

SPECIFICATION FOR AMOLED+HDMI Module

MODULE No:	ID-156UHOEN018-SP001A-HDMI
CUSTOMER:	

I-DISPLAY	INITIAL	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

CUSTOMER	INITIAL	DATE
APPROVED BY		

Revision History

[illegible]

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* **Description**

This is a color active matrix AMOLED module using Low Temperature Poly-silicon Thin Film Transistors as active switching devices, plus an HDMI board. This module has a 15.6 inch diagonally measured active area with 3840 horizontal by 2160 vertical pixel arrays. Each pixel is divided into RED and GREEN dots, or BLUE and GREEN dots, and two pixels share RED or BLUE dots which are arranged in vertical stripe and this module can display RGB 10bit/8bit+2FRC/8bit colors.

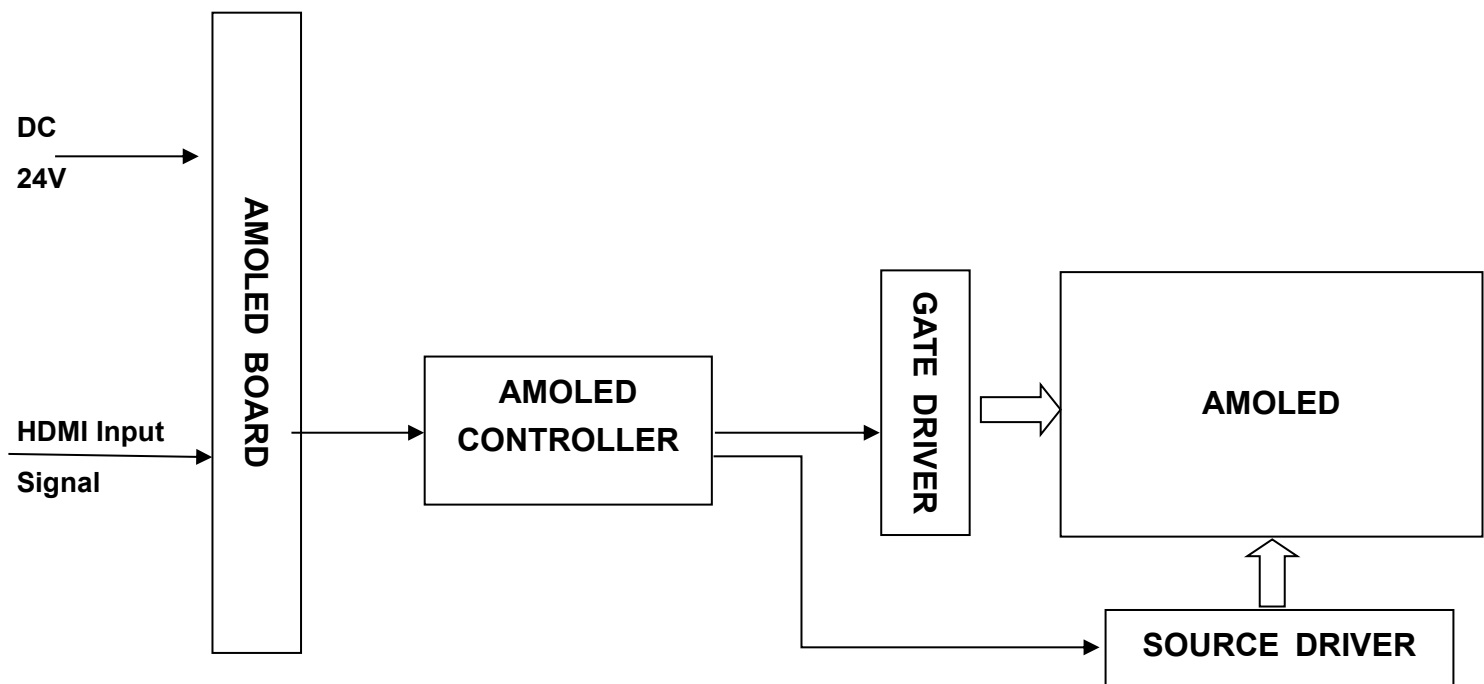
* **Features**

General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	344.2176(H)*193.6224 (V) (15.6 inch)	mm	
Driver element	LTPS TFT active matrix	-	
Display colors	RGB 10bit/8bit+2FRC/8bit	colors	
Number of pixels	3840(RGB)*2160	dots	
Pixel arrangement	RGB vertical stripe	-	
Pixel pitch	0.08964(H)*0.08964(V)	mm	
Viewing angle	ALL	o'clock	
Interface	HDMI(Type A)	-	
Operating temperature	-20~+70	℃	
Storage temperature	-30~+80	℃	

