

Display Elektronik GmbH

DATA SHEET

TFT MODULE

DEM 19201080H VM-PW-N

15,6“ TFT

Product Specification

Version: 0

14.12.2024

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*** Description**

This is a color active matrix TFT (Thin Film Transistor) LCD (liquid crystal display) that uses amorphous silicon TFT as a switching device. This module is composed of a Transmissive type TFT-LCD Panel, driver circuit, back-light unit. The resolution of a 15.6 " TFT-LCD contains 1920X1080 pixels, and can display up to 16.7M colors.

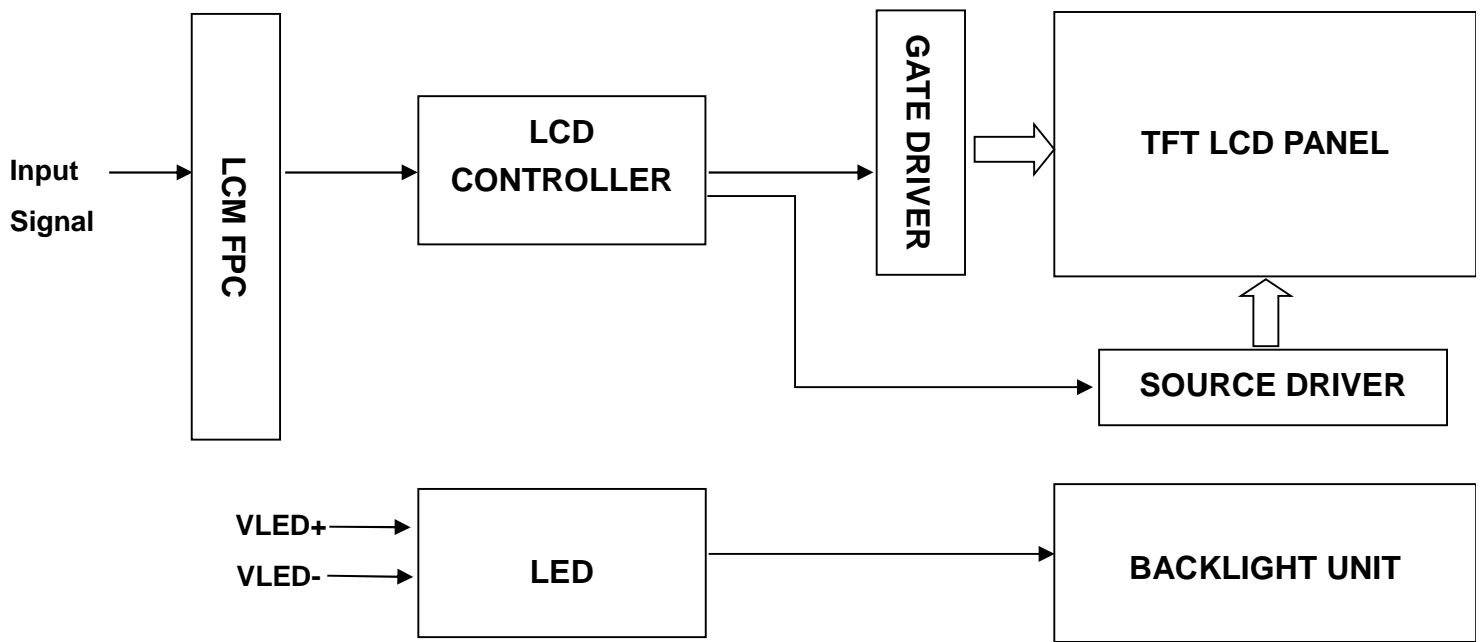
*** Features**

General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	344.16(H)* 193.59(V) (15.6 inch)	mm	
Driver element	TFT active matrix	-	
Display colors	16.7M	colors	
Number of pixels	1920(RGB)*1080	dots	
Pixel arrangement	RGB Vertical Stripe	-	
Pixel pitch	0.17925(H)* 0.17925(V)	mm	
Viewing angle	ALL	o'clock	
Display mode	Transmissive /Normally Black	-	
LCM Interface	LVDS	-	
Operating temperature	0~+50	°C	
Storage temperature	-20~+60	°C	

*** Mechanical Information**

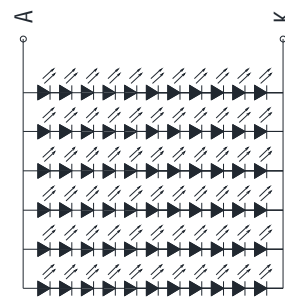
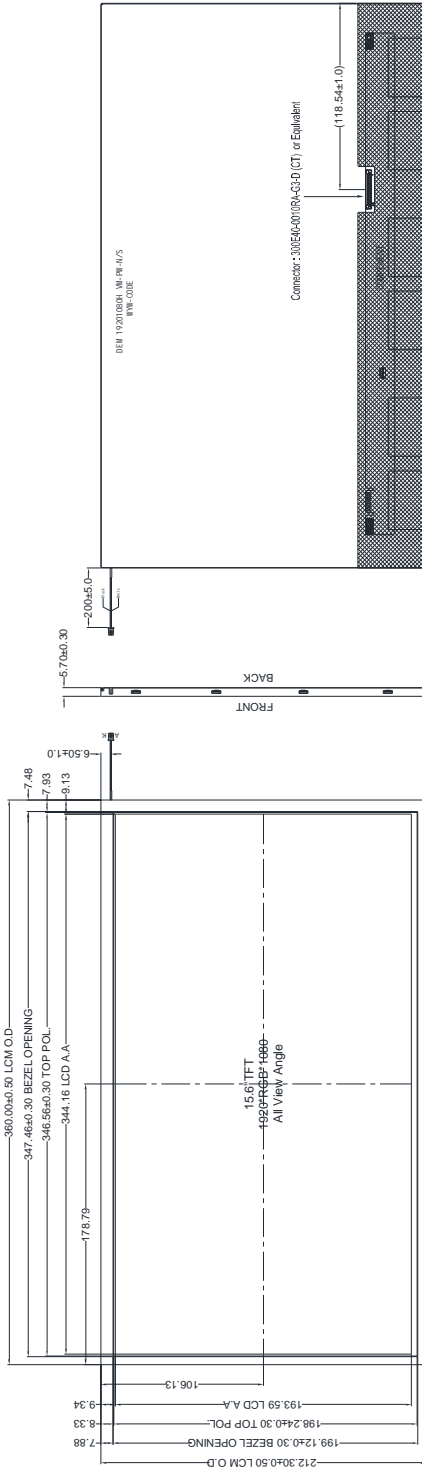
Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)	-	360.0	-	mm	
	Vertical(V)	-	212.3	-	mm	
	Depth(D)	-	5.7	-	mm	
Weight		-	TBD	-	g	

1. Block Diagram



2. Outline dimension

Pin	Name
1	RK0C-
2	RK0C+
3	RK0I-
4	RK0I+
5	RK0Z-
6	RK0Z+
7	GND
8	RK0CLK-
9	RK0CLK+
10	GND
11	RK0S-
12	RK0S+
13	GND
14	RKEU-
15	RKEU+
16	RKEI-
17	RKEI+
18	RKEZ-
19	RKEZ+
20	GND
21	RRECLK-
22	RRECLK+
23	GND
24	RRES-
25	RRES+
26	GND
27	LCD_VCC
28	LCD_VCC
29	BIST
30	NC
31	NC
32	NC
33	NC
34	NC
35	NC
36	GND
37	GND
38	GND
39	ID1
40	ID2



- NOTES:
1. DISPLAY TYPE: 15.6", TFT LCD, 16.7M COLORS
 2. DISPLAY MODE: NORMALLY BLACK, IPS
 3. VIEWING DIRECTION: FREE
 4. LCM DRIVER IC: ***** (COG)
 5. TFT INTERFACE: 2 Port LVDS
 6. TOUCH MODE: NA
 7. TOUCH DRIVER: NA
 8. CTP INTERFACE: NA
 9. TOUCH AND LCM BONDING TECHNOLOGY: NA
 10. LCD VCC: 12V
 11. OPERATING TEMP: 0°C TO 50°C
STORAGE TEMP: -20°C TO 60°C
 12. BACK LIGHT: LED WHITE, 66 LED, 480mA(Typ.), 53V(Typ.)
 13. RoHS AND REACH COMPLIANT.

