



**Ultra-High-Resolution CMOS
Monochrome Camera
CSC12M25BMP19-01B
INTERFACE SPECIFICATION**

Ver. 1.0

TOSHIBA TELI CORPORATION

Revision history

REV.	Item	Revision contents	Date
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1. Overview

This document explains the control interface specification of Ultra-High-Resolution CMOS monochrome camera CSC12M25BMP19-01B. CSC12M25BMP19-01B adopts the camera link interface, and uses the serial port on the camera link interface for the control of the camera.

2. Input-output interface

The input-output interface of this camera is in conformity with Camera Link version 1.2.

2-1. Video output/controlling (Camera Link Medium Configuration) CAMERA LINK1 · 2

Connector type: MDR 26-PIN connector 10226-2210PE (Manufactured by 3M)

2-2. Pin Assignment

●Connector name : CAMERALINK1

Pin No.	I/O	Signal name	Pin No.	I/O	Signal name
1	-	GND	14	-	GND
2	O	X0-	15	O	X0+
3	O	X1-	16	O	X1+
4	O	X2-	17	O	X2+
5	O	X CLK OUT-	18	O	X CLK OUT+
6	O	X3-	19	O	X3+
7	I	Ser TC (RxD) +	20	I	Ser TC (RxD) -
8	O	Ser TFG (TxD) -	21	O	Ser TFG (TxD) +
9	I	CC1 (TRIG) -	22	I	CC1 (TRIG) +
10	I	CC2 (MULTI) +	23	I	CC2 (MULTI) -
11	I	CC3-	24	I	CC3+
12	I	CC4+	25	I	CC4-
13	-	GND	26	-	GND

●Connector name : CAMERALINK2

Pin No.	I/O	Signal name	Pin No.	I/O	Signal name
1	-	GND	14	-	GND
2	O	Y0-	15	O	Y0+
3	O	Y1-	16	O	Y1+
4	O	Y2-	17	O	Y2+
5	O	Y CLK OUT-	18	O	Y CLK OUT+
6	O	Y3-	19	O	Y3+
7	-	100Ω terminated (20)	20	-	100Ω terminated (7)
8	-	N.C.	21	-	N.C.
9	-	N.C.	22	-	N.C.
10	-	N.C.	23	-	N.C.
11	-	N.C.	24	-	N.C.
12	-	N.C.	25	-	N.C.
13	-	GND	26	-	GND

2 – 3. (Camera bit assignment)

Medium Configuration

Camera Out	8bit	10bit
DATA OUT1 =	A[7:0]	A[9:0]
DATA OUT2 =	B[7:0]	B[9:0]
DATA OUT3 =	C[7:0]	C[9:0]
DATA OUT4 =	D[7:0]	D[9:0]

Port/bit	8bit	10bit
Port A0	A0	A0
Port A1	A1	A1
Port A2	A2	A2
Port A3	A3	A3
Port A4	A4	A4
Port A5	A5	A5
Port A6	A6	A6
Port A7	A7	A7
Port B0	B0	A8
Port B1	B1	A9
Port B2	B2	n/a
Port B3	B3	n/a
Port B4	B4	B8
Port B5	B5	B9
Port B6	B6	n/a
Port B7	B7	n/a
Port C0	C0	B0
Port C1	C1	B1
Port C2	C2	B2
Port C3	C3	B3
Port C4	C4	B4
Port C5	C5	B5
Port C6	C6	B6
Port C7	C7	B7
Port D0	D0	D0
Port D1	D1	D1
Port D2	D2	D2
Port D3	D3	D3
Port D4	D4	D4
Port D5	D5	D5
Port D6	D6	D6
Port D7	D7	D7
Port E0	n/a	C0
Port E1	n/a	C1
Port E2	n/a	C2
Port E3	n/a	C3
Port E4	n/a	C4
Port E5	n/a	C5
Port E6	n/a	C6
Port E7	n/a	C7
Port F0	n/a	C8
Port F1	n/a	C9
Port F2	n/a	n/a
Port F3	n/a	n/a
Port F4	n/a	D8
Port F5	n/a	D9
Port F6	n/a	n/a
Port F7	n/a	n/a

Base Configuration

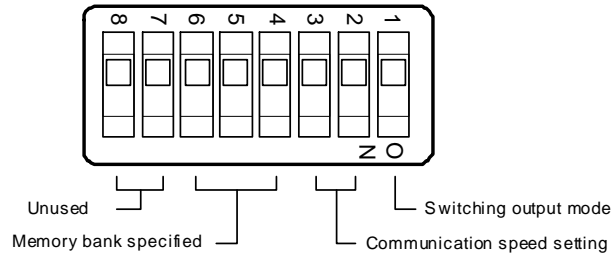
Camera Out	8bit	10bit
DATA OUT1 =	A[7:0]	A[9:0]
DATA OUT2 =	B[7:0]	B[9:0]
DATA OUT3 =	(N/A)	(N/A)
DATA OUT4 =	(N/A)	(N/A)

Port/bit	8bit	10bit
Port A0	A0	A0
Port A1	A1	A1
Port A2	A2	A2
Port A3	A3	A3
Port A4	A4	A4
Port A5	A5	A5
Port A6	A6	A6
Port A7	A7	A7
Port B0	B0	A8
Port B1	B1	A9
Port B2	B2	n/a
Port B3	B3	n/a
Port B4	B4	B8
Port B5	B5	B9
Port B6	B6	n/a
Port B7	B7	n/a
Port C0	C0	B0
Port C1	C1	B1
Port C2	C2	B2
Port C3	C3	B3
Port C4	C4	B4
Port C5	C5	B5
Port C6	C6	B6
Port C7	C7	B7

The allocation of the port conforms to the Camera Link standard.

3. Dip switch setting

Various settings are available with the dip switch on the back.



“ * ” is Factory default

(1) Output mode switching

Switch between Medium Configuration and Base Configuration.

The power of the camera needs be turned on again to switch modes.

SW1	Output mode
OFF	* Medium Configuration
ON	Base Configuration

(2) Baud rate setting

The speed of the serial communication can be set by the camera link.

The power of the camera needs be turned on again to switch modes.

SW2	SW3	Baud rate
OFF	OFF	* 9600 bps
ON	OFF	19200 bps
OFF	ON	38400 bps
ON	ON	57600 bps

(3) Specifying a memory bank before starting

Specify a memory bank to be referenced before turning on the power of the camera for SW4 through SW6. The power of the camera needs be turned on again to switch modes.

SW4	SW5	SW6	Memory bank
OFF	OFF	OFF	* Bank 1
ON	OFF	OFF	Bank 2
OFF	ON	OFF	Bank 3
ON	ON	OFF	Bank 4
OFF	OFF	ON	Bank 5
ON	OFF	ON	Bank 6
OFF	ON	ON	Bank 7
ON	ON	ON	Bank 8

*SW7 and SW8 are not used. (Fixed to OFF)

4. Camera Link interface specification

4-1. Serial communication protocol

The serial communications between frame grabber board and the camera are done with SerTFG and the SerTC signal on the Camera Link interface. The communication protocol shall be in conformity with the camera link standard. (refer to the following)

- | | |
|-------------------------|--|
| (1) Communication speed | 9600 / 19200 / 38400 / 57600 bps switching |
| (2) Start bit | 1bit |
| (3) Data bit | 8bit |
| (4) Stop bit | 1bit |
| (5) Parity | None |
| (6) Handshake | None |

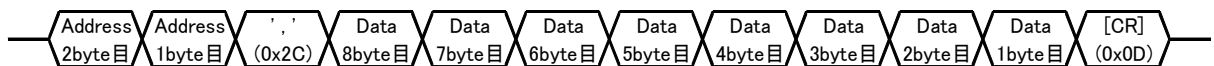
4-2. Command Communication Protocol

The command communication protocol is the TELI standard method (method in which parameters are set in the registers in the camera).

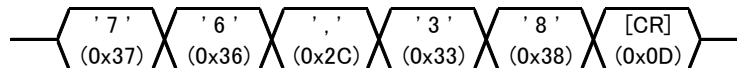
In command send/receive operation, hexadecimal address and data are converted to ASCII data. All ASCII alphabetic characters used are uppercase characters.

(1) Write to a register

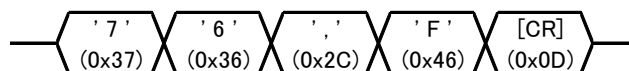
When writing it in the register, the address and the data are comma-delimited as follows, and the CR code is added at the end. Longest width of the address is 2 bytes, and longest width of data is 8 bytes.



For example, to write data 0x38 to address 0x76, send a command, as follows:



When the data of one digit (0x0F or less) is written in the register to which the data of two digits or more (0x10 or more) can be set by the hexadecimal number, "0" of a high-ranking digit can be omitted as follows.

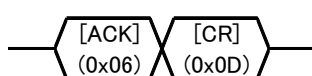


Moreover, because the data size of each address that can be set is decided, the transmission which the data width exceeding the data size is unacceptable. For instance, since the data size of the address 0xA0(shutter speed denominator register) is 2byte, not more than 5 byte but up to 4byte can be received. Even though high-ranking digit is 0 which seems within the data size as a value, it cannot be received.

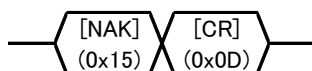
(Although "A0,00001000" cannot be received, "A0,1000" can be received.)

The camera responds to the write command with No Error (ACK) or Error (NAK), as follows:

No Error (ACK):



Error (NAK):



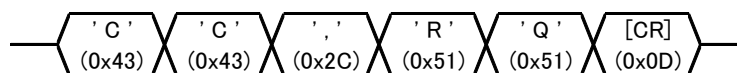
*Setting one of register related to WOI needs five kinds of data at the maximum, the setting is reflected by writing the register for "Set value application".

*Depending on the internal process status of the camera, the response to the command might take about three seconds.

