Product Specification

Model Name:　EF60UBA68.A

Description：15.6” (3840RGB x 2160) AMOLED

Doc. Version：01

Customer：

■Approved for Preliminary Specification

□Approved for Final Specification

□Approved for Final Specification & Sample

Prepared	Checked	Approved

Customer’s Approval

Version History			
Version. No	Date	Contents	Remark
01	2022/6/2	First Version	Ann

Contents

1. Scope

This Specification defines AMOLED manufactured by EverDisplay Optronics (Shanghai) Limited, from here on refer as EDO. In the case of any unspecified item, it may require both EDO and the party designs this module into its product to work out a solution.

2. Features

1.1 Product Applications

monitor

1.2 Product Features

1) Display color：RGB 10bit/8bit+2FRC/8bit
2) Display format：15.6” (3840RGBx2160)
3) Pixel arrangement：Real RGB arrangement
4) Interface：eDP 1.4b
5) T-con: TBD
6) Source IC: RM98110
7) Power IC: TBD

1.3 Model Name:

Code	Definiation	Description
E	Suppler Name	EDO
F60	Display Size	15.60 inch
U	Resolution	3840RGB×2160
B	Technology	LTPS/Real RGB/0.3mm glass
A	Touch technology	NA
6	Delivery type	FOG
8	Customer code	

3. General Information

Item	Specification	Unit	Note
Active area	344.2176 (H) x 193.6224 (V)	mm	
Diagonal size	15.6	inch	
Driver Element	LTPS TFT active matrix		
Display mode	OLED		
Display Colors	RGB 10bit		
Number of pixel	3840*2160(UHD)	Pixel	16:9
Pixel Arrangement	RGB Delta Type		
Pixel pitch	89.64x89.64	μm	
Surface treatment	Glare		

4. Maximum Rating

Item		Symbol	Min.	Max.	Unit	Note
Storage temperature		TSTG	-40	85	℃	-
Operating temperature		TOPR	-20	70	℃	-
Supply Voltage	System	VCC_3.3V	-0.3	+4.6	V	-
	EL Power	VBAT	-0.3	+24	V	-

5. Mechanical Specifications

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	348.02	348.22	348.42	mm	
	Vertical (V)	201.42-	201.62-	201.82	mm	
	Thickness (Panel)	-	1.05	1.215	mm	
Weight				TBD	g	

6. Electrical Specifications

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
System	Analog/ Logic Vol.	VCC_3.3V	-	3.0	3.3	3.6	V	
Panel	Analog Vol.	VBAT	-	8.0	12.0	21.0	V	
Current	Logic	VCC_3.3V	Full white VDD_3.3V =3.3V VBAT=12V	-	420	640	mA	(1)
	Panel	VBAT		-	1100	1370		
Power Consumption	Logic	VCC_3.3V		-	1.4	2.1	W	(1)
	Panel	VBAT		-	13.2	16.4		
Frame Frequency		fps	-	-	60	-	Hz	

Note(1): VCC_3.3V=3.3 (V) VBAT=12.0 (V), Full White pattern, Temperature = 22 ± 3 ℃ Room Temperature

7. Optical Specification

Test condition：25℃±3℃，65±20%RH，Dark room.

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)

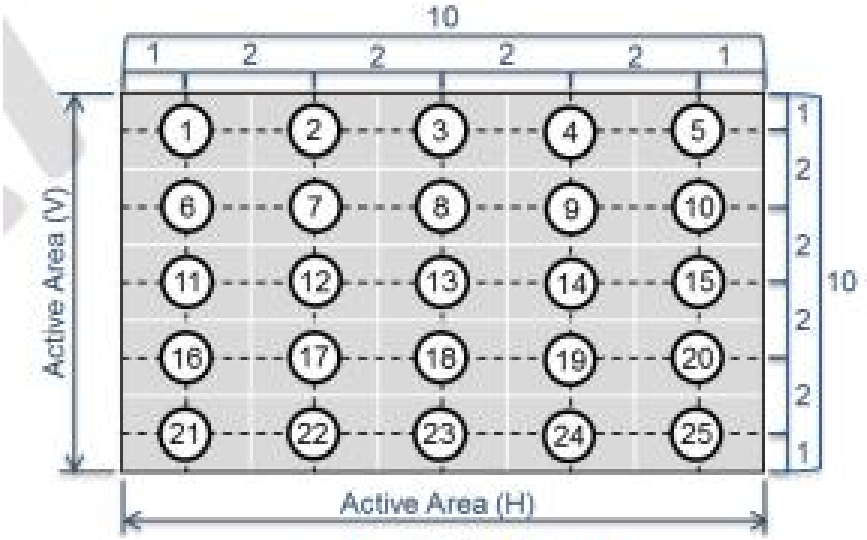
Note 1: Brightness follows MicroSoft brightness3 (Based on OPR 50%).