3. Input terminal Pin Assignment

3.1 Interface Pin Assignment

Connector:300E40-001RA-G3-D(CT) or equivalent

NO.	SYMBOL	DISCRIPTION	I/O
1	RxO0-	Negative LVDS differential data input (Odd data)	P
2	RxO0+	Positive LVDS differential data input (Odd data)	P
3	RxO1-	Negative LVDS differential data input (Odd data)	P
4	RxO1+	Positive LVDS differential data input (Odd data)	P
5	RxO2-	Negative LVDS differential data input (Odd data)	-
6	RxO2+	Positive LVDS differential data input (Odd data)	P
7	GND	Ground	I
8	RxOCLK-	Negative LVDS differential clock input (Odd clock)	I
9	RxOCLK+	Positive LVDS differential clock input (Odd clock)	P
10	GND	Ground	I
11	RxO3-	Negative LVDS differential data input (Odd data)	I
12	RxO3+	Positive LVDS differential data input (Odd data)	P
13	GND	Ground	I
14	RxE0-	Negative LVDS differential data input (Even data)	I
15	RxE0+	Positive LVDS differential data input (Even data)	P
16	RxE1-	Negative LVDS differential data input (Even data)	I
17	RxE1+	Positive LVDS differential data input (Even data)	I
18	RxE2-	Negative LVDS differential data input (Even data)	P
19	RxE2+	Positive LVDS differential data input (Even data)	I
20	GND	Ground.	I
21	RxECLK-	Negative LVDS differential clock input (Even clock)	P
22	RxECLK+	Positive LVDS differential clock input (Even clock)	I
23	GND	Ground.	I
24	RxE3-	Negative LVDS differential data input (Even data)	P
25	RxE3+	Positive LVDS differential data input (Even data)	I

26	GND	Ground.	I
27	LCD_VCC	LCD VCC(12V)	P
28	LCD_VCC	LCD VCC(12V)	I
29	BIST	LCD self-test (Normal mode: NC or pull L; BIST mode: pull H)	I
30	NC	--	P
31	NC	--	I
32	NC	--	I
33	NC	--	P
34	NC	--	I
35	NC	--	I
36	GND	Ground.	P
37	GND	Ground.	P
38	GND	Ground.	P
39	ID1	Reserved PIN, Default ' H' , Recommend NC	O
40	ID2	Reserved PIN, Default ' L' , Recommend NC	O

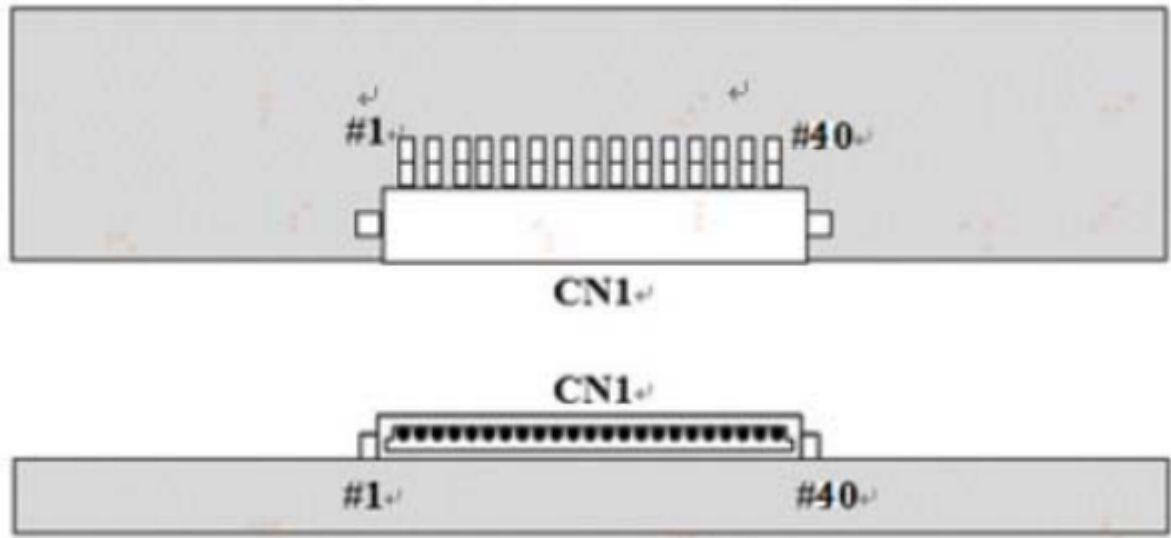
3.2 BL PIN Defin

Connector(CON2/CON3):PH2.0-2PIN

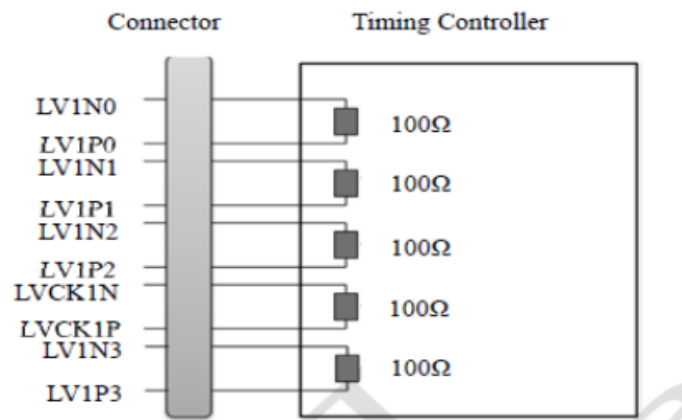
NO.	SYMBOL	DISCRIPTION	I/O
1	LEDA+	Anode pin of backlight	P
2	LEDK-	Cathode pin of backlight	P

Note:

(1) The direction of pin assignment is shown as below:



3.3 Block Diagram of Interface

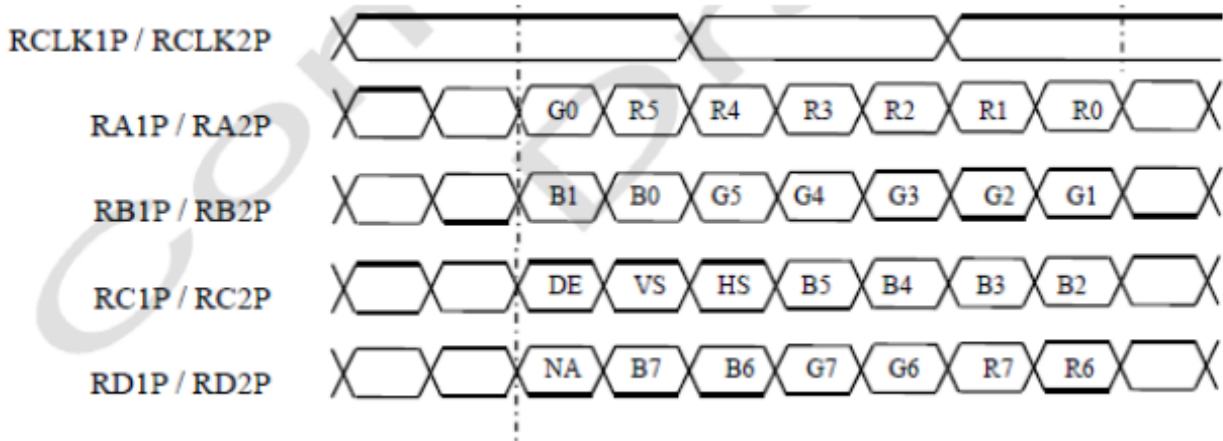


Attention:

- (1) This open cell uses a 100 ohms (Ω) resistor between positive and negative lines of each receiver input.
- (2) LVDS cable impedance shall be 50 ohms per signal line or about 100 ohms per twist-pair line respectively.