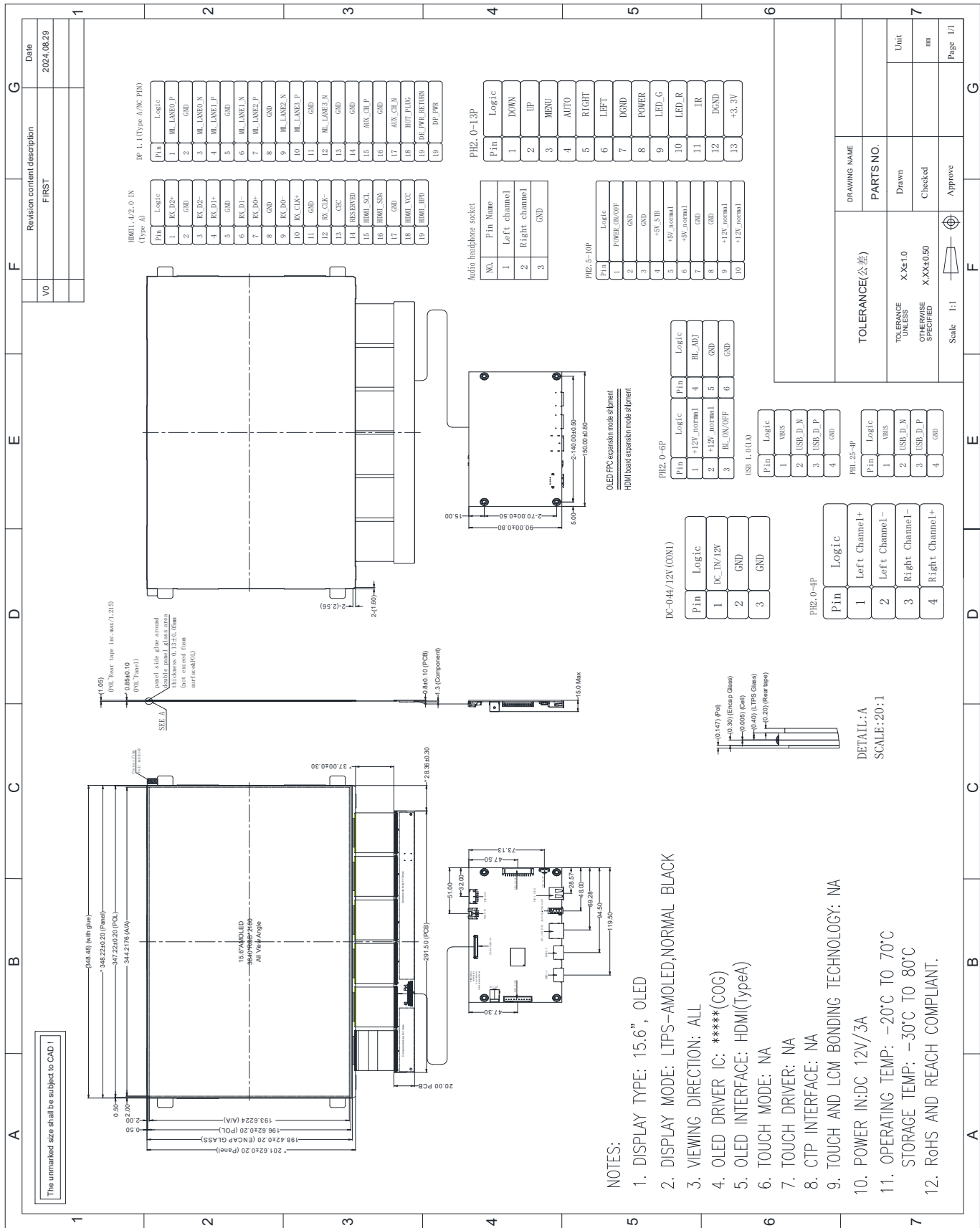
* **Mechanical Information**

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)	--	348.48	--	mm	-
	Vertical(V)	--	201.62	--	mm	-
	Depth(D)	--	1.05	--	mm	PCB
Weight			TBD		g	-

1. Block Diagram



2. Outline dimension



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3. Input terminal Pin Assignment

3.1 Power Input

CON1(DC-044 Socket)

NO.	SYMBOL	DISCRIPTION	I/O
1	DC_IN	Power supply (DC 24V).	P
2	GND	Ground	P
3	GND	Ground	P

3.2 HDMI Input

The type of HDMI connector is a type A.

NO.	SYMBOL	DISCRIPTION	I/O
1	RX_D2+	HDMI Receiver channel 2 positive analog input.	I/O
2	GND	Ground.	P
3	RX_D2-	HDMI Receiver channel 2 negative analog input.	I/O
4	RX_D1+	HDMI Receiver channel 1 positive analog input.	I/O
5	GND	Ground.	P
6	RX_D1-	HDMI Receiver channel 1 negative analog inpsut.	I/O
7	RX_D0+	HDMI Receiver channel 0 positive analog input.	I/O
8	GND	Ground.	P
9	RX_D0-	HDMI Receiver channel 0 negative analog input.	I/O
10	RX_CLK+	HDMI Receiver clock positive analog input.	I
11	GND	Ground.	P
12	RX_CLK-	HDMI Receiver clock negative analog input.	I
13	CEC/DET_HDMI	No connection.	--
14	NC	No connection.	--
15	HDMI_SCL	HDMI Receiver DDC data channel.	I
16	HDMI_SDA	HDMI Receiver DDC clock channel.	I/O
17	GND	Ground.	P
18	HDMI_5V	HDMI Supply voltage (5.0V).	P
