



# PRODUCT SPECIFICATIONS

For Customer: \_\_\_\_\_

: APPROVAL FOR SPECIFICATION

Customer Model No. \_\_\_\_\_

: APPROVAL FOR SAMPLE

Module No.: PV02015D0140T

Date : 2023-10-17

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## For Customer's Acceptance:

Approved By	Comment

PREPARED	CHECKED	VERIFIED BY QA DEPT	VERIFIED BY R&D DEPT
LC			



## 2. Revision Record

Date	Rev.No.	Page	Revision Items	Prepared
2020-08-25	V0		The first release	CJ
2020-09-08	V1		Updated the drawing in Item#4	CJ
2020-09-25	V2		Added customer P/N	CJ
2020-09-28	V3		Added Display mode in Item#3 and updated the drawing in Item#4	CJ
2020-09-28	V4		Updated the drawing in Item#4	CJ
2020-09-29	V5		Updated the drawing in Item#4	CJ
2020-12-3	V6		Updated the drawing in Item#4	CJ
2021-5-18	V7		Updated the Color of CIE Coordinate in the Item#7	CJ
2021-8-8	V8		Updated Item#10	CJ
2021-8-10	V9		Updated Item#10	CJ
2023-6-5	V10		Revised 9 measured spots to be 5 measured spots in Item#7.0 Note#1&#2 and Removed the FOAM in the drawing of Item#4.0	CJ
2023-8-11	V11		Added ID value in Item#4.0	CJ
2023-8-18	V12		Revised 5 measured spots to be 9 measured spots in Item#7.0	CJ
2023-10-17	V13		Added Note 6 of lifetime in Item # 10	CJ



### 3. General Specifications

*PV02015D0140T is a TFT-LCD module. It is composed of a TFT-LCD panel, driver IC, FPC, a back light unit . The 2.0'' display area contains 320 x (RGB) x 240 pixels and can display up to 65K colors. This product accords with ROHS environmental criterion.*

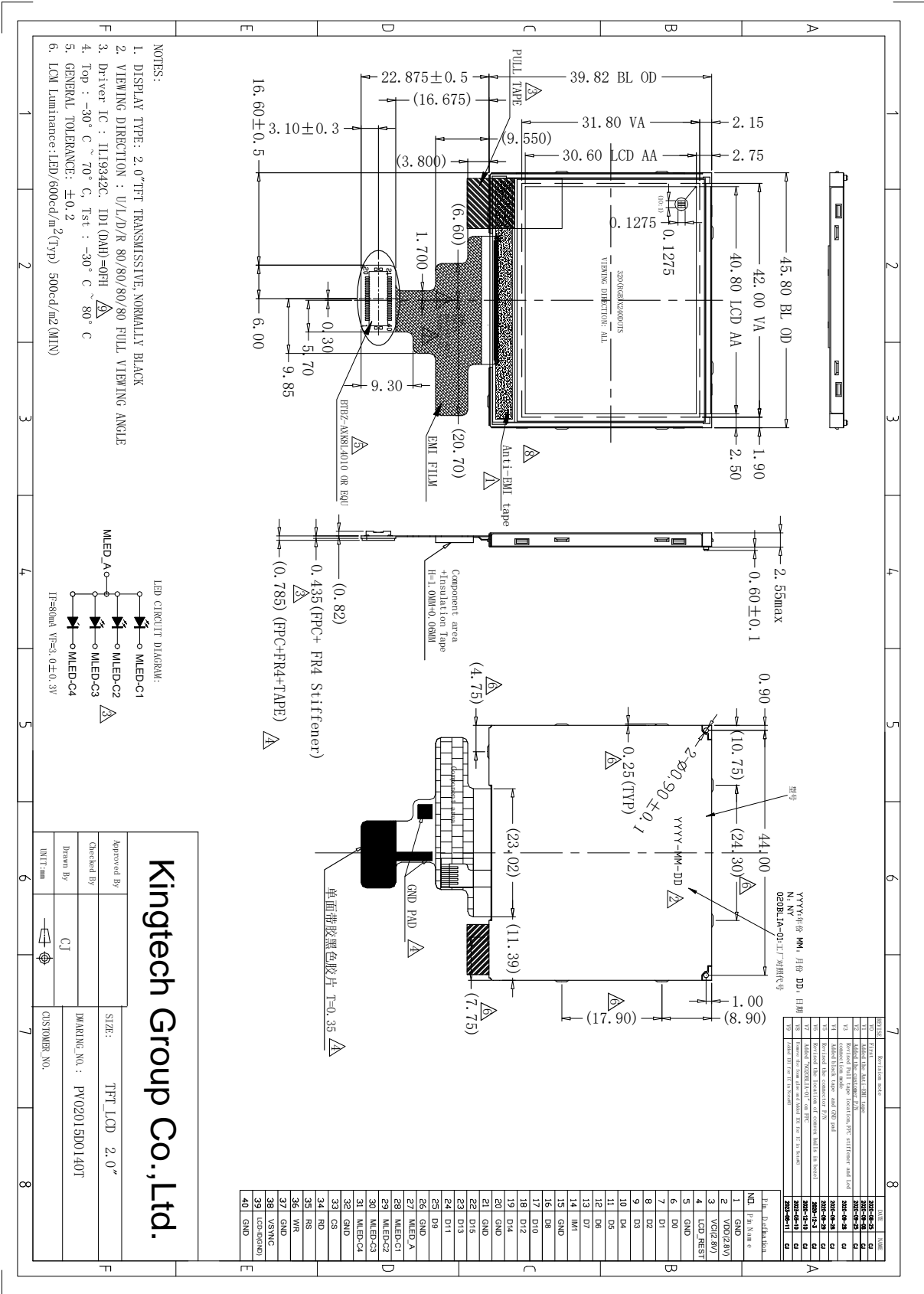
Item	Contents	Unit	Note
LCD Type	TFT	-	
Display color	65K	-	1
Display mode	Normally black	-	
Viewing Direction	ALL	O'Clock	
Operating temperature	-30~+70	°C	
Storage temperature	-30~+80	°C	
Module size	45.80 X 39.82 X 2.55	mm	2
Active Area(W×H)	40.80 X 30.60	mm	
Number of Dots	320(RGB) X 240	dots	
TFT Controller	ILI9342C	-	
Power Supply Voltage	2.8	V	
Backlight	4P-LEDs (white)	-	
Weight	---	g	
Interface	80 MCU16bit/ 80 MCU8bit	-	

