US Micro Products
ENGINEERED DISPLAY SOLUTIONS

TFT SPECIFICATION

Part Number	USMP-T057-032024NAF-A0
Size	5.7"
Resolution	320 x 240
Brightness	1200 cd/m²
Contrast	450:1
Viewing Angle	50/65/65/65
Operating Temp.	-20 ~ 70°C

FOR ADDITIONAL INFORMATION
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Issue Date	Approved by (customer use)	Checked by	Prepared by

Revise Records

Rev.	Date	Contents	Written	Approved
A	2010/04/30	Preliminary Specification	Kobe su	Sychang
A	2010/12/09	Add RoHS Compliance	Kavin chang	Sychang
A	2014/01/17	Add IIS	Kevin Huang	Roger Yan

Special Notes

Note1.	
Note2.	
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Note5.	

Contents

1. General Description and Features

USMP-T057-032024NAF-A0 is a transmissive type color active matrix TFT (Thin Film Transistor) liquid crystal that uses amorphous silicon TFT as a switching device. This model is composed of a TFT-LCD module, a driver circuit and a back-light unit. Graphics and texts can be displayed on a QVGA 320 (W) x 3 x 240 (H) dots with 262, 144 colors by supplying 18 bits data signal (6bits/each color).

The following table described the features of USMP-T057-032024NAF-A0.

1.1 Features

- Transmissive and back-light with 30th LEDs are available.
- TN (Twisted Nematic) mode.
- Digital RGB (6bits/color) data transfer. n
- RoHS Compliance
- IIS T057QNP01

1.2 LCD Module

Item	Specification	Unit
Screen Size	5.7 inches	Diagonal
Display Resolution	320 (H) x 240 (V)	Pixel
Active Area	115.20 (H) x 86.40 (V)	mm
Outline Dimension	144.00 (H) x 104.60 (V) x 13.0 (T)	mm
Display Mode	Normally white mode/ Transmissive/ Wide view	--
Pixel Arrangement	R,G,B Vertical Tripe	--
Pixel size	120 x 360	um
Display Color	262K Colors	--
Viewing Direction	6 o'clock (Gray Inversion)	--
Input Interface	Digital RGB (6bits/color) Data Transfer	--

2. Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	--	144.00	--	mm	(1,2,3)
	Vertical (V)	--	104.60	--	mm	(2)
	Thickness (T)	--	13.0	--	mm	(1,3)
Weight		--	TBD	--	g	--

Note (1) Not include FPC. Refer to the Outline Dimension Drawing as attached.
(2) Back-light unit is included.
(3) Excluding backlight cables.

3. Electrical Specifications

3.1 Absolute Max. Ratings

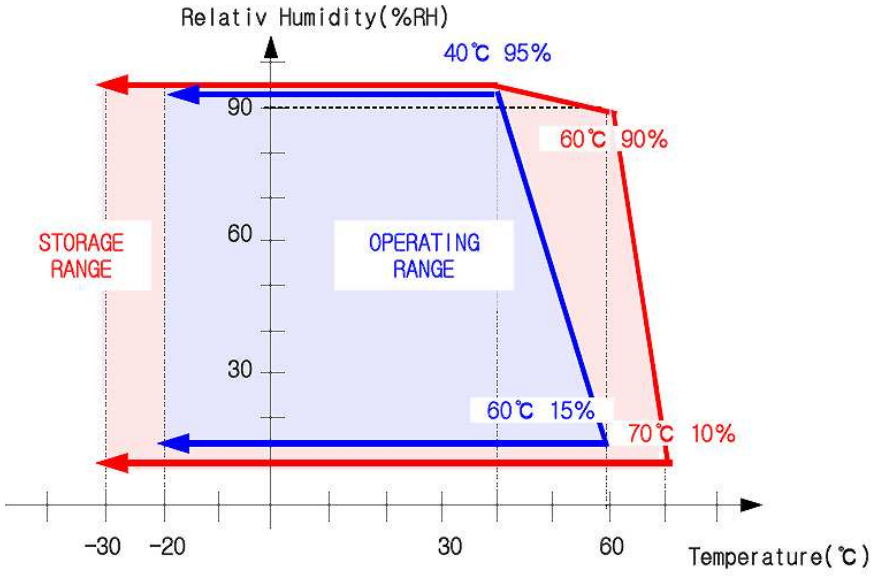
3.1.1 Absolute Ratings of Environment

If the operating condition exceeds the following absolute maximum ratings, the TFT LCD module may be damaged permanently.

(Ta=25±2°C, V_{SS}=GND=0)

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T_{STG}	-30	80	°C	(1)
Operating temperature	T_{OPR}	-20	70	°C	(1,2,3)

Note (1) 95 % RH Max. (40 °C ≥ Ta). Maximum wet-bulb temperature at 39 °C or less. (Ta > 40 °C) No condensation.



Note (2) In case of below 0°, the response time of liquid crystal (LC) becomes slower and the color of panel becomes darker than normal one. Level of retardation depends on temperature, because of LC's character

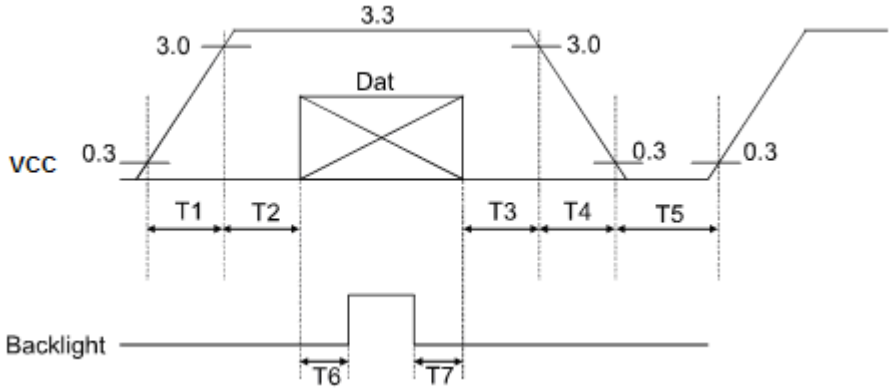
Note (3) Only operation is guarantied at operating temperature. Contrast, response time, another display quality are evaluated at +25°C.

