

Chefree Technology Corp.

AMOLED DISPLAY MODULE

MODEL: CH156ZLXEWN-001

(Complied with RoHS)

UHD
eDP interface

Version: P01

Customer : _____
Approved By : _____
Date: _____

CHEFREE		
APPROVAL	CHECKER	PREPARE
Tim	Mark	Benson

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1. RECORD OF REVISION

Rev	DATE	PAGE	SUMMARY
P00	2022.06.30	ALL	Preliminary specification was first issued
P01	2024.07.22	-	FPC length changed
P02	2024.07.31	14.15	9.TOUCH PANEL SPECIFICATION → TIMING SPECIFICATION

2. MECHANICAL SPECIFICATIONS

(1)	Number of Dots	3840(R.G.B) x 2160
(2)	Module Size(mm)	348.22(H) x 201.62(V) x 1.05 (D)
(3)	Active Area(mm)	344.2176 (H) x 193.6224 (V)
(4)	Pixel Pitch(mm)	0.08964(H) x 0.08964(V)
(5)	LCD Model	AMOLED
(6)	Display Colors	RGB 10bit
(7)	Viewing Direction	All direction
(8)	Electrical Interface	eDP Interface
(9)	Color Configuration	RGB Delta Type
(10)	Touch Panel Mode	Without Touch
(11)	Module Weight(g)	200g±5%



4. INTERFACE PIN CONNECTION

4.1 TFT LCM PANEL PIN DEFINE

Connector : I-PEX 20455-040E-66 or Equivalent

PIN NO.	Definition	I/O	Description	Remark
1	NC	-	No connection	
2	H_GND	P	High Speed Ground	
3	Lane3_N	I	Complement Signal Link Lane3	
4	Lane3_P	I	True Signal Link Lane3	
5	H_GND	P	High Speed Ground	
6	Lane2_N	I	Complement Signal Link Lane2	
7	Lane2_P	I	True Signal Link Lane2	
8	H_GND	P	High Speed Ground	
9	Lane1_N	I	Complement Signal Link Lane1	
10	Lane1_P	I	True Signal Link Lane1	
11	H_GND	P	High Speed Ground	
12	Lane0_N	I	Complement Signal Link Lane0	
13	Lane0_P	I	True Signal Link Lane0	
14	H_GND	P	High Speed Ground	
15	Aux_CH_P	I	True signal Aux channel	
16	Aux_CH_N	I	Complement signal Aux channel	
17	H_GND	P	High Speed Ground	
18	Logic_GND	P	Logic and driver ground	
19	Logic_GND	P	Logic and driver ground	
20	Logic_GND	P	Logic and driver ground	
21	BIST_EN	I	BIST enable signal	
22	VCC_3.3V	P	Logic and driver power	
23	VCC_3.3V	P	Logic and driver power	
24	VCC_3.3V	P	Logic and driver power	
25	HPD	I	HPD signal	
26	EN_GND	P	Ground for EL PMIC	
27	EN_GND	P	Ground for EL PMIC	
28	NC	-	No connection	
29	VBAT	P	Power for EL PMIC	
30	VBAT	P	Power for EL PMIC	
31	VBAT	P	Power for EL PMIC	
32	NC	-	No connection	
33	NC	-	No connection	
34	NC	-	No connection	
35	NC	-	No connection	
36	NC	-	No connection	