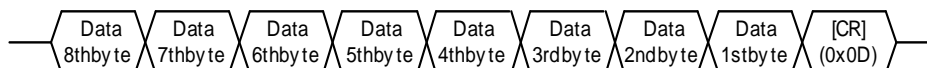
*It is not possible to communicate in the exposure period at the random trigger shutter.

(2) Reading the register

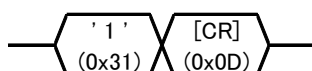
To read data from a register, send 'R' and 'Q' in addition to 'address', 'comma' and its' followed by [CR] code. For example, to read data in address 0x91, send a command, as follows:



The camera responds to the read request, as follows (Data's max-length is 8 bytes):



The actual response is described by minimum data length.: For example, to read data 0x10 to address 0x91, the camera responds as follows:



4-3. Register Map

Address	Access	Memory	CMOS Monochrome Camera CSC12M25BMP19-01B	
0x00	R. O.	—	Manufacturer(Maker) name	Manufacturer(Maker) name TOSHIBA TELI
0x0F	R. O.	—	ASCII format	
0x10	R. O.	—	Model name	Model name CSC12M25BMP19-01B
0x2F	R. O.	—	ASCII format	
0x30	R. O.	—	Serial number	Serial number xxxxxxx
0x3F	R. O.	—	ASCII format	
0x40	R. O.	—	Firmware version	Firmware version 02.01.01
0x47	R. O.	—	ASCII format	
0x48	R. O.	—	FPGA1 version	FPGA1 version 02.01.01
0x4F	R. O.	—	ASCII format	
0x50	R. O.	—	FPGA2 version	FPGA2 version 02.01.01
0x57	R. O.	—	ASCII format	
0x58	R. O.	—	CPLD1 version	CPLD1 version 01.01.01(例)
0x5F	R. O.	—	ASCII format	
0x60	R. O.	—	Register map version	Register map version 01.02.01
0x67	R. O.	—	ASCII format	
0x68	N. A.	—	Reserved	Status The status after the camera control is executed is stored.
0x69	R. O.	—	Status	
0x6A	R. O.	—	Extended status	Extended status Detailed information corresponding to status is stored.
0x6B	N. A.	—	Reserved	
0x6C	R. O.	—	Check memory bank	Check memory bank 0x00 - 0xFF Default: 0x00
0x6D	W. O.	—	Save memory	
0x6E	R/W	—	Call memory	Save memory 0x01 - 0x08 Default: ---
0x6F	W. O.	—	Initialize memory	Call memory 0x00 - 0x08 Default: 0x00
0x70	R/W	○	Setup	Initialize 0x01 - 0x08 Default: ---
0x72	N. A.	—	Reserved	Setup 0x0000(0LSB) - 0x0210(132LSB@10bit, 33LSB@8bit) Default: 0x0108(33LSB@10bit, 8LSB@8bit)
0x75	N. A.	—	Reserved	
0x76	R/W	○	Gain	Gain 0x00(0dB) - 0xB4(18dB) Default: 0x00(0dB)
0x77	N. A.	—	Reserved	Output control 0x00(OFF) / 0x01(ON) / 0x02(Test pattern) Default: 0x01(ON)
0x85	N. A.	—	Reserved	
0x86	R/W	—	Output control	Number of output bits 0x08(8bit) / 0x0A(10bit) / 0x18(extend 8bit) Default: 0x08(8bit)
0x87	R/W	○	Number of output bits	
0x88	R/W	—	Test pattern	Test pattern 0x00 - 0xFF Default: 0x07(OFF)
0x89	N. A.	—	Reserved	
0x8A	N. A.	—	Reserved	Defective pixel correction 0x00(OFF) / 0x01(ON) Default: 0x01(ON)
0x8B	R/W	○	Defective pixel correction	
0x8C	N. A.	—	Reserved	Scan mode 0x00(Normal) / 0x01(WOI) / 0x02(Binning) / 0x03(Subsampling) / 0x04(Binnig-WOI) Default: 0x00(Normal)
0x8D	N. A.	—	Reserved	
0x8E	N. A.	—	Reserved	
0x8F	N. A.	—	Reserved	
0x90	R/W	○	Shutter mode	Shutter mode 0x00(Normal shutter OFF) / 0x01(Normal shutter ON) / 0x02() / 0x03(Test mode) Default: 0x00(Normal shutter OFF)
0x91	R/W	○	Shutter mode	
0x92	R/W	○	Random trigger mode	
0x93	R/W	○	Trigger polarity	
0x94	R/W	○	Subsampling	Random trigger mode 0x00(FIX) / 0x01(Pulse Width) Default: 0x00(FIX)
0x95	N. A.	—	Reserved	
0x96	N. A.	—	Reserved	Trigger polarity 0x00(Negative) / 0x01(Positive) Default: 0x00(Negative)
0x99	N. A.	—	Reserved	
0x9F	N. A.	—	Reserved	Subsampling 0x02(x2) / 0x04(x4) / 0x08(x8) Default: 0x02(x2)

Access
R/W : Read/Write possible
R.O. : Read Only
W.O. : Write Only
N.A. : Not Available

Address	Access	Memory	CMOS Monochrome Camera CSC12M25BMP19-01B
0xA0	R/W	○	Shutter speed denominator
0xA2	N.A.	—	Reserved
0xA3	N.A.	—	Reserved
0xA4	R/W	○	Shutter speed numerator
0xA5	N.A.	—	Reserved
0xBF	N.A.	—	Reserved
0xC0	W.O.	—	WOI update
0xC1	R/W	○	WOI area number
0xC2	R/W	○	WOI horizontal start coordinate
0xC4	R/W	○	WOI vertical start coordinate
0xC6	R/W	○	WOI horizontal width
0xC8	R/W	○	WOI vertical height
0xCA	N.A.	—	Reserved
0xCB	R/W	—	Save/call WOI bank
0xCC	R/W	○	WOI area effective
0xD0	R/W	—	Defect pixel correction data /addressing
0xD2	N.A.	—	Reserved
0xD3	W.O.	—	Defect pixel correction data/save
0xD4	R/W	—	Defect pixel correction data/data
0xD8	R/W	—	Specify user area/address
0xDA	R/W	—	Specify user area/data
0xDB	W.O.	—	Erase user area
0xDC	R/W	○	Number of bytes to read user area
0xDD	N.A.	—	Reserved
0xDE	N.A.	—	Reserved
0xDF	N.A.	—	Reserved
0xE0	N.A.	—	Reserved
0xE1	R/W	○	Multi slope
0xE2	R/W	○	Step correction
0xE3	R/W	○	Step interpolation
0xE4	R/W	○	FPN correction
0xE5	W.O.	—	FPN correction data/save
0xE6	R/W	○	FPN correction data/call
0xE7	W.O.	—	FPN correction data/creation
0xE8	R/W	○	Low gain
0xFF	N.A.	—	Reserved

Access
R/W : Read/Write possible
R.O. : Read Only
W.O. : Write Only
N.A. : Not Available

Shutter speed denominator 0x0001 - 0x4E20 Default: 0x0019(1/25s)	Shutter speed 1/20000s - 2s
Shutter speed numerator 0x01 - 0xFF Default: 0x01(1/25s)	
WOI update 0x01 Default: ---	WOI area number 0x00 - 0x1B Default: 0x00
WOI horizontal start coordinate 0x0000 - 0x0FF0 (only the multiple of 4) Default: 0x0000	WOI vertical start coordinate 0x0000 - 0x0BFF Default: 0x0000
WOI horizontal width 0x0010 - 0x1000 (only the multiple of 4) Default: 0x1000	WOI vertical height 0x0001 - 0x0C00 Default: 0x0C00
Save/call WOI bank 0x00 - 0x08(Call) / 0x81 - 0x88(Save) Default: 0x00	
WOI area effective 0x00000001 - 0x0FFFFFFF Default: 0x00000001	
Defect pixel correction data /addressing 0x0000 - 0x07FF Default: 0x0000	
Defect pixel correction data/save 0x01(Save) / 0x81(Erase) Default: ---	
Defect pixel correction data/data 0x00000000 - 0x00FFFBFF Default: It depends on the preserved correction data (0xFFFFFFFF when there is no data).	
Specify user area/address 0x0000 - 0x07FF Default: 0x0000	Specify user area/data 0x00 - 0xFF Default: 0x00
Erase user area 0x01(Erase) Default: ---	Number of bytes to read user area 0x01 - 0x80 (only the multiple of 4 excluding 0x01.) Default: 0x01
Multi slope 0x00(OFF) / 0x01(mode1) / 0x02(mode2) / 0x03(mode3) Default: 0x00(OFF)	
Step correction 0x00(OFF) / 0x01(ON) Default: 0x01(ON)	Step interpolation 0x00(OFF) / 0x01(ON) Default: 0x00(OFF)
	FPN correction 0x00(OFF) / 0x01(ON) Default: 0x01(ON)
FPN correction data/save 0x01 - 0x02 Default: ---	
FPN correction data/call 0x00 - 0x02 Default: 0x00	FPN correction data/creation 0x01 Default: ---
Low gain 0x00(OFF) / 0x01(ON) Default: 0x00(OFF)	

4-4. Error status

When NAK is sent back to the transmitted command, detailed information of the error can be acquired by accessing the status register.

Please inquire of our Sales Department when the error status not in the following table is acquired.