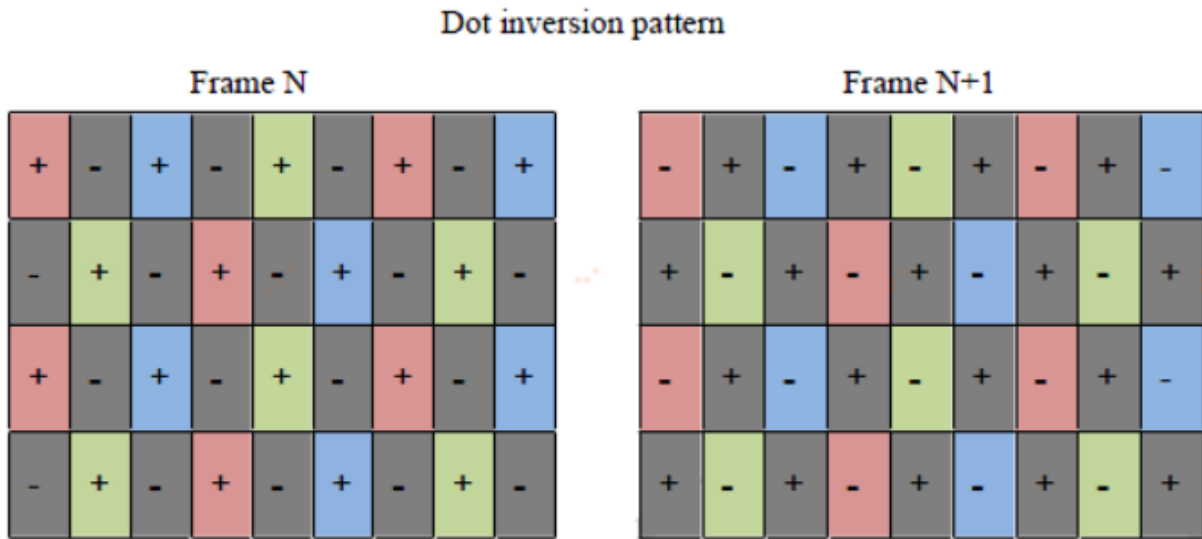
3.4 LVDS Interface

3.4.1 VESA Format



3.5 Flicker Pattern

Flicker should be adjusted by the Dot on/off pattern, where are displayed alternately at vertical line. (Dot inversion)



4. LCD Optical Characteristics

4.1 Optical specification

Item	Symbol	Condition	Min.	Typ.	Max.	Unit.	Note
Contrast Ratio	CR	$\Theta=0$	--	3000	--		(1)(2)
Response time	Rising	T_{R+T_F}	--	30	35	msec	(1)(3)
	Falling						
Color Gamut	S(%)		68	72	--	%	
Color Filter Chromaticity	White	W_X	-0.03	0.283	+0.03		(1)(4) CA-310
		W_Y		0.299			
	Red	R_X		0.650			
		R_Y		0.338			
	Green	G_X		0.312			
		G_Y		0.615			
	Blue	B_X		0.150			
		B_Y		0.071			
Viewing angle	Hor.	Θ_L	80	89	--		(1)(4)
		Θ_R	80	89	--		
	Ver.	Θ_U	80	89	--		
		Θ_D	80	89	--		
Option View Direction	ALL						

*The data comes from the LCD specification.

Measuring Condition

Measuring surrounding : dark room

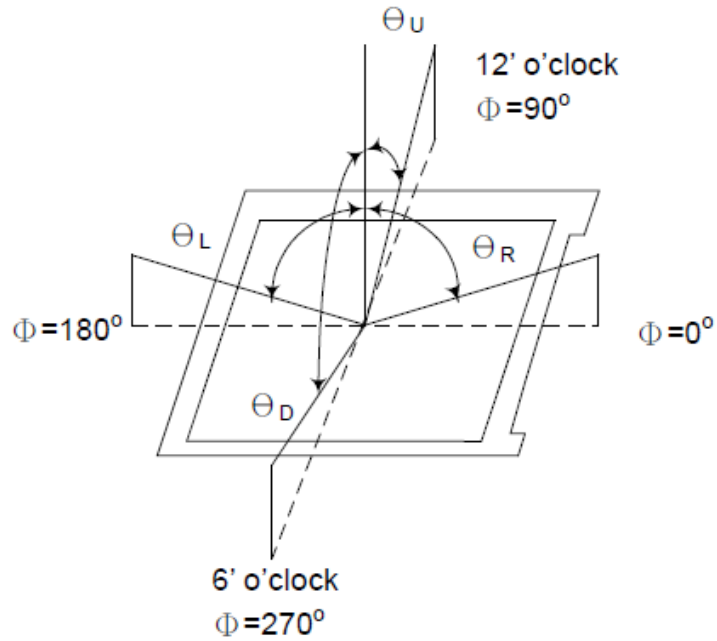
Ambient temperature : 25 ± 2 °C

15min. warm-up time.

Measuring Equipment

FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

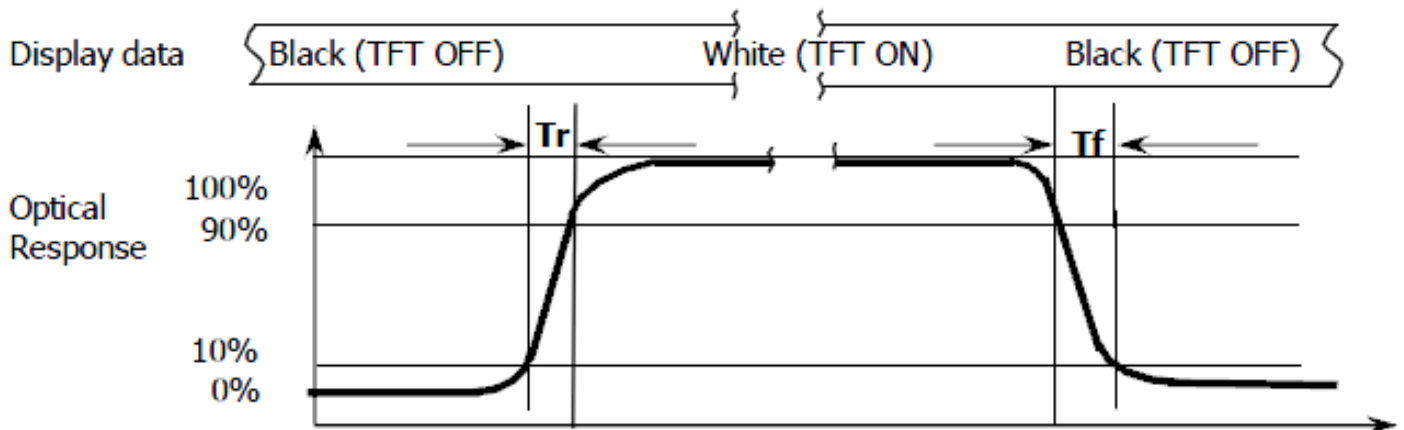
Note (1): Definition of Viewing Angle :



