SPECIFICATION
FOR
Flexible AMOLED Module

MODULE No:	KD133QXFEN020
CUSTOMER:	

STARTEK	INITIAL	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

CUSTOMER	INITIAL	DATE
APPROVED BY		

Revision History

Date	Rev. No.	Page	Summary
2025.02.17	V1.0	ALL	FIRST ISSUE

Contents

* Description

This is a color active matrix Flexible AMOLED module using Low Temperature Poly-silicon Thin Film Transistors as active switching devices. This module has a 13.3 inch diagonally measured active area with 1536 horizontal by 2048 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 16.7M colors.

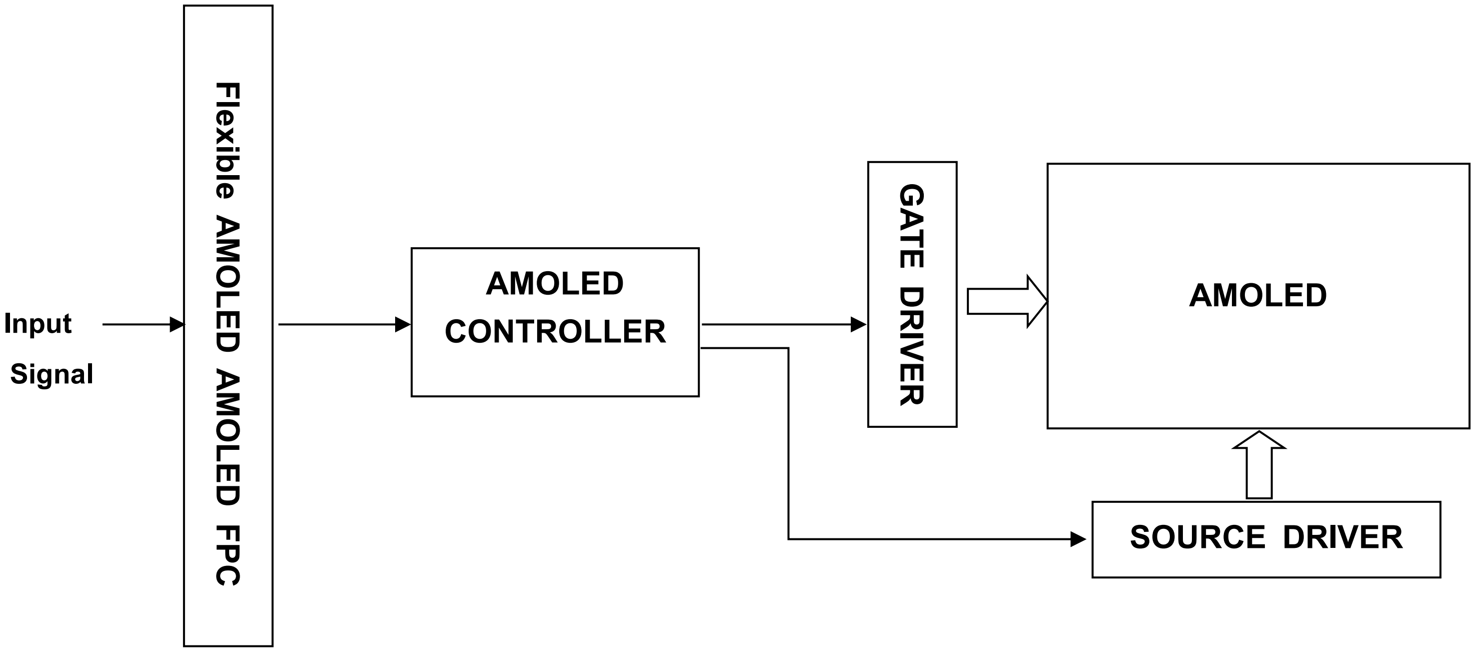
* Features

General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	202.752(H)*270.336(V) (13.3 inch)	mm	
Driver element	active matrix	-	
Display colors	16.7M	colors	
Number of pixels	1536(RGB)*2048	dots	
Pixel pitch	0.132(H)*0.132(V)	mm	
Viewing angle	ALL	o'clock	
Controller IC	TBD	-	
Touch MODE	USB	-	
LCM Interface	EDP1.3	-	
Display mode	Flexible AMOLED	-	
Operating temperature	0～+50	℃	
Storage temperature	-20～+60	℃	

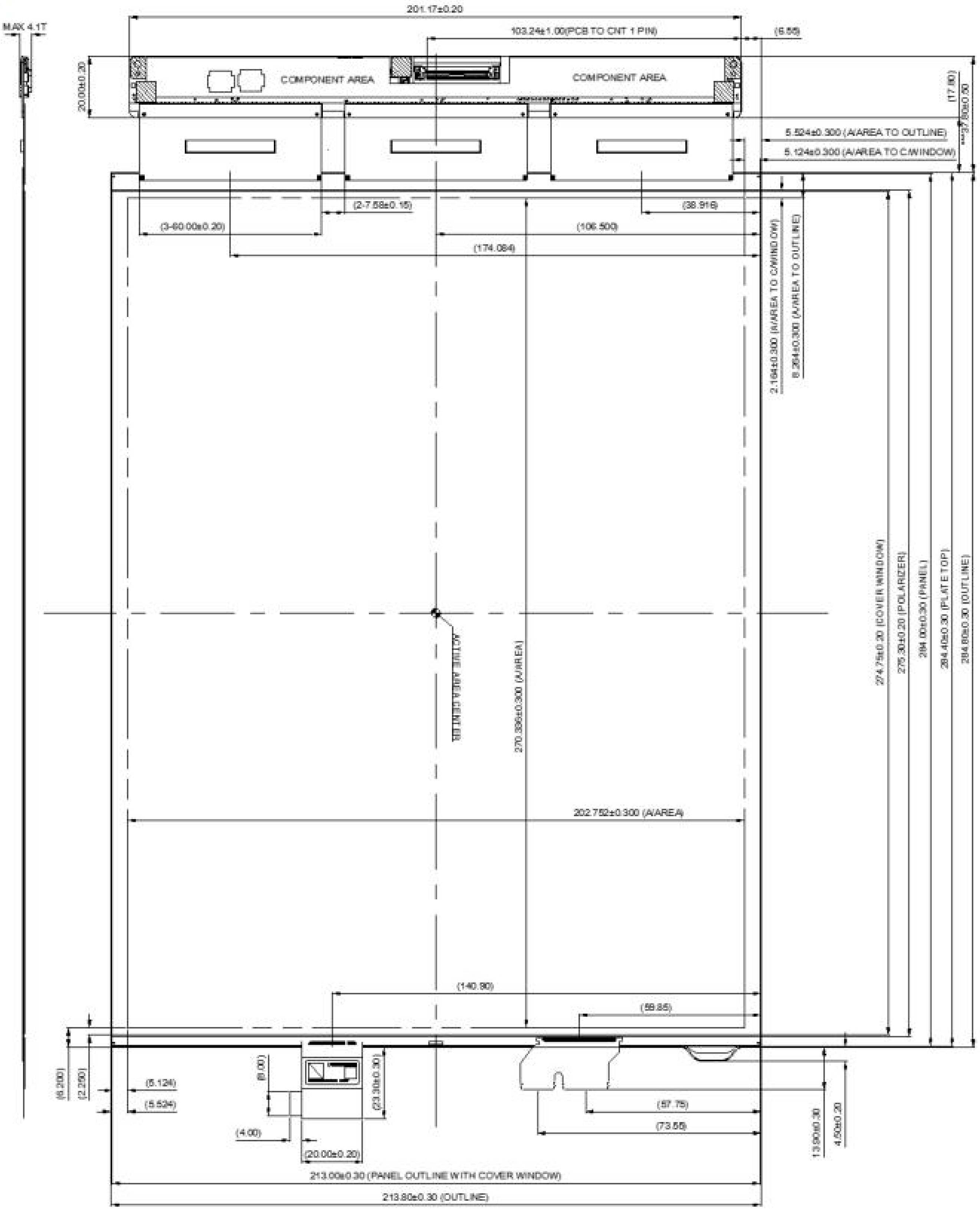
* Mechanical Information

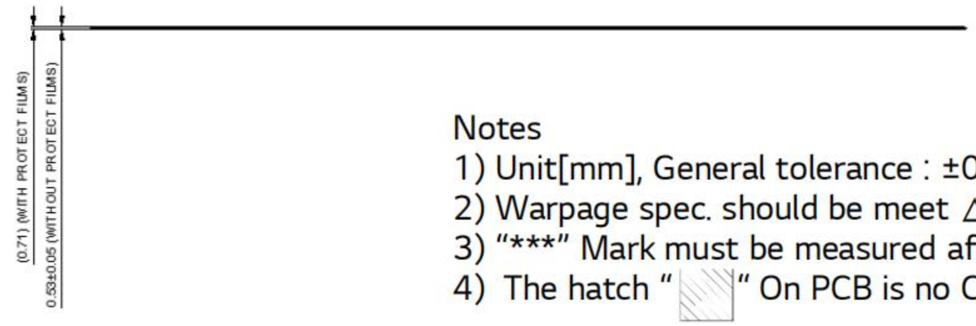
Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)		213.80		mm	-
	Vertical(V)		284.80		mm	-
	Depth(D)		0.53		mm	-
Weight			120		g	-

1. Block Diagram



2. Outline dimension

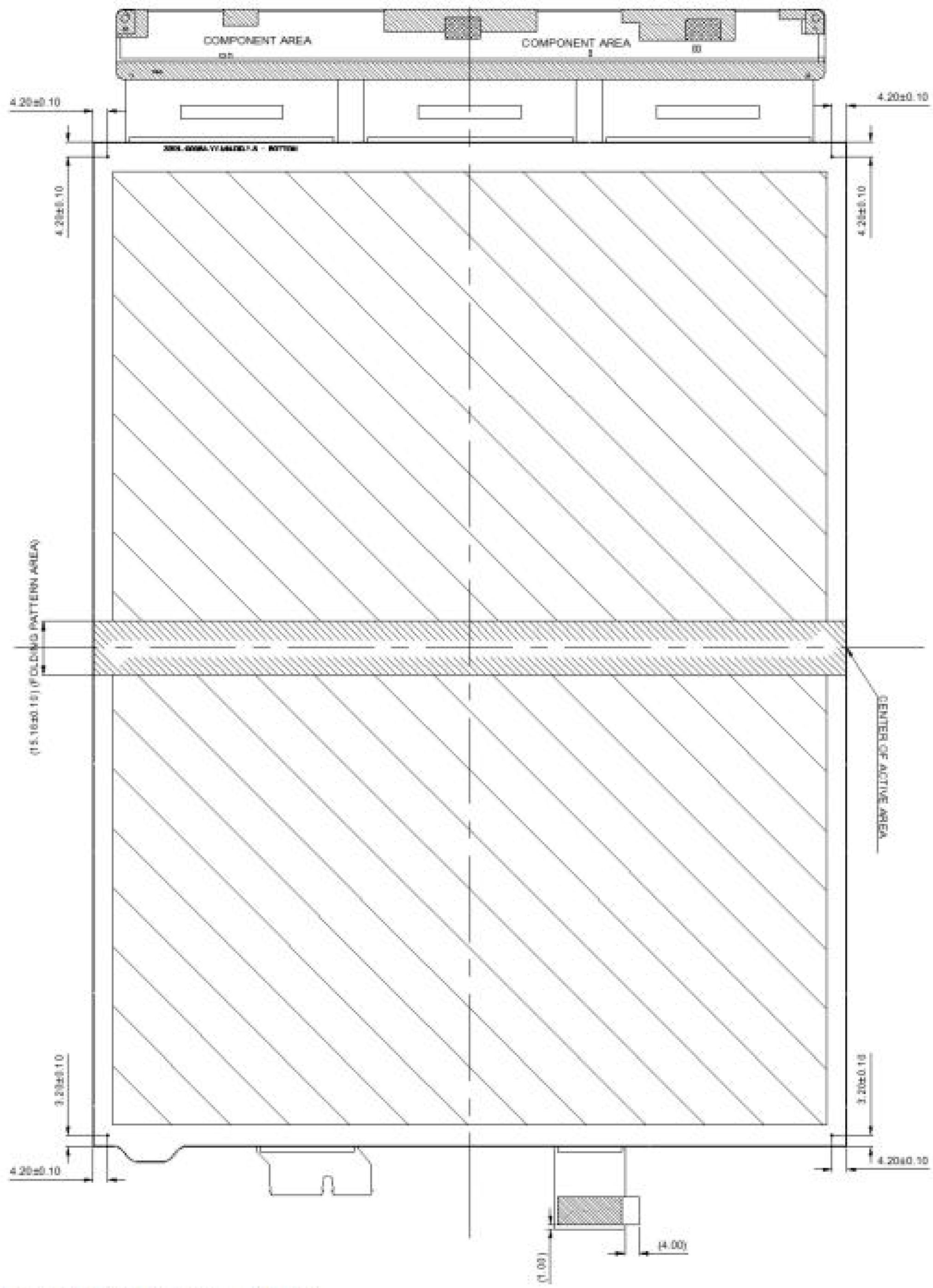




Notes

1) Unit[mm], General tolerance : ±0.5mm
2) Warpage spec. should be meet △S_Max.100 < 6.5
3) "***" Mark must be measured after unfolded COF
4) The hatch "▨" On PCB is no Component area(5 points)

