

**DISPLAY Elektronik GmbH**

# DATA SHEET

*LCD MODULE*

**DEM 2801424A VMH-PW-N**

*Product Specification*

*Version: 2*

**01.09.2021**

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**2. General Specifications**

	Feature	Spec
Characteristics	Size	7 Inch
	Resolution	280 (H) x RGB x 1424 (V)
	Interface	MIPI
	Connect type	Connector
	Color Depth	16.7 Million
	Technology type	a-Si (IPS)
	Display Spec. Pixel pitch (mm)	0.12 x 0.12
	Pixel Configuration	R.G.B. Vertical Stripe
	Display Mode	Normally Black
	Driver IC	OTA7290B
	CTP Driver IC	-
	Viewing Direction	Full View
Mechanical	LCM (W x H x D) (mm)	38.20 x 186.62 x 3.50
	Active Area(mm)	33.60 x 170.88
	With /Without TSP	without CTP
	Weight (g)	TBD
	LED Numbers	16 LEDs

Note 1: Viewing direction is follow the data which measured by optics equipment.

Note 2: Requirements on Environmental Protection: RoHS

Note 3: LCM weight tolerance: +/- 5%

**3. Input / Output Terminals****LCD PIN-MAP**

No	Symbol	Description
1	GND	GROUND
2	MIPI_3N	MIPI Negative Data Signal(-)
3	MIPI_3P	MIPI Positive Data Signal(+)
4	GND	GROUND
5	MIPI_D2N	MIPI Negative Data Signal(-)
6	MIPI_D2P	MIPI Positive Data Signal(+)
7	GND	GROUND
8	MIPI_CKN	MIPI Negative Clock Signal(-)
9	MIPI_CKP	MIPI Positive Clock Signal(+)
10	GND	GROUND
11	MIPI_D1N	MIPI Negative Data Signal(-)
12	MIPI_D1P	MIPI Positive Data Signal(+)
13	GND	GROUND
14	MIPI_D0N	MIPI Negative Data Signal(-)
15	MIPI_D0P	MIPI Positive Data Signal(+)
16	GND	GROUND
17	GND	GROUND
18	TE	Sync Signal for Touch Panel
19	RESET	Device Reset Signal
20	GND	GROUND
21-23	VCI	Power Supply for logic Operation
24	GND	GROUND
25-26	NC	No Connect
27-28	LEDK	LED Cathode
29-30	LEDA	LED Anode

### 4 Absolute Maximum Ratings

Item	Symbol	MIN	Typ	MAX	Unit	Remark
Supply Voltage	V <sub>DD</sub>	-0.3	-	5.0	V	-
Operating Temperature	T <sub>OPR</sub>	-20	-	70	°C	-
Storage Temperature	T <sub>STG</sub>	-30	-	80	°C	-

### 5 Electrical Characteristics

#### 5.1 Driving TFT LCD Panel

Item	Symbol	MIN	Typ	MAX	Unit	Remark
Supply Voltage	V <sub>CI</sub>	3.0	3.3	3.6	V	-
Input Voltage “H”level	V <sub>IH</sub>	0.7V <sub>DD</sub>	-	V <sub>DD</sub>	V	-
Input Voltage “L”level	V <sub>IL</sub>	0	-	0.3V <sub>DD</sub>	V	-

#### 5.2 Driving Backlight

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	I <sub>F</sub>	-	40	-	mA	
Forward Voltage	V <sub>F</sub>	22.4		27.2	V	
Backlight Power Consumption	W <sub>BL</sub>	0.896		1.09	W	
LED Lifetime		-	30000	-	Hrs	

Note 1: Each LED: I<sub>F</sub> =20 mA, V<sub>F</sub> =2.8~3.4V.

Note 2: Optical performance should be evaluated at Ta=25°C only.

Note 3: If LED is driven by high current, high ambient temperature & humidity condition.

The lifetime of LED will be reduced. Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated Data.

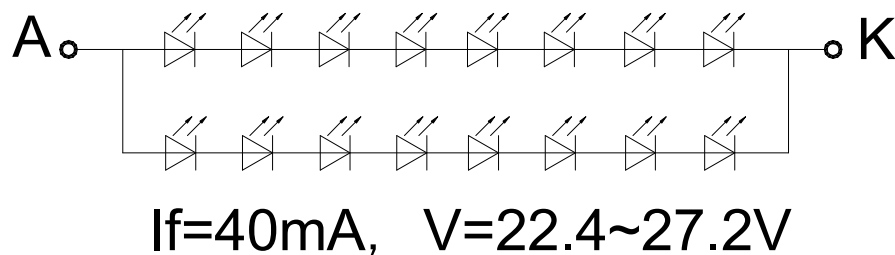
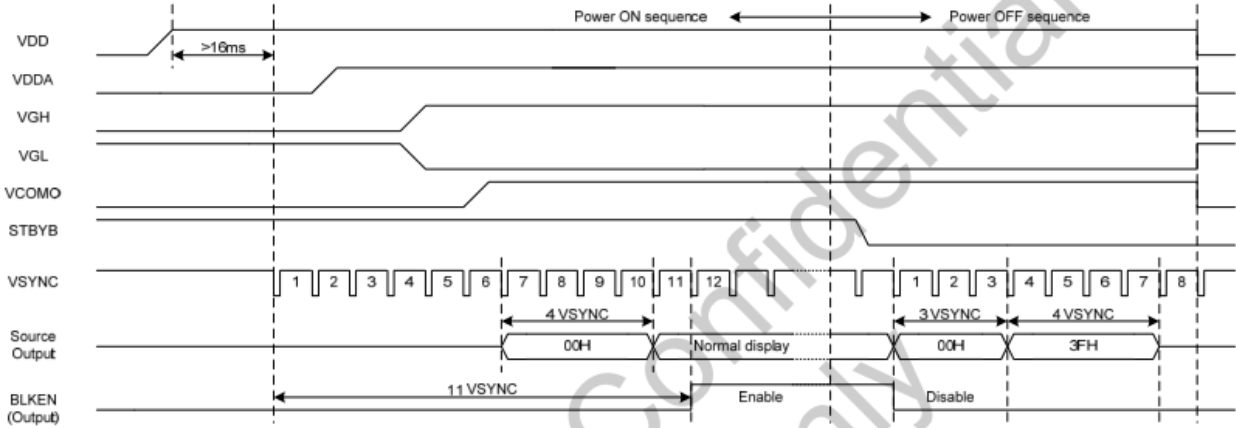


