BOE

1.0 cm(Type 0.39) Active Matrix Color OLED Panel Module

1. Overview/Application

BO039M1920M is a 0.39 inch (1 cm) diagonal, FHD resolution(1920 x1080), active matrix color OLED (Organic Light Emitting Display)panel module based on single crystal silicon backplane . The pixel circuits and driving IC are integrated on the silicon backplane to get the compact size and very low power consumption.

(Potential applications: Virtual Reality application（AR/VR）, Head mounted displays, Near-Eye Displays etc.)

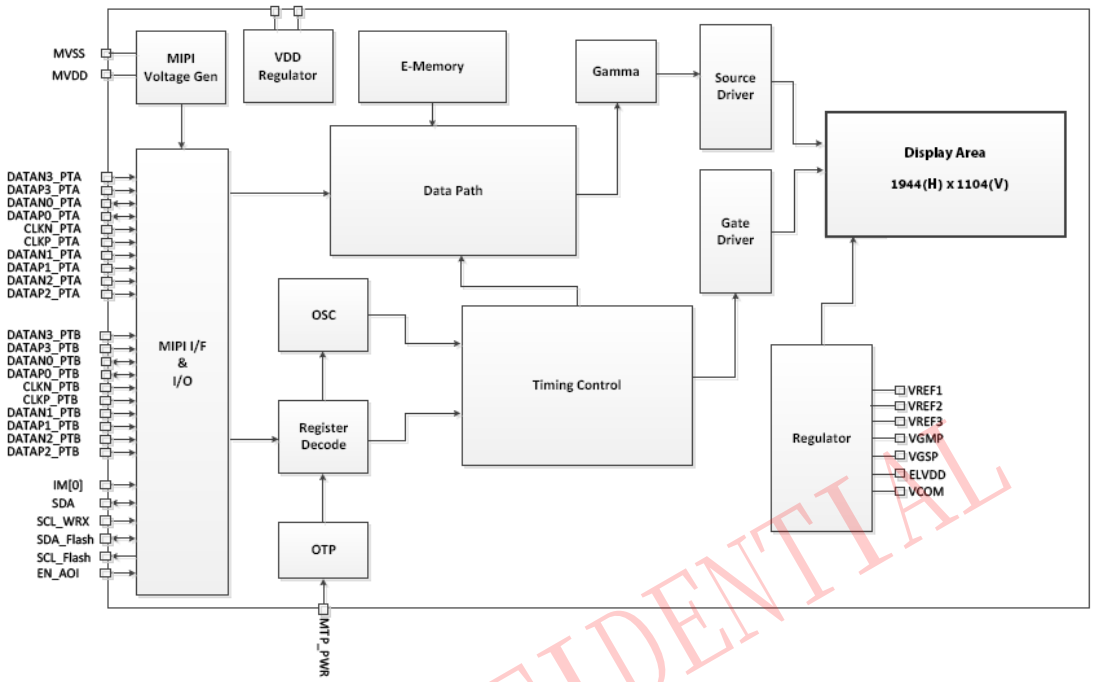
2. Features

- Small-size, high resolution 0.39 FHD Display PPI=5644
- AP Operated Resolution (8*M, M=40~240) x RGB x (8*N, N=30~135)
- Full color mode, 16.7M colors
- Fast response
- Thin and light in weight
- Color enhancement, Sharpness enhancement
- High contrast mode
- High fluency mode
- Power-saving (PS) mode
- Scan direction selection, up or down
- Interface, Support MIPI only or MIPI(data)+I^2C(CMD)

3. Module Structure

- Active matrix color OLED display with on-chip driver based on single crystal silicon transistors

4. System Block Diagram



5. Pin Description

5.1 Interface Logic Pin

Signal	Type	Description
RESX	I	This signal will reset the device and must be applied to properly initialize the chip. Signal is active low.
IM[0]	I	Use to select the Interface type. IM[0] / Command Execute / Image Write 0 / MIPI / MIPI 1 / I2C / MIPI Note: MIPI 1port or 2port is selected by register setting
OCP_OUT	O	Over current protect flag.
OTP_SEL	I	MTP type selection. OTP_SEL=0: use internal OTP OTP_SEL=1: use external OTP
MTP_PWR	I	MTP program power, 7.75V. If not use, please connect to GND or OPEN.
EN_AOI	I	AOI mode enable. EN_AOI=0: AOI mode disable EN_AOI=1:AOI mode enable

5.2 Interface Pin

Signal	Type	Description
CLKP_PTA/B CLKN_PTA/B	I	These pins are DSI-CLK+/- differential clock signals if MIPI Port A/B interface is used. CLKP/N_PTA/B are differential small amplitude signals. If not used, please keep it open.
DATA0P_PTA/B DATA0N_PTA/B	I/O	These pins are DSI-D0+/-differential clock signals if MIPI Port A/B interface is used. DATA0P/N_PTA/B are differential small amplitude signals. If not used, please keep it open.
DATA1P_PTA/B DATA1N_PTA/B	I/O	These pins are DSI-D1+/-differential clock signals if MIPI Port A/B interface is used. DATA1P/N_PTA/B are differential small amplitude signals. If not used, please keep it open.
DATA2P_PTA/B DATA2N_PTA/B	I/O	These pins are DSI-D2+/-differential clock signals if MIPI Port A/B interface is used. DATA2P/N_PTA/B are differential small amplitude signals. If not used, please keep it open.
DATA3P_PTA/B DATA3N_PTA/B	I/O	These pins are DSI-D3+/-differential clock signals if MIPI Port A/B interface is used. DATA3P/N_PTA/B are differential small amplitude signals. If not used, please keep it open.
SDA	I	Bi-direction data PIN in I2C I/F. If this pin is not used, please connect to VDDI.
SCL_WRX	I/O	Synchronous clock signal in I2C I/F. If this pin is not used, please connect to VDDI
SDA_FLASH	I/O	Bi-direction data PIN in I2C I/F for external EEROM. If this pin is not used, please keep it open.
SCL_FLASH	O	Synchronous clock signal in I2C I/F for external EEROM. If this pin is not used, please keep it open.

5.3 Power Supply Pin

Signal	Type	Description
VDDI	P	Power supply for interface system except for the interface
AVDD AVDD_DC	P	Power supply for analog system. AVDD/AVDD_DC should be the same input voltage. Please divide the signals on panel layout and connect the signals together on FPC. Need stabilize capacitance
ELVDD	P	Power supply for OLED cell.
AVEE	P	Power supply for OLED cell.
VSS	P	System GND for internal digital system.
AVSS	P	System GND for analog system.
AVSS_DC	P	System GND for power generation system. Please divide the signals on panel layout and connect the signals to AVSS on FPC.
MVSS	P	System GND for MIPI interface.