19	HPD	HDMI Receiver hot plug detect output	O

4. AMOLED Optical Characteristics

4.1 Optical specification

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Brightness			Normal (White mode)	352	400	448	cd/m ²	(1)
Peak Luminance(10% Box)			VESA HDR		520	-	cd/m ²	500TB
Brightness Uniformity			Full white		-	1.4		(2)
Contrast Ratio			Normal Θ=Φ=0°	-	100,000	-	-	(3)
Color of CIE Coordinate	White	x	Normal Θ=Φ=0°	0.293	0.313	0.333	-	
		y		0.309	0.329	0.349	-	
	Red	x		0.663	0.683	0.703	-	
		y		0.297	0.317	0.337	-	
	Green	x		0.195	0.235	0.275	-	
		y		0.694	0.734	0.774	-	
	Blue	x		0.117	0.137	0.157	-	
		y		0.024	0.044	0.064	-	
Color Gamut			DCI-P3	98	-100	--	%	(4)
			Adobe	95			%	
			sRGB	100	-	-	%	
White Temperature°K			Normal Θ=Φ=0°	6000	6500	7000	K	
Gamma			Normal Θ=Φ=0°	2.0	2.2	2.4	-	(5)
Response time			On/Off	-	1	2	ms	(6)
Viewing Angle			Top/Bottom/Right/ Left CR>10	85		-	°	(7)
Color Shift		Δuv	Θ=Φ=45°	-	-	0.025	-	(8)
Image Sticking		ΔL	Macbeth pattern, Max Lum, 3000h, Ambient : ~25℃, Panel : ~45℃	-	-	3.5	%	
Flicker			Normal Θ=Φ=0°	-	-	-35	dB	
Crosstalk			Normal Θ=Φ=0°	-	-	1.5	%	(9)
TUV blue ray certification			415-455nm/400-500nm			50	%	(10)
OLED Life Time			T50 @ 25℃	15,000	-	-	Hrs	(11)

Note 1: Brightness follows MicroSoft brightness3 (Based on OPR 50%).