Error classification	Error status (0x69)	Extended error status (0x6A)	Contents
No error	0x00	0x00	No error
Protocol	0x03	0x01	The command format is illegal
		0x04	Uncertain command
		0x05	No comma
		0x06	There is no address setting
		0x07	There is no data setting
		0x08	The address is illegal
		0x09	The data is illegal
		0x0A	The small letter was input to the command (command is capital letter only).
		0x0B	The character and the sign were input to the address value (the address value is numerical value only (hexadecimal number)).
		0x0C	Uncertain error
Register	0x04	0x01	The address is invalid
		0x02	The data is invalid
		0x03	The value of 0x100 or more was set to → 1 byte address (0xFF or less) where data had exceeded the register.
		0x06	Reading is improper
		0x07	Writing is improper
		0x0C	Uncertain error
Memory bank	0x0A	0x01	No data
		0x02	Reading failure
		0x03	Initialization failure
		0x04	The bank number is outside the range
		0x05	Uncertain error
Digital process	0x0B	0x01	The setup is outside a setting range
		0x03	The gain is outside a setting range
		0x05	The output control is outside a setting range
		0x06	The number of output bits is outside a setting range
		0x25	The defect pixel correction is outside a setting range
		0x29	The step correction is outside a setting range
		0x30	The step interpolation is outside a setting range
		0x32	The test pattern output was set in modes other than the test pattern.
		0x36	The test pattern mode was set in the partial reading mode.
		0x37	Uncertain error
Scan mode	0x0C	0x01	The scan mode is outside a setting range
		0x02	The number of subsampling is outside a setting range
		0x04	Uncertain error
Shutter mode	0x0D	0x01	The shutter mode is outside a setting range
		0x02	The random trigger mode is outside a setting range
		0x03	The trigger polarity is outside a setting range
		0x04	The shutter speed denominator is outside a setting range
		0x05	The shutter speed numerator is outside a setting range
		0x06	The shutter speed is outside a setting range
		0x11	The shutter speed denominator were set at shutter OFF
		0x12	The shutter speed numerator were set at shutter OFF
		0x14	The random trigger shutter pulse width mode were set at multi slope ON.
		0x15	The random trigger shutter pulse width mode were set at shutter OFF.
		0x18	The test mode were set at multi slope ON.
0x19	The random trigger mode was set at multi slope ON and the mode of the pulse width of a random trigger.		
0x17	Uncertain error		

Error classification	Error status (0x69)	Extended error status (0x6A)	Contents
WOI	0x0F	0x01	Update failure
		0x02	The WOI area number is outside a setting range
		0x03	The WOI horizontal start coordinate is outside a setting range
		0x04	The WOI vertical start coordinate is outside a setting range
		0x05	The WOI horizontal width is outside a setting range
		0x06	The WOI vertical height is outside a setting range
		0x07	Only the WOI mode can be set(access)
		0x08	The WOI area effective is outside a setting range
		0x09	The WOI update is outside a setting range
		0x0A	The sum of start position and the size sticks out of a screen.
		0x0E	The WOI bank is outside a setting range
		0x0F	Uncertain error
User area	0x12	0x01	The address is outside a setting range
		0x02	The data is outside a setting range
		0x04	The data size is outside a setting range
		0x05	Uncertain error
		0x15	The number of subsampling was set in modes other than the subsampling.
TG	0x13	0x1F	The test pattern was set in the WOI mode.
		0x20	Uncertain error
		0x01	The FPN correction data preservation did the time-out.
Fixed pattern noise (FPN)	0x21	0x03	Call FPN correction data bank is not preserving it.
		0x04	The FPN correction data preservation or FPN correction data call is outside a setting range.
		0x05	Uncertain error
		0x01	The multi slope mode is outside a setting range
Mauti slope	0x22	0x02	The multi slope was set at the pulse width mode of a random trigger.
		0x03	The multi slope was set at electronic shutter OFF.
		0x04	Uncertain error
		0x03	Uncertain error
etc..	0x23	0x03	Uncertain error

5. Camera control

5-1. Camera information

The information such as manufacturer name, the model name of the camera, and serial number, firmware, FPGA, CPLD, and the version of the register map can be read by the register access.

● Register explanation

Address: 0x00 – 0x0F Manufacturer name

Function	bit								Default
	7	6	5	4	3	2	1	0	
Manufacturer name (Read Only)	Manufacturer name information (ASCII code)								※

Manufacturer name information of this camera can be read.

- bit7-0 One character from manufacturer name (by ASCII code)

◎ Manufacturer name information is stored as follows by one character at each address with ASCII code.

Address	ASCII code	Character
0x00	0x54	' T '
0x01	0x4F	' O '
0x02	0x53	' S '
0x03	0x48	' H '
0x04	0x49	' I '
0x05	0x42	' B '
0x06	0x41	' A '
0x07	0x20	' '
0x08	0x54	' T '
0x09	0x45	' E '
0x0A	0x4C	' L '
0x0B	0x49	' I '
0x0C	0x00	[NULL]
0x0D	0x00	[NULL]
0x0E	0x00	[NULL]
0x0F	0x00	[NULL]

Address: 0x10 – 0x2F

Model name

Function	7 6 5 4 3 2 1 0	Default
Model name (Read Only)	Model name information (ASCII code)	※

Model name information on this camera can be read.

- bit7-0 One character from model name (by ASCII code)

◎ Model name information is stored as follows by one character at each address with ASCII code.

Address	ASCII code	Character
0x10	0x43	' C '
0x11	0x53	' S '
0x12	0x43	' C '
0x13	0x31	' 1 '
0x14	0x32	' 2 '
0x15	0x4D	' M '
0x16	0x32	' 2 '
0x17	0x35	' 5 '
0x18	0x42	' B '
0x19	0x4D	' M '
0x1A	0x50	' P '
0x1B	0x31	' 1 '
0x1C	0x39	' 9 '
0x1D	0x2D	' - '
0x1E	0x30	' 0 '
0x1F	0x31	' 1 '
0x20	0x42	' B '
0x21	0x00	[NULL]
0x22	0x00	[NULL]
0x23	0x00	[NULL]
0x24	0x00	[NULL]
0x25	0x00	[NULL]
0x26	0x00	[NULL]
0x27	0x00	[NULL]
0x28	0x00	[NULL]
0x29	0x00	[NULL]
0x2A	0x00	[NULL]
0x2B	0x00	[NULL]
0x2C	0x00	[NULL]
0x2D	0x00	[NULL]
0x2E	0x00	[NULL]
0x2F	0x00	[NULL]

Address: 0x30 – 0x3F

Serial number

Function	7 6 5 4 3 2 1 0	Default
Serial number (Read Only)	Serial number information (ASCII code)	※

Serial number information on this camera can be read.

- bit7-0 One character from serial number (by ASCII code)

◎ Serial number information is stored as follows by one character at each address with ASCII code. (example: serial number "1234567")

Address	ASCII code	Character
0x30	0x31	' 1 '
0x31	0x32	' 2 '
0x32	0x33	' 3 '
0x33	0x34	' 4 '
0x34	0x35	' 5 '
0x35	0x36	' 6 '
0x36	0x37	' 7 '
0x37	0x00	[NULL]
0x38	0x00	[NULL]
0x39	0x00	[NULL]
0x3A	0x00	[NULL]
0x3B	0x00	[NULL]
0x3C	0x00	[NULL]
0x3D	0x00	[NULL]
0x3E	0x00	[NULL]
0x3F	0x00	[NULL]

Address: 0x40 – 0x47 Firmware version

Function	7 6 5 4 3 2 1 0 bit	Default
Firmware version (Read Only)	Firmware version information (ASCII code)	※

Firmware version information on this camera can be read.

- bit7-0 One character from firmware version (by ASCII code)

© Firmware version information is stored as follows by one character at each address with ASCII code. (example: version "01.01.01")

Address	ASCII code	Character
0x40	0x30	' 0 '
0x41	0x31	' 1 '
0x42	0x2E	' . '
0x43	0x30	' 0 '
0x44	0x31	' 1 '
0x45	0x2E	' . '
0x46	0x30	' 0 '
0x47	0x31	' 1 '

Address: 0x48 – 0x4F FPGA1 version

Function	7 6 5 4 3 2 1 0 bit	Default
FPGA1 version (Read Only)	FPGA1 version information (ASCII code)	※

FPGA1 version information on this camera can be read.

- bit7-0 One character from FPGA1 version (by ASCII code)

© FPGA1 version information is stored as follows by one character at each address with ASCII code. (example: version "01.01.01")

Address	ASCII code	Character
0x48	0x30	' 0 '
0x49	0x31	' 1 '
0x4A	0x2E	' . '
0x4B	0x30	' 0 '
0x4C	0x31	' 1 '
0x4D	0x2E	' . '
0x4E	0x30	' 0 '
0x4F	0x31	' 1 '

Address: 0x50 – 0x57 FPGA2 version

Function	7 6 5 4 3 2 1 0 bit	Default
FPGA2 version (Read Only)	FPGA2 version information (ASCII code)	※

FPGA2 version information on this camera can be read.

- bit7-0 One character from FPGA2 version (by ASCII code)

◎ FPGA2 version information is stored as follows by one character at each address with ASCII code. (example: version "01.01.01")

Address	ASCII code	Character
0x50	0x30	' 0 '
0x51	0x31	' 1 '
0x52	0x2E	' . '
0x53	0x30	' 0 '
0x54	0x31	' 1 '
0x55	0x2E	' . '
0x56	0x30	' 0 '
0x57	0x31	' 1 '

Address: 0x58 – 0x5F CPLD1 version

Function	7 6 5 4 3 2 1 0 bit	Default
CPLD1 version (Read Only)	CPLD1 version information (ASCII code)	※

CPLD1 version information on this camera can be read.

- bit7-0 One character from CPLD1 version (by ASCII code)

◎ CPLD1 version information is stored as follows by one character at each address with ASCII code. (example: version "01.01.01")

Address	ASCII code	Character
0x58	0x30	' 0 '
0x59	0x31	' 1 '
0x5A	0x2E	' . '
0x5B	0x30	' 0 '
0x5C	0x31	' 1 '
0x5D	0x2E	' . '
0x5E	0x30	' 0 '
0x5F	0x31	' 1 '

Address: 0x60 – 0x67

Register map version

Function	7 6 5 4 3 2 1 0 bit	Default
Register map version (Read Only)	Register map version information (ASCII code)	※

Register map version information on this camera can be read.

