

Product Specification

❖ Product Name: AMOLED

❖ Model Name: DO0200FS01

❖ Description: 1.91 inch (240x536)

Proposed by			Customer's Approval
Designed	Checked	Approved	

Document Revision History

Rev. No.	Date	Contents	Remark
0.0	2022-08-11	-.Initial issue	Preliminary
0.1	2022-11-23	-.Add the description of i8080-8bit	
		-.Add the description of QSPI	
1.0	2024-05-14	-.Add the timing of i8080-8bit	
1.0	2024-05-14	-.Add the timing of QSPI	
1.0	2024-05-14	-.Add the timing of SPI_3/4Wire	
1.0	2024-05-14	-.Modify Size Description	

1.General Description:

- Driving Mode: Active Matrix.
- Color Mode: 16.7M/262K/65K color
- Display Format: 1.91" (240RGB x 536)
- Pixel arrangement: Real RGB arrangement
- Display Driver IC : RM67162
- Interface: SPI-3Wire / SPI-4Wire / i8080-8Bit / QSPI
- Application: Handheld & PDA & Wearable
- RoHS Compatible

2.Mechanical Data

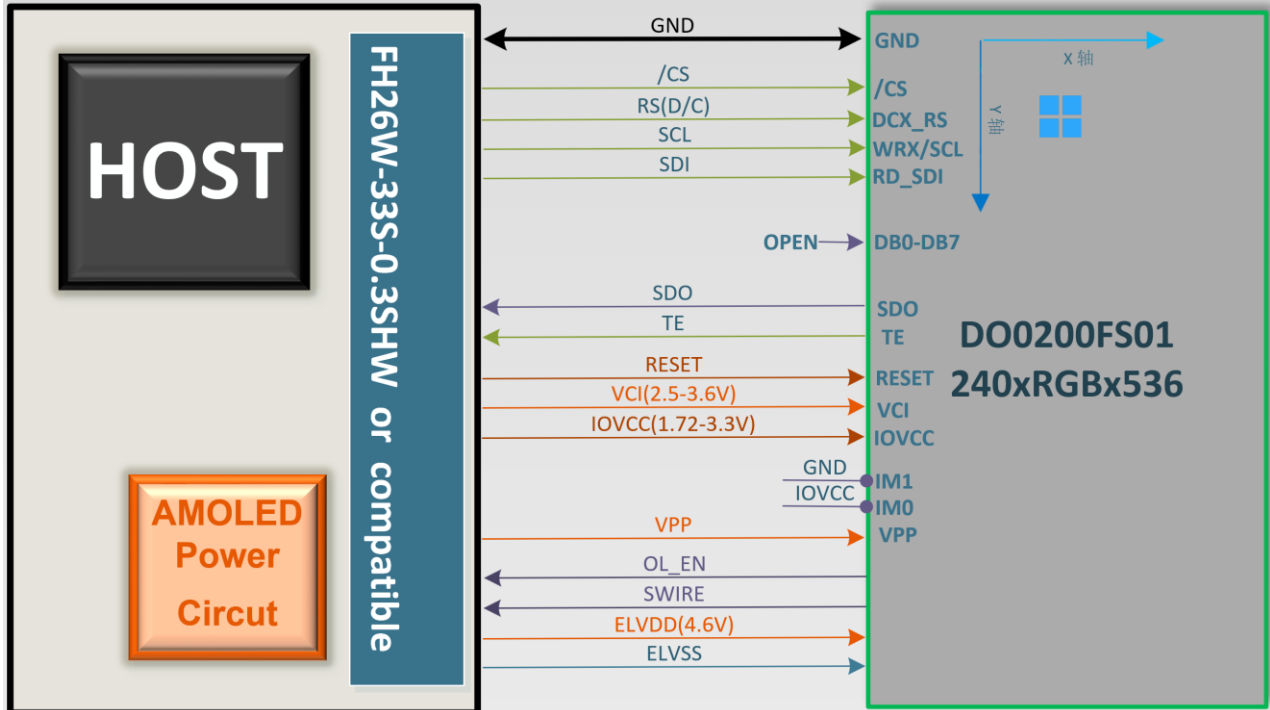
Item	Specifications	Unit
Dimensional outline	22.4(W) x 51.32(H)	mm
Thickness	0.89	mm
Number of dots	240(W) x RGB x 536(H)	Dots
Active area	19.80(W) x 44.22(H)	mm
Diagonal Inch	1.91	inch

***See attached drawing for details.**

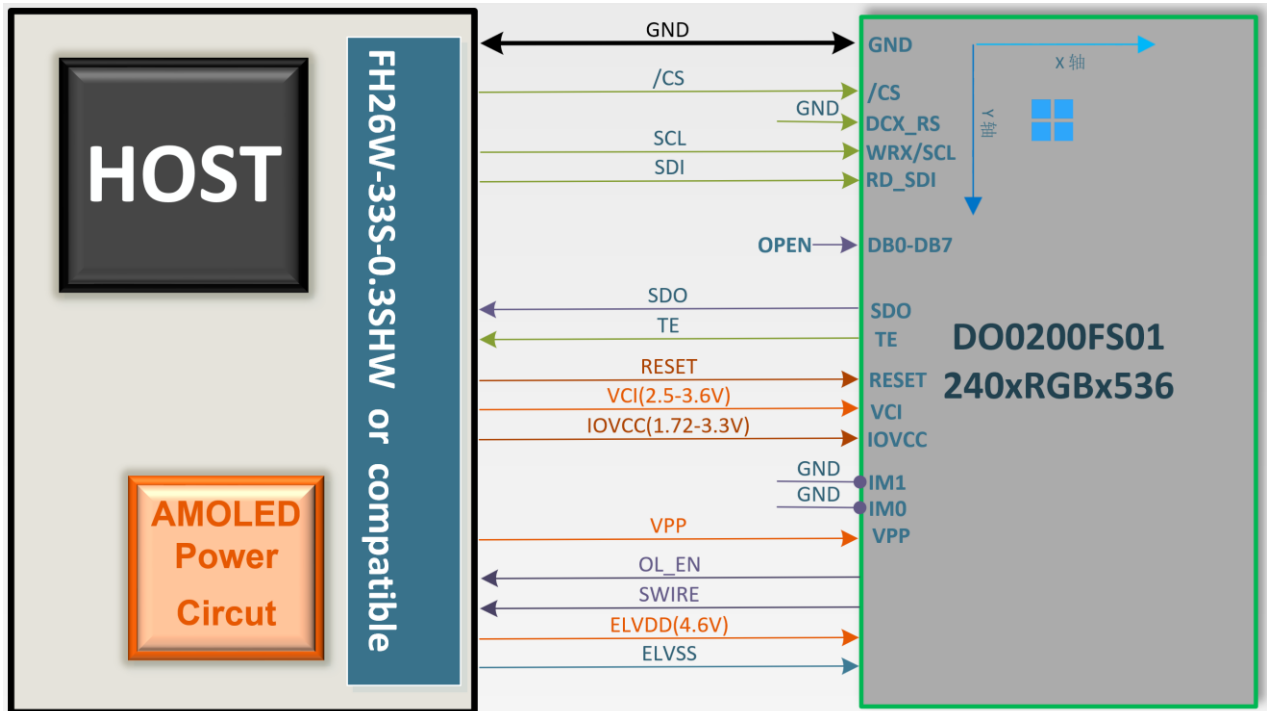
3. Block Diagram

DO0200FS01 support various interfaces, and interfaces are selected by setting the **IM[2:0]** pins.