37	NC	-	No connection	
38	NC	-	No connection	
39	NC	-	No connection	
40	NC	-	No connection	

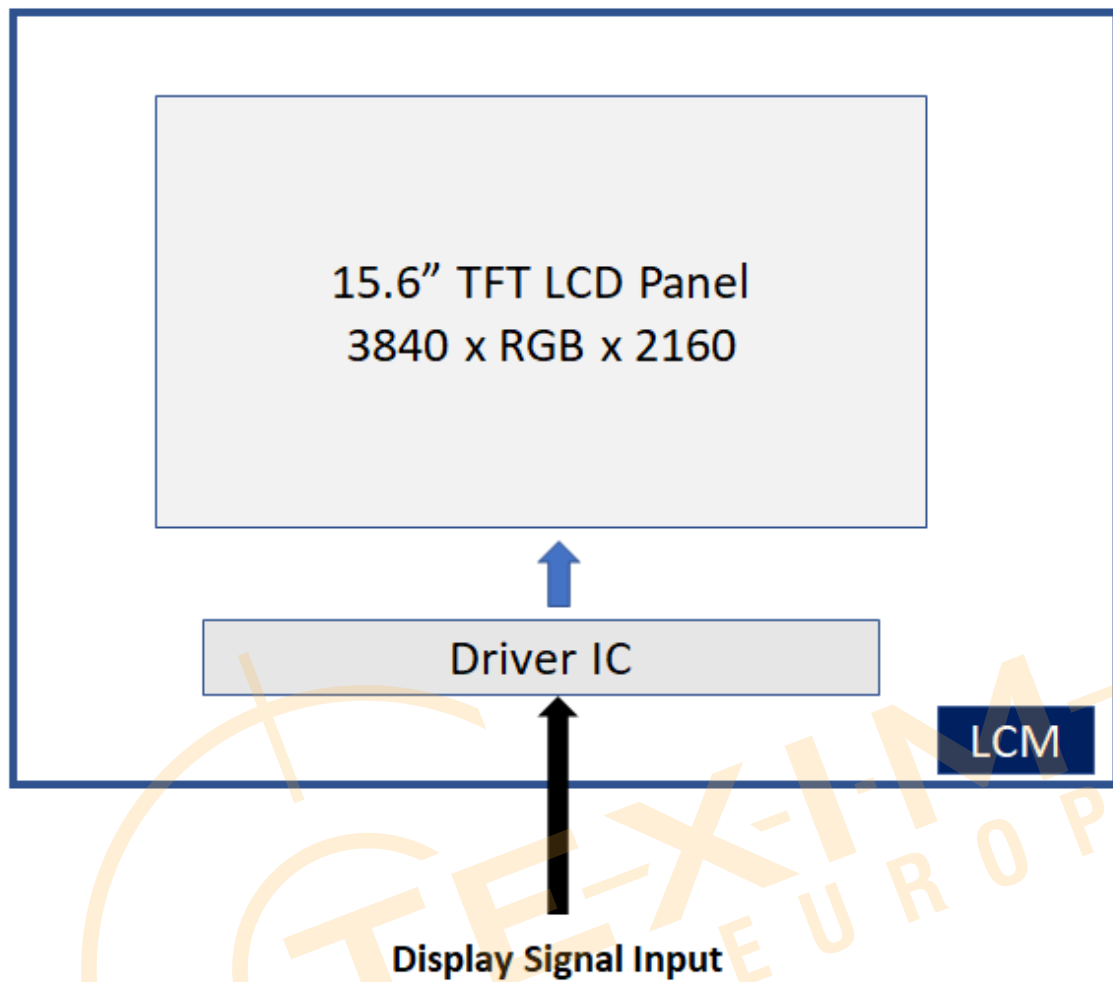
Note : 'P' stand for Power, ' I ' stand for Input ,

4.2 CTP Specification:

Without Touch



5. BLOCK DIAGRAM



6. ABSOLUTE MAXIMUM RATINGS

6.1 ELECTRICAL ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	MIN.	MAX.	UNIT	REMARK
Supply Voltage for System	VDD	-0.3	4.6	V	
Supply Voltage for EL Power	VBAT	-0.3	24	V	
Power Voltage For CTP	/	/	/	V	

Note : The absolute maximum rating values of this product not allowed to be Exceeded at any times. Should be module be used with any of absolute maximum ratings exceeded. The characteristics of the module may not be recovered, or in an extreme case, the module may be permanently destroyed.