5.4 Regulator Pin

Signal	Type	Description
DVDD	O	Regulator output for logic system power. Connect a capacitor for stabilization.
MVDDA	O	Regulator output for MIPI digital system power. Connect a capacitor for stabilization.
MVDDL	O	Regulator output for MIPI analog system power. Connect a capacitor for stabilization.
VGMP	O	Regulator output for gamma high voltage generation. Connect a capacitor for stabilization.
VGSP	O	Regulator output for gamma low voltage generation. Connect a capacitor for stabilization.
VCOM	O	Regulator output for common electrode voltage. Connect a capacitor for stabilization
VREF1	O	Regulator output for internal reference voltage. Connect a capacitor for stabilization.
VREF2	O	Regulator output for internal reference voltage. Connect a capacitor for stabilization.
VREF3	O	Regulator output for internal reference voltage. Connect a capacitor for stabilization.

5.5 Test Pin

Signal	Type	Description
PADA PADB PADC PADD	-	Bonding test pin.

6. Absolute Maximum Ratings

The absolute maximum rating is listed on the below table. When the VTOS6201 is used beyond the absolute maximum ratings, it may be permanently damaged. It is strongly recommended use the drive IC within the following specified limits for normal operation. If these electrical characteristic conditions are exceeded during normal operation, the driver IC will malfunction and cause poor reliability.

Item	Symbol	Value	Unit
Power Supply Voltage (1)	VDDI	4	V
Power Supply Voltage (2)	AVDD-AVSS	7	V
	AVEE-AVSS	7	V
Power Supply Voltage in AOI mode 1	VDDI	1.65	V
	AVDD-AVSS	7	V
	AVEE-AVSS	7	V
Power Supply Voltage in AOI mode 2	AOI_VDDI	1.65	V
	AOI_AVDD	7	V
	AOI_ELVDD	7	V
	AOI_AVEE	7	V
MIPI Differential Input	CLKP_PTA/B, CLKN_PTA/B DATAP0_PTA/B, DATAN0_PTA/B DATAP1_PTA/B, DATAN1_PTA/B DATAP2_PTA/B, DATAN2_PTA/B DATAP3_PTA/B, DATAN3_PTA/B	1.32	V
Input Voltage of Interface	Vin	-0.3~VDDI+0.3	V
Output Voltage of Interface	Vo	-0.3~VDDI+0.3	V
Operating temperature	Topr	-40~85	℃
Storage temperature	Tstg	-55~125	℃

7. Recommended Operating Conditions

Item	Parameter	Min	Typ	Max	Unit
Power Supply Voltage	VDDI	1.65	1.8	1.95	V
	AVDD-AVSS	5		6	V
	AVEE-AVSS	-5		-6	V
Power Supply Voltage in AOI mode 1	VDDI		1.6		V
	AVDD-AVSS	1.8		5	V
	AVEE-AVSS	-2		-5	V
Power Supply Voltage in AOI mode 2	AOI_VDDI		1.6		V
	AOI_AVDD	1.8		5	V
	AOI_ELVDD	1.8		5	V
	AOI_AVEE	-2		-5	V
	AOI_VSS		0		V
Input Voltage of Interface	Vin	-0.3		VDDI+0.3	V
Output Voltage of Interface	Vo	-0.3		VDDI+0.3	V
Operating temperature	Topr	-40		85	℃
Storage temperature	Tstg	-55		125	℃

8. Electrical Characteristics

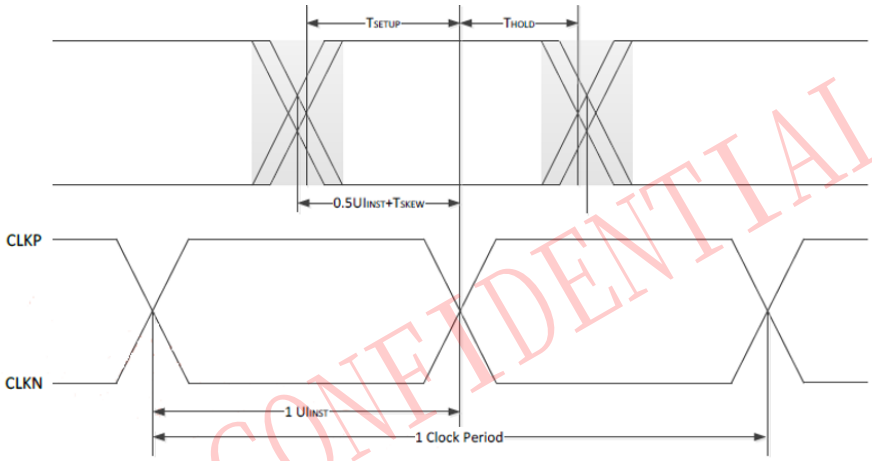
8.1 DC Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Power & Operation Voltage						
AVDD Input Level	AVDD	-	5.0		6.0	V
Digital I/O Power Supply (non-MIPI I/O)	VDDI	-		1.8		V
Digital I/O Input Level @Logic High	VIH	VDDI=1.65V ~ 1.95V	0.7*VDDI	-	VDDI	V
Digital I/O Input Level @Logic Low	VIL	VDDI=1.65V ~ 1.95V	0		0.3*VDDI	V
Digital I/O Output Level @Logic High	VOH	Iout = -1mA	0.8*VDDI	-	VDDI	V
Digital I/O Output Level @Logic Low	VOL	Iout = +1mA	0	-	0.2*VDDI	V
Digital I/O Input leakage @Logic High	IIHD	Vin = VDDI			1	uA
Digital I/O Input leakage @Logic Low	IILD	Vin = 0	-1			uA
MIPI I/O Power Supply	MVDD	-	-	1.2	-	V
MIPI Input leakage @Logic High	IIHMD	Vin = MVDD			1	uA
MIPI Input leakage @Logic Low	IILMD	Vin = 0	-1			uA
Reference Voltage	VREF1	-	-	1.9	-	V
Panel Reference Voltage	VREF2	-	-0.3	-	-2	V
	VREF3	-	-0.3	-	-2	V
	VCOM	-	-1	-	-5.5	V

8.2 AC Characteristics

8.2.1 High Speed Mode Characteristics

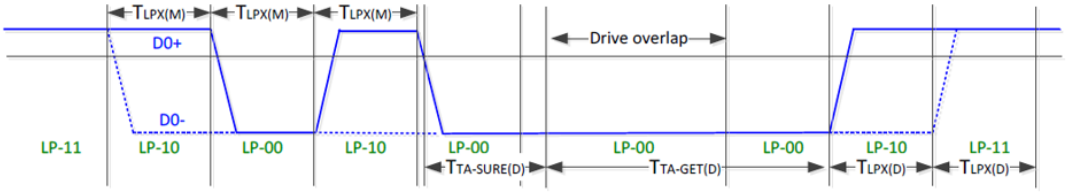
Parameter	Symbol	Min.	Typ.	Max.	Unit
UI instantaneous	UIINST	1	-	3	ns
T Data to Clock Skew	TSKEW	-0.15	-	0.15	UIHS
RX Data to Clock Setup Time Tolerance	TSETUP	0.15	-	-	UIHS
RX Data to Clock Hold Time Tolerance	THOLD	0.15	-	-	UIHS