The Brightness of full white pattern (OPR 100%) is the same as that of OPR 50%.



Note 2: Brightness uniformity

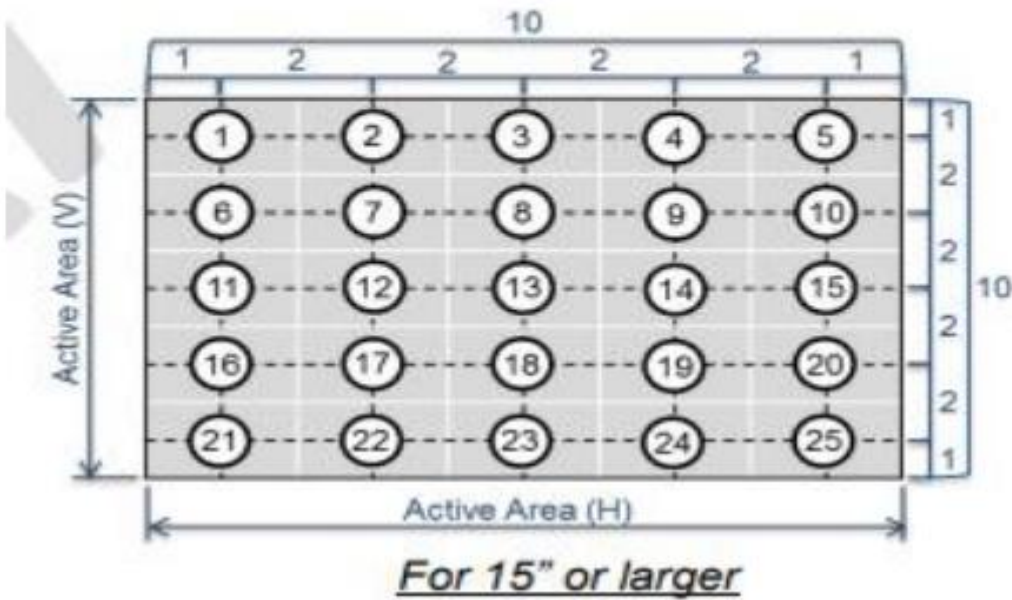
For brightness uniformity measure, EDO's request as below:

- 1. The test condition is at 25°C and measured on the surface of Display panel module.
- 2. Measurement equipment: CA310 or similar equipment.
- 3. The brightness uniformity is calculated by using following formula:

$$\text{Brightness Uniformity} = \text{Bp (Max.)} / \text{Bp (Min.)}$$

Bp (Max.) = Maximum brightness in 25 measured spots

Bp (Min.) = Minimum brightness in 25 measured spots.



Note 3: Contrast Ratio

Dark Room C.R=LW/LB
LW: full white brightness of display center P0;
LB: full black brightness of display center P0.

