

# AMOLED SPECIFICATION

Part Number	USMP-A014-032036CBN-A1
Size	1.41"
Resolution	320 x 360
Brightness	350 cd/m <sup>2</sup>
Contrast	10000:1 (Min)
Viewing Angle	80/80/80/80 (Min)
Operating Temp.	-20 ~ 70°C

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## 1 Scope

This Specification defines AMOLED supplied by USMP, from here on refer as USMP. In the case of any unspecified item, it may require both USMP 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: 1.41 "(320RGBx360)
- 3) Pixel arrangement: Real RGB arrangement
- 4) Interface: MIPI

## 3 Mechanical Specifications

Item	Specification	unit
LTPS Glass outline	26.04x31.78	mm
Encapsulation Glass outline	26.04 x30.18	mm
Number of dots	320(W) x RGB x 360(H)	dots
Active area	23.84x26.82	mm
Diagonal size	1.413	inch
Pixel pitch	74.49 x 74.49	μm
Glass thickness (LTPS/Encap. glass)	0.2 / 0.3	mm
Weight	2.01	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	-

## 5 Electrical Specifications

### 5.1 Electrical Characteristics

#### 5.1.1 Power Characteristic:

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
AMOLED Power positive	ELVDD	4.55	4.6	4.65	V	-
AMOLED power Negative	ELVSS	-2.45	-2.4	-2.35	V	Ref
Digital Power supply	VDDIO	1.65	1.8	1.95	V	Ref
Analog Power supply	VCI	2.7	2.8	2.9	V	Ref

#### 1) Normal Mode

**Power Supply:** IOVCC=1.8V VCI=2.8V

**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	IELVDD /ELVSS	-	16	19	mA	Ref
	IVCI	-	6.0	7.2	mA	Ref
	IVDDIO	-	5.8	6.0	mA	Ref
50% Pixel On 175nits	IELVDD /ELVSS	-	8	9.5	mA	Ref
	IVCI	-	6.6	8	mA	Ref
	IVDDIO	-	5.8	6.0	mA	Ref

#### 2) Idle Mode

**Power Supply:** IOVCC=1.8V VCI=2.8V

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

Display Condition	Symbol	Min.	Typ.	Max.	Unit	Remark
10% Pixel On 30 nits	IELVDD /ELVSS	-	-	-	mA	Supplied by Driver IC
	IVCI	-	5	6.5	mA	Ref
	IVDDIO	-	0.5	1	mA	Ref

#### 3) Deep Standby Mode

Display Condition	Symbol	Min.	Typ.	Max.	Unit	Remark
Deep Standby	IVCI	-	-	3	uA	-
	IVDDIO	-	-	3	uA	-

