

 EverDisplay Optronics (Shanghai) Limited	Confidential
	Page: 1/19
Product Specification	Doc No:
	Ver No: 01

AMOLED

Product Specification

Model Name: ED178AM368MS

Description: 1.78"

Doc. Version: 01

Customer: 公版

- Approved for Preliminary Specification
- Approved for Final Specification
- Approved for Final Specification & Sample

Prepared	Checked	Approved
张羽	段钰	陈晟

Customer's Approval

 EverDisplay Optronics (Shanghai) Limited	Confidential
	Page: 2/19
Product Specification	Doc No:
	Ver No: 01

Version History			
Version. No	Date	Contents	Remark
01	2019-01-09	First Draft	

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 EverDisplay Optronics (Shanghai) Limited	Confidential
	Page: 3/19
Product Specification	Doc No:
	Ver No: 01

Contents

1	Scope.....	4
2	Features	4
2.1	Product Applications	4
2.2	Product Features	4
3	Mechanical Specifications	4
4	Maximum Rating	4
5	Electrical Specifications.....	5
5.1	Electrical Characteristics	5
5.2	TP IC Recommended Operating Conditions	6
5.3	I/O Connection	7
5.4	Graphic memory writing direction	8
5.5	Recommended Operating Sequence.....	8
6	Electro-Optical Specification.....	12
7	Reliability.....	17
7.1	Environmental Test.....	17
7.2	Electrical Test	17
7.3	Mechanical Test.....	17
8	Outline Dimension Drawing	18
9	Packing Specification.....	19
10	The Control of Hazardous Substances.....	19

 EverDisplay Optronics (Shanghai) Limited	Confidential
	Page: 4/19
Product Specification	Doc No:
	Ver No: 01

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

2.1 Product Applications

Smart Watch

2.2 Product Features

- 1) Display color: 16.7M (RGB x 8bits)
- 2) Display format: 1.78"(368RGBx448)
- 3) Pixel arrangement: Real RGB arrangement
- 4) Interface: MIPI/SPI

3 Mechanical Specifications

Item	Specification	unit
LTPS Glass outline	30.6*37.99	mm
Encapsulation Glass outline	30.6*37.24	mm
Number of dots	368(W) x RGB x 448(H)	dots
Active area	28.7*34.94	mm
Diagonal size	1.78	inch
Pixel pitch	78*78	μm
Glass thickness (LTPS/Encap. glass)	0.2 / 0.3	mm
Weight	TBD	g

4 Maximum Rating

Parameter	Symbol	Spec			Unit	Note
		Min.	Typ.	Max.		
Analog/boost power voltage	VCI	-0.3	-	5.5	V	-
I/O voltage	VDDIO	-0.3	-	5.5	V	-
Operating temperature	Top	-20	-	70	°C	-
Storage temperature	Tstg	-40	-	80	°C	-

 EverDisplay Optronics (Shanghai) Limited	Confidential
	Page: 5/19
Product Specification	Doc No:
	Ver No: 01

5 Electrical Specifications

5.1 Electrical Characteristics

Power Characteristic:

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Battery power Voltage	Vbat	2.9	3.7	4.8	V	-
Digital Power supply	VDDIO	1.65	1.8	1.95	V	Ref

1) Normal Mode

Power Supply: VDDIO=1.8V Vbat=3.7V

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

Display Condition	Symbol	Min.	Typ.	Max.	Unit	Remark
100% Pixel On,350nits	Normal mode	-	186	210	mW	Ref

2) Idle Mode

Power Supply: VDDIO=1.8V Vbat=3.7V

Frame Frequency: $F_{frame}=15\text{HZ}$ @ 25degC, Brightness 30 nits,

Display Condition	Symbol	Min.	Typ.	Max.	Unit	Remark
10% Pixel On,30nits	Idle mode	-	12	16	mW	Ref

3) Deep Standby Mode

Display Condition	Symbol	Min.	Typ.	Max.	Unit	Remark
All Pixel Off,0nits/ Vci off/Vddio on	Standby mode	-	-	50	μW	-

5.1.2 Driver IC

RM69090 (refer to the datasheet).

