



Part Number

PT124768150-TLMWU-EC

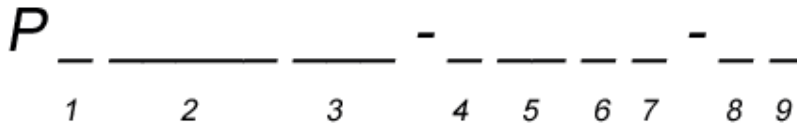
CUSTOMER	
CUSTOMER PART NUMBER	
DESCRIPTION	
APPROVED BY	
DATE	

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3. Module Numbering System



1. LCD TYPE

C = Character
G = Graphic
T = TFT
COG = Chip on Glass
COF = Chip on Flex
TAB = Tape Automated Bonding

6. BACKLIGHT COLOR

B = Blue
Y = Yellow
G = Green
S = Yellow-Green
W = White

2. LENGTH x WIDTH

in pixels. Zeroes removed from this section.

7. VIEWING DIRECTION

D = 6 o'clock
U = 12 o'clock

3. DIAGONAL DIMENSION

Product size in inches

8. A ~ Z CODE

Assigned by P-tec

4. LCD MODE

T = TN

9. TOUCH PANEL TYPE

None = Blank
R = Resistive
C = Capacitive

5. POLARIZER

LF = Transflective
LM = Transmissive



4. Application

This specification is applied to the 15.0 inch XGA supported TFT-LCD module, and can display true 16.7M colors(8 bit/ color). The module is designed for OA, Car TV application and other electronic products which require flat panel display of digital signal interface. This module is composed of a 15.0" TFT-LCD panel, a driver circuit and backlight unit and uses as the input devices for general electric appliances via both finger and Capacitive stylus pen.

5. Features

- XGA (1024×768 pixels) resolution.
- 6 bit & 8 bit LVDS Interface
- Dot inversion mode with stripe type.
- Projected Capacitive Touch
 - USB Interface
 - Multi Touch (Ten points)

6. General Specifications

Item	Specifications	Unit
Screen Size	15.0 (Diagonal)	inch
Display Format	1024RGB(H)×768(V)	dot
Active Area	304.128(H)×228.096(V)	mm
Pixel Pitch	0.297(H)×0.297(V)	mm
Pixel Configuration	RGB Vertical Stripe	-
Display Mode	TN Type Transmissive Mode Normally White	-
Surface Treatment	Clear(7H)	-
Viewing Direction	12 O'clock (The Gray Inversion will appear at this direction)	-
Outline Dimension	326.5(W)×253.5(H)×14.5(D)	mm
Weight	1465	g
RoHS Compliance	P-TEC certifies this product to be in compliance with European Union Directive 2002/95/EC on the restriction of certain hazardous substances in electrical and electronic equipment.	-

**7. Absolute Maximum Ratings****7.1 Absolute Ratings of Environment**

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T _{ST}	-30	+80	°C	(1)(2)
Operating Ambient Temperature	T _{OP}	-20	+70	°C	(1)(2)

Note1: Background color changes slightly depending on ambient temperature.

This phenomenon is reversible.

Note2: Please refer to item of RELIABILITY.

7.2 Electrical Absolute Ratings**7.2.1 TFT-LCD Module**

(Ta=25±2°C)

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	VCC	-0.3	4.0	V	-
Input voltage for signals	V _i	-0.3	4.0	V	-

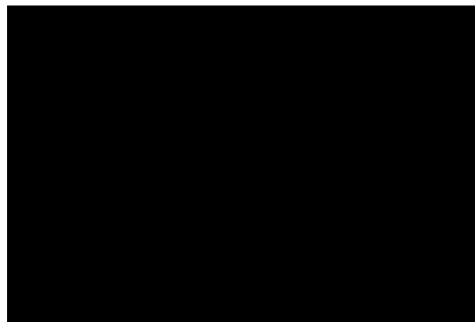
**8. Electrical Characteristics****8.1 TFT-LCD Module**

(Ta=25±2°C)

ITEM	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Power Supply Voltage	VCC	3.0	3.3	3.6	V	-
Power supply ripple	Vp-p			200mV	V	Including spike noise
Power Supply Current	ICC	-	500	550	mA	VDD = 3.3V (1)
Permissible ripple voltage	VRP	-	-	100	mV	VDD
Differential Input Voltage	Vid	250	-	450	mV	-
Differential input threshold voltage for LVDS receiver	High	VTH	-	-	100	VCM = 1.25V (2)
	Low	VTL	-100	-	-	
Input voltage width for LVDS receiver	Vi	0	-	1.90	V	-
Terminating resistor	RT	-	100	-	Ω	-
Rush Current	Irush	-	-	1.5	A	(3)
Input voltage for MSL signals	High	VFH	2.0	-	VCC	-
	Low	VFL	0	-	0.4	

Note 1: All black pattern

Black Pattern / 0 Gray

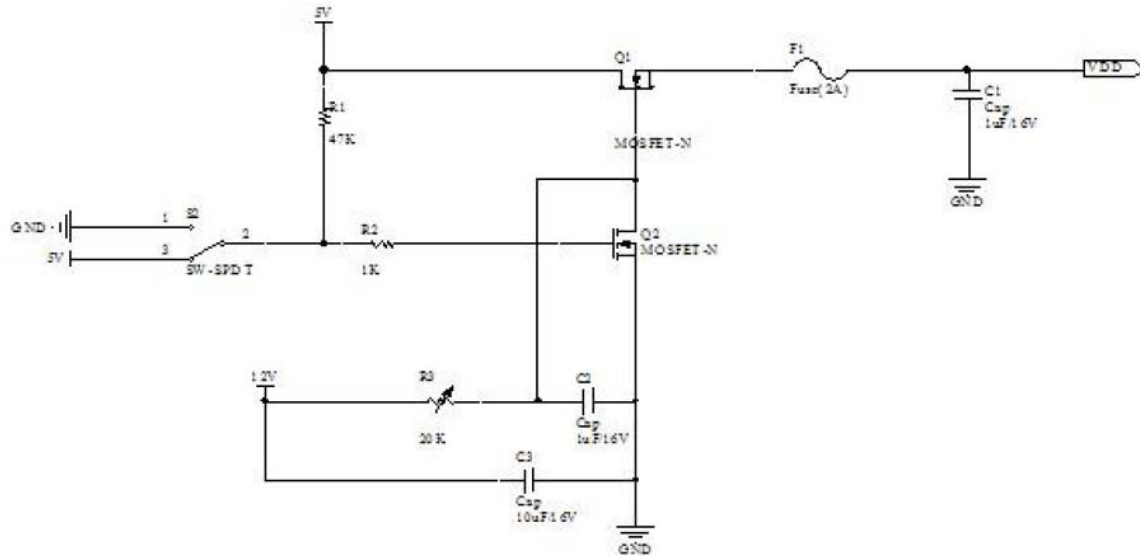


Active Area

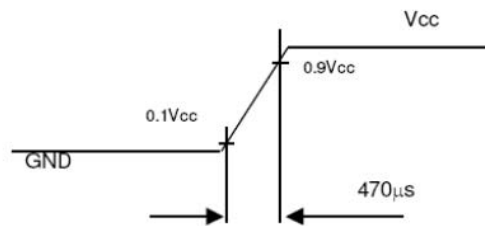
Note 2: Common mode voltage for LVDS receiver



Note 3: Measurement Conditions:



Vcc rising time is 470 μ s





8.2 Backlight Unit

(Ta=25±2°C)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage	VDD	10.8	12.0	12.6	V	
Power supply current	IDD	-	750		mArms	
Light bar life time	Hr	50000	-	-	Hour	Note1
Input voltage for PWM signal	High	VDFH1	2.0		5.0	V
	Low	VDFL1	0		0.4	V
Input voltage for BRTC signal	High	VDFH2	2.0		5.0	V
	Low	VDFL2	0		0.4	V
PWM frequency	fpwm	200		20K	Hz	
PWM pulse width	tPWH	10			us	

Note1: The operating lifetime is mean time to half-luminance. In case the product works under room temperature environment.