*Note 1: Color tune is slightly changed by temperature and driving voltage.*

*Note 2: Without FPC and Solder.*



## 4. Outline Drawing



Kingtech Group Co., Ltd.

Approved By	SIZE: TFT_LCD 2.0"
Checked By	MARKING_NO.: PV02015D0140T
Drawn By	CJ
INT: #	CUSTOMER_NO.



## 5. Absolute Maximum Ratings( $T_a=25\text{ }^\circ\text{C}$ )

### 5.1 Electrical Absolute Maximum Ratings.( $V_{SS}=0V, T_a=25\text{ }^\circ\text{C}$ )

Item	Symbol	Min.	Max.	Unit	Note
Power Supply	VCI	-0.3	+4.2	V	1, 2
Power Supply (Logic)	VDD	-0.3	+4.2	V	1, 2

**Notes:**

1. If the module is above these absolute maximum ratings. It may become permanently damaged. Using the module within the following electrical characteristic conditions are also exceeded, the module will malfunction and cause poor reliability.
2.  $V_{DD} > V_{SS}$  must be maintained.
3. Please be sure users are grounded when handing LCD Module.

### 5.2 Environmental Absolute Maximum Ratings.

Item	Storage		Operating		Note
	MIN.	MAX.	MIN.	MAX.	
Ambient Temperature	-30 $^\circ\text{C}$	80 $^\circ\text{C}$	-30 $^\circ\text{C}$	70 $^\circ\text{C}$	1,2
Humidity	-	-	-	-	3

**Notes:**

1. The response time will become lower when operated at low temperature.
2. Background color changes slightly depending on ambient temperature.  
The phenomenon is reversible.
3.  $T_a \leq 40\text{ }^\circ\text{C}$ : 85%RH MAX.  
 $T_a > 40\text{ }^\circ\text{C}$ : Absolute humidity must be lower than the humidity of 85%RH at 40 $^\circ\text{C}$ .



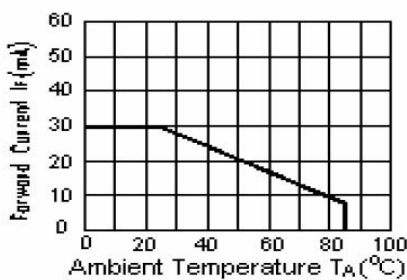
## 6. Electrical Specifications

### 6.1 Electrical characteristics ( $V_{SS}=0V, T_a=25^\circ C$ )

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Note	
Power supply	VCI	$T_a=25^\circ C$	2.6	2.8	3.3	V		
Power supply	VDD	$T_a=25^\circ C$	1.65	1.8	3.3	V		
Input voltage	'H'	$V_{IH}$	$T_a=25^\circ C$	0.7IOVCC	-	IOVCC	V	
	'L'	$V_{IL}$	$T_a=25^\circ C$	0	-	0.3IOVCC	V	

### 6.2 LED backlight specification ( $V_{SS}=0V, T_a=25^\circ C$ )

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply voltage	Vf	$I_f=80mA$	2.7	3.0	3.3	V	
Uniformity	$\Delta Bp$	$I_f=80mA$	75	80	-	%	
Life Time	time	$I_f=80mA$	-	20K	-	hours	1
Supply current	$I_f$			80	100	mA	



Note 1: Brightness to be decreased to 50% of the initial value at ambient temperature  $T_a=25^\circ C$