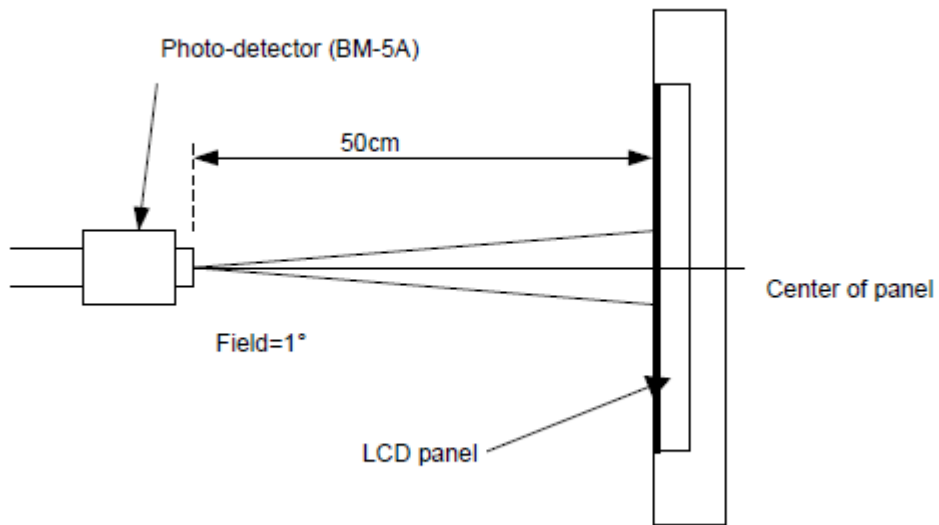
Note (2): Definition of Contrast Ratio(CR) :measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

Note (3): Response Time



Note (4): Definition of optical measurement setup



5. Electrical Characteristics

5.1 Absolute Maximum Rating

Characteristics	Symbol	Min.	Max.	Unit	Note
Digital Supply Voltage	VDD	-0.3	13.2	V	Note1
Operating temperature	T _{OP}	0	+50	°C	
Storage temperature	T _{ST}	-20	+60	°C	

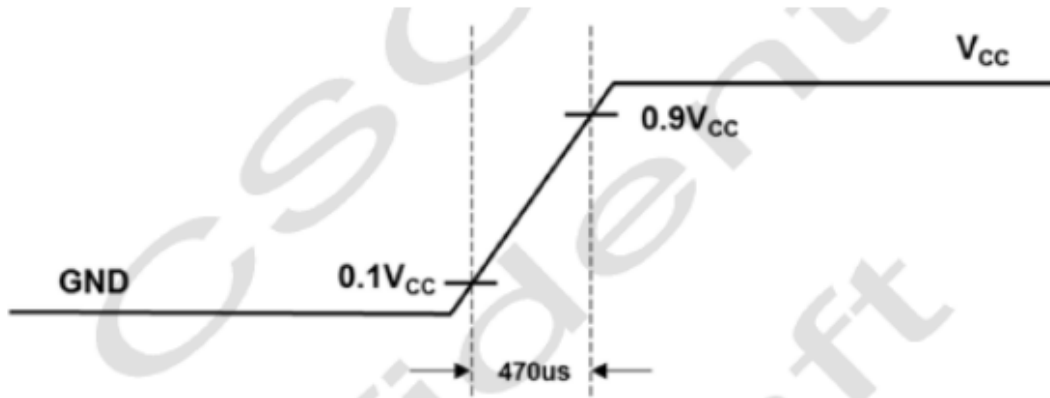
NOTE1: If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.

5.2 DC Electrical Characteristics

Characteristics		Symbol	Min.	Typ.	Max.	Unit	Note
Digital Supply Voltage		VDD	10.8	12	13.2	V	(1)
Rush Current		I _{rush}	--	--	3000	mA	(2)
Power Supply Current	White Pattern	I _{cc}	--	0.209	0.269	A	(3)
	Horizontal Stripe		--	0.251	0.311	A	
	Black Pattern		--	0.2	0.26	A	
	Mosaic Patern		--	0.204	0.264	A	
Power Consumption (Mosaic Pattern)		P _{oc}	0	2.448	3.168	Watt	60Hz

Note:

- (1) The ripple voltage should be controlled less than 10% of VCC.
- (2) Measurement condition: VCC rising time = 470 μs.

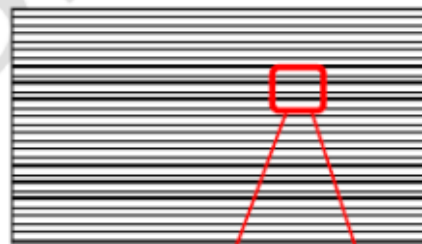


(3) Measurement condition: VCC = 12 V, Ta = 25 ± 2 °C. The test patterns are shown as below.

A. White Pattern



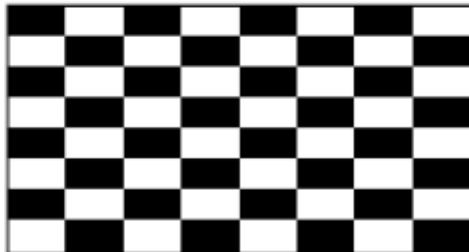
B. Horizontal Stripe Pattern



C. Black Pattern



D. Mosaic Pattern



5.3 LED Backlight Characteristics

The back-light system is edge-lighting type with 66 chips LED

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I _F	--	480	--	mA	
Forward Voltage	V _F	29.7	33.0	37.4	V	
LCM Luminance	LV	800	1000	--	cd/m ²	Note3
LED life time	Hr	20000	30000	--	Hour	Note1,2
Uniformity	Avg	75	80	--	%	Note3

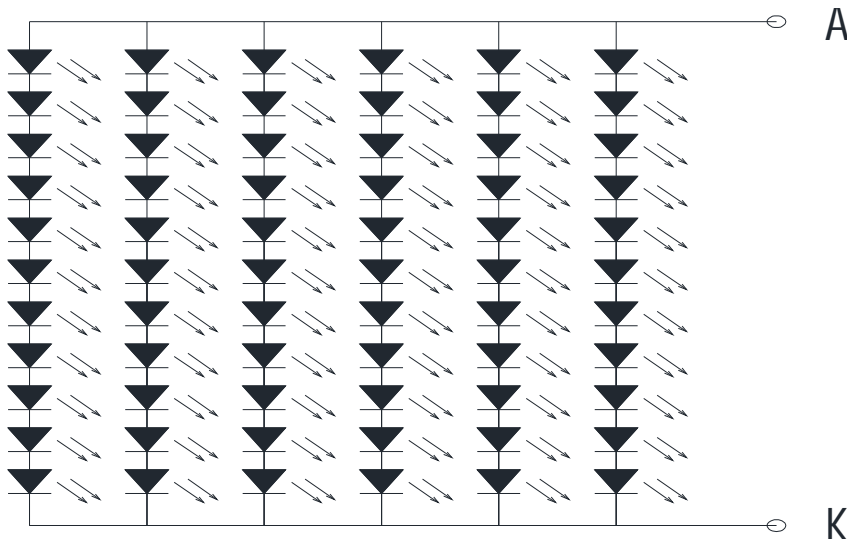
Note1: LED life time (Hr) can be defined as the time in which it continues to operate under the condition:

T_a=25±3 °C, typical IL value indicated in the above table until the brightness becomes less than 50%.