8.3 Projected Capacitive Touch

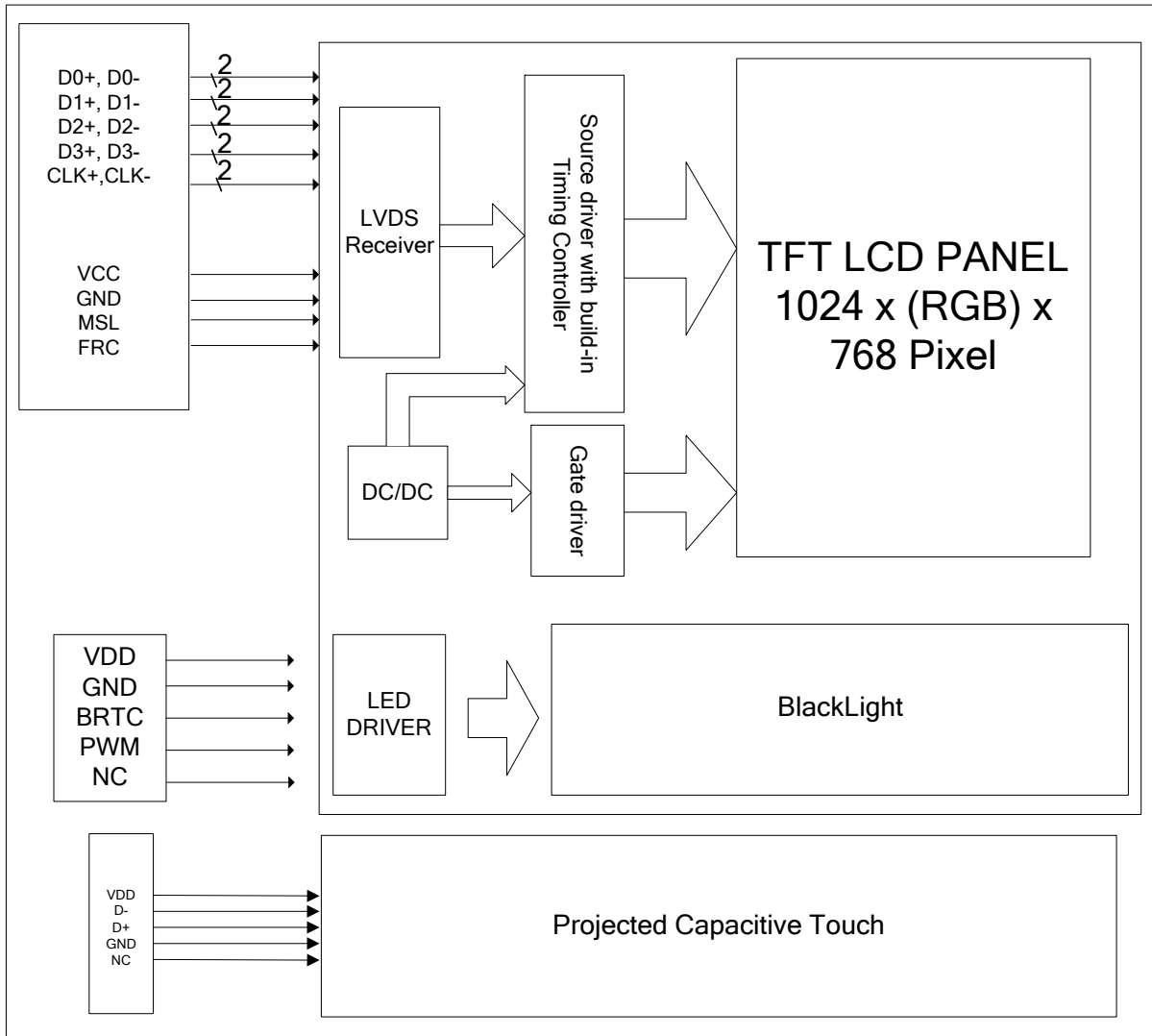
Item	Value			Unit	Note
	Min.	Typ.	Max.		
Operating Voltage	4.8	5.0	5.2	V	-
Power Supply Current	-	32.2	45.1	mA	(1)
Power Consumption	-	161.0	225.5	mW	@5.0V
Interface	USB				-
Function	Multi Touch				-

Note (1) This test condition is touched with 10 points.



9. Block Diagram

9.1 TFT-LCD Module with Backlight Unit



**10. Input / Output Terminals Pin Assignment****10.1 TFT-LCD Module**

CN1 socket (Module side): 185083-20121 (P-TWO ELECTRIC TECHNOLOGY CO., LTD.)

Pin No.	Symbol	Signal	Description			Remarks
			Input data signal: 8bit		Input data signal: 6bit	
			MAP A	MAP B		
1	VCC	Power supply	Power supply			
2	VCC					
3	GND	Ground	Ground			-
4	GND					
5	D0-	Pixel data	R2-R7,G2	R0-R5,G0		
6	D0+					
7	GND	Ground	Ground			-
8	D1-	Pixel data	G3-G7,B2-B3	G1-G5,B0-B1		
9	D1+					
10	GND	Ground				
11	D2-	Pixel data	B4-B7,DE	B2-B5,DE		
12	D2+					
13	GND	Ground	Ground			
14	CLK-	Pixel clock	Pixel clock			
15	CLK+					
16	GND	Ground	Ground			
17	D3-	Pixel data	R0-R1, G0-G1, B0-B1	R6-R7, G6-G7, B6-B7	Ground	
18	D3+					
19	MSL	Selection of LVDS Input data map	High	Low or NC	High	-
20	FRC	Selection of the number of colors	Low		High or NC	



10.2 Backlight

CN2: MSB24038P5 (Produced by STM) or equivalent.

Pin	Symbol	Description
1	VDD	12V
2	GND	Ground
3	BRTC	Back light ON/OFF control: 5V-On / 0V-Off
4	PWM	PWM Luminance control
5	NC	NC

10.3 Projected Capacitive Touch

Connector: JST S5B-PH-SM4-TB

No.	Symbol	Functions
1	VDD	+5.0V power supply.
2	D-	USB D-
3	D+	USB D+
4	GND	System ground.
5	NC	Not Connection



10.4 Color Data Input Assignment

The brightness of each primary color(red, green and blue) is based on the 8 bit gray scale data input for the color. The higher the binary input, the brighter the color. The table provides the assignment of color versus data input.