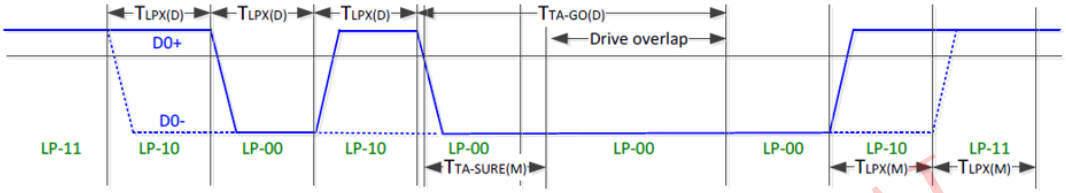
8.2.2 Low Power Mode Characteristics

Parameter	Description	Min.	Typ.	Max.	Unit
$T_{LPX(M)}$	Transmitted length of any Low-Power state period (MCU to display module)	50	-	-	ns
$T_{LPX(D)}$	Transmitted length of any Low-Power state period (display module to MCU)	50	-	-	ns
$T_{TA-SURE}$	Time that the new transmitter waits after the LP-10 state before transmitting the Bridge state(LP-00) during a Link Turnaround	T_{LPX}	-	$2*T_{LPX}$	
T_{TA-GET}	Time that the new transmitter drives the Bridge state(LP-00) after accepting control during a Link Turnaround	$5*T_{LPX}$			
T_{TA-GO}	Time that the transmitter drives the Bridge state(LP-00) before releasing control during a Link Turnaround	$4*T_{LPX}$			

- Bus Turnaround from MPU to display module

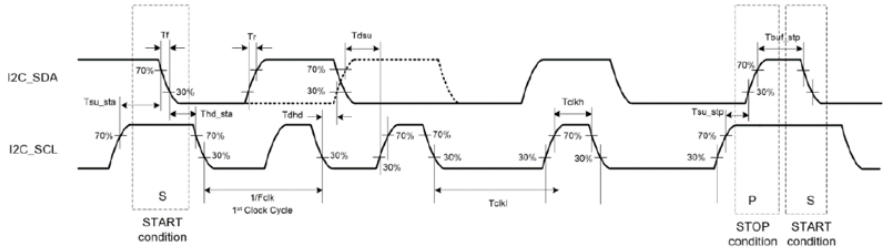


- Bus Turnaround from display module to MPU



8.2.3 I2C Interface Timing

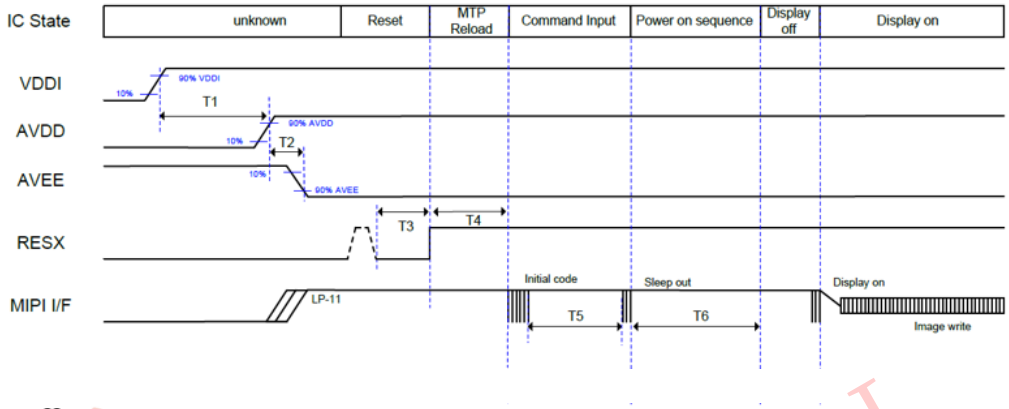
Parameter	Symbol	Min.	Typ.	Max.	Unit
I2C Clock Frequency	Fclk	-	-	400	kHz
I2C Clock Low	Tclk	1300	-	-	ns
I2C Clock High	Tclkh	600	-	-	ns
I2C Data Rising Time	Tdr	-	-	300	ns
I2C Data Falling Time	Tdr	-	-	300	ns
I2C Data Setup Time	Tdsu	100	-	-	ns
I2C Data Hold Time	Tdhd	-	-	TBD	ns
I2C Setup Time (Start Condition)	Tsu_sta	600	-	-	ns
I2C Hold Time (Start Condition)	Thd_sta	600	-	-	ns
I2C Setup Time (Stop Condition)	Tsu_stp	600	-	-	ns
I2C Bus Free Time (Stop Condition)	Tbutf_stp	1300	-	-	ns