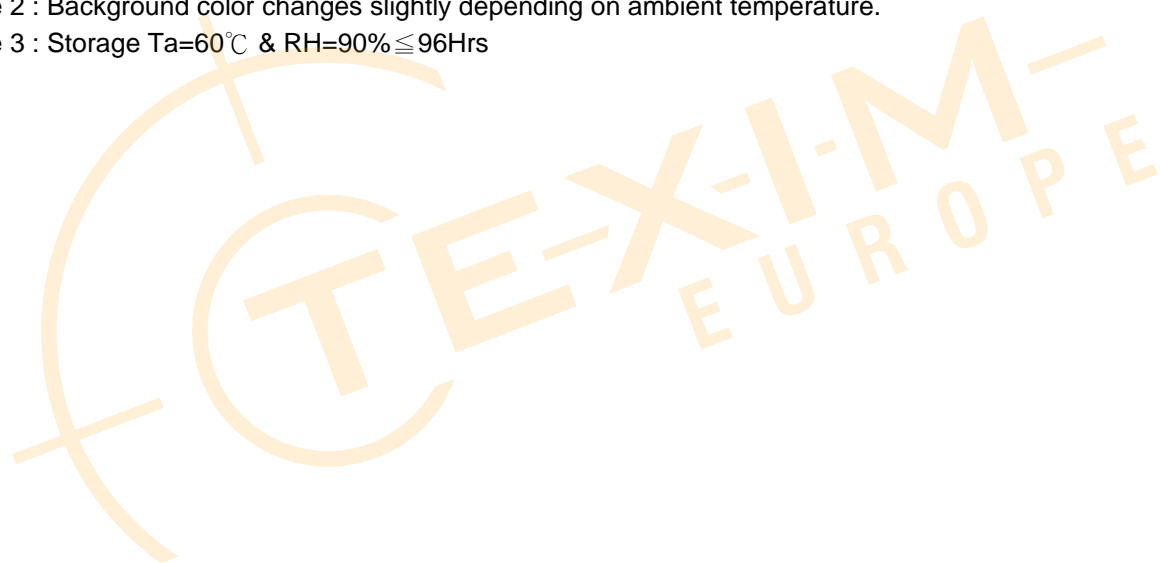
6.2 ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

ITEM	OPERATING		STORAGE		REMARK
	MIN.	MAX.	MIN.	MAX.	
Ambient Temperature(°C)	-20	70	-40	85	Note 1,2
Humidity(% RH)	10~90(Note3)		10~90(Note 3)		-

Note 1 : The response time will become lower when operated at low temperature.

Note 2 : Background color changes slightly depending on ambient temperature.

Note 3 : Storage Ta=60°C & RH=90% ≤ 96Hrs



7. ELECTRICAL CHARACTERISTICS

7.1 ELECTRICAL CHARACTERISTICS

Ta=25°C

ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARK
System	Analog/Logic Voltage	VDD	3.0	3.3	3.6	V	
Panel	Analog Voltage	VBAT	8.0	12.0	21.0	V	
Current	Logic	IDD	-	420	640	mA	
	Panel	IVBAT	-	1100	1370	mA	
Consumption	Logic	PVDD	-	1.4	2.1	W	
	Panel	PVBAT	-	13.2	16.4	W	
Frame Frequency		fps	-	60	-	Hz	

Note : VDD_3.3V=3.3 (V) VBAT=12.0 (V), Full White pattern, Temperature = 22±3°C Room Temperature

7.2 CTP ELECTRICAL CHARACTERISTICS

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARK
Power Voltage For PCAP	VCC	/	/	/	V	

8. OPTICAL CHARACTERISTICS

8.1 Optical specification

Ta=25°C

ITEM	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	REMARK
Contrast Ratio	CR		-	100,000	-	-	Note 3
Response Time	TR		-	1	2	ms	Note 6
Color Chromaticity	White	Wx	0.293	0.313	0.333		
		Wy	0.309	0.329	0.349		
	Red	Rx	0.663	0.683	0.703		
		Ry	0.297	0.317	0.337		
	Green	Gx	0.195	0.235	0.275		
		Gy	0.694	0.734	0.774		
	Blue	Bx	0.117	0.137	0.157		
		By	0.024	0.044	0.064		
Viewing Angle	Hor.	θ_L	85	-	-	Deg.	Note 7
		θ_R	85	-	-		
	Ver.	θ_U	85	-	-		
		θ_D	85	-	-		
Brightness		Normal (White mode)	352	400	448	cd/m ²	Note 1
Peak Luminance(10% Box)		VESA HDR	-	520	-	cd/m ²	
Brightness Uniformity	BUNI	Full white	-	-	1.4	%	Note 2
Color Gamut		adobe	95			%	
		DCI-P3	98	100			
		sRGB	100			%	
White Temperature°K		Normal $\Theta=\Phi=0$	6000	6500	7000	K	
Gamma		Normal $\Theta=\Phi=0$	2.0	2.2	2.4		Note 5
Color Shift	Δuv	$\Theta=\Phi=45^\circ$	-	-	0.025		Note 8
Image Sticking	ΔL	Macbeth pattern Max Lum, 3000h Ambient : ~25 °C Panel : ~45°C	-	-	3.5	%	
Flicker		Normal $\Theta=\Phi=0^\circ$	-	-	-35	dB	
Crosstalk		Normal $\Theta=\Phi=0^\circ$	-	-	1.5	%	Note 9

