



# PALM TECHNOLOGY CO., LTD.

*The LCD(M) Specialist*

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PART NO. : PT0282432-B905

FOR MESSRS. : \_\_\_\_\_

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ACCEPTED BY : \_\_\_\_\_

PROPOSED BY : \_\_\_\_\_

## RECORD OF REVISION

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DATE	PAGE	SUMMARY
2020.10.30	ALL	-

## 1.General Description and Features

PT0282432-B905 is a TM (Transmissive) type color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) 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 . The resolution of a 2.8" contains 240RGBx320 dots and can display up to 262 K colors. The following table described the features of PT0282432-B905.

### LCD Module

Item	Specification	Unit
Screen Size	2.8inches	Diagona
Display Resolution	240RGB(H)x320(V)	Dot
Active Area	43.2(H) x57.6 (V)	mm
Outline Dimension	50.0(W) x 69.2 (H) x 2.49 (D)	mm
Display Mode	Normally white/Transmissive	--
Pixel Arrangement	RGB-Vertical Stripe	--
Display Color	262K	--
Gray scale inversion Direction	12 o'clock	
Viewing Direction	6 o'clock	--
Drive IC	ILI9341V	--

## 2.Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	--	50.0	--	mm	--
	Vertical (V)	--	69.2	--	mm	(1)
	Thickness (T)	--	2.49	--	mm	(2)
Weight		--	N/A	--	g	--

Note (1) Not include FPC.

Refer to the Outline Dimension for further information.

(2) Back-light unit are included.

### 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<sub>SS</sub>=GND=0)

Item	Symbol	Min.	Max.	Unit	Note
Operating temperature	T <sub>OPR</sub>	-20	70	°C	(1)
Storage temperature	T <sub>STG</sub>	-30	80	°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 guaranteed at operating temperature. Contrast, response time, another display quality are evaluated at +25°C.

#### 3.2 Electrical Absolute Rating

##### 3.2.1 TFT-LCD Module

(Voltage Referenced to V<sub>SS</sub>)

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Power supply	VDD	2.6	3.0	3.3	V	
Input Voltage for logic	H Level	0.8xVDD	-	VDD	V	
	L Level	0	-	0.2xVDD	V	
Power Supply current	IDD	-	-	50	mA	Note 1

## 4 Electrical Characteristics

### 4.1 Backlight Unit

The back-light system is an edge-lighting type with 4 white LEDs (Light Emitting Diode).

(Ta=25±2°C)

Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
LED Voltage	V <sub>F</sub>	11.8	12.8	13.8	V	
LED Current	I <sub>F</sub>	-	20	--	mA	
Power Consumption	P <sub>BL</sub>	-	256	-	mW	

Note (1) Where I<sub>F</sub> = 20mA, V<sub>F</sub> = 12.8, P<sub>BL</sub> = V<sub>F</sub> × I<sub>F</sub>

## 5 Input Terminal Pin Assignment

PIN.NO	SYMBOL	I/O/P	FUNCTI	MEMARK
1	GND	P	GROUND.	
2	VCI(2.8V)	P	POWER SUPPLY FOR LCD.	
3	VCC(1.8V)	P	Power Supply For I/O.	
4	NC	P	NO CONNECTION.	
5	SDA	P	SERIAL DATA INPUT/OUTPUT PIN.	
6-9	NC	I	NO CONNECTION.	
10	VSYNC	I	FRAME SYNCHRONOUS SIGNAL FOR RGB INTERFACE OPERATION.	
11	HSYNC	I	LINE SYNCHRONOUS SIGNAL FOR RGB INTERFACE OPERATION.	
12	DOTCLK	I	DOT CLOCK SIGNAL FOR RGB INTERFACE OPERATION.	
13	DE	I	DATA ENABLE SIGNAL FOR RGB INTERFACE OPERATION.	
14-31	D17-D0	I/O	CORRESPONDING RGB DATA COMPONENT	
32	NC		NO CONNECTION.	
33	SCL	I/O	SERIAL CLOCK SIGNAL.	
34	NC	I	NO CONNECTION.	
35	CS	I	CHIP SELECTION SIGNAL.	
36	FLM(TE)		FRAME HEAD PULSE FOR TEARING EFFECT.	
37	RESET	I	RESET SIGNAL INPUT PIN.	
38	GND	O	GROUND.	
39	LEDA	P	POWER SUPPLY FOR LED BACKLIGHT ANODE INPUT.	
40	LEDK	P	POWER SUPPLY FOR LED BACKLIGHT CATHODE INPUT.	
41-61	NC	I		