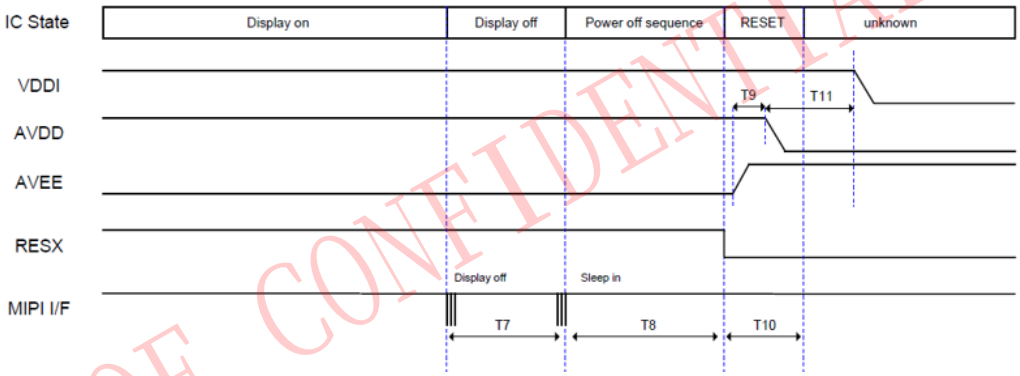
9. Power Supply Sequence

9.1 Power On/Off Sequence

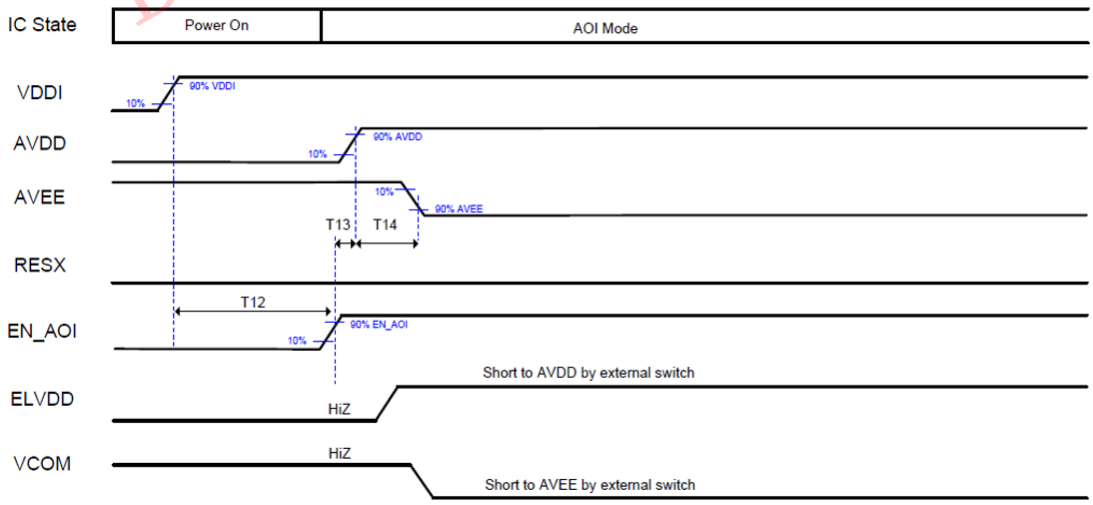
power on sequence



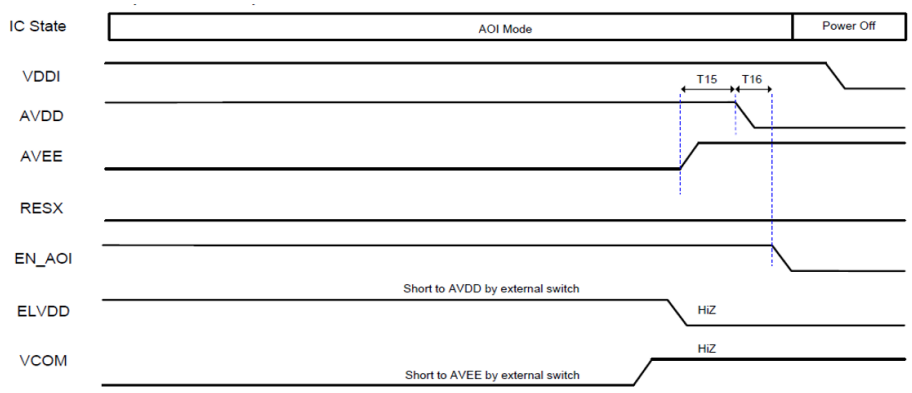
power off sequence



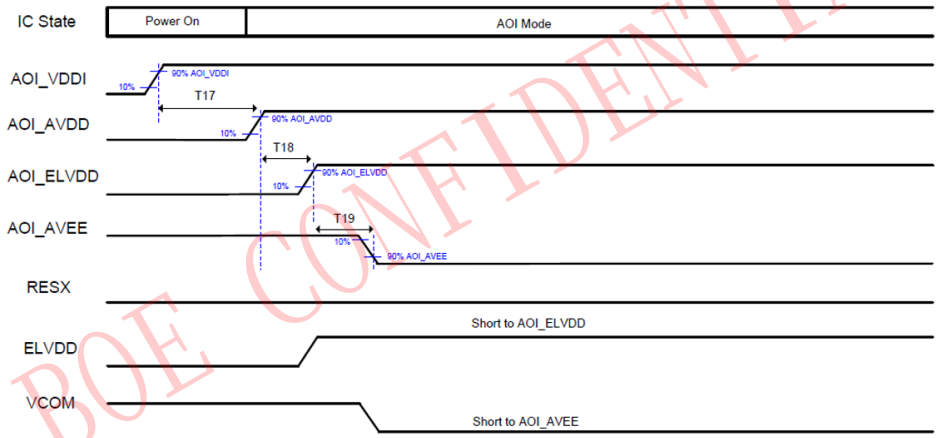
AOI mode1 power on sequence



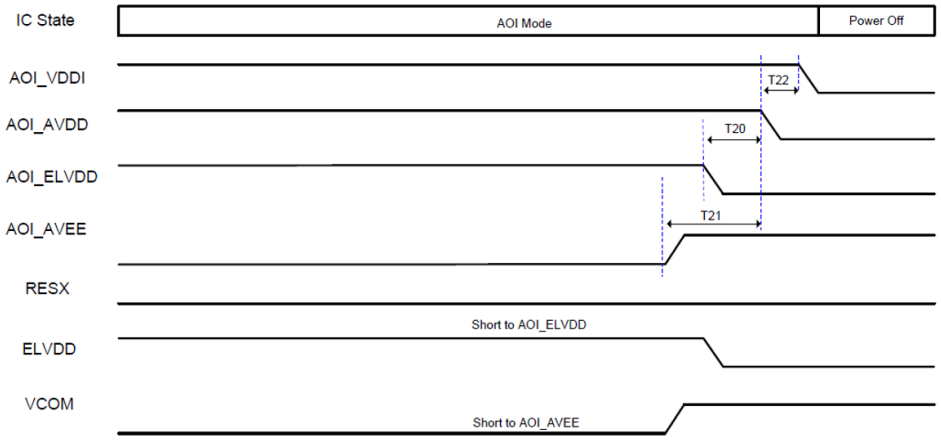
AOI mode1 power off sequence



AOI mode2 power on sequence



AOI mode2 power off sequence



9.2 Power Supply Sequence

Symbol	Min.	Typ.	Max.	Unit	Description
T1	1	-	-	ms	Power on time between AVDD and VDDI
T2	1	-	-	ms	Power on time between AVDD and AVEE
T3	1	-	-	ms	Effective hardware reset period
T4	20	-	-	ms	MTP reload time
T5	0	-	-	ms	The time is between initial code finished and sleep-out command
T6	2	-	8	VS	Power on sequence, the period can be modified
T7	1	-	-	VS	Blanking region
T8	-	1	-	VS	Power off sequence, the period can be modified
T9	1	-	-	ms	Power off time between AVEE and AVDD
T10	1	-	-	ms	Effective hardware reset period
T11	1	-	-	ms	Power off time between AVEE and VDDI
T12	5	-	-	ms	Power on time between VDDI and EN_AOI in AOI mode1
T13	1	-	-	ms	Power on time between EN_AOI and AVDD in AOI mode1
T14	1	-	-	ms	Power on time between AVDD and AVEE in AOI mode1
T15	1	-	-	ms	Power off time between AVEE and AVDD in AOI mode1
T16	1	-	-	ms	Power off time between AVDD and EN_AOI in AOI mode1
T17	5	-	-	ms	Power on time between AOI_VDDI and AOI_AVDD in AOI mode2
T18	1	-	-	ms	Power on time between AOI_AVDD and AOI_ELVDD in AOI mode2
T19	1	-	-	ms	Power on time between AOI_ELVDD and AOI_AVEE in AOI mode2
T20	1	-	-	ms	Power off time between AOI_ELVDD and AOI_AVDD in AOI mode2
T21	1	-	-	ms	Power off time between AOI_AVEE and AOI_ELVDD in AOI mode2
T22	1	-	-	ms	Power off time between AOI_AVDD and AOI_VDDI in AOI mode2