TUV blue ray certification		415-455nm/400-500nm			50	%	Note 10
OLED Life Time		T50 @ 25°C	15,000			Hr	Note 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

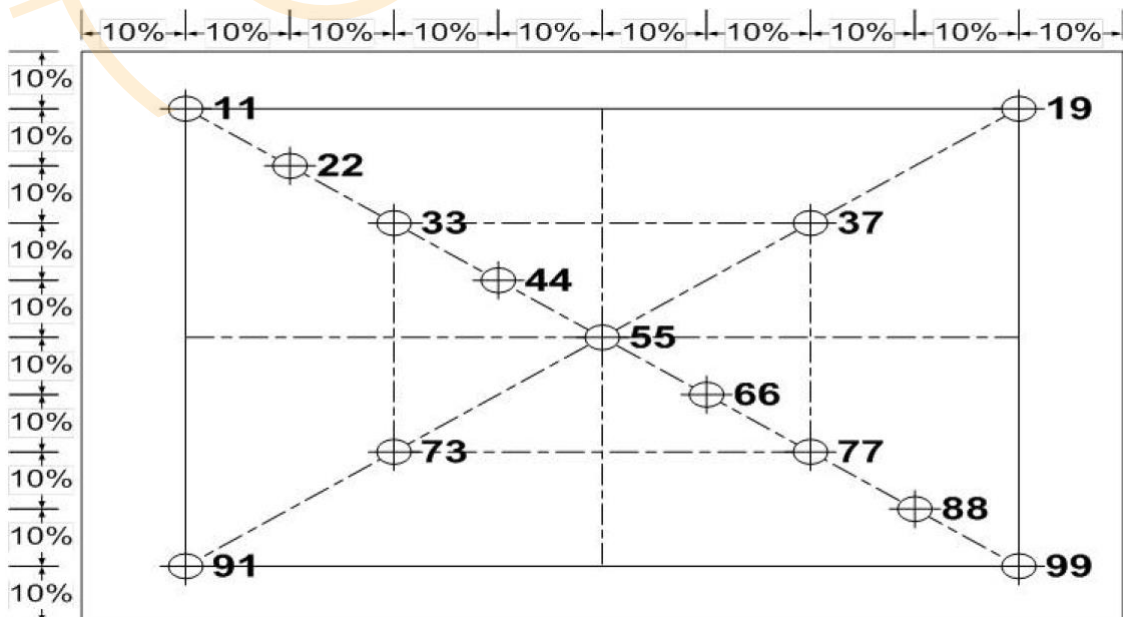
For brightness uniformity measure, EDO's request as below:

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

$$\text{Brightness Uniformity} = \text{Bp (Min.)} / \text{Bp (Max.)} \times 100 (\%)$$

Bp (Max.) = Maximum brightness in 13 measured spots

Bp (Min.) = Minimum brightness in 13 measured spots.



Note 3: Contrast Ratio

Dark Room C.R=LW/LB

LW: full white brightness of display center P0;

LB: full black brightness of display center P0.