## 6 Optical Characteristics

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods. Measuring equipment: BM-7A

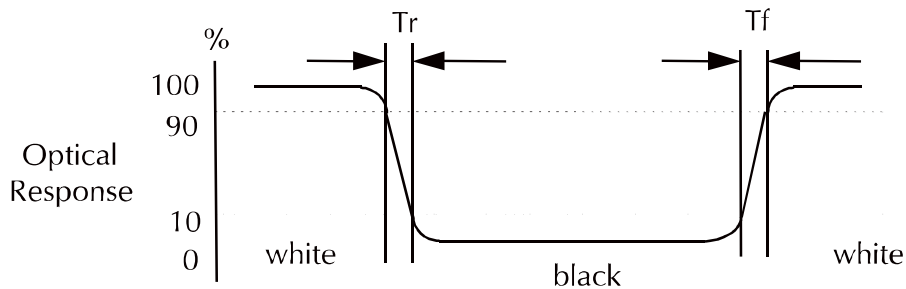
Item	Symbol	Condition	Min	Type	Max	Unit	Note	
Brightness	B		--	250	--	cd/m <sup>2</sup>		
Response time	T <sub>r</sub>	θ=0°	-	16	25	ms	.	
	T <sub>f</sub>		--			ms		
Contrast ratio	CR	At optimized viewing angle	400	500	--	--		
Luminance Uniformity	ΔL		70	80		%		
Color Chromaticity (CIE 1931)	White	W <sub>x</sub>	θ=0° Normal Viewing Angle	0.250	0.290	0.330	--	BM-7A
		W <sub>y</sub>		0.26	0.318	0.36		
Viewing Angle (6H)	Hor.	θ <sub>R</sub>	CR≥10	35	45	--	Degree	
		θ <sub>L</sub>		35	45	--		
	Ver.	θ <sub>U</sub>		40	50	--		
		θ <sub>D</sub>		10	20	--		

### 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".

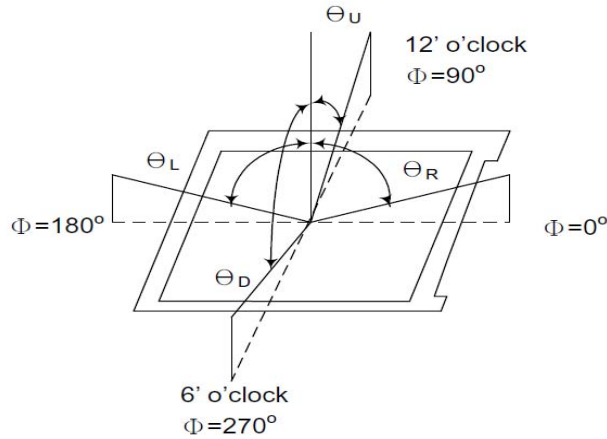




c. Definition of contrast ratio:

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

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



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

Light Source of Back-Light Unit	LED Type
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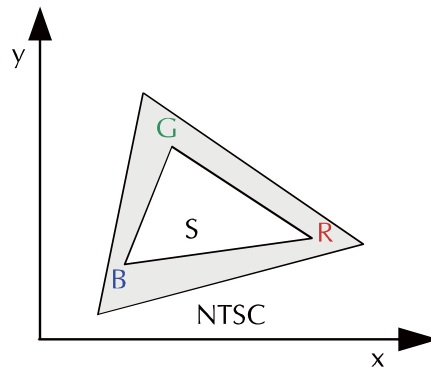
f. Definition of White Uniformity

$$\text{White Uniformity} = \frac{\text{Min. luminance of white among 9-points}}{\text{Max. luminance of white among 9-points}} \times 100\%$$