5.2 TP IC Recommended Operating Conditions

Touch IC: TMA525C (refer to the datasheet)

Symbol	Description	Min	TYP	MAX	UNIT
VCCA	Analog power supply voltage	2.7	2.8	3.6	V
V _{IN} (I2C)	Input voltage range	0	-	3.6	V
V _{OUT} (I2C)	Output voltage range	0	-	3.6	V
V _{IN} (INT)	Input voltage range	0	-	3.6	V
V _{OUT} (INT)	Output voltage range	0	-	3.6	V
V _{OUT} (TX)	Output voltage range	0	-	VCCA	V
V _{OUT} (RX)	Input voltage range	0	-	VCCA	V



 EverDisplay Optronics (Shanghai) Limited	Confidential
	Page: 7/19
Product Specification	Doc No:
	Ver No: 01

Item	Spec	Remark
Operating voltage	2.7-3.6V	
Operating current	2mA	
Linearity	Center part $\leq 1\text{mm}$	Test tool: $\phi 7\text{mm}$ copper cylinder
	The peripheral position $\leq 2\text{mm}$	
Sensitivity	No broken line	Lineation with 5mm/s & 20mm/s respectively by $\Phi 7\text{mm}$ copper cylinder
Response time	$\leq 10\text{ms}$	

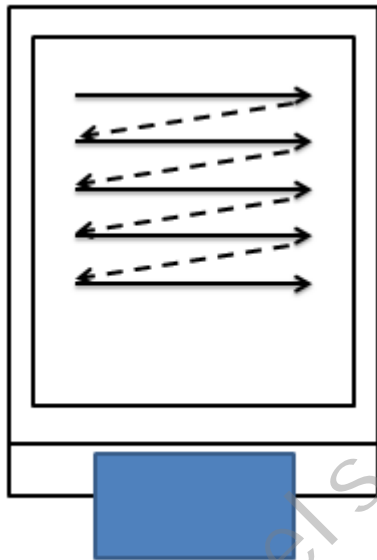
5.3 I/O Connection(TBD)

#	Pin name	I/O	Description
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
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 EverDisplay Optronics (Shanghai) Limited	Confidential
	Page: 8/19
Product Specification	Doc No:
	Ver No: 01