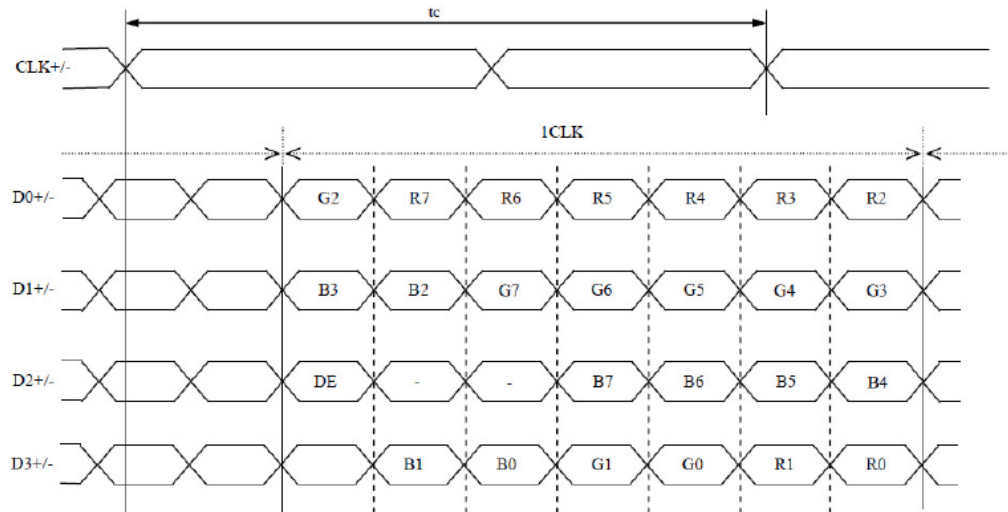
Color		Data Signal																						
		Red								Green								Blue						
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	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	1	1	1	1	1
Gray Scale Of RED	Red(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	Red(253)	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Red(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Gray Scale Of Green	Green(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
	Green(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	Green(253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	
	Green(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	
Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0		
Gray Scale Of Blue	Blue(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	
	Blue(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	
Blue(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1		

**11. Interface Timing****11.1 Input Signal Characteristics****Timing Characteristics**

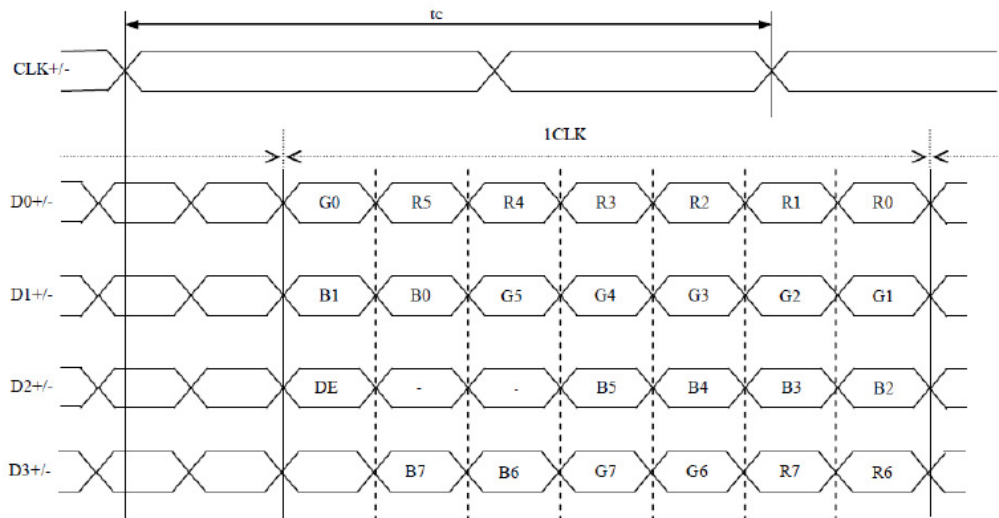
Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Clock	Frequency	1/tc	50	65.0	81.25	MHz	15.384ns
		tc	20	15.4	12.31	ns	(typ.)
Horizontal signals	Cycle	th	16.54	20.68	25.77	μs	48.36kHz
			1150	1344	1800	CLK	(typ.)
	Display period	thd	1024				-
Vertical signals	Cycle	tv	13.1	16.67	20	ms	60.0Hz(typ.)
			776	806	1023	H	
	Display period	tvd	768				-



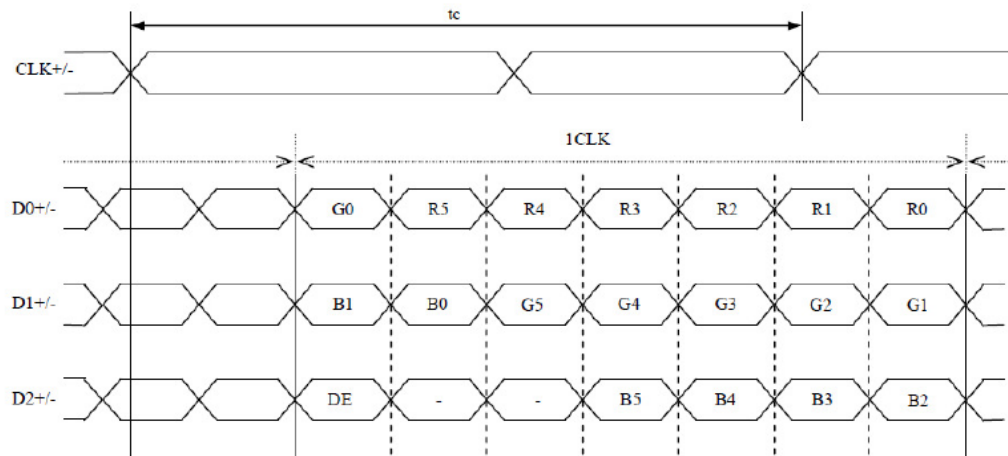
(1) LVDS Input data signal: 8bit, MAP A (MSL: High, FRC: Low)



(2) LVDS Input data signal: 8bit, MAP B (MSL: Low or NC, FRC: Low)



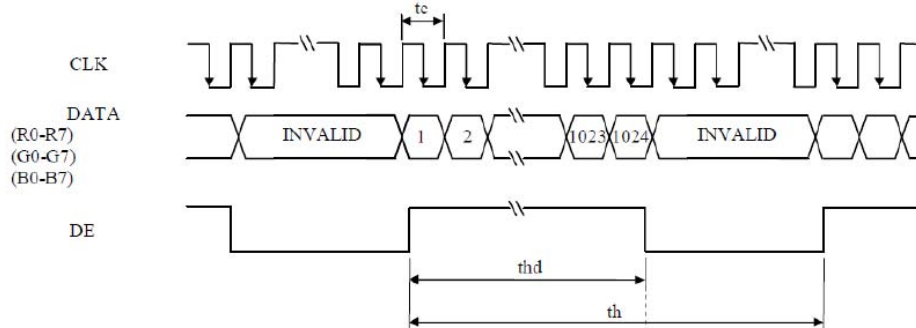
(3) Input data signal: 6bit (MSL: High, FRC: High or NC)