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

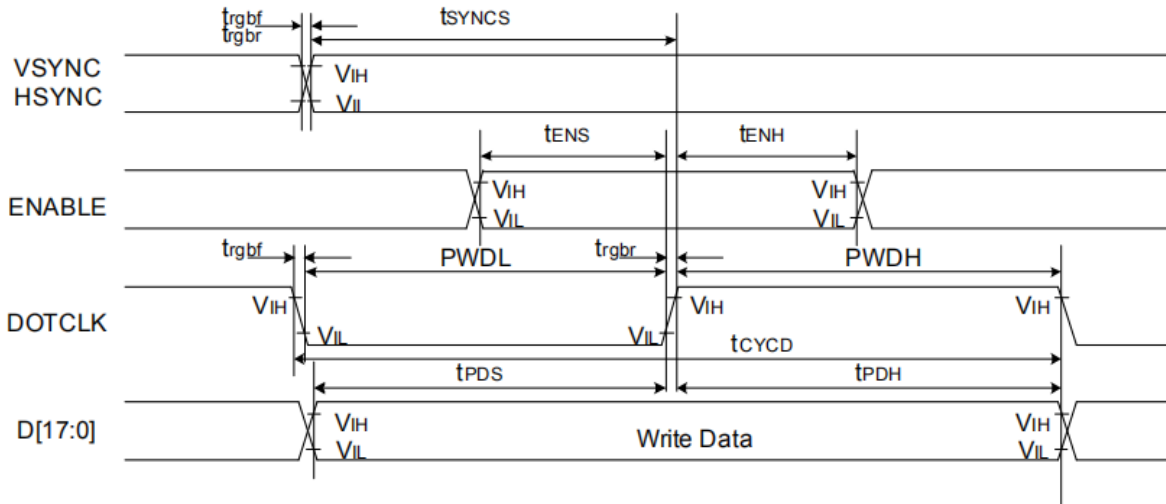
Color coordinate of white & red, green, blue at center point.

$$\text{Color Gamut : NTSC(\%)} = (\text{RGB Triangle Area} / \text{NTSC Triangle Area}) \times 100$$