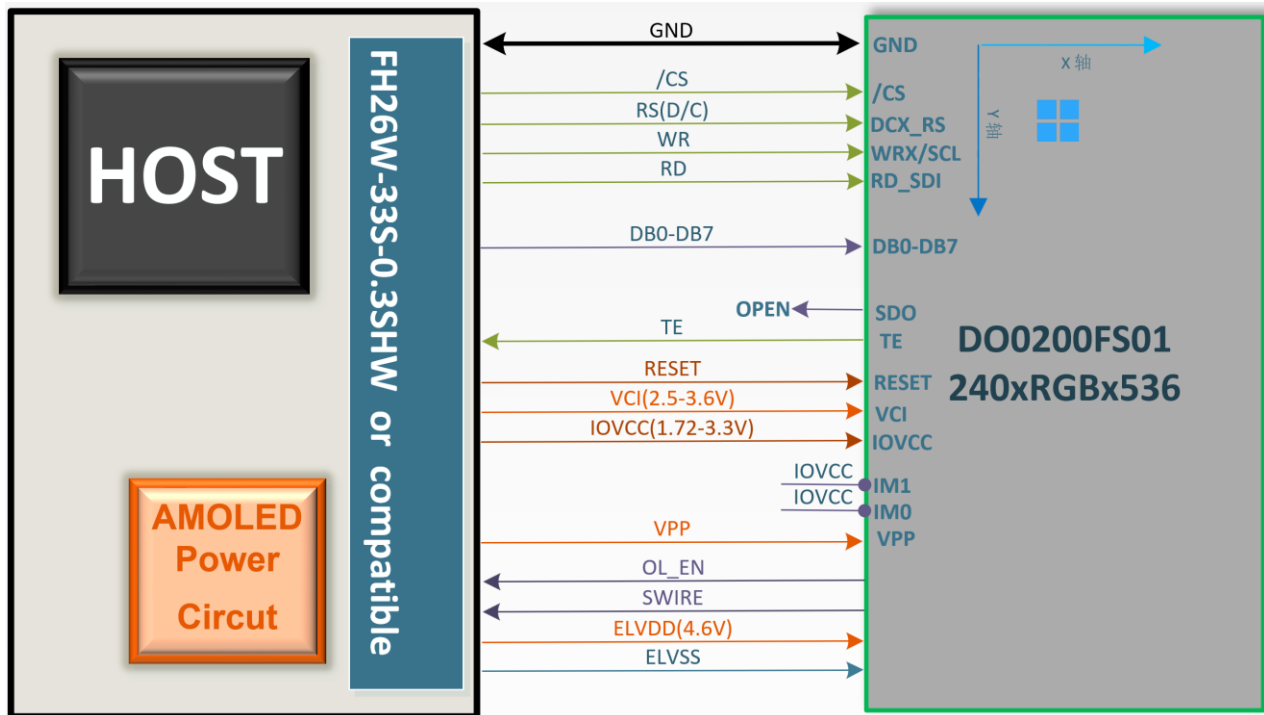
A: If IM1=GND, IM0=IOVCC, DO0200FS01 set to **spi-4wire interface**



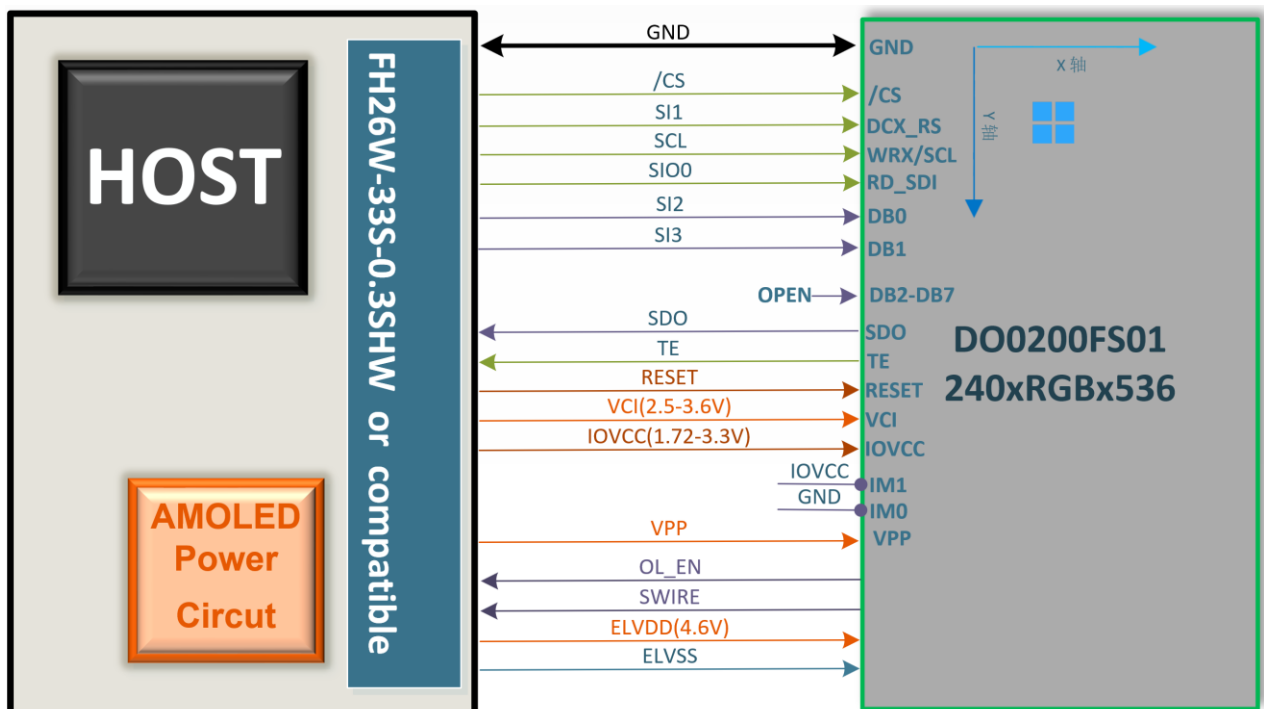
B: If IM1=GND, IM0=GND, DO0200FS01 set to **spi-3wire interface**



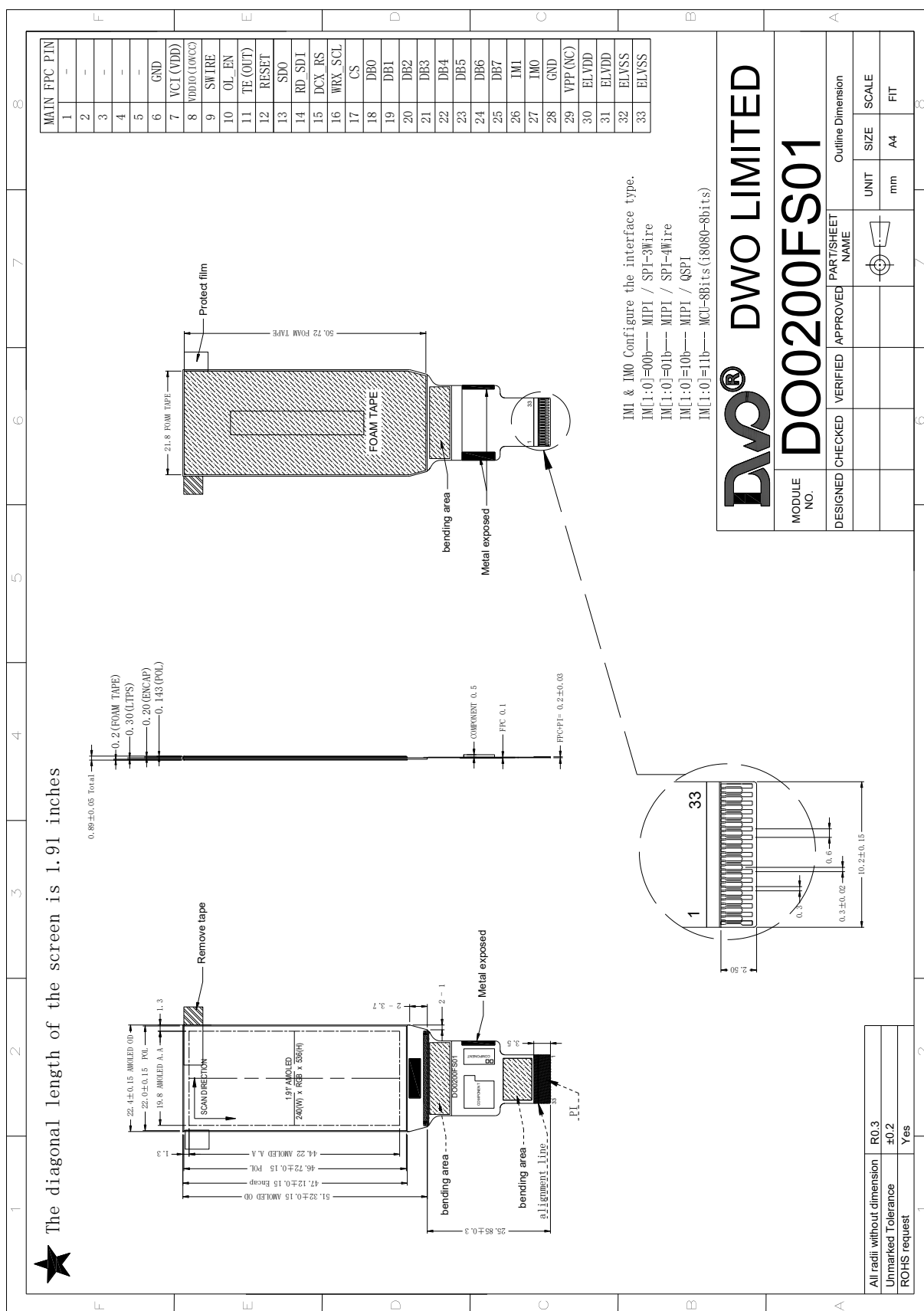
C: If IM1=IOVCC,IM0=IOVCC, DO0200FS01 set to **i8080-8bits** interface