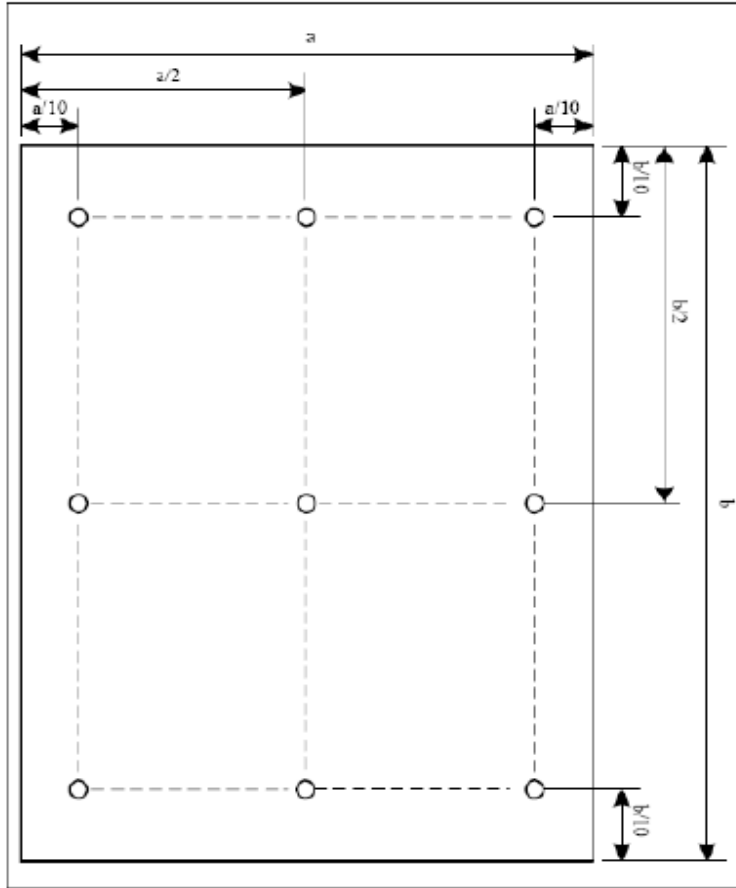
Note 2: The “LED life time” is defined as the module brightness decrease to 50% original brightness at

T_a=25°C and I_L=480mA. The LED lifetime could be decreased if operating I_L is larger than 480mA.

The constant current driving method is suggested.



Note (3) Luminance Uniformity of these 9 points is defined as below:



$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$

$$\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$$

6. LVDS Timing Characteristics

6.1 LVDS Characteristics

Parameter	Symbol	Value			Unit	Note	
		Min.	Typ.	Max.			
LVDS Interface	Differential Input High Threshold Voltage	V _{TH}	-	-	+100	mV	(1)
	Differential Input Low Threshold Voltage	V _{TL}	-100	-	-	mV	
	Common Input Voltage	V _{CM}	1.0	1.2	1.4	V	
	Differential Input Voltage	V _{ID}	100	-	600	mV	
	Terminating Resistor	R _T	87.5	100	112.5	ohm	
CMOS Interface	Input High Threshold Voltage	V _{IH}	2.7	-	3.3	V	
	Input Low Threshold Voltage	V _{IL}	0	-	0.7	V	

Note:

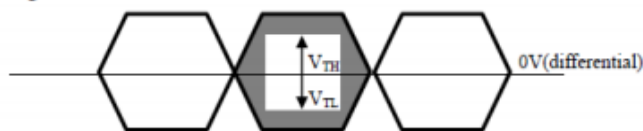
(1) The product should be always operated within above ranges.

(2) The LVDS input signal has been defined as follows:

Single end Signals



Differential Signal



6.2 Temperature Specifications

Parameter	Symbol	Spec			Unit	Note
		Min.	Typ.	Max.		
Source driver	T _{DRIVER}	-	-	115	°C	(1)
PMIC	T _{PMIC}	-	-	100	°C	(1)
TCON	T _{TCON}	-	-	105	°C	(1)

Note:

(1) Any point on the IC surface must be less than Max. specification under any condition, If the surface temperature is out of the specification, thermal solutions should be applied to avoid to be damaged.

6.3 Interface Timing

6.3.1 Timing Table (DE Only Mode)

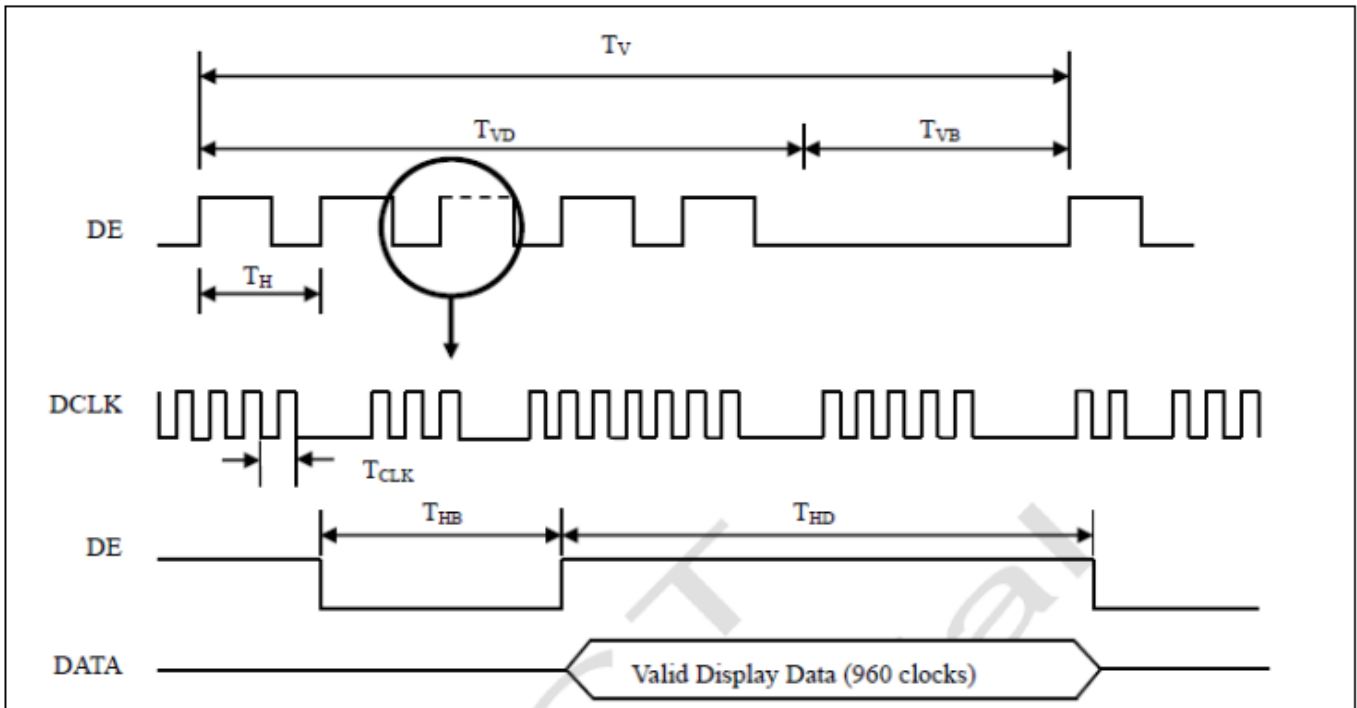
Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Receiver Clock	Frequency	Fclk (=1/TClk)	59.4	74.25	77.34	MHz	(1) (2)
	Input cycle to cycle jitter	Trcl	-	-	200	ps	(3)
	Spread spectrum modulation range	Fclk_mod	Fclk-2%	-	Fclk+2%	MHz	(4)
	Spread spectrum modulation frequency	FSSM	60	-	200	KHz	
LVDS Receiver Data	Receiver Skew Margin	TRSM	-400	-	400	ps	(5)
Vertical Active Display Term	Frame Rate	F	48	60	62.5	Hz	
	Total	TV	1092	1125	1380	TH	TV = TVD +TVB
	Display	TVD	1080				
	Blank	TVB	12	45	300	TH	
Horizontal Active Display Term	Total	TH	1046	1100	1174	TCLK	TH = THD + THB
	Display	THD	960				960=1920/2port
	Blank	THB	86	140	214	TCLK	

Note:

(1) The TFT LCD open cell is operated in DE only mode, H sync and V sync input signal have no effect on normal operation.