- bit7-0 One character from Register map version (by ASCII code)

◎ Register map version information is stored as follows by one character at each address with ASCII code. (example: version "01.01.01")

Address	ASCII code	Character
0x60	0x30	' 0 '
0x61	0x31	' 1 '
0x62	0x2E	' . '
0x63	0x30	' 0 '
0x64	0x31	' 1 '
0x65	0x2E	' . '
0x66	0x30	' 0 '
0x67	0x31	' 1 '

5-2. Memory control

● Function explanation

Each register value can be saved in EEPROM. After the camera power supply is turned off, the content of the memory is maintained.

● Register explanation

Address: 0x6C

Check memory bank

Function	7 6 5 4 3 2 1 0 bit	Default
Check memory bank (Read Only)	Memory bank where setting is preserved The bit of the "memory bank -1" becomes "1".	0x00

(Memory bank number -1) which the setting would have been saved is set.

- bit 7-0 Check memory bank (Range that can be acquired : 0x00~0xFF)

例) 0x00 : User setting is not saved

0x01 : The user setting is saved in the bank "1".

0x80 : The user setting is saved in the bank "8".

0xFF : The user settings would have been saved in all banks ("8" from "1").

Address: 0x6D

Save memory

Function	7	6	5	4	bit	3	2	1	0	Default
Save memory (Write Only)	0					Number of memory bank				-

Each register value is saved in memory area (EEPROM) corresponding to the memory bank number. Please refer to '4-3 . Register map' for the saved register.

- bit 3-0 Save memory (Range that can be set : 0x01~0x08)
 - 例) 0x01 : A current setting is saved in the memory bank "1".
 - 0x08 : A current setting is saved in the memory bank "8".

Address: 0x6E

Call memory

Function	7	6	5	4	bit	3	2	1	0	Default
Call memory	0					Number of memory bank				0

The register setting value saved in the specified memory is called. Moreover, the memory bank number called at the end can be confirmed by reading the register.

The register where the setting is called is only a register where the setting can be saved. Please refer to '4-3 . Register map' for the saved register.

- bit 3-0 Call memory (Range that can be set : 0x00~0x08)
 - 例) 0x00 : The memory bank "0" (factory shipment setting) is called.
 - 0x01 : The memory bank "1" is called.
 - 0x08 : The memory bank "8" is called.

Address: 0x6F

Initialize memory

Function	7	6	5	4	bit	3	2	1	0	Default
Initialize memory (Write Only)	0					Number of memory bank				-

The user setting being saved in the specified memory bank is initialized (deleted).

- bit 3-0 Initialize memory (Range that can be set : 0x01~0x08)
 - 例) 0x01 : The saved content of the memory bank "1" is deleted.
 - 0x08 : The saved content of the memory bank "8" is deleted.

5-3. Setup level setting

- Function

The setup level (standard black level) of the camera can be adjusted only toward plus direction.

- Register

Address: 0x70

Setup

Function	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Default
Setup	0						Setup (additional value)										0x0108

The setup (additional value) is set.

When 10bit is output, the value actually added is the value which is a quarter of the set value (Round down after the decimal point). And when 8bit is output, it becomes the value which is a sixteenth part of the set value (Round down after the decimal point).

- bit 9-0 Setup (Configurable range : 0x0000~0x0210)

5-4. Gain setting

- Function

The gain in digital steps of the photographic image can be adjusted. The variable range is 0 to +18dB (calculation value).

- Register

Address: 0x76

Gain

Function	7	6	5	4	3	2	1	0	Default
Gain	Gain								0x00

The gain is set in about 0.1dB.

0x00 becomes 0dB and 0xB4 becomes +18dB. The gain changes to a set value almost proportionally. (However, it is a calculation value.)

- bit 7-0 Gain (Configurable range : 0x00~0xB4)

5-5. Image format

● Function

Information of the present image output format of the camera can be acquired and the setting can be changed.

● Register

Address: 0x86 Output control

Function	7	6	5	4	3	2	1	0	Default
Output control	0						ON/OFF Test pattern		0x01

ON/OFF of the image output is set.

In the random trigger shutter mode, it is reflected to the image taken with the trigger after this register is set (It is not possible to control only by setting this register).

The test pattern cannot be set at sub-sampling, binning and binning-WOI.

- bit 1-0 Output ON/OFF
 - 0x00 : Output OFF (Black image)
 - 0x01 : Output ON
 - 0x02 : Test pattern

Address: 0x87 Number of output bits

Function	7	6	5	4	3	2	1	0	Default
Number of output bits	0				Number of output bits				0x08

The number of output bits of camera images (step) is set.

- bit 3-0 Number of output bits
 - 0x08 : 8bit
 - 0x0A : 10bit
 - 0x18 : Extended 8bit

Ⓢ As for 8bit output, the frame rate at WOI and binning is faster than 10bit output.

Ⓢ The frame rate at WOI and binning becomes slower than 8bit output though 10bit output can output more detailed steps than 8bit output.

Ⓢ Internal processing of the camera in extended 8bit output is executed in 10bit, and is processed to 8bit output. Therefore, the frame rate of WOI becomes equal to 10bit output though 8bit image can be output without any step omission.

(Reference : 7. Gradation)

Address: 0x88

Test pattern output

Function	7 6 5 4 3 2 1 0	Default
Test pattern	Test pattern mode / direction / etc.	0x00

The type of the output test pattern is set. Only when test pattern output (0x02) has been selected at output control (0x86), it is possible to set it.

- bit 0-2 Test pattern mode
 - 0x00 : Black
 - 0x01 : White
 - 0x02 : Gray(25%)/Gray(75%)
 - 0x03 : Gray(50%)
 - 0x04 : Stripe
 - 0x05 : 16-Step
 - 0x06 : Lamp
 - 0x07 : Mix
- bit 3 Direction of pattern
 - 0x00 : Horizontal
 - 0x01 : Vertical
- bit 4 Line
 - 0x00 : OFF
 - 0x01 : ON
- bit 5 Center marker
 - 0x00 : OFF
 - 0x01 : ON
- bit 6 Character
 - 0x00 : OFF
 - 0x01 : ON
- bit 7 Brightness reversing
 - 0x00 : Normal
 - 0x01 : Reverse

Address: 0x8B

Defect pixel correction

Function	7	6	5	4	3	2	1	0	Default	
Defect pixel correction	0								ON/OFF	0x01

ON/OFF of defect pixel correction is set.

- bit 0 Defect pixel correction
0x00 : Defect pixel correction OFF
0x01 : Defect pixel correction ON

◎ The pixel that becomes an object might be different depending on the camera settings and the ambient environment, please switch and use the correction according to the condition this correction is used.

◎ Defect pixel correction is compulsorily turned off in Binning, Sub-sampling and Binning-WOI.

5—6. Scan control

● Function

The image output mode can be selected at all pixels readout(normal scan), binning, sub-sampling, binning-WOI and partial readout(WOI).

● Register

Address: 0x90

Scan mode

Function	7	6	5	4	3	2	1	0	Default
Scan mode	0				Scan mode				0x00

The readout method of the camera (scanning mode) is set.

Defect pixel correction is turned off when setting it to binning, sub-sampling and binning-WOI (When a normal scanning and WOI are set, it is set to original again).

- bit 1-0 Scan mode
0x00 : Normal scan
0x01 : WOI
0x02 : Binning
0x03 : Sub-sampling
0x04 : Binning-WOI

5-7. Shutter control

● Function

The following 3 modes can be switched as a shutter mode.

- Normal shutter OFF
- Normal shutter
- Random trigger shutter

● Register

Address: 0x91

Shutter mode

Function	7	6	5	4	3	2	1	0	Default
Shutter mode	0						Shutter mode		0x00

The shutter mode is set.

When the multi slope is effective, normal shutter OFF cannot be set.

- bit 1-0 Shutter mode
 - 0x00 : Normal shutter OFF
 - 0x01 : Normal shutter
 - 0x02 : Random trigger shutter
 - 0x03 : Test mode

© The shutter mode cannot be switched during the exposure period. Therefore, it replies NAK with not being able to switch the mode when the exposure continues longer than the fixed time after receiving the command (It is the case when the mode switching is executed with keeping the exposure maintained in the random trigger shutter and the pulse width mode).

Moreover, the time period until responding changes at normal shutter (OFF) a random trigger shutter, a fixed mode because time from the command reception to the exposure completion is not constant. (When the long exposure is set, the influence becomes remarkable).

© Please don't set it to the static test mode.

Address: 0x92

Random trigger shutter

Function	7	6	5	4	3	2	1	0	Default	
Random trigger mode	0								Fix/ Pulse	0x00

The random trigger mode (exposure method) is set.

Only when the shutter mode is set to the random trigger shutter, this register can be set.

When the multi slope is effective, it is not possible to set to the pulse width mode.

- bit 0 Random trigger shutter mode
 0x00 : Fix mode
 0x01 : Pulse width mode

Address: 0x93

Trigger polarity

Function	7	6	5	4	3	2	1	0	Default	
Trigger polarity	0								Nega /Posi	0x00

The polarity of the trigger signal is set.

Only when the shutter mode is set to the random trigger shutter, the trigger polarity can be set.

- bit 0 Trigger polarity
 0x00 : Negative
 0x01 : Positive

© The state of the exposure might change according to the state of an external trigger if the switch of the trigger polarity is executed in the random trigger shutter mode.

When switching trigger polarity after setting to random trigger shutter mode, please set the trigger polarity after switching shutter mode. The setting should be done after making the external trigger be in the state of negative (In this state, Hi would mean the negative polarity, Low would mean the positive polarity) against the state which the trigger polarity has been switched.

Address: 0x94 Sub-sampling

Function	7	6	5	4	bit	3	2	1	0	Default
Number of sub-sampling	0					Number of sub-sampling				0x02

The number of sub-sampling in the sub-sampling scanning is set.