10. Description of Function

10.1 Display Mode

10.1.1 Power Mode

ITEM	Code value
Sleep In	0x10
Sleep Out	0x11
Display On	0x29
Display Off	0x28

10.1.2 Idle Mode

ITEM	Code value
Idle On	0x39(Default value)
Idle Off	0x38

10.1.3 BIST Mode

Register setting:

◆ BIST On/Off Control (C4h CMD2 Page1)

Instruction	R/W	Address name		Parameter								
		MIPI	Other	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0
BISTONOFF	R/W	C4h	C400h	-	1	0	1	0	0	1	0	1
			C401h	-	0	1	0	1	0	1	0	1
			C402h	-	-	-	-	-	-	-	-	BION1
			C403h	-	BION2	-	-	-	-	-	-	-
Description	This command is used to control BIST function (Free Run mode). BIST function enable step: 1. Enter Sleep-In(10h) mode and stop MIPI video data. 2. Setting PATENICYC[1:0] and BISTPATEN[11:0] to control the display cycle time and pattern. 3. Setting BION1="1" and BION2="1", the driver IC will start to run the BIST function. BIST function disable step: 1. Setting BION1="0" and BION2="0",the driver IC will return to normal function. 2. Sending MIPI video data and enter Sleep-Out(11h) mode for normal display.											
Restriction	-											
Default	Status	Default Value										
	Power On Sequence	C400h	AAh									
		C401h	55h									
		C402h	00h									
		C403h	00h									

◆ BIST CTRL (C5h CMD2 Page1)

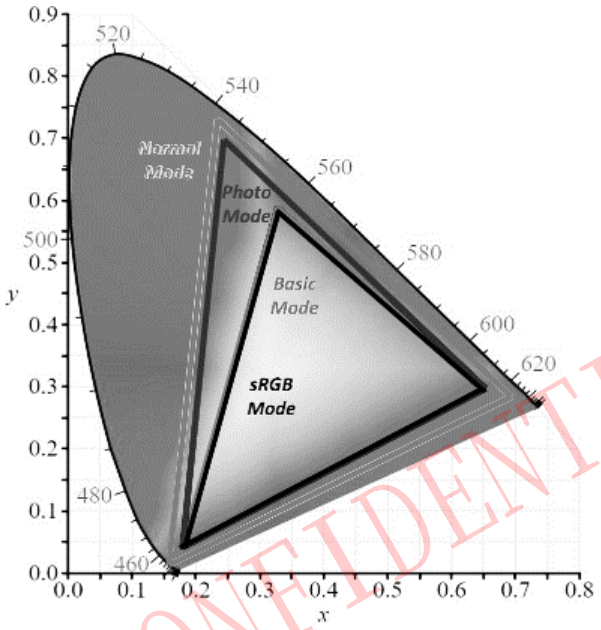
<table>
<tr><th rowspan="2">Instruction</th><th rowspan="2">R/W</th><th colspan="2">Address name</th><th colspan="9">Parameter</th></tr>
<tr><th>MIPI</th><th>I2C</th><th>D15-D8</th><th>D7</th><th>D6</th><th>D5</th><th>D4</th><th>D3</th><th>D2</th><th>D1</th><th>D0</th></tr>
<tr><td rowspan="3">BISTSET</td><td rowspan="3">R/W</td><td rowspan="3">C5h</td><td>C500h</td><td>-</td><td>0</td><td>0</td><td colspan="2">PATENICYC[1:0]</td><td colspan="4">BISTPATEN[11:8]</td></tr>
<tr><td>C501h</td><td>-</td><td colspan="8">BISTPATEN[7:0]</td></tr>
<tr><td>C502h</td><td>-</td><td colspan="8">GRAY_LEVEL[7:0]</td></tr>
<tr><td>Description</td><td colspan="11">This command is used to set the display pattern in BIST function.
PATENICYC[1:0] : Cycle time between each display pattern.
<table>
<tr><th>PATENICYC[1:0]</th><th>Pattern cycle time</th></tr>
<tr><td>0h</td><td>256 Frame</td></tr>
<tr><td>1h</td><td>512 Frame</td></tr>
<tr><td>2h</td><td>1024 Frame</td></tr>
<tr><td>3h</td><td>2048 Frame</td></tr>
</table>
BISTPATEN[11:0] : Select the display pattern in BIST function.
<table>
<tr><th>BISTPATEN[9:0]</th><th>Description</th></tr>
<tr><td>BISTPATEN[0]</td><td>Red pattern.</td></tr>
<tr><td>BISTPATEN[1]</td><td>Green pattern.</td></tr>
<tr><td>BISTPATEN[2]</td><td>Blue pattern.</td></tr>
<tr><td>BISTPATEN[3]</td><td>Black pattern.</td></tr>
<tr><td>BISTPATEN[4]</td><td>Gray Level pattern. (Set by BIST_GRAY_LEVEL[7:0])</td></tr>
<tr><td>BISTPATEN[5]</td><td>Vertical Gradation pattern.</td></tr>
<tr><td>BISTPATEN[6]</td><td>Horizontal Gradation pattern.</td></tr>
<tr><td>BISTPATEN[7]</td><td>Color Bar pattern.</td></tr>
<tr><td>BISTPATEN[8]</td><td>Crosstalk with boundary pattern.</td></tr>
<tr><td>BISTPATEN[9]</td><td>Source CP Pattern</td></tr>
<tr><td>BISTPATEN[10]</td><td>Gamma CP Pattern</td></tr>
<tr><td>BISTPATEN[11]</td><td>Reserved</td></tr>
</table>
Note1: the patterns which the bit number of BISTPATEN[9:0] is set to “1” will display and change automatically.
Note2: When BISTPATEN[11:0]=12’h000, display pattern will be black pattern.