D: If IM1=IOVCC,IM0=GND, DO0200FS01 set to **QSPI** interface



4.Dimension



5.Pin Description

NO.	Pin Name	I/O	Description
1-5	NC	-	No Connect
6	GND(0V	P	Ground Terminal
7	VDD	P	Analog Voltage for Driver (2.6~3.3V)
8	IOVCC	P	Driver IC Digital I/O Power Supply(1.7~3.3V)
9	SWIRE	O	Swire protocol setting pin of Power IC
10	OL_EN	O	Power IC enable control pin
11	TE	O	Tearing Effect
12	RESET	I	AMOLED Reset signal Input
13	SDO	O	Serial output signal in SPI I/F.
14	RD_SDI	P	SDI: Serial input signal in SPI I/F. The data is input on the rising edge of the SCL signal. RDX : Reads strobe signal to write data when RDX is "Low" in 80-series MPU interface.
15	DCX_RS	P	Display data / command selection in 80-series MPU I/F and 4-wire SPI I/F. D/CX = "0" : Command D/CX = "1" : Display data or Parameter
16	WRX_SCL	P	WRX : Writes strobe signal to write data when WRX is "Low" in 80-series MPU I/F. SCL: A synchronous clock signal in SPI I/F.
17	CS	P	Chip select input pin ("Low" enable) in 80-series MPU I/F and SPI I/F.
18	DB0	I/O	Bi-directional data bus for 80-series MPU I/F(LSB)
19	DB1	I/O	Bi-directional data bus for 80-series MPU I/F
20	DB2	I/O	Bi-directional data bus for 80-series MPU I/F
21	DB3	I/O	Bi-directional data bus for 80-series MPU I/F
22	DB4	I/O	Bi-directional data bus for 80-series MPU I/F
23	DB5	I/O	Bi-directional data bus for 80-series MPU I/F
24	DB6	I/O	Bi-directional data bus for 80-series MPU I/F
25	DB7	I/O	Bi-directional data bus for 80-series MPU I/F(MSB)
26	IM1	I	Interface type selection
27	IM0	I	Interface type selection
28	GND	P	Ground Terminal
29	VPP	P	OTP Power Supply(Let it open)

30	ELVDD	P	AMOLED power positive
31	ELVDD	P	
32	ELVSS	P	AMOLED power negative
33	ELVSS	P	

Note: The connections of IM[1:0] which not shown in table are invalid

IM[1:0]	Display Data	Command
00	3-wire SPI	3-wire SPI
01	4-wire SPI	4-wire SPI
10	QSPI	QSPI
11	I8080- 8-bit	I8080- 8-bit

6. DC Characteristics

6-1 Power Characteristic:

Parameter	Symbol	Conditions	Min.	Typ.	Max	Unit	Remark
Power supply for Logic	VDDIO		1.65	1.8	3.3	V	
Power supply for Analog	VCI		2.7	2.8	3.6	V	
AMOLED power positive	ELVDD		4.5	4.6	4.7	V	
AMOLED power negative	ELVSS		5.2	-2.4	-2.0	V	

When ELVSS= -2.4V, match the best display effect.

1) ELNormal Mode

Power Supply: IOVCC=1.8V VCI=2.8V Vbat=3.7V

Frame Frequency: F_{frame}=60HZ @ 25degC, Brightness 350 nits, Command Mode,

Parameter	Symbol	Conditions	Min.	Typ.	Max	Unit	Remark
Current for VDDIO	Ivddio		-	6.5	7.8	mA	
Current for VCI	Ivci		-	6.0	7.2	mA	

2) Idle Mode

Power Supply: IOVCC=1.8V VCI=2.8V

Frame Frequency: F_{frame}=15HZ @ 25degC, Brightness 50 nits,

Display Condition	Symbol	Min.	Typ.	Max.	Unit	Remark
10% Pixel On 50 nits						
	IVCI	-	3	3.6	mA	Ref
	IVDDIO	-	1	1.2	mA	Ref

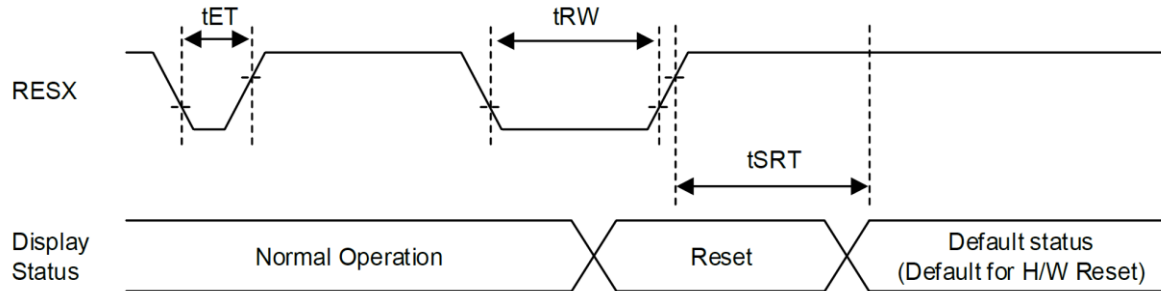
3) Sleep Mode

Display Condition	Symbol	Min.	Typ.	Max.	Unit	Remark
Deep Standby	IVCI	-	0.25	0.30	mA	-
	IVDDIO	-	0.10	0.12	mA	-

7.AC characteristics

7-1 Reset Timing

Reset timing characteristic



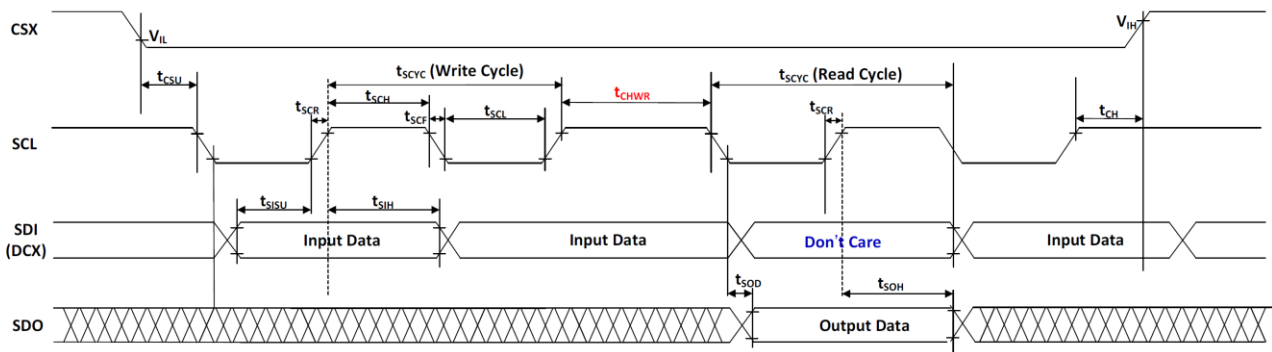
VSS=0V, VDDIO=1.7V to 3.3V, VCI=2.5V to 3.3V, Ta = -30 to 70°C