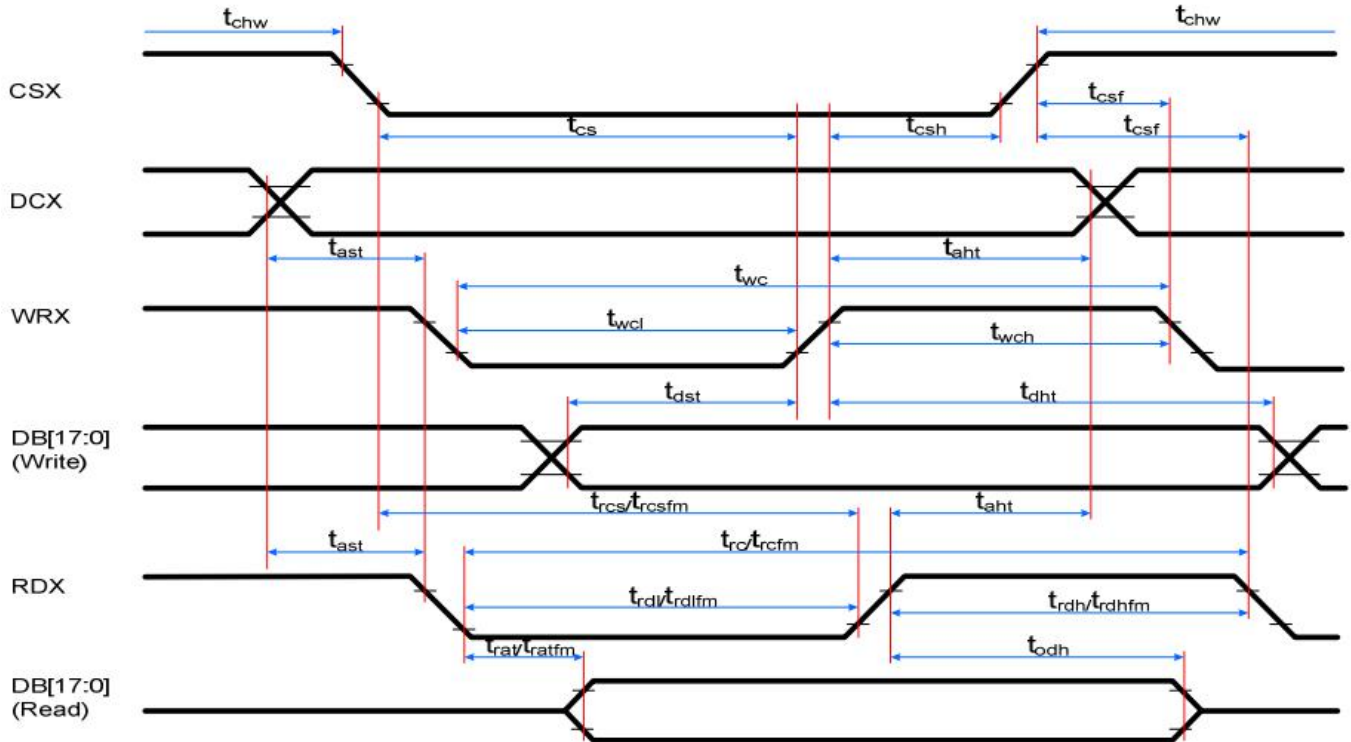
### 6.3 Interface signals

Pin No.	Symbol	I/O	Function
1	GND	P	Ground
2	VDD(2.8V)	P	,Power supply for interface logic circuits 1.65~3.3V
3	VCI(2.8V)	P	Power Supply (analog)2.6~3.3V
4	LCD_REST	I	Reset signal,Signal is active low
5	GND	P	Ground
6-13	D0-D7	I	Data input.
14	IM1	I	IM1='H',MCU16bit,D[15:0].
			IM1='L',MCU8bit,D[7:0].
15	GND	P	Ground
16	D8	I	Data input.
17	D10	I	Data input.
18	D12	I	Data input.
19	D14	I	Data input.
20-21	GND	P	Ground
22	D15	I	Data input.
23	D13	I	Data input.
24	D11	I	Data input.
25	D9	I	Data input.
26	GND	P	Ground
27	MLED_A	P	LED anode
28-31	MLED_C1-C4	P	LED cathode
32	GND	P	Ground
33	CS	I	Chip select input pin ("Low" enable).
34	RD	I	Read enable in MCU parallel interface.
35	RS	I	Display data/command selection pin
36	WR	I	Write enable in MCU parallel interface
37	GND	P	Ground
38	VSYNC	-	Vsync output signal from LDI.
39	LCD_ID	I	ID Pin(GND).
40	GND	P	Ground