3.1.2 Electrical Absolute Maximum Ratings

(V_{SS}=GND=0)

Parameter	Symbol	Min.	Max.	Unit	Remark
Power supply voltage	V_{CC}	-0.3	5.0	V	
Signal input voltage	R0-R5,G0-G5, B0-B5,DCLK,DE	-0.3	Vcc+0.3	V	--
Permissive input ripple voltage	V_{RF}	--	100	mVp-p	V_{CC} = +3.3V

Display On/Off Sequence :



Data: DCLK, R0 ~ R5, G0 ~ G5, B0 ~ B5, DE

T1≤10ms, 50ms≤T2, 0<T3≤50ms, 0<T4≤10ms, 1s≤T5, 200ms≤T6, 200ms≤T7

3.2 Electrical Characteristics

3.2.1 DC Electrical Characteristics of the TFT LCD

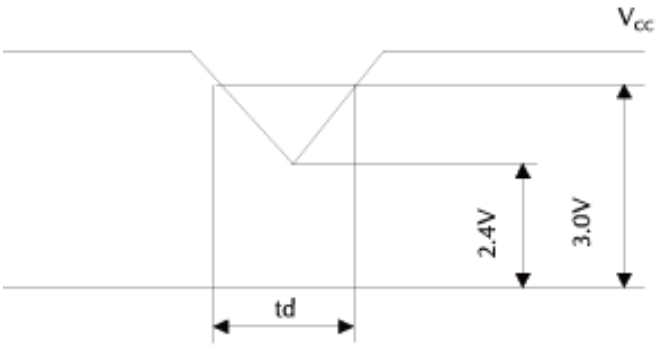
(Ta=25±2°C, V_{SS}=GND=0)

Item		Symbol	Min.	Typ.	Max.	Unit	Remark
Power supply		VCC	3.0	3.3	3.6	V	Note 1
Input Voltage for logic	H Level	VIH	0.7VDD	-	VDD	V	
	L Level	VIL	0	-	0.3VDD	V	
Power Supply current		ICC		(65)	TBD	mA	Note 2