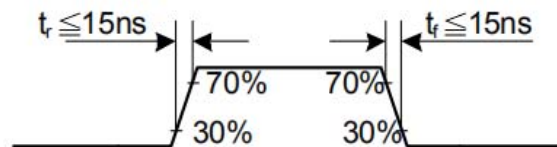
## 7 Interface Timing

### 18.3.5 Parallel 18/16/6-bit RGB Interface Timing Characteristics

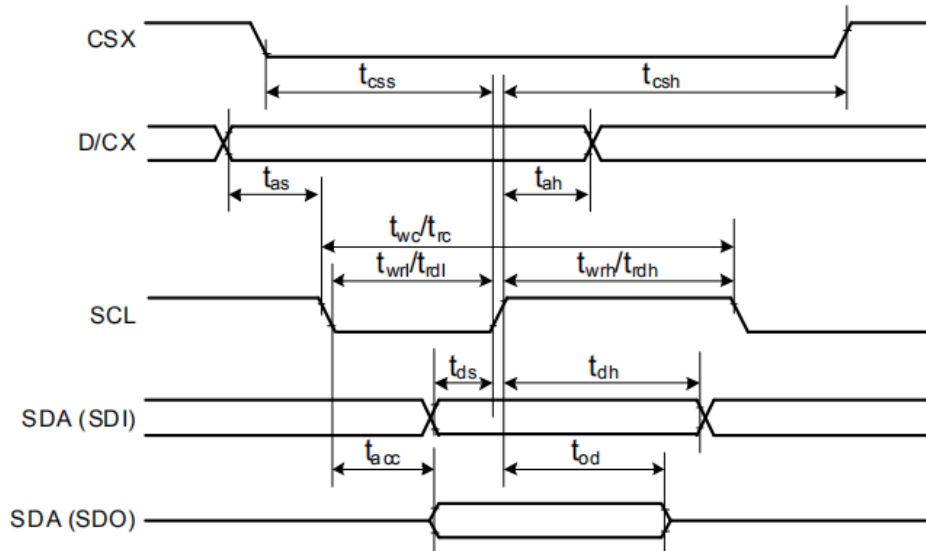


Signal	Symbol	Parameter	min	max	Unit	Description
VSYNC / HSYNC	$t_{SYNCS}$	VSYNC/HSYNC setup time	15	-	ns	18/16-bit bus RGB interface mode
	$t_{SYNCH}$	VSYNC/HSYNC hold time	15	-	ns	
DE	$t_{ENS}$	DE setup time	15	-	ns	
	$t_{ENH}$	DE hold time	15	-	ns	
D[17:0]	$t_{POS}$	Data setup time	15	-	ns	
	$t_{PDH}$	Data hold time	15	-	ns	
DOTCLK	PWDH	DOTCLK high-level period	15	-	ns	
	PWDL	DOTCLK low-level period	15	-	ns	
	$t_{CYCD}$	DOTCLK cycle time	100	-	ns	
	$t_{rgr}, t_{rgrf}$	DOTCLK, HSYNC, VSYNC rise/fall time	-	15	ns	
VSYNC / HSYNC	$t_{SYNCS}$	VSYNC/HSYNC setup time	15	-	ns	6-bit bus RGB interface mode
	$t_{SYNCH}$	VSYNC/HSYNC hold time	15	-	ns	
DE	$t_{ENS}$	DE setup time	15	-	ns	
	$t_{ENH}$	DE hold time	15	-	ns	
D[17:0]	$t_{POS}$	Data setup time	15	-	ns	
	$t_{PDH}$	Data hold time	15	-	ns	
DOTCLK	PWDH	DOTCLK high-level pulse period	15	-	ns	
	PWDL	DOTCLK low-level pulse period	15	-	ns	
	$t_{CYCD}$	DOTCLK cycle time	50	-	ns	
	$t_{rgr}, t_{rgrf}$	DOTCLK, HSYNC, VSYNC rise/fall time	-	15	ns	

Note:  $T_a = -30$  to  $70$  °C,  $V_{DDI} = 1.65V$  to  $3.3V$ ,  $V_{CI} = 2.5V$  to  $3.3V$ ,  $AGND = VSS = 0V$

