SONY

IMX273 / IMX287 Application Note

Short Exposure Mode

The data except this specification conform to those of IMX273 / IMX287.

Description

The function which can set shorter exposure than Normal exposure mode is described.

* There is possible that this mode affects the quality of image. Please use this after evaluating and checking enough.

Features

◆Mode
Super Short Exposure mode
Ultra Short Exposure mode

Contents

Register Map

The register map for Short Exposure Mode is shown below.
Please refer to the product specification for register setup other than those list.

Register list of Super Short Exposure mode

Registers corresponding to Chip ID = 03h in Write mode. (I2C:31**h)

Address	Bit	Register name	Description	Default Value after reset	Reflection timing
C8h	[7:0]		Super Short Exposure mode : 0Ah	FEh	S
C9h	[7:0]		Super Short Exposure mode: 00h	00h	S
D0h	[7:0]		Super Short Exposure mode: 0Bh	FFh	S
D1h	[7:0]		Super Short Exposure mode: 00h	00h	S

Registers corresponding to Chip ID = 0Ah in Write mode. (I2C:38**h)

Address	Bit	Register name	Description	Default Value after reset	Reflection timing
30h	[7:0]		Super Short Exposure mode : 03h	ECh	S
31h	[7:0]		Super Short Exposure mode: 00h	00h	S
32h	[7:0]		Super Short Exposure mode: 0Ch	0Ch	S
33h	[7:0]		Super Short Exposure mode: 00h	01h	S
48h	[7:0]		Super Short Exposure mode: FFh	6Dh	S
49h	[7:0]		Super Short Exposure mode: 0Fh	00h	S
4Ah	[7:0]		Super Short Exposure mode: 00h	9Fh	S
4Bh	[7:0]		Super Short Exposure mode: 00h	00h	S
60h	[7:0]		Super Short Exposure mode: 01h	22h	S
61h	[7:0]		Super Short Exposure mode: 00h	00h	S
90h	[7:0]		Super Short Exposure mode: FFh	6Ch	S
91h	[7:0]		Super Short Exposure mode: 0Fh	00h	S
92h	[7:0]		Super Short Exposure mode: 00h	A0h	S
93h	[7:0]		Super Short Exposure mode: 00h	00h	S
94h	[7:0]		Super Short Exposure mode: 00h	21h	S
95h	[7:0]		Super Short Exposure mode: 00h	00h	S
A0h	[7:0]		Super Short Exposure mode: 02h	EBh	S
A1h	[7:0]		Super Short Exposure mode: 00h	00h	S
A2h	[7:0]		Super Short Exposure mode: 0Dh	0Dh	S
A3h	[7:0]		Super Short Exposure mode: 00h	01h	S

Register list of Ultra Short Exposure mode

Registers corresponding to Chip ID = 03h in Write mode. (I2C:31**h)

Address	Bit	Register name	Description	Default Value after reset	Reflection timing
C8h	[7:0]		Ultra Short Exposure mode : 00h	FEh	S
C9h	[7:0]		Ultra Short Exposure mode : 00h	00h	S
CAh	[7:0]	S_SHSA [11:0]	Ultra Short Exposure mode : Controlling exposure time register	01h	S
CBh	[3:0]			00h	S
CCh	[7:0]		Ultra Short Exposure mode : F3h	FFh	S
CDh	[7:0]		Ultra Short Exposure mode : 00h	0Fh	S
D0h	[7:0]		Ultra Short Exposure mode : 00h	FFh	S
D1h	[7:0]		Ultra Short Exposure mode : 00h	00h	S
D2h	[7:0]	S_SHSB [11:0]	Ultra Short Exposure mode : Controlling exposure time register	00h	S
D3h	[3:0]			00h	S
D4h	[7:0]		Ultra Short Exposure mode : F4h	FFh	S
D5h	[7:0]		Ultra Short Exposure mode : 00h	0Fh	S
E2h	[7:0]		Ultra Short Exposure mode : FFh	01h	S
E3h	[7:0]		Ultra Short Exposure mode : 0Fh	00h	S
EAh	[7:0]		Ultra Short Exposure mode : FFh	00h	S
EBh	[7:0]		Ultra Short Exposure mode : 0Fh	00h	S

Description of Short Exposure Mode

Short Exposure mode is as below.