## 6.4 AC Characteristics

### Display Parallel 18/16/9/8-bit Interface Timing Characteristics

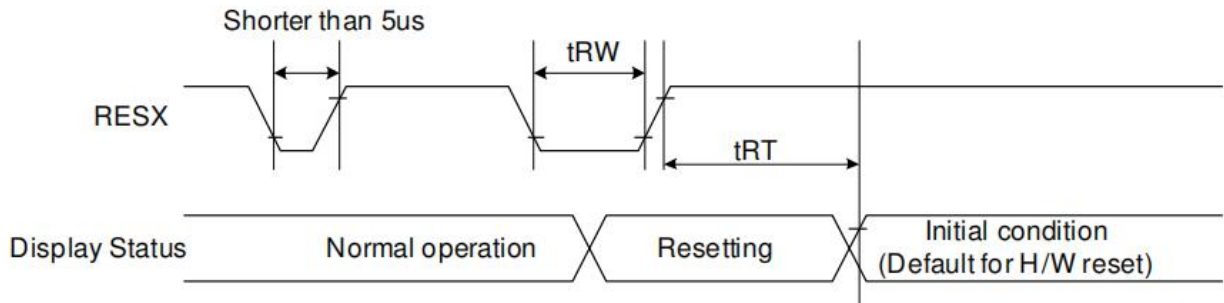


Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	10	-	ns	
CSX	tchw	CSX "H" pulse width	0	-	ns	
	tcs	Chip Select setup time (Write)	15	-	ns	
	trcs	Chip Select setup time (Read ID)	45	-	ns	
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	
WRX	tcsf	Chip Select Wait time (Write/Read)	10	-	ns	
	twc	Write cycle	66	-	ns	
	twrl	Write Control pulse L duration	15	-	ns	
RDX (FM)	twrh	Write Control pulse H duration	15	-	ns	
	trcfm	Read Cycle (FM)	450	-	ns	
	trdhfm	Read Control H duration (FM)	90	-	ns	
RDX (ID)	trdlfm	Read Control L duration (FM)	355	-	ns	
	trc	Read cycle (ID)	160	-	ns	
	trdh	Read Control pulse H duration	90	-	ns	
D[17:0], D[15:0], D[8:0], D[7:0]	trdl	Read Control pulse L duration	45	-	ns	
	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
trod	Read output disable time	20	80	ns		





## 6.5 Reset Timing



Signal	Symbol	Parameter	Min	Max	Unit
RESX	tRW	Reset pulse duration	10		uS
	tRT	Reset cancel		5 (note 1,5)	mS
				120 (note 1,6,7)	mS

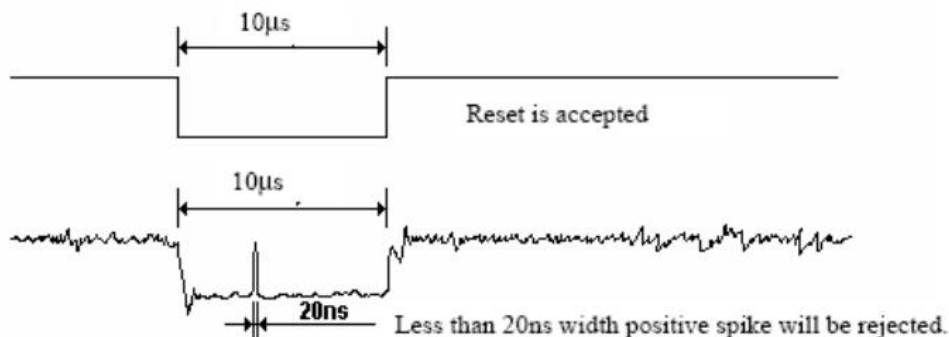
Note 1: The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NV memory to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

Note 2: Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below: -

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 10us	Reset
Between 5us and 10us	Reset starts

Note 3: During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In -mode.) And then return to Default condition for Hardware Reset.

Note 4: Spike Rejection also applies during a valid reset pulse as shown below:



Note 5: When Reset applied during Sleep In Mode.

Note 6: When Reset applied during Sleep Out Mode.

Note 7: It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.



## 7. Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Brightness	Bp	$\theta=0^\circ$ $\Phi=0^\circ$	500	600	-	Cd/m <sup>2</sup>	1	
Uniformity	$\Delta$ Bp		80	-	-	%	1,2	
Viewing Angle	3:00	Cr $\geq$ 10	70	80	-	Deg	3	
	6:00		70	80	-			
	9:00		70	80	-			
	12:00		70	80	-			
Contrast Ratio	Cr	$\theta=0^\circ$ $\Phi=0^\circ$	1000	1500	-	-	4	
Response Time	T <sub>r</sub> +T <sub>f</sub>		-	30	40	ms	5	
Color of CIE Coordinate	W	x	$\theta=0^\circ$ $\Phi=0^\circ$	Typ. -0.05	Typ. +0.05	-	1,6	
		y				-		
	R	x				0.616		-
		y				0.358		-
	G	x				0.353		-
		y				0.596		-
	B	x				0.141		-
		y				0.088		-
NTSC Ratio	S	55	60	-	%			

Note: The parameter is slightly changed by temperature, driving voltage and materiel

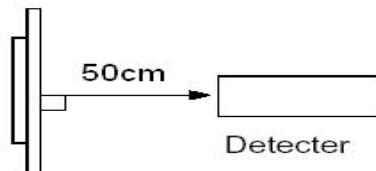


**Note 1:** The data are measured after LEDs are turned on for 5 minutes. LCM displays full white.  
 The brightness is the average value of 5 measured spots. Measurement equipment BM-7 (Φ5mm)

**Measuring condition:**

- Measuring surroundings: Dark room.
- Measuring temperature:  $T_a=25\text{ }^\circ\text{C}$ .
- Adjust operating voltage to get optimum contrast at the center of the display.

