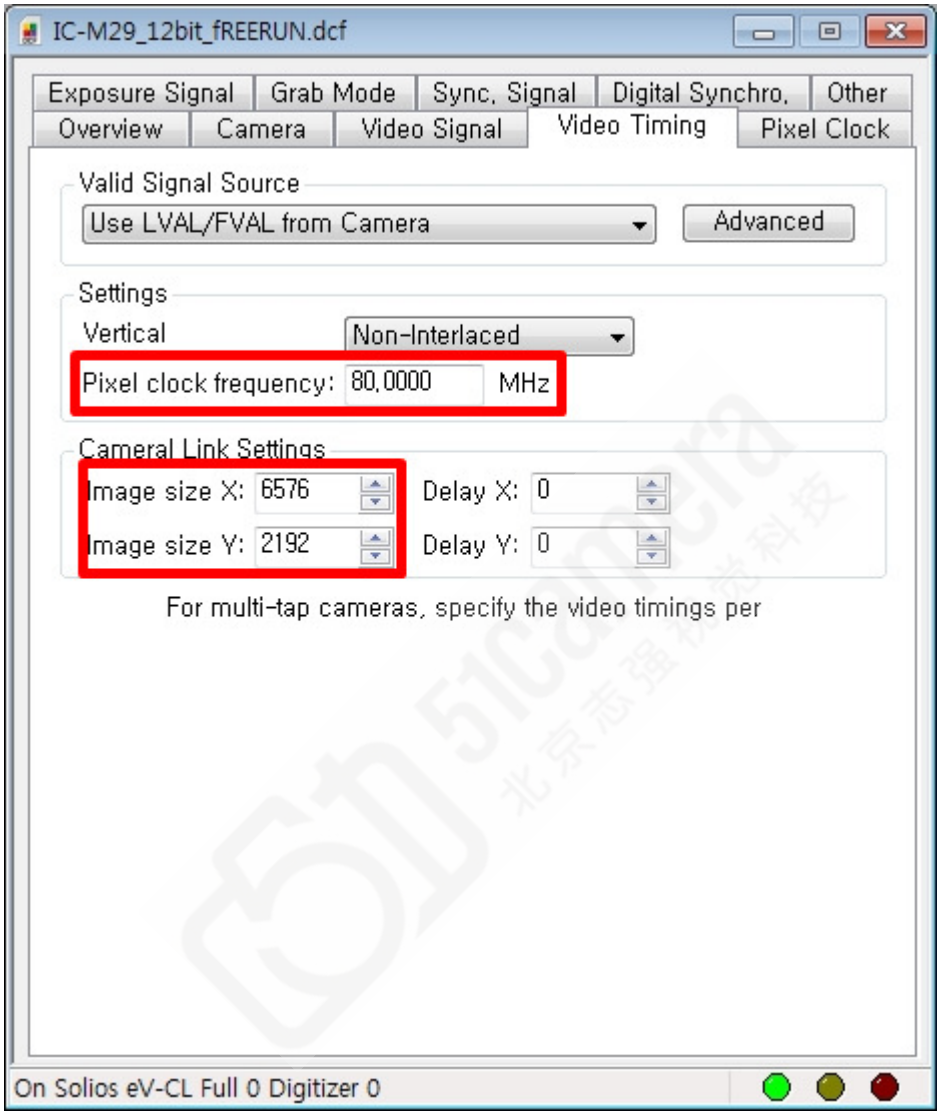


Fig. 9-6 Video Timing Tab

9.5 Pixel Clock Tab

▶ Pixel Clock Frequency : 80MHz

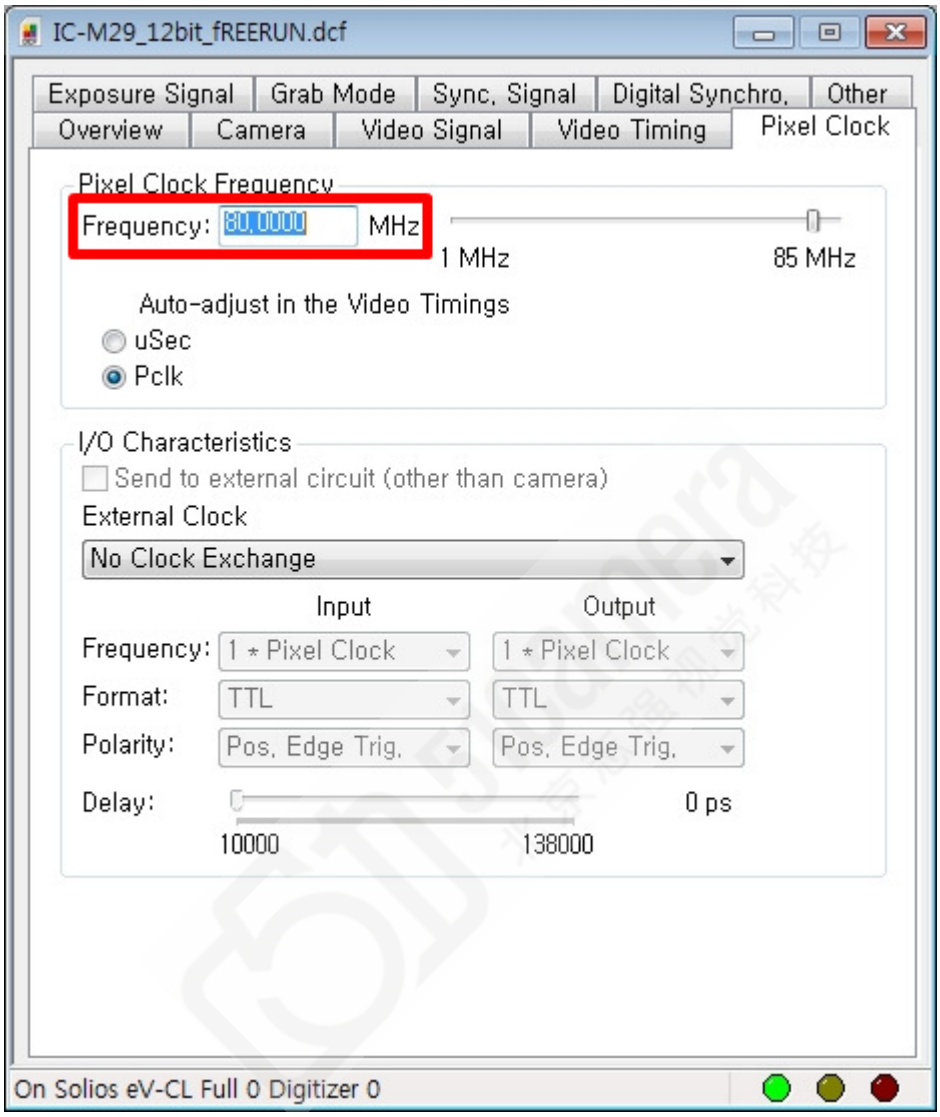


Fig. 9-7 Pixel Clock Tab

10 Firmware Writing

10.1 For Firmware Write requirements

10.1.1 Hardware

- **Altera USB-Blaster and Download Cable**

  : The USB-Blaster and download cable interface a USB port on a host computer to an Altera FPGA mounted on a printed circuit board.

  USB Blaster Datasheet : http://www.altera.com/literature/ug/ug_usb_blstr.pdf

Fig. 10-1 Altera USB-Blaster Download Cable

- **ISVI Firmware Cable**

  : The ISVI Fimware Cable interface a Circular 12pin on a ISVI camera to an Altera USB-Blaster Download Cable.

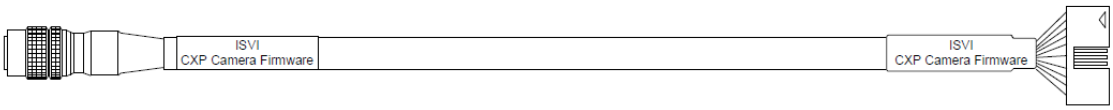


Fig. 10-2 ISVI Firmware Cable

10.1.2 Software

- **Quartus II Stand-Alone Programmer**

Download the 'Quartus II Stand-Alone Programmer' in Altera Download Center

This program is free-ware, you can get for free from the following link.