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24			

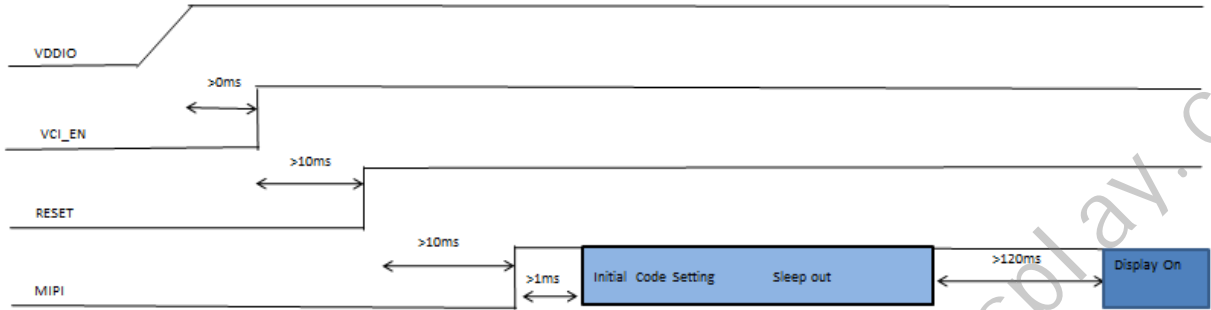
5.4 Graphic memory writing direction



5.5 Recommended Operating Sequence

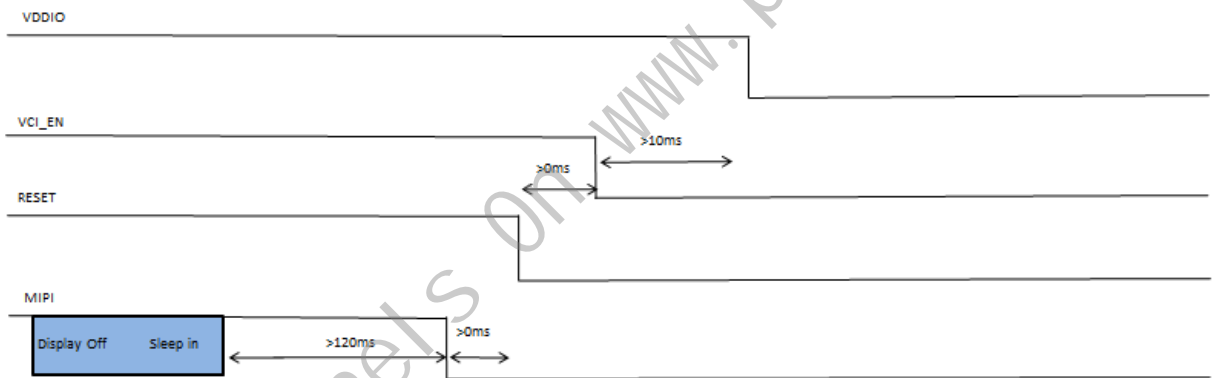
5.5.1 Power on sequence

Power On Sequence



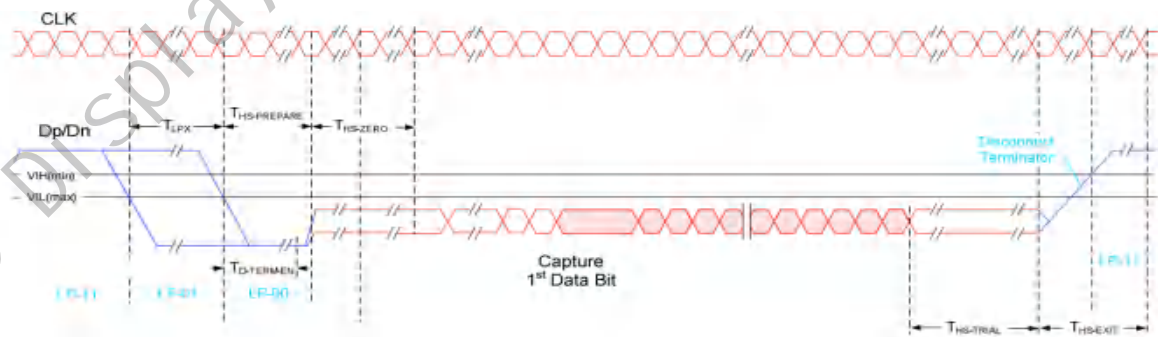
5.5.2 Power off sequence

Power Off Sequence



5.5.3 AC Characteristics (MIPI)

HS Data Transmission Burst



HS Clock Transmission

 EverDisplay Optronics (Shanghai) Limited	Confidential
	Page: 11/19
Product Specification	Doc No:
	Ver No: 01

	associated Data Lane beginning the transition from LP to HS mode.				
TCLK-SETTLE	Time interval during which the HS receiver shall ignore any Clock Lane HS transitions, starting from the beginning of TCLK-PRE.	95	-	300	ns
TCLK-TERM-EN	Time for the Clock Lane receiver to enable the HS line termination, starting from the time point when Dn crosses VIL,MAX.	Time for Dn to reach VTERM-EN		38	ns
THS-SETTLE	Time interval during which the HS receiver shall ignore any Data Lane HS transitions, starting from the beginning of THSPREPARE.	85 ns + 6*UI		145 ns + 10*UI	ns
TEOT	Time from start of THS-TRAIL or TCLK-TRAIL period to start of LP-11 state	-	-	105ns+48*UI	ns
THS-EXIT(1)	time to drive LP-11 after HS burst	100	-	-	ns
THS-PREPARE	Time to drive LP-00 to prepare for HS transmission	40ns + 4*UI	-	85ns+6*UI	ns
THS-PREPARE + THS-ZERO	THS-PREPARE + Time to drive HS-0 before the Sync sequence	145ns + 10*UI	-	-	ns
THS-SKIP	Time-out at RX to ignore transition period of EoT	40	-	55ns+4*UI	ns
THS-TRAIL	Time to drive flipped differential state after last payload data bit of a HS transmission burst	60 + 4*UI	-	-	ns
TLPX	Length of any Low-Power state period	50	-	-	ns
Ratio TLPX	Ratio of TLPX(MASTER)/TLPS(SLAVE)	2/3	-	3/2	ns

	between Master and Slave side				
TTA-GET	Time to drive LP-00 by new TX	5*TLPX	5*TLPX	5*TLPX	ns
TTA-GO	Time to drive LP-00 after Turnaround Request	4*TLPX	4*TLPX	4*TLPX	ns
TTA-SURE	Time-out before new TX side starts driving	TLPX	-	2*TLPX	ns

Timing requirements for RESETB

When RESETB of the reset pin equals to Low, it will be in the condition of reset.

When it is in the condition of reset, it will make the device recover the initial set.

However, in order to avoid the reset noise cause reset, there is a mechanism to judge about whether the reset is needed or not.