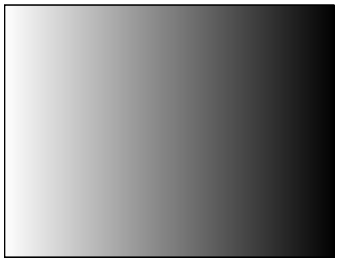
Note1: Vcc-dip conditions

Vcc-dip conditions should also follow the Vcc-turn-on conditions

Td ≤ 10ms



Note2: fv =60Hz , Ta=25°C , Display pattern : 64 Gray pattern



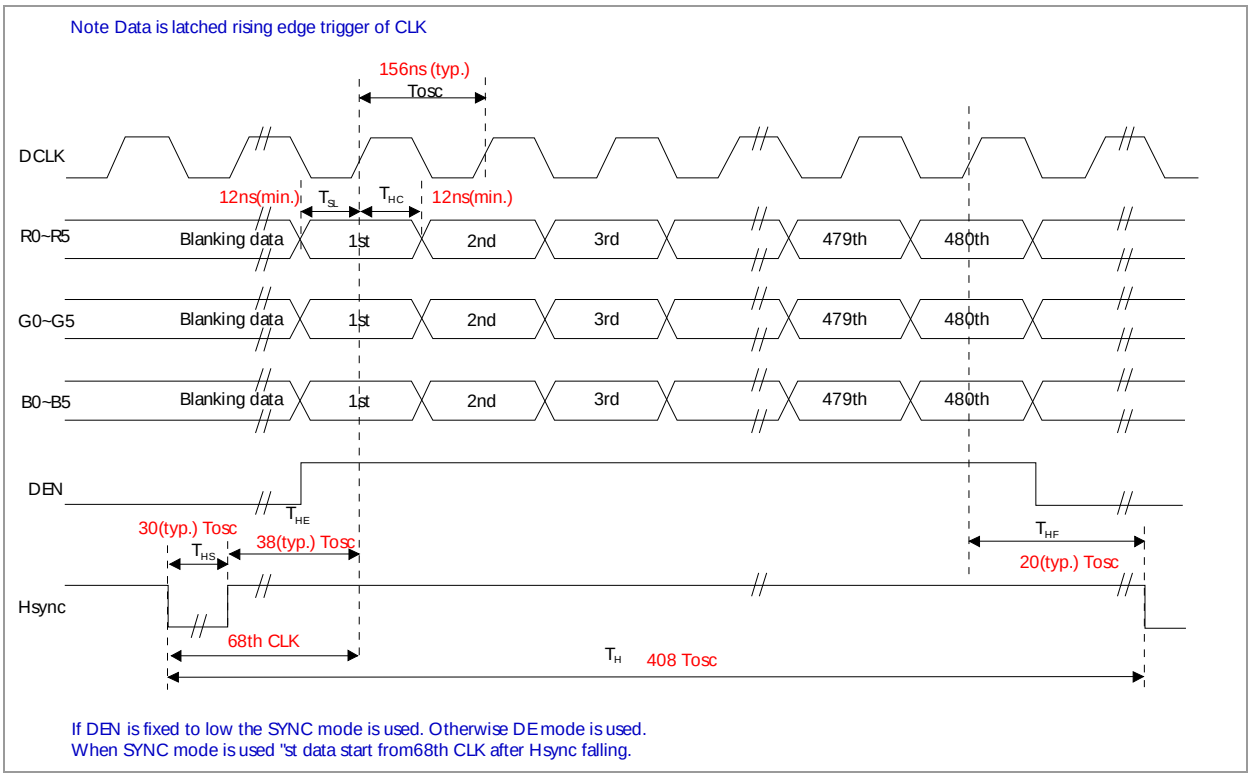
3.3 AC Timing Characteristic of The LCD

3.3.1 Timing Condition

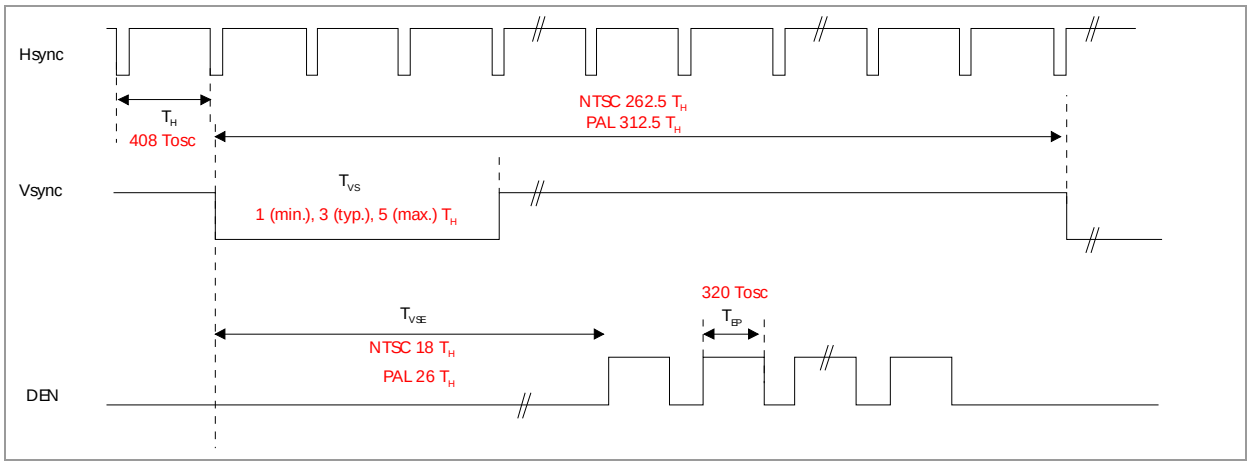
Signal	Parameter		Symbol	Min.	Typ.	Max.	Unit.	Remark
DCLK	DCLK period		TOSC	-	156	-	ns	
	Frequency		FOSC	-	6.4	-	MHz	
	DCLK High plus width		TCH	-	78	-	ns	
	DCLK Low plus width		TCL	-	78	-	ns	
RGB DATA	Data setup time		TSU	12	-	-	ns	
	Data hold time		THD	12	-	-	ns	
Hsync	Hsync period		TH	-	408	-	TOSC	
	Hsync pulse width		THS	5	30	-	TOSC	
	Back-Porch		THB		38		TOSC	
	Front-Porch		THF		20		TOSC	
	Hsync rising time		TCr	-	-	700	ns	
	Hsync falling time		TCf	-	-	300	ns	
Vsync	Vsync period	NTSC		-	262	-	TH	
		PAL		-	312	-	TH	
	Vsync pulse width		TVS	1	3	5	TH	
	Back-Porch	NTSC	TVB		15		TH	
		PAL			23		TH	
	Display Period		TVD		240		TH	
	Front Porch	NTSC	TVF		5		TH	
		PAL			46		TH	
	Vsync rising time		TVr	-	-	700	ns	
	Vsync falling time		TVf	-	-	1.5	μs	
	Vsync falling to Hsync rising time for odd field		THVO	1	-	-	TOSC	
	Vsync falling to Hsync falling time for even field		THVE	1	-	-	TOSC	
DEN	Vsync-DEN time	NTSC	TVSE	-	18	-	TH	
		PAL	TVSE	-	26	-	TH	
	Hsync-DEN time		THE	36	68	88	TOSC	
	DEN plus width		TEP	-	320	-	TOSC	

Note : If DEN is fixed to low, the SYNC mode is used. Otherwise DE mode is used. When SYNC mode is used, 1st data start from 68th CLK after H-sync falling

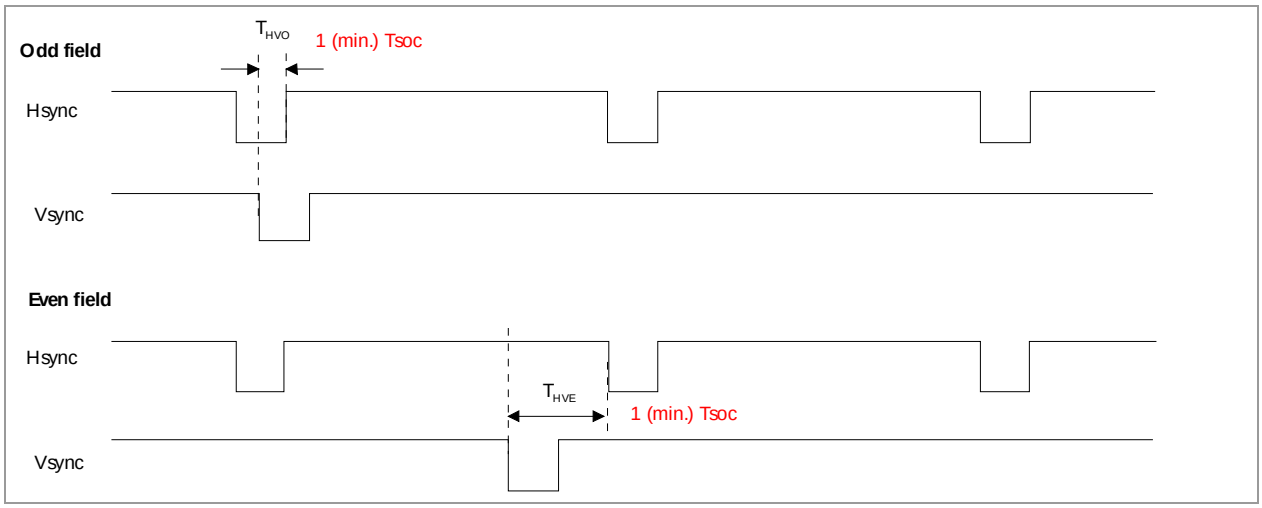
3.3.2 Horizontal Display Timing



3.3.3 Vertical Display Timing



3.3.4 Hsync and Vsyne Timing



3.4 Back-Light Unit

The Back-light system is an edge-lighting type with 30 white LED(Light Emitting Diode)s. The characteristics of 30 white LEDs are shown in the following tables.

(Ta= Room Temp)

Characteristics		Symbol	Min.	Typ.	Max.	Unit	Note
Current		I_B	-	200	TBD	mA	(1)
Voltage Forward		V_F	-	(9.6)		V	
Power Consumption		P_{BL}	-	(1920)		mW	(2)
LED Life Time	25°C	-	(30000)	-	-	hr	(3)

Note (1) LEDS in 3 series x 10 parallel type.