Note 4: Color Gamut

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

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

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

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

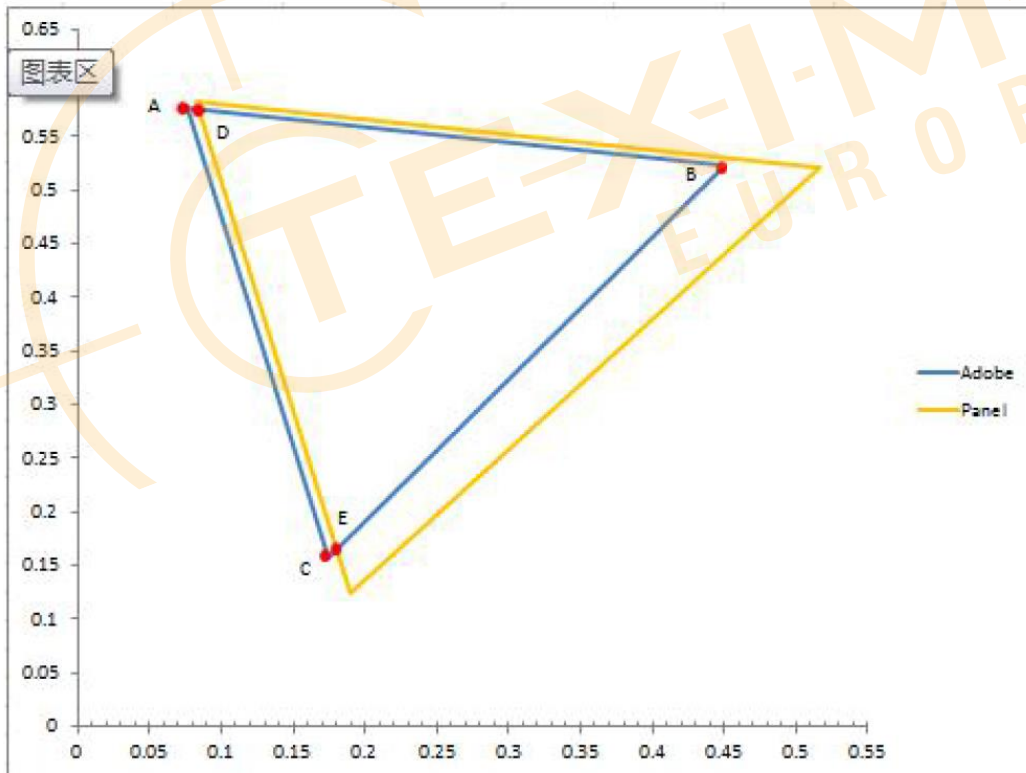
Color Gamut % = S coverage / S

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 % = SDEB/SABC %



Note 5: Gamma

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

1. Calibration the test instrument. Set the screen size parameters, and measure the center point.
2. EDO will test the gray scale below, if possible also can use the patterns of gray 0 to 255 to test: for example:

16, 17, 18, 19, ..., 237, 238, 239, 240. Total 225pcs patterns.

3. Output the measure data. Data number normalization and draw the chart.

4. The whole screen should be complied with the gamma curve of gamma 2.0 or 2.4, it means +/-0.2 error is allowed. But if there are special requirements for the special project, its required specifications can be used as a standard value, please refer the project spec.