<REAR VIEW>



Notes

1) Unit[mm], General tolerance : ±0.5mm

2) The hatch "▨" On PCB is no Component area (6 points)

3) The hatch "▩" On PCB is GND area (2 points)

3. Input terminal Pin Assignment

FPC connector: Hirose, KN38A-40S-0.5H (40pin, 0.5pitch) or equivalent

NO.	SYMBOL	DISCRIPTION	I/O
1	VCC_3.3V	Logic and driver power	P
2	VCC_3.3V	Logic and driver power	P
3	VCC_3.3V	Logic and driver power	P
4	VCC_3.3V	Logic and driver power	P
5	SEN_INT	Sensing command（NC）	
6	SEN_SCL	Sensing command（NC）	
7	SEN_SDA	Sensing command（NC）	
8	GND	Ground	P
9	LANE3_N	Complement Signal Link Lane 3	I
10	LANE3_P	True Signal Link Lane 3	I
11	GND	Ground	P
12	LANE2_N	Complement Signal Link Lane 2	I
13	LANE2_P	True Signal Link Lane 2	I
14	GND	Ground	P
15	LANE1_N	Complement Signal Link Lane 1	I
16	LANE1_P	True Signal Link Lane 1	I
17	GND	Ground	P
18	LANE0_N	Complement Signal Link Lane 0	I
19	LANE0_P	True Signal Link Lane 0	I
20	GND	Ground	P
21	AUX_CH_P	True Signal Auxiliary Channel	I
22	AUX_CH_N	Complement Signal Auxiliary Channel	I
23	GND	Ground	P
24	HPD	HPD Signal	I

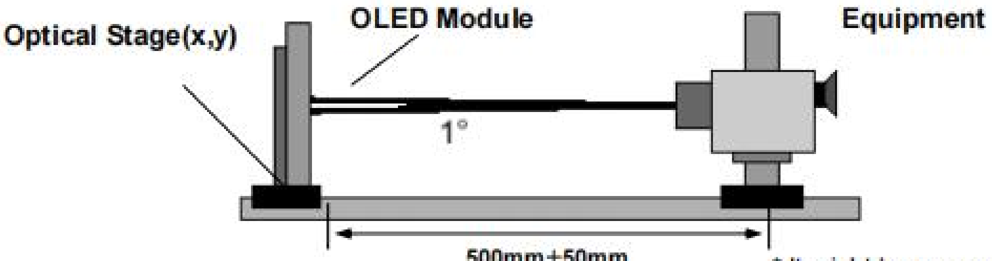
25	EL_EN	EL on/off contro	I/O
26	EL_PWM	System PWM signal input for dimming	I/O
27	BIST or NC	Panel Self Test Enable (Optional)	
28	GND	Ground	P
29	GND	Ground	P
30	GND	Ground	P
31	GND	Ground	P
32	NC	NC	
33	VEL	EL power (7.4V Typical)	P
34	VEL	EL power (7.4V Typical)	P
35	VEL	EL power (7.4V Typical)	P
36	VEL	EL power (7.4V Typical)	P
37	VEL	EL power (7.4V Typical)	P
38	VEL	EL power (7.4V Typical)	P
39	VEL	EL power (7.4V Typical)	P
40	VEL	EL power (7.4V Typical)	P

4. AMOLED Optical Characteristics

4.1 Optical specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 20 minutes in a dark environment at 25°C. The values specified are at an approximate distance 50cm from the OLED surface at a viewing angle of Φ and Θ equal to 0°.
FIG. 1 presents additional information concerning the measurement equipment and method.

FIG. 1 Optical Characteristic Measurement Equipment and Method



* It might be measured by landscape mode

Table 7. OPTICAL CHARACTERISTICS Ta=25°C, VCC=3.3V, fv=60Hz

Parameter		Symbol	Values			Units	Notes
			Min	Typ	Max		
Contrast Ratio		CR	5000	-	-		1
Surface Luminance, white (OPR 80%)		L_{WH}	270	300	330	cd/m^2	2
Surface Luminance, white (OPR 100%)		L_{WH}	216	240	264	cd/m^2	2
Luminance Variation		$\delta_{WHITE\ (5P)}$	80	-	-	%	3
		$\delta_{WHITE(13P)}$	60	-	-		
Response Time		Tr+Tf	-	2	-	ms	4
Color Coordinates	RED	Rx	- 0.030	0.695	+ 0.030	-	5
		Ry		0.305			
	GREEN	Gx		0.176			
		Gy		0.740			
	BLUE	Bx		0.140			
		By		0.056			
	WHITE	Wx	-0.020	0.313	+0.020		
		Wy		0.329			
Color Gamut	NTSC	-	-	111	-	%	Area Ratio (CIE 1931)
	Adobe			95			Covering Ratio (CIE 1931)
	DCI-P3			95			
Viewing Angle	x axis, right(Φ=0°)	-	-	85	-	Degree	6
	x axis, left (Φ=180°)	-	-	85	-		
	y axis, up (Φ=90°)	-	-	85	-		
	y axis, down (Φ=270°)	-	-	85	-		
Viewing Angle (color)	θ= 45˚ / 60˚ (R,L,U,D)	ΔXY	-	0.05	0.07	-	7
Gray Scale (Gamma)		-	-	2.2	-	-	8

Note)

1. It should be measured in the center of screen(1 Point). Contrast Ratio(CR) is defined mathematically as

$$\text{Contrast Ratio(1 Point)} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

2. Surface luminance is the center of screen(1 Point, Typ) across the OLED surface 50cm from the surface with 80% pixels displaying white. For more information see FIG 2.
   This model apply to enable PLC(Peak Luminance Control).

L_{WH} = 1 Point, Typ

* OPR : Open Pixel Ratio

3. The variation in surface luminance , The panel total variation (δ WHITE) is determined by measuring N at each test position 1 through 13 and then defined as following numerical formula.
   For more information see FIG 2.

$$\delta\ \text{WHITE (5P)} = \frac{\text{Minimum (1,2, ... 5 Point)}}{\text{Maximum (1,2, ... 5 Point)}} \qquad \delta\ \text{WHITE (13P)} = \frac{\text{Minimum (1,2, ... 13 Point)}}{\text{Maximum (1,2, ... 13 Point)}}$$

4. Response time is the time required for the display to transition from black to white (rise time, Tr) and from white to black (falling time, Tf) at first peak. For additional information see FIG 3.

5. It should be measured in the center of screen (1Point).

6. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the OLED surface. For more information see FIG 4.

7. Difference between color coordinates of front (Wx0,Wy0), (Rx0,Ry0), (Gx0,Gy0), (Bx0,By0) and color coordinates of viewing angle (Wxn, Wyn), (Rxn, Ryn), (Gxn, Gyn), (Bxn, Byn)

$$\text{Delta xy } (\triangle xy) = \sqrt{(Wxn-Wx0)^2 + (Wyn-Wy0)^2}$$

8. Gray scale specification under OPR 80%

Gray Level0	Luminance [%] (Typ)
L0	0.0
L31	0.9
L63	4.4
L95	10.9
L127	21.3
L159	35.0
L191	52.5
L223	74.1
L255	100.0

Gamma 2.2 for gray scale more than 16/255 Gray

FIG. 2 Luminance

<Measuring point for Luminance & measuring point for Luminance variation>

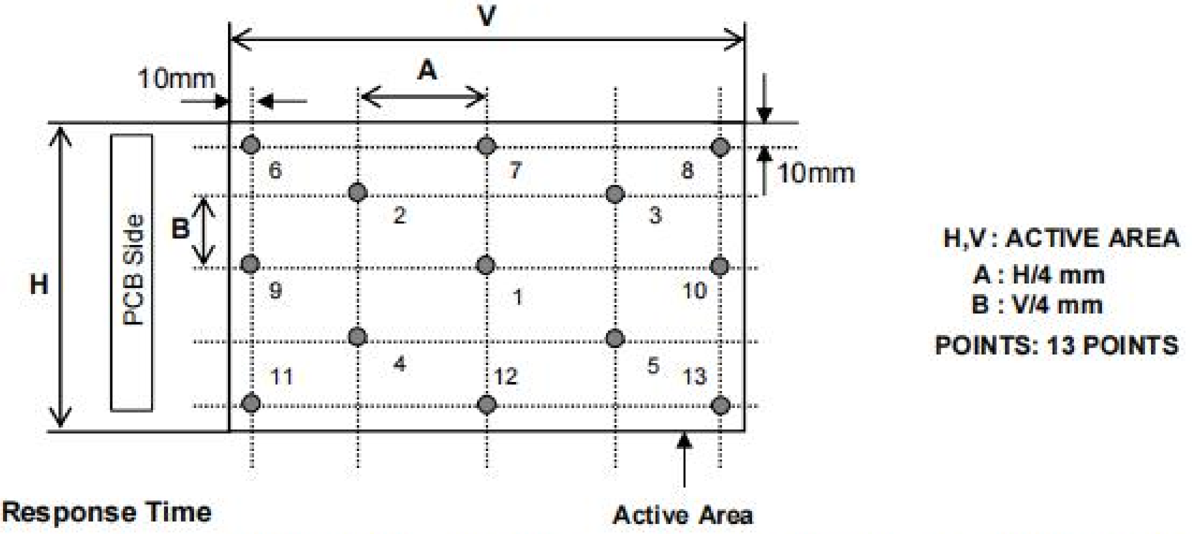


FIG. 3 Response Time

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white" at first peak

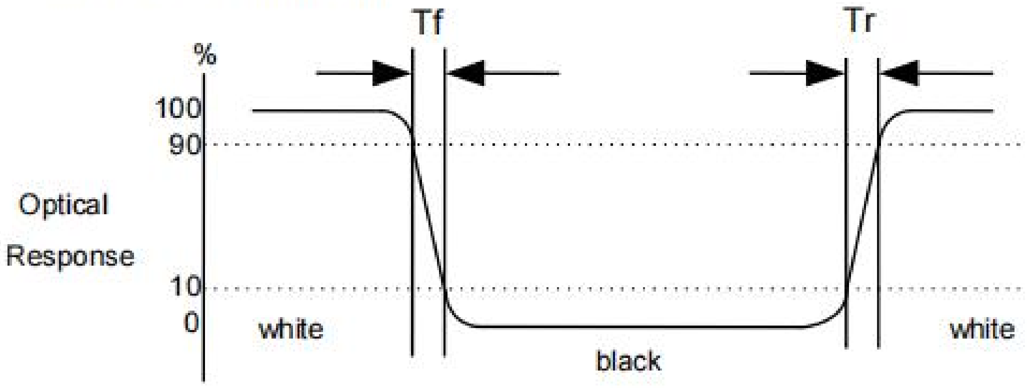
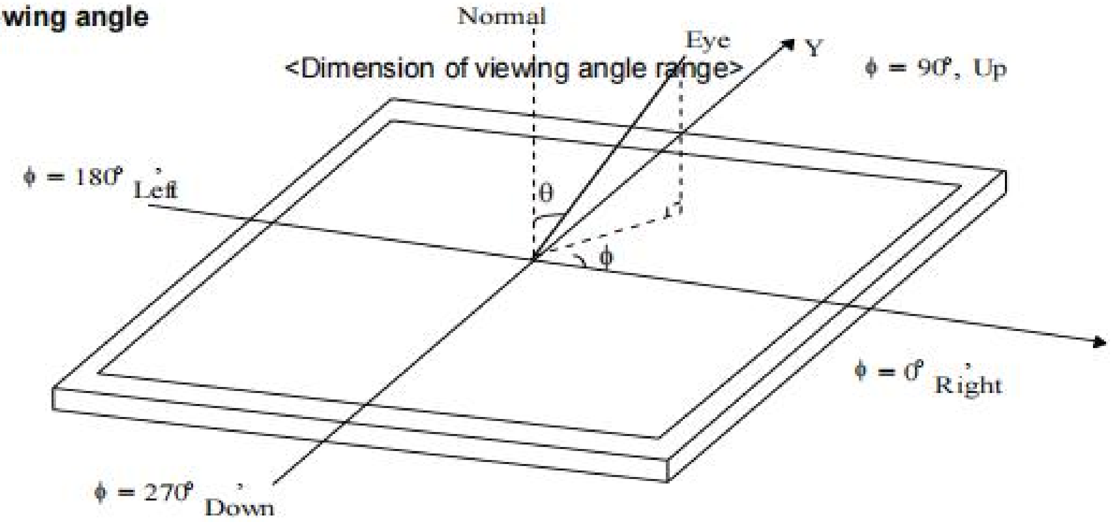