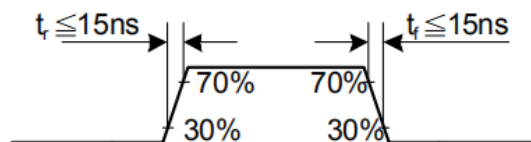


### 18.3.4 Display Serial Interface **Timing** Characteristics (4-line SPI system)

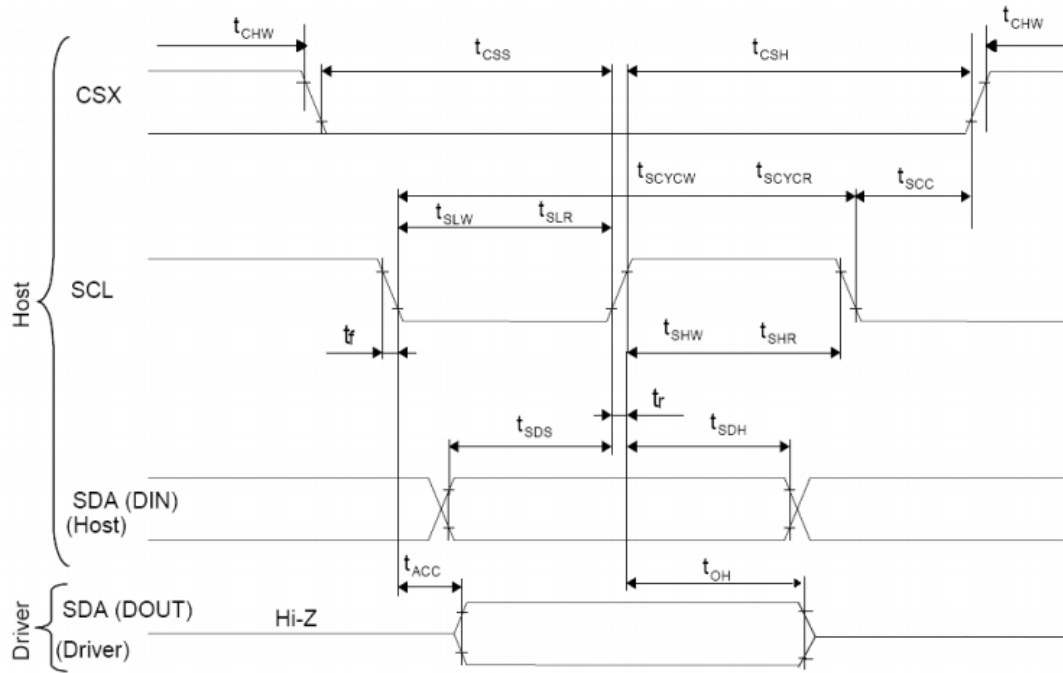


Signal	Symbol	Parameter	min	max	Unit	Description
CSX	$t_{css}$	Chip select time (Write)	40	-	ns	
	$t_{csh}$	Chip select hold time (Read)	40	-	ns	
SCL	$t_{wc}$	Serial clock cycle (Write)	100	-	ns	
	$t_{wrh}$	SCL "H" pulse width (Write)	40	-	ns	
	$t_{wrl}$	SCL "L" pulse width (Write)	40	-	ns	
	$t_{rc}$	Serial clock cycle (Read)	150	-	ns	
	$t_{rdh}$	SCL "H" pulse width (Read)	60	-	ns	
	$t_{rdl}$	SCL "L" pulse width (Read)	60	-	ns	
D/CX	$t_{as}$	D/CX setup time	10	-		
	$t_{ah}$	D/CX hold time (Write / Read)	10	-		
SDA / SDI (Input)	$t_{ds}$	Data setup time (Write)	30	-	ns	
	$t_{dh}$	Data hold time (Write)	30	-	ns	
SDA / SDO (Output)	$t_{acc}$	Access time (Read)	10	-	ns	For maximum CL=30pF
	$t_{od}$	Output disable time (Read)	10	50	ns	For minimum CL=8pF

Note:  $T_a = 25\text{ }^\circ\text{C}$ ,  $V_{DDI}=1.65\text{V to }3.3\text{V}$ ,  $V_{CI}=2.5\text{V to }3.3\text{V}$ ,  $AGND=V_{SS}=0\text{V}$

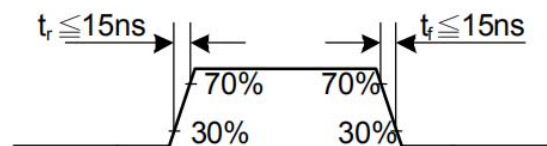


### 18.3.3 Display Serial Interface **Timing** Characteristics (3-line SPI system)



Signal	Symbol	Parameter	min	max	Unit	Description
SCL	tscycw	Serial Clock Cycle (Write)	100	-	ns	
	tshw	SCL "H" Pulse Width (Write)	40	-	ns	
	tslw	SCL "L" Pulse Width (Write)	40	-	ns	
	tscycr	Serial Clock Cycle (Read)	150	-	ns	
	tshr	SCL "H" Pulse Width (Read)	60	-	ns	
	tslr	SCL "L" Pulse Width (Read)	60	-	ns	
SDA / SDI (Input)	tsds	Data setup time (Write)	30	-	ns	
	tsdh	Data hold time (Write)	30	-	ns	
SDA / SDO (Output)	tacc	Access time (Read)	10	-	ns	
	toh	Output disable time (Read)	10	50	ns	
CSX	tsc	SCL-CSX	20	-	ns	
	tch	CSX "H" Pulse Width	40	-	ns	
	tcs	CSX-SCL Time	60	-	ns	
	tcs		65	-	ns	

Note:  $T_a = 25\text{ }^\circ\text{C}$ ,  $V_{DDI}=1.65\text{V to }3.3\text{V}$ ,  $V_{CI}=2.5\text{V to }3.3\text{V}$ ,  $AGND=VSS=0\text{V}$



## 8 Reliability Condition for LCD

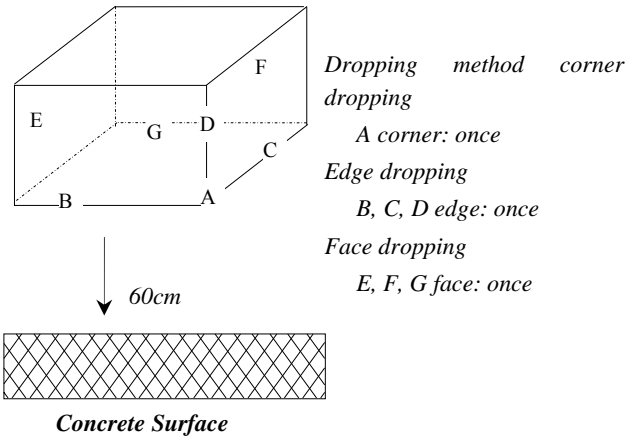
No change on display and in operation under the following test condition.

Condition: Unless otherwise specified, tests will be conducted under the following condition.