Parameter	Symbol	Pad	Min.	Typ.	Max.	Unit	Note
Reset low pulse width	t _{RW}	RESX	10	—	—	μs	—
Secure reset completion time	t _{SRT}	RESX	—	—	5	ms	Reset during Sleep In mode
		RESX	—	—	150		Reset during Sleep Out mode
Reset un-reacted pulse width	t _{ET}	RESX			5	μs	—

7-2 SPI Timing

SPI-3Wire/ SPI-4Wire Interface Characteristics

3/4-wire SPI

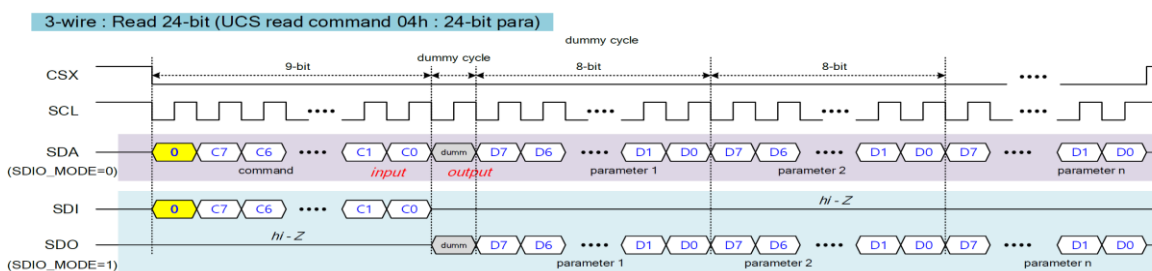
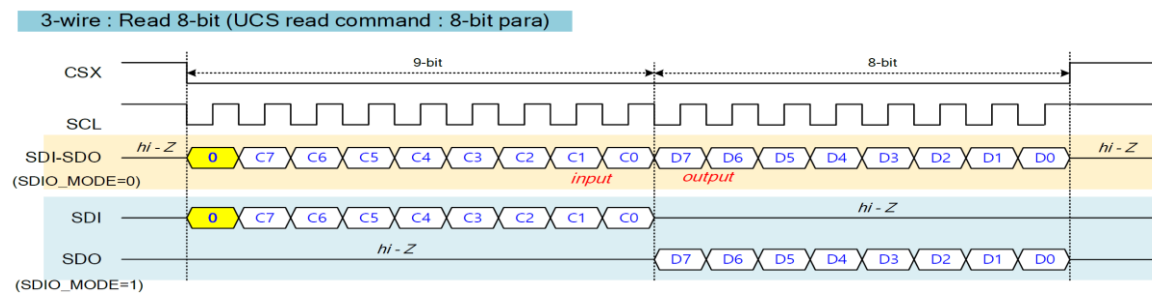
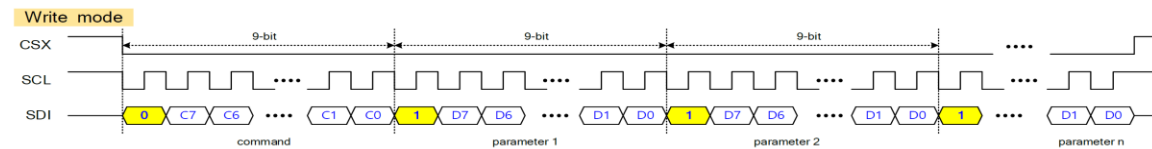


Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Clock cycle	t_{SCYC}	Write	20			ns
		Read	300			ns
Clock high pulse width	t_{SCH}	Write	6.5			ns
		Read	140			ns
Clock low pulse width	t_{SCL}	Write	6.5			ns
		Read	140			ns
Clock rise time	t_{SCR}	$0.2 \cdot V_{DDI} \rightarrow 0.8 \cdot V_{DDI}$			3.5	ns
Clock fall time	t_{SCF}	$0.8 \cdot V_{DDI} \rightarrow 0.2 \cdot V_{DDI}$			3.5	ns
Chip select setup time	t_{CSU}		10			ns
Chip select hold time	t_{CH}		10			ns
Data input setup time	t_{SISU}	To V_{IL} of SCL's rising edge	5			ns
Data input hold time	t_{SIH}		5			ns
Access time of output data	t_{SOD}	From V_{IL} of SCL's falling edge			120	ns
Hold time of output data	t_{SOH}	From V_{IH} of SCL's rising edge	5			ns
Transition time from Write cycle to Read cycle	t_{CHWR}	From V_{IH} of SCL's rising edge	150			ns

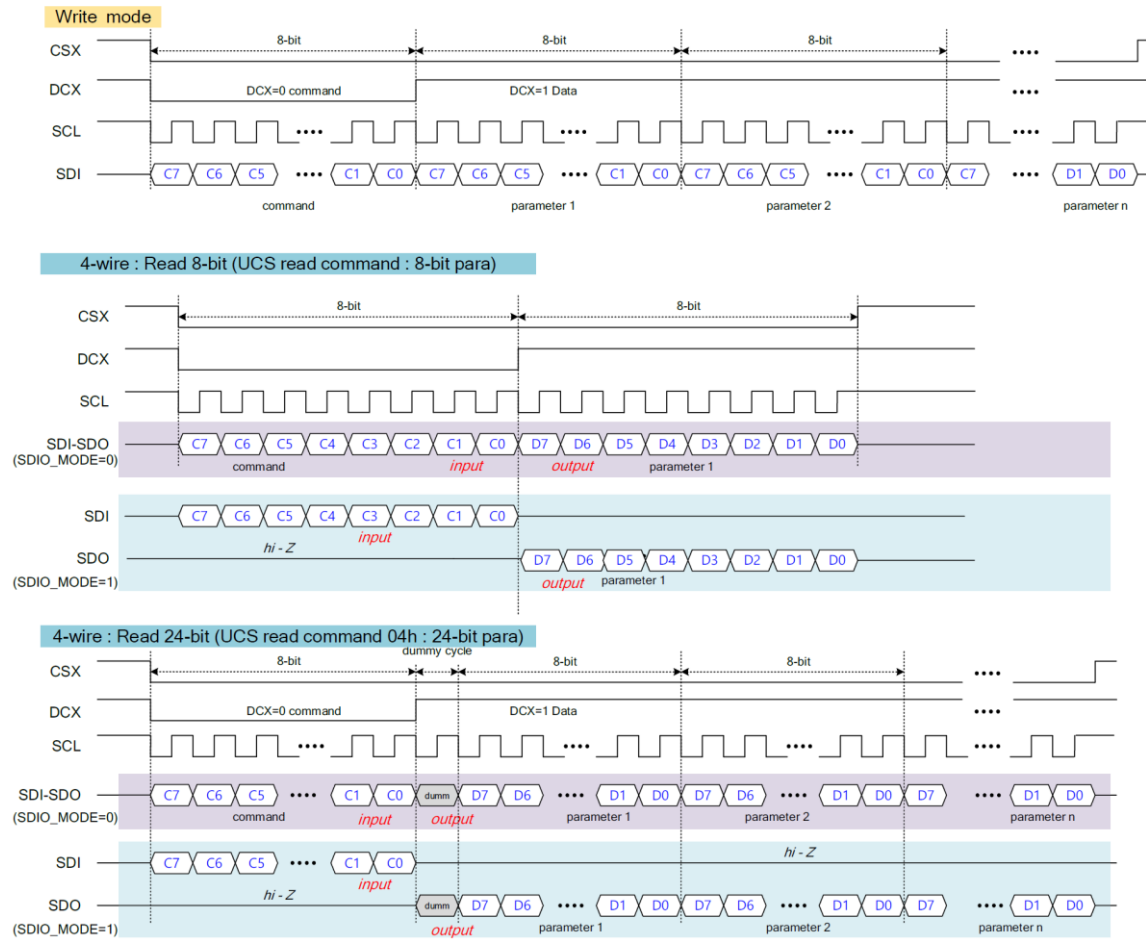
Notes:

- (1) Logic high and low levels are specified as 80% and 20% of V_{DDI} for Input signals.
- (2) For the 4-wire SPI, the DCX's timing is the same as input data.
- (3) $T_a = -30^{\circ}\text{C}$ to 70°C , $V_{DDI}=1.65\text{V}$ to 3.3V , $V_{CI}=2.7\text{V}$ to 3.6V , and $V_{SS}=0\text{V}$

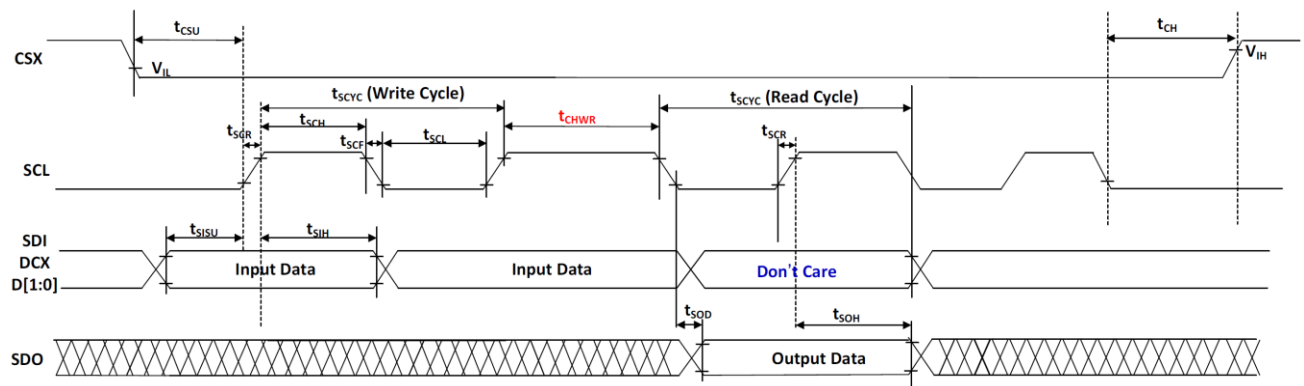
SPI-3 Wire (9-Bit) Interface Protocol – Register Write and Read



SPI-4 Wire (8-Bit) Interface Protocol – Register Write and Read



7-3 QSPI Interface Characteristics



Note: The max SCL frequency for each pixel data format is specified as the below table.

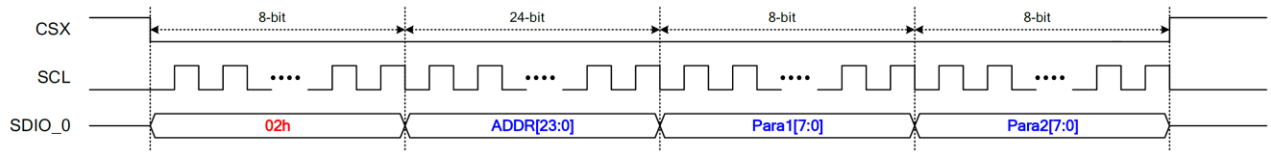
Note: Logic high and low levels are specified as 20% and 80% of VDDI for Input signals.