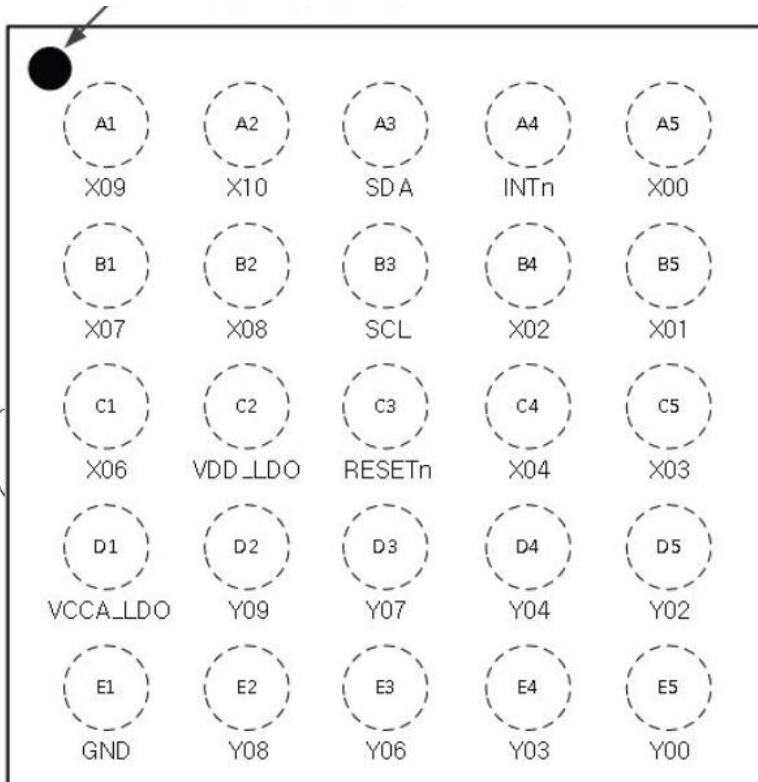
#### 5.1.2 Driver IC

**RM67162 (refer to the datasheet).**

## 5.2 TP IC Recommended Operating Conditions

Touch IC: ZTW522 (refer to the datasheet)

Symbol	Description	Min	TYP	MAX	UNIT
VCCA	Analog power supply voltage	2.7	3.3	3.6	V
V <sub>IN</sub> (I2C)	Input voltage range	0	-	3.6	V
V <sub>OUT</sub> (I2C)	Output voltage range	0	-	VBUS	V
V <sub>IN</sub> (INT)	Input voltage range	0	-	3.6	V
V <sub>OUT</sub> (INT)	Output voltage range	0	-	VBUS	V
V <sub>OUT</sub> (TX)	Output voltage range	0	-	3.3	V
V <sub>OUT</sub> (RX)	Input voltage range	0	-	3.3	V



25 Ball WLCSP (TOP VIEW) assignments

项目	规格	备注
Operating voltage	2.7-3.6V	
Operating current	2.5mA	
Linearity	Center part≤1mm	Test tool: φ6mm copper cylinder

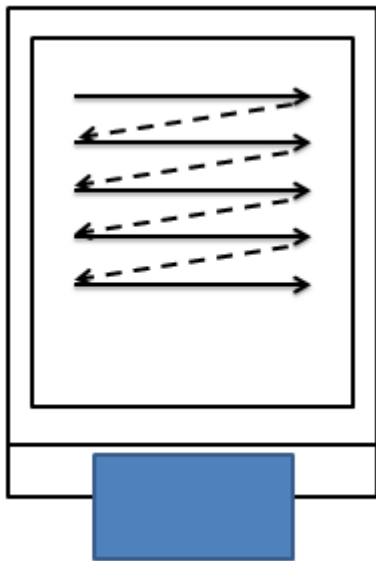
	The peripheral position $\leq 2\text{mm}$	
Sensitivity	No broken line	Lineation with 5mm/s&20mm/s respectively by $\Phi 6\text{mm}$ copper cylinder
Response time	$\leq 10\text{ms}$	

### 5.3 I/O Connection

#	Pin name	I/O	Description
1	ELVDD	Power	Power supply for OLED
2	ELVSS	Power	Power supply for OLED
3	VPP	Power	Power supply for OTP. Leave the pin to open when not in use.
4	GND_1	Power	GND
5	DSI_CLKN	I/O	MIPI DSI clock-
6	DSI_CLKP	I/O	MIPI DSI clock+
7	GND_2	Power	GND
8	XRES	I	This signal will reset the device and must be applied to properly initialize the chip. Active low.
9	VDD1	Power	Driver IC analog supply
10	TP_RESX	I	Reset
11	TP_SDA	I/O	I2C Data Line
12	TP_INT	I/O	Interrupt to Host
13	GF1	-	For customer's requirement
14	GF3	-	For customer's requirement
15	GND_3	Power	GND
16	GND_4	Power	GND
17	GND_5	Power	GND
18	GF2	-	For customer's requirement
19	NC	-	No connector
20	TP_SCL	I/O	I2C Clock Line
21	TP_VDD	Power	TP Power Supply
22	VDD2	Power	Driver IC analog supply
23	TE	O	Tear effect output
24	GND_6	Power	GND
25	DSI_D0P	I/O	MIPI DSI data0+