Measured value at the center point of LCD panel after more than 5 minutes while back light turning on.

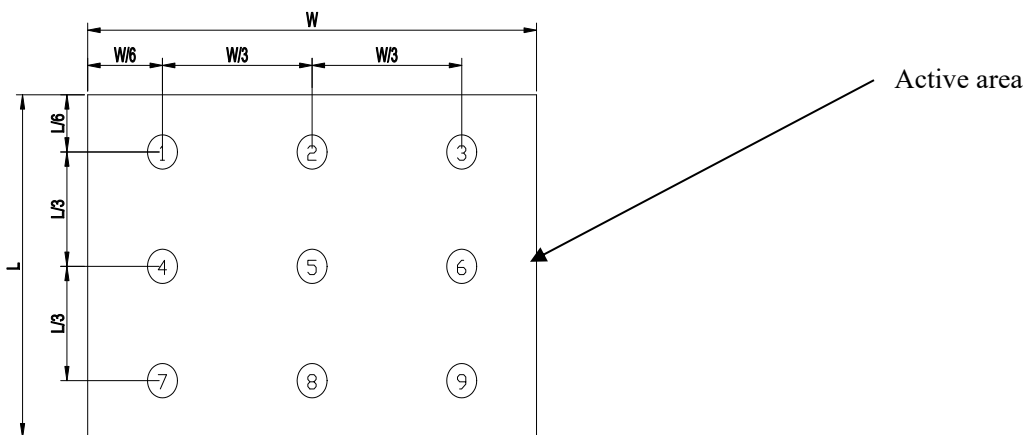


**Note 2:** The luminance uniformity is calculated by using following formula.

$$\Delta B_p = B_p (\text{Min.}) / B_p (\text{Max.}) \times 100 (\%)$$

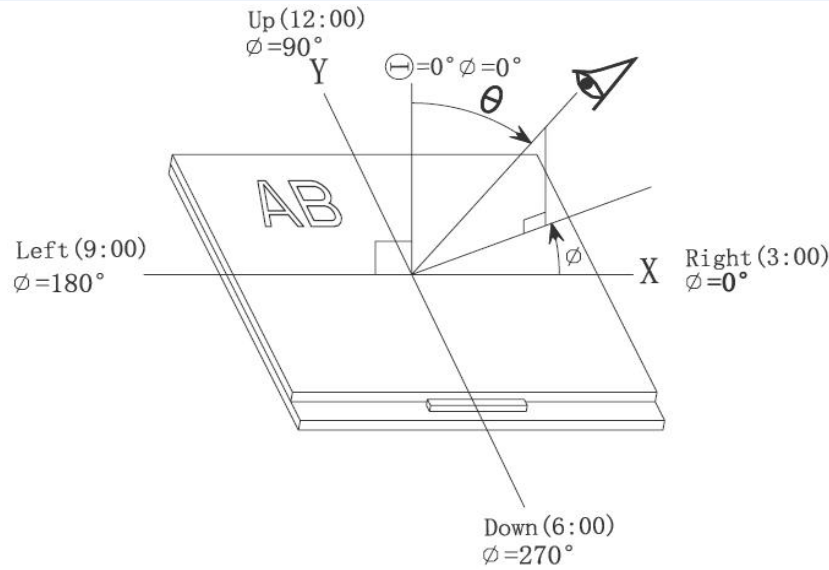
$B_p (\text{Max.})$  = Maximum brightness in 9 measured spots

$B_p (\text{Min.})$  = Minimum brightness in 9 measured spots.