The Brightness of full white pattern (OPR100%) 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℃ 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:
   Brightness Uniformity = Bp (Max.)/ Bp (Min.)
   Bp (Max.) = Maximum brightness in 25 measured spots
   Bp (Min.) = Minimum brightness in 25 measured spots.



For 15" or larger

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:

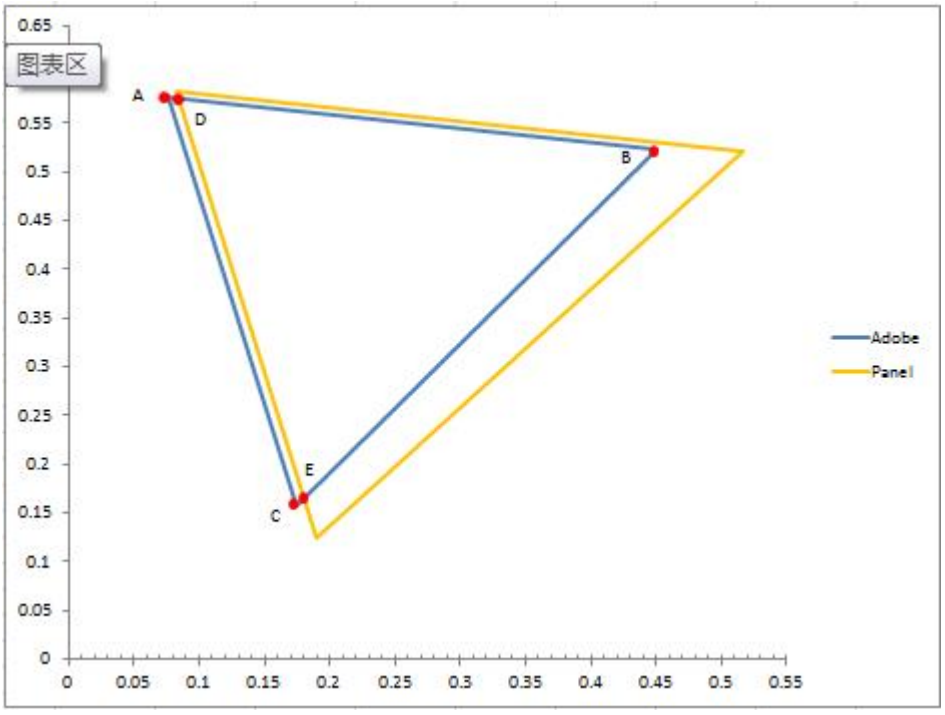
Color Gamut % = $S_{coverage}$ / $S_{original\ color\ gamut}$

$S_{coverage}$: 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.