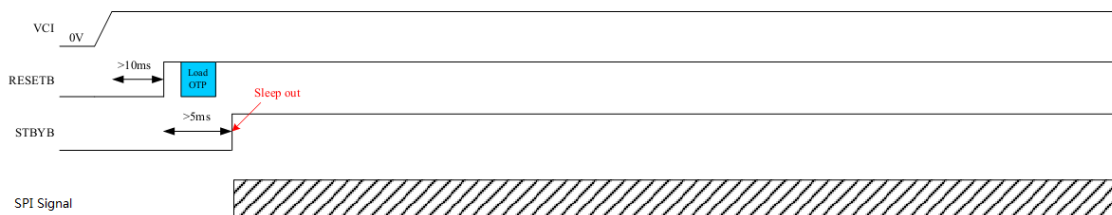
26	DSI_D0N	I/O	MIPI DSI data0-
27	GND_7	Power	GND
28	VDDIO1	Power	Driver IC digital I/O supply.
29	VDDIO2	Power	Driver IC digital I/O supply.
30	SWIRE	O	Power IC control signal.

#### 5.4 Graphic memory writing direction



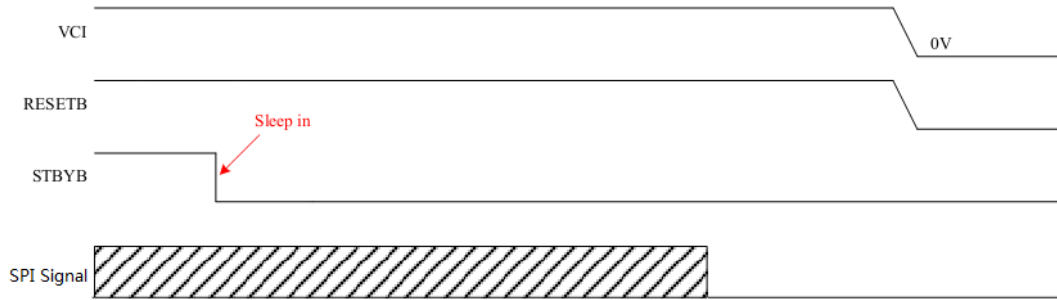
#### 5.5 Recommended Operating Sequence

##### 5.5.1 Power on sequence



##### 5.5.2 Power off sequence





### 5.5.3 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

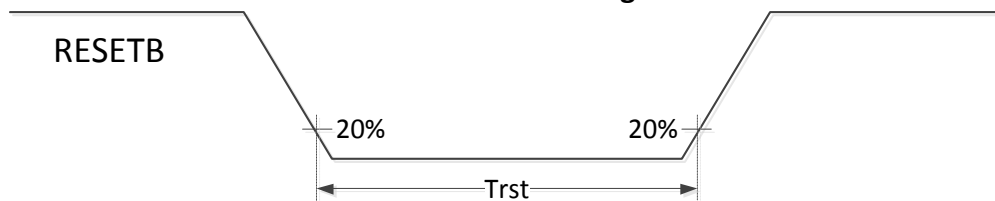


Figure: Reset timing

## 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	300	350	385	cd/m <sup>2</sup>	Note1.	
2	Brightness Uniformity	UL	Full white	80	-	-	%	Note4	
3	Contrast Ratio	CR	Normal θ=Φ=0°	10000	-	-	-	Note3.	
4	Response time	Ton+Toff	Normal θ=Φ=0°	-	2	4	ms	Note2.	
5	Color Coordinate of CIE1931	White	Normal θ=Φ=0°	X	0.28	0.30	0.32	-	Note1.
				Y	0.29	0.31	0.33		
		Red		X	0.63	0.66	0.69		
				Y	0.31	0.34	0.37		
		Green		X	0.16	0.21	0.26		
				Y	0.68	0.73	0.78		

