TS25MCXP-85M Area Scan Camera

User Manual

(V0.8　Mar.14, 2025)

Hefei I-TEK Optoelectronics Co., LTD.

http://www.i-tek.cn/

Revision History

Revision	Date	Description
0.1	2022/02/10	● Initial version
0.2	2022/04/25	● Update the logo of company ● Update legends in section 7 ● Update trigger interface pin definition ● Add section 6.9 Strobe
0.3	2022/11/23	● Update appearance of camera
0.4	2023/02/11	● Modify description of flat field correction ● Update company address
0.5	2023/04/10	● Update product appearance and mechanical dimension
0.6	2023/08/02	● Update chapter 7 ● Add description of flat field correction polling function
0.7	2025/03/04	● Update the structure diagram and exposure time
0.8	2025/03/14	● Update the structural diagram

Manufacturer Information

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Contents

1 Precautions

- **General**

① Do not drop, damage, disassemble the camera.
② Do not let children touch the camera without supervision.
③ Do not use the camera for other purposes than those specified herein.
④ Should there be any problem with the camera, please contact us in time for technical support.

- **Installation and Maintenance**

① Do not install the camera in an environment with direct sunlight, high humidity or heavy dust.
② Keep the camera away from an environment with strong electromagnetic interference.
③ Keep the camera away from heat sources.
④ Be careful not to let the camera soak in liquid, such as water and drinks.
⑤ Clean dust on the surface of the camera as often as possible to avoid dust entering the camera, otherwise it may cause fault to the camera.
⑥ To clean the dust on the camera surface, do not wash with water. Please use a soft object dipped in a small amount of 70% alcohol to wipe it off.

- **Power Supply**

① Camera can be powered through CXP cable PoCXP mode or external power supply. For external power supply, it is recommended to use a voltage of +12~24V (±10%) , the current must be 1.5A.
② Hefei I-TEK Optoelectronics Co., LTD. does not provide power supply with the camera, users may prepare the power supply on their own.

- **Document**

① Hefei I-TEK Optoelectronics Co., LTD. does not warrant that the document is the final version. The document may be updated after product upgrade. Please contact market@i-tek.cn for the latest version, which is provided for the authorized users free of charge.

2 Camera Models

- **Camera Product Model**

Abbreviation	Name	Description
Line Scan Camera:		
PA	Panther	Panther (Single line industrial line scan camera)
PL	Plasma	Plasma (Multi-line industrial line scan camera)
PH	Phoenix	Phoenix (TDI industrial line scan camera)
TPH	TEC-Phoenix	TEC-Phoenix (TEC-TDI industrial line scan camera)
PN	Pneuma	Pneuma (Basic industrial line scan camera)
PR	Prometheus	Prometheus (High resolution industrial line scan camera)
PU	PupMaya	PupMaya (High width industrial line scan camera)
PT	Ptepare	Ptepare (Special custom industrial line scan camera)
PM	Prism	Prism line scan camera
Area Scan Camera:		
TM	Taurus-Prism	Prism area scan camera
HS	Hercules	Hercules (CCD industrial area scan camera)
TS	Taurus	Taurus (CMOS industrial area scan camera)
THS	TEC-Hercules	TEC-Hercules (CCD TEC industrial area scan camera)
TTS	TEC-Taurus	TEC-Taurus (CMOS industrial area scan camera)
XS	XStream	XStream (Super high speed camera)

- **Interface Specification**

Abbreviation	Interface Type
GV	GigE Vision
CL	Camera Link
CXP/CXP10/CXP12	CoaXPress
U30	USB3.0
XGV	10 GigE Vision
PCIe	PCI-Express
SFP	Small Form Pluggable

- **Color Form**

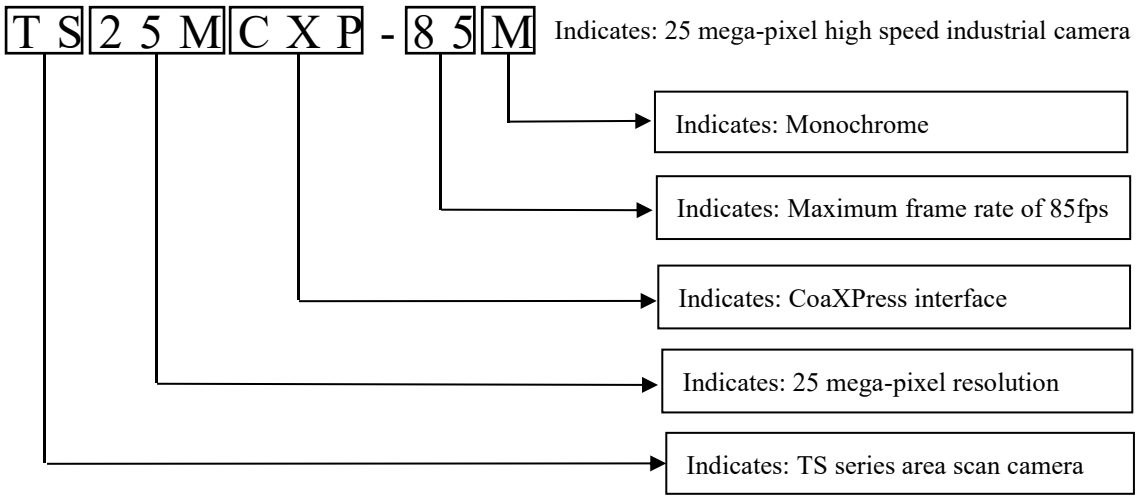
Abbreviation	Image Mode
M	Monochrome
C	Color
F	Full Color
T	Monochrome TDI (Time Delay Integration)
X	Time Division Camera
U	UV (Ultraviolet)
N	NIR (Near Infrared)

S	SWIR (Short Wave Infrared)
W	MWIR (Middle Wave Infrared)
L	LWIR (Long Wave Infrared)

- **Line Rate or Frame Rate**

Camera Type	Description
Line Scan Camera	Maximum line rate, e.g. 30kHz
Area Scan Camera	Maximum frame rate, e.g. 4000fps

e.g.



3 Product Appearance

Fig. 1 Product Appearance

Note:

① The front and the side of camera provide threaded holes for mounting camera.

② Please refer to “Mechanical Dimensions and Interfaces” below for detailed camera dimensions.

4 Product Specifications

TS25MCXP camera adopts advanced global shutter CMOS image sensor and CoaXPress data interface. It is a high-speed area scan camera designed specifically for industrial measurement and inspection. It has high reliability and stability, and is suitable for occasions with high requirements (high resolution, high speed) for image acquisition, such as surface inspection, electronic placement inspection, etc.

4.1 Main Features

- Global Shutter CMOS Sensor
- 25 Mega-Pixel Resolution
- Full Frame Rate Maximum Frame Rate 85fps
- High Sensitivity and Low Noise
- ROI
- Rich Exposure Control Modes (External Trigger, Free-Run)
- Minimum Exposure Time: 2us, Exposure Time Step: 1us
- Output Pixel Format: 8/10bit
- LUT
- Defect Pixel Correction
- Flat Field Correction
- Analog Gain / Digital Gain / Offset Control
- Support CoaXPress 1.1.1 Protocol
- Real-time Temperature Monitor

4.2 Camera Specifications

Table 1 TS25MCXP-85M Product Specifications

Model	TS25MCXP-85M
Product Description	25 mega-pixel high speed industrial camera
Resolution	5120 x 5120
Pixel Size	4.5um x4.5um
Sensor Type	Global shutter CMOS
Image Type	Monochrome
Sensor Size	32.58mm (diagonal)
Dynamic Range	≥55dB
SNR	40dB
Lens Mount	M58/F Mount
Max Frame Rate	85.099fps@8bit, 70.225fps@10bit
Analog Gain	x1/x1.26/x1.87/x3.17
Analog Offset	-100~511
Digital Gain	0.001~8
Digital Offset	-1023~1023
Trigger Mode	External trigger, Free-Run

External Trigger	External IO / CXP
Exposure Control	Pulse Width Control, Timed
Exposure Time	40us~99912us (Step: 1us)
Data Format	8/10bit
Operating Temperature	0~50°C
Data Interface	CoaXPress
Data Rate	2300MB/s
Power Supply	DC 12~24V (±10%) 1.5A or PoCXP power supply
Power Consumption	9.5W (DC power supply) or 10.0W (PoCXP power supply)
Mechanical	M58 interface: 75mm x 75mm x 55.9mm F interface: 75mm x 75mm x 90.9mm

Note: This table is for 3.3-3.1 version of TS25MCXP camera specifications, which may vary slightly from version to version.

4.3 Camera Block Diagram

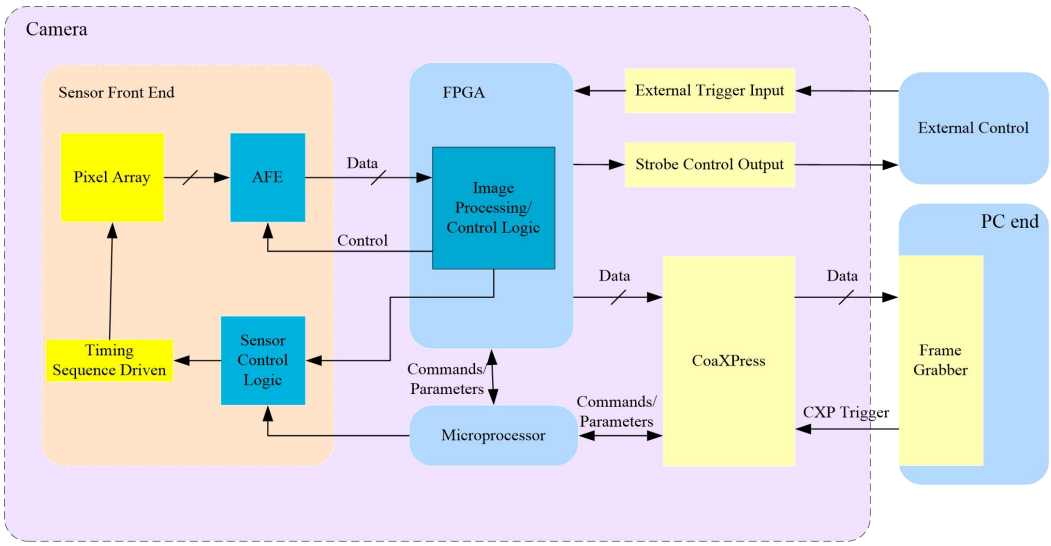


Fig. 2 Internal Implementation Structure of Camera

TS25MCXP camera is designed based on a high-speed surface scanning image sensor. The pixel array is uniformly sampled and maintained by a global shutter control system, converted from an analog front-end to a digital signal, processed by FPGA algorithms, and transmitted to a PC acquisition card through the CoaXPress interface.