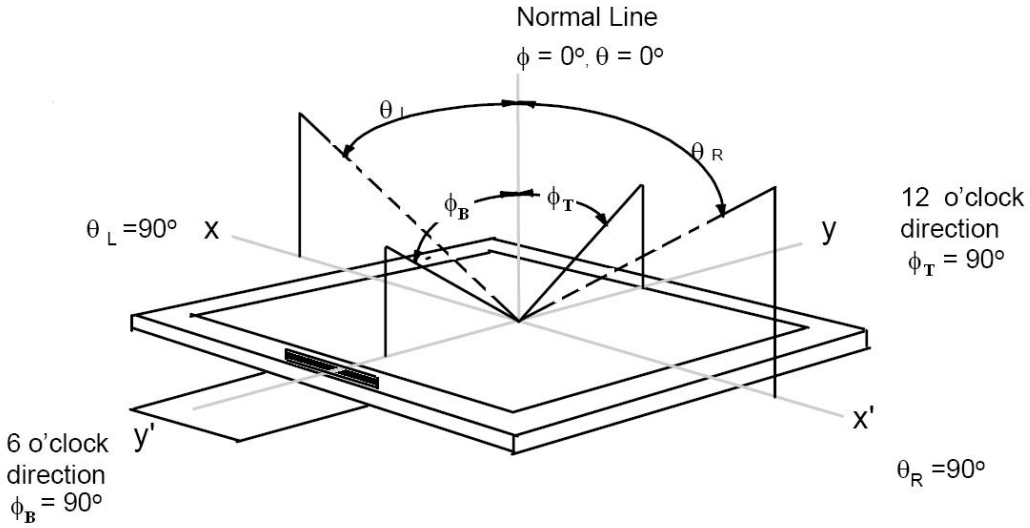
3. Output the measure data. Data number normalization and draw the chart.
4. The whole screen should be complied with the gamma curve of gamma 2.0 or 2.4, it means +/-0.2 error is allowed. But if there are special requirements for the special project, its required specifications can be used as a standard 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 θ=0 F=0°, we can get the color coordinate (u_1', v_1') and on θ=45° F=45° we can get another color coordinate (u_2', v_2')

Delta = 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

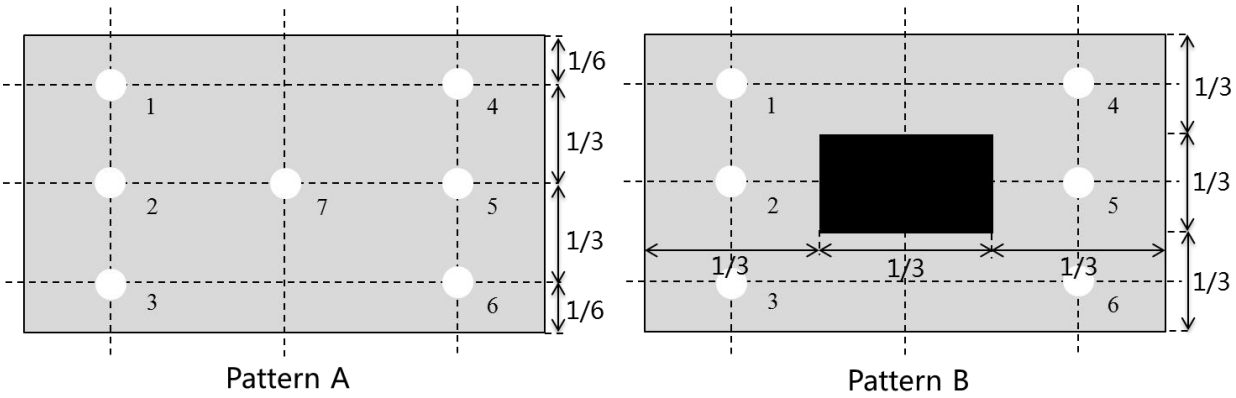
6.25 JNCD means Delta u'v'<0.0250.

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:
   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}/A5 }.

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℃), 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.