Note: Ta = -30 to 70 °C, VDDI=1.65V to 3.3V, VCI=2.7V to 3.6V, GND=0V

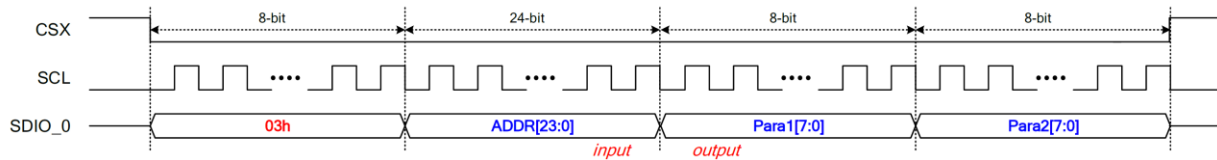
QSPI Timing

Quad SPI Interface Protocol – Register Read and Write

Command Write

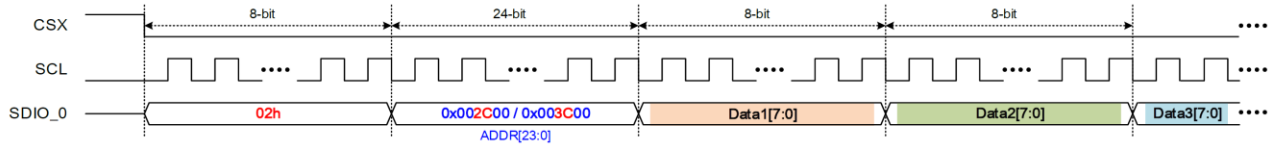


Command Read

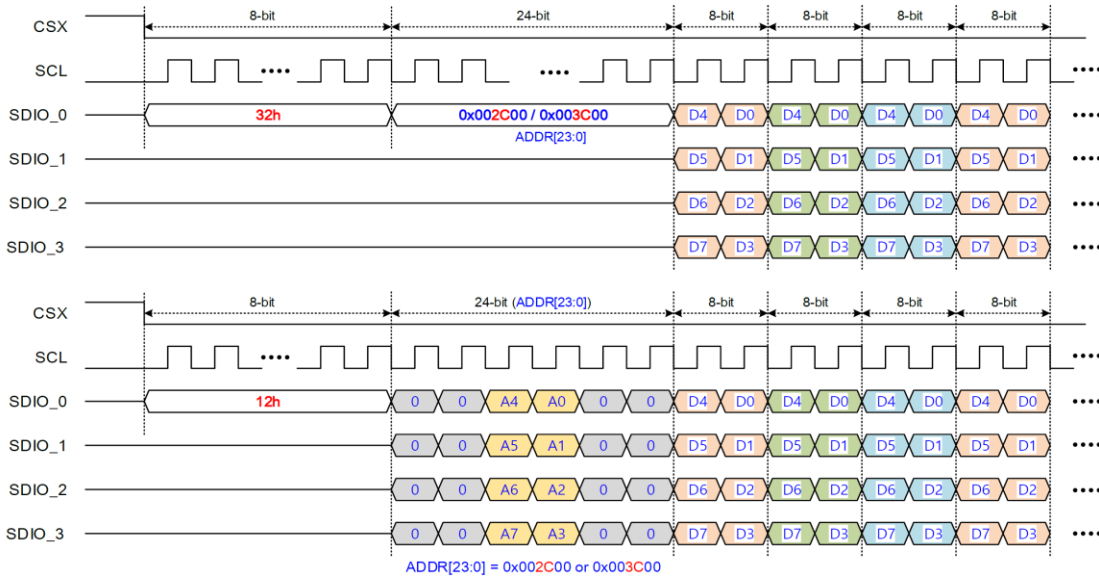


Quad SPI Interface Protocol – Pixel Interface

1-Wire Pixel Write

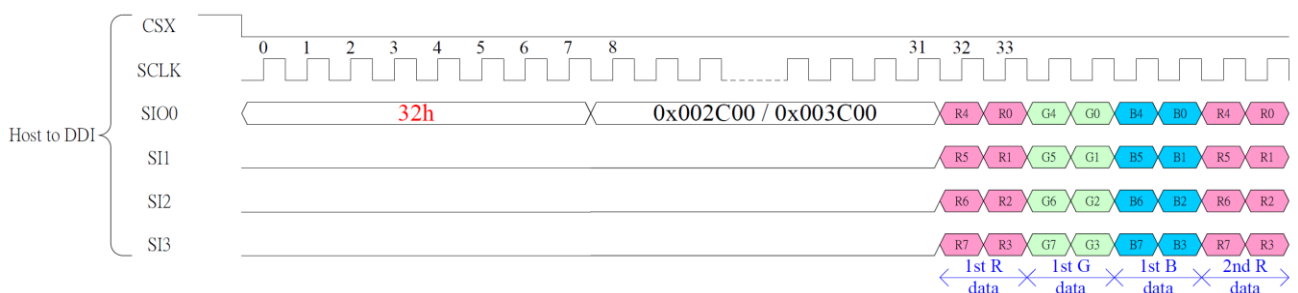


4-Wire Pixel Write

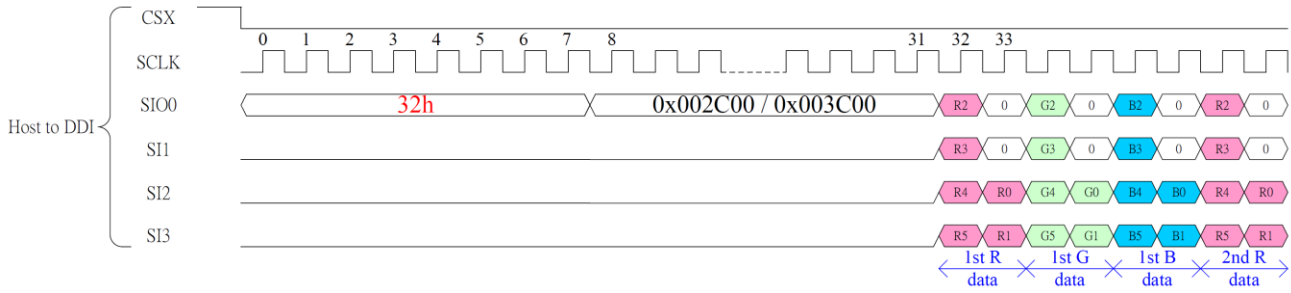


SPI-4Lanes Pixel Write Data Waveform

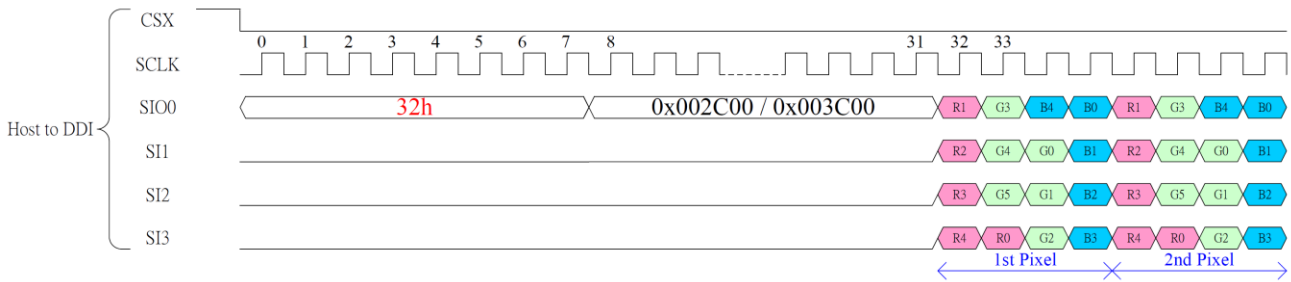
RGB888 – 4-Lanes



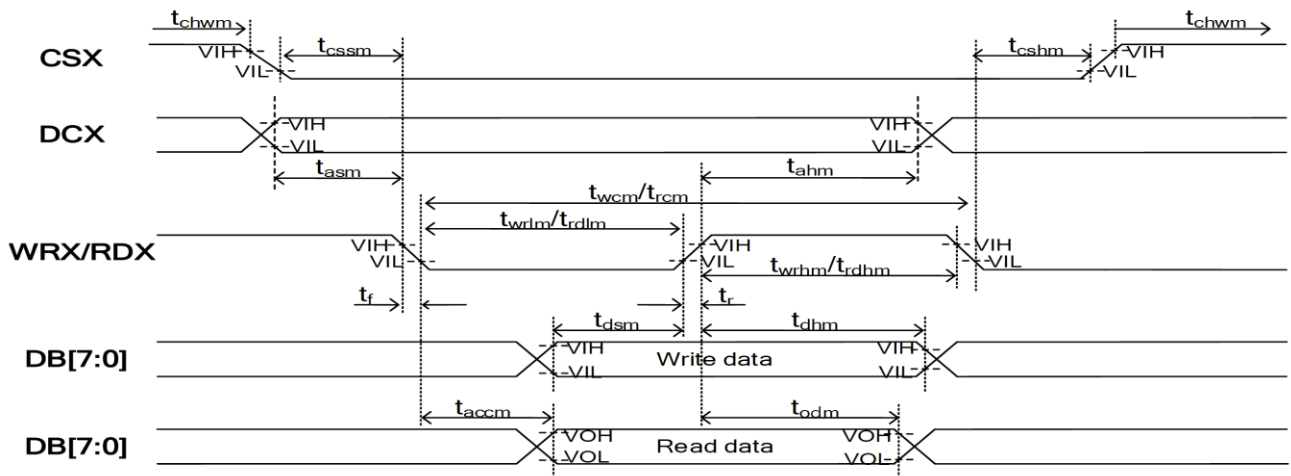
RGB666 – 4-Lanes



RGB565 – 4-Lanes



7.4 i8080-8Bits Interface Characteristics

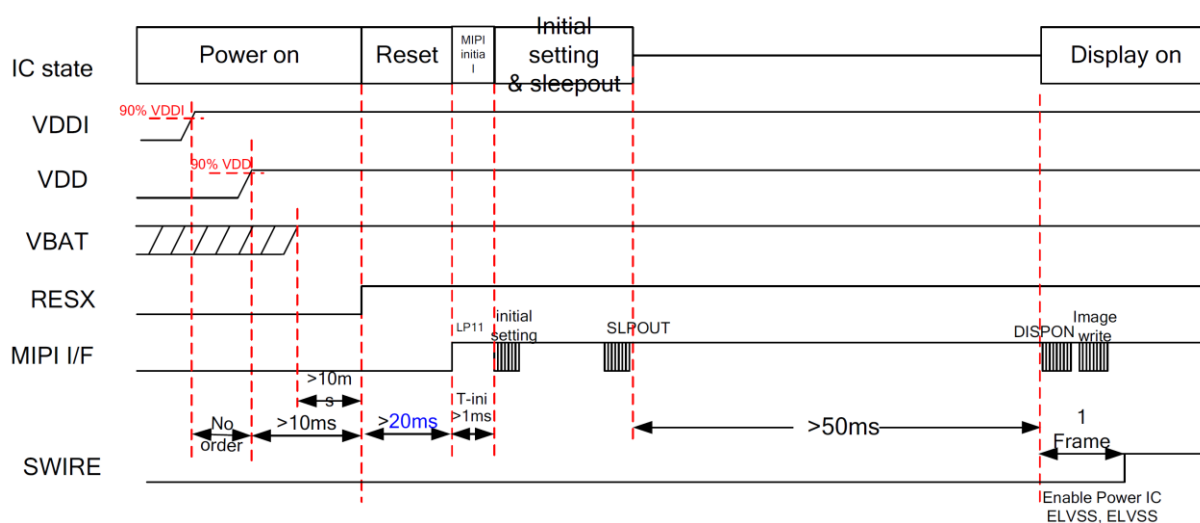


Characteristic	Symbol		Specification		Unit
			Min.	Max.	
Chip select setup time	CSX	t _{cssm}	10	—	ns
Chip select hold time		t _{cshsm}	10	—	ns
Chip select “High” pulse width		t _{chwm}	20	—	ns
Address setup time	DCX	t _{asm}	10	—	ns
Address hold time(Write/Read)		t _{ahm}	10	—	ns
Write cycle time	WRX (Write)	t _{wcm}	20	—	ns
WRX “High” period (Write)		t _{wrhsm}	10	—	ns
WRX “Low” period (Write)		t _{wrlm}	10	—	ns
Read cycle time (Register Read)	RDX (Register Read)	t _{rcm}	100	—	ns
RDX “High” period (Register Read)		t _{rdhm}	50	—	ns
RDX “Low” period (Register Read)		t _{rdlm}	50	—	ns
Read cycle time (Memory Read)	RDX (Memory Read)	t _{rcm}	200	—	ns
RDX “High” period (Memory Read)		t _{rdhm}	100	—	ns
RDX “Low” period (Memory Read)		t _{rdlm}	100	—	ns
Data setup time	DB[7:0]	t _{dsm}	10	—	ns
Data hold time		t _{dhm}	10	—	ns
Access time	DB[7:0]	t _{accm}	—	40	ns
Output disable time		t _{odm}	20	—	ns
Rise/Fall time	-	t _r /t _f	—	1	ns