Only when the scanning mode is set to the sub-sampling, the number of sub-sampling can be set.

- bit 3-0 Number of sub-sampling
 0x02 : x2 sub-sampling
 0x04 : x4 sub-sampling
 0x08 : x8 sub-sampling

Address: 0xA0 Shutter speed denominator

Function	15	14	13	12	11	10	9	8	bit	7	6	5	4	3	2	1	0	Default
Shutter speed denominator	0																Shutter speed denominator	0x0019

Setting of The denominator (b) at the shutter speed (a/b[sec]).

Only when the shutter mode is set to a normal shutter and the random trigger shutter, the denominator of the shutter speed can be set.

- bit 14-0 Shutter speed denominator (Configurable range : 0x0001~0x4E20)

Address: 0xA4 Shutter speed numerator

Function	7	6	5	4	bit	3	2	1	0	Default
Shutter speed numerator	Shutter speed numerator									0x01

Setting of the numerator (a) at the shutter speed (a/b[sec]).

Only when the shutter mode is set to a normal shutter and the random trigger shutter, the numerator of the shutter speed can be set.

- bit 7-0 Shutter speed numerator (Configurable range : 0x01~0xFF)

© The shutter speed can be finally set within the range of 2/1[sec] to 1/20000[sec]. When it is set to more length than 1/25[sec] in normal shutter mode, one frame period nearly becomes the same as the shutter speed setting time. It is possible to expose 2[sec] long without using the random trigger shutter when this is used.

© In case the denominator "b" is the reach of 0x0001-0x4E20, the numerator "a" is the reach of 0x01-0xFF and the fractional calculation result is the reach of 2/1-1/20000, the

shutter speed can be set freely.

Example1) numerator a=0xFF、denominator b=0xC8 ⇒ 255/200 ⇒ 1.275 [sec](Long exposure)

Example2) numerator a=0x64、denominator b=0x4650 ⇒ 100/18000 ⇒ 1/180[sec]
Exposure time of 1/180sec or the equivalence

5—8. WOI setting

● Function

WOI is a setting of output that achieves further high frame rate by skipping an unnecessary range in outputting the effective pixel, and taking image only of a necessary range. Only when the scanning mode (The address: 0x90) is set to WOI and Binning-WOI, the following settings can be done.

● Register

The output of Binning-WOI becomes 1/2 of the set value of the position and width though. The following register related to WOI is common in WOI and Binning-WOI.

Address: 0xC0

WOI update

Function	7	6	5	4	3	2	1	0	Default
WOI update (Write Only)	0							Update	-

At the time of executing updating, if each register value ("WOI horizontal beginning coordinates (The address: 0xC2)", "WOI vertical beginning coordinates (The address: 0xC4)", "Horizontal width of WOI (The address: 0xC6)", and "Vertical height of WOI (The address: 0xC8)") is judged as a setting which can be displayed, the setting of the area specified by "WOI area number (The address: 0xC1)" is updated according to each register value. When the updated area is effectively set by "WOI effective area (The address: 0xCC)", it is reflected in the image output with the trigger after the setting is completed.

- bit 0 WOI update
0x01 : WOI update execution

◎ When WOI set to the register protrudes outputting effective pixel 4096(H)x3072(V)), NAK is sent back without reflecting the setting in the camera. And, the content set before the update

is replaced to the content set to the specified WOI area number. Therefore, when the update is executed again, ACK is sent back. However, if the WOI area number is specified right after

the NAK is sent back, the content which is further set to WOI area number is replaced.

Address: 0xC1 WOI area number

Function	7	6	5	bit				3	2	1	0	Default
WOI area number	0			WOI area number							0x00	

The area which makes setting reflected at the time of WOI update (address :0xC0) execution is set.

- bit 3-0 WOI area number (Configurable range : 0x00~0x1B)

◎ When specifying the WOI area number, the value set to the WOI area number which is specified by the each register value of "The WOI horizontal beginning coordinates (Address: 0xC2)", "WOI vertical beginning coordinates (Address: 0xC4)", "Horizontal width of WOI (Address: 0xC6)" and "Vertical height of WOI (Address: 0xC8)" is updated.

When the update is executed specifying WOI area number after setting the each register of "WOI horizontal beginning coordinates (Address: 0xC2)", "WOI vertical beginning coordinates (Address: 0xC4)", and "Horizontal width of WOI (Address: 0xC6)" "Vertical height of WOI (Address: 0xC8)", the value which is set to the each register before specifying WOI area number is reflected to WOI area number.

(Even if the WOI area number is set, the value set to the register is not cleared).

Address: 0xC2 WOI horizontal start coordinate

Function	15	14	13	12	11	10	9	8	bit				7	6	5	4	3	2	1	0	Default
WOI horizontal start coordinate	0				WOI horizontal start coordinate																0x0000

The WOI horizontal start coordinates are set.

The assignable value is in a configurable range and is a multiple of 4.

- bit 11-0 WOI horizontal start coordinate (Configurable range : 0x0000~0x0FF0 Only the multiple of 4)

◎ Because a minimum, set value of "Horizontal width of WOI" is 0x10, a value (=0x0FF0) which horizontal effective pixel (0x1000) is subtracted by 0x0010 becomes the maximum value of "WOI horizontal start coordinates".

The value set to the register is not reflected in the specified WOI area number until the update is executed. Besides it is not possible to be acquired.

◎ Please set to become the multiple of 8 at Binning-WOI.

© Please set to become the multiple of 8 at Binning-WOI.

Address: 0xCB Save/call WOI bank

Function	7 6 5 4 3 2 1 0	Default
WOI bank save / call	WOI bank number WOI bank number + 0x80	0x00

The registers related to WOI "the WOI area number" "WOI horizontal start coordinate" "WOI vertical start coordinate" "the WOI horizontal width" "the WOI vertical height" "WOI area effective" and all area 1-28 of "WOI horizontal start coordinate" "WOI vertical start coordinate" "the WOI horizontal width" "the WOI vertical height" is saved or called at one time. Moreover, by reading the register, the WOI bank number called at the end can be confirmed.

- bit 7-0 Save/call WOI bank
 - 0x00 : Default configuration call
 - 0x01~0x08 : Call of saved WOI bank
 - 0x81~0x88 : Save of WOI bank

© Higher speed processing is possible comparing memory preservation (The address: 0x6D) and the memory call (The address: 0x6E). However, calling or saving a register not related to WOI is not possible.

The register "WOI horizontal beginning coordinates", "WOI vertical beginning coordinates", "Horizontal width of WOI", and "Vertical height of WOI" in area 1-28 of each WOI bank is not saved in the memory save. Therefore, all the contents of the WOI bank when the power supply are turned to default (The horizontal start coordinates: 0 and the vertical start coordinates: 0 and the horizontal width: 4096 and vertical height: 3072).

Address: 0xCC WOI area effective

Function	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16	Default
WOI area effective	0 WOI area effective [27:16]	0x00000001
	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0	
	WOI area effective [15:0]	

Effective and invalidity in each WOI area are set.

All WOI area cannot be invalidly set. The setting is immediately reflected.

Only the case the range is specified in an effective WOI area, the image data is output. Even if the range specified in two or more WOI areas comes in succession, it is output only once.

- bit 27-0 WOI area effective (Configurable range : 0x00000001~0x0FFFFFFF)
 Example) 0x00000001 : The WOI setting of area 1 is effective.
 0x00000820 : The WOI setting of area 6 and area 12 are effective.
 0x0000C000 : The WOI setting of area 15 and area 16 are effective.
 0x0FFFFFFF : The WOI setting of all area is effective.

5—9. Pixel correction data save

● Function

The user can arbitrarily set the correction pixel by writing coordinates information on the defect pixel in FlashROM in the camera.

Defect pixel correction is compulsorily turned off in Binning, Sub-sampling and Binning-WOI.

● Register

Address: 0xD0 Defect pixel correction data /addressing

Function	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0	Default
Defect pixel correction data /addressing	0 Address	0x0000

The address where the correction data of the defect pixel (coordinates information) is written or is read is specified.

- bit 10-0 Defect pixel correction data /addressing
 (Configurable range : 0x0000~0x07FF)
 Example) 0x0000 : Preparation for writing data at address of 0x0000.
 0x07FF : Preparation for writing data at address of 0x07FF.

Address: 0xD3 Defect pixel correction data save/erase

Function	7 6 5 4 3 2 1 0	Default
Defect pixel correction data save/erase	Defect pixel correction data save/erase	0x00

Pixel defect correction data "Horizontal coordinates" and "Vertical coordinates" are sequentially saved. Moreover, the saved correction data can be erased.

- bit 7-0 Defect pixel correction data save/erase
 0x01 : Defect pixel correction data / save
 0x81 : Defect pixel correction data / erase

Address: 0xD4

Defect pixel correction data / data

Function	31 30 29 28 27 26 25 24 bit	23 22 21 20 19 18 17 16	Default
Defect pixel correction data / data	0		0x00000000
	Horizontal coordinate [23:12]		
	15 14 13 12 11 10 9 8 bit	7 6 5 4 3 2 1 0	
	Vertical coordinate [11:0]		

The correction data of the defect pixel (coordinates information) is set to the address which is set to the correction data · address. Please set the correction data from coordinates on the top left sequentially toward lower right coordinates.

- bit 23-12 Horizontal coordinate (Configurable range : 0x00000000~0x00FFF000)
- bit 11-0 Vertical coordinate (Configurable range : 0x00000000~0x00000BFF)

5—10. Data storage to user area

● Function

Writing arbitrary data (environmental in surrounding information etc. on the camera) in the user area of EEPROM enables to manage additive information by communication.

● Register

Address: 0xD8

Specify user area / address

Function	15 14 13 12 11 10 9 8 bit	7 6 5 4 3 2 1 0	Default
Specify user area / address	0		0x0000
	Address		

The address is specified at the destination of the data writing.