FIG. 4 Viewing angle



5. AMOLD Electrical Characteristics

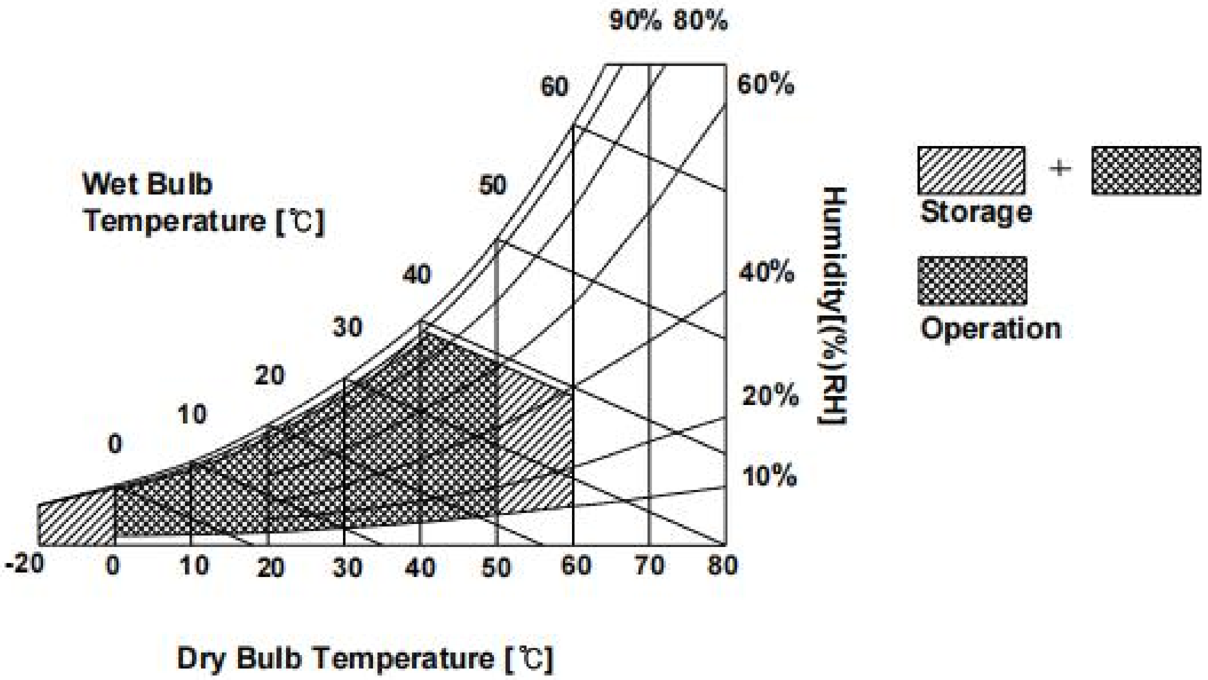
5.1 Absolute Maximum Rating (Ta=25 VSS=0V)

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Values		Units	Notes
		Min	Max		
Power Input Voltage	VCC	-0.3	4.0	V_{DC}	at 25 ± 2°C
Operating Temperature	TOP	0	50	°C	1
Storage Temperature	TST	-20	60	°C	1,2
Operating Ambient Humidity	HOP	10	90	%RH	1
Storage Humidity	HST	10	90	%RH	1,2

Note : 1. Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be 39°C Max, and no condensation of water.
Note : 2. Storage Condition is guaranteed with unfolding under packing condition.



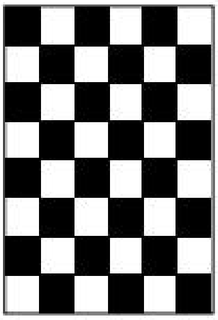
5.2 OLED DC Electrical Characteristics

Table 2. ELECTRICAL CHARACTERISTICS

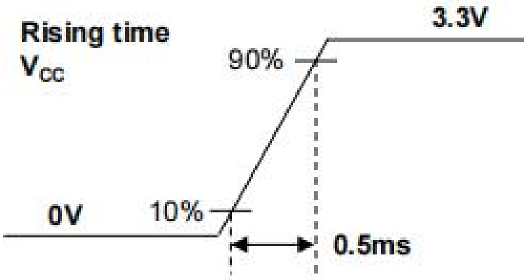
Parameter		Symbol	Values			Unit	Notes
			Min	Typ	Max		
Power Supply Input Voltage		Vcc	3.0	3.3	3.6	V	1
Permissive Power Supply Input Ripple		VCCrp	-	-	100	mV_{p-p}	
Power Supply Input Current	Mosaic	Icc	-	515	605	mA	2
Power Consumption		Pcc	-	1.7	2.0	W	
Power Supply Inrush Current		Icc_P	-	-	2.5	A	3
Differential Impedance		ZeDP	90	100	110	Ω	

Note)

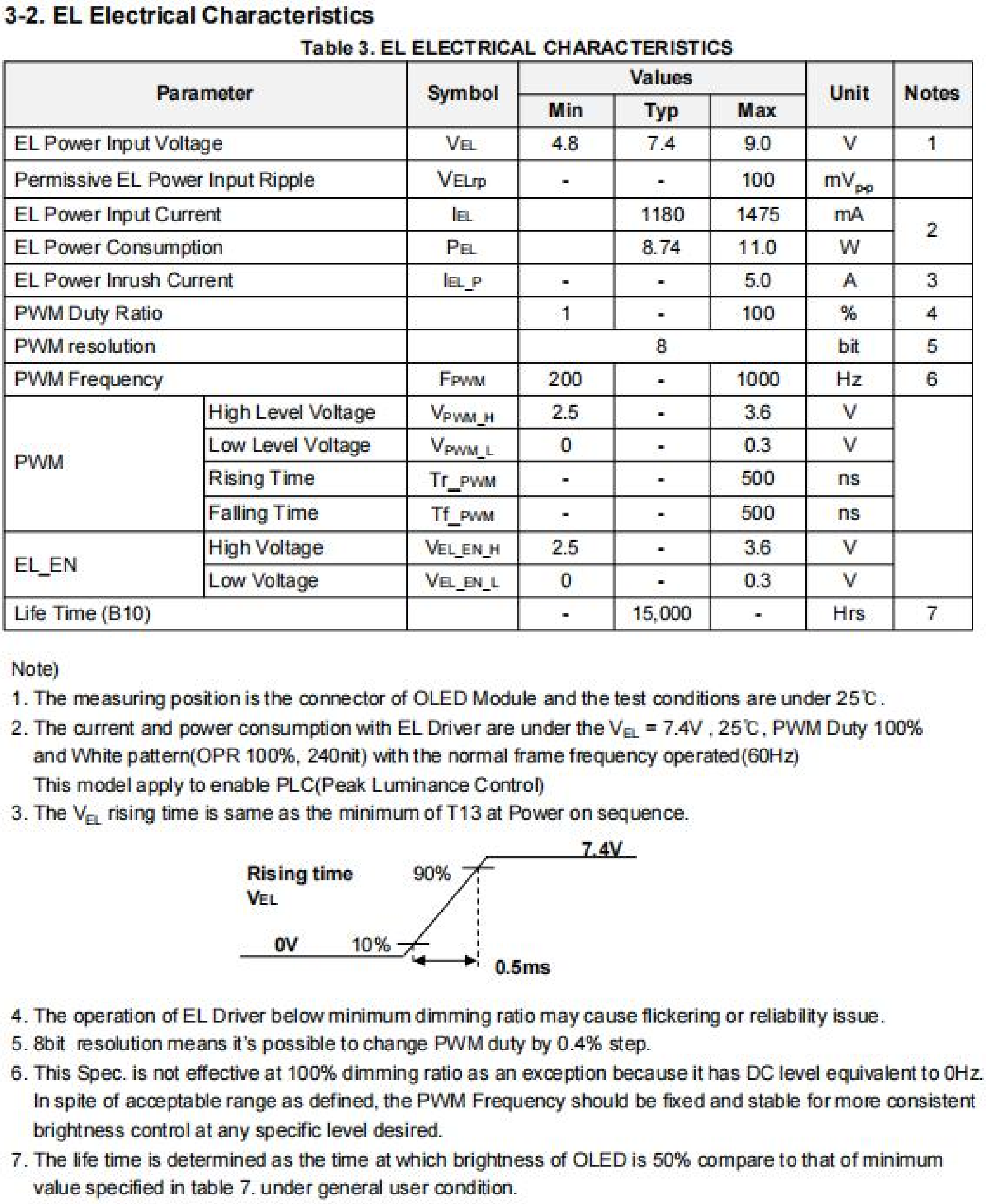
1. The measuring position is the connector of Module and the test conditions are under 25℃, fv = 60Hz
2. The specified I_{CC} current and power consumption are under the V_{CC} = 3.3V , 25℃, fv = 60Hz condition and Mosaic pattern. (without Burning Compensation)



3. The V_{CC} rising time is same as the minimum of T1 at Power on sequence.



5.3 EL Electrical Characteristics



3-2. EL Electrical Characteristics

Table 3. EL ELECTRICAL CHARACTERISTICS

Parameter		Symbol	Values			Unit	Notes
			Min	Typ	Max		
EL Power Input Voltage		V_{EL}	4.8	7.4	9.0	V	1
Permissive EL Power Input Ripple		V_{ELrp}	-	-	100	mV_{p-p}	
EL Power Input Current		I_{EL}		1180	1475	mA	2
EL Power Consumption		P_{EL}		8.74	11.0	W	
EL Power Inrush Current		I_{EL_P}	-	-	5.0	A	3
PWM Duty Ratio			1	-	100	%	4
PWM resolution			8			bit	5
PWM Frequency		F_{PWM}	200	-	1000	Hz	6
PWM	High Level Voltage	V_{PWM_H}	2.5	-	3.6	V	
	Low Level Voltage	V_{PWM_L}	0	-	0.3	V	
	Rising Time	Tr_{PWM}	-	-	500	ns	
	Falling Time	Tf_{PWM}	-	-	500	ns	
EL_EN	High Voltage	$V_{EL\_EN\_H}$	2.5	-	3.6	V	
	Low Voltage	$V_{EL\_EN\_L}$	0	-	0.3	V	
Life Time (B10)			-	15,000	-	Hrs	7

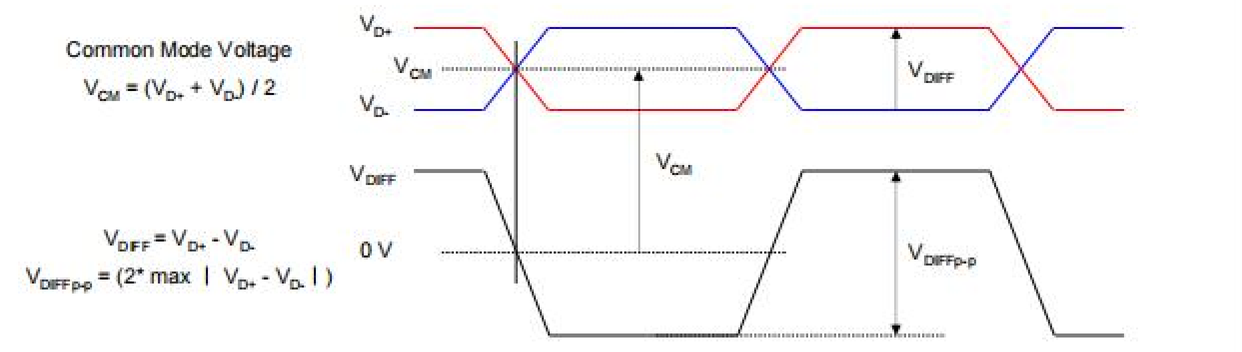
Note)

1. The measuring position is the connector of OLED Module and the test conditions are under 25℃.
2. The current and power consumption with EL Driver are under the V_{EL} = 7.4V , 25℃, PWM Duty 100% and White pattern(OPR 100%, 240nit) with the normal frame frequency operated(60Hz)
   This model apply to enable PLC(Peak Luminance Control)
3. The V_{EL} rising time is same as the minimum of T13 at Power on sequence.

4. The operation of EL Driver below minimum dimming ratio may cause flickering or reliability issue.
5. 8bit resolution means it's possible to change PWM duty by 0.4% step.
6. This Spec. is not effective at 100% dimming ratio as an exception because it has DC level equivalent to 0Hz. In spite of acceptable range as defined, the PWM Frequency should be fixed and stable for more consistent brightness control at any specific level desired.
7. The life time is determined as the time at which brightness of OLED is 50% compare to that of minimum value specified in table 7. under general user condition.