GRAY_LEVEL[7:0] : Set the gray level when BISTPATEN[4]=”1” in BIST function.
<table>
<tr><th>GRAY_LEVEL[7:0]</th><th>Description</th></tr>
<tr><td>0h</td><td>Gray Level : 00h</td></tr>
<tr><td>1h</td><td>Gray Level : 01h</td></tr>
<tr><td>2h</td><td>Gray Level : 02h</td></tr>
<tr><td>:</td><td>:</td></tr>
<tr><td>FDh</td><td>Gray Level : FDh</td></tr>
<tr><td>FEh</td><td>Gray Level : FEh</td></tr>
<tr><td>FFh</td><td>Gray Level : FFh</td></tr>
</table></td></tr>
<tr><td>Restriction</td><td colspan="11">-</td></tr>
<tr><td>Default</td><td colspan="11">
<table>
<tr><th>Status</th><th colspan="2">Default Value</th></tr>
<tr><td rowspan="3">Power On Sequence</td><td>C500h</td><td>01h</td></tr>
<tr><td>C501h</td><td>FFh</td></tr>
<tr><td>C502h</td><td>FFh</td></tr>
</table></td></tr>
</table>

10.2 Image Enhancement

10.2.1 Gamut Mapping—Selectable Color Mode with Different Gamut

◆ 0.39" Micro OLED support Normal Mode/Photo Mode/ Basic Mode(sRGB Mode).



◆ Register Setting

Gamut mapping (57 CMD1).

5700H	GAMUT										
Instruction	R/W	Address name		Parameter							
		MIPI	I2C	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0
GAMUT	R/W	57h	5700h	-	-	-	-	-	-	-	GAMUT_SEL [1:0]	
Description	This command sets the control of gamut mapping.											

Bit	Symbol	Description	Comment
2bit	GAMUT_SEL[1:0]	Gamut mapping control	0h= Gamut mapping 0 —Normal Mode 1h= Gamut mapping 1—Photo Mode 2h= Gamut mapping 2—Basic Mode

Restriction	-

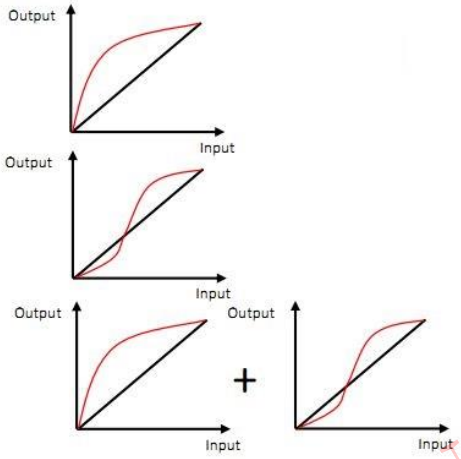
Default	Status	Default Value	
	Power On Sequence	5700h	00h

10.2.2 Contrast/Edge Enhancement

Contrast Enhancement：

◆ Adaptive curve for indoor and outdoor environment

In order to increase the readable, we need trade-off between brightness and contrast ratio.



Adaptive curve of contrast

◆ 2D Edge enhancement

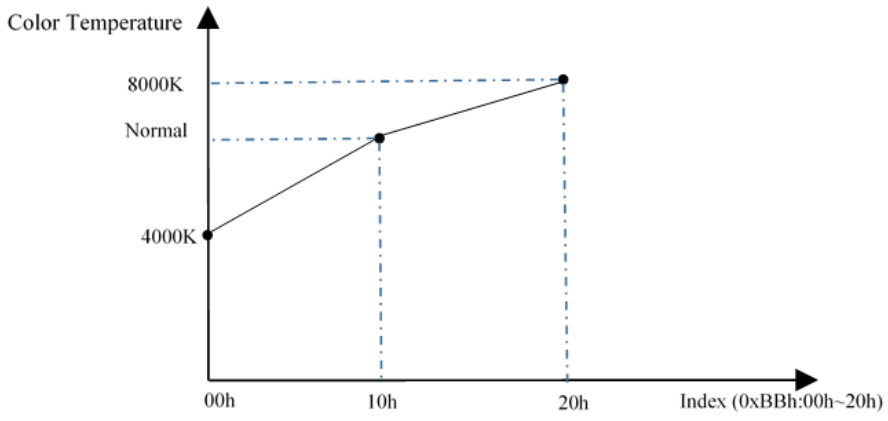
The 0.39”Micro OLED support a better display effect by the “2D Edge enhancement”, such as increasing the image sharpness, Jagger, Overshooting and Noise Depression.

10.2.3 High Brightness or High Contrast Mode

High Brightness for AR Application, High Contrast for VR Application. This function adjusts the display mode according to the register “53h”.

10.3 Color Temperature Function (Auto White Balance Control)

This function adjusts the R/G/B gamma parameter according to the register BBh setting to adjust the White balance and change the color temperature at the same time.

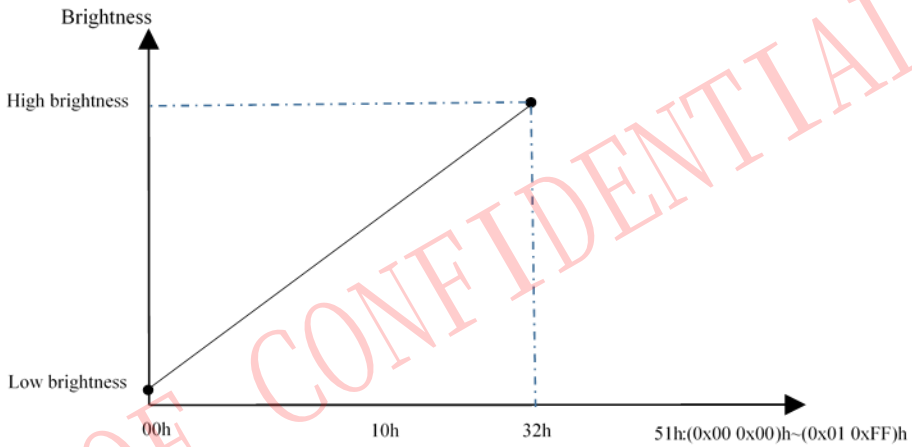


◆ Register setting

ITEM	Address name	Code value	Default value
Color Temperature	0xBBh CMD Page1	00h~20h	10h

10.4 Brightness Control(BC) Functions

This function adjusts the gamma parameter according to the register 51h and 53h setting to adjust the luminance.



◆ Register setting

White Display Brightness(51h CMD1).