- bit 10-0 Specify user area / address (Range that can be set : 0x0000~0x07FF)
Example) 0x0000 : Preparation for writing data at address of 0x0000.
0x07FF : Preparation for writing data at address of 0x07FF.

Address: 0xDA

Specify user area / data

Function	7 6 5 4 bit	3 2 1 0	Default
User area / data	Data		0x00

One byte's worth of data is written in the house number specified by the addressing register (The address: 0xD8). It reads, only the number of values specified by reading byte number

register (The address: 0xDC) reads the house number from the house number of the addressing register at times, and data can be read continuously.

- bit 7-0 Specify user area / data (Configurable range : 0x00~0xFF)
 Example) 0x30 : 0x30 ("0" in ASCII code) is written.
 0x41 : 0x41 ("A" in ASCII code) is written.

© When the address is set to the addressing register, data is called in the data specification register. Moreover, when data is set to the data specification register, the address of the addressing register is done and the increment is done automatically (If the increment is done in address value 0x07FF, it becomes 0x0000). When the increment is done, the incremented address is read out, therefore the value is set to the data specification register. Therefore, to acquire the data set to the data specification register, reading the data specification register after the address is set is required. (The data of the following address is read even if it reads out data following the data setting).

When reading out the data specification register, the data for the number of bytes specified at the number of read out byte register is read by two hexadecimal number digits per data (In case of 0x00~0x0F, "00"~"0F" is read out), the address of the addressing register is incremented automatically only by the number of reading byte.

Therefore, it is possible to read continuously without specifying the address.

However, when trying to read a data from the present address for the number of byte which specified at reading byte number register, NAK is sent. Then set again the address or the number of the read out byte. If read the data of address 0x07FF, the address becomes 0x0800 and not possible to set or read the data. Accordingly please set the address 0x07FF or less.

Address: 0xDB

Erase user area

Function	7	6	5	4	3	2	1	0	Default	
Erase user area (Write only)	0								Erase	-

The content of the user's area writing is deleted in the lump (The value of all house numbers is NULL in "0x00" and ASCII code).

- bit 0 Erase user area
 0x01 : Erase

Address: 0xDC

Number of bytes to read user area

Function	7	6	5	4	3	2	1	0	Default
Number of bytes to read user area	Reading number of bytes								0x01

The number of house numbers which is continuously read at the time of reading the user's area is specified.

The assignable value is a multiple of 4 in the configurable range or 0x01.

- bit 7-0 Number of bytes to read user area
(Configurable range : 0x01~0x80 0x01 Only the multiple of 4)

Example) 0x01 : A continuous reading of 1 byte (1 character in ASCII) is possible.
 0x04 : A continuous reading of 4 byte (4 characters in ASCII) is possible.
 0x80 : A continuous reading of 128 byte (128 characters in ASCII) is possible.

5—11. Setting of camera function

● Function

The camera function is set.

● Register

Address: 0xE1

Multi slope

Function	7	6	5	4	3	2	1	0	Default
Multi slope	0						Multi slope	0	0x00

The mode of multi slope OFF and three patterns is set.

It is not possible to set it in normal shutter OFF and a random trigger pulse width mode.

- bit 1-0 Multi slope
 0x00 : Multi slope OFF
 0x01 : mode1
 0x02 : mode2
 0x03 : mode3

Address: 0xE2

Step correction

Function	7	6	5	4	3	2	1	0	Default
Step correction	0								0x01

ON/OFF of the step correction function is set. (Reference : 7 . Gradation)

- bit 0 Step correction
0x00 : Step correction OFF
0x01 : Step correction ON

Address: 0xE3

Step interpolation

Function	7	6	5	4	3	2	1	0	Default
Step interpolation	0								0x00

ON/OFF of the step interpolation function is set. (Reference : 7 . Gradation)

- bit 0 Step interpolation
0x00 : Step interpolation OFF
0x01 : Step interpolation ON

Address: 0xE4

FPN correction

Function	7	6	5	4	3	2	1	0	Default
FPN correction	0								0x01

ON/OFF of the FPN correction function is set.

- bit 0 FPN correction
0x00 : FPN correction OFF
0x01 : FPN correction ON

Address: 0xE5

FPN correction data/save

Function	7	6	5	4	3	2	1	0	Default
FPN correction data / save	0						Data save		-

The FPN correction data generated by FPN data generation (0xE7) is saved.

Approx one minute is required to complete saving(ACK replies) after the command is input.

Meanwhile, the camera cannot be communicated.

- bit 1-0 FPN correction data/save (Configurable range : 0x01~0x02)
 - 0x01 : FPN correction data 1 is save
 - 0x02 : FPN correction data 2 is save

Address: 0xE6

FPN correction data/call

Function	7	6	5	4	3	2	1	0	Default
FPN correction data / call	0						Data call		0x00

The FPN correction data saved in the memory is called.

- bit 1-0 FPN correction data/call
 - 0x00 : FPN correction data 0 (Factory data) is call.
 - 0x01 : FPN correction data 1 is call.
 - 0x02 : FPN correction data 2 is call.

Address: 0xE7

FPN correction data/creation

Function	7	6	5	4	3	2	1	0	Default
FPN correction data/creation	0						Creation		-

The FPN correction data is created. The created data is lost by power supply OFF.

- bit 0 FPN correction data/creation
 - 0x01 : The create of the FPN correction data is executed.

Address: 0xE8

Low gain

Function	7	6	5	4	3	2	1	0	Default	
Low gain	0								ON/ OFF	0x00

ON/OFF of the low gain function is set.

Sensitivity decreases to about 75% comparing the sensitivity at normal time when this function is turned on. The image with less noise than usual can be obtained by sensitivity decrease.

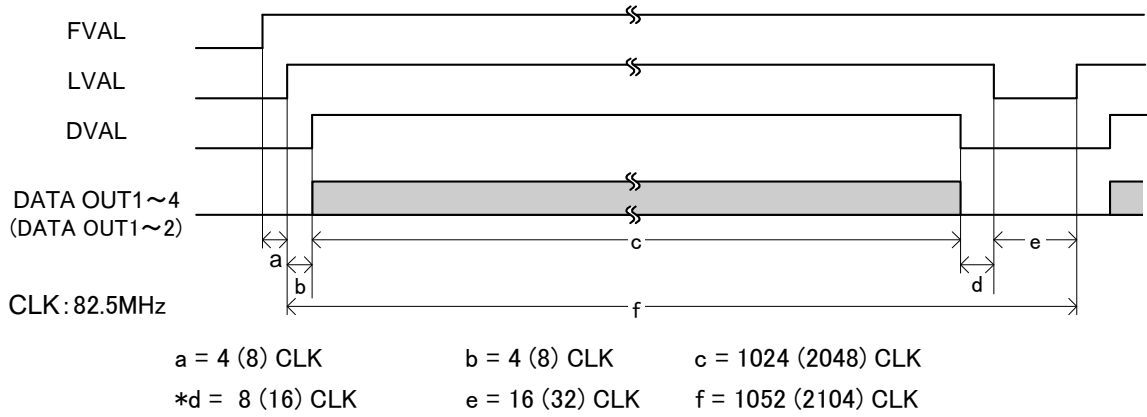
- bit 0 Low gain
0x00 : Low gain OFF
0x01 : Low gain ON

6. Timing chart

6-1. Normal shutter OFF (All pixels readout)

(1) Horizontal Timing

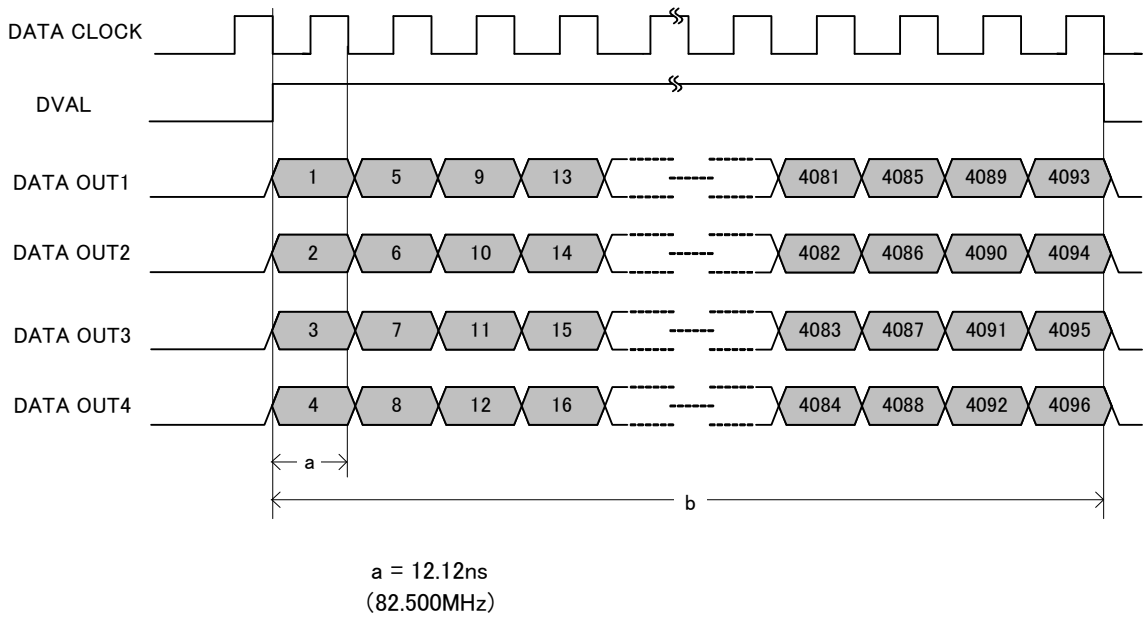
* For Medium configuration Figures in parentheses are for Base configuration