Super Short Exposure mode:
This mode can set short exposure time by setting t_{OFFSET} be shorter than Normal Exposure mode.

Ultra Short Exposure mode
This mode can set short exposure time by controlling registers.
This mode can be use at trigger mode, but it controls only the start timing of exposure.

Each mode has the characteristics as below.

Function mode	Control method	Exposure method	Unit of exposure time	note
Normal Exposure mode	Normal mode	Register SHS	1H	—
	Sequential Trigger mode	XTRIG pin	1H	
	Fast Trigger mode	XTRIG pin	XTRIG width	
Super Short Exposure mode	Normal mode	Register SHS	1H	・This mode can controlled by the method of Normal Exposure mode ・There is possible to affect the image ・The exposure time is affected by the environment.
	Sequential Trigger mode	XTRIG pin	1H	
	Fast Trigger mode	XTRIG pin	XTRIG width	
Ultra Short Exposure mode	Normal mode	Specialized registers	53.87 ns	・The range of exposure time: 0.81 ~ 13.31 [µs] ・Controlling exposure time is only specialized register. The controlling method of Normal Exposure mode can't be used. ・Controlling exposure time by SHS or XTRIG pin is ignored. ・At Trigger mode, exposure is started at the rise timing of XTRIG pin. ・The delay until starting exposure is larger than Normal exposure mode. ・There is possible to affect the image ・The exposure time is affected by the environment.
	Sequential Trigger mode	Specialized registers	53.87 ns	
	Fast Trigger mode	Specialized registers	53.87 ns	

Super Short Exposure mode

This mode can set short exposure time by setting t_{OFFSET} = 14.26 [µs] to 0.59 [µs].
But there is possible that this mode affects the quality of image. Please use this after evaluating and checking enough.
There is possible that the exposure time of this mode is changed about ±500 nsec by the sample and environment (temperature, power voltage and so on). And in case of using the intense light source, the exposure time looks like it is changed by PLS and so on. Please use this after evaluating and checking enough.

Each parameter and control method is same as Normal Exposure mode.

Exposure time

Global Shutter (Normal Mode) Operation

Exposure time [s] = (1 H period) × (Number of lines per frame - SHS) + 0.59 [µs]

List of Exposure Setting (In case of All-pixel IMX273)

Drive mode	memory wait time [H]	Number of lines per frame [DEC]	SHS Setting value [DEC]	Exposure Setting value [H]	8 ch LVDS / Maximum frame rate					
					Frame rate [frame/s]			Actually exposure [ms]		
					8 bit	10 bit	12 bit	8 bit	10 bit	12 bit
All-pixel	14	1130	1129	1	276.0	226.5	165.9	0.004	0.004	0.006
			1128	2				0.007	0.008	0.011
			…	…				…	…	…
			15	1115				3.575	4.355	5.947
			14	1116				3.578	4.359	5.953

Global Shutter (Sequential Trigger Mode) Operation

Exposure time [s] = (XTRIG low level pulse width [H]) + 0.59 [µs]

Global Shutter (Fast Trigger Mode) Operation

Exposure time [s] = (XTRIG low level pulse width [µs]) + 0.59 [µs]

Ultra Short Exposure mode

This mode can set short exposure time by controlling registers.
But there is possible that this mode affects the quality of image. Please use this after evaluating and checking enough.
There is possible that the exposure time of this mode is changed about ±500 nsec by the sample and environment (temperature, power voltage and so on). And in case of using the intense light source, the exposure time looks like it is changed by PLS and so on. Please use this after evaluating and checking enough.

Description of process

Global Shutter (Normal Mode) Operation

t_{OFFSET} = 13.31 [µs] in this mode.