		Blue	X		0.09	0.13	0.17		
			Y		0.02	0.06	0.10		
6	Color Gamut		NTSC	CIE1931	90	105	-	%	
7	Viewing Angle			Top/Bottom/Right/Left CR ratio ≥1000	80			°	Note3.
8	Gamma			$\text{Log}(L_v - L_b) = \log(V) + \log(a)$ $V(\text{Gray}) = 48, 72, 104, 132, 164, 192, 224, 252, 255$ $\text{Lum}(\text{gray}255) = 350 \text{ nit}$	2.0	2.2	2.4	-	
9	Luminance decrease ratio			@30 degree	-	-	45	%	Note5.
10	Flicker			Normal $\Theta = \Phi = 0^\circ$	-	-35	-30	dB	Note6.
11	Crosstalk			-	-	-	4	%	Note7.
12	OLED Life Time			$L > 92\% @ 25^\circ\text{C}$	100				Note8.

See the note in the table below:

No	Item	Details
Note1	Brightness	
Note 2	Response time	

<p>Note 3</p>	<p>Viewing Angle</p>	<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>
<p>Note 4</p>	<p>Brightness Uniformity</p>	<p>A: 1/4H B: 1/4V H,V: Active Area</p>
<p>Note 5</p>	<p>Luminance decrease ratio</p>	<p>Definition of Luminance decrease ratio Test pattern : Full White The luminance decrease ratio is calculated by using following formula:</p> $\text{Luminance decrease ratio} = 1 - \frac{\text{Luminance test at left, right, top, bottom}}{\text{Luminance test at left, right, top, bottom}}$
<p>Note 6</p>	<p>Flicker</p>	<p>Suggested Instruments: <b>Konica Minolta CA-310</b> or <b>Klein Instruments K-8</b></p> <p><b>Odd row : L0 Black</b> <b>Even row : L186 gray level</b></p> <p><b>Flicker Test Pattern</b></p>

The flicker level is defined by **Fast Fourier Transformation (FFT)** as follows:

$$Flicker = 20 \log_{10} \left( 2 \frac{f_{FFTC}(n)}{f_{FFTC}(0)} \right) + FS(Hz) \quad (dB)$$

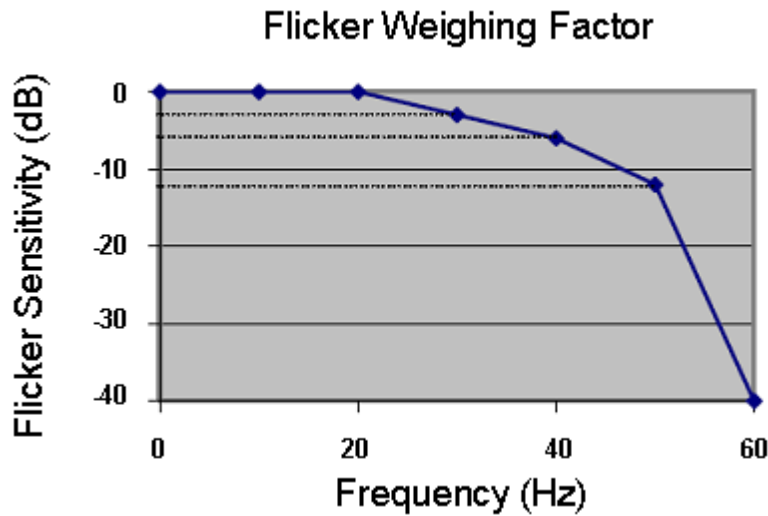
Where

$f_{FFTC}(n)$  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.