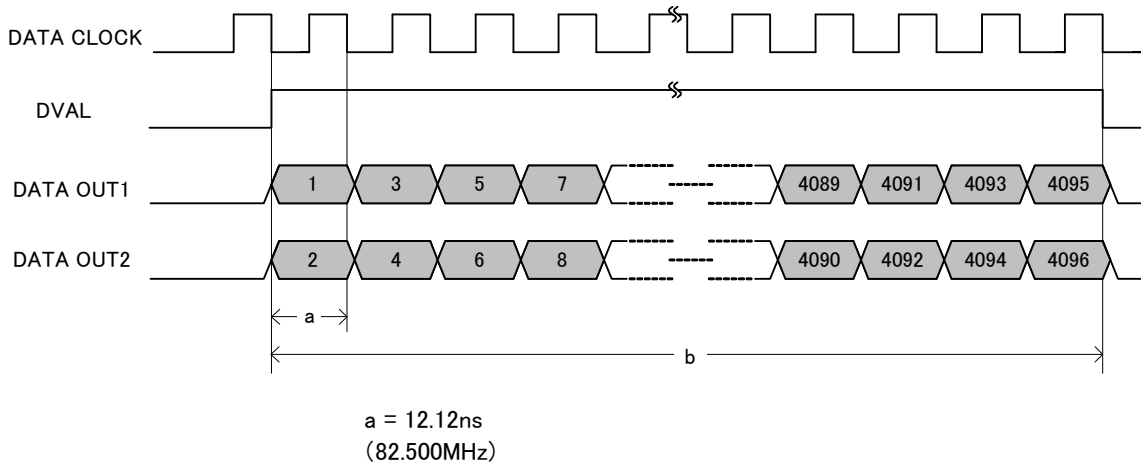
(The sign "*" is that the number of CLKs might change.)

CLK rate

● Medium Configuration

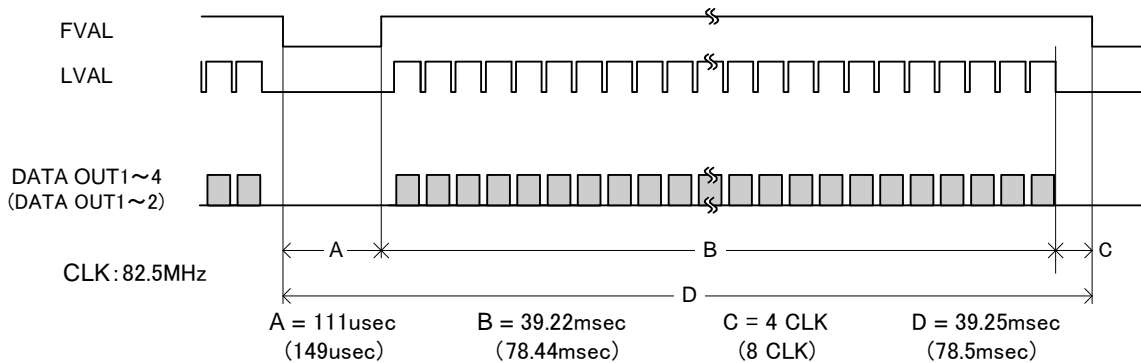


● Base Configuration



(2) Vertical Timing

*For Medium configuration Figures in parentheses are for Base configuration



Note: The frame rate changes according to the shutter speed when the shutter is ON.
(The period "A" in the chart indicates the period of the shutter speed.)

6-2. Random trigger shutter

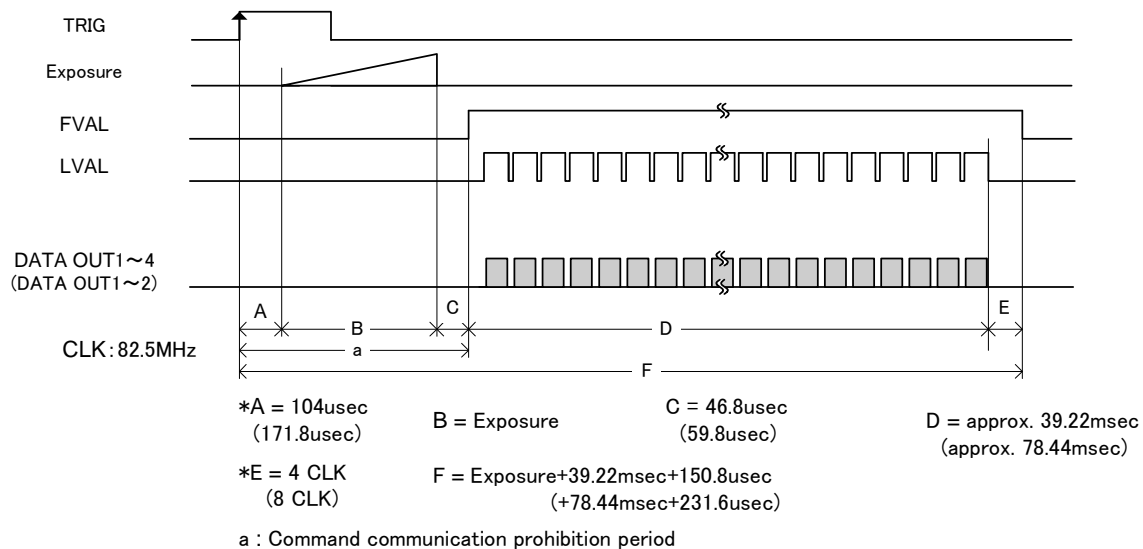
Images can be taken and imported at any timing by inputting an external trigger signal in a random trigger shutter mode.

- External trigger signals can be input from either the camera link I/F CC1 or the DC IN connector. However, signals cannot be input at the same time. Fix an unused input to Low.
- It starts exposure at a rising trigger edge when the polarity is set to positive polarity while it starts exposure at a negative-going trigger edge when the polarity is set to negative polarity.
- Random trigger shutter operates in either the fixed mode and the pulse width mode and has different ways to determine the exposure time depending on the mode.
- Exposure is not possible during reading out the image at random shutter. Input the trigger after completing image output from the camera in case inputting trigger consecutively.
- The command communication is not available during the exposure period.

(1) Fix mode

- The exposure time is determined by the set value of the shutter speed.

*Example of timing charts to expose all pixels

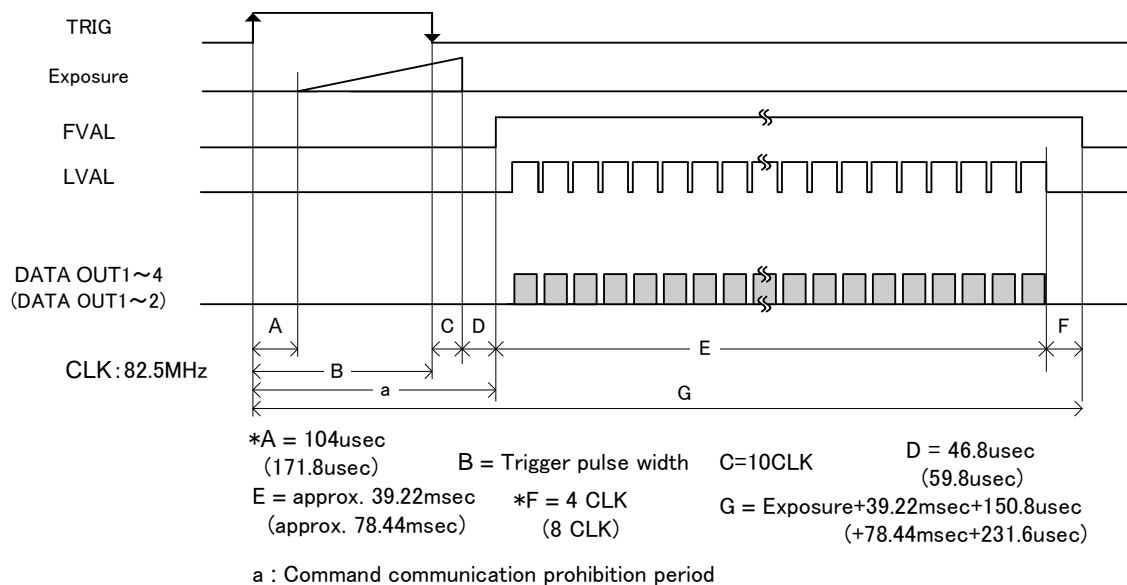


(The sign "*" is that the number of CLKs might change.)

(2) Pulse width mode

- The exposure time is determined by the pulse width (exposure time = pulse width + 2CLK).
- The pulse width should be more than 50 µsec.

*Example of timing charts to expose all pixels



(* The sign is that the number of CLKs might change.)

6-3. Multi slope

A wider dynamic range is obtainable through exposure twice.

Note that the tone may not be correctly represented for the point where the slope switches.

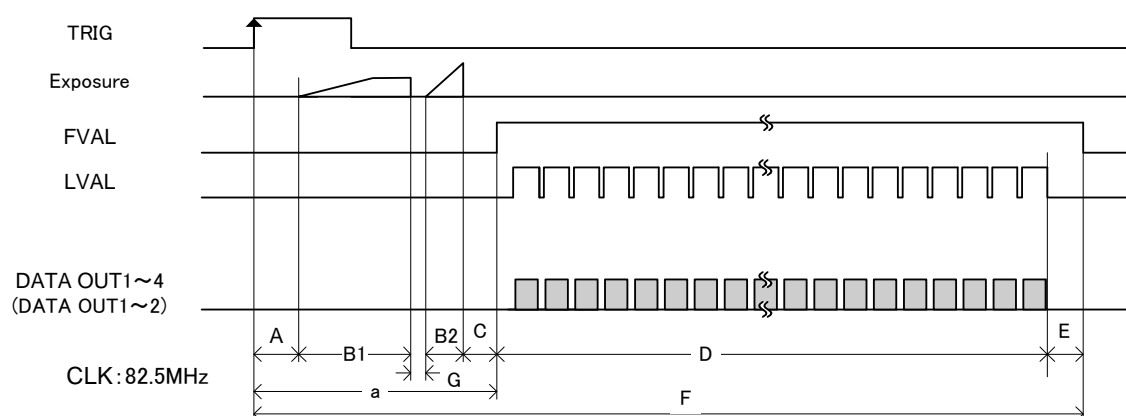
Fixed pattern noise may increase depending on the setting.