Figure: LED Connection of Backlight

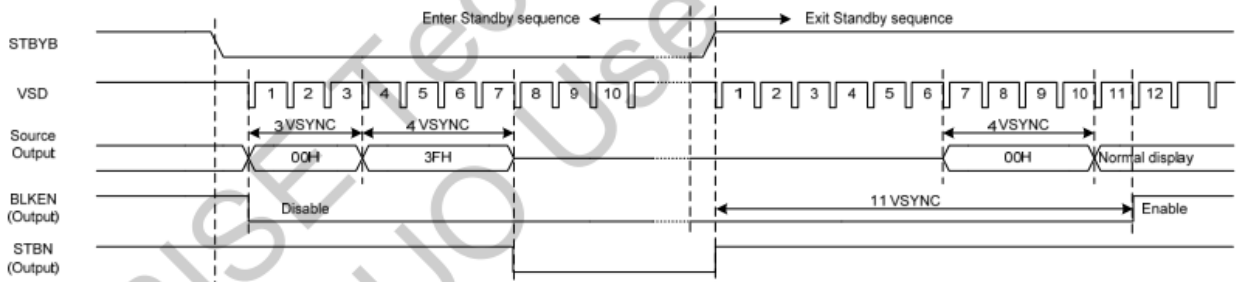
5.3 POWER ON / OFF SEQUENCE

In order to prevent IC from power on reset fail, the rising time ( $T_{POR}$ ) of the digital power supply VDD should be maintained within the given specifications. Refer to "AC Characteristics" for more detail on timing.

Power-On/Off Timing Sequence:

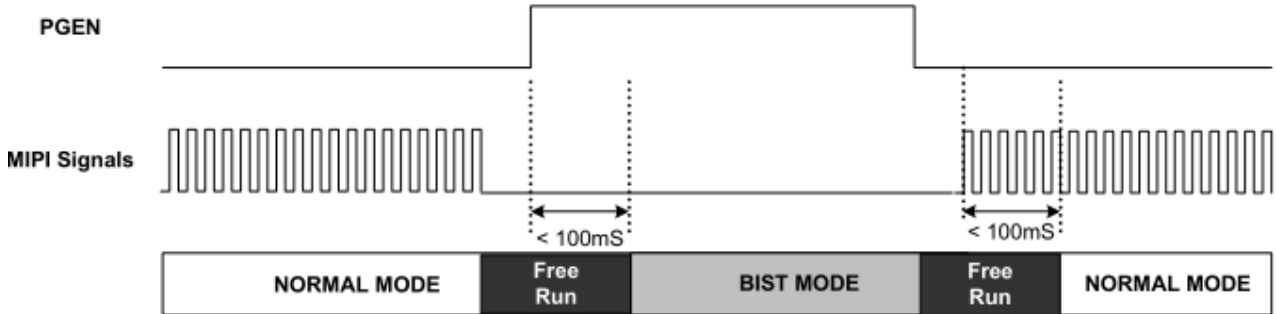
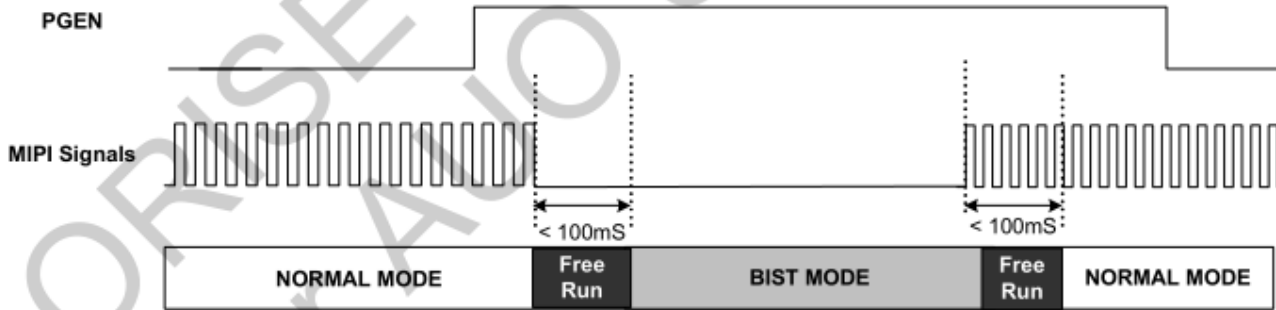


Enter and Exit Standby Mode Sequence:



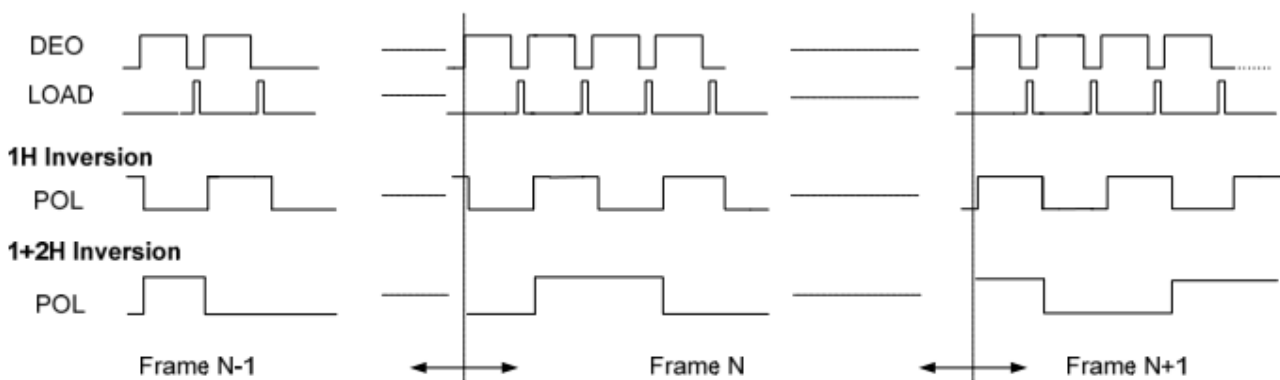
### 5.4 RESET TIMING CHARACTERISTICS

#### BIST Timing



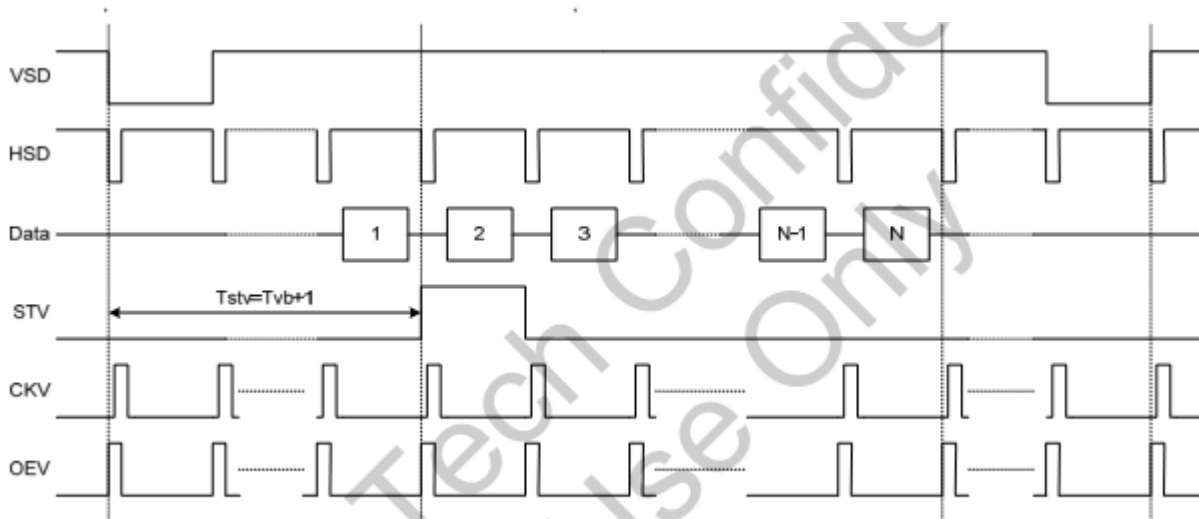
#### TCON Timing

##### Polarity Control

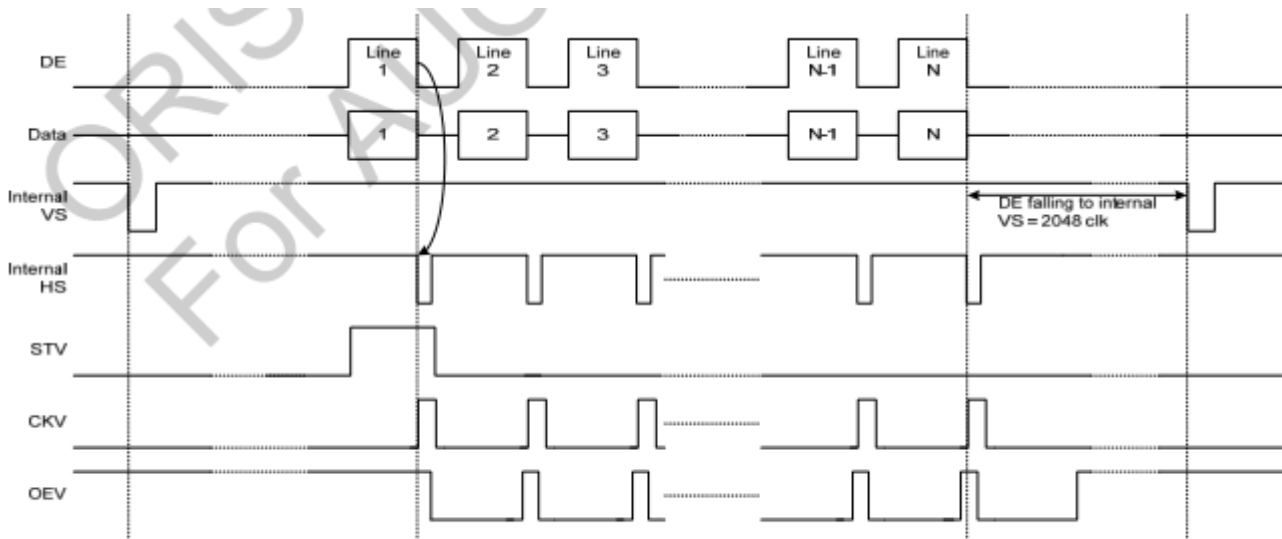




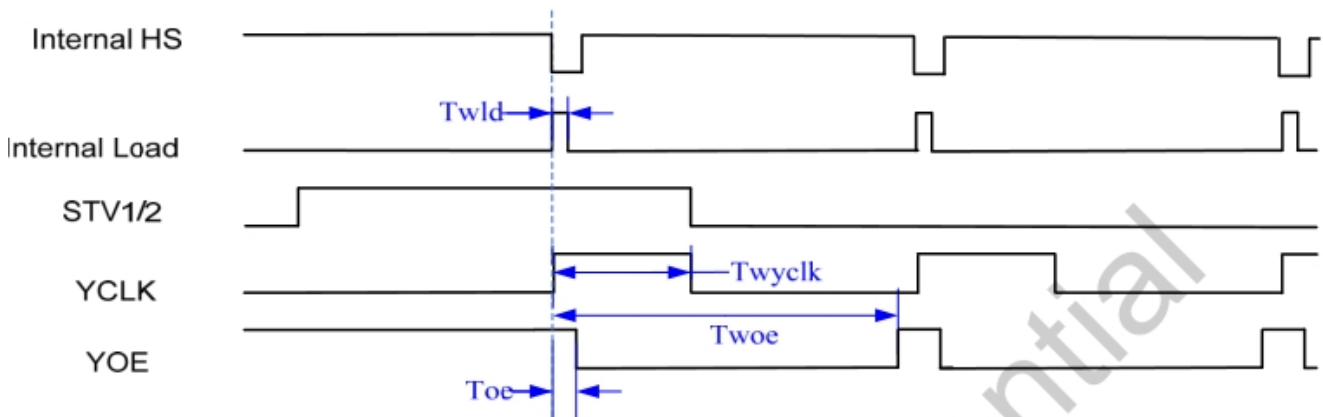
Vertical Timing Diagram HV (Cascade)