The closed interval of Low can be shown as the following.

(Test condition: VDDIO=1.65V~3.6V, VSS=0V, TA=-20°C~+70°C)

Parameter	Symbol	Conditions	Spec			Unit
			Min.	Typ.	Max.	
Reset low pulse width	Trst	-	20	-	-	μs

Table: Reset timing



6 Electro-Optical Specification

Test condition: 25°C±3°C, 65±20%RH, darkroom.

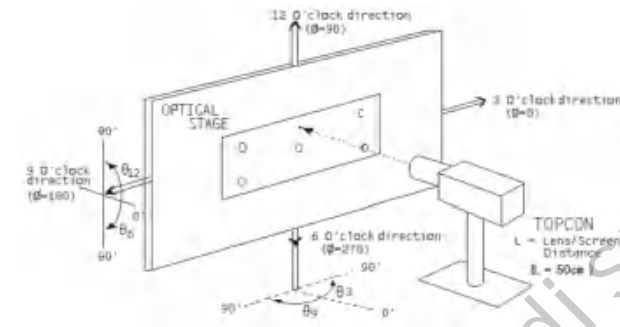
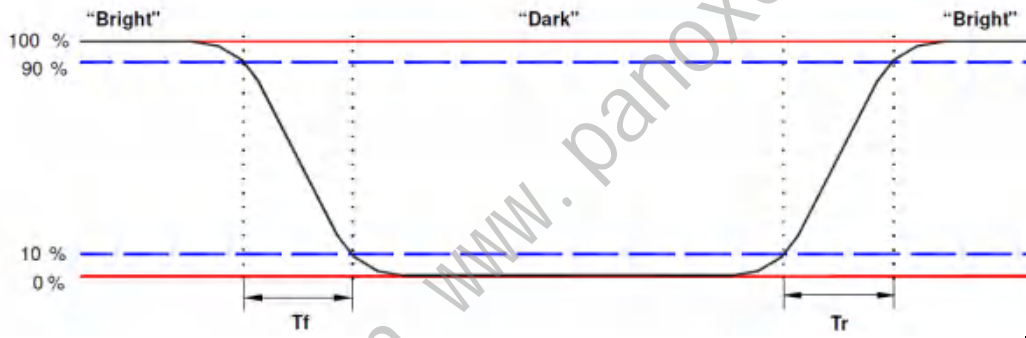
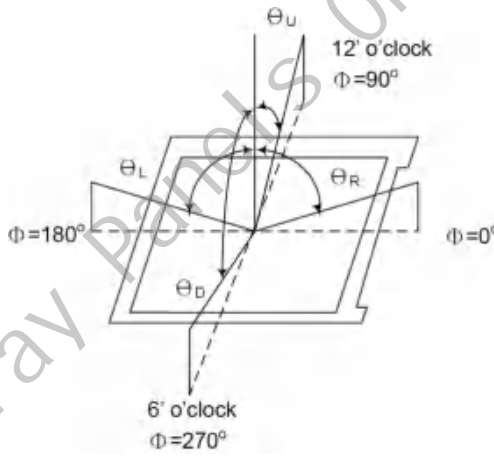
No	Item	Symbol	Condition	Value			Unit	Remark
				Min.	Typ.	Max.		
1	Brightness	L	Full white Without CG	315	350	385	cd/m ²	Note1.
2	Brightness Uniformity	UL	Full white	80	85	-	%	Note4
3	Contrast Ratio	CR	Normal θ=Φ=0°	10000	100000	-	-	Note3.
4	Response time	Ton+Toff	Normal θ=Φ=0°	-	2	4	ms	Note2.

 EverDisplay Optronics (Shanghai) Limited	Confidential
	Page: 13/19
Product Specification	Doc No:
	Ver No: 01