With this camera, three modes from which the shutter speed of 2nd slope differs by shutter speed setup of 1st slope can be chosen. However, the shutter speed of 2nd slope does not become shorter than 50microsec.

It cannot be used in the time of Shutter OFF, and random trigger shutter pulse width mode.

Mode	Reset level of 1 st slope	Exposure time of 2 nd slope
1	Approx. 75%	1/4 of 1 st slope
2	Approx. 75%	1/16 of 1 st slope
3	Approx. 75%	1/64 of 1 st slope

*Example of timing charts to random trigger shutter fix mode.



- *A = 104μsec (171.8μsec)
- B1 = 1st slope of exposure
- B2 = 2nd slope of exposure
- C = 46.8μsec (59.8μsec)
- D = approx. 39.22msec (approx. 78.44msec)
- *E = 4 CLK (8 CLK)
- G = 12CLK
- F = Exposure+39.22msec+150.8μsec (+78.44msec+231.6μsec)
- a : Command communication prohibition period

("*" The sign is that the number of CLKs might change.)

7. Gradation

The bit depth of the video is selectable either 8 bit or 10 bit.

Because of the specification of the sensor, all of the data and the depth cannot perform at 100%. The data is adjusted so that the video data can perform at maximum by adding the digital gain. Therefore there regularly exists some data which might be lost without being output.

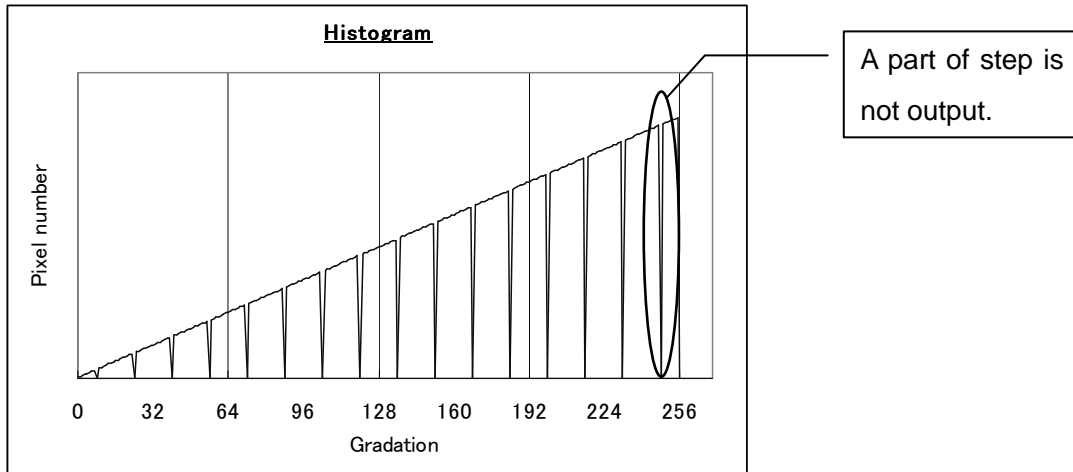


Fig 7. Example of outputting step of this camera(8bit output)

The expression of the step can be changed by the following functions.

7-1. Step correction

If this function is turned off, the digital gain in camera is turned off. Therefore, the lack of the step is not happen. However, the saturation point might not reach up to the maximum step.

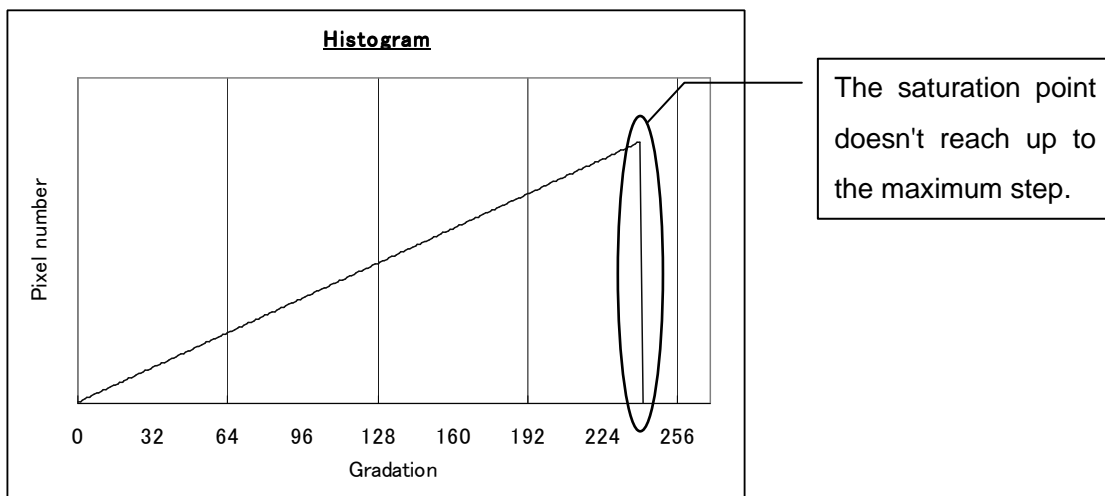


Fig 7-1. Example of step correction function (8bit output)

7-2. Step interpolation

The step missed by turning on this function is interpolated.

However, the lack step is not completely interpolated.

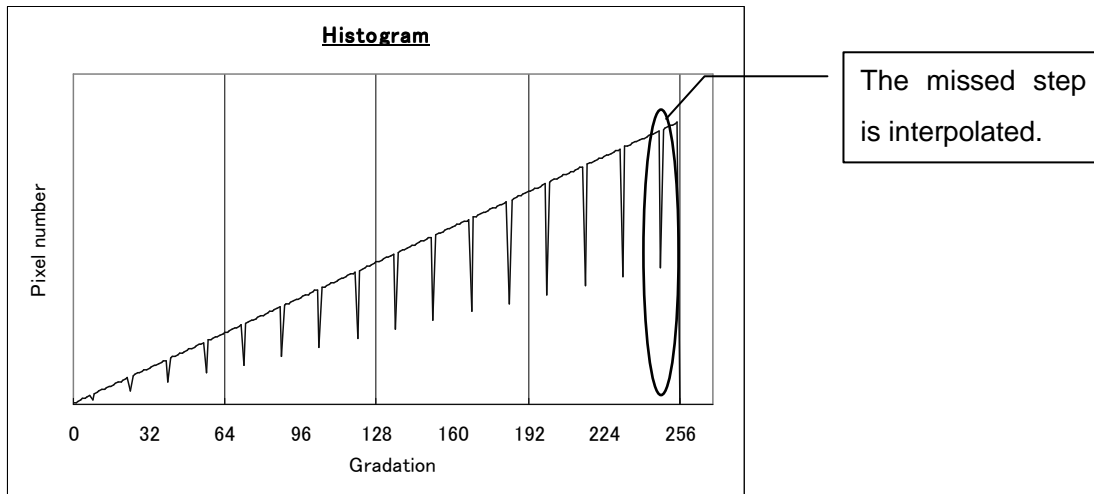


Fig 7-2. Example of step interpolation function (8bit output)

8. Exemption Clauses

- TELI assumes no responsibility or liability for damage arising from fire, earthquake, an act by a third party or other accidents, or intentional or careless error or misuse by the user, or use under abnormal conditions.
- TELI assumes no responsibility or liability for incidental damages (e.g., loss of business profits or interruption of business) arising from use of or inability to use the camera equipment.
- TELI assumes no responsibility or liability in the case damages or losses are caused by failure to observe the information contained in the operation manual and specifications and interface specifications.
- TELI assumes no responsibility or liability in the case damages or losses are caused by use contrary to the instructions in this operation manual and specifications and interface specifications.
- TELI assumes no responsibility or liability in the case damages or losses are caused by malfunction or other problems resulting from use of equipment or software that is not specified.
- TELI assumes no responsibility or liability in the case damages or losses are caused by repair or modification conducted by the customer or any unauthorized third party (such as an unauthorized service representative).
- Expenses we bear on this product shall be limited to the individual price of the product.
- TELI does NOT guarantee the items that are not described in the specification.

9. Restriction For Use

- Should the equipment be used in the following conditions or environments, give consideration to safety measures and inform us of such usage:
 1. Use of the equipment in the conditions or environment contrary to those specified, or use outdoors.
 2. Use of the equipment in applications expected to cause potential hazard to people or property, which require special safety measures to be adopted.
- This product can be used under diverse operating conditions. Determination of applicability of equipment or devices concerned shall be determined after analysis or testing as necessary by the designer of such equipment or devices, or personal related to the specifications. Such designer or personal shall assure the performance and safety of the equipment or devices.
- This product is not designed or manufactured to be used for control of equipment directly concerned with human life (*1) or equipment relating to maintenance of public services/functions involving factors of safety (*2). Therefore, the product shall not be used for such applications.

(*1): Equipment directly concerned with human life refer to:

Medical equipment such as life-support systems, equipment for operating theaters.

Exhaust control equipment for exhaust gases such as toxic fumes or smoke.

Equipment mandatory to be installed by various laws and regulations such as the Fire Act or Building Standard Law.

Equipment related to the above.

(*2): Equipment relating to maintenance of public service/functions involving factors of safety refer to:

Traffic control systems for air transportation, railways, roads, or marine transportation.

Equipment for nuclear power generation.

Equipment related to the above.

Although sufficient check is performed about translation of these specifications, we will apply a Japanese sentence, if a doubt should occur.



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