Vertical Timing Diagram DE (Cascade)



Gate output timing diagram (Cascade)



MIPI DC Characteristics

HS Receiver DC Specification

Parameter	Symbol	Rating			Unit	Note
		Min	Typ	Max		
Operation Voltage	VDD	1.5-10%	1.5	1.5+10%	mV	
Differential Input Voltage	VID	70	200	260	mV	
Common Mode Voltage	$V_{CMRX(DC)}$	70	-	330	mV	
Differential Input High Threshold Voltage	VTH	-	-	70	mV	
Differential Input Low Threshold Voltage	VTL	-70	-	-	mV	
Singled-ended input high voltage	$V_{IHHS}$	-	-	460	mV	
Singled-ended input low voltage	$V_{ILHS}$	-40	-	-	mV	
Singled-ended threshold for HS termination enable	$V_{TERM-EN}$	-	-	450	mV	
Differential input impedance	$Z_{ID}$	80	100	125	ohm	
Pin leakage current	$I_{LEAK}$	-10	-	10	uA	
Common-mode interference beyond 450MHz	$\Delta V_{CMRX(HF)}$	-	-	100	mV	
Common-mode interference 50MHz - 450MHz	$\Delta V_{CMRX(LF)}$	-50	-	50	mV	
Common-mode termination	$C_{CM}$	-	-	60	pF	
Embedded Termination	$R_T$	90	100	110	ohm	2bits $RT\_SEL[1: 0]$ for termination resistor selection 00 $\rightarrow$ 200ohm 10, 01 $\rightarrow$ 150ohm 11 $\rightarrow$ 100ohm (default)  1bit $ERMEN$ for termination resistor enable $TERMEN=0$ , termr disable $R=(OPEN)$ $TERMEN=1$ , termr enable

Note:

- (1) Excluding possible additional RF interference of 100mV peak sine wave beyond 450MHz.
- (2) This table value includes a ground difference of 50mV between the transmitter and the receiver, the static common-mode level tolerance and variations below 450MHz.



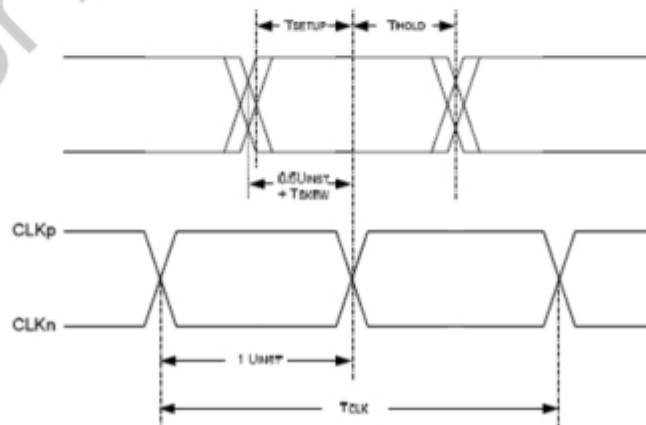
MIPI AC Characteristics

HS Receiver AC Timing Characteristics

Parameter	Symbol	Rating			Unit	Note
		Min	Typ	Max		
Bandwidth per lane	-	-	-	1000	Mbps	Bandwidth selected by register 'speedup' Speedup=0 → Max=550Mbps Speedup=1 → Max=1000Mbps
Operation frequency	-	-	-	500	MHz	
UI instantaneous	$UI_{INST}$	1	-	12.5	ns	1
Data to Clock Skew	$T_{skew}$	-0.15	-	0.15	$UI_{INST}$	
Inter-lane static skew	$T_{skew-lane}$	-	-	$UI_{INST}/50$	$UI_{INST}$	
Data to Clock Setup Time	$T_{SETUP}$	0.25	-	-	$UI_{INST}$	2
Data to Clock Hold Time	$T_{HOLD}$	0.25	-	-	$UI_{INST}$	
Common-mode interference beyond 450MHz	$\Delta V_{CMRX(HF)}$	-	-	100	mV	4
Common-mode interference 50MHz- 450MHz	$\Delta V_{CMRX(LF)}$	-50	-	50	mV	3,6
Common-mode termination	$C_{CM}$	-	-	60	pF	5

Note:

- (1) Total silicon and package delay budget of  $0.3 \cdot UI_{INST}$
- (2) Total setup and hold window for receiver of  $0.3 \cdot UI_{INST}$
- (3) Excluding 'static' ground shift of 50mV
- (4)  $\Delta V_{CMRX(HF)}$  is the peak amplitude of a sine wave superimposed on the receiver input
- (5) For higher bit rates a 14pF capacitor will be needed to meet the common-mode return loss specification.
- (6) Voltage difference compared to the DC average common-mode potential.