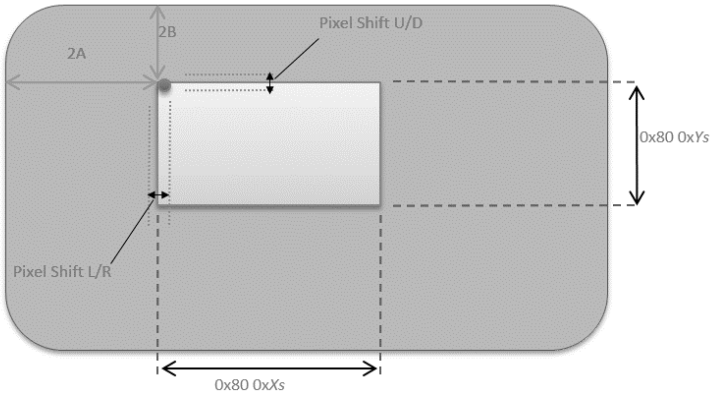
5100H	WRDISBV										
Instruction	R/W	Address		Parameter							
		MIPI	Other	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0
WRDISBV	W	51h	5100h	-	DBV[7:0]							
			5101h	-	-	-	-	-	-	-	-	DBV [8]
Description	This command is used to adjust brightness.											
Restriction	-											
Default	Status	Default Value										
	Power On Sequence	5100h	00h									
		5101h	00h									

White CTRL Display (53h CMD1)

<table>
<tr><td>5300H</td><td colspan="12">WRCTRLD</td></tr>
<tr><td rowspan="2">Instruction</td><td rowspan="2">R/W</td><td colspan="2">Address</td><td colspan="10">Parameter</td></tr>
<tr><td>MIPI</td><td>I2C</td><td>D15-D8</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr>
<tr><td>WRCTRLD</td><td>W</td><td>53h</td><td>5300h</td><td>-</td><td>-</td><td>-</td><td>BCTRL</td><td>-</td><td>DD_BC</td><td>-</td><td>-</td><td>HBHC_SEL</td></tr>
<tr><td>Description</td><td colspan="12">This command is used to set brightness control and display diming control.
<table>
<tr><th>Bit</th><th>Symbol</th><th>Description</th><th>Comment</th></tr>
<tr><td>D5</td><td>BCTRL</td><td>Brightness control</td><td>1= Brightness control enable
0= Brightness control disable</td></tr>
<tr><td>D3</td><td>DD_BC</td><td>Display dimming control</td><td>1= Display dimming control enable
0= Display dimming control disable</td></tr>
<tr><td>D0</td><td>HBHC_SEL</td><td>Display mode control</td><td>0=High Brightness Low Contrast
1=Low Brightness High Contrast</td></tr>
</table></td></tr>
<tr><td>Restriction</td><td colspan="12"></td></tr>
<tr><td>Default</td><td colspan="12">
<table>
<tr><th>Status</th><th colspan="2">Default Value</th></tr>
<tr><td>Power On Sequence</td><td>5300h</td><td>00h</td></tr>
</table></td></tr>
</table>

10.5 Display Active-Area(AA) Control

ITEM	Description	Code 值
Resolution	X-direction: Support 8N, N=40~240 Y-direction: support 8M, M=30~135	CMD1：0x80(NC[7:0] NL[7:0])
Active-Area(AA) control	Display start pointer	Xs：CMD1：0x2A Ys：CMD1：0x2B
	Pixel shift：±12pixel/step=4pixel	CMD2 Page0：0xB4



10.6 Auto Temperature Compensation Function

Brightness and white point of OLED depends on display panel temperature as show in below. This module integrates Brightness and white point compensation function against panel temperature variation. This function allows to sustain relatively constant luminance and white point even if panel temperature changing as shown in below.

◆ Register Settings

2300H	ALLPON											
Instruction	R/W	Address name		Parameter								
		MIPI	Other	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0
ALLPON	R/W	25h	2500h	-	-	-	-	-	-	-	-	TC_ENABLE
Description	This command is used to turn on temperature sensor.											
Restriction	-											
Default	Status			Default Value								
	Power On Sequence			2500h								00h

11. Optical Characteristics

11.1 Optical Characteristics

Item			0.39 Micro OLED SPEC
White Brightness	Center		1500 cd/m²
White Uniformity 9 point	White (255)		>90%
	White (128)		>90%
	White (64)		>90%
View Angle (White)	Lum. Decay (50%)		-55°~55°
	Color Shift (Δu'v'<0.025)		-45°~45°
Contrast	CR		>10000:1
Color Coordinate	Red	CIE-x	0.64±0.03
		CIE-y	0.33±0.03
	Green	CIE-x	0.26±0.03
		CIE-y	0.67±0.03
	Blue	CIE-x	0.15±0.03
		CIE-y	0.07±0.03
	White	CIE-x	0.31±0.03
		CIE-y	0.31±0.03
Color Gamut (NTSC)			>80%
Color Temperature			>6000K

11.2 Measurement System・Measurement Method

The luminance and chromaticity are measured in Measurement System A shown below.

Measurement temperature: Tpnl = 30°C

Measurement point: One point on the screen center

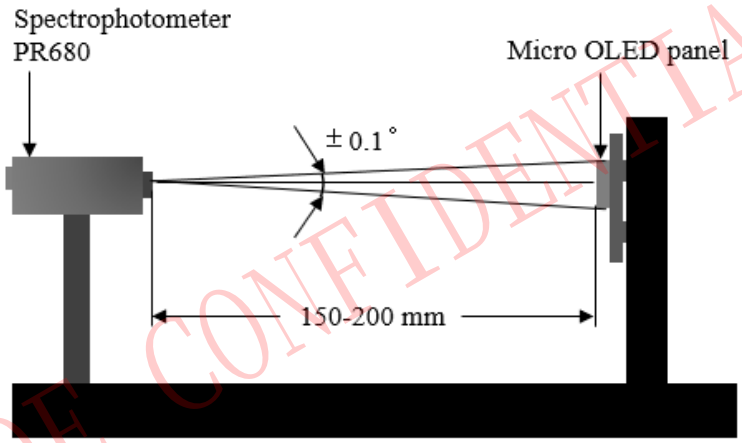
All white display: All RGB signal data is set to High.

All black display: All RGB signal data is set to Low.

Luminance and chromaticity: Measure the luminance and chromaticity in all white display in Measurement System A.