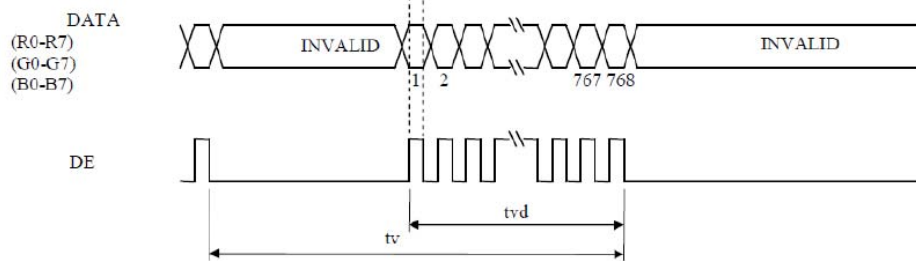


11.2 Timing Diagram of Interface Signal

Horizontal timing



Vertical timing

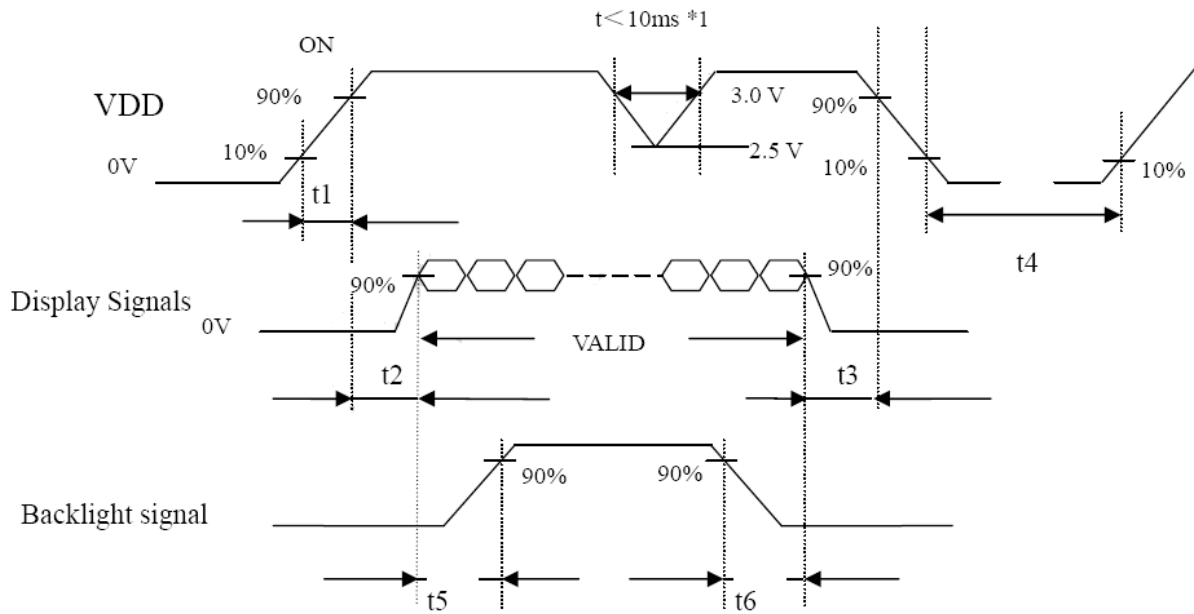


The following chart is the coordinates of per pixel

D(1,1)			D(1,1)	D(2,1)	D(3,1)	...	D(1024,1)
			D(1,2)	D(2,2)	D(3,2)	...	D(1024,2)
R			D(1,3)	D(2,3)	D(3,3)	...	D(1024,3)
		
G		
		
B			D(1,768)	D(2,768)	D(3,768)	...	D(1024,768)
		



11.3 Power Sequence



Timing Specifications:

- t1 :0.5ms<t1 <10ms;
- t2 :0.5 ms<t2 <50ms;
- t3 :0ms<t3 <50ms;
- t4 :t4 >1000ms;
- t5 :t5 >200ms;
- t6 :t6 >200ms;

11.4 USB Interface

11.4.1 Single Touch Function

Single Touch Function works with plug'n play under system Windows 2000, Windows XP and Windows7.

For other operating systems like Linux a driver must be programmed.

11.4.2 Multi Touch Function

The Multi Touch Function works with plug'n play under system Windows7.

For older Windows systems or other operating systems a driver must be programmed.



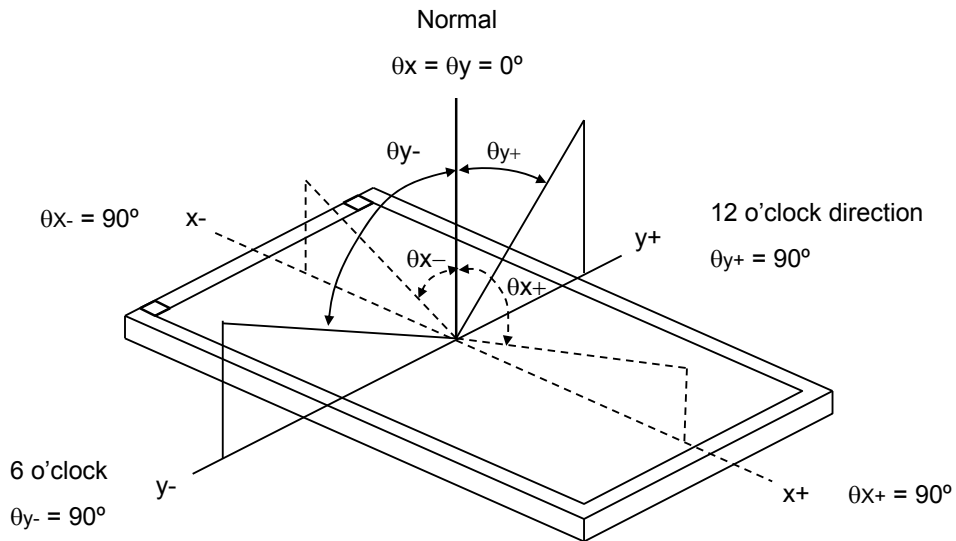
12. Optical Characteristics

The optical characteristics should be measured in a dark environment (≤ 1 lux) or equivalent state with the methods shown in Note (4).

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR		400	600	-	-	(2)
Response Time		$T_R + T_F$		-	8	12	ms	(3)
Luminance(Center)		Y		300	350	-	cd/m ²	(4)
Brightness uniformity		BUNI		75	80	-	%	(5)
Color Chromaticity	Red	Rx		$\theta_x=0^\circ, \theta_y=0^\circ$ Viewing Normal Angle	0.581	0.631	0.681	-
		Ry	0.305		0.355	0.405	-	
	Green	Gx	0.294		0.344	0.394	-	
		Gy	0.558		0.608	0.658	-	
	Blue	Bx	0.103		0.153	0.203	-	
		By	0.037		0.087	0.137	-	
	White	Wx	0.263		0.313	0.363	-	
		Wy	0.279		0.329	0.379	-	
Viewing Angle	Horizontal	θ_{x+}	CR \geq 10	70	80	-	deg.	
		θ_{x-}		70	80	-		
	Vertical	θ_{y+}		70	80	-		
		θ_{y-}		70	80	-		



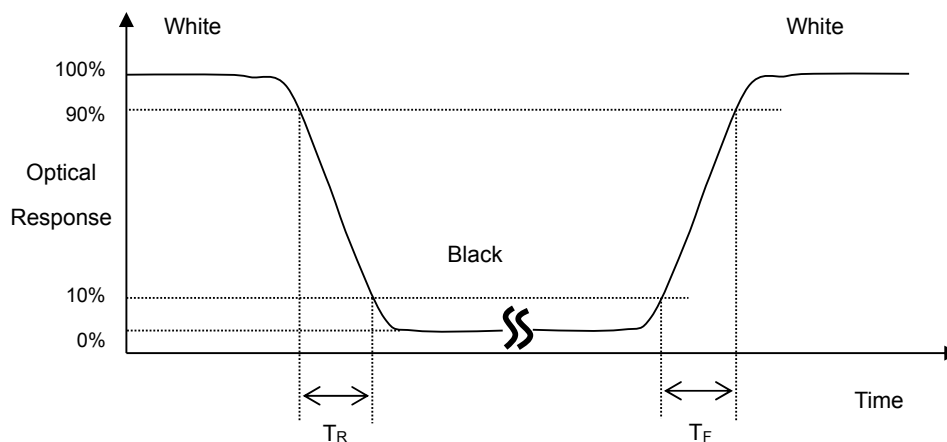
Note (1) Definition of Viewing Angle (θ_x, θ_y):