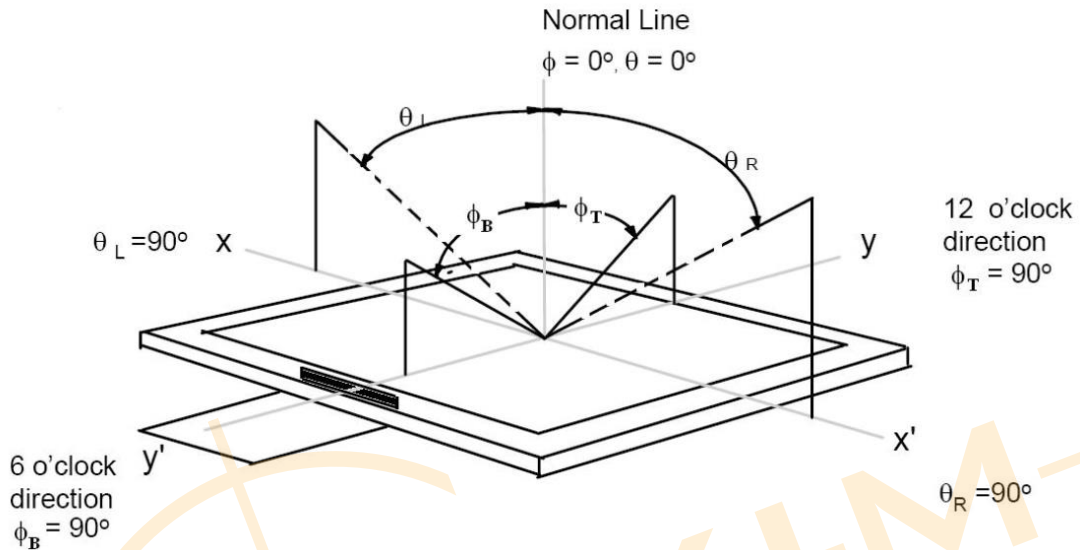
Note 6: Response Time

Response time=Pixel turn on and turn off time (White<=>Black).

It is measuring transition time from 10% to 90% of luminance.

Note 7: The definition of Viewing Angle

Refer to the graph below marked by θ and ϕ



Note8: Color Shift

For color shift measure:

Fix on white pattern,

On the condition $\theta=0$ $F=0^\circ$, we can get the color coordinate (u', v') and on $\theta=45^\circ$ $F=45^\circ$ we can get another color coordinate $(u2', v2')$

$$\Delta = \text{Square Root}((u2'-u1')^2 + (v2'-v1')^2)$$

JNCD stands for "Just Noticeable Color Difference"

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

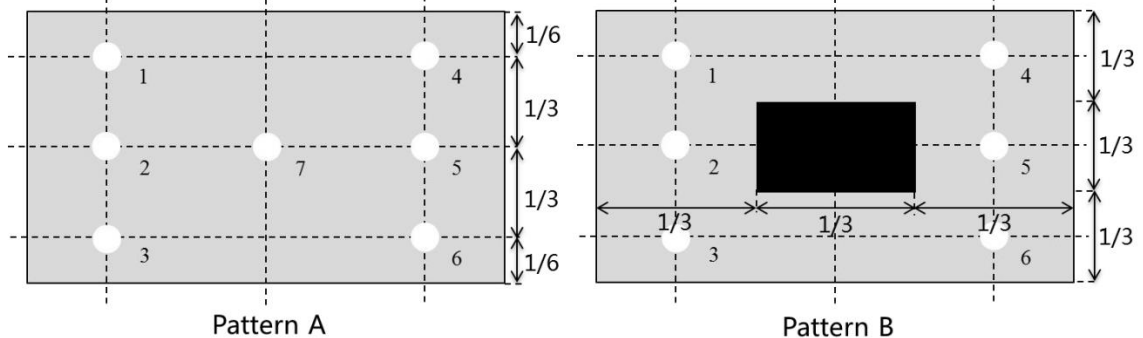
6.25 JNCD means $\Delta u'v' < 0.0250$.

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

Note9: Crosstalk

For crosstalk measure, EDO's request as below:

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



2. Calibrate the test instrument.

3. Point 7 in pattern A is used as brightness calibration for each panel. Then measure the brightness of points 1 to 6 in pattern A and B.

4. Calculate the value of crosstalk according to the formula:

$$\text{Crosstalk} = \max\{ \{(B2-A2)-[(B1-A1)+(B3-A3)]/2\}/A2; \{(B5-A5)-[(B4-A4)+(B6-A6)]/2\}/A5 \}.$$