8. I/O connection & Block Diagram

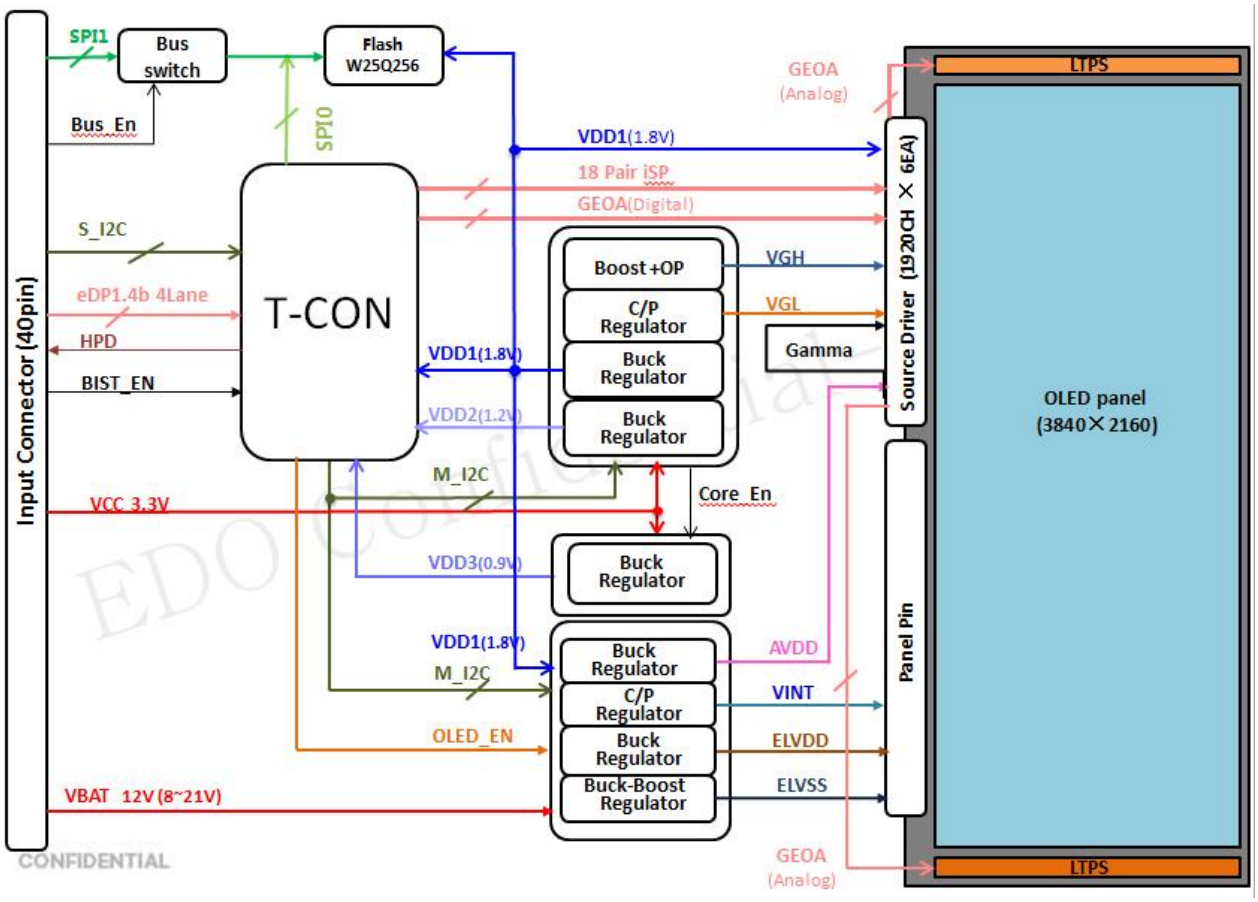
8.1 I/O Connection

Connecter Type :20455-040E-66

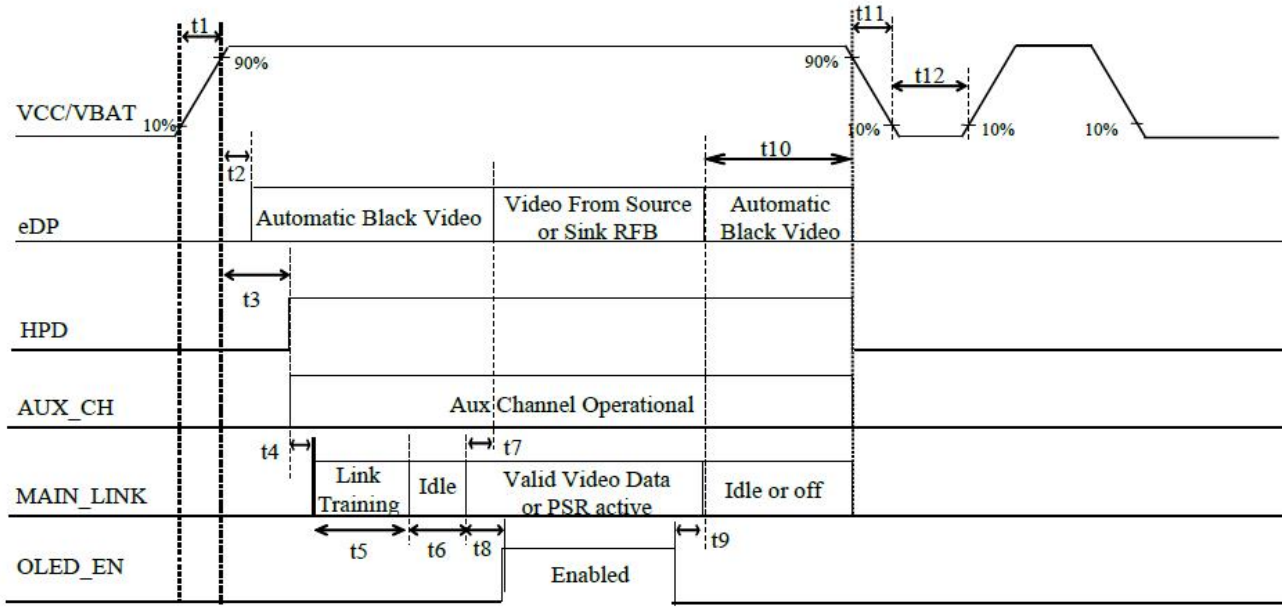
Pin #	Signal Name	Signal Description	Pin #	Signal Name	Signal Description
1	NC(HSync)	Do not used. Test pin for display.	21	BIST_EN	BIST enable signal
2	H_GND	High Speed Ground	22	VCC_3.3V	Logic and driver power
3	Lane3_N	Complement Signal Link Lane3	23	VCC_3.3V	Logic and driver power
4	Lane3_P	True Signal Link Lane3	24	VCC_3.3V	Logic and driver power
5	H_GND	High Speed Ground	25	HPD	HPD signal
6	Lane2_N	Complement Signal Link Lane2	26	EN_GND	Ground for EL PMIC
7	Lane2_P	True Signal Link Lane2	27	EN_GND	Ground for EL PMIC
8	H_GND	High Speed Ground	28	NC	NC
9	Lane1_N	Complement Signal Link Lane1	29	VBAT	Power for EL PMIC
10	Lane1_P	True Signal Link Lane1	30	VBAT	Power for EL PMIC
11	H_GND	High Speed Ground	31	VBAT	Power for EL PMIC
12	Lane0_N	Complement Signal Link Lane0	32	NC(EEP_WP)	Do not used. Test pin for display