Note (2) Definition of Contrast Ratio (CR):

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

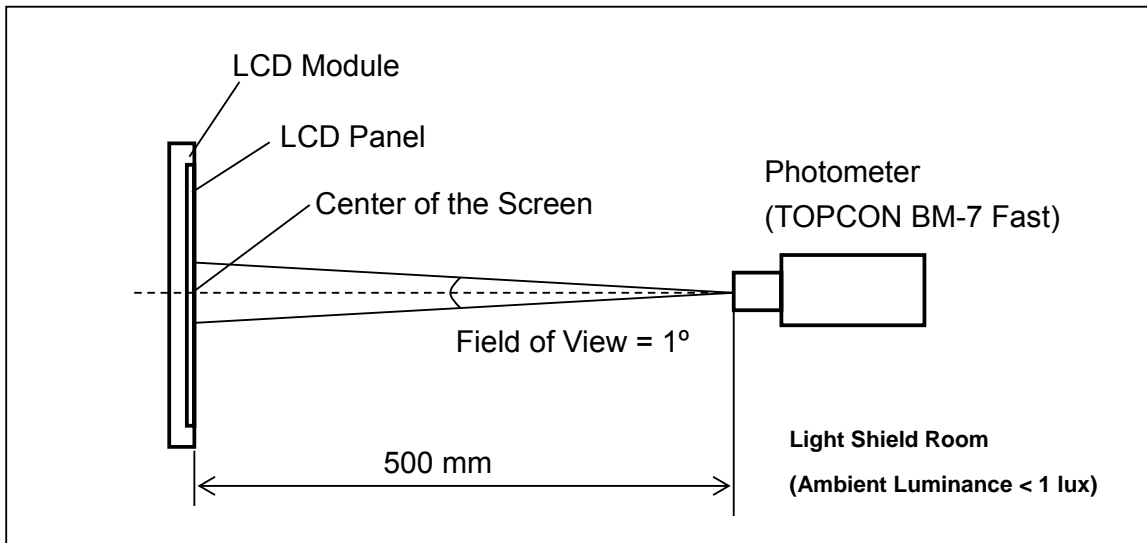
Note (3) Definition of Response Time (T_R, T_F):





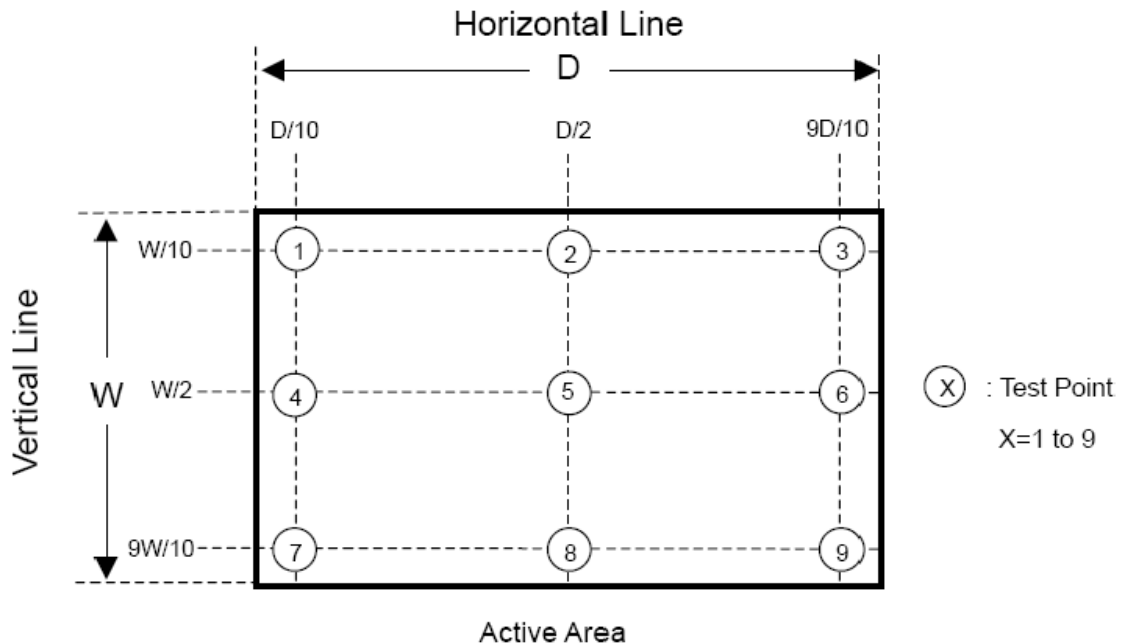
Note (4) Measurement Set-Up:

The LCD module should be stabilized at a given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 30 minutes in a windless room.



Note (5) Definition of brightness uniformity

Brightness uniformity=(Min Luminance of 9 points)/(Max Luminance of 9 points)×100%



**13. Reliability Test**

No.	Test Items	Test Condition	Remark
1	High Temperature Storage Test	T _a = 80°C 240 hours	(1),(3),(4)
2	Low Temperature Storage Test	T _a = -30°C 240 hours	(1),(3),(4)
3	High Temperature Operation Test	T _s = 70°C 240 hours	(2),(3),(4)
4	Low Temperature Operation Test	T _a = -20°C 240 hours	(1),(3),(4)
5	High Temperature and High Humidity Operation Test	T _a =60°C 60%RH 240 hours	(3), (4)
6	Electro Static Discharge Test (non-operating)	-Panel Surface/Top Case : 150pF, 330Ω Air : ±15kV, Contact: ±8kV	(3)
7	Mechanical Shock Test (non-operating)	Half sine wave, 100G, 6ms 3 times shock of each six surfaces	(3)
8	Vibration Test (non-operating)	Sine wave:10 ~ 55 ~ 10Hz amplitude:1.5mm 3 axis, 2 hours/axis	(3)
9	Thermal Shock Test (non-operating)	-20°C (30min) ~ 60°C (30min) ,10 cycles	(3) , (4)
10	Drop Test(with Carton)	Height : 80 _{cm} 1 corner, 3 edges, 6 surfaces	(3)

Note 1 : T_a is the ambient temperature of samples.