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

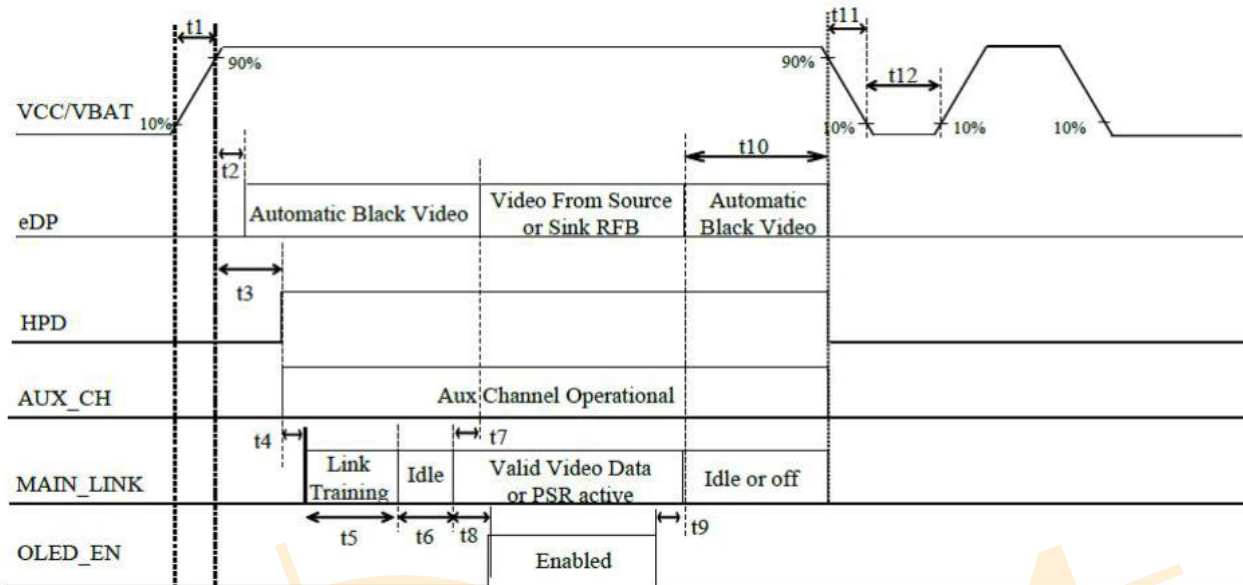
The test procedure is as follows:

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



9. TIMING SPECIFICATIONS

9.1 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

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.

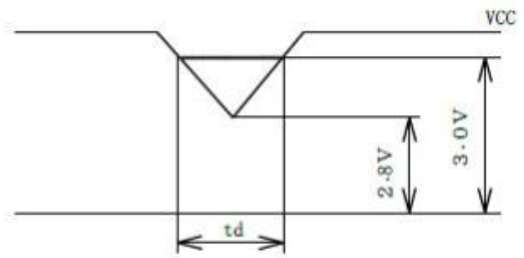
VCC-dip Condition

- 1) $2.8\text{ V} \leq V_{CC} < 3.0\text{ V}$
 $t_d \leq 10\text{ ms}$

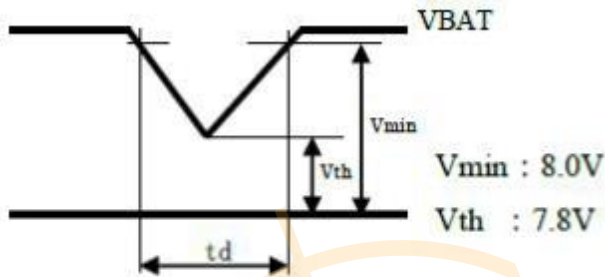
Under above condition, the display image should return to an appropriate figure after VCC voltage recovers.

- 2) $V_{CC} < 2.8\text{ V}$

VCC-dip conditions should also follow the ON-OFF conditions for supply voltage



VBAT-dip Condition



- 1) $V_{th} \leq V_{BAT} < V_{min} : t_d \leq 20\text{ms}$
- 2) $V_{BAT} < V_{th}$: The condition of instantaneous voltage drop is apply to display exception

10. RELIABILITY TEST

ENVIRONMENTAL TEST				
NO.	ITEM	CONDITIONS	TIME PERIOD	REMARK
1	High Temperature Storage	Ta= 85°C	240Hours	1,2,3,4
2	Low Temperature Storage	Ta= -40°C	240Hours	1,2,3,4
3	High Temperature Humidity Storage	60°C,93%RH	240Hours	1,2,3,4
4	High Temperature Operation	Ts= 70°C	240Hours	1,2,3,4
5	Low Temperature Operation	Ta= -20°C	240Hours	1,2,3,4,5
6	Temperature Cycle	-45°C~85°C	100 CYCLES 0.5H/CYCLE	1,2,3

In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but don't guarantee all of the cosmetic specification.

Note 1 : Ta is the ambient temperature of samples.

Note 2 : Ts is the temperature of panel's surface.