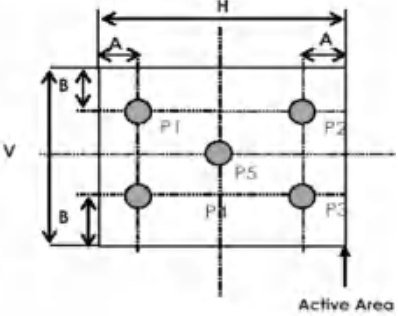
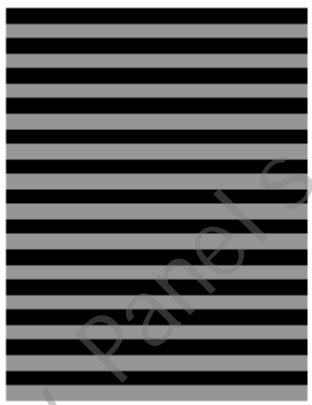
5	Color Coordinate of CIE1931	White	X	Normal $\Theta=\Phi=0^\circ$	0.28	0.30	0.32	-	Note1.
			Y		0.29	0.31	0.33		
		Red	X		0.648	0.688	0.728		
			Y		0.272	0.312	0.352		
		Green	X		0.17	0.22	0.27		
			Y		0.675	0.735	0.785		
		Blue	X		0.102	0.142	0.182		
			Y		0.002	0.042	0.082		
6	Color Gamut	NTSC	CIE1931	90	105	-	%		
7	Viewing Angle	Top/Bottom/Right/Left CR ratio ≥ 1000		80			°	Note3.	
8	Gamma	$\text{Log}(L_v - L_b) = \log(V) + \log(a)$ $V(\text{Gray}) = 48, 72, 104, 132, 164, 192, 224$ $\text{Lum}(\text{gray}255) = 350\text{nit}$		2.0	2.2	2.4	-		
9	Flicker	Normal $\Theta=\Phi=0^\circ$		-	-35	-30	dB	Note6.	
10	Crosstalk	-		-	-	4	%	Note7.	
11	Color shift	$\Theta_L = 30^\circ$			5	5.5			
12	OLED Life Time	0.95*(TYP brightness) At 25°C, with white color pattern		240			hrs	Note8.	
13	Image Retention	With 8*8 black-white chess board test image, lighting on with maximum luminance for 10min		8*8 black-white chess board 10min, to G128, 20s disappear					

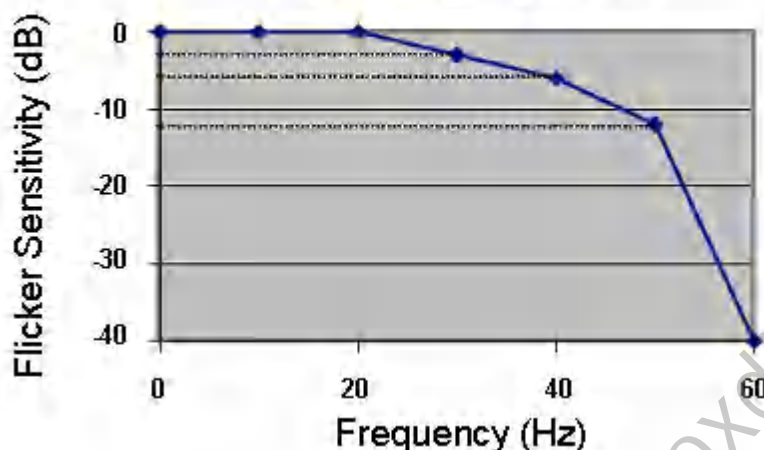
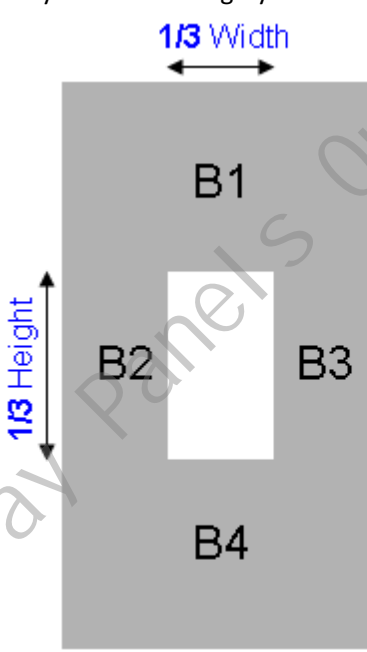

 EverDisplay Optonics (Shanghai) Limited	Confidential
	Page: 14/19
Product Specification	Doc No:
	Ver No: 01

See the note in the table below:

No	Item	Details
Note1	Brightness	
Note 2	Response time	
Note 3	Viewing Angle	 <p>Contrast Ratio Dark Room C.R=LW/LB LW: full white brightness of display center P0; LB: full black brightness of display center P0.</p>
Note 4	Brightness Uniformity	

 EverDisplay Optronics (Shanghai) Limited	Confidential
	Page: 15/19
Product Specification	Doc No:
	Ver No: 01