## LP Receiver AC Timing Characteristics

Parameter	Symbol	Rating			Unit	Note
		Min	Typ	Max		
Input pulse rejection	$e_{\text{SPIKE}}$	-	-	300	V-ps	1,2,3
Minimum pulse width response	$T_{\text{MIN-RX}}$	20	-	-	ns	
Peak interference amplitude	$V_{\text{INT}}$	-	-	200	mV	
Interference frequency	$f_{\text{INT}}$	450	-	-	MHz	
Logic 1 input voltage	$V_{\text{IH}}$	880	-	-	mV	
Logic 0 input voltage, not in ULP State	$V_{\text{IL}}$	-	-	550	mV	
Logic 0 input voltage, ULP State	$V_{\text{IL-ULPS}}$	-	-	300	mV	
Input Hysteresis	$V_{\text{HYST}}$	25	-	-	mV	
Logic 1 contention threshold	$V_{\text{IHCD}}$	450	-	-	mV	
Logic 0 contention threshold	$V_{\text{ILCD}}$	-	-	200	mV	

## Note:

- (1) Time-voltage integration of a spike above  $V_{\text{IL}}$  when being in LP-0 state or below  $V_{\text{IH}}$  when being in LP-1state.
- (2) An impulse less than this will not change the receiver state.
- (3) In addition to the required glitch rejection, implementers shall ensure rejection of known RF-interferers.

## 6. Optical Characteristics

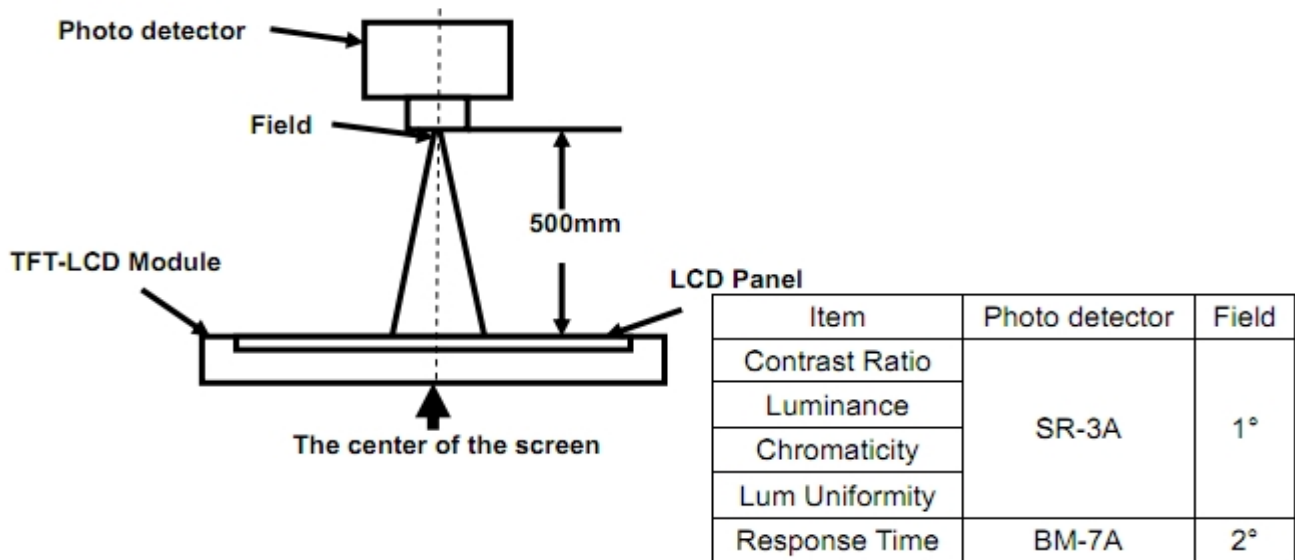
Items	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	
Viewing angles	$\theta_T$	Center CR $\geq$ 10	75	80	-	Degree.	Note2	
	$\theta_B$		75	80	-			
	$\theta_L$		75	80	-			
	$\theta_R$		75	80	-			
Contrast Ratio	CR	$\Theta = 0$	800	1000	-	-	Note1, Note3	
Response Time	T <sub>ON</sub>	25°C	-	30	40	ms	Note1, Note4	
	T <sub>OFF</sub>							
Chromaticity	White	Backlight is on	X <sub>W</sub>	TBD	TBD	TBD	-	Note1, Note5
			Y <sub>W</sub>	TBD	TBD	TBD	-	
	Red		X <sub>R</sub>	0.594	0.644	0.694	-	
			Y <sub>R</sub>	0.282	0.332	0.382	-	
	Green		X <sub>G</sub>	0.274	0.324	0.374	-	
			Y <sub>G</sub>	0.516	0.566	0.612	-	
	Blue		X <sub>B</sub>	0.087	0.137	0.187	-	
			Y <sub>B</sub>	0.075	0.125	0.175	-	
Luminance Uniformity	LU		70	75	-	%	Note1, Note6	
Luminance	L		450	550		cd/m <sup>2</sup>	Note1, Note7	

### Test Conditions:

1. IF= 20mA (one channel), the ambient temperature is 25°C.
2. The test systems refer to Note 1 and Note 2.

Note 1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Note 2: Definition of viewing angle range and measurement system.

Viewing angle is measured at the center point of the LCD by CONOSCOPE(ergo-80).