TS25MCXP camera can receive external signal trigger acquisition, from the 6-pin interface signal or the CXP signal of the CoaXPress interface.

4.4 Spectral Response

The spectral response of TS25MCXP camera is shown below.

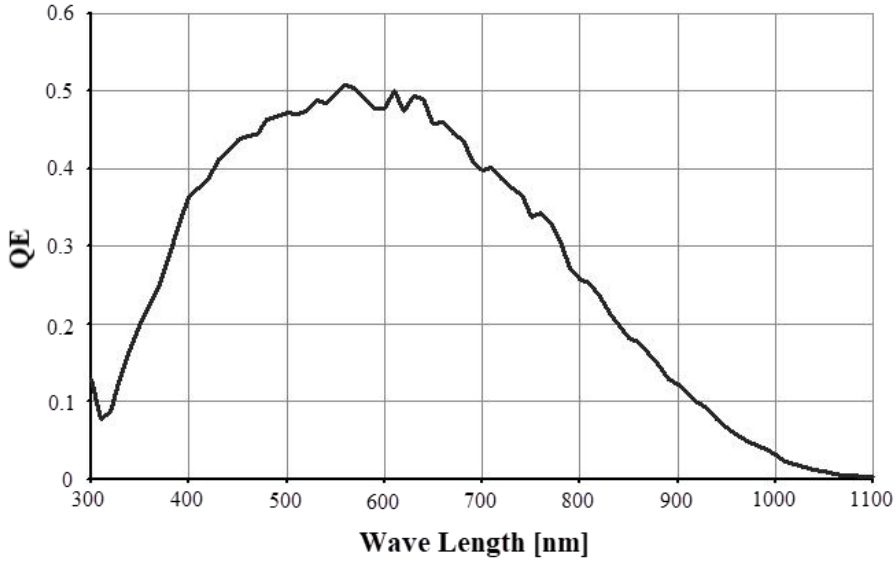


Fig. 3 Spectral Response

4.5 Environmental Requirements

(1) Operating temperature: 0℃~50℃, humidity: 10%~80%; Storage temperature:-20℃~75℃.

(2) The sensor in the camera has dustproof sealing setting, which can effectively prevent dust from entering the sensor surface. If the lens cap is open, dust may enter. Therefore, tighten the lens cap when the camera is not in use.

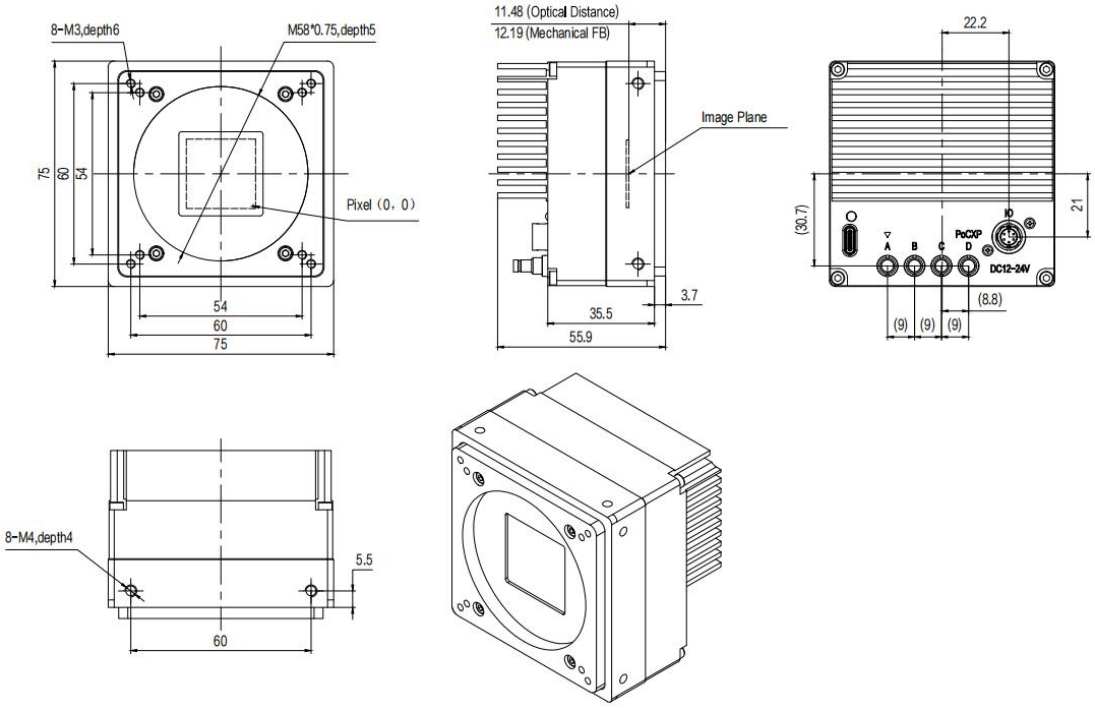
4.6 RoHS Certification

All camera components (including electronic components, PCB, and shell) are RoHS compliant.

5 Mechanical Dimensions and Interfaces

5.1 Mechanical Dimensions

M58 Mount:



F Mount:

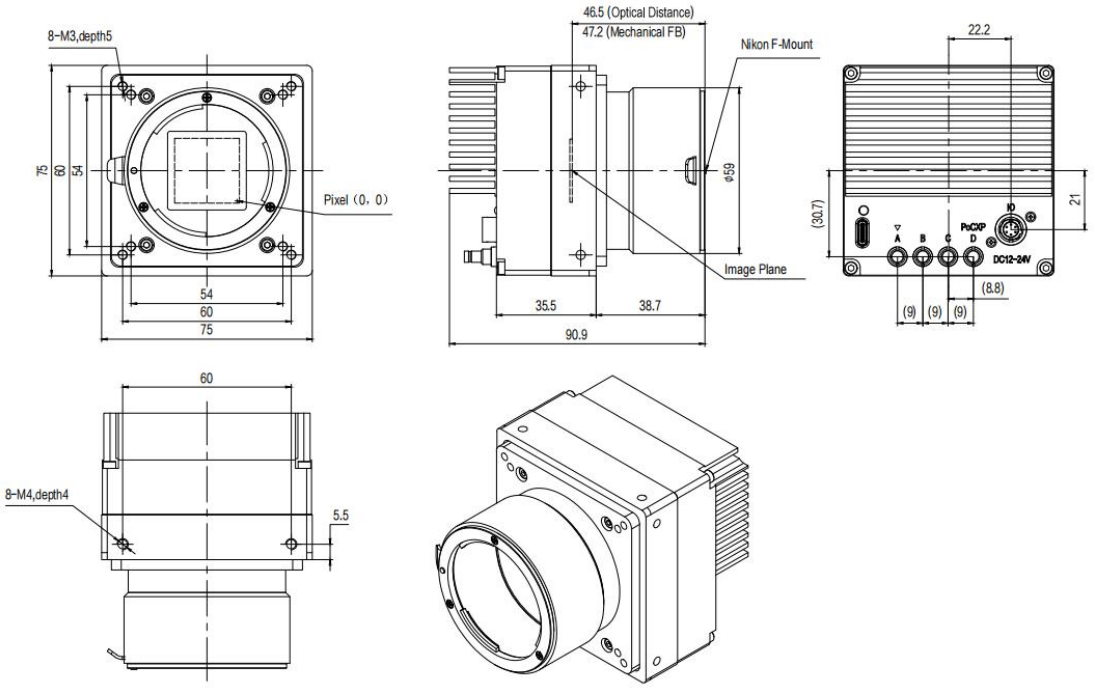


Fig. 4 Camera Mechanical Dimensions

5.2 Camera Interface

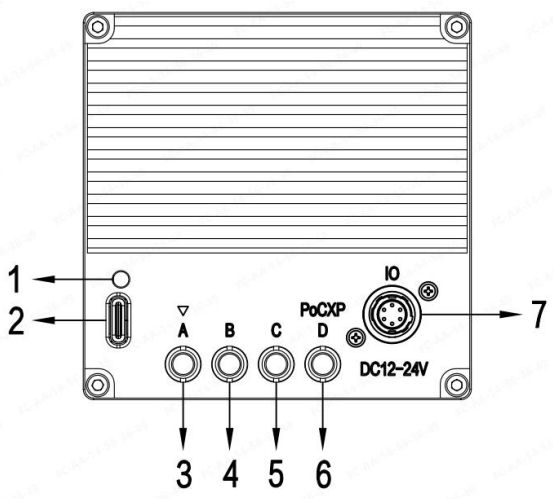


Fig. 5 External Interfaces of Camera

① Camera Status Indicator
② Type-C Interface
③ CoaXPress Connection A **(Master)**
④ CoaXPress Connection B
⑤ CoaXPress Connection C
⑥ CoaXPress Connection D **(PoCXP Power Supply)**
⑦ 6-pin Power and Control Interface

5.2.1 Camera Status Indicator

The camera status indicator is used to indicate the real-time status of the camera, as shown in the table below:

Table 2 Camera Status Indicators

LED Status Indicators	Camera Status
Solid Green	Normal
Blinking Green	No trigger input within three seconds in external trigger mode
Solid Red	Processor is starting or in error
Blinking Red	Camera fatal error (need contact technical support)
Solid Yellow	Camera is initializing or executing command

5.2.2 Power & Control Interface

The power and control interface is a 6-pin interface with the model:
Hirose HR10A-7R-6PB (Male).