13	Lane0_P	True Signal Link Lane0	33	NC(MSCL)	Do not used. Test pin for display
14	H_GND	High Speed Ground	34	NC	Do not used. Test pin for display
15	Aux_CH_P	True signal Aux channel	35	NC	Do not used. Test pin for display
16	Aux_CH_N	Complement signal Aux channel	36	NC	Do not used. Test pin for display
17	H_GND	High Speed Ground	37	NC	Do not used. Test pin for display
18	Logic_GND	Logic and driver ground	38	NC	Do not used. Test pin for display

19	Logic_GND	Logic and driver ground	39	NC	Do not used. Test pin for display
20	Logic_GND	Logic and driver ground	40	NC	Do not used. Test pin for display

8.2 Display Module Block Diagram



9. Recommended Operating Sequence



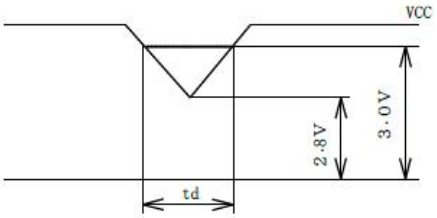
- It needs minimum 1200ms HPD~Valid Video Data(T4-T6). During the period display back data and valid video data before 1200ms can be lost.
- Do not keep the interface signal high-impedance or unusual signal when power is on.