(2) Where I_B = 200mA, V_F = 9.6, $P_{BL} = V_F \times I_B$

(3) The environmental conducted under ambient air flow ,at Ta=25±2°C,60%RH±5%

4. Optical Characteristics

4.1 Optical characteristic of the LCD

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (1).

Measuring equipment: BM-5A, BM-7

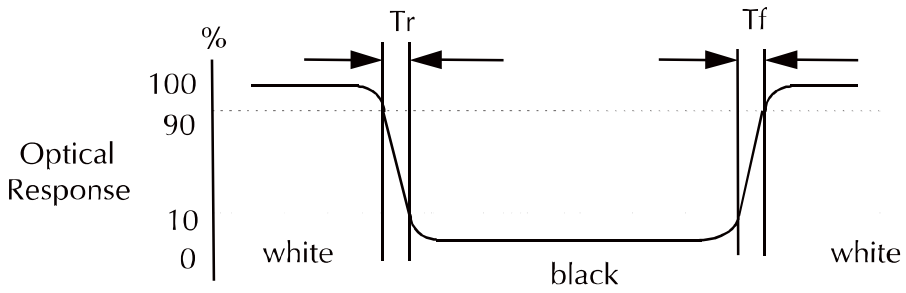
Item		Symbol	Condition	Min	Type	Max	Unit	Note
Brightness				(1000)	(1200)	--	cd/m^2	
Response time		T_r	θ=0°	-	15	20	ms	.
		T_f		--	25	35	ms	
Contrast ratio		CR	At optimized viewing angle	300	(450)	--	--	
Color Gamut		NTSC %	--	--	50	--	%	
Color Chromaticity (CIE 1931)	Red	R_x	θ=0° Normal Viewing Angle	0.610	0.640	0.670	--	
		R_y		0.314	0.344	0.374		
	Green	G_x		0.268	0.298	0.328	--	
		G_y		0.553	0.583	0.613		
	Blue	B_x		0.107	0.137	0.167	--	
		B_y		0.139	0.159	0.179		
	White	Wx		0.282	0.312	0.342	--	
		Wy		0.309	0.339	0.369		
Viewing Angle (6H)	Hor.	θ_R	CR≥10	55	65	--	Degree	
		θ_L		55	65	--		
	Ver.	ϕ_H		40	50	--		
		ϕ_L		55	65	--		

a. Test equipment setup

After stabilizing and leaving the panel alone shall be warmed up for the stable operation of LCM, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7(fast) with a viewing angle of 2° at a distance of 50cm and normal direction.

b. Definition of response time: Tr and Tf

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

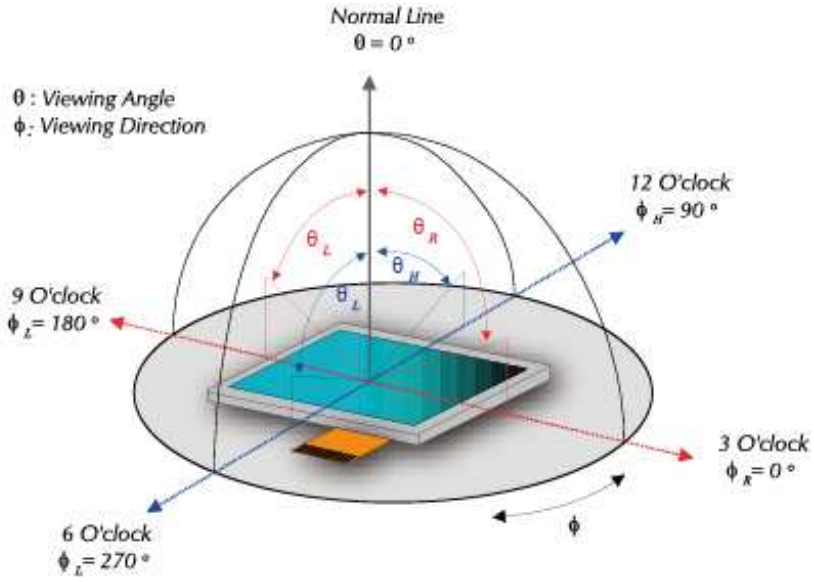


c. Definition of contrast ratio:

$$\text{Contrast Ratio (CR)} = \frac{\text{Brightness measured when LCD is at "white state"}}{\text{Brightness measured when LCD is at "black state"}}$$

d. Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

e. View Angle



f. Definition of Luminance of White: Luminance of white at the center points

Light Source of Back-Light Unit	LED Type

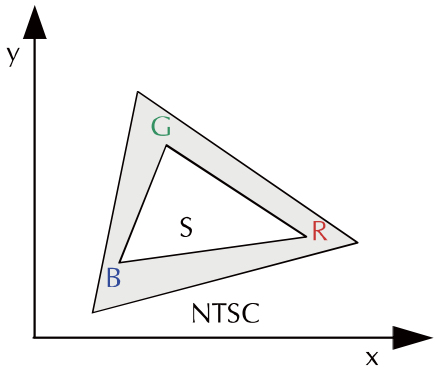
g. Definition of White Uniformity

$$\text{White Uniformity} = \frac{\text{Min. luminance of white among 9-points}}{\text{Max. luminance of white among 9-points}}$$

h. The definition of Color Gamut -Color Chromaticity CIE 1931

Color coordinate of white & red, green, blue at center point.