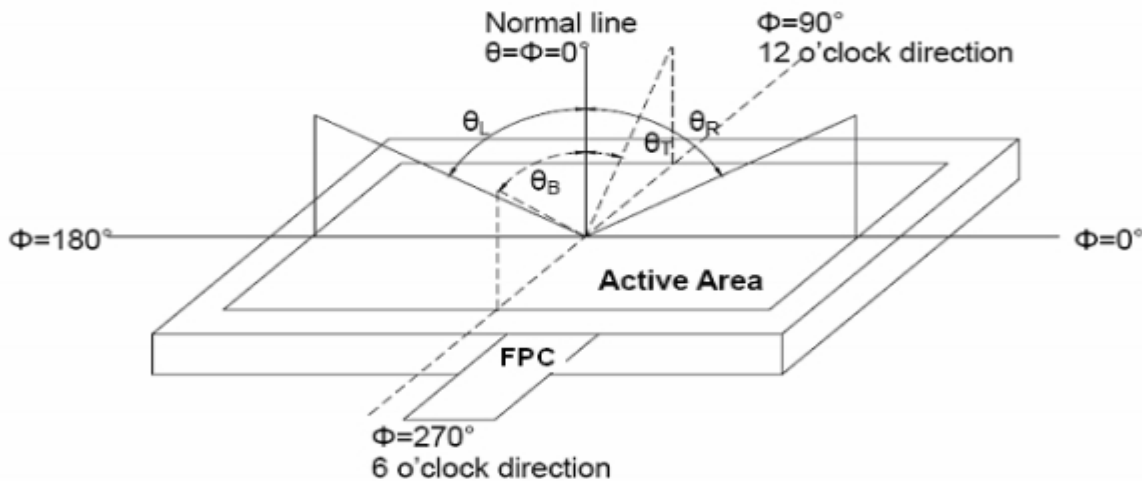


Fig. 1 Definition of viewing angle

Note 3: Definition of contrast ratio

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

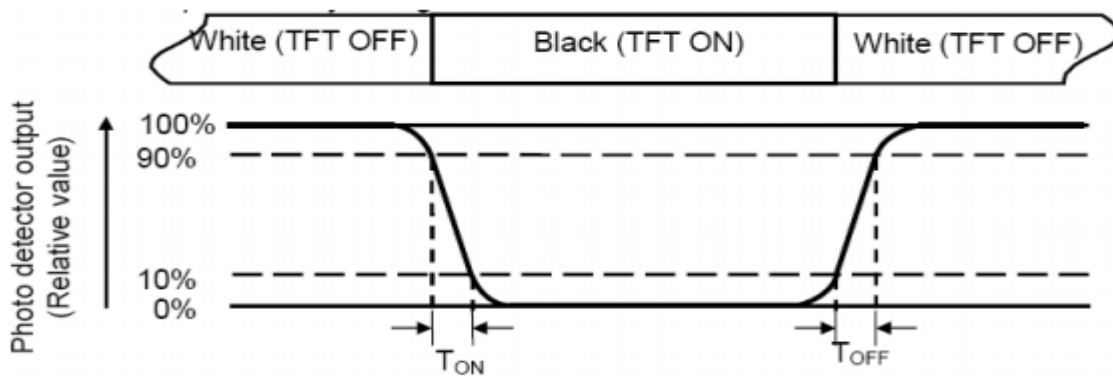
“White state “:The state is that the LCD should be driven by Vwhite.

“Black state”: The state is that the LCD should be driven by Vblack.

Vwhite: To be determined    Vblack: To be determined.

Note 4: Definition of Response time

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time (TON) is the time between photo detector output intensity changed from 90% to 10%. And fall time (TOFF) is the time between photo detector output intensity changed from 10% to 90%.



Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note 6: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity}(U) = L_{\min} / L_{\max} \times 100\%$$

L-----Active area length W----- Active area width



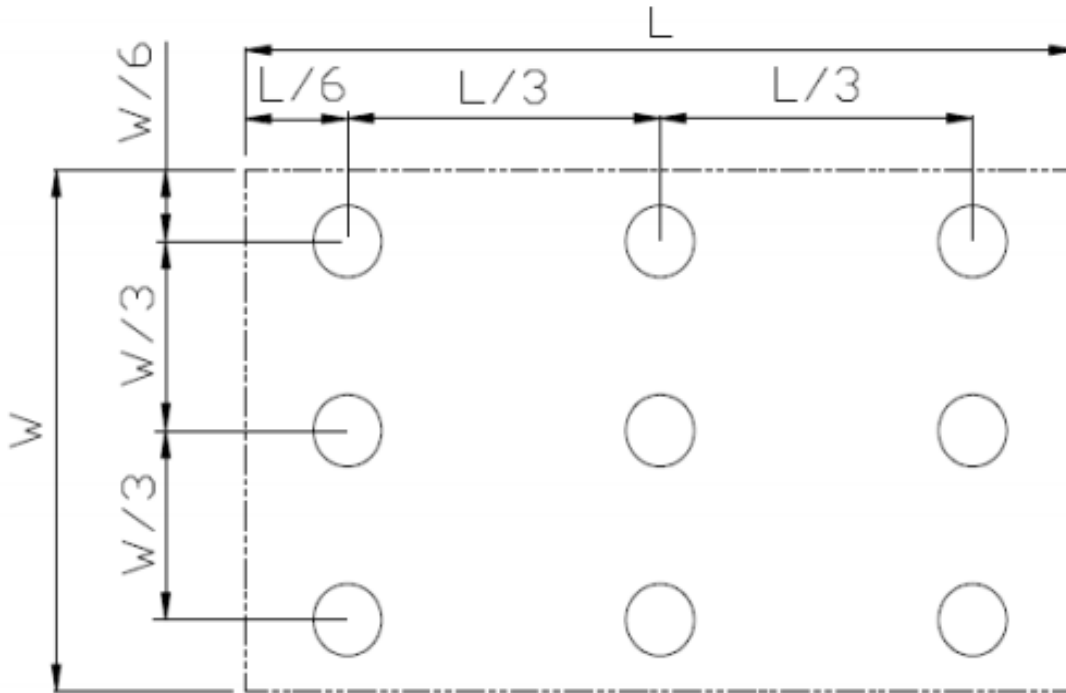


Fig. 2 Definition of uniformity

$L_{max}$ : The measured maximum luminance of all measurement position.

$L_{min}$ : The measured minimum luminance of all measurement position.

Note 7: Definition of Luminance :

Measure the luminance of white state at center point.