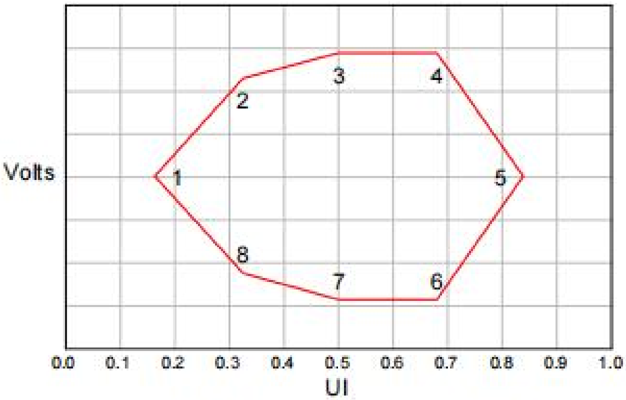
6. eDP Signal Timing Specifications

6.1 Definition of Differential Voltage

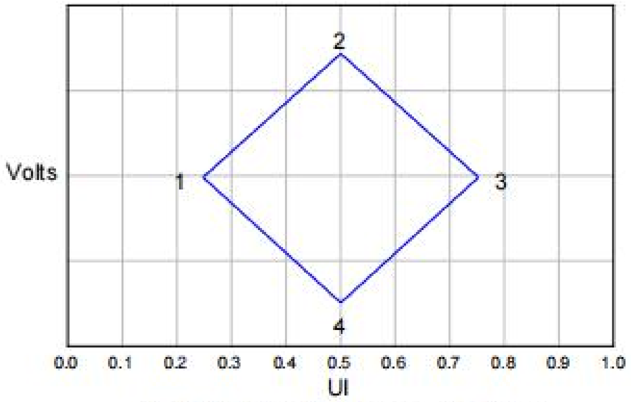


[Definition of Differential Voltage]

6.2 Main Link EYE Diagram



[EYE Mask at Source Connector Pins]



[EYE Mask at Sink Connector Pins]

Point	Reduced Bit Rate		High Bit Rate	
	Time(UI)	Voltage(V)	Time(UI)	Voltage(V)
1	0.127	0.000	0.210	0.000
2	0.291	0.160	0.355	0.140
3	0.500	0.200	0.500	0.175
4	0.709	0.200	0.645	0.175
5	0.873	0.000	0.790	0.000
6	0.709	-0.200	0.645	-0.175
7	0.500	-0.200	0.500	-0.175
8	0.291	-0.160	0.355	-0.140

[EYE Mask Vertices at Source Connector Pins]

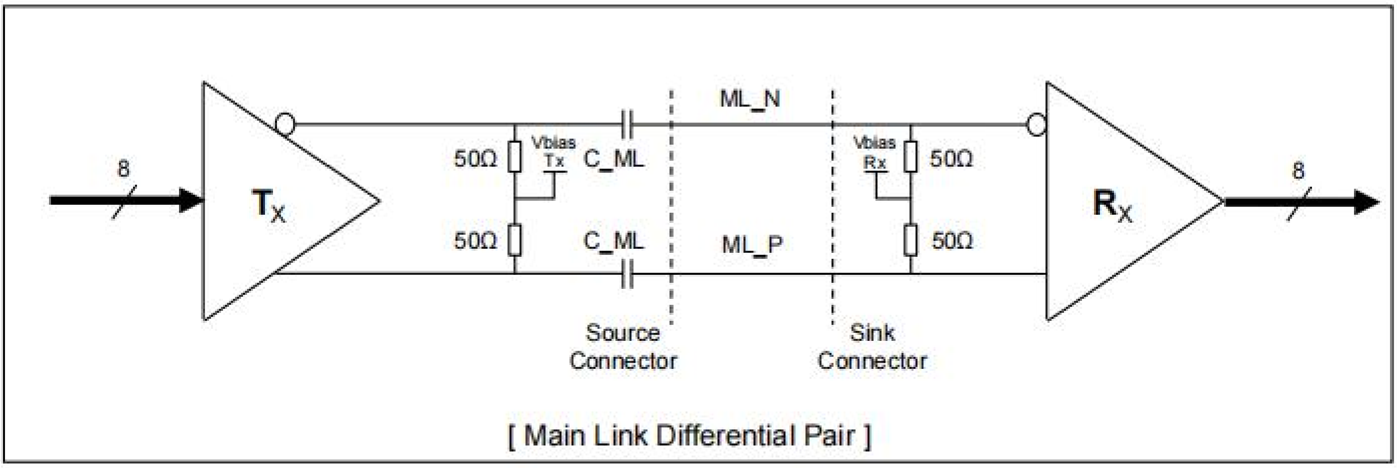
Point	Reduced Bit Rate		High Bit Rate	
	Time(UI)	Voltage(V)	Time(UI)	Voltage(V)
1	0.375	0.000	0.246	0.000
2	0.500	0.023	0.500	0.075
3	0.625	0.000	0.755	0.000
4	0.500	-0.023	0.500	-0.075

[EYE Mask Vertices at Sink Connector Pins]

Point	Reduced Bit Rate		High Bit Rate	
	Time(UI)	Voltage(V)	Time(UI)	Voltage(V)
1	0.270	0.000	0.246	0.000
2	0.500	0.068	0.500	0.075
3	0.731	0.000	0.755	0.000
4	0.500	-0.068	0.500	-0.075

[EYE Mask Vertices at embedded DP Sink Connector Pins]

6.3 eDP Main Link Signal



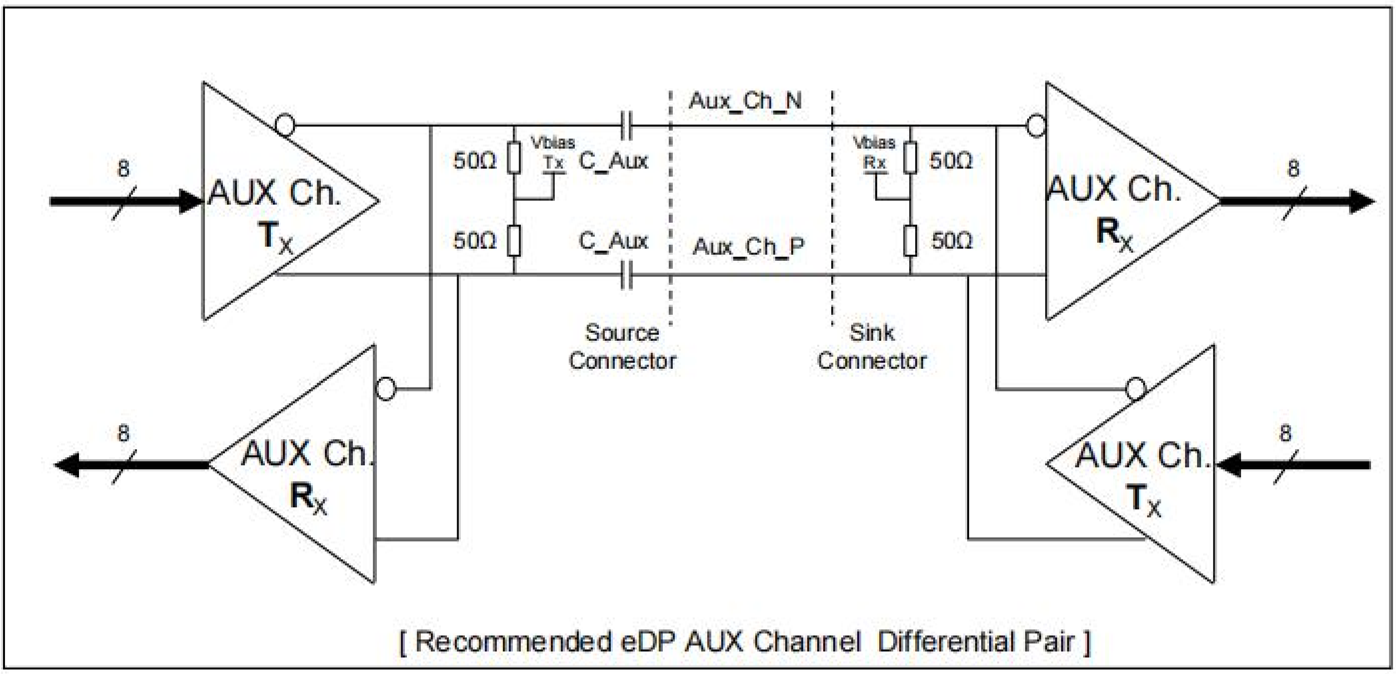
[Main Link Differential Pair]

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Unit Interval for high bit rate (2.7Gbps / lane)	UI_HBR	-	370	-	ps	
Unit Interval for reduced bit rate (1.62Gbps / lane)	UI_RBR	-	617	-	ps	
Link Clock Down Spreading	Amplitude	0	-	0.5	%	
	Frequency	30		33	kHz	
Differential peak-to-peak voltage at Source side connector	$V_{TX\text{-}DIFFp\text{-}p}$	350	-	-	mV	For HBR(2.7Gbps)
		400	-	-		For RBR(1.62Gbps)
EYE width at Source side connector	$T_{TX\text{-}EYE\text{-}CONN}$	0.58	-	-	UI	For HBR(2.7Gbps)
		0.75	-	-	UI	For RBR(1.62Gbps)
Differential peak-to-peak voltage at Sink side connector	$V_{RX\text{-}DIFFp\text{-}p}$	150	-	-	mV	For HBR(2.7Gbps)
		136	-	-		For RBR(1.62Gbps)
EYE width at Sink side connector	$T_{RX\text{-}EYE\text{-}CONN}$	0.51	-	-	UI	For HBR(2.7Gbps)
		0.46	-	-	UI	For RBR(1.62Gbps)
Rx DC common mode voltage	$V_{RX\ CM}$	0	-	2	V	
AC Coupling Capacitor	C_{SOURCE_ML}	75		200	nF	Source side

Note)

1. Termination resistor is typically integrated into the transmitter and receiver implementations.
2. AC Coupling Capacitor is not placed at the sink side.
3. In cabled embedded system, it is recommended the system designer ensure that EYE width and voltage are met at the sink side connector pins.

6.4 eDP AUX Channel Signal



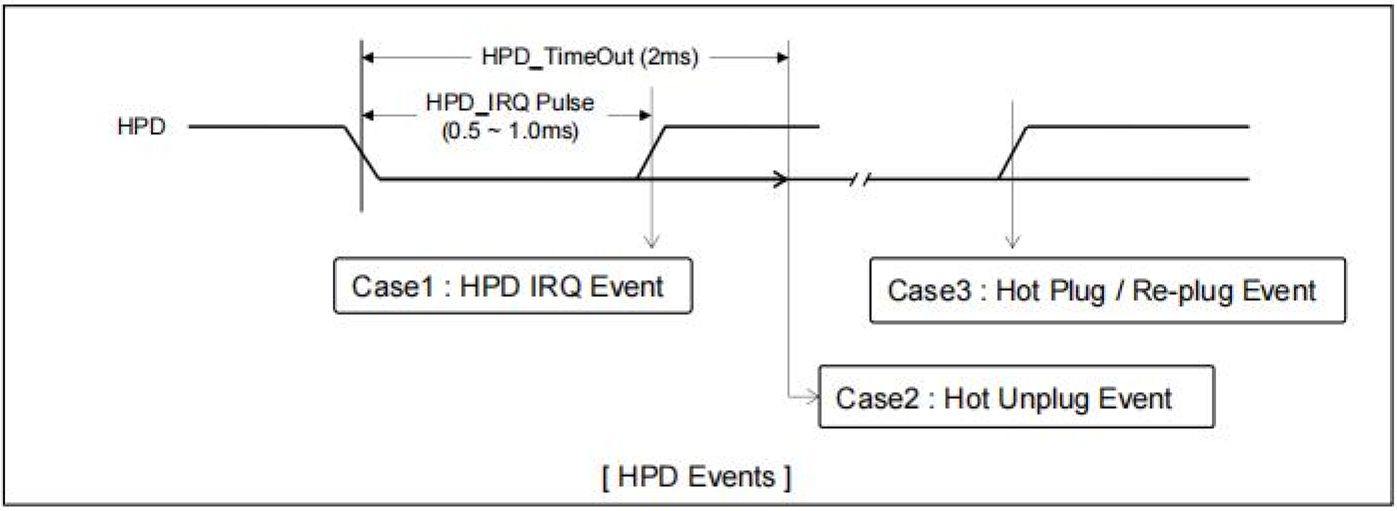
[Recommended eDP AUX Channel Differential Pair]

Parameter	Symbol	Min	Typ	Max	Unit	Notes
AUX Unit Interval	UI	0.4	-	0.6	us	
AUX Jitter at Tx IC Package Pins	T_{jitter}	-	-	0.04	UI	Equal to 24ns
AUX Jitter at Rx IC Package Pins		-	-	0.05	UI	Equal to 30ns
AUX Peak-to-peak voltage at Connector Pins of Transmitting	$V_{AUX\text{-}DIFFp\text{-}p}$	0.39	-	1.38	V	
AUX Peak-to-peak voltage at Connector Pins of Receiving		0.36	-	1.36	V	
AUX EYE width at Connector Pins of Tx and Rx		0.98	-	-	UI	
AUX DC common mode voltage	$V_{AUX\text{-}CM}$	0	-	1.0	V	
AUX AC Coupling Capacitor	$C_{SOURCE\text{-}AUX}$	75		200	nF	Source side