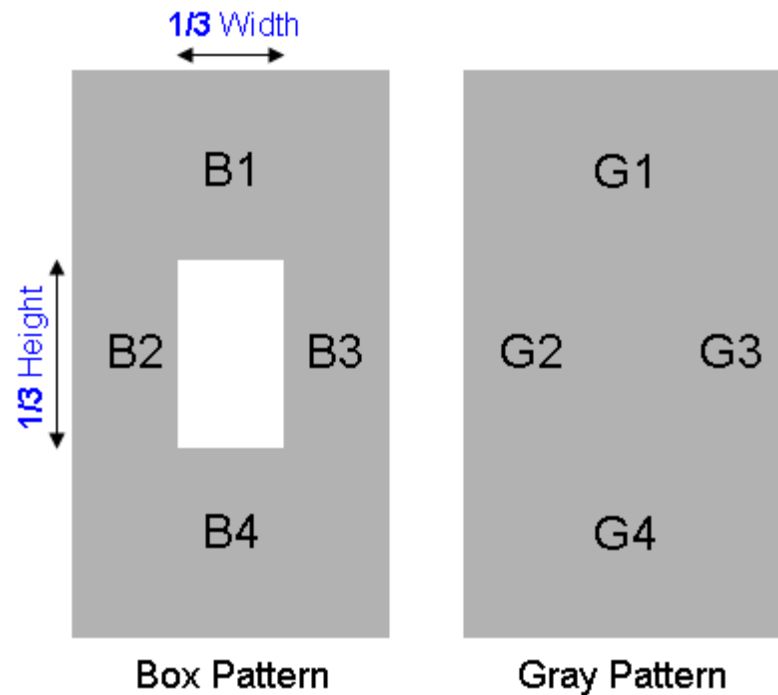
The peak flicker level shall be reported based on the calculation using above formula in which  $FS(Hz)$  is determined by the flicker weighing factor shown below.



Crosstalk shall be calculated by the luminance of **B1~B4** and **G1~G4** in the patterns shown below.

Box Pattern: **L128** gray level background with a **L255** White window in the central area.

Gray Pattern: **L128** gray level background only.



Note 7 **Crosstalk**

		<i>Crosstalk</i> $\equiv \text{Maximum} : \left\{ \frac{ B1 - G1 }{G1}, \frac{ B2 - G2 }{G2}, \frac{ B3 - G3 }{G3}, \frac{ B4 - G4 }{G4} \right\} \times 100\%$
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Note 8	<b>Life Time</b>	OLED life time is defined by the <b>Minimum Duration Time</b> that the luminance is decayed to a specific ratio (ex. <b>95%</b> ) of initial state. Test Pattern under duration period: <b>L255 White</b>
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## 7 Reliability

### 7.1 Environmental Test

Item	Main spec	No. of failures / No. of examinations
High Temperature Operation	70°C / 128hrs	0/5
Low Temperature Operation	-20°C / 128hrs	0/5
High Temperature Storage	80°C / 128hrs	0/5
Low Temperature Storage	-40°C / 128hrs	0/5
High Temperature Humidity Operation	60°C/93%RH/ 128hrs	0/10
Thermal Shock	-40°C~85°C dwell time=0.5hr, 50 cycles.	0/16

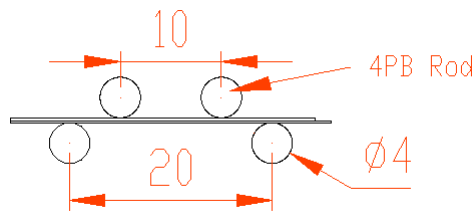
### 7.2 Electrical Test

Item	Main spec	Note
Air Discharge	±2 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