Corresponding connector on the power cable model:
Hirose HR10A-7P-6S (Female).

The power and control interface on the back of the camera is shown as follows:

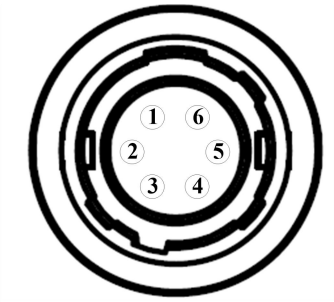


Fig. 6 Pin Assignments for Interface

Table 3 Power Connector Pin Definition

Signal	Pin	Signal	Pin
Power_VCC	1	Strobe Out	4
Trigger In+	2	IO_GND	5
Trigger In-	3	Power_GND	6

The schematic diagram of trigger input circuit is shown below:

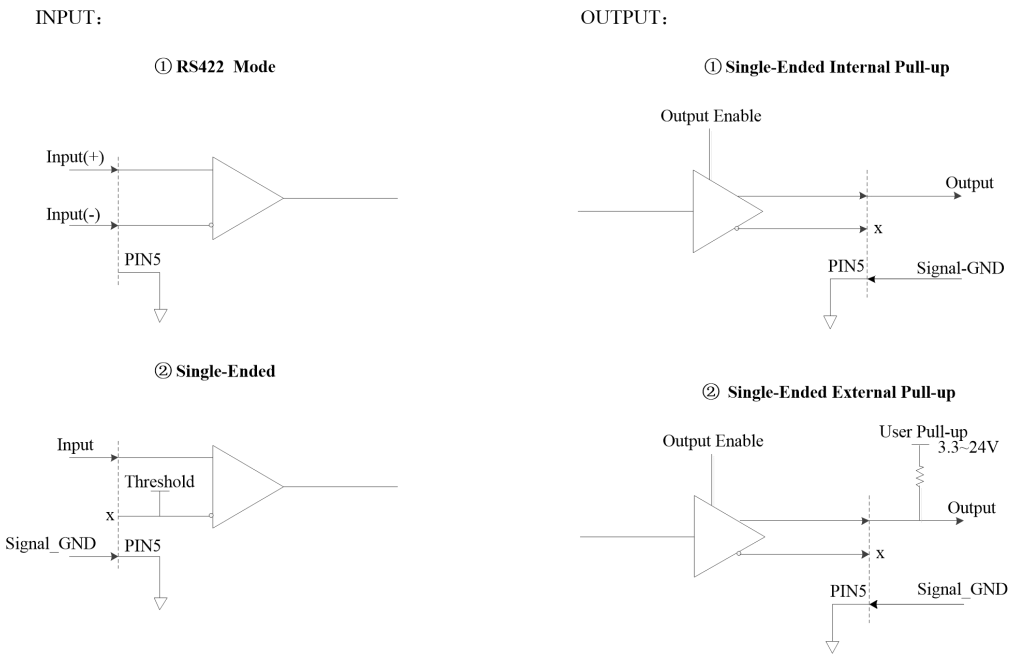


Fig.7 Trigger Input Circuit Schematic

- Trigger voltage range: 3.3~24V
- Strobe signal pull-up voltage range: 3.3~24V

5.2.3 Data Interface

TS25MCXP camera implements the standard Quad CoaXPress protocol, and the data interface is four DIN 1.0/2.3 sockets on the back of the camera. The data interface on the back of the camera is shown

in the red box below:

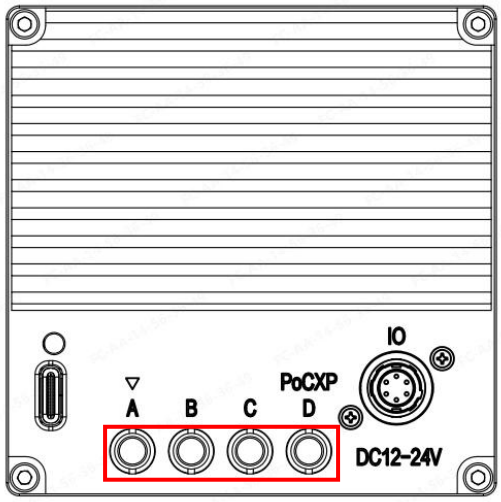


Fig. 8 Data Interface

The mechanical drawing of DIN 1.0/2.3 socket is as follows:

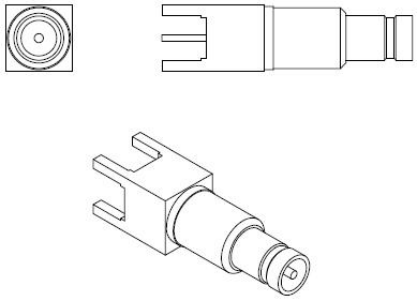


Fig. 9 DIN 1.0/2.3 Socket

6 Camera Features

This chapter details the internal features of TS25MCXP camera.

6.1 Trigger Mode

TS25MCXP camera supports three trigger modes: Free-Run mode, External Pulse mode and External PWM mode.

6.1.1 Free-Run Mode

In the Free-Run mode(TriggerMode = Off，ExposureMode = Timed), the camera generates the relevant control sequence internally according to the frame period and exposure time parameters configured by users and outputs the image.

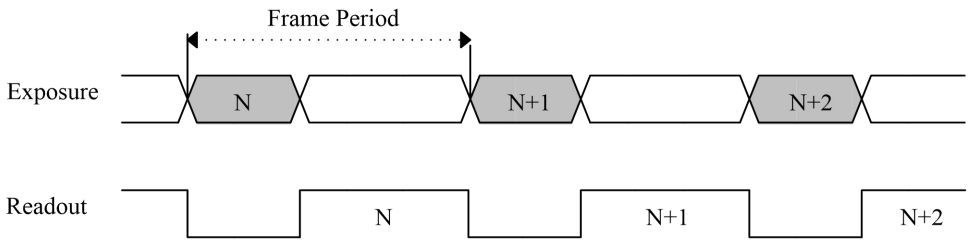


Fig. 10 Free-Run Mode

To achieve normal image output, TS25MCXP camera limits the range of frame periods and exposure time. Minimum frame period should be longer than both exposure time and readout time of a frame data.

6.1.2 External Pulse Mode

In the External Pulse mode (TriggerMode = On， ExposureMode = Timed), the camera starts exposure at the rising edge of the external trigger signal, while the exposure time is set by users command (consistent with the Free-Run mode). The frame rate of the camera is determined by the frame period between the rising edges of the external trigger pulse, as shown in the figure below.

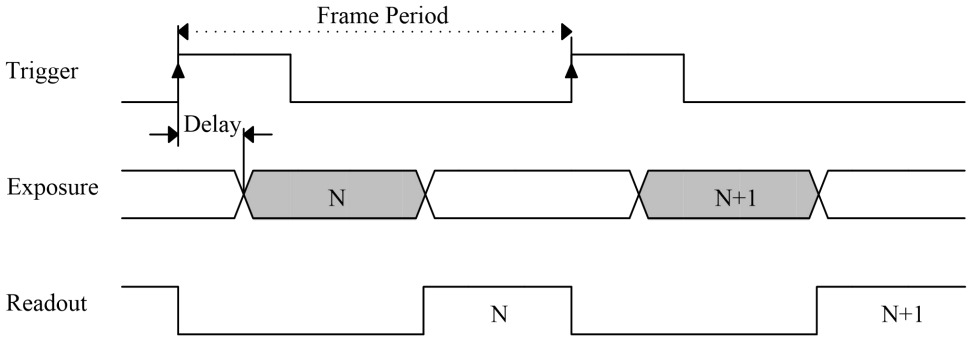


Fig. 11 External Pulse Mode

The external trigger signal can be input from CoaXPress interface or I/O control interface, and the input source could be selected by users. To get a higher frame rate, a new trigger pulse can be fired at the same time the camera reads the data after the last frame exposure. In this fast mode, since it is

necessary to ensure that the readout stages of two frames do not conflict, the external trigger with an interval less than 1 frame readout time will be automatically ignored by the camera, as shown in the figure below.

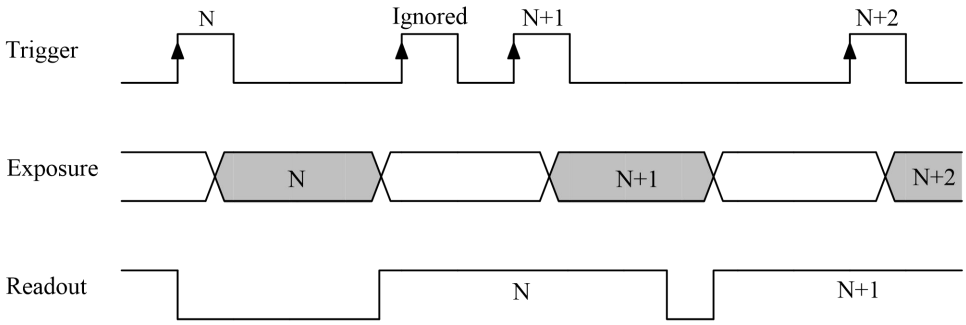


Fig. 12 Frame Period of External Trigger is Too Short

6.1.3 External PWM Mode

In the External PWM mode (TriggerMode = On，ExposureMode = TriggerWidth), the camera exposure starts at the rising edge and ends at the falling edge of the external trigger signal. That is, the actual exposure time is equal to the high level duration of the external trigger, and the frame period is equal to the pulse interval.