Temperature:  $20\pm 5^{\circ}\text{C}$

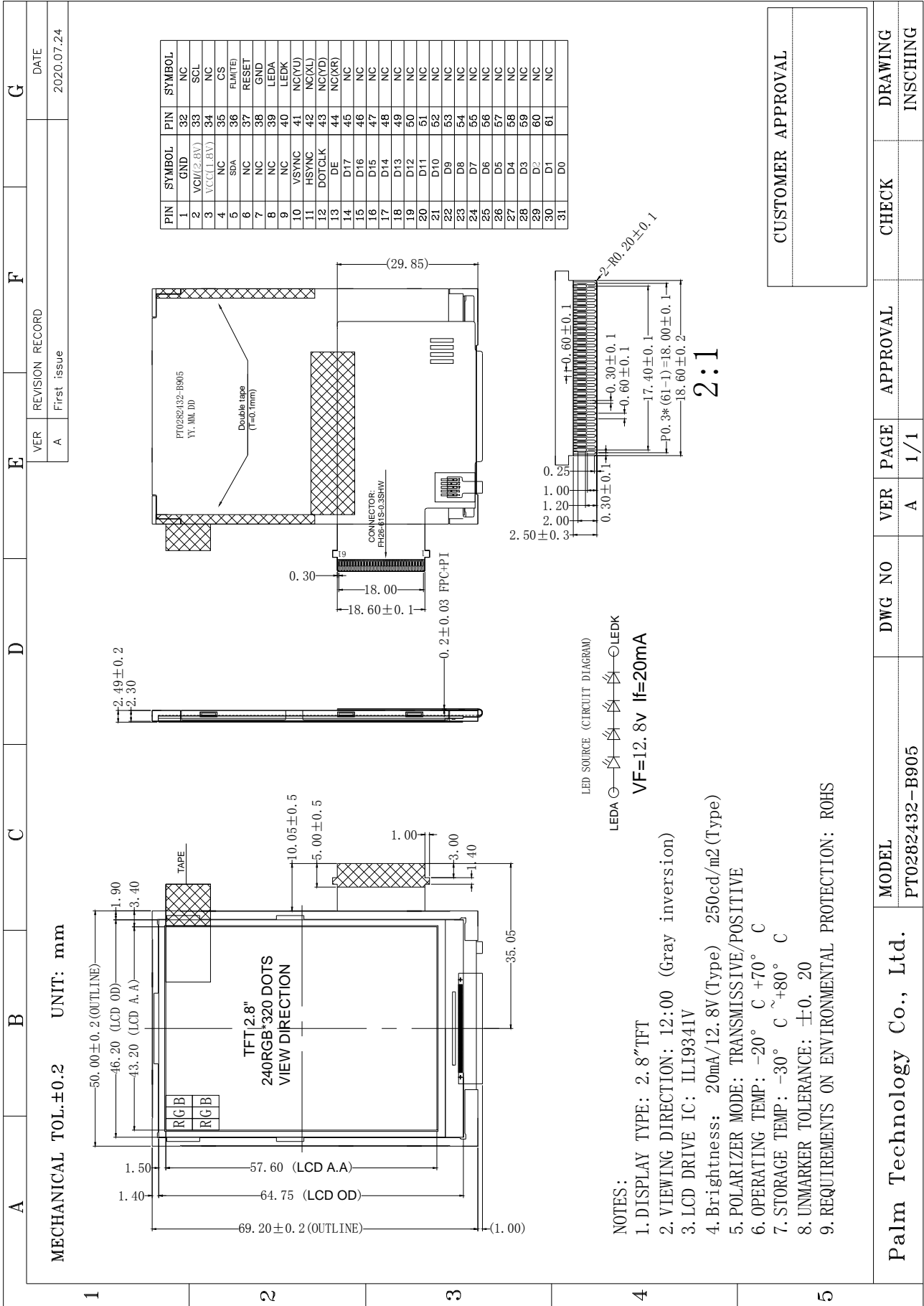
Humidity:  $65\pm 5\% \text{RH}$

Tests will be not conducted under functioning state.

No.	Parameter	Condition	Notes
1	High Temperature Operating	$70^{\circ}\text{C}\pm 2^{\circ}\text{C}$ , 48hrs (Operation state)	--
2	Low Temperature Operating	$-20^{\circ}\text{C}\pm 2^{\circ}\text{C}$ , 48hrs (Operation state)	--
3	High Temperature Storage	$80^{\circ}\text{C}\pm 2^{\circ}\text{C}$ , 48hrs	--
4	Low Temperature Storage	$-30^{\circ}\text{C}\pm 2^{\circ}\text{C}$ , 48hrs	--
5	High Temperature and High Humidity Operation Test	$60^{\circ}\text{C}\pm 2^{\circ}\text{C}$ , 90%, 48hrs	--
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. 	--

- Notes:
1. No dew condensation to be observed.
  2. The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.
  3. Vibration test will be conducted to the product itself without putting I in a container.