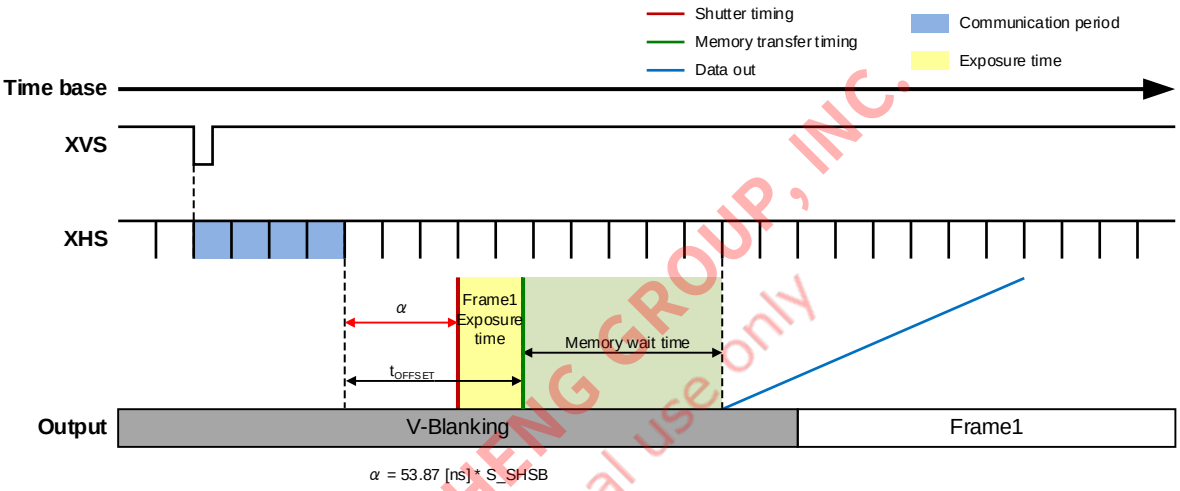

Image Drawing of Global Shutter (Normal Mode)

Global Shutter (Sequential Trigger Mode) Operation

t_{OFFSET} = 13.31 [µs] in this mode.

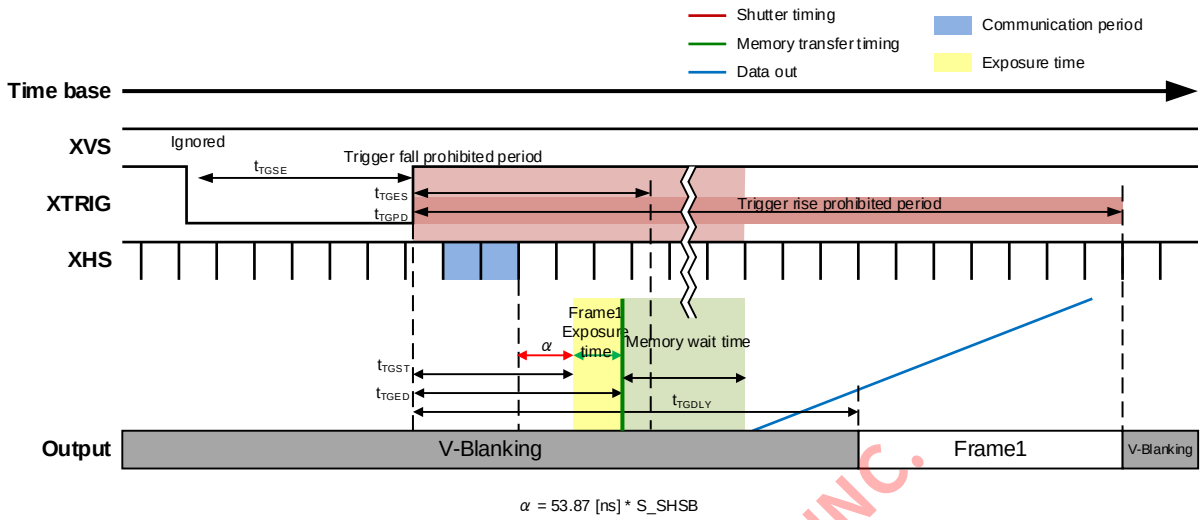

Image Drawing of Global Shutter (Sequential Trigger Mode)

Parameter List of Global Shutter (Sequential Trigger Mode)

(Please refer to the product specification for register setup other than those list.)