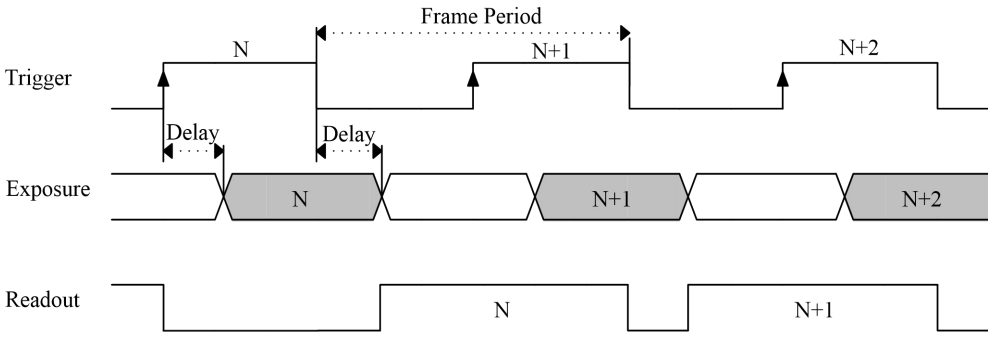


Fig. 13 High Level Trigger Mode

Please note that in this model, external trigger signal should be greater than minimum exposure time. In fact, for pulses less than minimum exposure time, camera will always process them according to minimum exposure time.

Too short frame period of external trigger will lead to the conflict between the data readout of the previous and current frames of the camera. The pulses that do not meet the requirements will be ignored inside the camera, so that the device can maintain its normal operation. Therefore, in this mode, it should be ensured that the frame period between the falling edges of adjacent external triggers is greater than one-frame readout time.

For external trigger mode, TS25MCXP camera provides rich timing parameter control, including external trigger polarity, delay, etc.

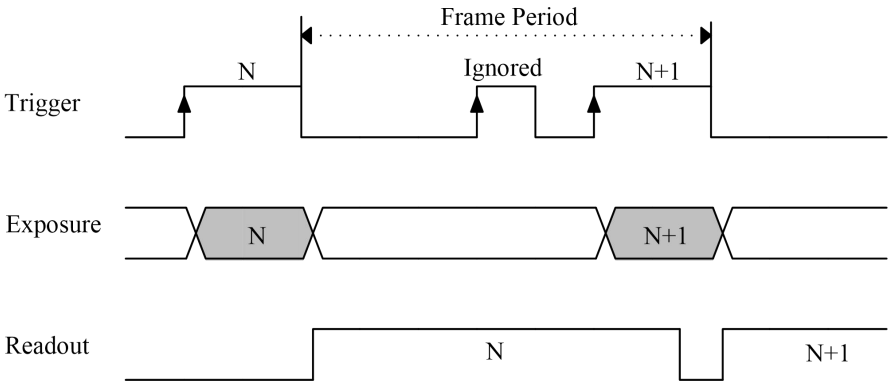


Fig. 14 Frame Period of External Trigger is Too Short

6.2 ROI

Region of interest (ROI) is part of a specified sensor array. Users can obtain frame data from a specified part of the sensor array with the same frame quality as from the entire sensor array. When the starting point and the number of pixel lines are specified in both horizontal and vertical directions, the ROI is determined to be an overlap of the two regions, as shown in the figure below.

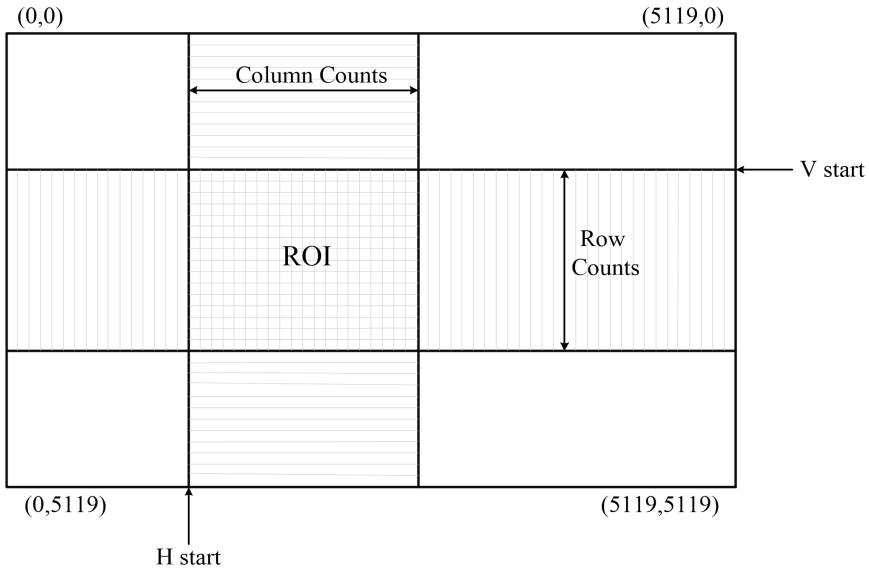


Fig. 15 ROI

Table 4 Maximum Frame Rate Depending on ROI Values

ROI Size H	ROI Size V	8bit	10bit
5120	5120	85.099fps	70.225fps
4096	5120	89.429fps	89.429fps
3072	5120	89.429fps	89.429fps
2048	5120	89.429fps	89.429fps
1024	5120	89.429fps	89.429fps
128	5120	89.429fps	89.429fps
5120	4096	106.180fps	87.650fps

5120	3072	141.123fps	116.564fps
5120	2048	210.393fps	173.943fps
5120	1024	413.052fps	342.583fps
5120	512	796.813fps	664.894fps
5120	128	2631.579fps	2262.443fps
128	128	2732.240fps	2732.240fps

6.3 Binning

Binning supports 2 x 2 or 4 x 4 binning. After normal exposure acquisition, the camera performs a sum operation on the values of adjacent pixels and outputs them as a separate pixel value. By using binning, the pixel response value can be improved, and the effective pixels of a frame can be reduced to one fourth or one sixteenth of the original value.

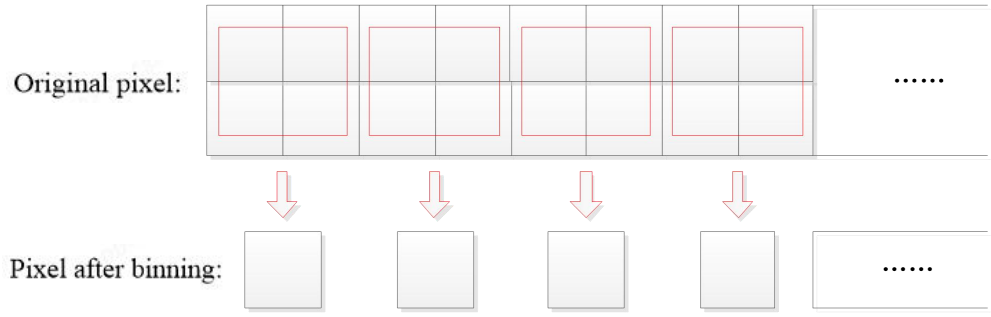


Fig. 16 Binning_2x2

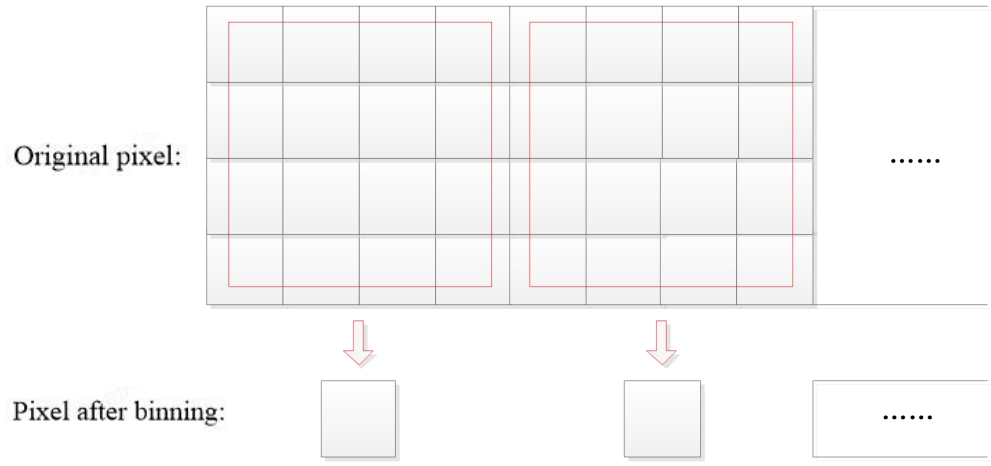
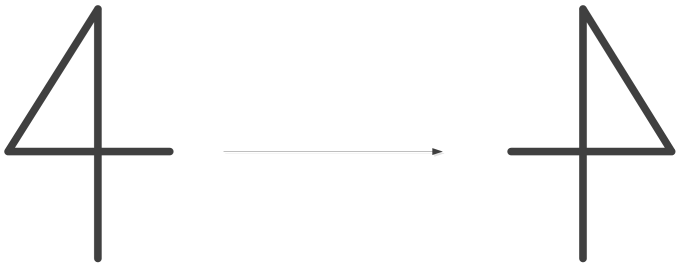


Fig. 17 Binning_4x4

6.4 Image Flipping

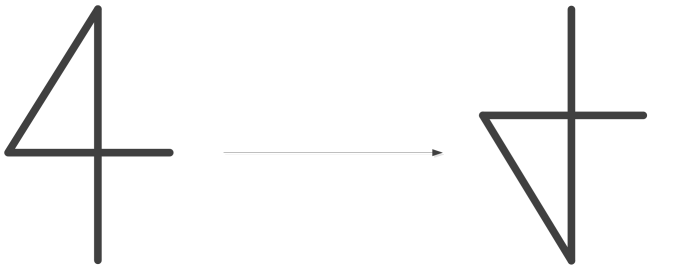
TS25MCXP camera scanning direction is divided into horizontal scanning direction and vertical scanning direction. The horizontal scanning direction supports left to right and right to left, while the vertical scanning direction supports top to bottom and bottom to top.