## 7. Environmental / Reliability Tests

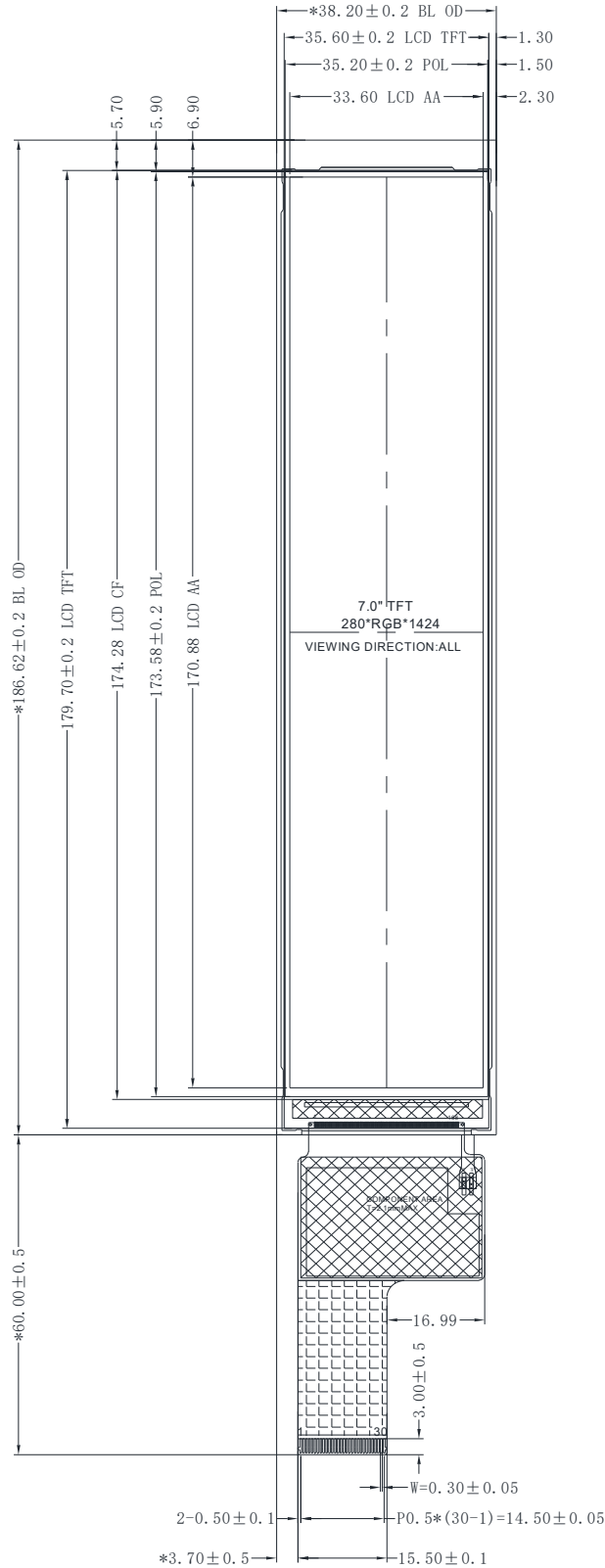
No	Test Item	Condition	Remarks
1	High Temperature Operation	Ts= +70°C, 96hrs	IEC60068-2-1:2007 GB2423. 2-2008
2	Low Temperature Operation	Ta= -20°C, 96hrs	IEC60068-2-1:2007 GB2423.1-2008
3	High Temperature Storage	Ta= +80°C,96hrs	IEC60068-2-1:2007 GB2423. 2-2008
4	Low Temperature Storage	Ta= -30°C, 96hrs	IEC60068-2-1:2007 GB2423.1-2008
5	High Temperature & Humidity Operation	Ta= +60°C, 90% RH max,240 hours	IIEC60068-2-78:2001 GB/T2423.3-2006
6	Thermal Shock (Non-operation)	-30°C 30 min ~ +80°C 30 min Change time: 5min, 20 Cycle	Start with cold temperature, end with high temperature IEC60068-2-14:1984, GB2423.22-2002
7	ESD	C=150pF, R=330 Ω, 5 points/panel , Air:±8KV, 5 times Contact: ±4KV, 5 times (Environment: 15°C ~ 35°C, 30% ~ 60%, 86Kpa ~ 106Kpa)	IEC61000-4-2:2001 GB/T17626.2-2006
8	Vibration (Non-operation)	Frequency range: 10~55Hz, Stroke: 1.5mm , Sweep: 10Hz~55Hz~10Hz 2 hours for each direction of X .Y. Z. (6 hours for total)	IEC60068-2-6:1982 GB/T2423.10-1995
9	Mechanical Shock (Non-operation)	Half Sine Wave 60G ,6ms,±X,±Y,±Z 3times for each direction	IEC60068-2-27:1987 GB/T2423.5—1995
10	Package Drop Test	Height: 60 cm, 1 corner, 3 edges, 6 surfaces	IEC60068-2-32:1990 GB/T2423.8-1995

**Notes:**

1. The test result shall be evaluated after the sample has been left at room temperature and humidity for 2 hours without load. No condensation shall be accepted. The sample will not be accepted if appear these defects:
  - 1). Air bubble in the LCD;
  - 2). Seal leak
  - 3). Non-display
  - 4). Missing segments
  - 5). Glass crack
  - 6). CR reduction >40%
  - 7). IDD increase >100%
  - 8). Brightness reduction >50%
  - 9). Color coordinate tolerance >0.05
2.  $\leq 7.0$  inch: The size of sample is 5pcs;  
 $> 7.0$  inch: The size of sample is 2pcs;
3. One test sample must complete each test item;
4. In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part.
5. In the test of High Temperature Operation and High Temperature & Humidity Operation, the operation temperature is the surface temperature of module.