Note 4: Color Gamut

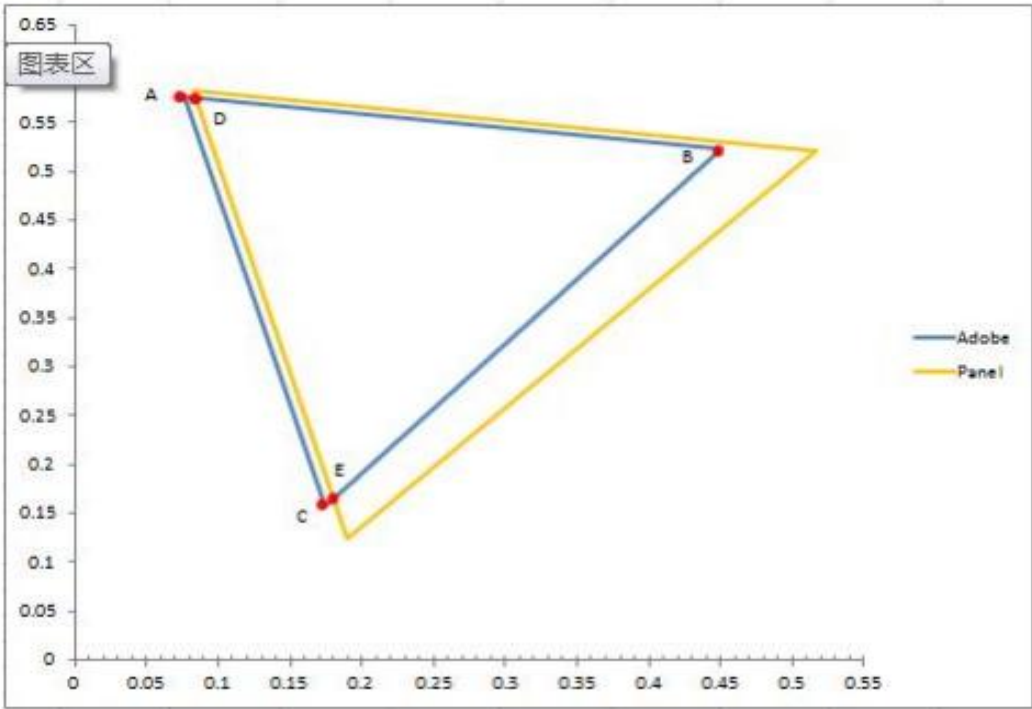
For brightness uniformity measure, EDO's request as below:

- 1. Measurement equipment: CS2000A or similar equipment.
- 2. DCI-P3 & Adobe color data:

CIE1976	R	G	B
DCI-P3	(0.496,0.526)	(0.099,0.578)	(0.175,0.158)
Adobe	(0.451,0.523)	(0.076,0.576)	(0.175,0.158)
sRGB	(0.451,0.523)	(0.125,0.563)	(0.175,0.158)

- 3. The color gamut is calculated by using following formula:

Color Gamut % = $S_{coverage} / S_{original\ color\ gamut}$
 $S_{coverage}$: The area covered by panel color gamut
 $S_{original\ color\ gamut}$: The triangle area of Adobe or DCI-P3 color gamut
For example:
Color Gamut % = S_{DEB} / S_{ABC} %



Note 5: Gamma

For gamma curve control, EDO's request as below:

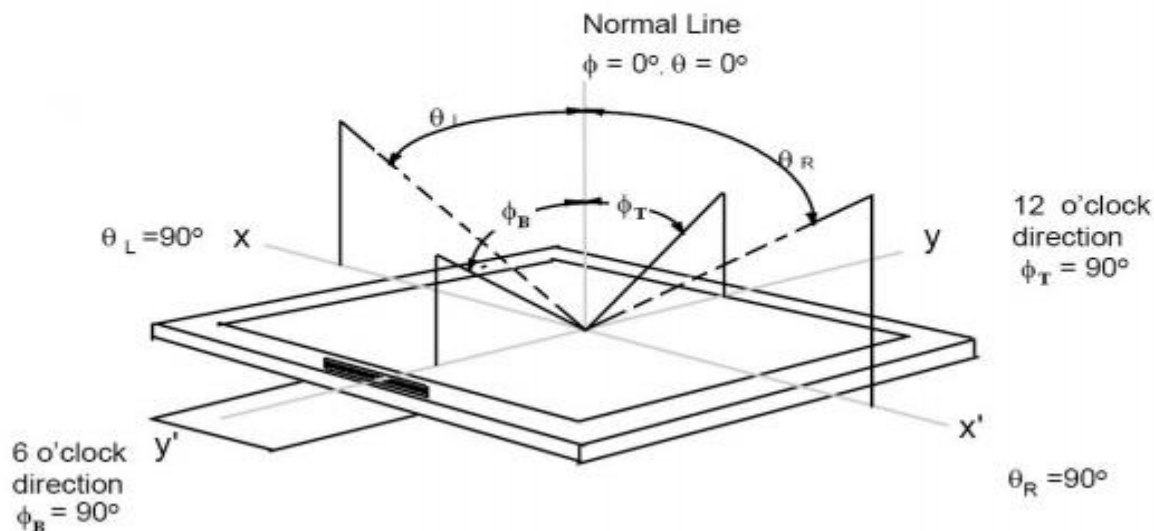
- 1. Calibration the test instrument. Set the screen size parameters, and measure the center point.
- 2. EDO will test the gray scale below, if possible also can use the patterns of gray 0 to 255 to test:
for example:
16, 17, 18, 19, ... , 237, 238, 239,240. Total 225pcs patterns.
- 3. Output the measure data. Data number normalization and draw the chart.
- 4. The whole screen should be complied with the gamma curve of gamma 2.0 or 2.4, it means +/-0.2 error is allowed. But if there are special requirements for the special project, its required specifications can be used as a standard value, please refer the project spec.