Note)

1. Termination resistor is typically integrated into the transmitter and receiver implementations.
2. AC Coupling Capacitor is not placed at the sink side.
3. $V_{AUX\text{-}DIFFp\text{-}p} = 2^* \mid V_{AUXP} - V_{AUXN} \mid$

6.5 eDP HPD Signal



[HPD Events]

Parameter	Symbol	Min	Typ	Max	Unit	Notes
HPD Voltage	HPD	2.25	-	3.6	V	Sink side Driving
Hot Plug Detection Threshold		2.0	-	-	V	Source side Detecting
Hot Unplug Detection Threshold		-	-	0.8	V	
HPD_IRQ Pulse Width	HPD_IRQ	0.5	-	1.0	ms	
HPD_TimeOut		2.0	-	-	ms	HPD Unplug Event

Note)

1. HPD IRQ : Sink device wants to notify the Source device that Sink's status has changed so it toggles HPD line, forcing the Source device to read its Link / Sink Receiver DPCD field via the AUX-CH
2. HPD Unplug : The Sink device is no longer attached to the Source device and the Source device may then disable its Main Link as a power saving mode
3. Plug / Re-plug : The Sink device is now attached to the Source device, forcing the Source device to read its Receiver capabilities and Link / Sink status Receiver DPCD fields via the AUX-CH

6.6 Signal Timing Specifications

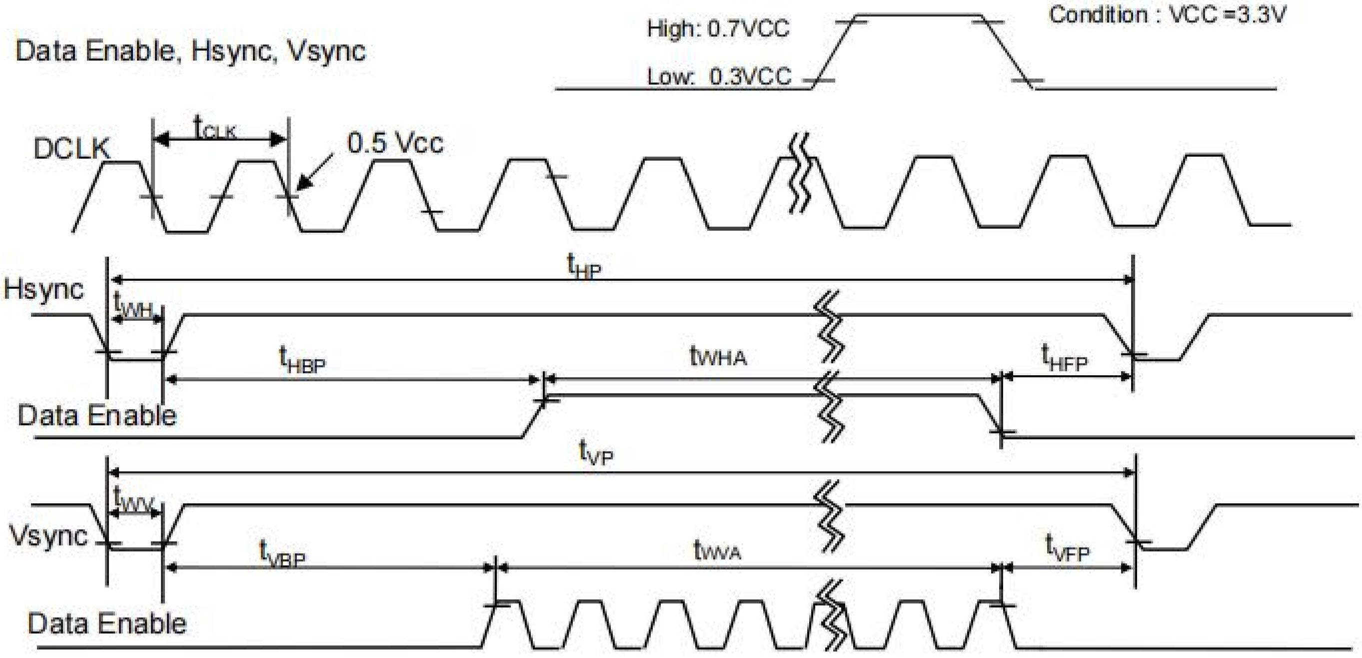
This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications and specifications of eDP Tx/Rx for its proper operation.

Table 4. TIMING TABLE

ITEM	Symbol		Min	Typ	Max	Unit	Note
DCLK	Frequency	f_{CLK}	-	215.0	-	MHz	
Hsync	Period	t_{HP}	-	1696	-	t_{CLK}	
	Width	t_{WH}	-	32	-		
	Width-Active	t_{WHA}		1536			
Vsync	Period	t_{VP}	-	2112	-	t_{HP}	
	Width	t_{WV}	-	10	-		
	Width-Active	t_{WVA}		2048			
Data Enable	Horizontal back porch	t_{HBP}	-	80	-	t_{CLK}	
	Horizontal front porch	t_{HFP}	-	48	-		
	Vertical back porch	t_{VBP}	-	51	-	t_{HP}	
	Vertical front porch	t_{VFP}	-	3	-		

Notice. All reliabilities are specified for timing specification based on refresh rate of 60Hz.

6.7 Signal Timing Waveform



6.8 Power Structure and On/Off Sequence

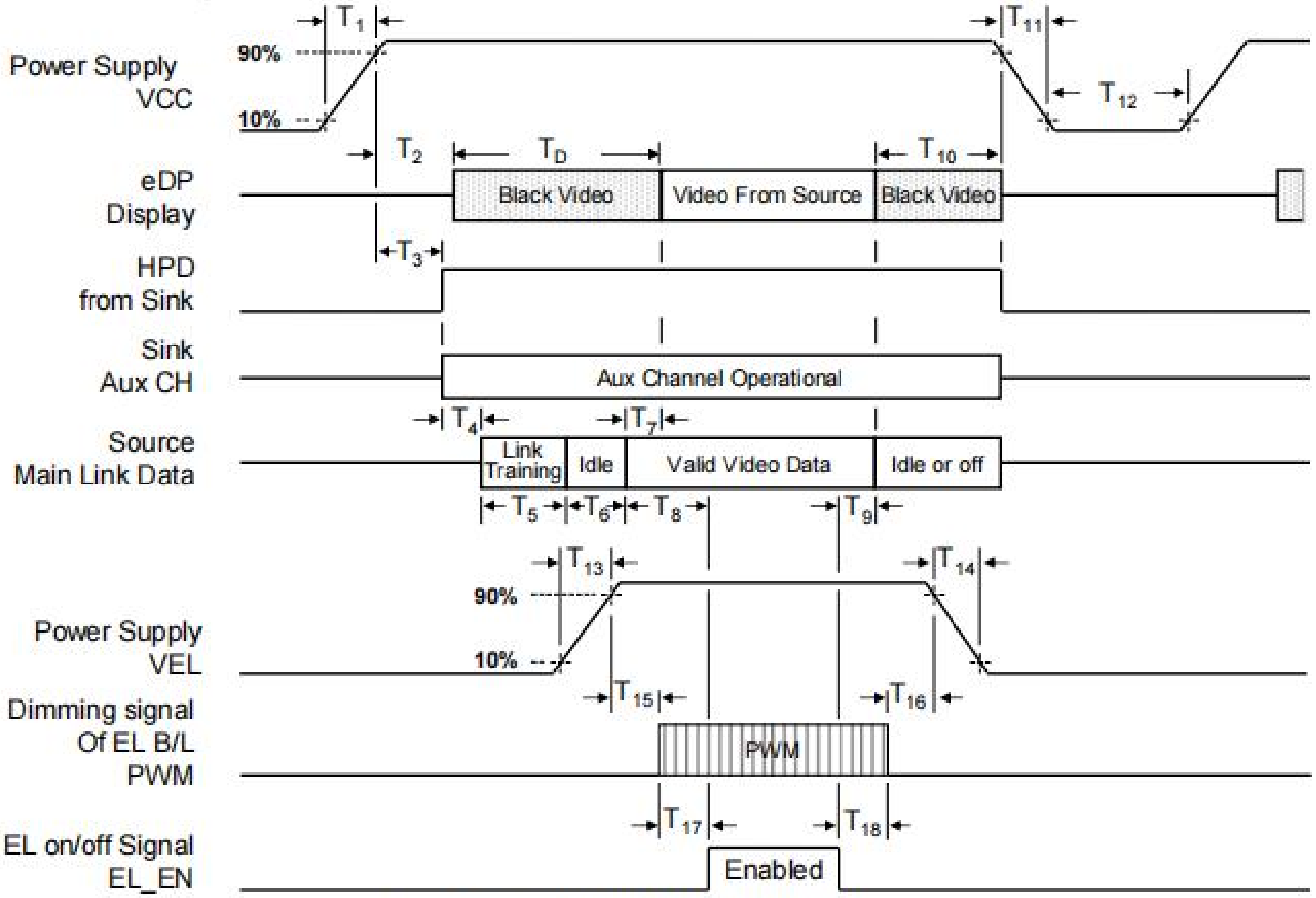


Table 6. POWER SEQUENCE TABLE

Symbol	Required By	Limits		Units	Notes
		Min	Max		
T_1	Source	0.5	10	ms	-
T_2	Sink	600	-	ms	-
T_3	Sink	0	500	ms	-
T_4	Source	-	-	ms	-
T_5	Source	-	-	ms	-
T_6	Source	-	-	ms	-
T_7	Sink	0	50	ms	-
T_8	Source	-	-	ms	LGD recommend Min 200ms
T_9	Source	-	-	ms	

Symbol	Required By	Limits		Units	Notes
		Min	Max		
T_{10}	Source	0	500	ms	-
T_{11}	Source	-	10	ms	-
T_{12}	Source	500	-	ms	-
T_{13}	Source	0.5	10	ms	-
T_{14}	Source	0.5	10	ms	-
T_{15}	Source	10	-	ms	-
T_{16}	Source	40	-	ms	-
T_{17}	Source	0	-	ms	-
T_{18}	Source	0	-	ms	-
T_D	Sink		1700	ms	Compensation Enable case

Note) 1. Do not insert the mating cable when system turn on.
2. Valid Data have to meet "3-3. eDP Signal Timing Specifications"
3. Video Signal, EL_EN and PWM need to be low condition on invalid status.
4. LGD recommend the rising sequence of VEL after the Vcc and valid status of Video Signal turn on.

7. Touch Specification

7.1 Electrical Characteristics

7.1.1 Absolute Maximum Rating

Item	Symbol	Min.	Max.	Unit	Note
TP power supply Input	USB_5V	0	+5	V	
Operating temperature	T_{OP}	-0	+50	℃	
Storage temperature	T_{ST}	-20	+60	℃	

7.1 USB TIMING

TBD

8. Quality Level

8.1 AMOLED Module of Characteristic Inspection

The environmental condition and visual inspection shall be conducted as below:

8.1.1 Inspection conditions

Test conditions: OLED is not light, cold white fluorescent lamp, illumination 1000 ± 200lux; OLED lighting source shall not be higher than 200lux, with black background around.

8.1.2 Inspection distance: the standard observation distance of all surfaces of the tested object is 30cm ± 5cm.

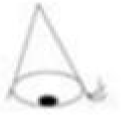
8.1.3 Inspection angle: the angle between the product and the horizontal plane is 45 °, and the eyes are perpendicular to the inspection plane. During inspection, the product needs to rotate 45 ° up, down, left and right. The observation line of sight needs to be within the half section of the cone. The observation angle is 45 ° with the vertical axis of the product apex. The central axis of the cone must be standard and perpendicular to the product surface and pass through the fluorescent lamp; For non-conventional display defects (including but not limited to local bright lines or local floodlights), the observation angle is 75 degrees from the normal of the product surface; Full visual angle of appearance.

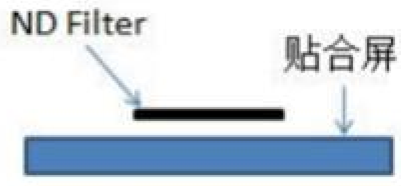
8.1.4 Inspection time: the inspection time without lighting is at least 10-12 seconds; The time of OLED lighting inspection for each picture is 1~3 seconds. If the defect is still not visible within the specified time, the inspection piece is deemed to be qualified.