Schematic diagram of horizontal and vertical scanning directions is as follows, and the two can also be combined for use.



Left to Right Right to Left

Fig. 18 Horizontal Scanning Direction



Top to Bottom Bottom to Top

Fig. 19 Vertical Scanning Direction

6.5 LUT

LUT uses a look-up table with 10bit input and 10bit output to map and convert the values of the original image. Users can use this function to implement gamma correction.

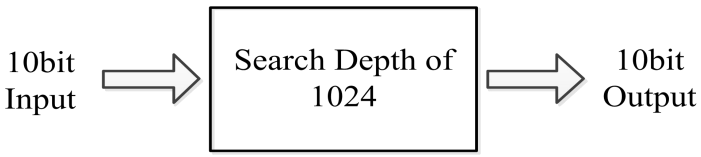


Fig.20 LUT Structure

The LUT mapping curve for Gamma=0.5 is shown below:

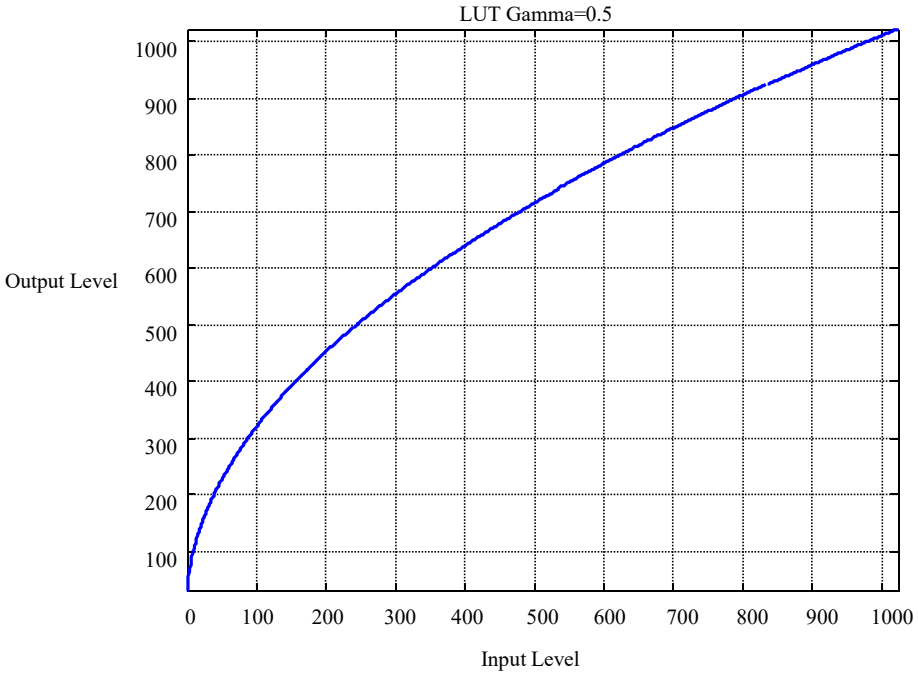


Fig.21 LUT Gamma = 0.5

6.6 Flat Field Correction

Generally, in the application process of area scan cameras, due to the vignetting effect of the lens and the inconsistency of illumination, there is a certain difference between the image output by the camera and the actual signal, that is, the output data of the camera is different for the signal with the same brightness. TS25MCXP camera provides a flat field correction function to correct this problem. Actually, users can achieve flat field effect by by flat field correction.

Taking into account the pixel array scale and vignetting effect of area scan cameras, this camera uses 64 x 64 pixel block data, combined with image algorithms to achieve real-time flat field correction algorithms. The fundamental is shown in the figure below:

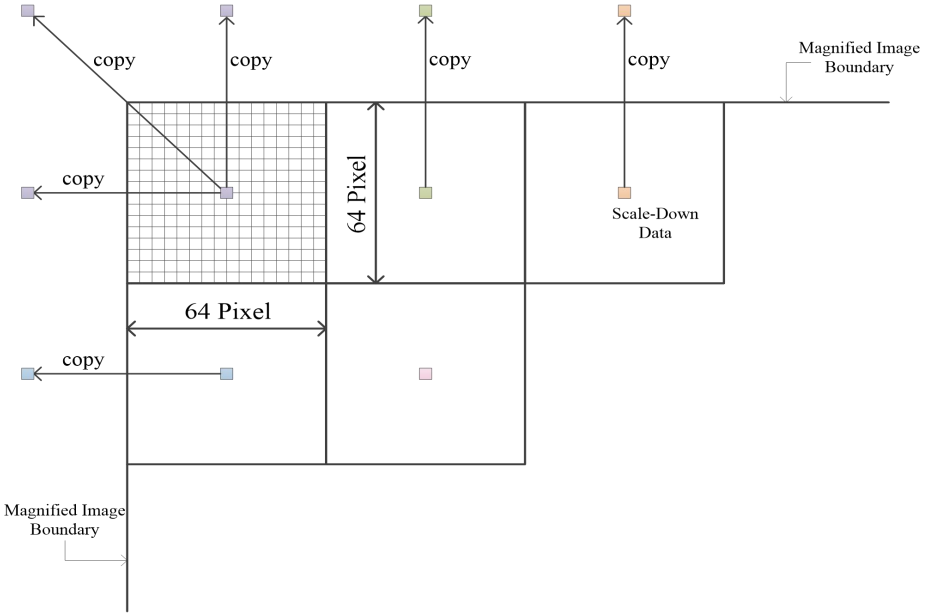


Fig. 22 Flat Field Correction Schematic

In practical applications, users sometimes use multiple different light sources to switch between for taking photos, and there is a problem of uneven grayscale values in images under different light sources. At this time, a set of flat field correction parameters cannot meet the scenario of multiple light sources switching between each other. TS25MCXP camera provides a flat field correction polling function internally to correct this issue.

Taking three different light sources taking turns switching for imaging as an example. The user first needs to perform flat field correction under three different light sources, and save the correction parameters in the flat field correction parameter set with indexes 1, 2, and 3 in sequence. Then enable the flat field correction polling function, set the polling list to 123, and after starting image acquisition, the first image uses the first set of flat field correction parameters, the second image uses the second set of flat field correction parameters, the third image uses the third set of flat field correction parameters, the fourth image uses the first set of flat field correction parameters again, and so on.

6.7 Defect Pixel Correction

Due to the defects of the material itself and the issue with the process flow of semiconductor production, there are usually a certain number of pixels in area scan imaging sensors that cannot properly response to the input light, which we call defect pixels. TS25MCXP camera provides with defect pixel automatic correction feature. The defect pixel information of the imaging sensor is written into the camera before the camera is delivered out of the factory. Users can control whether to enable the defect pixel correction, add new defect pixels and read out the current defect pixel list from the camera.

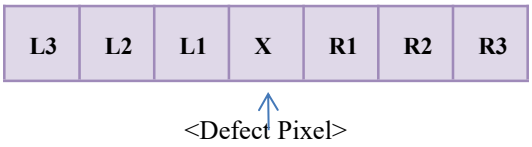


Fig. 23 Defect Pixel Position Needs to be Corrected

Define the following adjacent pixels L3, L2, L1, X, R1, R2, R3, and the specific replacement rules are as follows:

- If X is the beginning of a line and R1 is not a bad point, then X is replaced with R1;
- If X is the beginning of a line and R1 is a bad point, then X is replaced with R2;
- If X is the end of the line and L1 is not a bad point, then X is replaced with L1;
- If X is the end of the line and L1 is a bad point, then X is replaced with L2;
- If X is the middle pixel and L1 is not a bad point, then X is replaced with L1;
- If X is the middle pixel, L1 is a bad point, and R1 is not a bad point, then X is replaced with R1;
- If X is the middle pixel, and L1 and R1 are bad points, and L2 is not a bad point, then X is replaced with L2;
- If X is the middle pixel and L1, L2, and R1 are bad points, then X is replaced with R2.

Note: If there are more than 4 consecutive bad points, it will result in replacing them with bad points.

6.8 Test Image

TS25MCXP camera provides test images. Different from the collected images whose data comes from sensors, the test images are fixed patterns that are pre-edited and stored inside the camera, independent of the scene shot by the camera, and can be used to test whether the data link works normal.

The camera provides test images as shown in the figure below.

- Test Image1: scroll diagonal stripe image.
- Test Image2: fixed image with horizontal gray gradient.
- Test Image3: fixed image with vertical gray gradient.