https://www.altera.com/download/sw/dnl-sw-index.jsp

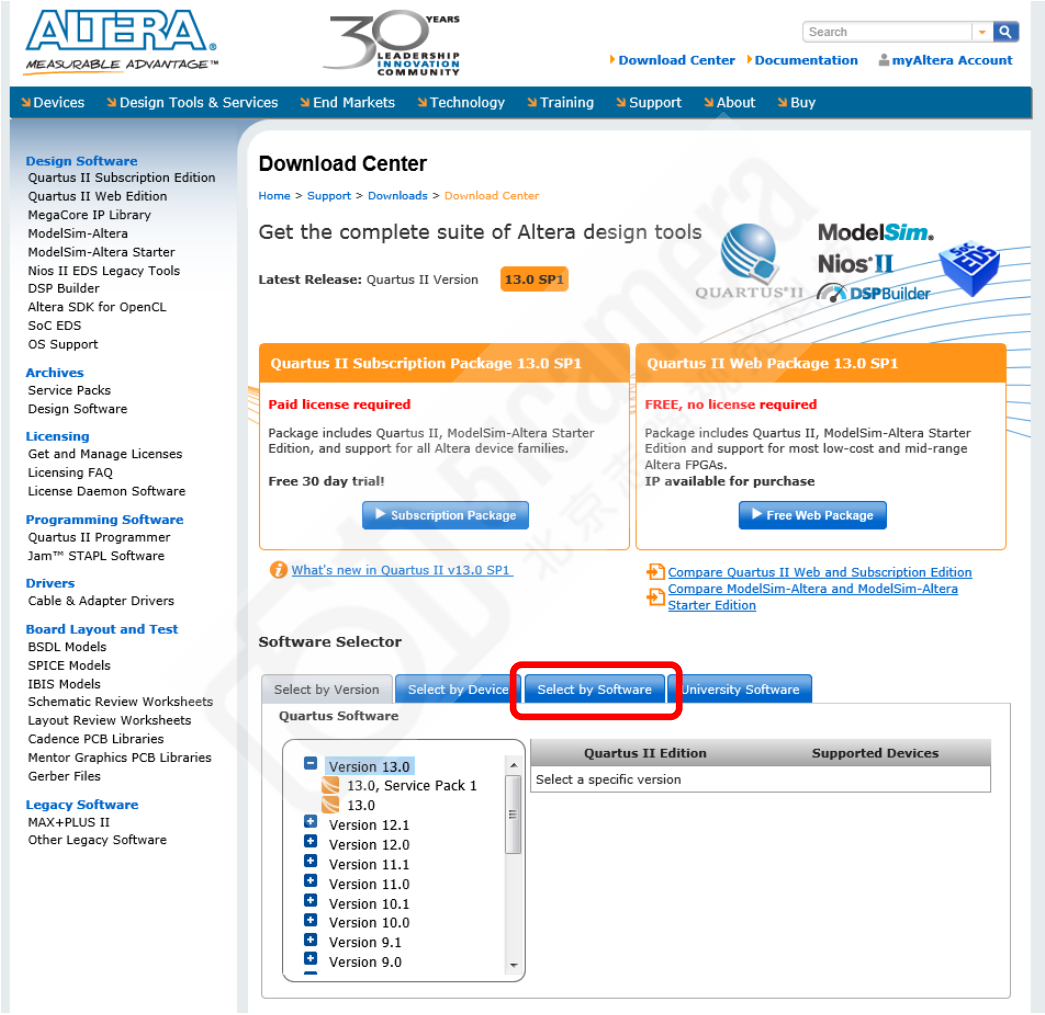


Fig. 10-3 Altera Download Center page

Fig.10-3 is a figure of Altera Download Center site.

Click the 'Select by software' tap at the bottom of the screen.