		 <p>A: 1/4H B: 1/4V H,V: Active Area</p>
Note 5	Luminance decrease ration	<p>Definition of Luminance decrease ratio Test pattern : Full White The luminance decrease ratio is calculated by using following formula:</p> $\text{Luminance decrease ratio} = 1 - \frac{\text{Luminance test at left, right, top, bottom}}{\text{Luminance test at left, right, top, bottom}}$
Note 6	Flicker	<p>Suggested Instruments: Konica Minolta CA-310 or Klein Instruments K-8</p>  <p>Odd row : L0 Black Even row : L186 gray level</p> <p style="text-align: center;">Flicker Test Pattern</p> <p>The flicker level is defined by Fast Fourier Transformation (FTT) as follows:</p> $\text{Flicker} = 20 \log_{10} \left(2 \frac{f_{FFTC}(n)}{f_{FFTC}(0)} \right) + FS(Hz) \quad (\text{dB})$ <p>Where $f_{FFTC}(n)$ is the n-th FFT coefficient. $f_{FFTC}(0)$ is the 0-th FFT coefficient which is DC component. $FS(Hz)$ is the flicker sensitivity as a function of frequency. The peak flicker level shall be reported based on the calculation using above formula in which $FS(Hz)$ is determined by the flicker weighing factor shown below.</p>

		<p style="text-align: center;">Flicker Weighing Factor</p>  <table border="1"> <caption>Flicker Weighing Factor Data</caption> <thead> <tr> <th>Frequency (Hz)</th> <th>Flicker Sensitivity (dB)</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td></tr> <tr><td>10</td><td>0</td></tr> <tr><td>20</td><td>0</td></tr> <tr><td>30</td><td>-2</td></tr> <tr><td>40</td><td>-5</td></tr> <tr><td>50</td><td>-10</td></tr> <tr><td>60</td><td>-40</td></tr> </tbody> </table>	Frequency (Hz)	Flicker Sensitivity (dB)	0	0	10	0	20	0	30	-2	40	-5	50	-10	60	-40
Frequency (Hz)	Flicker Sensitivity (dB)																	
0	0																	
10	0																	
20	0																	
30	-2																	
40	-5																	
50	-10																	
60	-40																	
<p>Note 7</p>	<p>Crosstalk</p>	<p>Crosstalk shall be calculated by the luminance of B1~B4 and G1~G4 in the patterns shown below.</p> <p>Box Pattern: L128 gray level background with a L255 White window in the central area.</p> <p>Gray Pattern: L128 gray level background only.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>Box Pattern</p> </div> <div style="text-align: center;">  <p>Gray Pattern</p> </div> </div> <p><i>Crosstalk</i></p> $\equiv \text{Maximum} : \left\{ \frac{ B1 - G1 }{G1}, \frac{ B2 - G2 }{G2}, \frac{ B3 - G3 }{G3}, \frac{ B4 - G4 }{G4} \right\} \times 100\%$																
<p>Note 8</p>	<p>Life Time</p>	<p>OLED life time is defined by the Minimum Duration Time that the luminance is decayed to a specific ratio (ex. 92%) of initial state.</p> <p>Test Pattern under duration period: L255 White</p>																

 EverDisplay Optronics (Shanghai) Limited	Confidential
	Page: 17/19
Product Specification	Doc No:
	Ver No: 01

7 Reliability

7.1 Environmental Test

Item	Main spec	No. of failures / No. of examinations
High Temperature Operation	70°C / 128hrs	0/10
Low Temperature Operation	-20°C / 128hrs	0/10
High Temperature Storage	80°C / 128hrs	0/10
Low Temperature Storage	-40°C / 128hrs	0/10
High Temperature Humidity Operation	60°C/93%RH/ 128hrs	0/32
Thermal Shock	-40°C~85°C dwell time=0.5hr, 50cycles.	0/10