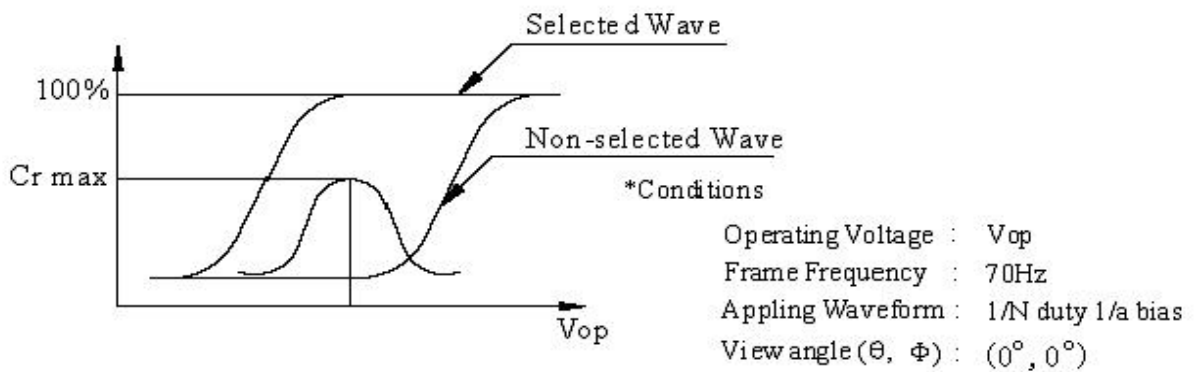


**Note 3:** The definition of viewing angle:

Refer to the graph below marked by  $\theta$  and  $\Phi$



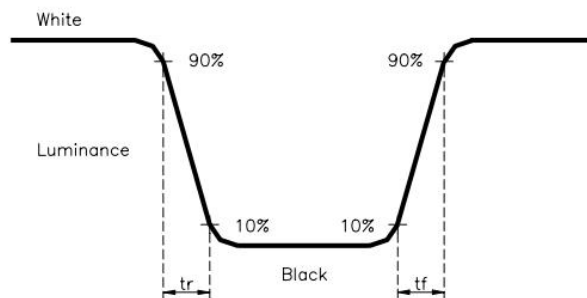
Note 4: Definition of contrast ratio.( Test LCD using DMS501)



$$\text{Contrast ratio}(Cr) = \frac{\text{Brightness of selected dots}}{\text{Brightness of non-selected dots}}$$

Note 5: Definition of Response time. (Test LCD using DMS501):

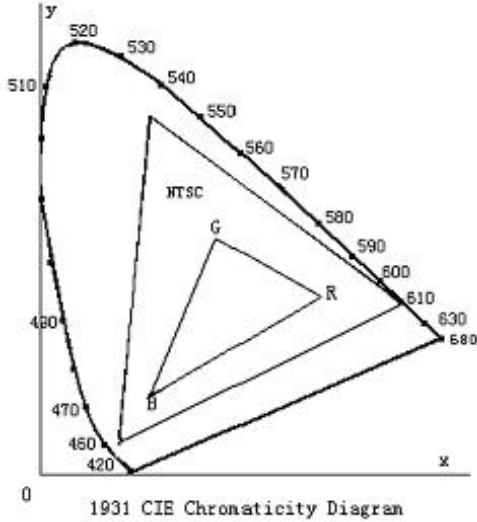
The output signals of photo detector are measured when the input signals are changed from “white” to “black”(rising time) and from “black” to “white”(falling time) , respectively. The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to figure as below.



The definition of response time



Note 6: Definition of Color of CIE Coordinate and NTSC Ratio.

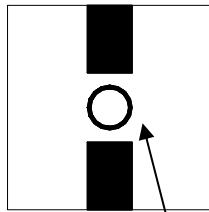


Color gamut:

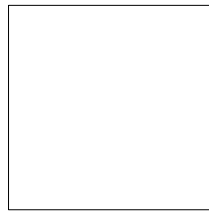
$$S = \frac{\text{area of RGB triangle}}{\text{area of NTSC triangle}} \times 100\%$$

Note 7: Definition of cross talk.

$$\text{Cross talk ratio(\%)} = \frac{|\text{pattern A Brightness} - \text{pattern B Brightness}|}{\text{pattern A Brightness}} \times 100$$



Pattern A



Pattern B

Measurement point(center)

Electric volume value =  $3F \pm 3Hex$



## 8. Reliability Test Items and Criteria

Test Item	Test condition	Remark
High Temperature Storage	Ta = 80°C 96hrs	Note1,Note3, 4
Low Temperature Storage	Ta = -30°C 96hrs	Note1,Note3, 4
High Temperature Operation	Ta = 70°C 96hrs	Note2,Note3, 4
Low Temperature Operation	Ta = -30°C 96hrs	Note1,Note3, 4
Operation at High Temperature/Humidity	+60°C, 90%RH 96hrs	Note3, 4
Thermal Shock	-30°C/30 min ~ +80°C/30 min for a total 10 cycles, Start with cold temperature and end with high temperature.	Note3, 4
Vibration Test	Frequency range:10~55Hz Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X. Y. Z. (6 hours for total)	
Mechanical Shock	100G 6ms,±X, ±Y, ±Z 3 times for each direction	
Package Vibration Test	Random Vibration : 0.015G*G/Hz from 5-200HZ, -6dB/Octave from 200-500HZ 2 hours for each direction of X. Y. Z. (6 hours for total)	
Package Drop Test	Height:60cm 1 corner, 3 edges, 6 surfaces	
Electro Static Discharge	±2KV, Human Body Mode, 100pF/1500Ω	

Note 1: Ta is the ambient temperature of samples.

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

Note 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 4: Before cosmetic and function test, the product must have enough recovery time,at least 2 hours at room temperature



## 9. Precautions for Use of LCD Modules

### 9.1 Handling Precautions

9.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

9.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

9.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

9.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

9.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

— Isopropyl alcohol      — Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

— Water                      — Ketone                      — Aromatic solvents

9.1.6 Do not attempt to disassemble the LCD Module.

9.1.7 If the logic circuit power is off, do not apply the input signals.

9.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

a. Be sure to ground the body when handling the LCD Modules.

b. Tools required for assembly, such as soldering irons, must be properly ground.

c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

d. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.