Color Gamut : NTSC(%) = (RGB Triangle Area / NTSC Triangle Area) x 100



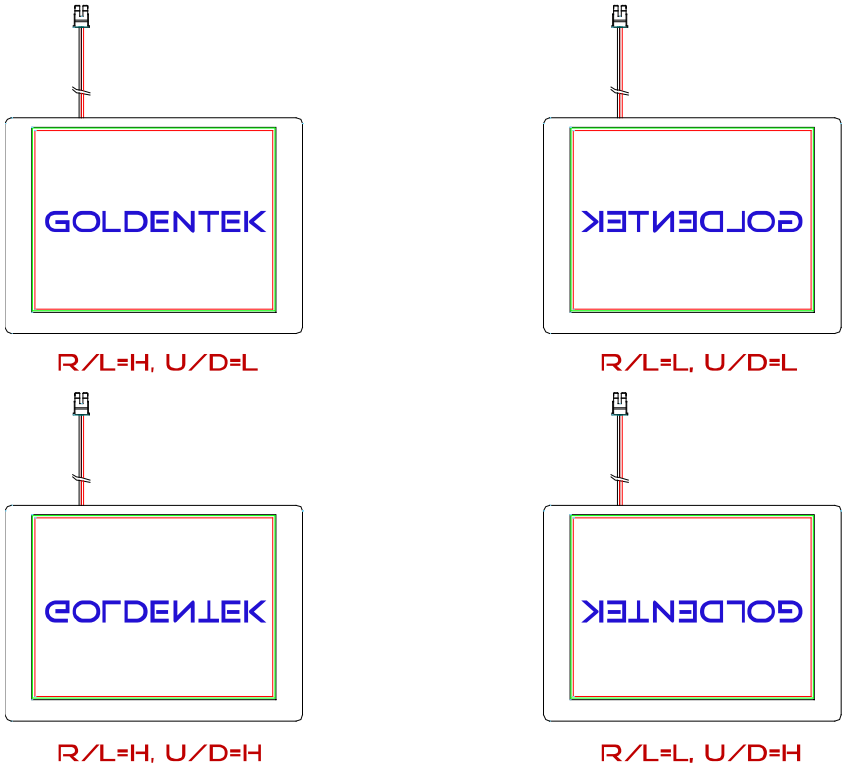
5. I/O Terminal

5.1 Pin Assignment

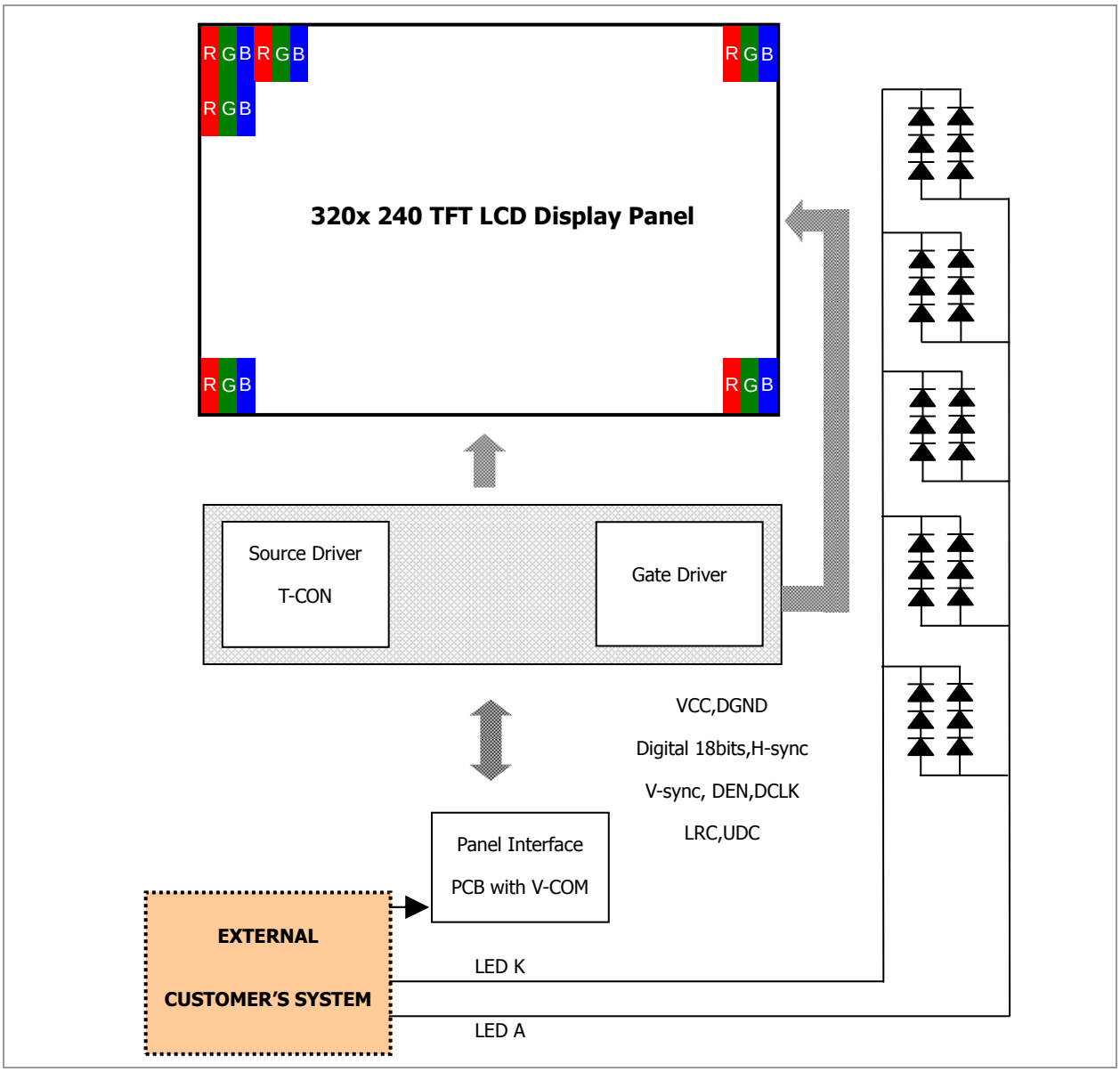
Pin No.	Symbol	I/O	Function	Remark
1	DGND	--	GND	
2	DCLK	I	Clock signal for sampling each data signal	
3	Hsync	I	Horizontal synchronous signal (Negative)	
4	Vsync	I	Vertical synchronous signal (Negative)	
5	GND	I	GND	
6	R0	I	RED data signal (LSB)	
7	R1	I	RED data signal	
8	R2	I	RED data signal	
9	R3	I	RED data signal	
10	R4	I	RED data signal	
11	R5	I	RED data signal (MSB)	
12	GND	--	GND	
13	G0	I	GREEN data signal (LSB)	
14	G1	I	GREEN data signal	
15	G2	I	GREEN data signal	
16	G3	I	GREEN data signal	
17	G4	I	GREEN data signal	
18	G5	I	GREEN data signal (MSB)	
19	GND	--	GND	
20	B0	I	BLUE data signal(LSB)	
21	B1	I	BLUE data signal	
22	B2	I	BLUE data signal	
23	B3	I	BLUE data signal	
24	B4	I	BLUE data signal	
25	B5	I	BLUE data signal(MSB)	
26	GND	--	GND	
27	DEN	I	Signal to settle the horizontal display position (Positive)	Note5-1
28	VCC	--	3.3V power supply	
29	VCC	--	3.3V power supply	
30	LRC	I	Horizontal display mode select signal H: Normal L: Left / Right reverse mode	Note5-2
31	UDC	I	Vertical display mode select signal L: Normal H: Up / Down reverse mode	Note5-2
32	NC	--	No Connection	
33	GND	I	GND	