9 Dimensional outlines



## 10 Incoming Inspection Standards

### 10.1 VISUAL & FUNCTION INSPECTION STANDARD

#### 10.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

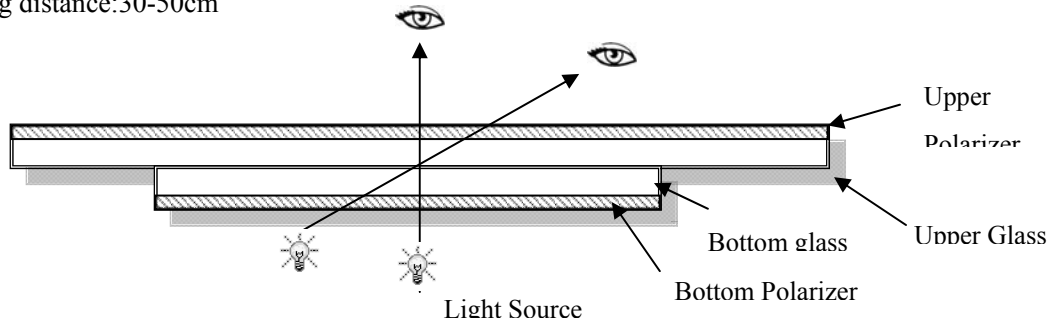
Temperature :  $25\pm 5^{\circ}\text{C}$

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

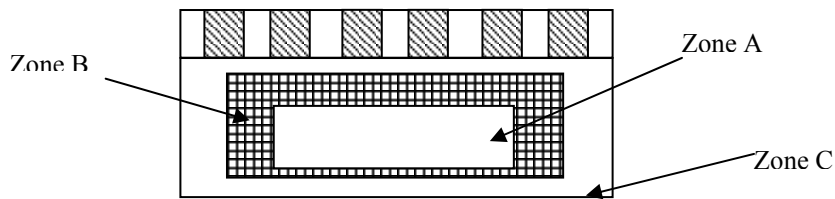
Viewing Angle : Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance:30-50cm



#### 10.1.2 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 .)

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.

### 10.1.3 Sampling Plan

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

AQL:

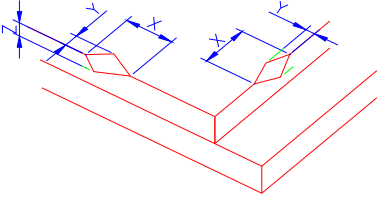
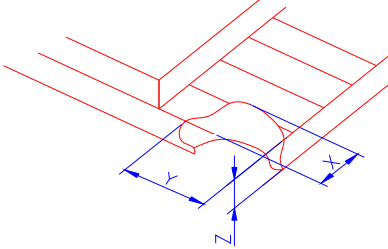
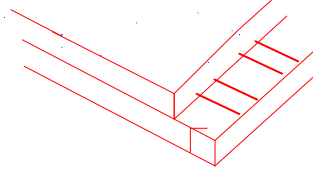
Major defect	Minor defect
0.65	1.5

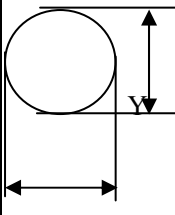
LCD: Liquid Crystal Display , TP: Touch Panel , LCM: Liquid Crystal Module

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. 4) TP no function	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed	
4	Color tone	Color unevenness, refer to limited sample	Minor
5	Soldering appearance	Good soldering , Peeling off is not allowed.	
6	LCD/Polarizer/TP	Black/White spot/line, scratch, crack, etc.	