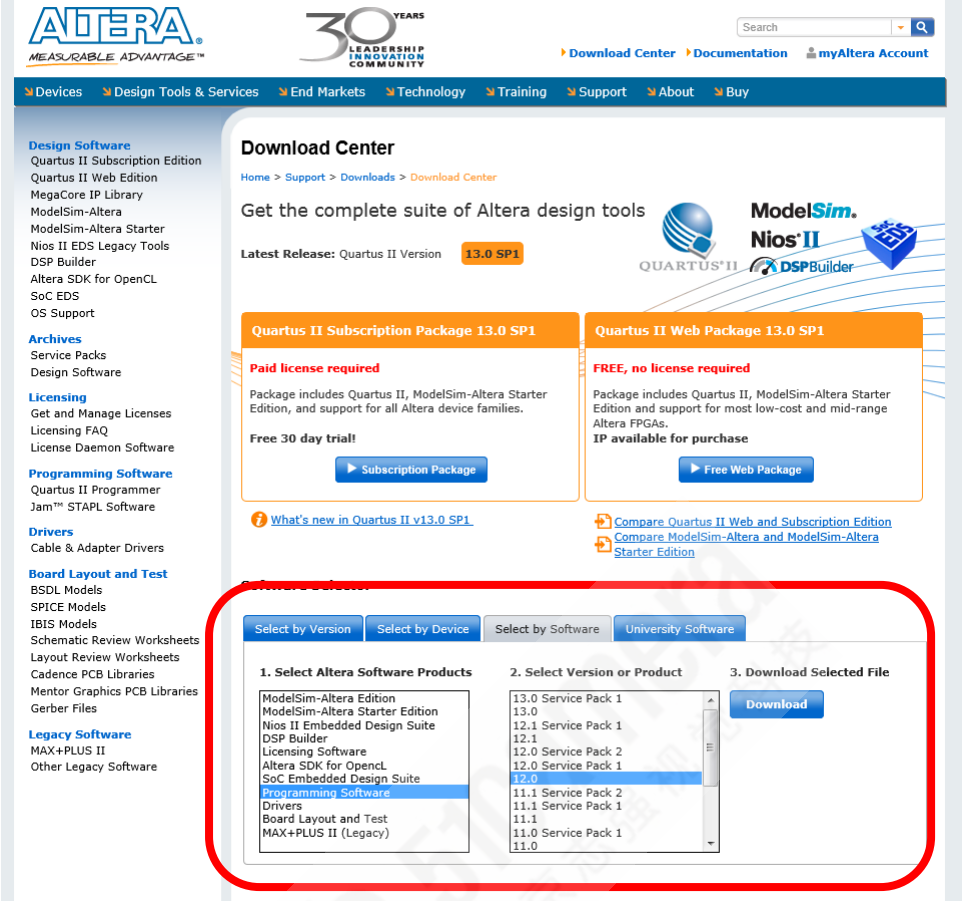


Fig. 10-4 Altera Download Center - Select by Software Tap

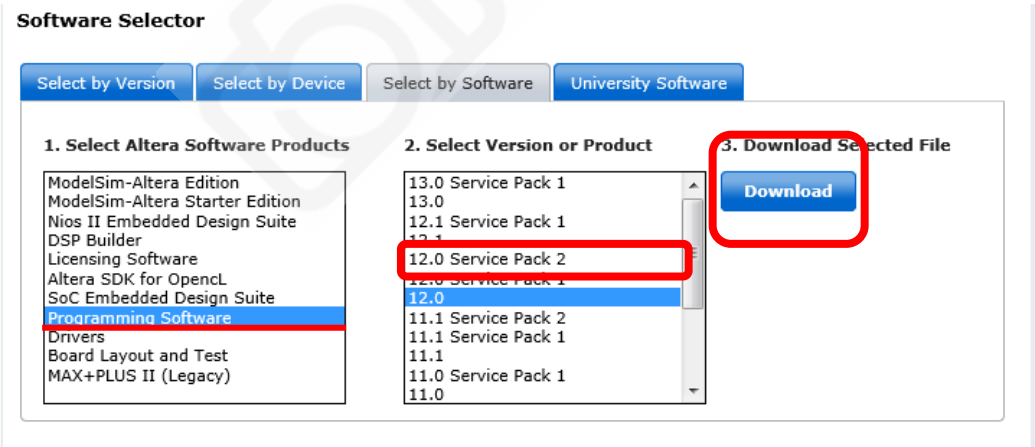


Fig. 10-5 Altera Download Center -Software Selector

Select sequentially Programming Software - 12.0 Service Pack 2, and then click the download button at the end.