7.2 Electrical Test

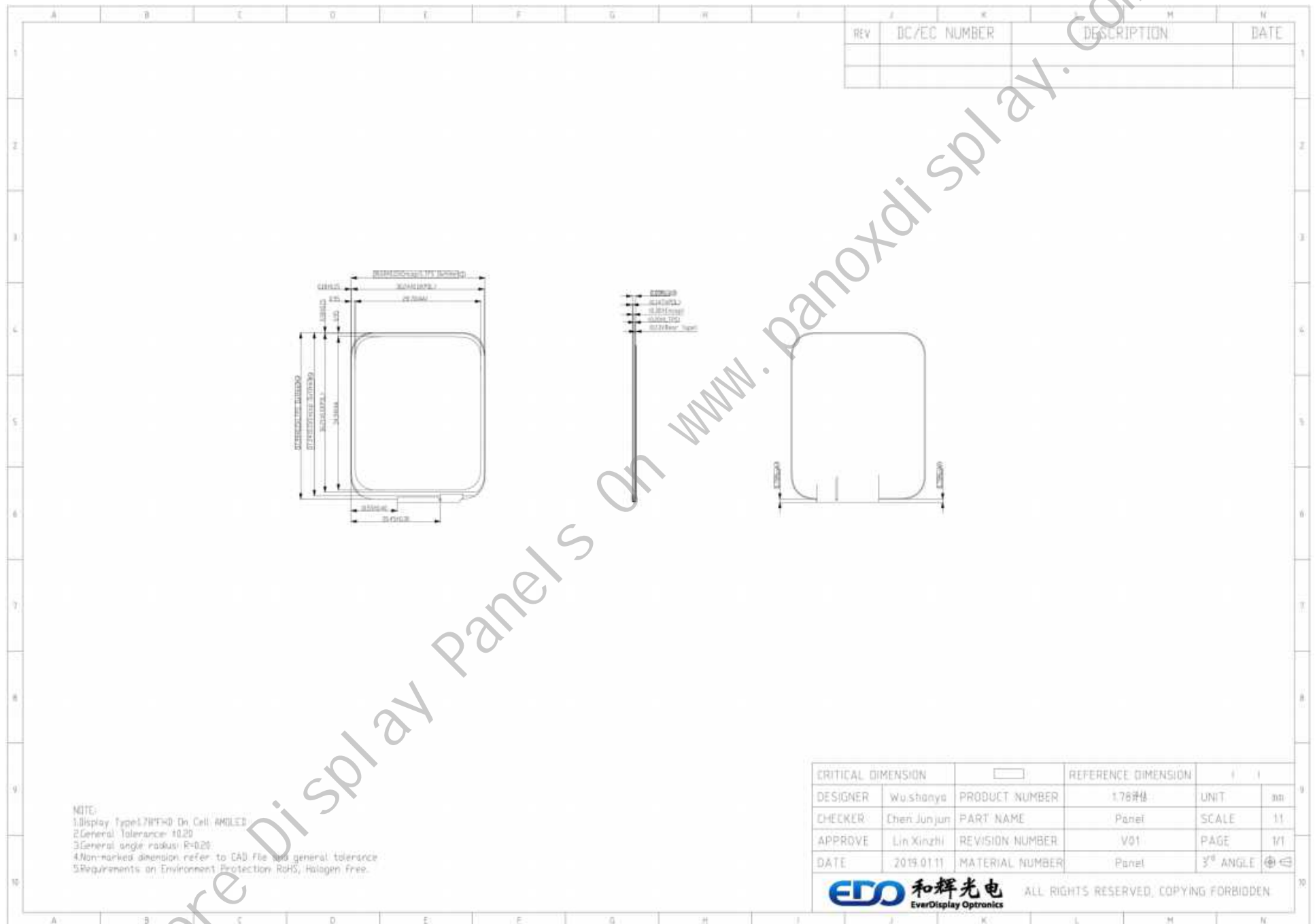
Item	Main spec	Note
Air Discharge	±4 kV , 150pF/330Ω (Module level; without CG)	5Points, Each 10times. After one time discharge, panel and gun touch the ground, through the whole test, turn on ion fan. No degradation of OLED performance after this test.
Contact Discharge	±2kV, 150pF/330Ω (Module level; without CG)	

7.3 Mechanical Test

Test item	Test condition	Note
Packing vibration-proof test	2g, f=10->55->10Hz apply in each of X, Y, and Z direction for 30 min	Package
Packing Drop test	Drop the packing from 60cm height, 6-faces, 3-edges and 1-corner(one time for each)	Package

 EverDisplay Optronics (Shanghai) Limited	Confidential
	Page: 18/19
Product Specification	Doc No:
	Ver No: 01

8 Outline Dimension Drawing



 EverDisplay Optronics (Shanghai) Limited	Confidential
	Page: 19/19
Product Specification	Doc No:
	Ver No: 01

9 Packing Specification

TBD

10 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, the latest version.

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