8.1.5 Test temperature: room temperature 15-35 ℃, ambient humidity: 20-75% RH.

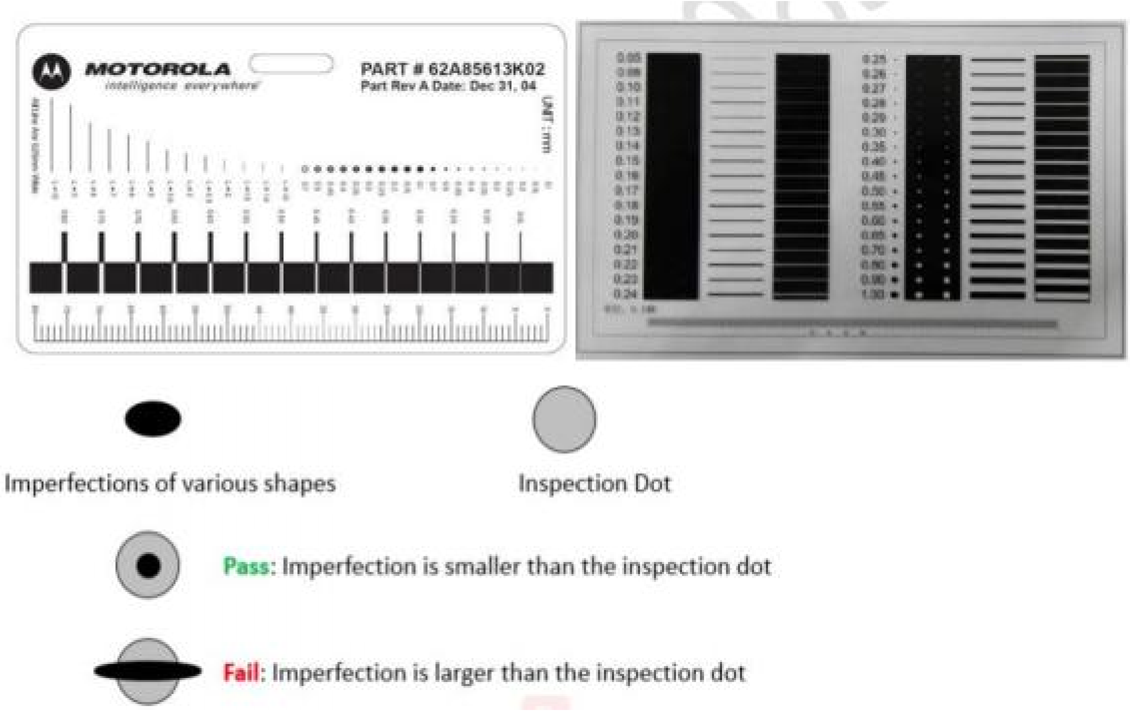
8.1.6 Inspection tools:

ND Filter: The ND Filter is placed at a distance of 2-3 cm above the defect for 2-3s to judge whether the defect is visible. As Figure below: (ND Filter is used to test mura isochromatic and light unevenness)





Point gauge (point gauge in the figure below is recommended), determination method: as shown in the figure, the point gauge film can cover is pass, and the point gauge film can not cover is Fail。 For example, a maximum of 0.2mm same-color spot defect is allowed on the Class A surface, and the pass that can be covered by 0.2mm on the film，The one that can be covered is Fail.



Pass: Imperfection is smaller than the inspection dot

Fail: Imperfection is larger than the inspection dot

Digital caliper: resolution 0.01mm.

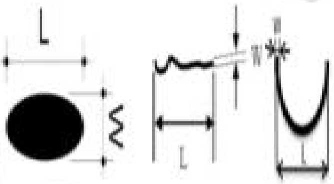
Projector: anime microscope, 3D projector.

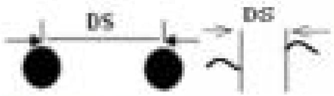
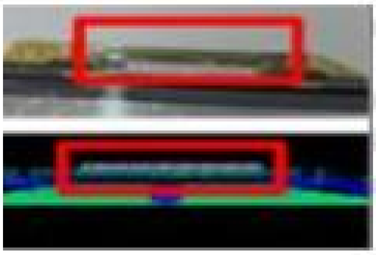
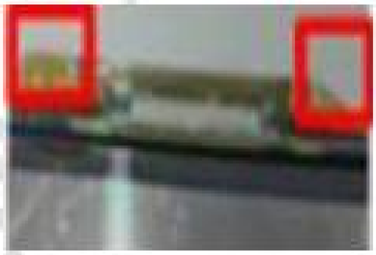
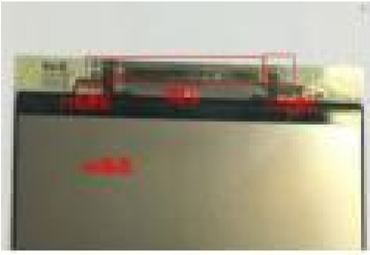
Judgment description

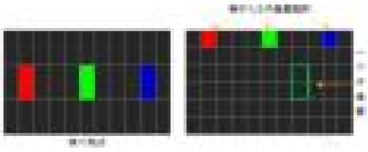
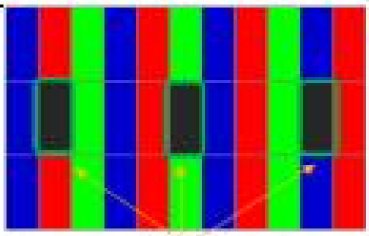
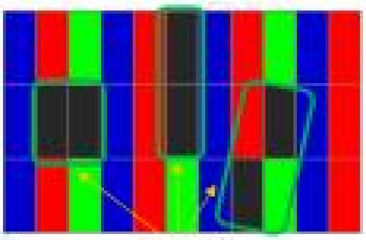
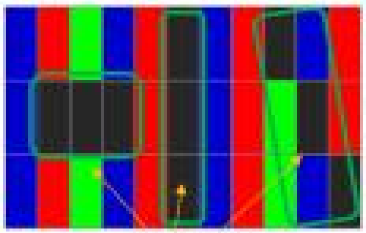
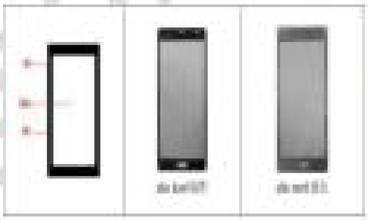
The measurement accuracy shall refer to the specification definition. When the measurement equipment accuracy is higher than the specification definition, the measured value needs to be rounded to the precision defined by the specificationthe. For example, the size of edge collapse is 0.20mm, and the thousandth is the reference position, which is rounded to 0.200mm~0.204mm is OK,>=0.205mm, it is judged as NG.

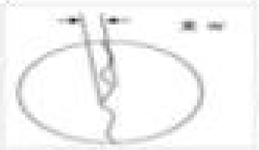
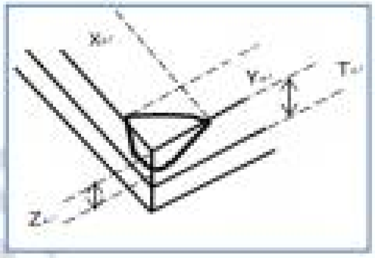
In addition to the tools used above, if additional inspection tools are needed to assist the judgment, they can only be carried out after the coordination of both parties.

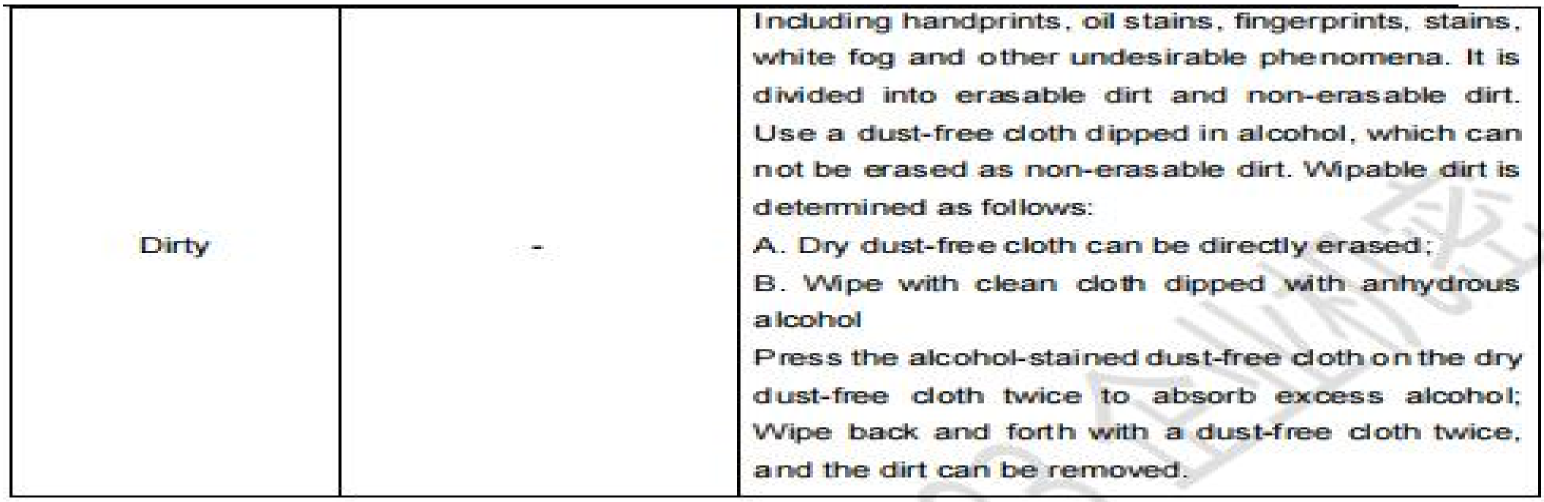
Bad code and definition

Code and name		legend	explain
N	Number	-	Visually calculate the number; The statistics of the total number of defects does not include the completely "omitted" part. For the column defined as "omitted" and "omitted", it is not counted as the number of defects if it meets the requirements, otherwise it is calculated as an independent defect.
L	Length (mm)		Dot line distinguishing rule: L is the long side, W is the short side A. When L ＞ 3W, handle as per line, otherwise handle as per point; B. When it is judged as line defect, S-shaped or C-shaped line appears, and the enclosed amount is less than 3/4 circle, it shall be treated as line defect; otherwise, it shall be treated as point defect, and the inner tangent circle shall simulate the size of point.
W	Width (mm)		
S	Area (mm^2)	-	Surface gauge
D	Diameter (mm) D=(L+W)/2	-	Point diameter calculation: calculated by half of the sum of the long side and the short side, that is,

			D=(L+W)/2, where D represents the diameter of the point, L is the long side, and W is the short side;
H	Depth (mm)	-	Digital micrometer
DS	Distance (mm)		Distance between two points or between two lines
Schematic diagram of screen area			AA area: display area; GA area: GIP circuit area; FA area: Frit area; OA area: outside FA area
Leader area			Screen GIP circuit area, screen data circuit area
PAD Bangding District			COG/FOG Bonding alignment mark and Bonding Pad on LTPS substrate
PAD Non-state area			Screen test pad, cutting area and lead-free area on LTPS substrate
CT crimping area			Pin end screen test pad

Highlights		A single sub-pixel (or red, or green, or blue) of one pixel is called a point; The definition of bright spot is that in the environment of 200 ± 50 Lux, the pixels or dots seen by employees with naked eyes are always bright, and the bright spot is checked under the black screen
Scotoma	 单个暗点	A single sub-pixel (or red, or green, or blue) of one pixel is called a point; A dark point is defined as a point that is not bright in a single sub-pixel seen with naked eyes in a 100% white picture under the environment of 200 ± 50 Lux.
Dark spot - two connection	 暗点-二连接	Two adjacent sub-pixels under the magnifying glass are not bright at the same time (horizontal, vertical and oblique)
Dark Spot - Three Links	 暗点-三连接	The adjacent R, G and B sub-pixels under the magnifying glass are not bright at the same time (horizontal, vertical and oblique)
CG monomer area division		AA: Front visible area, black ink internal area; A: Black ink area; B: Cover plate edge; The front defect that runs through the AA area and the A area shall be judged according to the specification of the strictest area, and the back defect shall be judged according to whether the AA area is visible.
Foreign matter highlights	-	Due to the foreign matter in the polarizer, the phenomenon that appears as a bright spot is called a foreign matter bright spot

point defect		There are bright spots and black spots in local positions, including but not limited to the internal dirt of the screen itself, pinholes, serrations, concave-convex spots, color spots, tiny bubbles, white spots, stains on the fitting of the polarizer, poor polarizer itself and other spot-like defects. Point defects are judged by diameter.
Linear defect		Linear impurities in the screen, including filaments, fibers, polarizer fitting impurities in the screen, and scratches on the surface of polarizer, etc. Linear defects are judged by length and width. Sensible scratch: also known as hard scratch, is a deep scratch on the surface, which is felt by hand. Senseless scratch: also known as fine scratch, no deep scratch on the surface, no feeling when touching.
Serrated defect		W: Distance from sawtooth crest to trough
Edge collapse/angle collapse		In the process of screen production, especially in the process of molding and cutting, the small glass missing at the glass edge is caused. X direction: parallel to FOG Pad or glass edge; Y direction: perpendicular to FOG Pad or glass edge; Z direction: screen thickness direction; T : The thickness of single-layer glass;
Pitting	-	In the unit area of 10mm * 10mm, the defect point with D ≤ 0.1mm, DS ≥ 2mm, and the number N ≥ 5. If the customer has other requirements, follow the customer's requirements.