Symbol	Min	Max	Unit	Description
t1	0.5	10	ms	Power rail rise time, 10 to 90%
t2	0	200	ms	Delay from VCC/VBAT to automatic Black Video
t3	0	200	ms	Delay from VCC/VBAT to HPD high
t4	-	-	ms	Allows for the Source device to read Link capability
t5	-	-	ms	Link Training duration
t6	-	-	ms	Link idle
t7	0	50	ms	Delay from valid video data from Source to video on display
t8	20	-	ms	Delay from valid video data from Source device to OLED_EN
t9	0	-	ms	Delay from OLED disable to end of valid video data
t10	0	500	ms	Delay from end of valid video data from the Source to power-off
t11	-	10	ms	Power rail fall time, 90 to 10%
t12	500	-	ms	Note

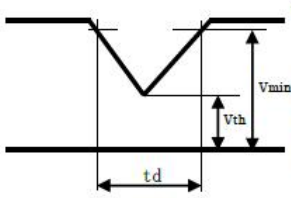
[Note] As for the power off-on sequence for VCC(t12), be sure to keep above mentioned timing. If the VCC power off-on sequence timing is other than shown above, Panel may cause permanent damage.

VCC-dip Condition

1) 2.8 V≦ VCC ＜3.0 V
td≦10 ms
Under above condition, the display image should return to an appropriate figure after VCC voltage recovers.
2) VCC＜2.8 V
VCC-dip conditions should also follow the ON-OFF conditions for supply voltage



VBAT-dip Condition



Vmin : 8.0V
Vth : 7.8V

1) Vth ≦ VBAT ＜ Vmin : td ≦ 20ms
2) VBAT ＜ Vth : The condition of instantaneous voltage drop is apply to display exception

10. Interface

Resolution	3840(H) × 2160(V)	
eDP Speed	Typ	5.4 Gbps
Frame Freq.	Typ	60 Hz
Porch	HFP + HBP (with HS)	160
	VFP + VBP (with VS)	48

11. Reliability

Item		Condition	Time/Cycle	QTY
High Temperature Operation		70℃	240hrs	5pcs
Low Temperature Operation		-20℃	240hrs	5pcs
High Temperature Storage		85℃	240hrs	5pcs
Low Temperature Storage		-40℃	240hrs	5pcs
High Temperature Humidity Operation		60℃/93%	240hrs	5pcs
Thermal Shock		-40℃/85℃ Dwell time=0.5h	100cycles	5pcs
ESD	Operating	Contact +/- 9kV, 150pF, 330Ω, Front 5point	once/point	3pcs
		Air +/- 10kV, 150pF, 330Ω, Front 5point	once/point	3pcs
Vibration test	Non-Operating	1.5Grma 10~500Hz Random X Y Z 1H		1Carton
Packing Drop test	Non-Operating	60cm height, 6-faces, 3-edges and 1-corner(one time for each		1Carton

12. Handling Precautions

12.1 When cleaning ITO pad, avoid using hard and abrasive material or corrosive solution.

12.2 Keep module away from direct sunlight or fluorescent light, and keep it at room temperature and humidity.

12.3 Strong impact & pressure on module and packing is prohibited.

12.4 Following normal power on/off sequence is necessary for preventing abnormal display or permanent damage to display.

12.5 Optimal contrast ratio under ideal voltage is AMOLED module's characteristic, hence it is recommended a voltage control function available.