Fig. 10-6 Quartus II Stand-Alone Programmer OS version select

Will be selected according to the OS Version

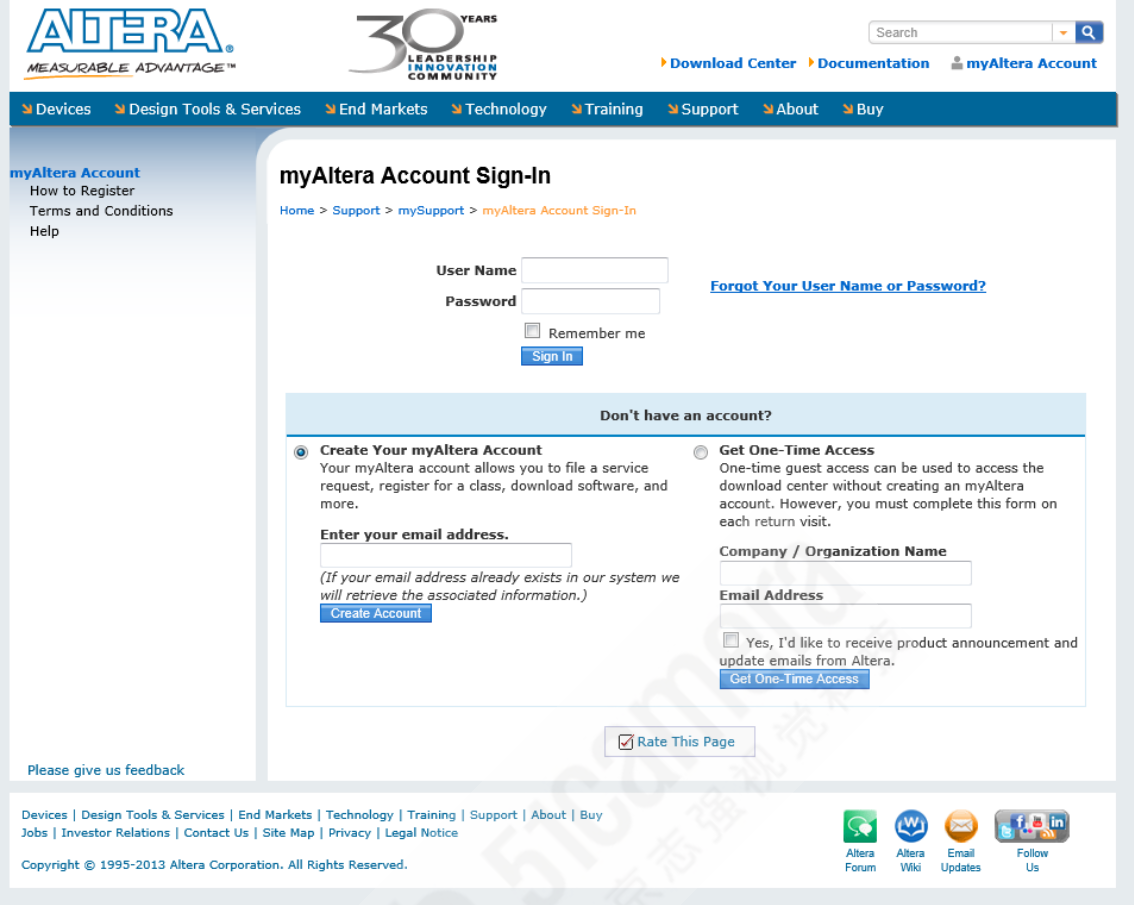


Fig. 10-7 myAltera Account sign-in

You must logged in to 'myAltera Account' If you want to download the program eventually.