Dirty	-	Including handprints, oil stains, fingerprints, stains, white fog and other undesirable phenomena. It is divided into erasable dirt and non-erasable dirt. Use a dust-free cloth dipped in alcohol, which can not be erased as non-erasable dirt. Wipable dirt is determined as follows: A. Dry dust-free cloth can be directly erased; B. Wipe with clean cloth dipped with anhydrous alcohol Press the alcohol-stained dust-free cloth on the dry dust-free cloth twice to absorb excess alcohol; Wipe back and forth with a dust-free cloth twice, and the dirt can be removed.

8.2 Sampling Procedures for Each Item Acceptance Table

Critical Defect (CR): any defect that directly or indirectly affects human health and safety, or the function of the product is lost.

Major Defect (MA): directly or indirectly affect the product function, or make part of the product function lost, and other customers do not acceptable defects.

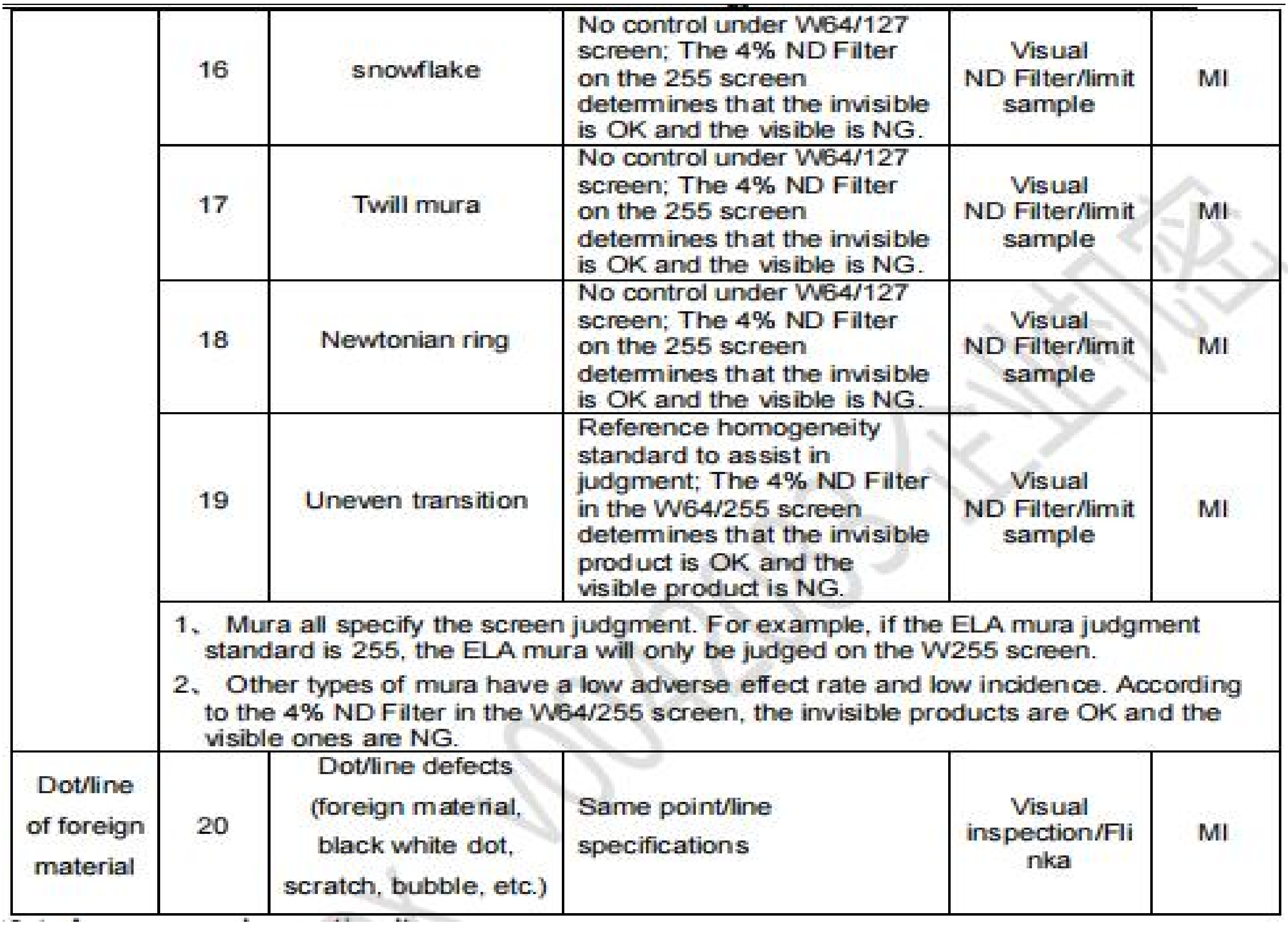
Minor Defect (MI): appearance defect that does not affect product function and can be accepted by customers.

Defect Type	Sampling Procedures	AQL
Critical Defect (CR)	Take the normal inspection solution of the sampling plan of GB/T2828.1-2012 Inspection levelⅡ	0.065
Major Defect (MA)	Take the normal inspection solution of the sampling plan of GB/T2828.1-2012 Inspection levelⅡ	0.65
Minor Defect (MI)	Take the normal inspection solution of the sampling plan of GB/T2828.1-2012 Inspection levelⅡ	1.0

8.3 Telecommunications Inspection Item

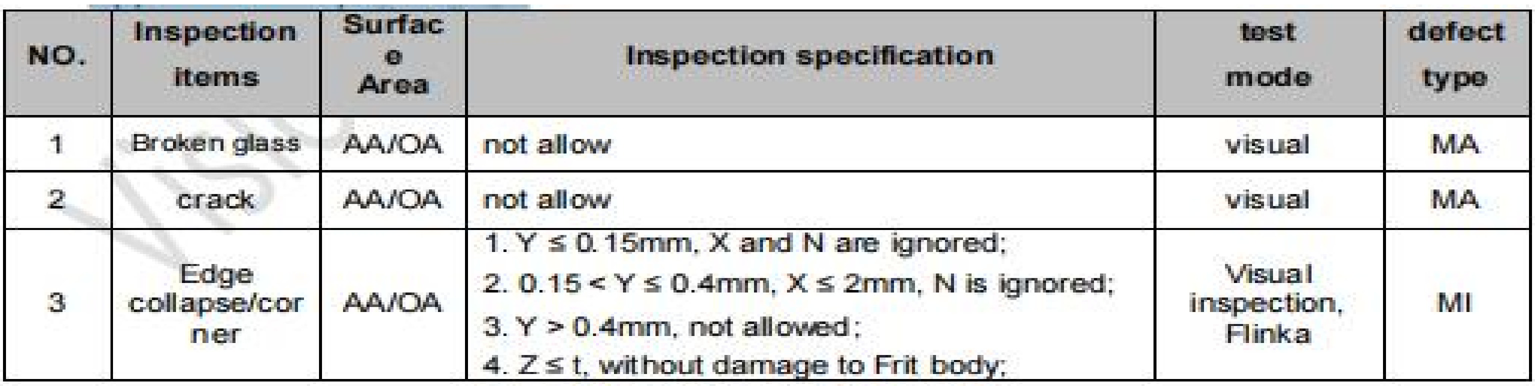
category	NO.	Inspection items	Inspection specification	test mode	defect type
	1	Display exception	not allow	visual	CR

Poor function	2	No display	not allow	visual	CR
	3	The picture flickers	not allow	visual	MA
TP function	4	TP test NG	not allow	visual	MA
Dot	5	Bright dot	not allow	visual	MI
	6	Partial Bright dot	ND6% or reference limit sample	visual	MI
	7	Dark dot	1.D≤0.15mm, ignored; 2.0.15mm < D≤ 0.2mm, DS ≥ 10mm, N ≤ 10; 3.D > 0.2mm,not allowed;	Visual inspection, Flinka	MI
Line	8	Bright line	not allow	visual	MA
	9	Dark line	not allow	visual	MA
	10	Slightly bright line	not allow	visual	MA
Mura	11	horizontal mura	No control under W64/127 screen; The 4%ND Filter on the 255 screen determines that the invisible is OK and the visible is NG.	Visual ND Filter/limit sample	MI
	12	vertical mura	No control under W64/127 screen; The 4% ND Filter on the 255 screen determines that the invisible is OK and the visible is NG.	Visual ND Filter/limit sample	MI
	13	White spot	No control under W64/127 screen; The 4% ND Filter on the 255 screen determines that the invisible is OK and the visible is NG.	Visual ND Filter/limit sample	MI
	14	Black spot	No control under W64/127 screen; The 4% ND Filter on the 255 screen determines that the invisible is OK and the visible is NG.	Visual ND Filter/limit sample	MI
	15	Color mura	4% ND Filter in W64/255 screen determines that the invisible is OK and the visible is NG	Visual ND Filter/limit sample	MI

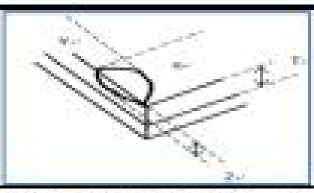
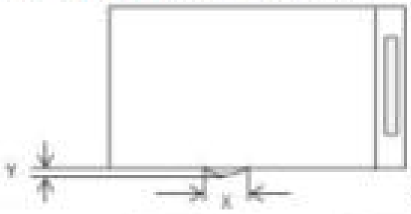


	16	snowflake	No control under W64/127 screen; The 4% ND Filter on the 255 screen determines that the invisible is OK and the visible is NG.	Visual ND Filter/limit sample	MI
	17	Twill mura	No control under W64/127 screen; The 4% ND Filter on the 255 screen determines that the invisible is OK and the visible is NG.	Visual ND Filter/limit sample	MI
	18	Newtonian ring	No control under W64/127 screen; The 4% ND Filter on the 255 screen determines that the invisible is OK and the visible is NG.	Visual ND Filter/limit sample	MI
	19	Uneven transition	Reference homogeneity standard to assist in judgment; The 4% ND Filter in the W64/255 screen determines that the invisible product is OK and the visible product is NG.	Visual ND Filter/limit sample	MI
	1、 Mura all specify the screen judgment. For example, if the ELA mura judgment standard is 255, the ELA mura will only be judged on the W255 screen. 2、 Other types of mura have a low adverse effect rate and low incidence. According to the 4% ND Filter in the W64/255 screen, the invisible products are OK and the visible ones are NG.				
Dot/line of foreign material	20	Dot/line defects (foreign material, black white dot, scratch, bubble, etc.)	Same point/line specifications	Visual inspection/Flinka	MI

8.4 Appearance Inspection Item



NO.	Inspection items	Surface Area	Inspection specification	test mode	defect type
1	Broken glass	AA/OA	not allow	visual	MA
2	crack	AA/OA	not allow	visual	MA
3	Edge collapse/corner	AA/OA	1. Y ≤ 0.15mm, X and N are ignored; 2. 0.15 < Y ≤ 0.4mm, X ≤ 2mm, N is ignored; 3. Y > 0.4mm, not allowed; 4. Z ≤ t, without damage to Frit body;	Visual inspection, Flinka	MI

					
4	flange	AA/OA	1. Y ≤ 0.2mm, X is uncontrolled; 2. Y > 0.2mm, not allowed; 	Visual inspection, Flinka	MI
5	Glass warp	Whole area	The product is placed horizontally on the front and back, and the lifting height at one end (plug gauge) ≤ 0.6mm	Visual inspection, Flinka	MI
6	Pin dirty	Bongding area	No control	visual	MI
7	Pin scratch	Bongding area	Scratches and whitening are found by visual inspection, and need to be rechecked with a microscope. The broken lead is not allowed, and the overlap is not allowed Note: CT pad area and pin non-bonding area are not controlled	visual	MI
8	PF film bump	LTPS	Touch is not allowed	visual	MI
9	PF film pinholes/pits	LTPS	No control	visual	MI
10	PF film scratch	LTPS	1. No scratch, no control; Scrape through, L<10mm; 2. The film shall be scraped through the exposed glass surface, referring to the lack of glue of PF film;	Visual inspection, Flinka	MI
11	PF film lacks glue	LTPS	50> 5mm, W>5mm not allowed	Visual inspection, Flinka	MI
12	PF membrane is dirty	LTPS	Wipable dirt needs to be wiped, and non-wipe dirt refers to the color difference of PF film;	visual	MI
13	PF film overflow	LTPS	1. Edge overflow W<0.2mm, acceptable; 2. W>0.2mm, not allowed;	Visual inspection, Flinka	MI