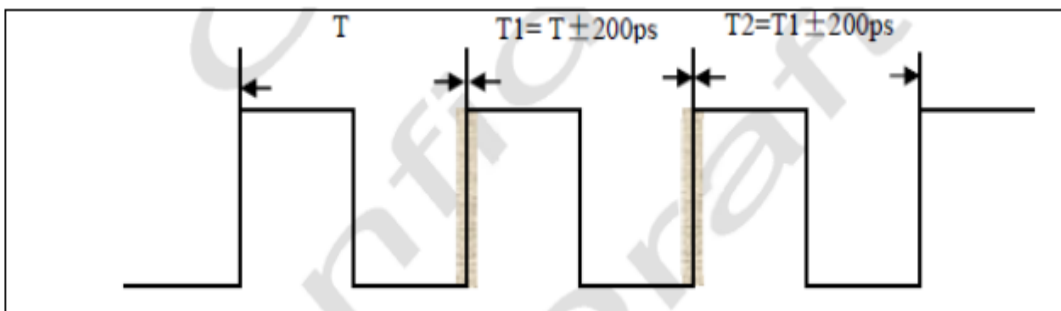
(2) Please make sure the range of pixel clock follows the following equations:

$$F_{clk(max)} \geq F_{max} \times T_v \times T_h \quad F_{min} \times T_v \times T_h \geq F_{clk(min)} \quad 74.25MHz=148.5/2port \text{ LVDS}$$



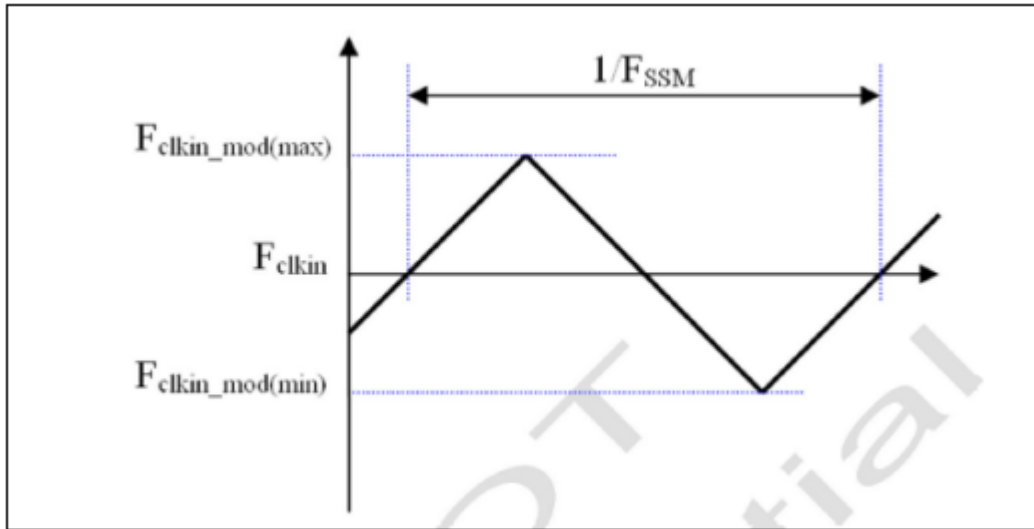
Interface signal timing diagram

(3)The input clock cycle-to-cycle is defined as below figures.



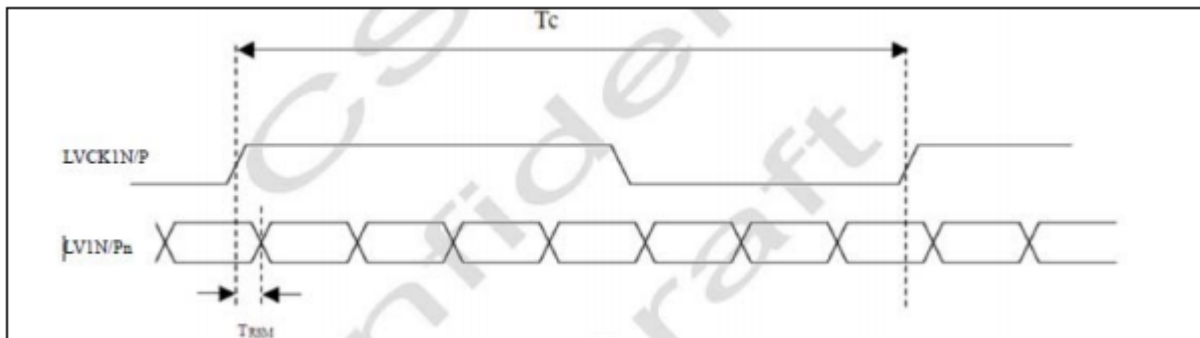
Jitter

(4) The SSCG (Spread Spectrum Clock Generator) is defined as the following figure. The LVDS SSCG's suggestion is off by default, SOC board must test all validation if SOC board opens the LVDS SSM.



SSM

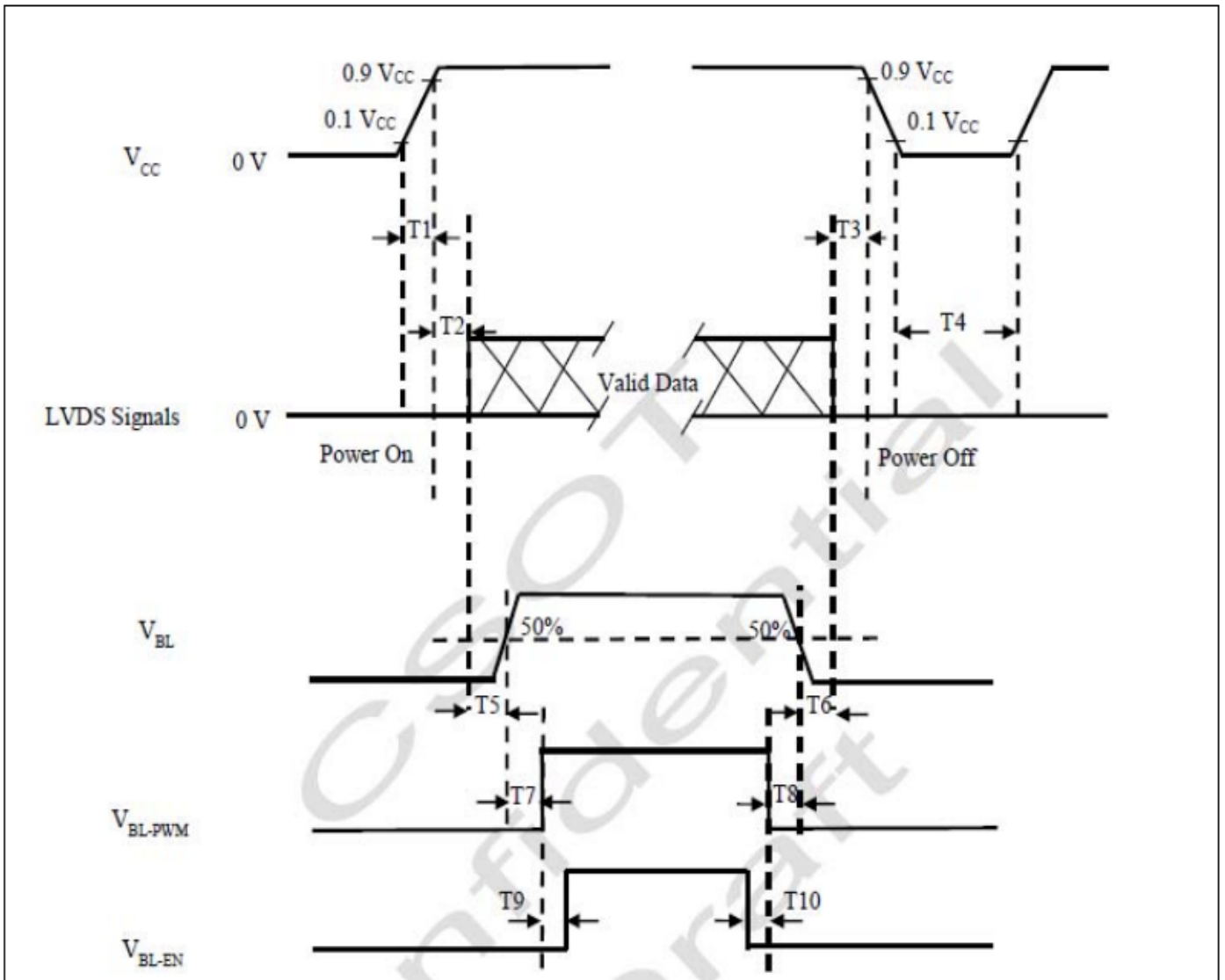
(5) The LVDS timing diagram and setup/hold time is defined and shown as the following figure.