Note5 - 1 The horizontal display start timing is settled in accordance with a rising timing of ENAB signal. In case ENAB is fixed "Low", the horizontal start timing is determined. Don't keep ENAB "High" during operation.

Note 5 - 2



5.2 Block Diagram



5.3 Back-light Unit (BLU)

Pin No.	Symbol	Function	Remark
1	LEDA	Power Supply for LED backlight	Red
2	LEDK	GND for LED backlight	Black

Connector: JST BHSR-02VS-1

5.4 Basic Display Color and Gray Scale

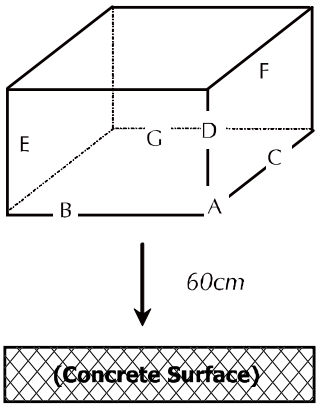
	Color & Gray Scale	Data Signal																	
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(0)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green(0)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue(0)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(61)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(31)	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(1)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(0)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Green	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Green(61)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(31)	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(1)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green(0)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Blue	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(31)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue(0)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Each basic color can be displayed in 64 gray scales from 6 bit data signals. With the combination of total 18 bit data signals, the 262,144-color display can be achieved on the screen.

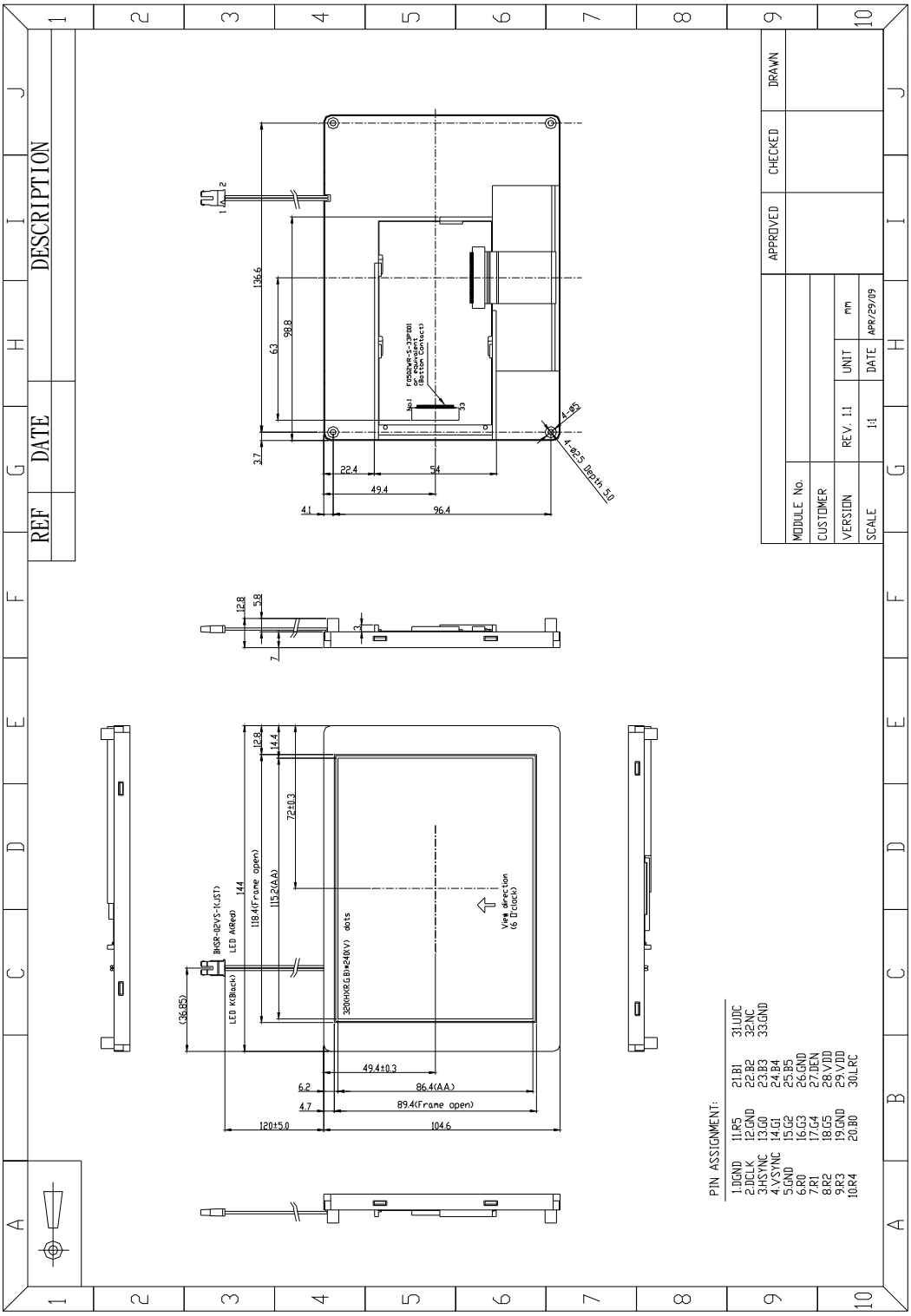
6. Test

No change on display and in operation under the following test condition.