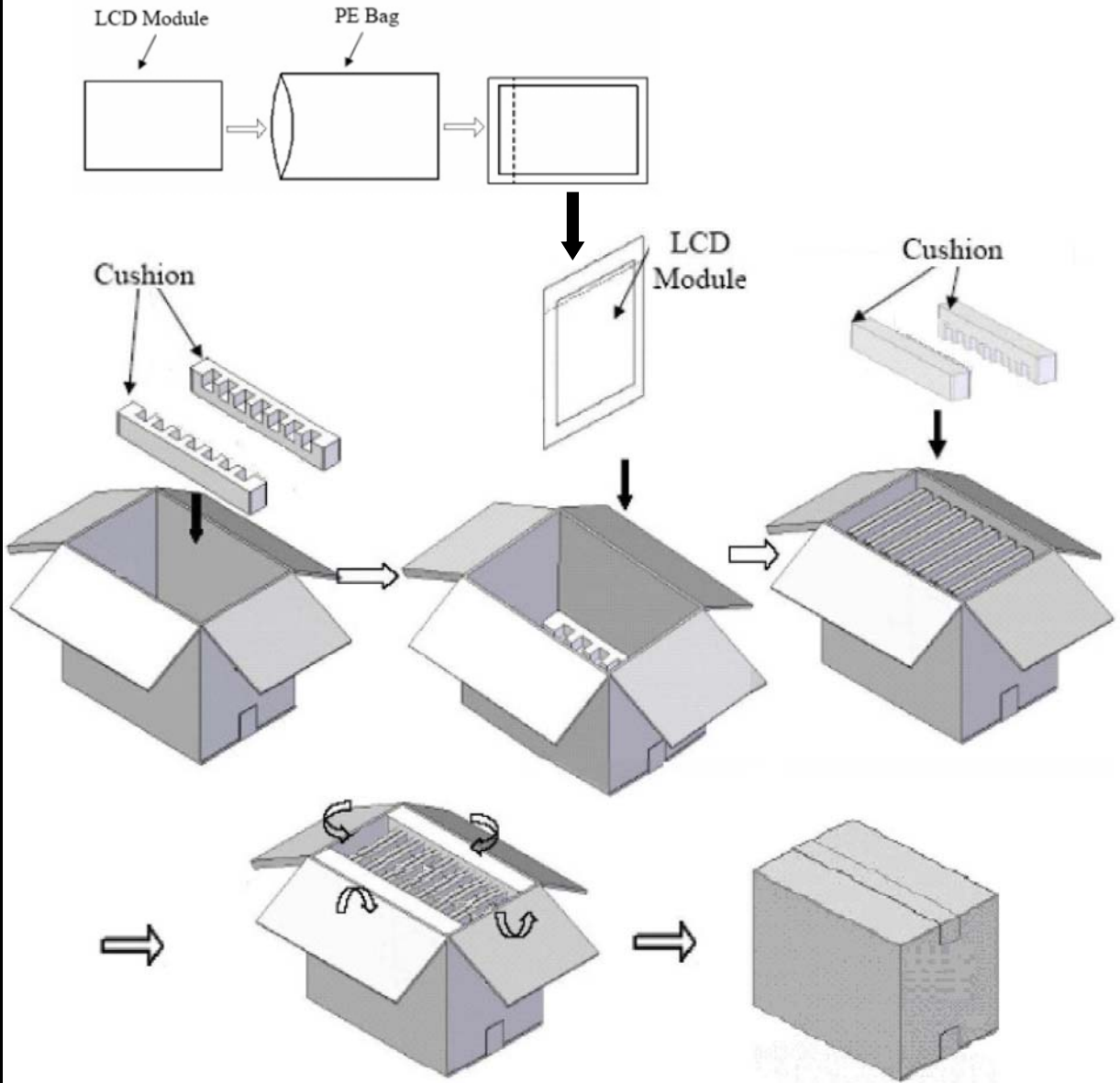
Note 2 : T_s is the temperature of panel' s surface.

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.



14. Packaging



PARTS LIST				
	ITEM	SIZE(LxWxH) unit:mm	MATERIAL	Q.T.Y
1	PE BAG	480.0x430.0x0.09		10
2	CUSHION	350.0x145.0x82.8	EPS	4
3	EXTERNAL BOX	475.0x370.0x375.0	CARTON	1
4	LCD MODULE	326.5x253.5x14.5		10



15. Precautions

15.1 Assembly and Handling Precautions

- (1) Do not apply rough force such as bending or twisting to the module during assembly.
- (2) It's recommended to assemble or to install a module into the user's system in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- (3) Don't apply pressure or impulse to the module to prevent the damage of LCD panel and Backlight.
- (4) Always follow the correct power-on sequence when the LCD module is turned on. This can prevent the damage and latch-up of the CMOS LSI chips.
- (5) Do not plug in or pull out the I/F connector while the module is in operation.
- (6) Do not disassemble the module.
- (7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- (8) Moisture can easily penetrate into LCD module and may cause the damage during operation.
- (9) High temperature or humidity may deteriorate the performance of LCD module. Please store LCD module in the specified storage conditions.
- (10) When ambient temperature is lower than 10°C, the display quality might be reduced. For example, the response time will become slow.

15.2 Safety Precautions

- (1) 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, skin or clothes, it has to be washed away thoroughly with soap.
- (2) After the module's end of life, it is not harmful in case of normal operation and storage.

15.3 Terms of Warrant

- (1) Acceptance inspection period

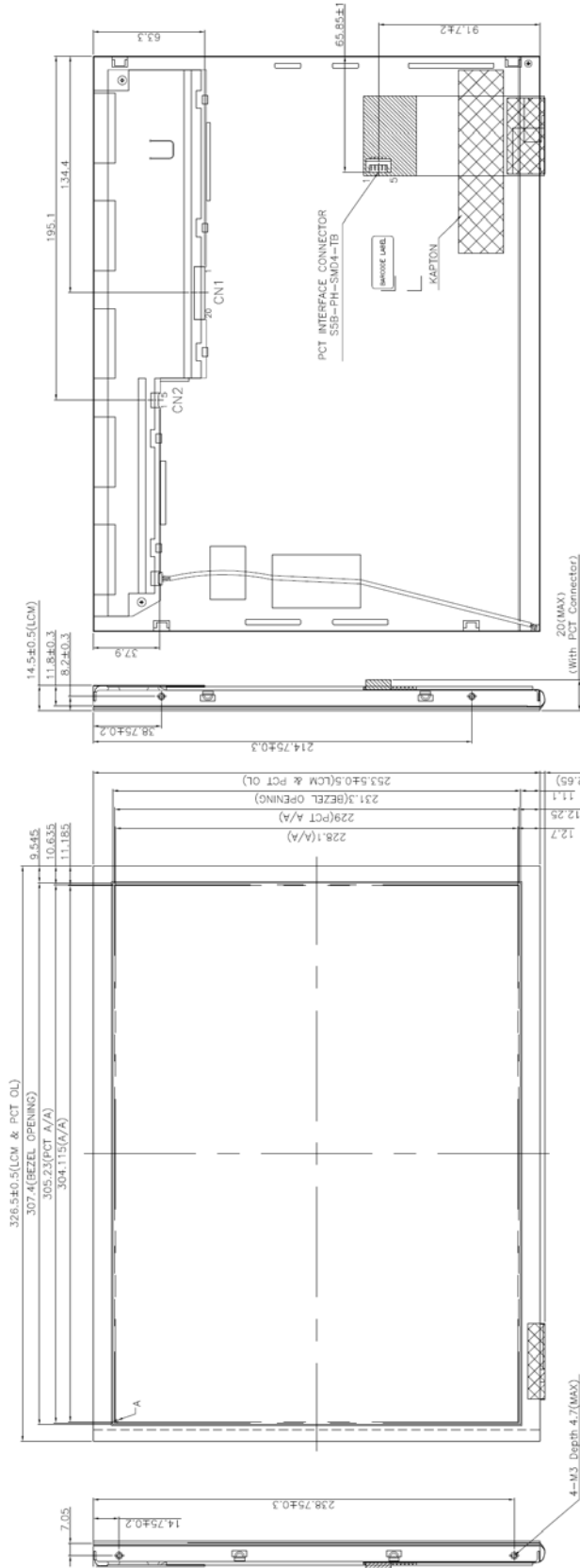
The period is within one month after the arrival of contracted commodity at the buyer's factory site.