LVDS receive interface timing diagram

6.4 Power On/Off Sequence

To prevent a latch-up or DC operation of the Open cell, the power on/off sequence should be as the diagram below.



Power on/off sequence

Parameter	Values			Unit	Note
	Min.	Typ.	Max.		
T1	0.5	-	10.0	ms	
T2	0.0	50	200	ms	
T3	0.0	50	200	ms	
T4	1000.0	-	-	ms	
T5	500.0	-	-	ms	
T6	100.0	-	-	ms	
T7	0	-	-	ms	
T8	0	-	-	ms	
T9	0	-	-	ms	
T10	0	-	-	ms	

Attention:

- (1) The supply voltage of the external system for the open cell input should follow the definition of VCC.
- (2) When the customer's backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.
- (3) In case that VCC is in off level, please keep the level of input signals on the low or high impedance. If $T2 < 0$, that may cause electrical overstress.
- (4) T4 should be measured after the module has been fully discharged between power off and on period.
- (5) Interface signal shall not be kept at high impedance when the power is on.

7. LCD Module Out-Going Quality Level

7.1 VISUAL & FUNCTION INSPECTION STANDARD

7.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

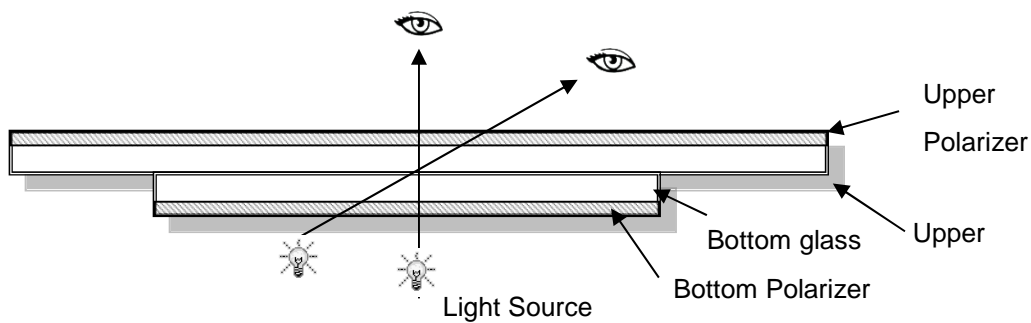
Temperature : $25\pm 5^{\circ}\text{C}$

Humidity : $65\%\pm 10\%\text{RH}$

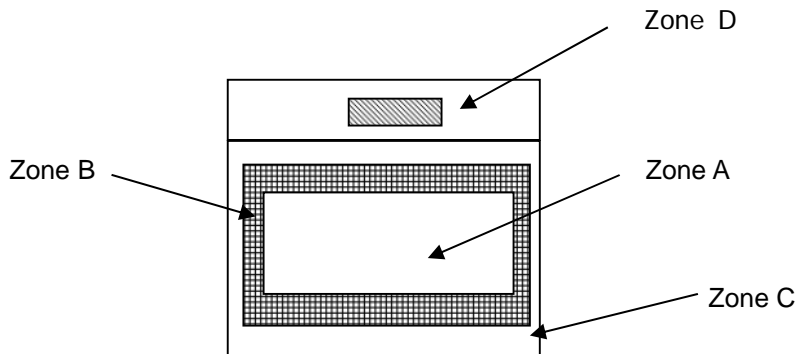
Viewing Angle : Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance:30-50cm



7.1.2 Definition



Zone A : Effective Viewing Area(Character or Digit can be seen)

Zone B : Viewing Area except Zone A

Zone C : Outside (Zone A+Zone B) which can not be seen after assembly by customer .)

Zone D : IC Bonding Area

Note:As a general rule ,visual defects in Zone C can be ignored when it doesn't effect product function or appearance after assembly by customer

7.1.3 Sampling Plan

According to GB/T 2828-2003 ; , normal inspection, Class II

AQL:

Major defect	Minor defect
0.65	1.5

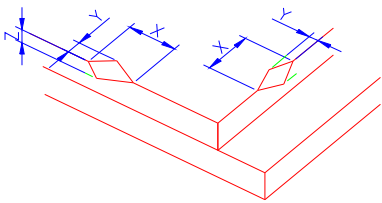
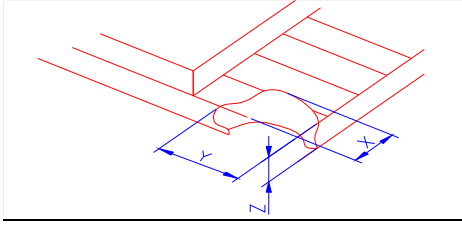
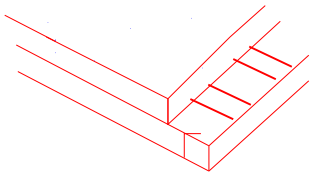
LCD: Liquid Crystal Display , LCM: Liquid Crystal Module

No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. etc...	Major
2	Missing	Missing components and etc...	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed, deformation and etc...	
4	Color tone	Color unevenness, refer to limited sample	Minor
5	Spot/Line defect	Light dot, Dim spot, (Note1) Polarizer Air Bubble, Polarizer accidented spot and etc...	
6	Soldering appearance	Good soldering , Peeling off is not allowed and etc...	
7	LCD/Polarizer	Black/White spot/line, scratch, crack, etc.	

Note1: a) Light dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

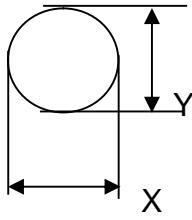
b) Dim dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.

7.1.4 Criteria (Visual)

Number	Items	Criteria(mm)						
1.0 LCD Crack/Broken NOTE: X: Length Y: Width Z: Height L: Length of ITO, T: Height of LCD	(1) The edge of LCD broken	 <table border="1" data-bbox="751 611 1452 757"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td><Inner border line of the seal</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3.0mm	<Inner border line of the seal	≤T
X	Y	Z						
≤3.0mm	<Inner border line of the seal	≤T						
	(2)LCD corner broken	 <table border="1" data-bbox="831 1066 1370 1167"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td>≤L</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3.0mm	≤L	≤T
X	Y	Z						
≤3.0mm	≤L	≤T						
	(3) LCD crack	 <p style="text-align: center;">Crack Not allowed</p>						

2.0

Spot defect



$$\Phi = (X + Y) / 2$$

① light dot (black/white spot , pinhole, stain, etc.)