## **9.2 Storage precautions**

9.2.1 *When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.*

9.2.2 *The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:*

*Temperature :        0 °C ~ 40 °C*

*Relatively humidity: ≤80%*

9.2.3 *The LCD modules should be stored in the room without acid, alkali and harmful gas.*

9.3 *The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.*





## 10 . Quality Assurance

### 10.1.Objective

The TFT criteria is set to formalize the TFT quality standards with reference to customer for inspection.

### 10.2.Scope

The criteria is applicable to all TFT products (Include TFT , TFT+RTP or TFT+CTP) manufactured by Kingtech.

### 10.3.Tools for Inspection

Tester, calipers, multi-meter, anti-static wrist straps, finger cots, desk Lamps, etc.

### 10.4.Sampling Plan and Reference Standards

#### 10.4.1.1 Sampling plan:

Refer to GB/T2828.1-2012/ISO2859-1:1999 //MIL-STD-105E

AQL: level II; normal:

1) MA=0.40

2) MI=0.65

#### 10.4.1.2 IPC-A-610 Acceptability of Electronic Assemblies.

### 10.5.Inspection Conditions and Inspection Reference

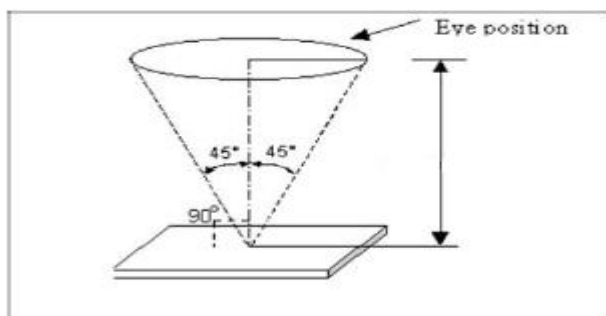
#### 10.5.1 Cosmetic inspection with naked eyes:

1) Temperature:  $23\pm 5^{\circ}\text{C}$ ; relative humidity: 45~75%RH

2) Illumination: 500lux~1000lux

3) Distance:  $30\text{cm}\pm 5$  from the inspector's naked eyes to the LCD panel.

4) View angle: within  $45^{\circ}$  from perpendicular to LCM surface (view direction and special parameters refer to production specification).





## 10.5.2 Definition

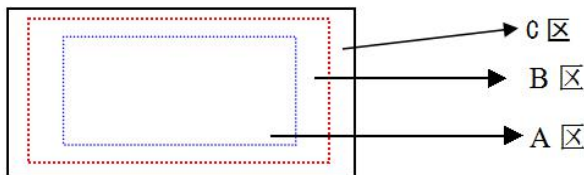
### 10.5.2.1 Area definition

A area: Active area (AA area)

B area: Viewing area (VA area)

C area: non-view area (out of B area)

10.5.2.2 Any cosmetic defect which do not affect product quality and customer assembling in C area, it's Acceptable. (The dimension is defined on the drawings)



10.5.2.3 Test condition: refer to product specification

## 10.5.3 Defect type:

### 10.5.3.1 A area defect type:

Line defect (scratch, soft flocks, fibre) 、 dot defect (white dot, black dot, same color dot, different color dot, bubble) , stain, pin-hole, light leak, scratch.

### 10.5.3.2 B area defect type:

Broken, crack/chipping, FPC defect

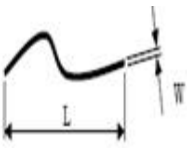
10.5.4 Undefined items or other special items, refer to mutual agreement and limited sample by customer.

10.5.5 Test condition: refer to product specification.

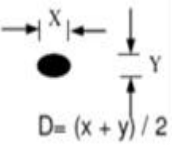
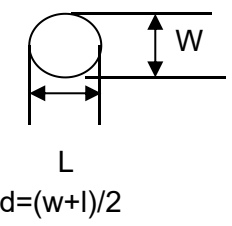
## 10.6. Defects and Acceptance Standards

### 10.6.1 Appearance inspection

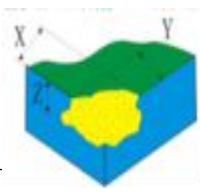
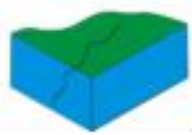
#### 10.6.1.1 Dot/line defect

Defect	S < 3.5"	Accepted standard	MAJ	MIN
<b>S/C , line defect</b> <b>W:width</b> <b>L:length</b> 	W ≤ 0.05mm and L ≤ 10	Accept		√
	0.05mm < W ≤ 0.08mm, L ≤ 10mm quantity ≤ 3 3mm (min) apart	Accept		√
	0.08mm < W ≤ 0.1mm, L ≤ 5mm quantity ≤ 1 3mm (min) apart	Accept		√
	W > 0.1mm or L > 10mm	Reject		√
<b>Dot defect</b> (black/white spot,	D ≤ 0.15mm 2mm (min) apart	Accept		√