- (2) Applicable warrant period

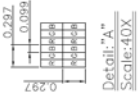
The period is within twelve months since the date of shipping out under normal using and storage conditions.



16.Outline Drawing



NOTE:
 1. Unspecified Tolerance: ±0.5
 2. CONNECTOR: CN1: Socket (Module side) : 185083-20121 (P-TWO ELECTRIC TECHNOLOGY CO., LTD.)
 CN2: MSB24038P5 (Produced by STM) or equivalent





17. Definition of Labels

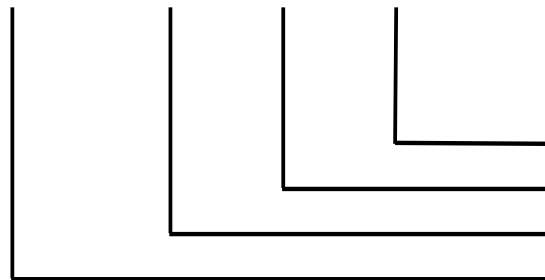
The bar code nameplate is pasted on each module as illustration, and its definitions are as following explanation.



(a) Module Name: PT124768150-TLMWU-EC

(b) Serial ID:

A B C D E F G H I J K L



Serial No.
 Factory Code
 Manufactured Date
 Screen Size

Serial ID includes the information as below:

(a) Screen size (Diagonal): Inch Code (ABCD)

3.5" → 0350

10.4" → 1040

(b) Manufactured Date: Year, Month, Day (EFG)

Year (E)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Mark	0	1	2	3	4	5	6	7	8	9
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Mark	A	B	C	D	E	F	G	H	I	J



Month (F)

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Mark	1	2	3	4	5	6	7	8	9	A	B	C

Day (G)

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mark	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G
Day	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Mark	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	

(c) Factory Code (H):

For P-TEC internal use.

(d) Serial No. (IJKL):

Manufacturing sequence of product, for example: 0001~9999.

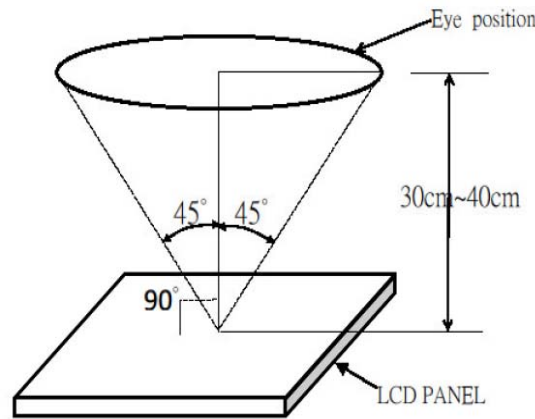


18. Incoming Inspection Standards

18.1 The environmental condition of inspection

The environmental condition and visual inspection shall be conducted as below.

- (1) Ambient temperature $25 \pm 5^{\circ}\text{C}$
- (2) Humidity: 45 ~ 65 % RH
- (3) Viewing distance is approximately 30 ~ 40 cm
- (4) Viewing angle is normal to the LCD panel as Fig _1 ($\pm 45^{\circ}$)
- (5) Ambient Illumination: 300 ~ 500 Lux for external appearance inspection



Fig_1

18.2 The defects classify of AQL as following:

- (1) Test method :According to [ANSI/ASQC Z 1.4](#) .General Inspection Level II take a single time
- (2) The defects classify of AQL as following:

Class of defects	AQL	Definition
Major	0.65%	It is defect that is likely to result in failure or to reduce materially the usability of the intended function.
Minor	1.5%	It is a defect that will not result in functioning problem with deviation classified.



18.3 Inspection Parameters

1. Scope

The incoming inspection standards shall be applied to TFT-LCD Cell (hereinafter called "Cell") that is supplied by P-TEC (hereinafter called "P-TEC ").

2. Incoming inspection right

The buyer (customer) shall inspect the Cells within twenty working days since the delivery date. The results of the inspection (acceptance or rejection) shall be recorded in writing, and a copy of this writing will be promptly sent to the P-TEC.

If the samples of Cell within a lot show a number of unacceptable defects in accordance with these incoming inspection standards, the buyer must promptly notify P-TEC in writing within three business days at the end of the inspection period. If does not notify P-TEC within the inspection period, the Cells shall be deemed to have been accepted by buyer.

P-TEC is only responsible for the defects which were found in IQC.

3. Inspection instruments

3-1 Pattern generator: model CM50PE-II or equivalent.

3-2 Video board: P-TEC uses CM50PE-II which integrates video board for outputting standard LVDS signal. If using other video board, the output of the signal should comply with the specifications provided by P-TEC.

4. Inspection Conditions

	Display inspection	Appearance inspection	note
Temperature	25±5°C	25±5°C	
Humidity	60±5% RH	60±5% RH	
View distance	20cm	20cm	Note1
Luminance	60 lux	700 lux	Note2
Inspection direction	0≤θL≤ 20° 0≤θR≤ 20° 0≤θU≤ 20° θD = 0°	0≤θL≤45° 0≤θR≤45° 0≤θU≤45° 0≤θD≤45°	Note3

Note1. Viewing distance: The distance between the inspector's eyes and screen

Note2. Inspection Luminance: The luminance at an inspection desk surface

Note3. Inspection direction: Viewing line should be perpendicular to the surface of the Cell. Refer to the figure 1 as following:

Note4. ND filter use: put the ND filter between the inspector's eyes and screen , the viewing distance is 2 cm from the screen, inspection time is 3sec.

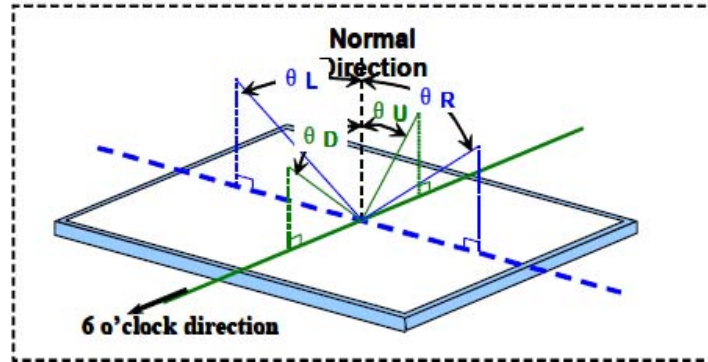


Figure 1: Inspection direction

5. Classification of defects:

Defects are classified as major defects and minor defects according to the defect classification defined herein.

5-1 Major defects:

A major defect is a defect that is likely to result in failure, or to reduce the usability of the product for its intended purpose evidently.

5-2 Minor defects:

A minor defect is either a defect that is not likely to reduce the usability of the product for its intended purpose evidently, or a stray from an intended purpose with little bearing on the effective usage.

Specific criteria of judgment on major and minor defects shall be in accordance with "the Classification of Defect" table below.