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.15$	Ignore		
$0.15 < \Phi \leq 0.25$	3(distance ≥ 10 mm)		
$0.25 < \Phi \leq 0.4$	2(distance ≥ 10 mm)		
$\Phi > 0.4$	0		

② Dim spot (light leakage, dent, dark spot, etc)


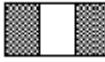
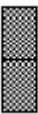
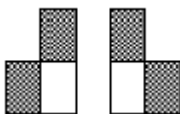
Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.15$	Ignore		
$0.15 < \Phi \leq 0.25$	3(distance ≥ 10 mm)		
$0.25 < \Phi \leq 0.4$	2(distance ≥ 10 mm)		
$\Phi > 0.4$	0		


③ Polarizer accidented spot

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.2$	Ignore		
$0.2 < \Phi \leq 0.5$	2(distance ≥ 10 mm)		
$\Phi > 0.5$	0		

④ Polarizer Bubble

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.2$	Ignore		
$0.2 < \Phi \leq 0.4$	2(distance ≥ 10 mm)		
$0.4 < \Phi \leq 0.5$	1		
$\Phi > 0.5$	0		

3.0	LCD Pixel defect	<p>Pixel bad points</p> <table border="1"> <thead> <tr> <th data-bbox="534 250 726 302">Item</th> <th data-bbox="726 250 1241 302">Zone A</th> <th data-bbox="1241 250 1492 302">Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td data-bbox="534 302 726 465" rowspan="3">Bright dot</td> <td data-bbox="726 302 1241 362">Random</td> <td data-bbox="1241 302 1492 362">N≤2</td> </tr> <tr> <td data-bbox="726 362 1241 414">2 dots adjacent</td> <td data-bbox="1241 362 1492 414">N≤0</td> </tr> <tr> <td data-bbox="726 414 1241 465">3 dots adjacent</td> <td data-bbox="1241 414 1492 465">N≤0</td> </tr> <tr> <td data-bbox="534 465 726 629" rowspan="3">Dark dot</td> <td data-bbox="726 465 1241 526">Random</td> <td data-bbox="1241 465 1492 526">N≤3</td> </tr> <tr> <td data-bbox="726 526 1241 577">2 dots adjacent</td> <td data-bbox="1241 526 1492 577">N≤0</td> </tr> <tr> <td data-bbox="726 577 1241 629">3 dots adjacent</td> <td data-bbox="1241 577 1492 629">N≤0</td> </tr> <tr> <td data-bbox="534 629 726 943">Distance</td> <td data-bbox="726 629 1241 943"> 1. Minimum Distance Between Bright dots. 2. Minimum Distance Between dark dots 3. Minimum Distance Between dark and bright dot. </td> <td data-bbox="1241 629 1492 943">5mm</td> </tr> <tr> <td colspan="2" data-bbox="534 943 1241 1003">Total bright and dark dot</td> <td data-bbox="1241 943 1492 1003">N≤4</td> </tr> </tbody> </table> <p>Note:</p> <p>A) Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.</p> <p>B) Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.</p> <p>C) 2 dot adjacent = 1 pair = 2 dots</p> <p>Picture:</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;">  <p>2 dot adjacent</p> </div> <div style="text-align: center;">  <p>2 dot adjacent</p> </div> <div style="text-align: center;">  <p>2 dot adjacent (vertical)</p> </div> <div style="text-align: center;">  <p>2 dot adjacent (slant)</p> </div> </div>	Item	Zone A	Acceptable Qty	Bright dot	Random	N≤2	2 dots adjacent	N≤0	3 dots adjacent	N≤0	Dark dot	Random	N≤3	2 dots adjacent	N≤0	3 dots adjacent	N≤0	Distance	1. Minimum Distance Between Bright dots. 2. Minimum Distance Between dark dots 3. Minimum Distance Between dark and bright dot.	5mm	Total bright and dark dot		N≤4
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4.0	Line defect (LCD /Polarizer backlight black/white line, scratch, stain)  W: width, L : length N : Count	<table border="1"> <thead> <tr> <th rowspan="2">Width(mm)</th> <th rowspan="2">Length(m m)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.05$</td> <td>Ignore</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.05 < W \leq 0.06$</td> <td>$L \leq 5.0$</td> <td colspan="3">N\leq3</td> </tr> <tr> <td>$0.06 < W \leq 0.08$</td> <td>$L \leq 4.0$</td> <td colspan="3">N\leq2</td> </tr> <tr> <td>$W > 0.08$</td> <td colspan="4">Define as spot defect</td> </tr> </tbody> </table>	Width(mm)	Length(m m)	Acceptable Qty			A	B	C	$\Phi \leq 0.05$	Ignore	Ignore			$0.05 < W \leq 0.06$	$L \leq 5.0$	N \leq 3			$0.06 < W \leq 0.08$	$L \leq 4.0$	N \leq 2			$W > 0.08$	Define as spot defect			
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$W > 0.08$	Define as spot defect																													
5.0	Electronic Components SMT.	Not allow missing parts, solderless connection, cold solder joint, mismatch, The positive and negative polarity opposite																												
6.0	Display color& Brightness.	1. Color: Measuring the color coordinates, The measurement standard according to the datasheet or samples. 2. Brightness: Measuring the brightness of White screen, The measurement standard according to the datasheet or Samples.																												
7.0	LCD Mura/Waving/ Hot spot	Not visible through 5% ND filter in 50% gray or judge by limit sample if necessary.																												

Criteria (functional items)

Number	Items	Criteria (mm)
1	No display	Not allowed
2	Missing segment	Not allowed
3	Short	Not allowed
4	Backlight no lighting	Not allowed

8. Reliability Test Result

Item	Condition	Inspection after test
High Temperature Operating	50°C,72H	
Low Temperature Operating	0°C, 72HR	
High Temperature Storage	60°C, 72HR	
Low Temperature Storage	-20°C, 72HR	
High Temperature & High Humidity Operating	+40°C, 90% RH ,70 hours.	

[Result Evaluation Criteria] Under the display quality test condition with normal operation state. Do not change these condition as such changes may affect practical display function. [Normal operation state] temperature: + 15~ + 35□, Humidity: 45~75%, Atmospheric pressure: 86~106kPa

9. Cautions and Handling Precautions

9.1 Handling and Operating the Module

(1) When the module is assembled, it should be attached to the system firmly.

Do not warp or twist the module during assembly work.

(2) Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and back-light unit.

(3) Note that polarizer is very fragile and could be easily damaged. Do not press or scratch the surface.

(4) Do not allow drops of water or chemicals to remain on the display surface.

If you have the droplets for a long time, staining and discoloration may occur.

(5) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.

(6) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane.

Do not use ketene type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.

(7) 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.

(8) Protect the module from static; it may cause damage to the CMOS ICs.

(9) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

(10) Do not disassemble the module.

(11) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.

(12) Pins of I/F connector shall not be touched directly with bare hands.

(13) Do not connect, disconnect the module in the "Power ON" condition.

(14) Power supply should always be turned on/off by the item 6.1 Power On Sequence & 6.2 Power Off Sequence

9.2 Storage and Transportation.

(1) Do not leave the panel in high temperature, and high humidity for a long time.

It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%

(2) Do not store the TFT-LCD module in direct sunlight.

(3) The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.

(4) It is recommended that the modules should be stored under a condition where no condensation is allowed. Formation of dewdrops may cause an abnormal operation or a failure of the module.

In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.

(5) This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.