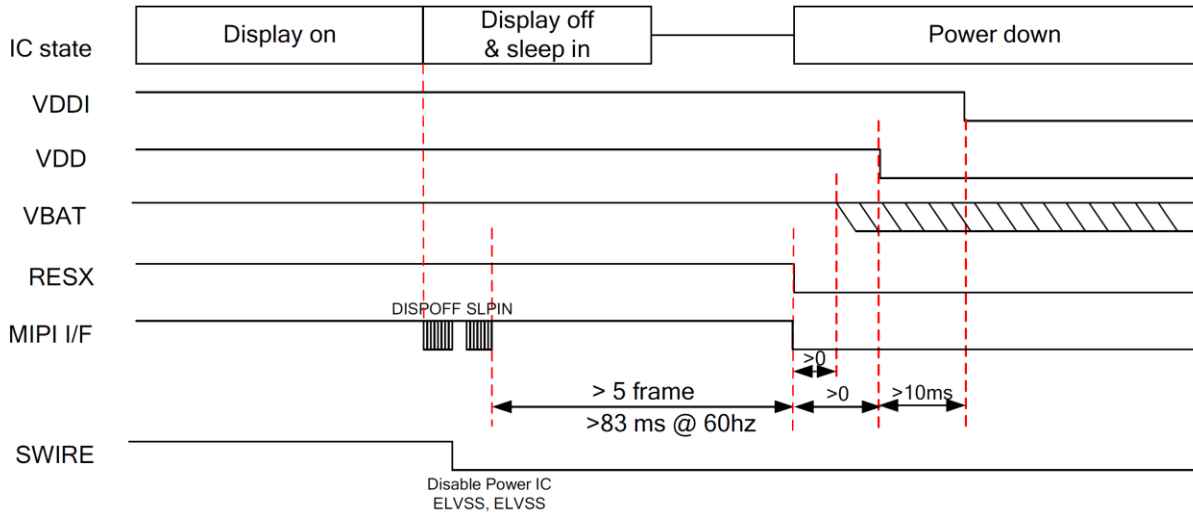
8.Recommended Operating Sequence

8.1 Power on/off sequence and timing

Power On sequence

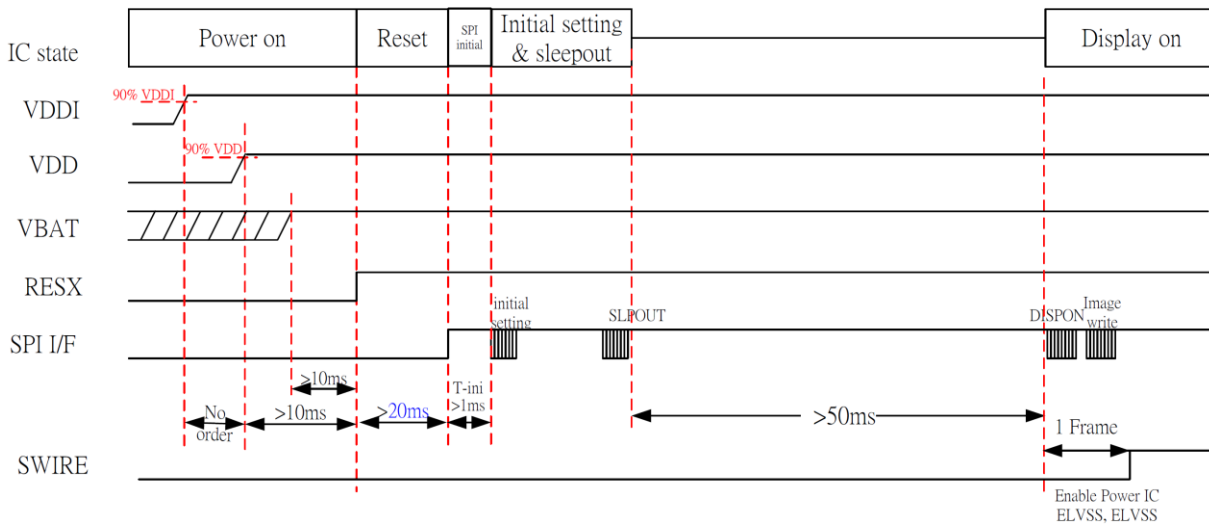


Power Off sequence



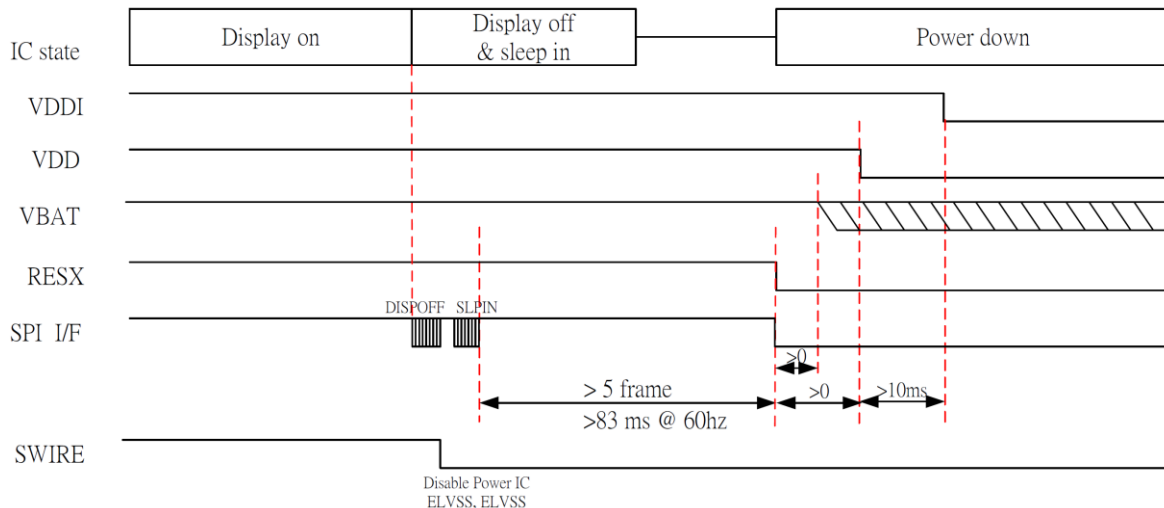
Power On sequence

SPI Interface



Power Off sequence

SPI Interface



9. Electro-optical characteristics

Item		Symbol	Condition	Value			Unit	Remark
				Min	Typ	Max		
Luminance		L	θ=0° Φ=0° without CG	315	350	385	cd/m2	
Uniformity				85	90	-	%	Note 2
Viewing Angle	Left	θ _L	Cr≥200	80	85	-	Deg.	
	Right	θ _R		80	85	-		
	Top	ψ _T		80	85	-		
	Bottom	ψ _B		80	85	-		
Contrast Ratio		CR	θ=0°	5000	10000	-	-	
Adobe cover Ratio		SOR	ICE1931	-	100	-	%	Note 1
Response Time		Tr+Tf	Φ=0°	-	2	4	ms	
Color Coordinate of CIE1931	Red	X	θ=0° Φ=0°	0.64	0.67	0.70	-	
		Y		0.30	0.33	0.36		
	Green	X		0.17	0.21	0.25		
		Y		0.69	0.73	0.77		
	Blue	X		0.11	0.14	0.17		
		Y		0.01	0.04	0.07		
	White	X		0.28	0.30	0.32		
		Y		0.29	0.31	0.33		
NTSC Ratio		NTSC	CIE1931	100	103	-	%	
Color Uniformity		Δ u′	θ=0 deg. Condition 1	-	-	0.007	Δ u′	Note 2
		Δ v′				0.007	Δ u′	
Flicker		-	60Hz, Worst pattern	-	-30	-	dB	
Gamma		-	θ=0 deg.	2.0	2.2	2.4		
Crosstalk			-	-	-	TBD	%	Note 3
Color temperature		CT		6700	7500	8300	K	
Luminance decrease ratio of full white			θ _L =30°		40	45	%	
			θ _R =30°		40	45	%	
			ψ _T =30°		40	45	%	
			ψ _B =30°		40	45	%	
White color shift		WAD	G255, 0 to 45 deg.	-	-	0.022	Δ u′v′	Note 4

Measurements condition as below, if not otherwise specified. Include touchpanel, OCA and Cover glass

Room temp: 25°C, Frame frequency=60Hz

Image Enhancement :OFF

Measurement points: Display center, $\theta=0$ deg.