Condition: Unless otherwise specified, tests will be conducted under the following condition.
Temperature: 20±5°C.
Humidity: 65±5%RH.
Tests will be not conducted under functioning state.

No.	Parameter	Condition	Notes
1	High Temperature Operating	70°C±2°C, 240hrs (Operation state).	-
2	Low Temperature Operating	-20°C±2°C, 240hrs (Operation state).	-
3	High Temperature Storage	80°C±2°C, 240hrs.	-
4	Low Temperature Storage	-30°C±2°C, 240hrs.	-
5	High Temperature and High Humidity Operation Test	60°C±2°C, 90%, 240hrs.	-
6	Vibration Test	Total fixed amplitude: 1.5mm. Vibration Frequency: 10~55Hz. One cycle 60 seconds to 3 direction of X, Y, Z each 15 minutes.	-
7.	Drop Test	To be measured after dropping from 60cm high on the concrete surface in packing state. 	-

7. Dimensional Outlines



Version:A

C O N T E N T S

ISSUE: 2013.APR.09

2. RECORD OF REVISION

Rev	DATE	PAGE	SUMMARY

3.適用範圍/Description

此份文件適用於富相科技生產之 **5.7”TFT** 模組

This document shall be applied to TFT-LCD Module for **5.7”**.

4.檢查條件與環境/ Inspection and Environment Conditions

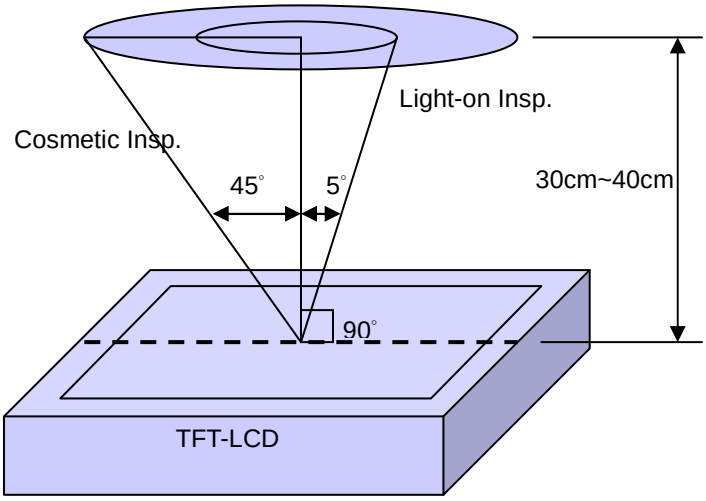
4.1 檢查條件/ Inspection Conditions:

(1)檢測距離/Inspection Distance: 35 cm±5cm

(2)觀看角度/ View Angle:

點燈檢驗角度/ Light-on Inspection Angle：±5°

外觀檢驗角度/ Cosmetic Inspection Angle：±45°



(垂直於液晶顯示表面/ perpendicular to LCD panel surface)

4.2 環境條件/Environment Conditions:

溫度/ Ambient Temperature		23℃±5℃
濕度/ Ambient Humidity		55±10%RH
Ambient Illumination	外觀檢驗 Cosmetic Inspection	more than 600 Lux
	點燈檢驗 Functional Inspection	300~500 Lux

4.3 抽樣條件/Sampling Conditions:

(1)批量：單次運送單一機種之數量

Lot Size: Quantity of shipment lot per model

(2)抽樣方法/Sampling Method:

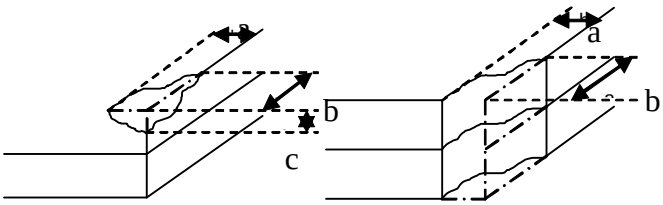
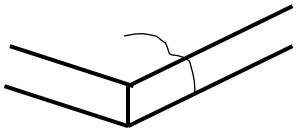
抽樣計畫 Sampling Plan		MIL-STD-105E 正常檢驗、單次抽樣 Normal Inspection, Single Sampling Level II
AQL	主要缺點 Major Defect	1.0%
	次要缺點 Minor Defect	1.5%

(3)主缺(MA)及次缺(MI)定義於"3.檢查標準"

The classification of Major (MA) and Minor (MI) defects is shown as 3. Inspection Criteria.

5.檢查標準/ Inspection Criteria

5.1 外觀檢查(面板)/Cosmetic Inspection(Panel):

項目/ Item	判斷標準/ Judgment Criteria	分類/ Classification
面板缺角 Chipping on Panel	 a≦3.0mm、b≦3.0mm、c≦t 單片玻璃厚度 (Bottom glass thickness)	MA
面板表面刮傷 Scratch on Panel *Note-2	1.BM: Ignored 2.Pixel area W≦0.05mm or L< 5mm: Ignored/不計 0.05mm<W≦0.1mm and L≦5mm: N≦5 W>0.1mm or L>5mm: Not allowed/不允許	MI
面板 表面氣泡,凹痕 Bubble or Dent on Panel *Note-3	1.BM: Ignored 2.Pixel area D≦0.2mm: Ignored/不計 0.2mm<D≦0.3mm: N≦5 D>0.3mm: Not allowed/不允許	MI
面板裂痕 Panel Crack	 不允許裂痕/ Not Allowed crack	MA
鐵殼變型 Bezel Deformation	不允許明顯的變形 Obvious deformation is not allowed.	MI