<b>foreign objects etc)</b> <b>D:Diameter</b> 	$0.15\text{mm} < D \leq 0.25\text{mm}$ quantity $\leq 3$ 5mm (min) apart	Accept		√
	$D > 0.25\text{mm}$	Reject		√
<b>Polarizer with air bubble, convex-concave dots or dent defect</b> 	$D \leq 0.25\text{mm}$	Accept		√
	Non visible area	Accept		√
	$0.25\text{mm} < D \leq 0.4\text{mm}$ quantity $\leq 4$ 5mm (min) apart	Accept		√
	$d > 0.4\text{mm}$	Reject		√

### 10.6.1.2 Chip and Crack

Defect	S < 5"	Accepted standard	MAJ	MIN
<b>Chip</b> 	$X \leq 0.3\text{mm}, Y \leq 0.3\text{mm},$ one side $\leq 1$	Accept		√
	$X > 0.3\text{mm},$ $Y > 0.3\text{mm}$	Reject		√
<b>Sensor chip</b>	Not affect ITO line, not lengthen, function test is OK. And be non-visual after attaching Lens.	Accept		√
	Affect ITO line and be visual.	Reject		√
<b>Glass crack</b> 	Glass crack.	Reject		√

### 10.6.1.3 Attaching defect (kapton tape/protective film)

Defect	Description	Accepted standard	MAJ	MIN
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<b>High temperature kapton tape</b>	Kapton tape attached on FPC doesn't meet the criterion of drawing.	Reject		√
<b>Protective film</b>	Clean、 attaching flat、 no shifting	Accept		√


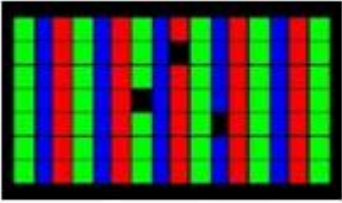
## 10.6.2 TFT defects and Inspection Criterion

### 10.6.2.1 Function items

Defects	Inspection Criterion	Pictures	Inspection method/tools	Defect category
No display /function	shows no picture/display in normal connected situation. ->Rejected		Naked eyes/ testers	MA
Missing segment	Shows missing lines in normal display.->Rejected		Naked eyes/ testers	MA
Flicker	Not accepted	/	Naked eyes/ testers	MA
Display abnormal	Not accepted		Naked eyes/ testers	MA
Display dim/bright	Refer to bright value definition	/	Naked eyes/ BM-7	MA
Contrast	Refer to SPEC	/	Naked eyes/ BM-7	MA
White/ black dot White/ black speckle	Refer to dot criterion	/	Naked eyes	MI



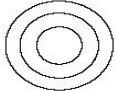
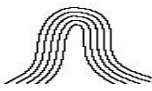
### 10.6.2.2 LCD pixel defect(defect category: MI)

Electrical Dot Defect	Bright and Black dot define:	
		
	and	
	Inspection pattern: Full white, Full black, Red, green and blue screens	
	Item	Acceptable Quantity
	Black dot defect	2
	Bright dot defect	0
	Total Dot	2

### 10.6.3 RTP defect)

Description	Judgment	Defect
Camera aperture window area does not allow any defects	NG	minor
Check under black background, see nothing	OK	minor
Ink splash point,pinhole	Dot line defect judgement	minor
Ink printed serration	Serrated size≤0.2 OK	minor
Ink printing defect	Not exceed line 1/2 OK	minor
Printing error,fuzzy,missing Broken line	NG	minor
---	NG or by limited sample	minor
---	Dot line defect judgement	minor
Beyond backlight frame, affect display,terminal assembly	NG	major
No more than 1.5 grid drift	OK	major



Touch no reaction when testing	NG	major
regular 	irregular 	area less than 1/6 area of the entire TP, and function is ok, no dead collapse  minor

### 10.6.4 B/L defect

Item	Description	Judgment	Defect
B/L scratch wound	---	Dot/line defect judgement	minor
Black display	Black light while power on	NG	major
B/L particle /white black dot	impurities, foreign body, fiber, top injury	Dot line defect judgement	minor
leaking	Vision area leaking	NG or by Sample	minor
	Leaking between LCD and Backlight	Can not exceed 1/2 single line	minor
Display irregular	Colour difference with Samples	NG	major
	Lighter or darker	NG or By sample	minor
Water/white print at Backlight	Water/ white print occurred when Lighting	NG	minor
Interference ripple	Interference ripple occurred when Lighting	NG	minor
B/L faulty	Not smooth,uneven light	NG or By sample	minor

### 10.7.Others

10.7.1 Some defect items are not defined in this document, obey to final negotiation between customer and manufacturer or sign limit sample.

10.7.2 If final goods includes FPC/PCB, inspection criterion refers to IPC-610, Level 2

*Note: 1. Dot defect is defined as the defective area of the dot area is larger than 50% of the dot area.*

*2. The distance between black dot defects or black and bright dot defects should be more than 5mm apart. The distance between two bright dot defects should be more than 15mm apart*

*3. Polarizer bubble is defined as the bubble appears on active display area. The*



*defect of polarizer bubble shall be ignored if the polarizer bubble appears on the outside of active display area.*

*4. Mura is checked by 6% ND filter.*

*5. Foreign particle on the surface of the LCM should be ignored.*

*6. Product warranty period of 1 year.*

**END**