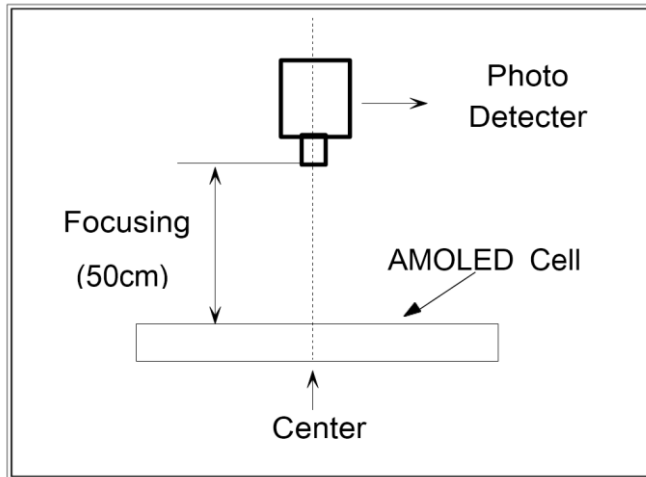
Measurement instrument: Uniformity CA2500,

Flicker CA310 or equivalent device. Other items CS2000

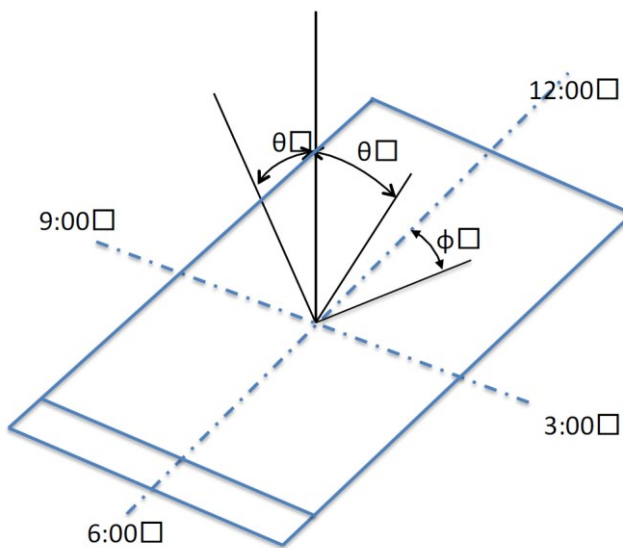
CS2000: To be measured on the center area of Panel with a viewing cone of 1° by luminance mater, after 15min operation

CA2500: To be measured on the Active area of Panel with a viewing cone of 35pixel/circle by luminance mater, after 15min operation

CA310: To be measured on “CA-P32/35” Probe



Viewing angle



Note1: Define of Adobe cover ratio

Green: RGB color chromaticity of this module

Rad : RGB color chromaticity of Adobe RGB

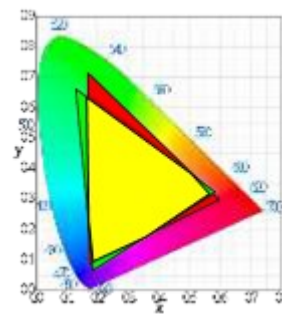
R: x0.64, y0.330

G: x0.21, y0.71

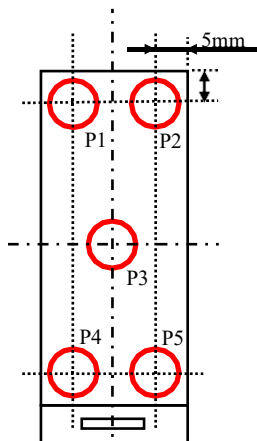
B: x0.15, y0.06

Yellow : The area where red and yellow are piled

Adobe RGB cover Ratio = Yellow / Rad *100[%]



Note2: Define of Brightness uniformity and Color uniformity



$$\text{Brightness uniformity} = \frac{\text{Minimum value}[P1:P5]}{\text{Maximum value}[P1:P5]}$$

$$\text{Color uniformity} = \text{Maximum value}[P1:P5] - \text{Minimum value}[P1:P5]$$

Note3: Define of Brightness uniformity and Color uniformity

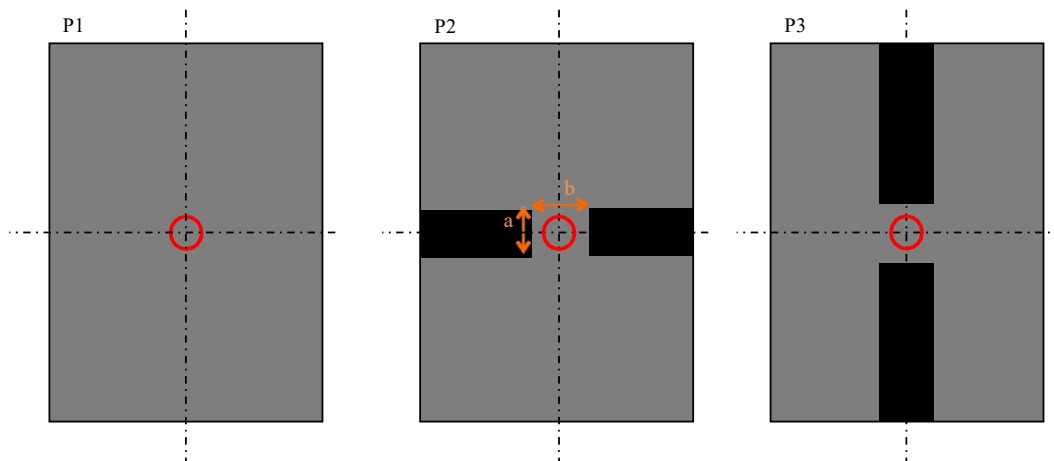
Define of crosstalk

Base color : V127

Measurement area (a,b) :

144dots*144dots Bar color :

white, red, green, blue, Black.



$$\text{Cross talk ratio P2} = \frac{|P1-P2|}{P1}$$

$$\text{Cross talk ratio P3} = \frac{|P1-P3|}{P1}$$

Cross talk ratio: maximum value of cross talk P2 and P3

Note4: Define of White color shift

White color shift is Maximum value of Color shift WADu' and Color shift WADv'

$$\text{WADu}' = |u'_{0} - u'_{45}|$$

$$WADv' = |v'_{0} - v'_{45}|$$

$$\Delta u'v' = \sqrt{WADu'^2 + WADv'^2}$$

u'_{0}, v'_{0} : white color chromaticity at $\Theta = 0\text{deg}$

u'_{45}, v'_{45} : white color chromaticity at $\Theta = 45\text{deg}$ * (φ = all angle)

10. Standard Specification For Reliability

No	Item	Condition	Cycles	Judgment Criterion
1	High Temperature Operation	80°C/ 240hours	10	1. No clearly visible defects or remarkable deterioration of display quality. However, any polarizer's deteriorations by the high temperature/ High humidity Storage test and the High temperature/ High humidity Operation test are permitted. 2. No function-related abnormalities.
2	Low Temperature Operation	-30°C/ 240hours	10	
3	High Temperature Storage	85°C/ 240hours	5	
4	Low Temperature Storage	-40°C/ 240hours	5	
5	High Temperature Humidity Operation	60°C/90%RH/ 240hours	5	
6	Thermal Shock	-40°C~85°C / 100cycles	5	

Note: The results must be measured after 2 hours later under room temperature keeping.

- END -