10.2 Firmware Writing

10.2.1 Cable Connection & Writing

First, USB cable of USB-Blaster Cable connect to PC

Second, 10pin connector(Female) of USB-Blaster Cable connected

10pin connector(Male) ISVI Firmware Cable.

Third, Circular 12pin connector of ISVI Firmware Cable is connected ISVI camera.

Finally, recheck the cable connection, IC-M29 camera power on

Execute Quartus II programmer

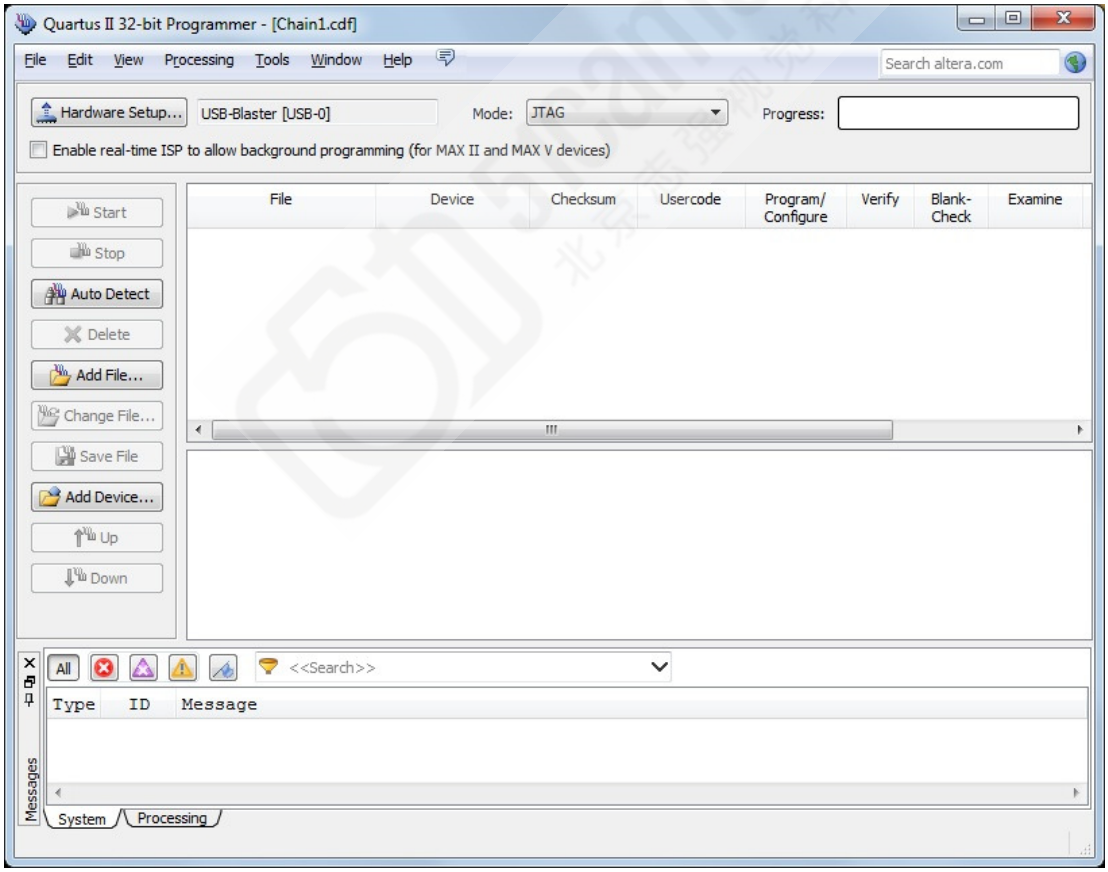


Fig. 10-8 Quartus II Programmer execute

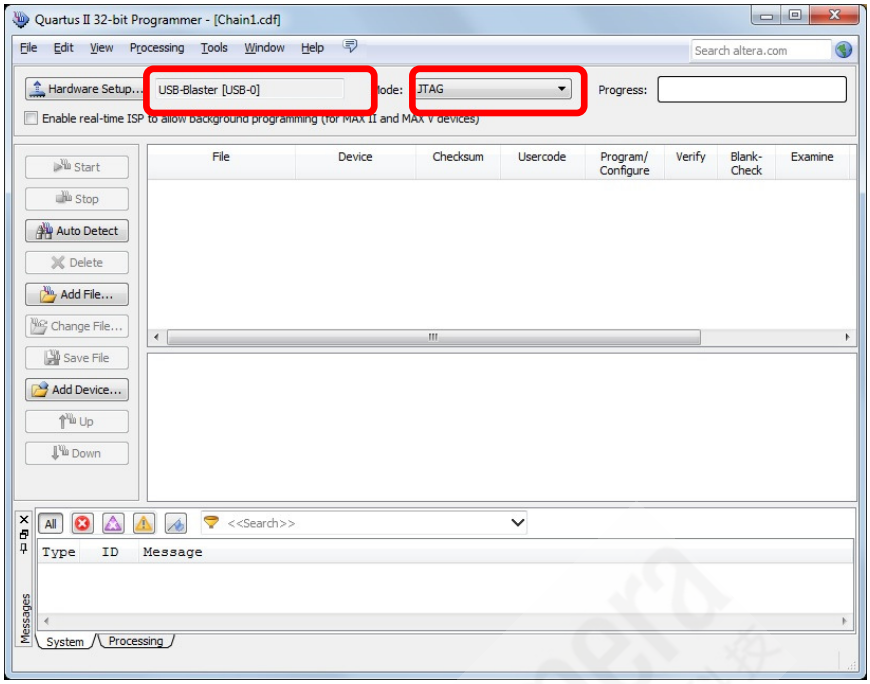


Fig. 10-9 Quartus II Programmer mode select

Check to be sure that USB-Blaster [USB-0]

Mode Select -> JTAG Mode

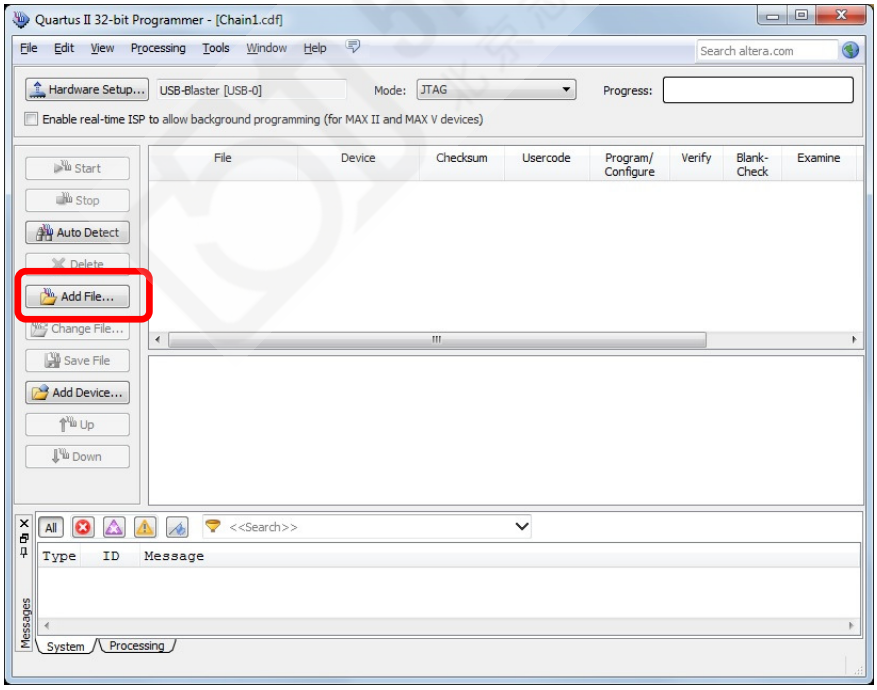


Fig. 10-10 Quartus II Programmer Add file

Add File Click.

JTAG Mode need *.jic file.(example : ts29m_s3_1.1b.jic)