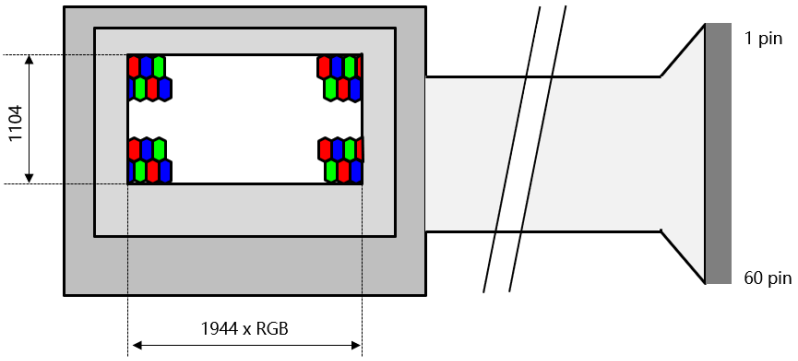
Contrast: Measure the luminance in all white display (@ : 500cd/m^2) and all black display in Measurement System A, and substitute them into the formula below.

Contrast = Luminance in all white display/Luminance in all black display



Measurement System

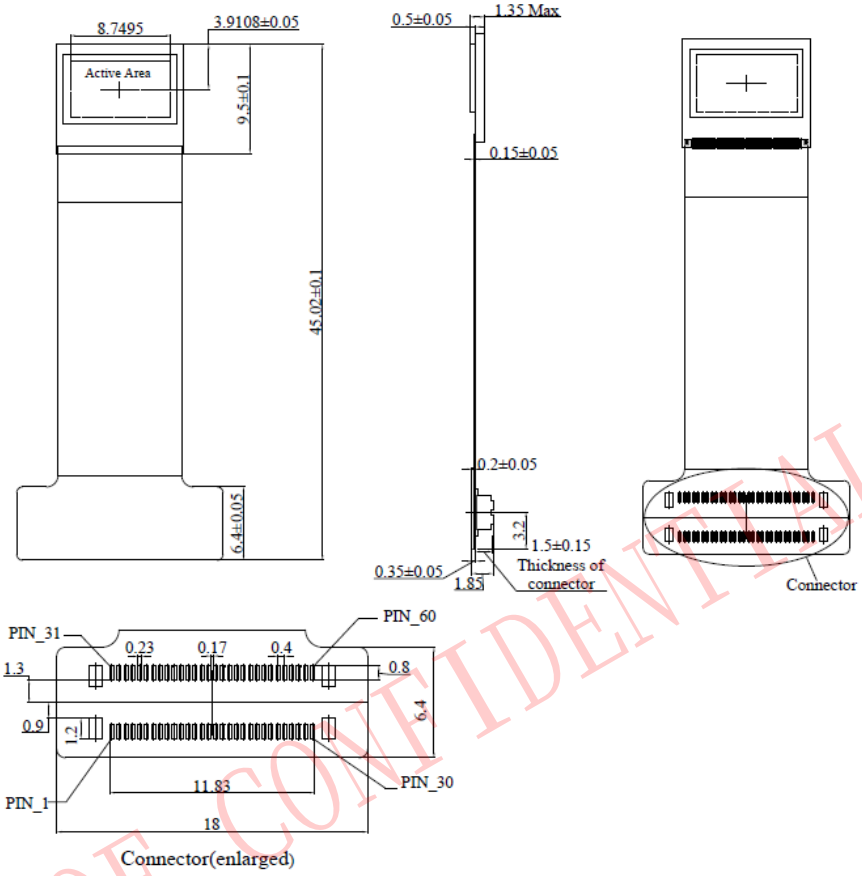
12. Pixel Alignment



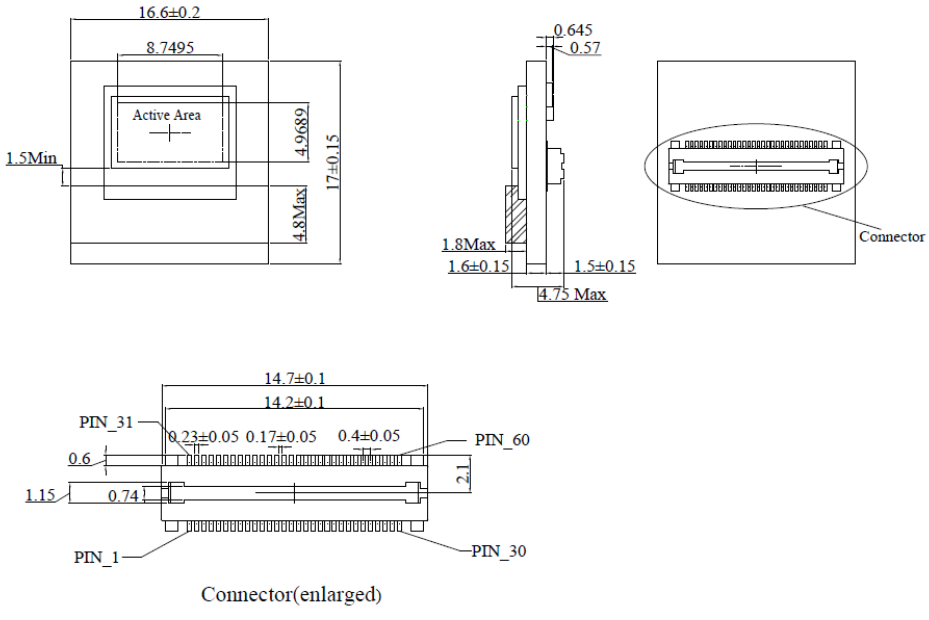
※Including orbit margin

13. Package Outline

13.1 FPC Module(Unit：mm)



13.2 PCB Module(Unit：mm)



14. Notes on Handling

14.1 Static charge prevention

Be sure to take the following protective measures. Organic EL panels are easily damaged by static charges.

(1) Use non-chargeable gloves or handle with bare hands.

(2) Use a wrist strap connecting ground when handling.

(3) Do not touch any electrodes on the panel.

(4) Wear non-chargeable clothes and conductive shoes.

(5) Install grounded conductive mats on the working floor and working table.

(6) Keep the panel away from any charged materials.

14.2 Protection from dust and dirt

(7) Operate in a clean environment.

(8) Do not touch the panel surface. The surface is easily scratched.
When cleaning on panel surface, use a clean-room wiper with isopropyl alcohol. Be careful not to leave stains on the surface.

(9) Use ionized air to blow dust off the panel surface.

14.3 Others

(10) Not hold FPC (Flexible Printed Circuit) , not twist the FPC, not bend FPC because connection area between the FPC and panel is easily broken by mechanical stress.

(11) The minimum fold radius of the FPC is 1.0 mm, So, do not fold the FPC less than 1.0mm radius.

(12) Do not drop the module.

(13) Do not twist or bend the module .

(14) Keep the module away from heat sources.

(15) Not be close the module to water or other solvents.

(16) Do not store or use the module at high temperatures or high humidity circumstance, as the circumstance may affect module specifications.

(17) When disposing of this, regard it as industrial waste and please comply with related regulations.

(18) Do not store or use the panel in reactive chemical substance (including alcohol) environments, as these may affect the specifications.