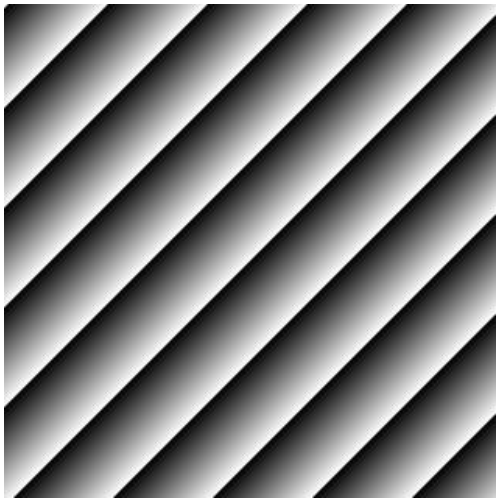


Fig. 24 Test Image1

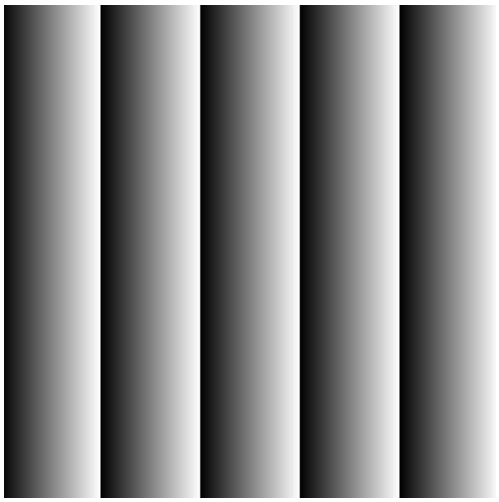


Fig. 25 Test Image2

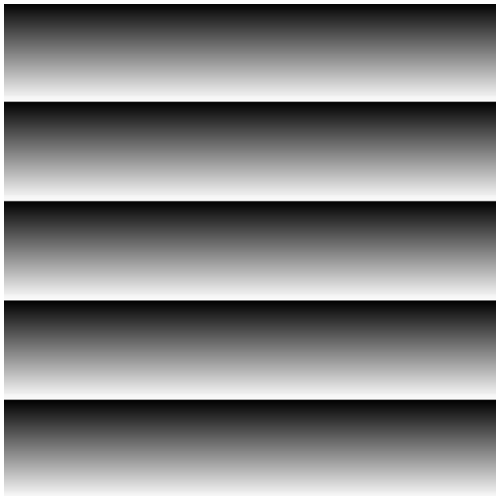


Fig. 26 Test Image3

6.9 Strobe

Strobe signal is used to synchronize the external light source with the camera. The timing of the strobe signal is exactly the same as that of the camera exposure. When the camera exposure begins, the strobe signal will pull down/up the level. It will return to its initial level when the camera exposure is over.

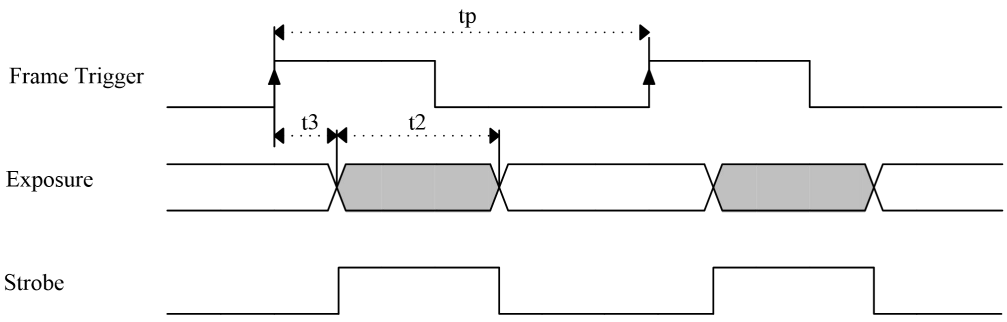


Fig. 27 Strobe Signal

6.10 Data Format

TS25MCXP camera provides two pixel data bit width, 8bit and 10bit. If bit width is 8bit, it is equivalent to truncating the top 8bit of 10bit.

Fig. 28 Data Format

6.11 Gain and Offset

The camera gain is divided into analog gain and digital gain.

Analog gain acts on the analog signal. By increasing analog gain, a stronger response can be generally obtained under weak illumination, thus realizing a higher SNR. Users can configure camera's analog gain. Similarly, the analog offset is commonly used to adjust the black level position of the front-end sensor.

Digital gain amplifies or reduces the data of the photoelectric conversion signal after AD, which is usually used to increase the dynamic range of the output image. Digital gain can also be used to adjust the brightness of the image. Digital offset is commonly used to adjust the overall background brightness of an image.

The effect of digital gain can be summarized by the following equation:

Data value (Output) = Data value (digital gain=1 & digital offset=0) x Digital gain value

The effect of digital offset can be summarized by the following equation (Data values less than 0 will be output as 0):

Data value (Output) = Data value (digital offset=0) + Digital offset value

Digital offset is set for 10bit data. If the image data is 8bit, the actual digital offset will be divided by 4.

6.12 Camera Temperature

TS25MCXP supports real-time acquisition of camera temperature. Users can monitor the working status of front-end sensors by reading camera temperature values

The operating environment temperature of the camera is recommended to be 0~50°C. If users detect abnormal internal temperature (such as over 60°C), it is recommended to stop the camera immediately to avoid component damage. Power off and contact our technical support in time.

6.13 Load / Save Configuration

TS25MCXP camera provides three working parameter sets to meet the use demand in most scenarios. Among them, the factory parameter set has already been optimized and cannot be modified by users. The camera is provided with two user operating parameter sets, among which the internal parameters can be modified and saved by users. The saved operating parameter set will be automatically loaded upon power-on next time.

If the camera is found abnormal after modification of the parameters, users can restore the camera to the factory parameter set.

7 Camera Control

7.1 GenICam Standard

GenICam standard, promulgated by European Machine Vision Association (EMVA), provides a unified programming interface for all types of industrial cameras. The programming interface (API) is the same regardless of which transmission protocol the camera uses or which functions it implements. It mainly contains the following three modules:

- GenAPI: Responsible for parsing XML files and solving problem of how to configure camera
- GenTL: Transport layer, for device enumeration, attribute control, and image acquisition
- SFNC: Standard for naming camera features

Camera XML description file is stored locally on the PC, and collection software will select the most appropriate XML file according to camera model. Application and camera communicate with each other through SFNC, GenAPI, and GigEVision, as shown in the figure below.

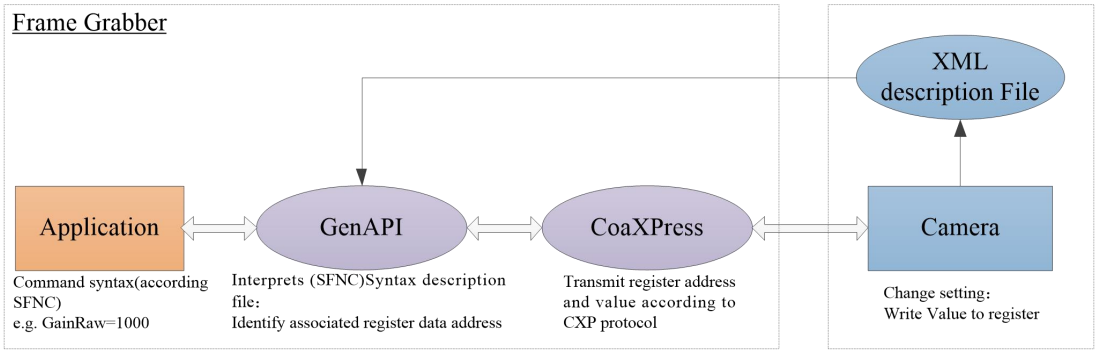


Fig. 29 Communication Principle Diagram Between Application and Camera

In fact, if users want to change camera settings, such as gain, GenICam (SFNC) specifies a standardized syntax:

```
if( IsAvailable(Camera.GainRaw) )
    Camera.GainRaw = 1000;
```

GenAPI can parse these commands through the description file. For example, in order to set the gain to 1000, the value of 0x3E8 (HEX) must be written to the register at address 0x0815 (HEX). Other tasks involved may be to check whether the camera has gain characteristics in advance and check whether the new value is consistent with the allowable gain range. This register message is transmitted and parsed via the CoaxPress protocol, and is used in the camera.

7.2 GenAPI Parameter Attributes

The actual method of controlling the camera is closely related to the software implementation of the frame grabber and SDK. Most of the frame grabber software provides a graphical user interface (GUI) that is automatically generated from an XML file. The focus of this manual is on the functions of the camera. It describes in detail the specific commands and their effects on camera operations. It lists the name, interface, access, description, range and default value of each GenAPI parameter.

(1) Register name

Each parameter is identified by a unique name. Most names are part of SFNC, and (T)TS65MCXP custom names are used for non-standard parameters.

(2) Register address

This parameter represents the address value of the register (hexadecimal format).

(3) Register size

This parameter represents the size of the register value (in byte).

(4) Register interface

The parameter interface represents the type of parameter, which is mainly used for the GUI of the frame grabber to assign a display type to the parameter.

Table 5 Overview of Parameter Interface

Interface	Interface Name	Description
Integer	I	Integer with value, minimum, maximum, and increment
Float	F	Float with value, minimum, maximum, and physical unit
String	S	String
Enumeration	E	Enumerate type
Command	C	Execute the command
Boolean	B	Boolean type

(5) Parameter access

This parameter represents whether the user can read (RO), write (WO) or read/write (RW) parameters.

(6) Default parameter value and range

When setting the parameter, it will check whether the input value is within the valid range of the parameter.

7.3 Register Classification

7.3.1 Bootstrap CoaXPress Registers

Table 6 Bootstrap CoaXPress Registers

Name	Address	Size	Interface	Access	Visibility
Standard	0x0	4	I	RO	Beginner
Revision	0x4	4	I	RO	Beginner
XmlManifestSize	0x8	4	I	RO	Guru
XmlManifestSelector	0xc	4	I	RW	Guru
XmlVersion	0x10	4	I	RO	Guru
XmlSchemeVersion	0x14	4	I	RO	Guru

XmlUrlAddress	0x18	4	I	RO	Guru
Iidc2Address	0x1c	4	I	RO	Guru
ConnectionReset	0x4000	4	I	RW	Guru
DeviceConnectionID	0x4004	4	I	RO	Guru
MasterHostConnectionID	0x4008	4	I	RW	Guru
ControlPacketSizeMax	0x400c	4	I	RO	Guru
StreamPacketSizeMax	0x4010	4	I	RW	Guru
ConnectionConfig	0x4014	4	E	RW	Beginner
ConnectionConfigDefault	0x4018	4	E	RO	Beginner
TestMode	0x401c	4	E	RW	Guru
TestErrorCountSelector	0x4020	4	I	RW	Guru
TestErrorCount	0x4024	4	I	RW	Guru
TestPacketCountTx	0x4028	8	I	RW	Guru
TestPacketCountRx	0x4030	8	I	RW	Guru
ElectricalCompliancyTest	0x4038	4	E	RW	Guru
WidthAddress	0x3000	4	I	RO	Guru
HeightAddress	0x3004	4	I	RO	Guru
AcquisitionModeAddress	0x3008	4	I	RO	Guru
AcquisitionStartAddress	0x300c	4	I	RO	Guru
AcquisitionStopAddress	0x3010	4	I	RO	Guru
PixelFormatAddress	0x3014	4	I	RO	Guru
DeviceTapGeometryAddress	0x3018	4	I	RO	Guru
Image1StreamIDAddress	0x301c	4	I	RO	Guru
HsUpconnection	0x403c	4	I	RO	Guru

- **Standard**
  Unique identification of CoaXPress standard.