Note 6: Response Time

Response time=Pixel turn on and turn off time (White<=>Black).
It is measuring transition time from 10% to 90% of luminance.

Note 7: The definition of Viewing Angle

Refer to the graph below marked by θ and Φ



Note8: Color Shift

For color shift measure:

Fix on white pattern,

On the condition $\theta=0^\circ$ $F=0^\circ$, we can get the color coordinate (u_1', v_1') and on $\theta=45^\circ$ $F=45^\circ$ we can get another color coordinate (u_2', v_2')

$$\Delta = \text{Square Root}((u_2' - u_1')^2 + (v_2' - v_1')^2)$$

JNCD stands for "Just Noticeable Color Difference"

For the (u', v') color space 1 JNCD=0.0040

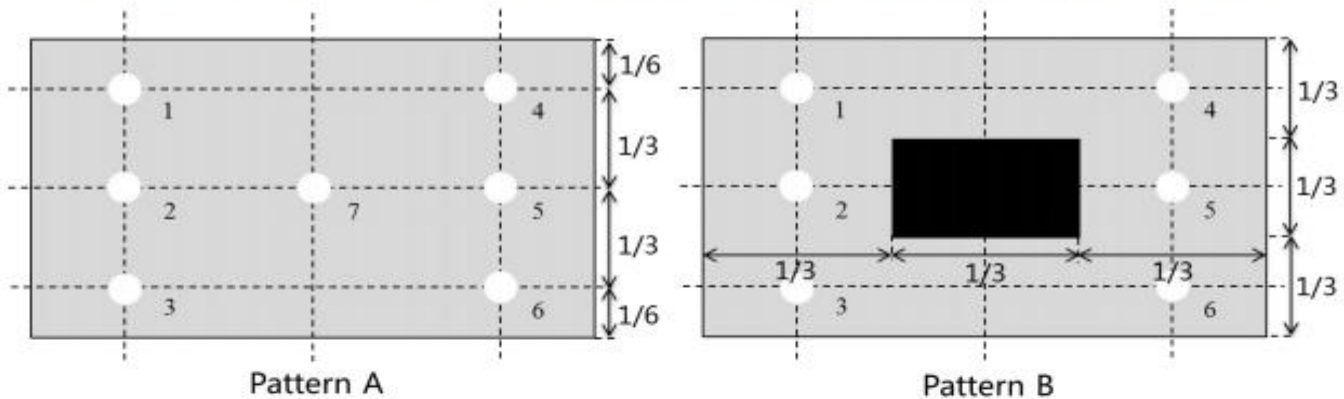
6.25 JNCD means $\Delta u'v' < 0.0250$.

This Requirement is from our customer and we have test some of our phone display and the result is OK.