Item	Symbol	Min.	Typ.	Max.	Unit
Integration start delay	t_{TGST}	2 + α	—	3 + α	H
Integration end delay	t_{TGED}	2 + t_{OFFSET}	—	3 + t_{OFFSET}	H
Pulse width	t_{TGSE}	1	—	—	H

Global Shutter (Fast Trigger Mode) Operation

t_{OFFSET} = 13.31 [µs] in this mode.

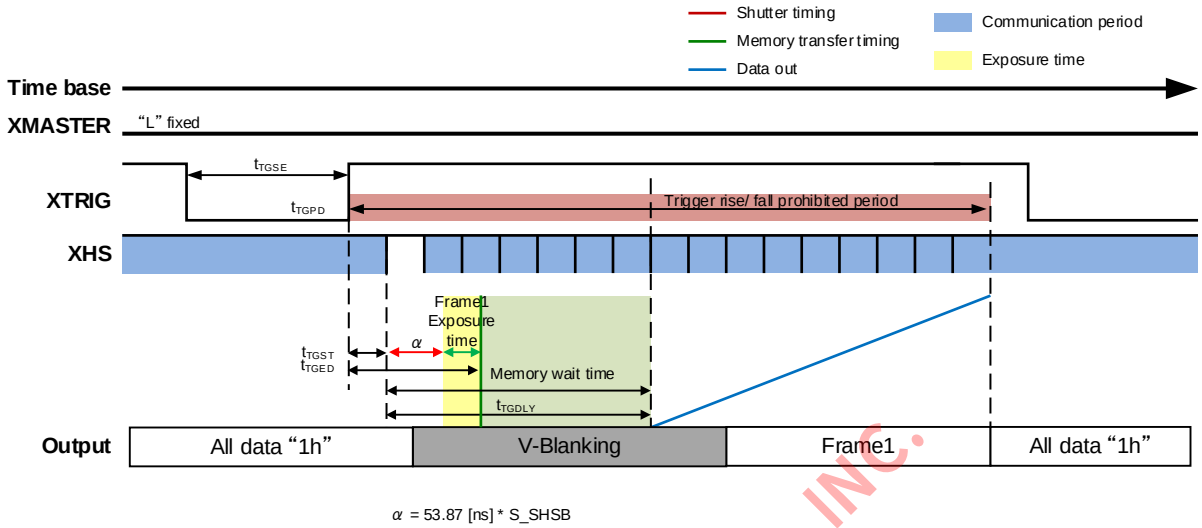

Image Drawing of Global Shutter (Fast Trigger Mode)

Parameter List of Global Shutter (Fast Trigger Mode)

(Please refer to the product specification for register setup other than those list.)

Item	Symbol	Min.	Typ.	Max.	Unit
Integration start delay	t_{TGST}	—	—	0.05 + α	µs
Integration end delay	t_{TGED}	—	—	0.05 + t_{OFFSET}	µs
Pulse width	t_{TGSE}	0.05	—	—	µs

Exposure time

The exposure time is set as below.

Exposure time = 13.31 [µs] – 53.87 [ns] * S_SHSB

0 ≤ S_SHSB ≤ 232

Exposure time is recommended more than 0.81 [µs].

If Exposure time is became more than 13.31 [µs], use Normal Exposure mode.

List of Exposure Setting

S_SHSA setting value [DEC]	S_SHSB setting value [DEC]	Exposure time [µs]
233	232	0.81
232	231	0.87
231	230	0.92
…	…	…
2	1	13.26
1	0	13.31

Mode transition

Each mode transition between Normal Exposure mode, Super Short Exposure mode and Ultra Short Exposure mode needs via the Standby state.

Revision History

Version	Date	Page	Remarks
Rev.0.1	10–Feb–17	–	First Edition
Rev.1.0	24–Jul–17	3	Correction: Register list of Super Short Exposure mode
		4	Correction: Register list of Ultra Short Exposure mode
		5	Update: The range of exposure time of Ultra Short Exposure mode on the table Added: Note of these mode
		6, 7	Added: Note of these mode
		6	Update: The actually exposure of Super Short Exposure mode on the table
		6	Deleted: Description of note*1 in table
		6, 7, 8, 9, 10	Update: The value of t_{OFFSET}
		9	Correction: The title of the figure
		10	Deleted: The range of S_SHSA of equation Update: The table of List of Exposure Setting