12.6 Image sticking may occur if an image displays for an extended period of time.

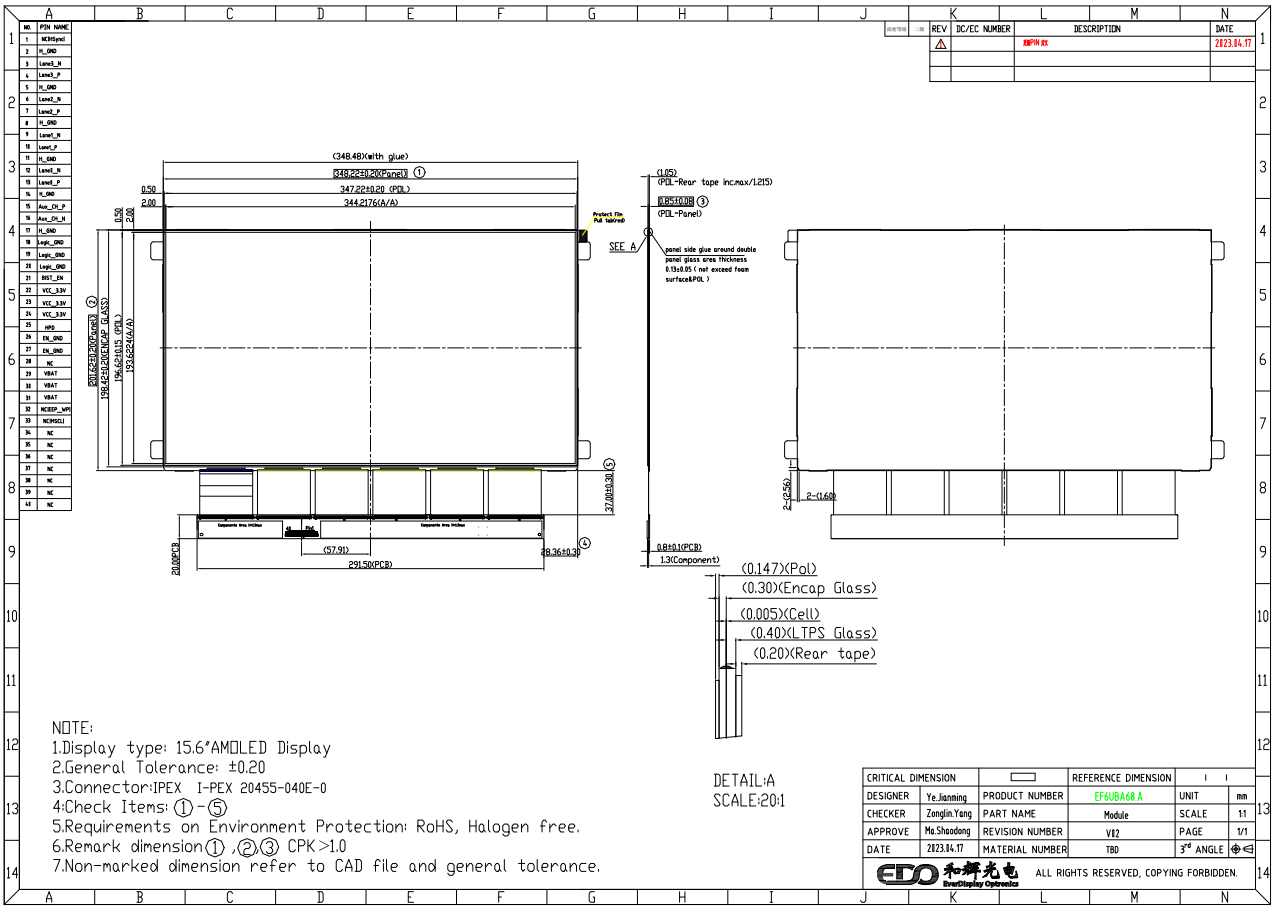
12.7 When interfered by system's overall mechanical design, an abnormal display may occur.