Defect items	Criterion for defects	Severity
Line Defect	Not allowed any vertical, horizontal and cross line	Major
Display abnormal	Not allowed any display abnormal at any pattern	Major
Foreign Material	shall be in accordance with the item 6.3"Foreign Material "in this standard	Minor
Polarizer Defect	Shall be in accordance with the item 6.4"Polarizer Defect "in this standard	Minor
Dot Defect	Shall be in accordance with the item 6.1"Dot defect" in this standard	Minor
Mura	Shall be in accordance with the item 6.5"Mura defect" in this standard	Minor



6. Inspection Criteria

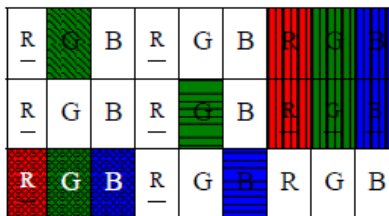
Display inspection

6-1-1 Dot Defect

- A. Every dot is a Sub-Pixel (each Red, Green or Blue color).
- B. Dot defect is defined as that the defective area of the dot is larger than 1/3 of the dot area.,
- C. Dot defect isn't defined as that the defective area of the single dot defect less than 1/3 of the dot area
- D. The luminance of the dots should be judged by ND 5%.

Defect Item	Max. Number of Defects	Min. Distance Between Defects	Test Condition
1) Bright Points (R, G, or B)	$N \leq 3$	$\geq 15\text{mm}$	Black
2) Bright Point Pairs (2 bright sub-pixels in 2 adjacent pixels with different color)	$N \leq 1$	--	Black
3) 3 or More Bright Sub-Pixels in 2 Adjacent Pixels	$N = 0$	--	Black
4) Dark Points (R,G, or B)	$N \leq 3$	$\geq 15 \text{ mm}$	White& R/G/B Pattern
5) Dark Point Pairs (2 dark sub-pixels in 2 adjacent pixels or single pixel)	$N \leq 0$	--	White& R/G/B Pattern
6) 3 or More Dark Sub-Pixels in 2 Adjacent Pixels	$N = 0$	--	White& R/G/B Pattern
7) Total Defective Sub-Pixels (bright and/or dark points)	$N \leq 6$	--	Black/White /R/G/B

6-1-2 Pixel Definition



Defective Sub-Pixel

Defective Pixel

Defective Adjacent Sub-Pixels

Defective Adjacent Pixels



6-2 Line Defects

Line defect : Not allowed any vertical, horizontal and cross line at any Pattern

Defect item	Visual Description	Specifications	Test Condition
Line defect		Not allowed	Any video pattern

6-3 Foreign Material

Defect Item	Visual Description	Line width(mm)	Line length(mm)	Judgment
Line shape		$W \leq 0.05$	—	Allowed
		$0.05 < W \leq 0.1$	$L \leq 0.7$	
			$0.1 < W$	$0.7 < L \leq 1.0$
		$1.0 < L$		—
Dot shape		Diameter(mm)		Judgment
		$D \leq 0.20$		Allowed
		$0.20 < D \leq 0.30$		$N \leq 10$
		$0.30 < D \leq 0.50$		$N \leq 3$
		$D > 0.50$		$N = 0$

Note1. D : diameter, W : width, L : length, N : count

Note2. Translucent edge is ignored in measuring the diameter of spot.

Note3. Line shape & Dot shape figure are as follows:

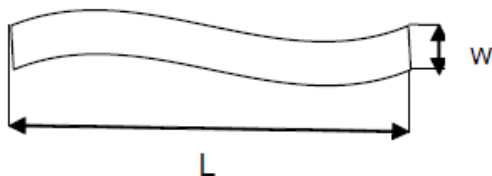


Figure 1

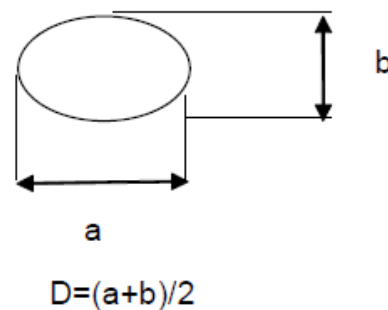


Figure 2



6-4 Polarizer Defects

A. Extraneous substances that can be wiped off such as Finger Prints , particles are not considered as defects.

B. Defects on the Black Matrix (outside the Active Area)are not considered defects.

Defect Item	Visual Description	Line width(mm)	Line length(mm)	Judgement
Bubbles , Wrinkles , Dent		Diameter(mm)		Judgement
		D ≤ 0.20		Allowed
		0.20 < D ≤ 0.30		N ≤ 10
		0.30 < D ≤ 0.50		N ≤ 3
		D > 0.50		Note1

Commonly, AVIC does not accept the RMA due to Polarizer scratch because the polarizer is protected by the protection film.

Note 1. D > 0.5 , judge by limit sample or equal to mura standard.

6-5 Mura

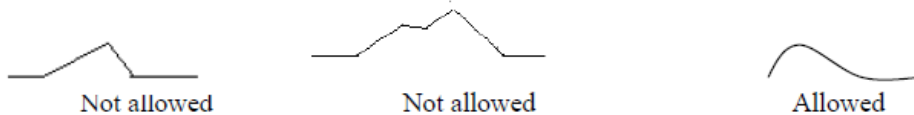
Defect item	Visual Description	Specifications	Test Condition
Mura		By Limit sample (equal to ND 8%)	128 Grayscale

6-6 Panel defect

A、 The panel defect can't damage the pins or seal;

B、 Cracks can't be extension inward;

C、 For example:



6-7 Leak light

Defect item	Visual Description	Specifications	Test Condition
Leak light		By Limit sample	Black

7. Inspection judgment:



7-1. If the number of defects is more than the applicable acceptance level, the lot shall be rejected and the buyer should inform the seller of the result of incoming inspection in writing.

7-2. Issue which is not defined in this criteria shall be discussed by both parties, Customer and Supplier, for better solutions.

8. Precaution:

Please pay attention to the following items when you use the cells.

8-1 Do not twist or bend the Cells and also avoid any inappropriate external force on display surface during assembly.

8-2 Adopt good ventilation measures. Be sure to use the Cells within the specified temperature range.

8-3 Avoid dust or oil mist during assembly.

8-4 Follow the correct power sequence while operating. Do not apply the invalid signal otherwise it will cause unexpected shutdown that damages the Cells.

8-5 The response time & brightness might vary at different temperature.

8-6 Avoid displaying at certain pattern (e.g. the white pattern) for a long time otherwise it might cause image sticking.

8-7 Be sure to turn off the power while connecting or disconnecting the circuit.

8-8 Display surface Polarizer scratches easily, please avoid dirt or stain on it and handle with care.

8-9 A dew drop may cause malfunction or worse situation. Wipe off any dew drop before using the Cells.

8-10 sudden temperature change might cause condensation of materials and possible Polarizer damage.

8-11 High temperature and high humidity might undermine the performance. Do not expose the Cells to the direct sunlight and so on.

8-12 Avoid any acetic acid or chlorine compounds, which are harmful to the Cells.

8-13 Static electricity might damage the Cells. Avoid direct touch of the Cells without any grounded device connected.

8-14 Do not disassemble and reassemble the Cells by yourself.

8-15 Avoid any strong vibration or shock, which might cause a broken Cells.

8-16 Peel off the protect film in appropriate environment to avoid the ESD damage.

8-17 Store the Cells in appropriate environment with regular packing.

8-18 Be careful of possible injury caused by a broken Cells. Also avoid the pressure added onto the (front or rear) surface of Cells, which might cause non-uniformity or other function issue to display.

18.4 Handling of LCM

(1) Don't give external shock.

(2) Don't apply excessive force on the surface.

(3) Liquid in LCD is hazardous substance. Must not lick and swallow. when the liquid is attach to your hand, skin, cloth etc. Wash it out thoroughly and immediately.

(4) Don't operate it above the absolute maximum rating.

(5) Don't disassemble the LCM.