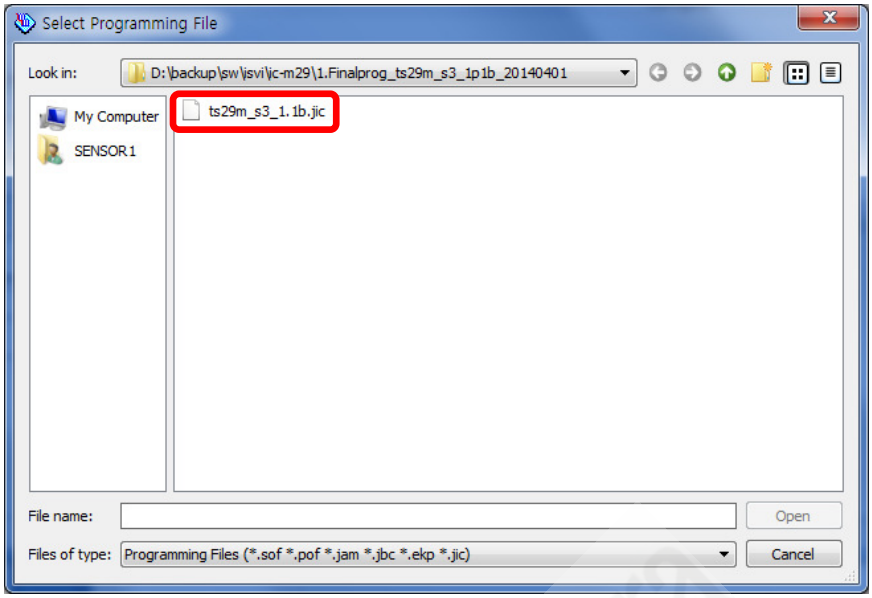


Fig. 10-11 : Quartus II Programmer Add file popup

You can see that likely below

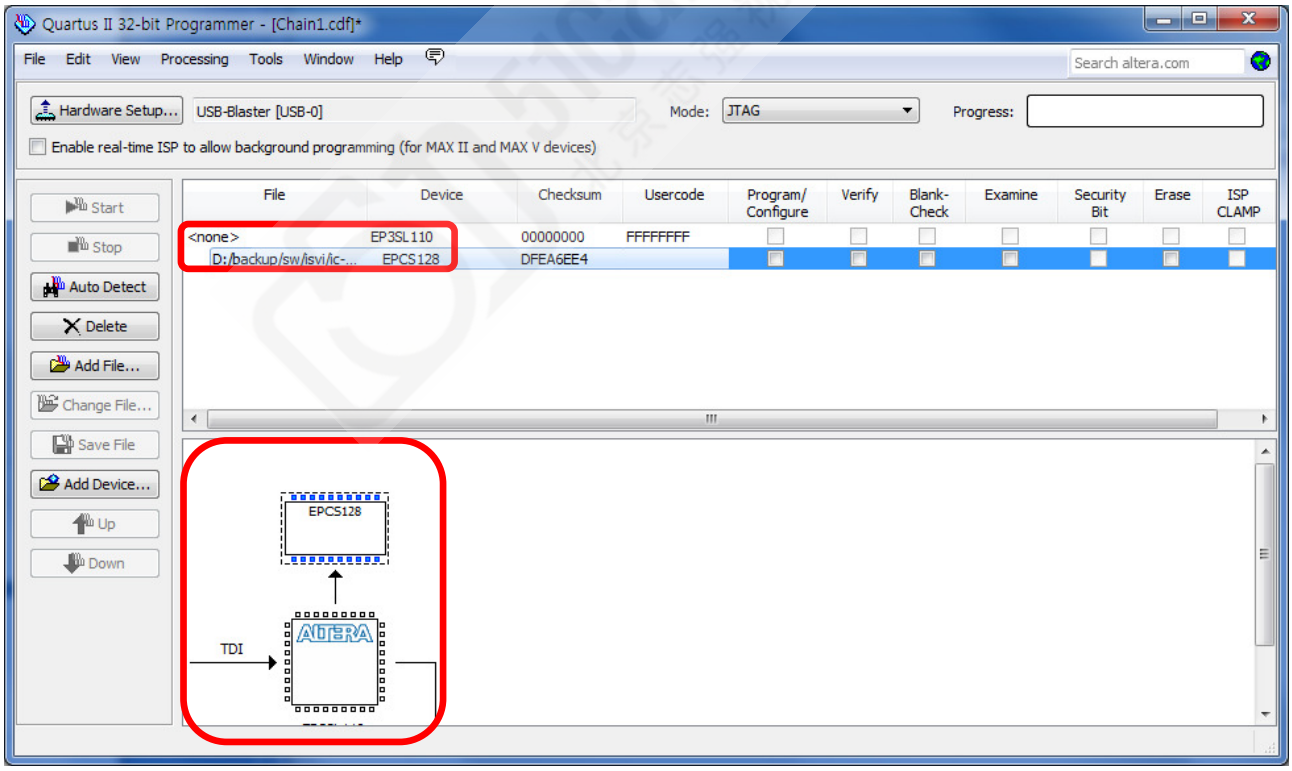


Fig. 10-12 Quartus II Programmer Added

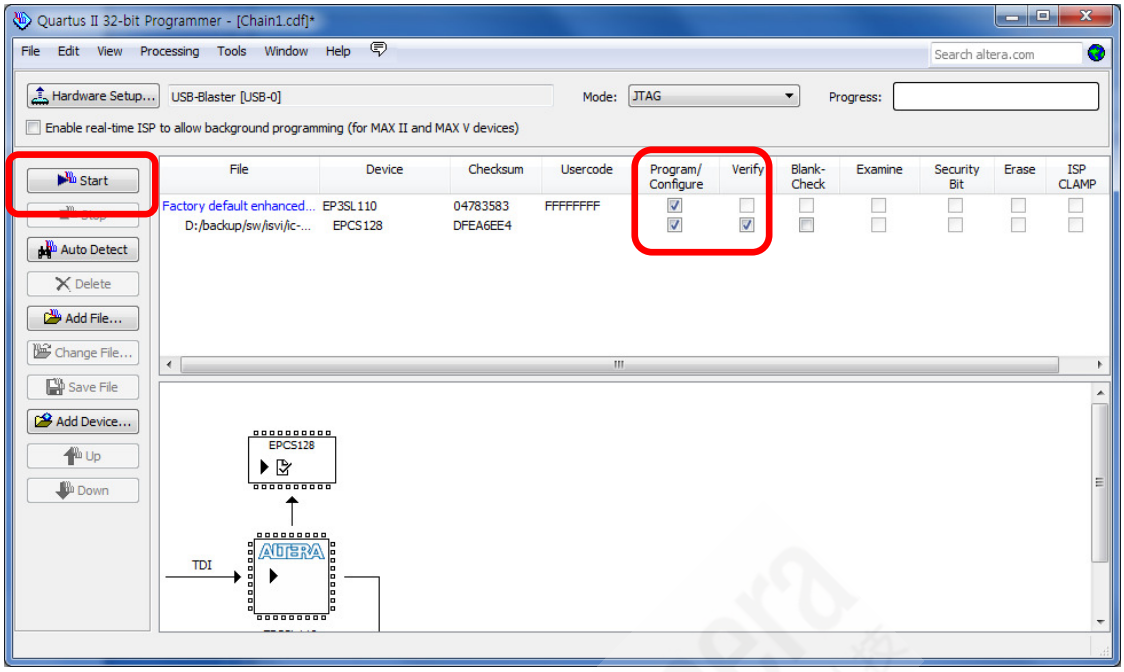


Fig. 10-13 Quartus II Programmer progress select

"Program/Configuration", "Verify" box check.

Start button click. You can see progress bar progressing.

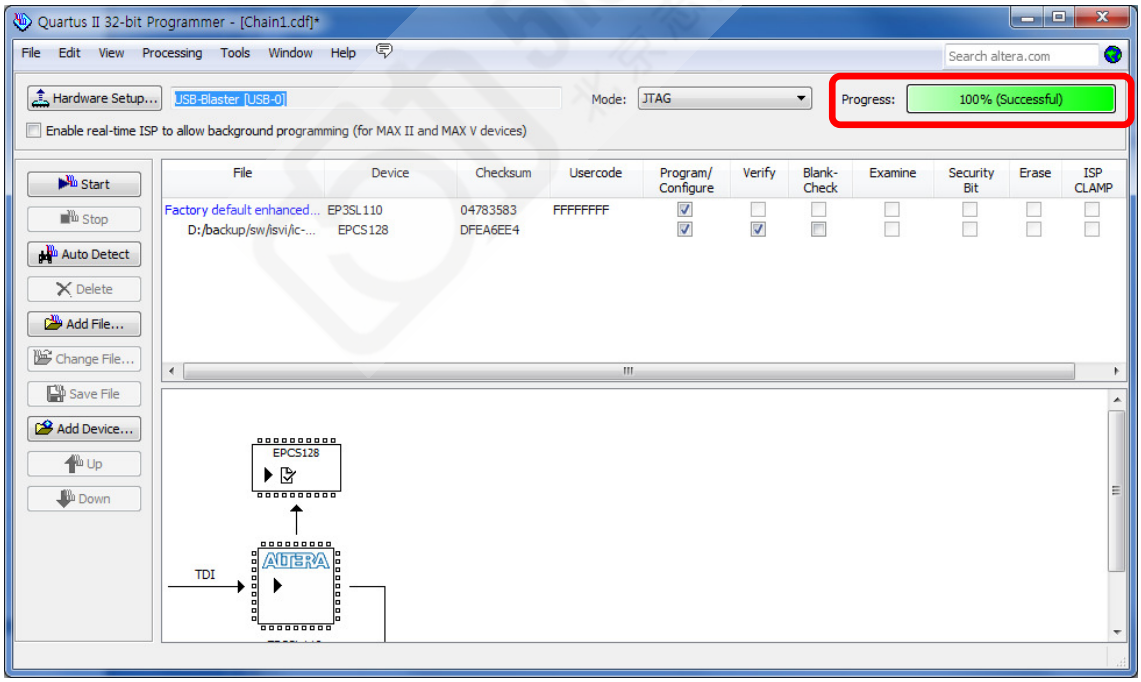


Fig. 10-14 Quartus II Programmer Progressing

Progress is 100% done, Camera power off, and ISVI Firmware Cable reject.

Download Time : About 85sec.

CE

EN 55024 : 1998+A1:2001, +A2:2003

EN 55022 : 2006+A1:2007 [Class A Equipment]

FCC

Section 15.107, Section 15.109 (Class A Equipment)

NOTE : This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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