<table>
<tr><td rowspan="1">14</td><td>Color difference/stain (no convex touch)</td><td>LTPS</td><td colspan="12">No control</td><td>visual</td><td>MI</td></tr>
<tr><td>15</td><td>PF film gluing offset</td><td>LTPS</td><td colspan="12">1. Step area is not allowed;
2. Except for the step area, the rest shall be controlled by 0.5 ± 0.2mm;</td><td>Visual inspection, Flinka</td><td>MI</td></tr>
<tr><td>16</td><td>Screen body is dirty</td><td>LTPS</td><td colspan="12">1. The front can be wiped and the dirt can be wiped, and the polarizer of the dirt cover cannot be wiped;
2. The back is not controlled;</td><td>visual</td><td>MI</td></tr>
<tr><td rowspan="3">17</td><td rowspan="3">point defect</td><td rowspan="3">AA</td><td colspan="4">D（mm）</td><td colspan="4">DS（mm）</td><td colspan="4">Acceptable number</td><td rowspan="3">Visual inspection, Flinka</td><td rowspan="3">MI</td></tr>
<tr><td colspan="4">D≤ 0.15mm</td><td colspan="4">/</td><td colspan="4">Ignore</td></tr>
<tr><td colspan="4">0.15mm< D≤0.2mm</td><td colspan="4">DS≥10</td><td colspan="4">N≤10</td></tr>
<tr><td rowspan="6">18</td><td rowspan="6">Linear defect/foreign matter linear/non-inductive scratch</td><td rowspan="6">AA</td><td colspan="3">W（mm）</td><td colspan="3">L（mm）</td><td colspan="3">DS（mm）</td><td colspan="3">Acceptable number</td><td rowspan="6">Visual inspection, Flinka</td><td rowspan="6">MI</td></tr>
<tr><td colspan="3">W≤ 0.03</td><td colspan="3">L≤5</td><td colspan="3">≥10</td><td colspan="3">ignore</td></tr>
<tr><td colspan="3">0.03< W≤ 0.05</td><td colspan="3">L≤2</td><td colspan="3">≥10</td><td colspan="3">ignore</td></tr>
<tr><td colspan="3">0.03< W≤ 0.05</td><td colspan="3">2＜L≤5</td><td colspan="3">≥10</td><td colspan="3">N≤4</td></tr>
<tr><td colspan="3">W>0.05</td><td colspan="3">-</td><td colspan="3">/</td><td colspan="3">Not allowed</td></tr>
<tr><td colspan="3">-</td><td colspan="3">L>5</td><td colspan="3">/</td><td colspan="3">Not allowed</td></tr>
<tr><td rowspan="4">19</td><td rowspan="4">Point/Line defects</td><td rowspan="4">Camera hole area/Blind hole area</td><td colspan="6">D(mm)</td><td colspan="6">Acceptable number</td><td rowspan="4">Visual inspection, Flinka</td><td rowspan="4">MI</td></tr>
<tr><td colspan="6">D≤0.15</td><td colspan="6">ignore</td></tr>
<tr><td colspan="6">0.15＜D≤0.2</td><td colspan="6">ignore</td></tr>
<tr><td colspan="12">D>0.2</td></tr>
<tr><td>20</td><td>Newton rings（Blind hole area）</td><td>Camera hole area/Blind hole area</td><td colspan="12">Not control</td><td>Visual inspection</td><td>MI</td></tr>
<tr><td>21</td><td>offset</td><td>Camera hole</td><td colspan="12">The metal ring extends inward 0.1mm ,ingore</td><td>Visual inspection</td><td>MI</td></tr>
</table>

		area/Blind hole area			
22	Blind hole color bias(same color)	Camera hole area/Blind hole area	Functional requirements such as transmittance and PV value are met,not control appearance	Visual inspection	MI
23	Protective film scratch	Whole area	No control under no hurt boby	Visual inspection	MI
24	Protective film starved/overflow glue/burr	Whole area	No control under no hurt boby	Visual inspection	MI
25	Dirt inside the protective film	Whole area	Not allowed	Visual inspection	MI
26	Easy to tear	Cover front	Function is invalid, damaged, leaked not allowed Wrinkles, bumps, dirt, punching bad, burr, overflow glue is not controlled	Visual inspection	MI
27	Polarizer edge overflow	AA	W≤0.35mm , Not control; W>0.35mm, Not allowed.	Visual inspection, Flinka	MI
28	Polarizer concave convex point	AA	convex point: D ≤ 0.2mm or refer to limit sample concave point: D≤3mm, DS≥10mm, N≤3 or refer to limit sample	Visual inspection, Flinka	MI
29	Polarizer fold / indentation	AA	Does not affect the display as OK or refer to limit sample;	Visual inspection	MI
30	Polarizer chromatism	AA	No control	Visual inspection	MI
31	IC chip	IC	Not allowed	Visual inspection	MI
32	FPC body defect	FPC	1. The parts on the FPC must be consistent with the product BOM table, and there are incorrect, multiple, or missing parts, which are not allowed; Polarities such as capacitors and inductors should not be soldered backwards or crooked; 2. FPC scratches/scratches are based on the absence of exposed copper; 3. Creases/Indentations: Indentations in the circuit area should not cause the back of the	Visual inspection	MI

			covering film to turn white; Non line area indentation should not cause FPC damage 4. Except for the golden finger. FPC foreign object: a. Spot shape: D ≤ 0.5mm, N ≤ 3; b. Linear: length and width ≤ 0.3 * 5mm;		
33	FPC gold finger defect	Golden Finger Region	1. Golden finger cracking: The length and width of the crack/damage at the top of the golden finger ≤ the line width; 2. Gold finger copper leakage: W ≤ 1/3 line width, L ≤ line width, unlimited quantity 3. Gold finger gap W1 ≤ 1/3 line width W, length L1 ≤ 1/2 line width W, unlimited quantity, all of the above conditions are met and allowed; 4. Gold finger pressure/scratch should not expose copper, there should be no unevenness, and there should be no depth visible to the naked eye, which does not affect assembly and is acceptable; 5. Gold fingers should not have sharp creases or dead folds; 6. FPC gold fingers should not have oxidation, blackening, burns, or browning;	Visual inspection	MI
34	connector	connector	There should be no tin or residual solder beads on the connector, and there should be no tin connection on the connector pins; PIN deformation shall be controlled within 0.05mm; Does not affect the lighting function; Visual inspection of pin breakage, pin detachment, and deformation of the outer frame is not allowed;	Visual inspection	MI
35	Insulating tape	Bonding area	There must be no obvious wrinkles or bubbles	Visual inspection	MI
		Component area	1. Scratches and glue splashes are uncontrollable; 2. Do not wipe dirt or dirt; 3. The offset of the insulation tape should not exceed the edge of the product, and other requirements should be determined based on the drawing; 4. Burr edges, no control over glue overflow;		

			5. Damaged, incomplete, or missing labels are not allowed;		
36	Composite tape	All	1. It is not allowed for the composite tape to leak out of the edge of the screen body; 2. Folding of composite tape, light leakage during assembly, or affecting assembly and thickness are not allowed; 3. Damaged composite tape is not allowed; 4. The size of the composite tape cutting defect does not meet the requirements of the drawing and cannot be controlled; 5. Composite tape should not be wiped with dirt or foreign objects, and foreign objects should follow the dotted line standard; 6. The burrs of the composite tape should not exceed the edge of the screen body, regardless of control; 8. Composite adhesive tape with no control over glue splashes or overflow; 9. Composite tape bubbles: D ≤ 5mm, N not included; 10. Composite tape bumps: acute angle bumps D ≤ 0.3mm, N ≤ 3; Smooth concave convex points D ≤ 0.8mm, N ≤ 3; 11. Composite tape foreign object (foreign object between copper foil and blue film): D ≤ 0.3mm, N ≤ 3; 12. Edge sawtooth of composite tape: 0.5 * 3mm, N ≤ 3; 13. The color difference of the protective film in the composite tape is not controlled; 14. Copper foil indentation and dead bending in composite tape are not allowed, which does not affect assembly and thickness control; Or reference limit sample; 15. No control of foreign objects/dents in copper foil in composite tape;	Visual inspection	MI
37	OCA overflow	All	Not allowed within AA area; Externally visible: Control standard ⩽ 0.15mm	Visual inspection	MI

38	Sealing glue	Pin	1. Broken adhesive is not allowed, and the circuit cannot be exposed. 2. The thickness of the colloid shall not be higher than the POL surface. 3. Bubble diameter<1mm. 4. Other: According to the drawings and work instructions.	Visual inspection	MI
39	Conductive cloth	All	1. Conductive cloth dirt: D ≤ 5mm, N ≤ 2; 2. Conductive cloth bubbles: D ≤ 2mm, N ≤ 2; 3. Conductive cloth foreign object: D ≤ 1mm, N ≤ 3; 4. Folding of conductive fabric: N ≤ 2;	Visual inspection	MI
40	Copper foil	All	Copper foil sticking is not allowed to leak out of the edge of the screen body; Abnormal color of copper foil refers to standard samples/sealed samples, and damage is not allowed. Soft scratches on the surface are not controlled.	Visual inspection	MI
41	QR code	QR code	It is not allowed to be unable to scan or difficult to scan (recognition can only be achieved after three consecutive scans), with a clear appearance, no blurring, missing printing, and other defects	Visual inspection	MI
42	Package	Other	Products should put into the anti-static trays, with non-overlapping, and the trays should be staggered placed.	visual	-
			Different products cannot be mixed into the same inner package.		
			The package should not have obvious defomation or breakage .The printing labels type and quantity are correct.		
			The package should have QC signature. ROHS label is needed if the product is under ROHS control.		
43	Boundary dimension NG	Other	It is not allowed to exceed the dimensional tolerance required by the specifications and drawings	Calipers, measuring instruments	-

8.5 Inspection picture library

Serial number	picture	Picture name	Mainly judged as defective	remarks
1	▓	W_GRAD(64) 64 gray scale	Point/line type, foreign matter point/line, mura type	/
2	▒	W_GRAD(128) 128 gray scale	Point/line type, foreign matter point/line, mura type	/
3	⬜	WHITE white	Point/line type, foreign matter point/line, mura type	/
4	⬛	Black black	Bright spot, bright line, dark mura	/
5	🟥	RED red	Point type, line type, foreign matter point/line	/
6	🟩	GREEN green	Point type, line type, foreign matter point/line	/
7	🟦	BLUE blue	Point type, line type, foreign matter point/line	/

Note: The actual sequence and lock seconds of the screen can be adjusted according to the customer's requirements and the needs of the factory.

9. Reliability Test Result

Item	Condition	Inspection after test
High Temperature Operating	50℃,96H	IEC60068-2-2,GB2423.2
Low Temperature Operating	0℃, 96HR	IEC60068-2-1 GB2423.1
High Temperature Storage	60℃, 96HR	IEC60068-2-2 GB2423.2
Low Temperature Storage	-20℃, 96HR	IEC60068-2-1 GB2423.1
High Temperature & High Humidity Storage	+60℃, 90% RH ,96 hours.	IEC60068-2-78 GB/T2423.3
Thermal Shock (Non-operation)	0℃,30 min ↔ 50℃,30 min, Change time:5min 20CYC.	Start with cold temperature, End with high temperature, IEC60068-2-14,GB2423.22

Note： Product reliability items in the form of GK are used as reference items. The test results shall refer to the results of the reliability test of Visionox standards.

10. Cautions and Handling Precautions

10.1 Handling Precautions:

(1) The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from height..

(2) Do not press down the screen or the adjoining areas too hard because the color tone may be shifted.

(3) The polarizer covering the display surface of the AMOLED module is soft and easily scratched. Handle this polarizer carefully.

(4) If the display surface is contaminated, blow on the surface and gently wipe it with a soft dry cloth. If it is still not completely clear, moisten the cloth with ethyl alcohol.

(5) Solvents may damage the polarizer. Do not use water, ketone or aromatic solvents except ethyl alcohol.
Do not attempt to disassemble the AMOLED Module.

(6) If the logic circuit power is off, do not apply the input signals.

(7) To prevent destruction from static electricity, be careful to maintain an optimum working environment.

(8) Be sure to make yourself in contact with the ground when handling with the AMOLED Modules.

(9) Tools required for assembly, such as soldering irons, must be properly ground.

(10) To reduce the generation of static electricity, do not conduct assembly or other work under dry conditions.

(11) To protect the display surface, the AMOLED Module is coated with a film. Be careful when peeling off this protective film, because static electricity may generate.

10.2 Storage Precautions.

(1) When storing the AMOLED modules, be sure that they are not directly exposed to the sunlight or the light of fluorescent lamps.

(2) The AMOLED modules should be stored under the storage temperature range. If the AMOLED modules will be stored for a long time, the recommended condition is: Temperature: 0℃~40℃ Relatively humidity: ≤80%

(3) The AMOLED modules should be stored in the room without acid, alkali or harmful gas.

10.3 Transportation Precautions:

(1) The AMOLED modules should not be suffered from falling and violent shocking during transportation. Besides, excessive press, water, damp and sunshine, should be avoided.

11. Packing

----TBD--------------