- **Revision**
  CoaXPress protocol version number.

- **XmlManifestSize**
  The number of XML files available.

- **XmlManifestSelector**
  Select XML manifest entry.

- **XmlVersion**
  The version of XML file referenced by XmlManifestSelector.

- **XmlSchemeVersion**
  The version of XML file format scheme referenced by XmlManifestSelector.

- **XmlUrlAddress**

  The URL address of XML file referenced by XmlManifestSelector.

- **Iidc2Address**

  If device supports IIDC 2 protocol, this register should provide start address of IIDC 2 register space.

- **ConnectionReset**

  Reset all connections to device.

- **DeviceConnectionID**

  Provide ID of device connection from which this register is read.

- **MasterHostConnectionID**

  ID of host device.

- **ControlPacketSizeMax**

  Provide maximum control packet data size, which is defined in bytes and should be multiples of 4 bytes.

- **StreamPacketSizeMax**

  Provide maximum flow packet data size that host can accept. The size is defined in bytes and should be a multiple of 4 bytes.

- **ConnectionConfig**

  Current device link speed and number of link channels. The enumeration names and values are as follows:

  - CXP3_X4 (0x00040038)
  - CXP6_X4 (0x00040048)

- **ConnectionConfigDefault**

  Default link speed and number of link channels. The enumeration names and values are as follows:

  - CXP3_X1 (65592)
  - CXP5_X1 (65600)
  - CXP6_X1 (65608)
  - CXP3_X2 (131128)
  - CXP5_X2 (131136)
  - CXP6_X2 (131144)
  - CXP3_X4 (262200)
  - CXP5_X4 (262208)
  - CXP6_X4 (262216)

- **TestMode**

Enable transmission of test packets from device to host. The enumeration names and values are as follows:

- Off (0)
- Mode1 (1)

- **TestErrorCountSelector**

  Test mode selection. The parameter range is as follows:
  - Maximum: 3
  - Minimum: 0
  - Increment: 1

- **TestErrorCount**

  Number of test errors.

- **TestPacketCountTx**

  Number of test error frames.

- **TestPacketCountRx**

  Number of test data frames.

- **ElectricalCompliancyTest**

  Electrical compatibility test.The enumeration names and values are as follows:
  - NormalOperatingMode (0)
  - CXP3_X1 (65592)
  - CXP5_X1 (65600)
  - CXP6_X1 (65608)
  - CXP3_X2 (131128)
  - CXP5_X2 (131136)
  - CXP6_X2 (131144)
  - CXP3_X4 (262200)
  - CXP5_X4 (262208)
  - CXP6_X4 (262216)

- **WidthAddress**

  Address of camera width register.

- **HeightAddress**

  Address of camera height register.

- **AcquisitionModeAddress**

  The address of camera acquisition mode register.

- **AcquisitionStartAddress**

  The address of camera acquisition register.

- **AcquisitionStopAddress**
  The camera stops grabbing address of register.

- **PixelFormatAddress**
  The address of camera pixel format register.

- **DeviceTapGeometryAddress**
  The address of camera Tap arrangement register.

- **Image1StreamIDAddress**
  Address of data stream register.

- **HsUpconnection**
  Whether camera supports address of uplink channel register.

7.3.2 Device Control Registers

Table 7 Device Control Registers

Name	Address	Size	Interface	Access	Visibility
DeviceVendorName	0x2000	32	S	RO	Beginner
DeviceModelName	0x2020	32	S	RO	Beginner
DeviceManufacturerInfo	0x2040	48	S	RO	Beginner
DeviceVersion	0x2070	32	S	RO	Beginner
DeviceSerialNumber	0x20b0	16	S	RO	Expert
DeviceUserId	0x20c0	16	S	RW	Beginner
DeviceTemperature	0xa004	4	F	RO	Beginner

- **DeviceVendorName**
  Device vendor name.

- **DeviceModelName**
  Device model name.

- **DeviceManufacturerInfo**
  Device manufacturer information.

- **DeviceVersion**
  Device version.

- **DeviceSerialNumber**
  Device serial number.

- **DeviceUserId**

User-defined ID.

- **DeviceTemperature**

  Device temperature.

7.3.3 Image Format Control Registers

Table 8 Image Format Control Registers

Name	Address	Size	Interface	Access	Visibility
Width	0xa800	4	I	RW	Beginner
Height	0xa804	4	I	RW	Beginner
SensorWidth	0xa808	4	I	RO	Expert
SensorHeight	0xa828	4	I	RO	Expert
Binning	0xa810	4	E	RW	Beginner
PixelFormat	0xa830	4	E	RW	Beginner
VideoMode	0xa834	4	E	RW	Beginner
HorizontalScanDirection	0xa838	4	E	RW	Beginner
VerticalScanDirection	0xa850	4	E	RW	Beginner
OffsetX	0xa80c	4	I	RW	Beginner
OffsetY	0xa82c	4	I	RW	Beginner

- **Width**

  Actual camera output width. The parameter range is as follows:
  - Maximum: 5120
  - Minimum: 128
  - Increment: 64

- **Height**

  Actual camera output height. The parameter range is as follows:
  - Maximum: 5120
  - Minimum: 128
  - Increment: 16

- **SensorWidth**

  Sensor width.

- **SensorHeight**

  Sensor height.

- **Binning**

  Binning. The enumeration names and values are as follows:
  - Binning_1X1 (1)
  - Binning_2X2 (2)
  - Binning_4X4 (4)

- **PixelFormat**

  Pixel format. The enumeration names and values are as follows:
  - Mono8 (0x01080001): Monochrome 8bit
  - Mono10 (0x01100003): Monochrome 10bit

- **VideoMode**

  Output image format. The enumeration names and values are as follows:
  - Original (0): Original image
  - Corrected (1): Corrected image
  - DiagonalPattern (2): Diagonal stripe test image
  - VerticalPattern (2): Vertical test image
  - HorizontalPattern (3): Horizontal test image

- **HorizontalScanDirection**

  Horizontal scanning direction. The enumeration names and values are as follows:
  - LeftToRight (0): From left to right
  - RightToLeft (1): From right to left

- **VerticalScanDirection**

  Vertical scanning direction. The enumeration names and values are as follows:
  - TopToBottom (0): From top to bottom
  - BottomToTop (1): From bottom to top

- **OffsetX**

  Horizontal offset. The parameter range is as follows:
  - Minimum: 0
  - Increment: 128

- **OffsetY**

  Vertical offset. The parameter range is as follows:
  - Minimum: 0
  - Increment: 16

7.3.4 Acquisition Control Registers

Table 9 Acquisition Control Registers

Name	Address	Size	Interface	Access	Visibility
AcquisitionMode	0xb050	4	E	RO	Beginner
AcquisitionStart	0xb054	4	C	RW	Beginner
AcquisitionStop	0xb058	4	C	RW	Beginner
AcquisitionFrameRate	/	/	F	/	Beginner
AcquisitionFramePeriod	0xb028	4	F	RW	Beginner
AcquisitionMaxFrameRate	0xb02c	4	C	WO	Beginner

ExposureMode	0xb03c	4	E	RW	Beginner
ExposureTime	0xb040	4	F	RW	Beginner

- **AcquisitionMode**

  Acquisition mode, usually default to continuous acquisition. The enumeration names and values are as follows:

  - Continuous (0): Continuous acquisition

- **AcquisitionStart**

  Start acquisition.

- **AcquisitionStop**

  Stop acquisition.

- **AcquisitionFrameRate**

  Acquisition frame rate in Hz. The parameter range is as follows:

  - Minimum: 0.09

- **AcquisitionFramePeriod**

  Acquisition frame period, unit is us. The parameter range is as follows:

  - Maximum: 11000000
  - Increment: 1

- **AcquisitionMaxFrameRate**

  Set acquisition frame rate to the maximum value.

- **ExposureMode**

  Exposure mode. Please refer to Section 6.1 for specific descriptions. The enumeration names and values are as follows:

  - Timed (2): Free-Run mode
  - TriggerWidth (3): External PWM mode

- **ExposureTime**

  Exposure time, the unit is us. The parameter range is as follows:

  - Minimum: 2

7.3.5 IO Control Registers

Table 10 IO Control Registers

Name	Address	Size	Interface	Access	Visibility
TriggerSoftware	0xb004	4	C	WO	Expert
TriggerMode	0xb008	4	E	RW	Beginner
TriggerSource	0xb014	4	E	RW	Beginner
LinePolarity	0xb030	4	E	RW	Beginner

LineDetectionLevel	0xf850	4	E	RW	Expert
LineDebouncingPeriod	0xf830	4	I	RW	Beginner
LineDelayPeriod	0xf834	4	I	RW	Beginner
LineTriggerInputFrequency	0xf83c	4	I	RO	Beginner
FlashStrobeActivation	0xf84c	4	E	RW	Beginner
FlashStrobePullUp	0xf85c	4	E	RW	Beginner

- **TriggerSoftware**

  Software trigger.