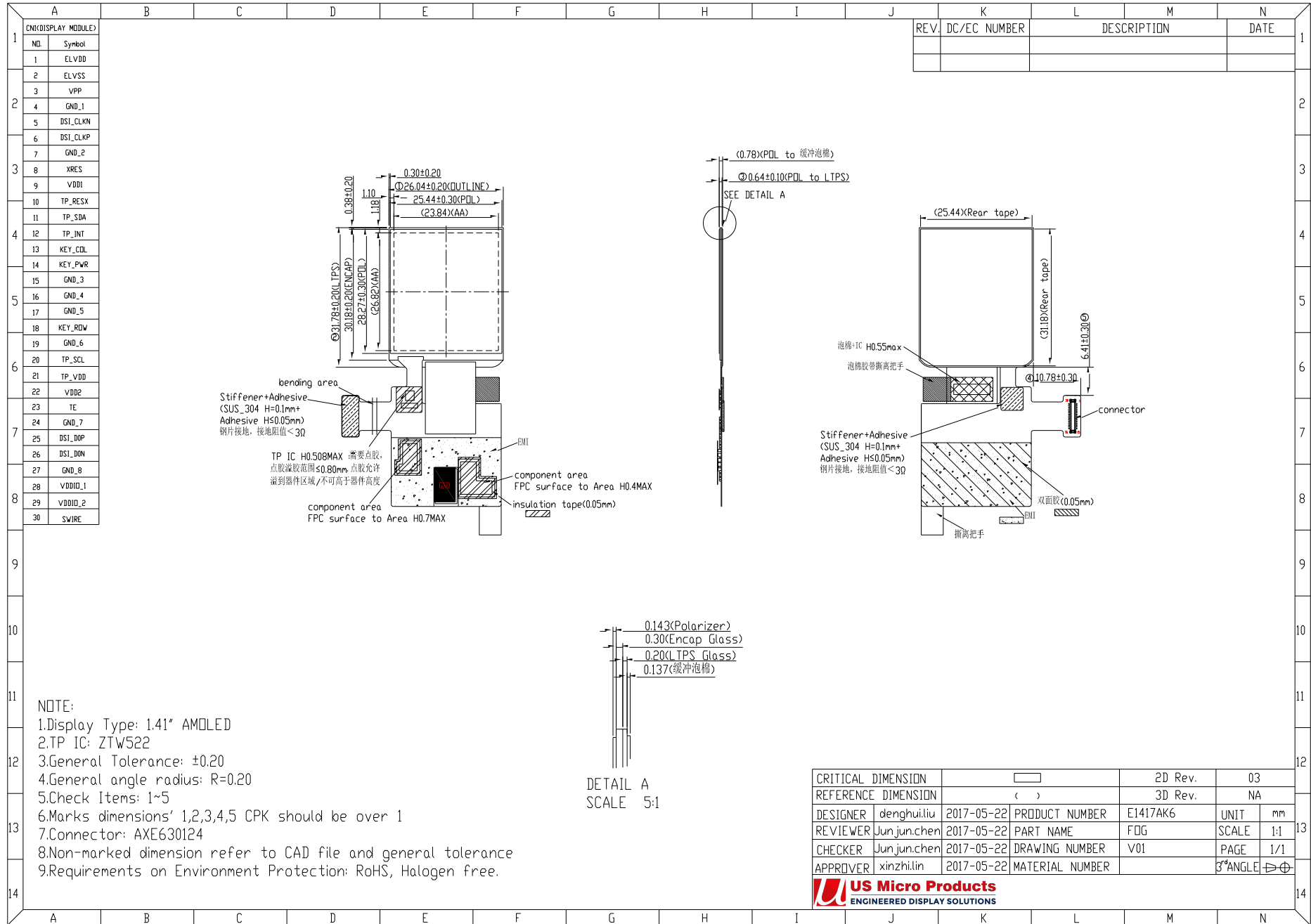
Test item	Test condition	Note
Packing vibration-proof test	2g, f=10->55->10Hz apply in each of X, Y, and Z direction for 30 min	Package
Packing Drop test	Drop the packing from 60cm height, 6-faces, 3-edges and 1-corner(one time for each)	Package