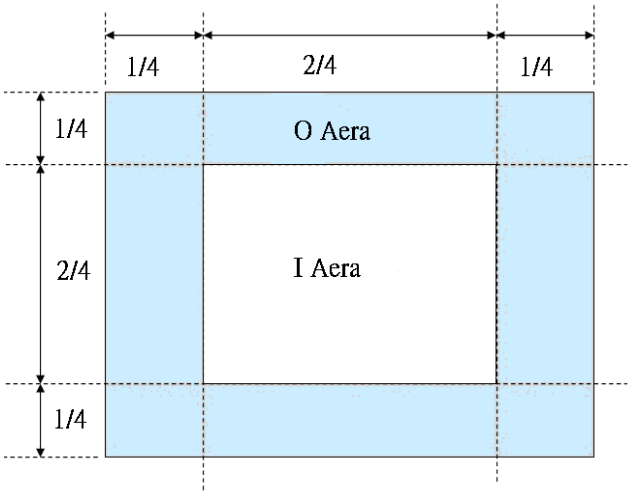
鐵殼氧化 Bezel Oxidation	生鏽不可連續超過一公分(馬口鐵不保證) Not allowed if it rusts continuously over 1 cm (It is out of warranty with rusted tin plate)	MI
鐵殼刮傷 Bezel Scratch	鐵件無感刮傷忽略; 鐵件有感刮傷 L≦20mm , W≦0.2 , N≦3	MI
鐵件壓痕/凹/凸點 (A 面) Metal Squash Dent /Flange(Front Side)	D(W)≦1,L≦3,N≦3;	MI
背光高壓線裸露 B/L High Voltage Wire Denudation	不允許 Not allowed	MA
偏光片脫膠/殘膠/溢膠 Polarizer flaw or leak out resin	顯示領域範圍內不可 Defect is defined as the active area.	MI
外觀尺寸 Outline Dimension	需符合 Product Spec.所示之規格 Must in Spec, refer to related product spec.	MI

5.2 點燈檢查/ Functional Inspection:

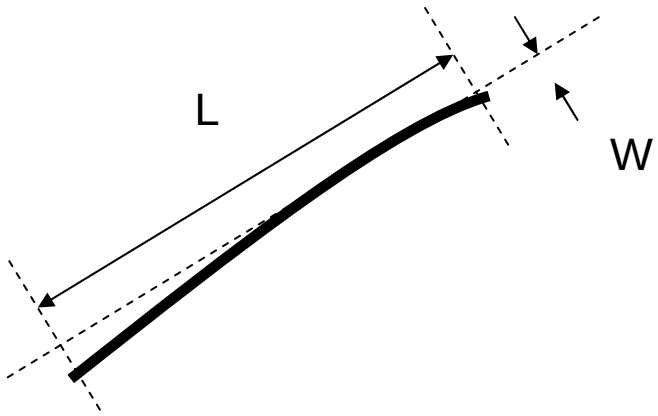
<table>
<tr><td rowspan="2">項目/ Item</td><td colspan="3">判斷標準/ Judgment Criteria</td><td rowspan="2">分類/
Classification</td></tr>
<tr><td colspan="2">Area(Note1)</td><td>I</td><td>O</td></tr>
<tr><td rowspan="11"></td><td rowspan="3">Bright dot
亮點</td><td>Random</td><td colspan="2">2</td><td rowspan="11">MI</td></tr>
<tr><td>2 dots adjacent</td><td>0</td><td>0</td></tr>
<tr><td>3 dots adjacent or more</td><td>0</td><td>0</td></tr>
<tr><td rowspan="3">Dark dot
暗點</td><td>Random</td><td colspan="2">3</td></tr>
<tr><td>2 dots adjacent</td><td colspan="2">0</td></tr>
<tr><td>3 dots adjacent or more</td><td>0</td><td>0</td></tr>
<tr><td colspan="2">Total Dot Defect 總數</td><td colspan="2">5</td></tr>
<tr><td rowspan="3">Distance
距離</td><td>Distance between Bright and Bright dot</td><td colspan="2">L≧5mm</td></tr>
<tr><td>Distance between Bright and Dark dot</td><td colspan="2">L≧5mm</td></tr>
<tr><td>Distance between Dark dot</td><td colspan="2">L≧5mm</td></tr>
<tr><td colspan="4">(1)缺陷大小>0.5dot 定義為點缺陷
It is defined as Point Defect if defect area＞0.5dot
(2)缺陷大小≦0.5dot 不計
It is ignored if defect area≦0.5dot
(3)微弱亮透過 ND Filter 6%仍可視計為點缺陷(全黑畫面檢查)
Weak point defect will be defined as Bright Dot if it can be observed through ND filter 6%(Full Screen Black Inspection)</td></tr>
<tr><td>線缺陷
Line Defect</td><td colspan="3">不允許明顯的線缺陷
Obvious vertical or horizontal line defect is not allowed.</td><td>MA</td></tr>
</table>

Mura or Leak	不允許任何透過 ND Filter 6 % 仍可視之 Mura Not allowed if it can be observed through ND Filter 6%	MI
點狀異物 Foreign Material in spot shape *Note-3	Visible under：ND6% D≦0.2mm: Ignored/不計 0.2mm<D≦0.5mm: N≦8 D>0.5mm: Not allowed/不允許	MI
線狀異物 Foreign Material in line or spiral shape *Note-4	Visible under：ND6% W≦0.05mm or L≦6mm: Ignored/不計 0.05mm<W≦0.2mm and L≦6mm: N≦8 W>0.2mm or L>5mm: Not allowed/不允許	MI
顯示異常 Display Function Abnormal	不允許任何顯示異常 No Malfunction can be allowed	MA

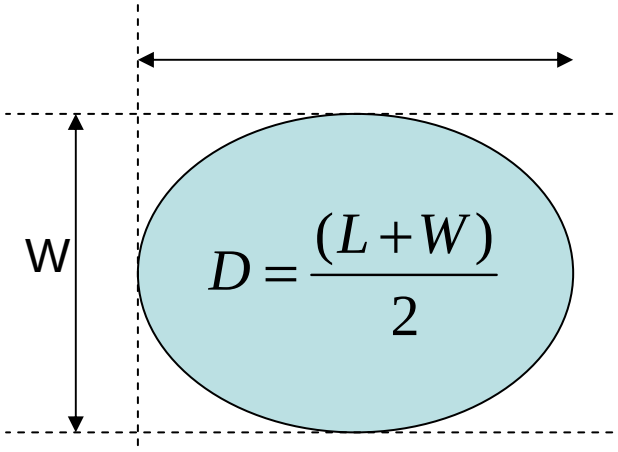
Note-1：I/O 區定義/ I/OArea Definition



Note-2：Polarizer 刮傷/ Polarizer Scratch



Note-3：點狀異物/ Spot Foreign Material
(W ≧L / 4)



Note-4：線狀異物 Line or Spiral Foreign Material
(W<L / 4)