Note9: Crosstalk

For crosstalk measure, EDO's request as below:

1. Pattern A and B are of 127 gray, the only difference is that black patch in the middle of pattern B.



2. Calibrate the test instrument.
3. Point 7 in pattern A is used as brightness calibration for each panel. Then measure the brightness of points 1 to 6 in pattern A and B.
4. Calculate the value of crosstalk according to the formula:
$$\text{Crosstalk} = \max\{ \{(B_2 - A_2) - [(B_1 - A_1) + (B_3 - A_3)]/2\}/A_2; \{(B_5 - A_5) - [(B_4 - A_4) + (B_6 - A_6)]/2\}/A_5 \}.$$

Note10: TUV blue ray certification

Under full white mode, test the spectra of center point, and then calculate the intensity in the range 415nm - 455nm and 400nm - 500nm. The ratio of intensity from 415nm - 455nm compared to 400nm - 500nm should be less than 50%.

Note11: OLED Life Time

The test procedure is as follows:

At room temperature(25 °C), light the module with typical value brightness(Full white). After that, record the brightness of center point every 24 hours. Then test 600 hours or more to collect the raw data. Finally, use the raw data and the specific formulas to calculate and estimate the T50.

5. AMOLED Electrical Characteristics

5.1 Absolute Maximum Rating (Ta=25 VSS=0V)

Characteristics	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	DC_IN	-0.5	24	V	Note1
Operating temperature	T _{OP}	-20	+70	°C	
Storage temperature	T _{ST}	-30	+80	°C	

NOTE: If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.

5.2 DC Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply Voltage	DC_IN	--	24	30	V	
Normal mode Current consumption	I _{DC_IN}	--	1400	--	mA	DC_IN=24V

6. Reliability Test Result

Item	Condition	Inspection after test
High Temperature Operating	70°C,96H	
Low Temperature Operating	-20°C, 96HR	
High Temperature Storage	80°C, 96HR	
Low Temperature Storage	-30°C, 96HR	
High Temperature & High Humidity Storage	+60°C, 90% RH ,96 hours.	
Thermal Shock (Non-operation)	-20°C,30 min ↔ 70°C,30 min, Change time:5min 20CYC.	
ESD test	C=150pF, R=330,5points/panel Air:±10KV, 5times; Contact:±6KV, 5 times; (Environment: 15°C~35°C, 30%~60%).	
Vibration (Non-operation)	5Hz to 200Hz logarithm sweep for 20 min/cycle 5Hz to 12.2Hz:The amplitude is 10mmp-p 12.2Hz to 100Hz : The acceleration is 3.0G 0-pk 101Hz to 200Hz : The acceleration is1.5G 0-pk 3 axis,18 sweeps per axis	
Box Drop Test	1 Corner 3 Edges 6 faces,80cm(MEDIUM BOX)	

Remark:

1.The test samples should be applied to only one test item.

2.Sample size for each test item is 5~10pcs.

3.For Damp Proof Test, Pure water(Resistance > 10MΩ) should be used.

4.In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.

5.Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

6. The color fading mura of polarizing filter should not care.

7. Cautions and Handling Precautions

7.1 Handling and Operating the Module

- (1) When cleaning ITO pad, avoid using hard and abrasive material or corrosive solution.
- (2) Keep module away from direct sunlight or fluorescent light, and keep it at room temperature and humidity.
- (3) Strong impact & pressure on module and packing is prohibited.
- (4) Following normal power on/off sequence is necessary for preventing abnormal display or permanent damage to display.
- (5) Optimal contrast ratio under ideal voltage is AMOLED module's characteristic, hence it is recommended a voltage control function available.
- (6) Image sticking may occur if an image displays for an extended period of time.
- (7) When interfered by system's overall mechanical design, an abnormal display may occur.
- (8) After considering emitting energy, you should plan your design to satisfy EMI standards.
- (9) Host side should place a surge-prevent circuit at power trace (ie: VCI, Vddi) to protect AMOLED module.

8. Packing

----TBD-----