Note 11 Glass Strength Test- 4PB

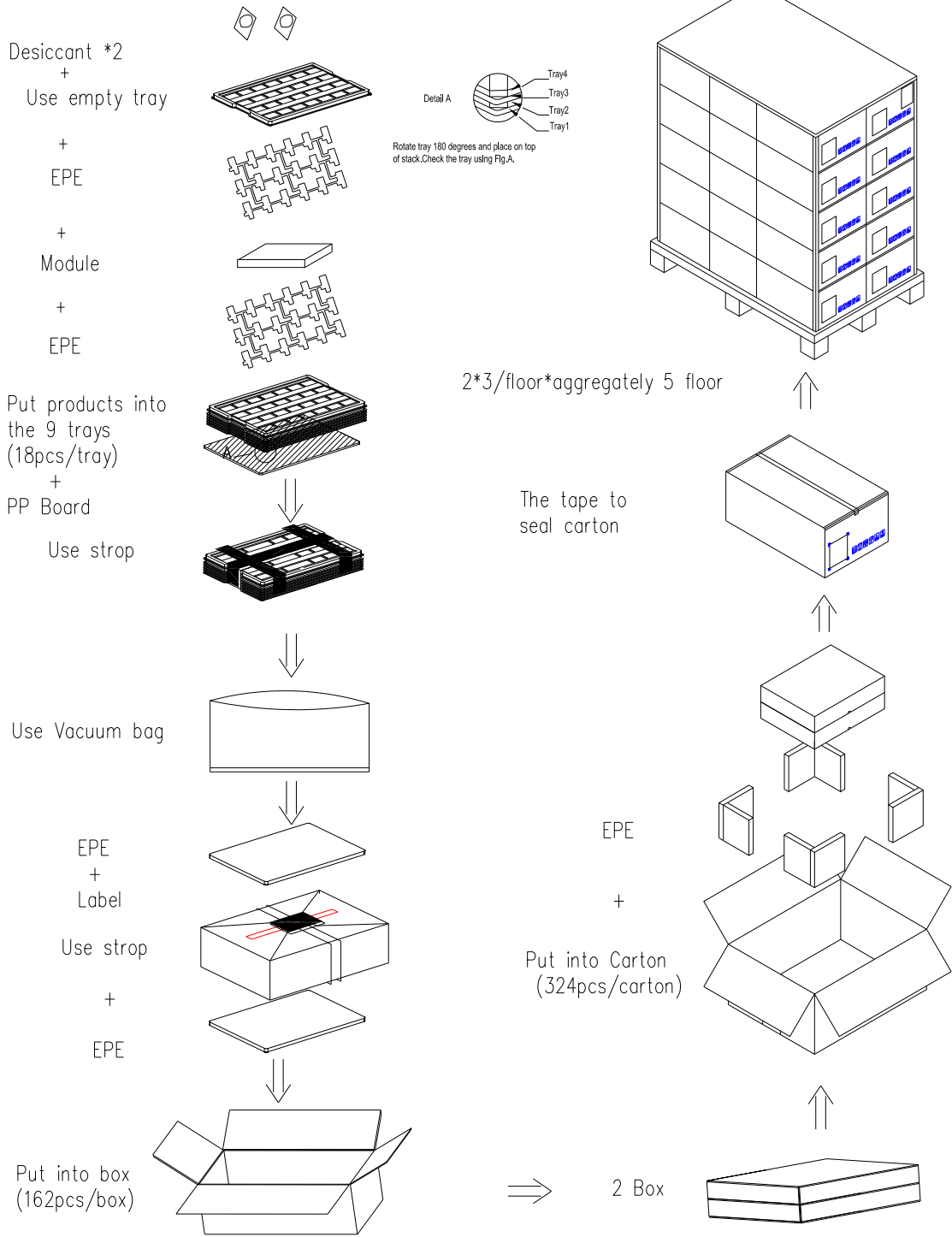


# 8 Outline Dimension Drawing

Refer to the 2D drawing.



## 9 Packing Specification



(2) Inner packing (material/identifying/package quantity)

NO	Item	Material	Size	Quantity	Module Quantity	Note
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1	Box	paper	459*294*115mm	2	162PCS /carton	
2	Tray	PET	455*290	20	9 layers under first empty tray, 18PCS/Tray	10 Tray/carton
4	Vocuum bag	Al	660*440*0.28mm	2	/	
5	EPE	EPE	394.3*228.23*0.1m	36	2/Tray	
6	Lable of inner box	PET	52*100*0.075mm	2	/	

(3) Outer packing (material/identifying/package quantity)

NO	Item	Material	Size	Quantity	Module Quantity	Note
1	Carton	paper	516*338*248mm	1	324PCS MDL/Carton	
2	Lable of outer carton	paster	52*100*0.1m	1	/carton	

(4) Others

Environment-friendly products need to be attached "ROHS" mark on outer packing.