**10.1.4 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="847 499 1391 656"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td>&lt;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="908 992 1329 1093"> <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>						

Number	Items	Criteria (mm)																									
2.0	Spot defect  $\Phi = (X+Y)/2$	① light dot (LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain) <table border="1"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.10</math></td> <td colspan="3">Ignore</td> </tr> <tr> <td><math>0.10 &lt; \Phi \leq 0.15</math></td> <td colspan="3">3( distance <math>\geq 10\text{mm}</math>)</td> </tr> <tr> <td><math>0.15 &lt; \Phi \leq 0.2</math></td> <td colspan="3">1</td> </tr> <tr> <td><math>0.2 &lt; \Phi</math></td> <td colspan="3">0</td> </tr> </tbody> </table>	Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.10$	Ignore			$0.10 < \Phi \leq 0.15$	3( distance $\geq 10\text{mm}$ )			$0.15 < \Phi \leq 0.2$	1			$0.2 < \Phi$	0				
		Zone Size (mm)		Acceptable Qty																							
			A	B	C																						
		$\Phi \leq 0.10$	Ignore																								
		$0.10 < \Phi \leq 0.15$	3( distance $\geq 10\text{mm}$ )																								
		$0.15 < \Phi \leq 0.2$	1																								
		$0.2 < \Phi$	0																								
		② Dim spot (LCD/TP/Polarizer dim dot, light leakage, dark spot) <table border="1"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.1</math></td> <td colspan="3">Ignore</td> </tr> <tr> <td><math>0.1 &lt; \Phi \leq 0.2</math></td> <td colspan="3">2( distance <math>\geq 10\text{mm}</math>)</td> </tr> <tr> <td><math>0.2 &lt; \Phi \leq 0.3</math></td> <td colspan="3">1</td> </tr> <tr> <td><math>\Phi &gt; 0.3</math></td> <td colspan="3">0</td> </tr> </tbody> </table>	Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.1$	Ignore			$0.1 < \Phi \leq 0.2$	2( distance $\geq 10\text{mm}$ )			$0.2 < \Phi \leq 0.3$	1			$\Phi > 0.3$	0				
		Zone Size (mm)		Acceptable Qty																							
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$\Phi > 0.3$	0																										
③ Polarizer accidented spot <table border="1"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.2</math></td> <td colspan="3">Ignore</td> </tr> <tr> <td><math>0.2 &lt; \Phi \leq 0.5</math></td> <td colspan="3">2( distance <math>\geq 10\text{mm}</math>)</td> </tr> <tr> <td><math>\Phi &gt; 0.5</math></td> <td colspan="3">0</td> </tr> </tbody> </table>	Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.2$	Ignore			$0.2 < \Phi \leq 0.5$	2( distance $\geq 10\text{mm}$ )			$\Phi > 0.5$	0										
Zone Size (mm)		Acceptable Qty																									
	A	B	C																								
$\Phi \leq 0.2$	Ignore																										
$0.2 < \Phi \leq 0.5$	2( distance $\geq 10\text{mm}$ )																										
$\Phi > 0.5$	0																										
Line defect (LCD/TP /Polarizer black/white line, scratch, stain)	<table border="1"> <thead> <tr> <th rowspan="2">Width(mm)</th> <th rowspan="2">Length(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.03</math></td> <td>Ignore</td> <td colspan="2">Ignore</td> <td rowspan="3">Ignore</td> </tr> <tr> <td><math>0.03 &lt; W \leq 0.05</math></td> <td><math>L \leq 3.0</math></td> <td colspan="2"><math>N \leq 2</math></td> </tr> <tr> <td><math>0.05 &lt; W \leq 0.08</math></td> <td><math>L \leq 2.0</math></td> <td colspan="2"><math>N \leq 2</math></td> </tr> <tr> <td><math>0.08 &lt; W</math></td> <td colspan="4">Define as spot defect</td> </tr> </tbody> </table>	Width(mm)	Length(mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.03$	Ignore	Ignore		Ignore	$0.03 < W \leq 0.05$	$L \leq 3.0$	$N \leq 2$		$0.05 < W \leq 0.08$	$L \leq 2.0$	$N \leq 2$		$0.08 < W$	Define as spot defect			
Width(mm)	Length(mm)			Acceptable Qty																							
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$0.08 < W$	Define as spot defect																										

3.0	Polarizer Bubble	Zone	Acceptable Qty		
		Size (mm)	A	B	C
		$\Phi \leq 0.2$	Ignore		Ignore
		$0.2 < \Phi \leq 0.4$	2(distance $\geq 10$ mm)		
		$0.4 < \Phi \leq 0.6$	1		
$0.6 < \Phi$	0				
4.0	SMT	According to IPC-A-610C class II standard . Function defect and missing part are major defect ,the others are minor defect.			