Note 3 : Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

Note 4 : Star with cold temperature and end with high temperature.

11. PRECAUTIONS FOR USE

11.1 SAFETY

- (1) Do not swallow any liquid crystal, even if there is no proof that liquid crystal is poisonous.
- (2) If the LCD panel breaks, be careful not to get liquid crystal to touch your skin.
- (3) If skin is exposed to liquid crystal, wash the area thoroughly with alcohol or soap.

11.2 STORAGE CONDITIONS

- (1) Store the panel or module in a dark place where the temperature is $23\pm 5^{\circ}\text{C}$ and the humidity is below $50\pm 20\%\text{RH}$.
- (2) Store in anti-static electricity container.
- (3) Store in clean environment, free from dust, active gas, and solvent.
- (4) Do not place the module near organics solvents or corrosive gases.
- (5) Do not crush, shake, or jolt the module.

11.3 HANDLING PRECAUTIONS

- (1) Avoid static electricity which can damage the CMOS LSI.
- (2) The polarizing plate of the display is very fragile. So, please handle it very carefully.
- (3) Do not give external shock.
- (4) Do not apply excessive force on the surface.
- (5) Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the Surface of plate.
- (6) Do not use ketonic solvent & Aromatic solvent, use with a soft cloth soaked with a cleaning naphtha solvent.
- (7) Do not operate it above the absolute maximum rating.
- (8) Do not remove the panel or frame from the module.
- (9) When the module is assembled, it should be attached to the system firmly, Be careful not to twist and bend the module.
- (10) Wipe off water droplets or oil immediately . If you leave the droplets for a long time, staining and discoloration may occur.
- (11) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.

11.4 WARRANTY

- (1) Acceptance inspection period. The period is within one month after the arrival of contracted commodity at the buyer's factory site.
- (2) Applicable warrant period. The period is within 12 months since the date of shipping out under normal using and storage conditions.

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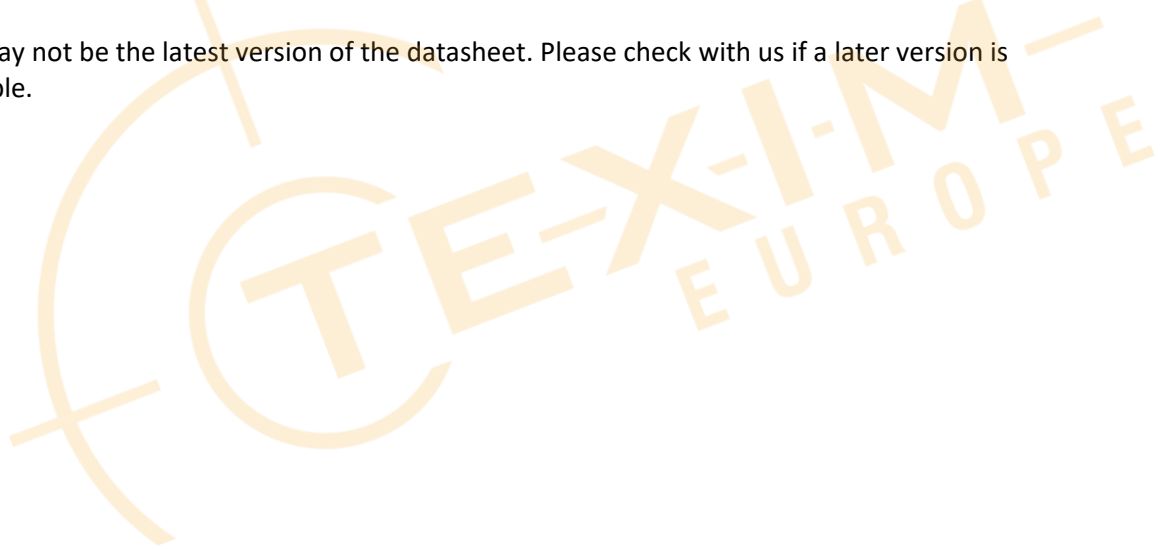
It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application.

Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time.

All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts.

Please contact us if you have any questions about the contents of the datasheet.

This may not be the latest version of the datasheet. Please check with us if a later version is available.





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