12.8 After considering emitting energy, you should plan your design to satisfy EMI standards.

12.9 Host side should place a surge-prevent circuit at power trace (ie: VCI, Vddi) to protect AMOLED module.

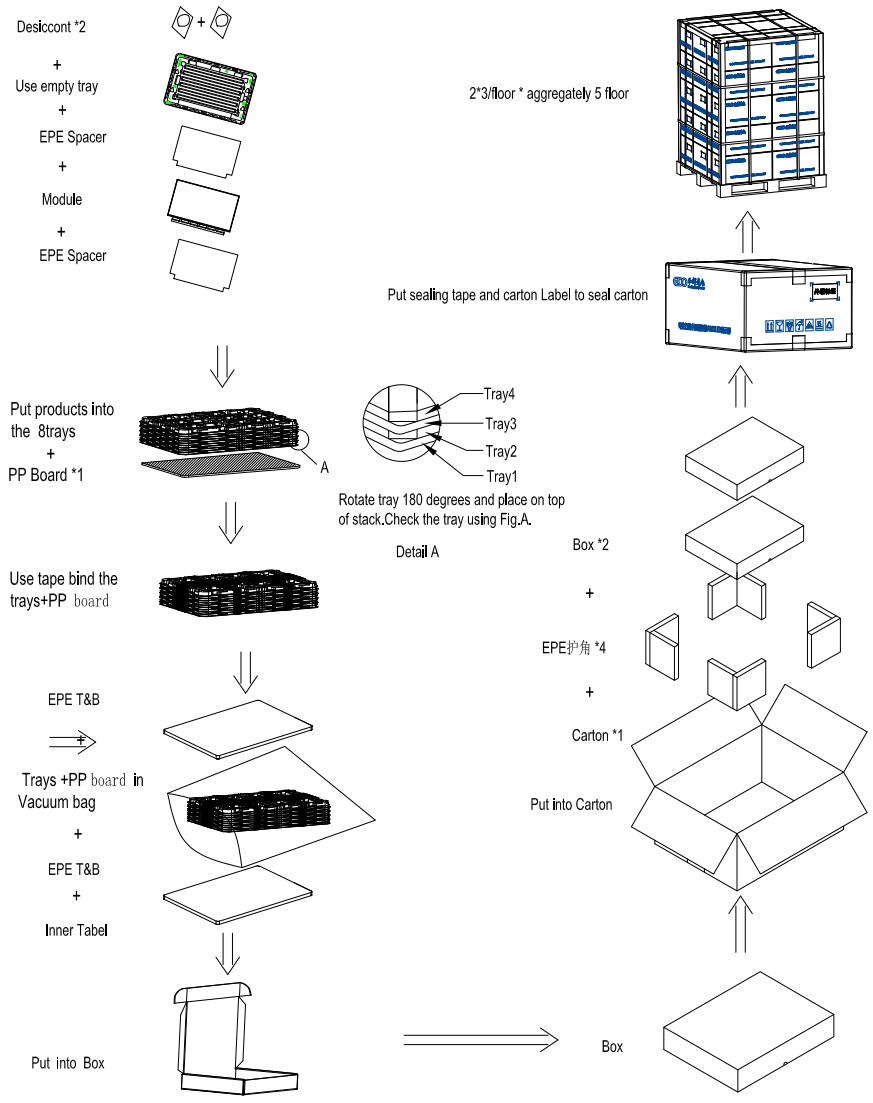
13. Outline Dimension Drawing

Refer to 2D drawing



14. Packing Specification

1. 整箱材料说明						
NO	料号	品名	材料	尺寸（mm）	数量（个）	备注
1	TBD	EF60UBA68.A	Module	348.22*201.62*1.05	16	
2	LA000001A	外箱标签	纸	52*100*0.1	1	
3	LA000002A	内箱标签	纸	52*100*0.075	2	
4	TBD	吸塑盘	PET	455*290*16	18	
5	TBD	EPE-Spacer	EPE	346.22*199.62*1	32	
6	PK500001A	EPE填充物（规格2）	EPE	457.00*292.00*10	4	
7	PK100001B	纸箱	纸	516*338*248	1	
8	PK200001A	纸盒	纸	459*294*115	2	
9	PK700001A	干燥剂	干燥剂	55*75	4	
10	PK300001A	静电防尘袋	PE	660*440*0.28	2	
11	PK600001A	PP 板	PP	457*292*5	2	
12	PK500002A	EPE护角	EPE	120*244*100	4	
13	TBD	栈板	木材	TBD	1/30	
2. 整栈板产品数量说明						
（1）整个吸塑盘的产品数量		每列的产品数量1个X每行的产品数量1个=1个				
（2）整个纸盒的产品数量		整个吸塑盘的产品数量1个X包装产品的吸塑盘数量8个（不包括最上方的空盘）=8 个				
（3）整个纸箱的产品数量		整个纸盒的产品数量8个X包装产品的纸盒数量2个=16个				
（3）整个栈板的产品数量		整箱产品数量16个X纸箱的数量30个=480个				



15. The Control of Hazardous substances

The Control of Hazardous substances refer to EDO document《有害物质管控标准书》(Standard document for the Control of Hazardous substances) EDO-IS-110,Version 05.