- **TriggerMode**

  Trigger mode on/off. The enumeration names and values are as follows:
  - Off (0)
  - On (1)

- **TriggerSource**

  Trigger source selection. The enumeration names and values are as follows:
  - CXPIn (1): CXP signal
  - Line1 (0): 6-pin interface signal
  - Software (2): Software trigger signal

- **LinePolarity**

  Trigger polarity. The enumeration names and values are as follows:
  - Low (1): Low level trigger acquisition
  - High (0): High level trigger acquisition

- **LineDetectionLevel**

  Input signal detection level, i.e. input voltage range. The enumeration names and values are as follows:
  - Threshold_for_3V3_to_5V (1): Voltage 3.3-5V effective
  - Threshold_for_6V_to_24V (0): Voltage 6~24V effective

- **LineDebouncingPeriod**

  Input signal to jitter the window length, and signals below this pulse width will be considered as gross signals and filtered out, unit is us. The parameter range is as follows:
  - Maximum: 6553
  - Minimum: 0

- **LineDelayPeriod**

  Trigger delay time, unit is us. The parameter range is as follows:
  - Maximum: 6553
  - Minimum: 0

- **LineTriggerInputFrequency**

Trigger signal rate, unit is Hz.

- **FlashStrobeActivation**

  Strobe signal polarity. The enumeration names and values are as follows:

  - FallingEdge (1): Default high level, pull-down level when generating strobe signal
  - RisingEdge (0): Default low level, pull-up level when generating strobe signal

- **FlashStrobePullUp**

  Strobe signal pull-up voltage. The enumeration names and values are as follows:

  - Internal_3V3 (1): Internal 3.3V pull-up voltage
  - External_5V_to_24V (0): External 5~24Vpull-up voltage

7.3.6 Analog Control Register

Table 11 Analog control register

Name	Address	Size	Interface	Access	Visibility
AnalogGain	0xb808	4	E	RW	Beginner
AnalogOffset	0xb80c	4	I	RW	Beginner

- **AnalogGain**

  Analog gain. The parameter range is as follows:

  - Gain_x1 (0)
  - Gain_x1p26 (1)
  - Gain_x1p87 (2)
  - Gain_x3p17 (3)

- **AnalogOffset**

  Analog offset. The parameter range is as follows:

  - Maximum: 511
  - Minimum: -100
  - Incerment: 1

7.3.7 Digital Control Registers

Table 12 Digital Control Registers

Name	Address	Size	Interface	Access	Visibility
DigitalGain	/	/	F	/	Beginner
GainRaw	0xc028	4	I	RW	Beginner
DigitalOffset	0xc004	4	I	RW	Beginner

- **DigitalGain**

  Digital gain. The parameter range is as follows:

  - Maximum: 8
  - Minimum: 0.001

- Increment: 0.001

- **GainRaw**

Digital gain raw data. The meaning and function of this parameter are consistent with the DigitalGain parameter, inherited from the old version of the camera, and only distinguished by naming. The parameter range is as follows:

- Maximum: 16384
- Minimum: 0
- Increment: 1

- **DigitalOffset**

Digital offset. The parameter range is as follows:

- Maximum: 1023
- Minimum: -1023
- Increment: 1

7.3.8 LUT Control Registers

Table 13 LUT Control Registers

Name	Address	Size	Interface	Access	Visibility
LUTEnable	0xd004	4	B	RW	Expert
LUTIndex	0xd008	4	I	RW	Expert
LUTValue	0xd00c	4	I	RW	Expert

- **LUTEnable**

Enable LUT function.

- **LUTIndex**

LUT data index, that is, the gray value of image before mapping lookup table. The parameter range is as follows:

- Maximum: 1023
- Minimum: 0
- Increment: 1

- **LUTValue**

LUT data value, that is, the gray value of image after mapping lookup table. The parameter range is as follows:

- Maximum: 1023
- Minimum: 0
- Increment: 1

7.3.9 Flat Field Correction Registers

Table 15 Flat Field Correction Registers

Name	Address	Size	Interface	Access	Visibility
PRNUEnable	0xd800	4	B	RW	Expert
PRNUSelector	0xd824	4	I	RW	Expert
PRNUStart	0xd814	4	C	WO	Expert
PRNUReset	0xd818	4	C	WO	Expert
PRNUListEnable	0xd828	4	B	RW	Expert
PRNUList	0xd82c	4	I	RW	Expert
PRNUListReset	0xd830	4	C	WO	Expert

- **PRNUEnable**

  Enable flat field correction.

- **PRNUSelector**

  Select a set of flat field correction parameters, and the flat field correction parameters under different conditions can be saved separately in different parameter sets. The parameter range is as follows:

  - Maximum:8
  - Minimum: 1
  - Increment: 1

- **PRNUStart**

  Perform flat field correction.

- **PRNUReset**

  Flat field correction to restore factory settings.

- **PRNUListEnable**

  Enable flat field correction polling function.

- **PRNUList**

  Flat field correction polling selection, where each number corresponds to the corresponding index of the flat field correction parameter set, and the flat field correction parameters are cyclically used during the collection process. Please refer to section 6.6 for specific description. The parameter range is as follows:

  - Maximum: 88888888
  - Minimum: 1

- **PRNUListReset**

  Flat field correction polling function restored to factory settings.

7.3.10 Defect Pixel Registers

Table 15 Defect Pixel Registers

Name	Address	Size	Interface	Access	Visibility
DefectPixelCorrectionEnable	0x60d0	4	B	RW	Guru
DefectPixelTotal	0x60d8	4	I	RO	Expert
DefectPixelSelect	0x60dc	4	I	RW	Expert
DefectPixelReadX	0x60e0	4	I	RO	Expert
DefectPixelReadY	0x60e4	4	I	RO	Expert
DefectPixelWriteX	0x60e8	4	I	RW	Expert
DefectPixelWriteY	0x60ec	4	I	RW	Expert
DefectPixelAdd	0x60f0	4	C	WO	Expert
DefectPixelRemove	0x60f4	4	C	WO	Expert
DefectPixelClearAll	0x60f8	4	C	WO	Expert
DefectPixelSave	0x60fc	4	C	WO	Expert

- **DefectPixelCorrectionEnable**

  Enable defect pixel correction function.

- **DefectPixelTestMode**

  Selection of defect pixel testing mode. The enumeration names and values are as follows:

  ➢ Replace (0): Alternative mode, which can replace defect pixels with horizontal interpolation, vertical interpolation, or horizontal nearest neighbor values, depending on the local defect distribution

  ➢ MarkDefectsWhiteOnVideo (1): Mark defect pixels

- **DefectPixelTotal**

  Total number of defect pixel.

- **DefectPixelSelect**

  Select index of defect pixel. The parameter range is as follows:

  ➢ Minimum: 0

  ➢ Increment: 1

- **DefectPixelReadX**

  Read the X coordinate of current defect pixel. The parameter range is as follows:

- **DefectPixelReadY**

  Read the Y coordinate of current defect pixel. The parameter range is as follows:

- **DefectPixelWriteX**

  Write the X coordinate of defect pixel. The parameter range is as follows:

  ➢ Minimum: 0

  ➢ Increment: 1

- **DefectPixelWriteY**

  Write the Y coordinate of defect pixel. The parameter range is as follows:

  - Minimum: 0
  - Increment: 1

- **DefectPixelAdd**

  Add defect pixel.

- **DefectPixelRemove**

  Remove current defect pixels.

- **DefectPixelClearAll**

  Remove all defect pixels.

- **DefectPixelSave**

  Save defect pixels.

7.3.11 User Set Control Registers

Table 20 User Set Control Registers

Name	Address	Size	Interface	Access	Visibility
UserSetSelector	0xe800	4	E	RW	Beginner
UserSetLoad	0xe804	4	C	WO	Beginner
UserSetSave	0xe808	4	C	WO	Beginner

- **UserSetSelector**

  User configuration selector. The enumeration names and values are as follows:

  - Default (0): Factory configuration
  - UserSet1(1): User configuration 1
  - UserSet2(2): User configuration 2

- **UserSetLoad**

  Load selected camera configuration.

- **UserSetSave**

  Save selected camera configuration.

8 FAQ

- **If the camera cannot be connected to computer,**

① Ensure that the CoaXPress interface cable is OK.

② Ensure that the serial port channel parameters in the CoaXPress interface are set correctly.

- **If the CoaXPress interface cannot receive camera clock signal,**

① Ensure that the camera has been turned on properly (i.e. the status indicator should be normally green).

② If a third-party Frame Grabber is used to acquire images, ensure that the Frame Grabber and supporting software are operating properly, which can be checked by restarting the computer.

③ Ensure that the CoaXPress interface cable is OK.

- **If the camera has no image output in External Pulse mode,**

① Ensure that the external input pulse is normal.

② Ensure that the camera has received the trigger pulse correctly (it can be confirmed by the status indicator display).

③ If the CoaXPress interface signal is used as the trigger input signal, ensure that the frame grabber is configured correctly.

- **If temperature of camera casing is abnormal,**

① Ensure that the voltage range of external connected power supply is normal.

② If the casing is hot or the camera emits smoke, immediately cut off the power and stop using the camera, then contact us for technical support.

- **If images are dark,**

① Ensure that the sensor aperture on the casing is not blocked.

② Ensure that the exposure time is set properly.

- **If the images are not clear,**

① Ensure that the sensor glass is clean.

② Ensure that the camera status indicator is normal.

- **If the camera cannot output images,**

① Check whether the CoaXPress interface is normal by the test image.

② Check whether the power supply is normal by the camera indicator status.

③ Check whether the external pulse input is normal in the External Pulse mode by the camera indicator.

If users have any problems during the use of the camera, please contact our technical support in time, we will provide you with the service as soon as possible.