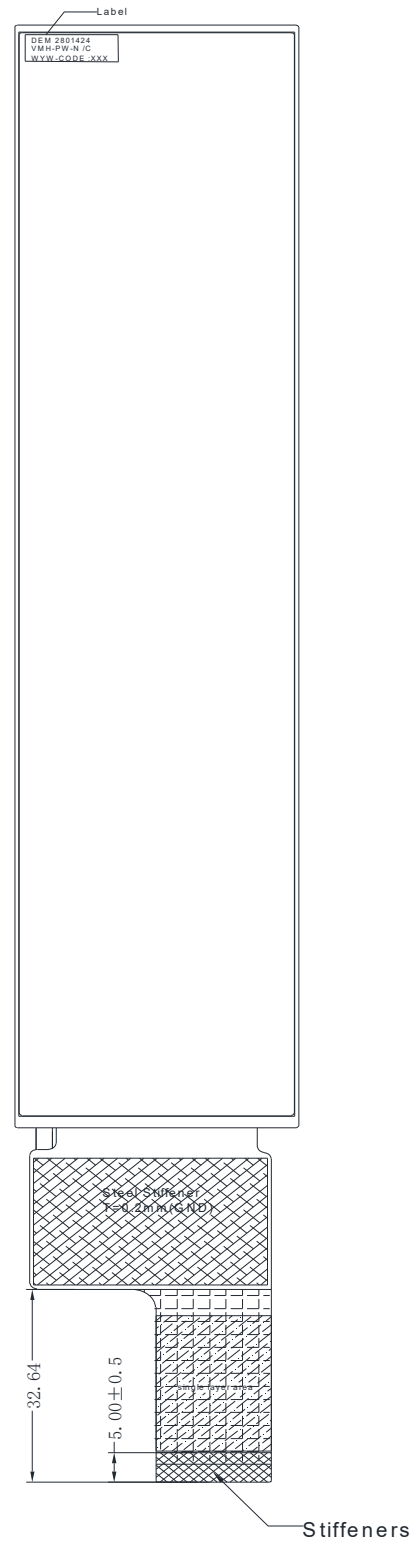
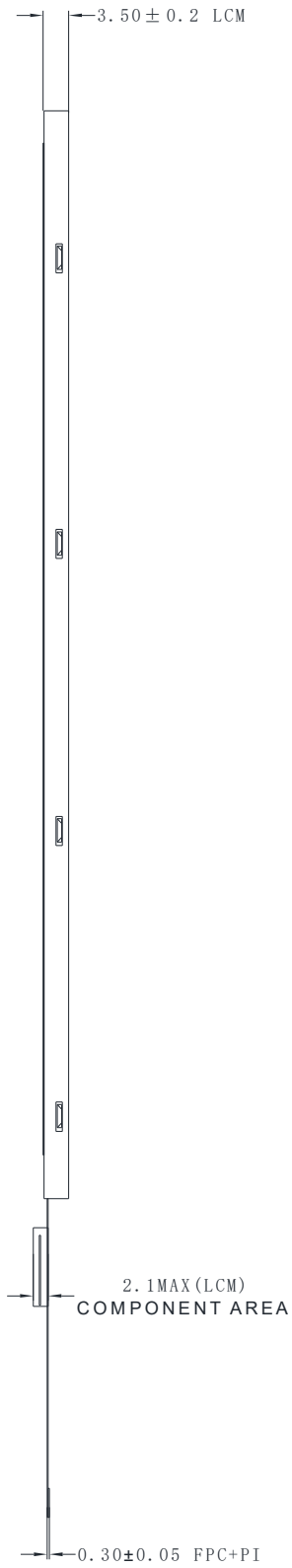
8. Mechanical Drawing

Front view



Side view

Rear view



## **9. TFT-LCD Module Inspection Criteria**

### **9.1 Scope**

The incoming inspection standards shall be applied to TFT - LCD Modules (hereinafter Called "Modules") that supplied by DISPLAY Elektronik GmbH.

### **9.2 Incoming Inspection**

The customer shall inspect the modules within twenty calendar days of the delivery date (the "inspection period") at its own cost. The result of the inspection (acceptance or rejection) shall be recorded in writing, and a copy of this writing will be promptly sent to The seller, If the results of the inspecting from buyer does not send to the seller within twenty Calendar days of the delivery date. The modules shall be regards as acceptance. Should the customer fail to notify the seller within the inspection period, the buyers Right to reject the modules shall be lapsed and the modules shall be deemed to have Been accepted by the buyer

### **9.3 Inspection Sampling**

- 3.1. Lot size: Quantity per shipment lot per model
- 3.2. Sampling type: Normal inspection, Single sampling
- 3.3. Inspection level: II
- 3.4. Sampling table: MIL-STD-105E
- 3.5. Acceptable quality level (AQL )  
Major defect: AQL=0.65 Minor defect: AQL=1.00

### **9.4 Inspection Conditions**

4.1 Ambient conditions:

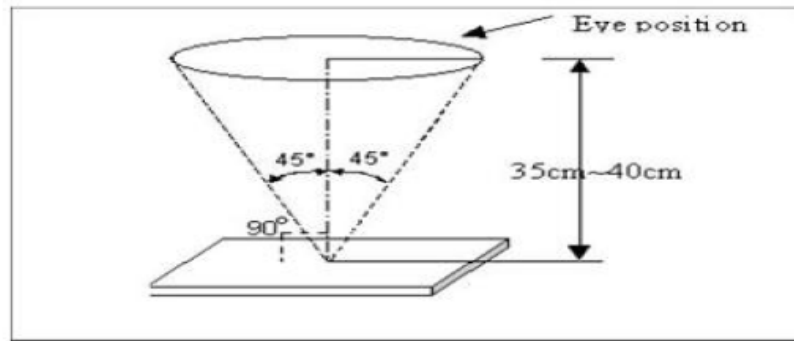
- a. Temperature: Room temperature  $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$
- b. Humidity:  $(60 \pm 10) \%RH$
- c. Illumination: Single fluorescent lamp non-directive (300 to 700 Lux)

4.2 Viewing distance

The distance between the LCD and the inspector's eyes shall be at least  $35 \pm 5$  cm.

4.3 Viewing Angle

U/D:  $45^{\circ} / 45^{\circ}$  , L/R:  $45^{\circ} / 45^{\circ}$



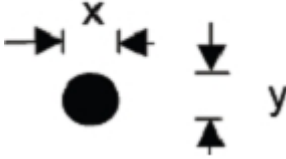
**9.5 Inspection Criteria**

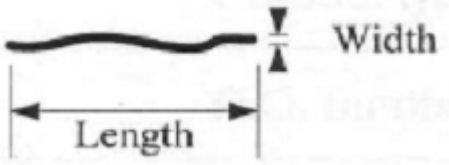
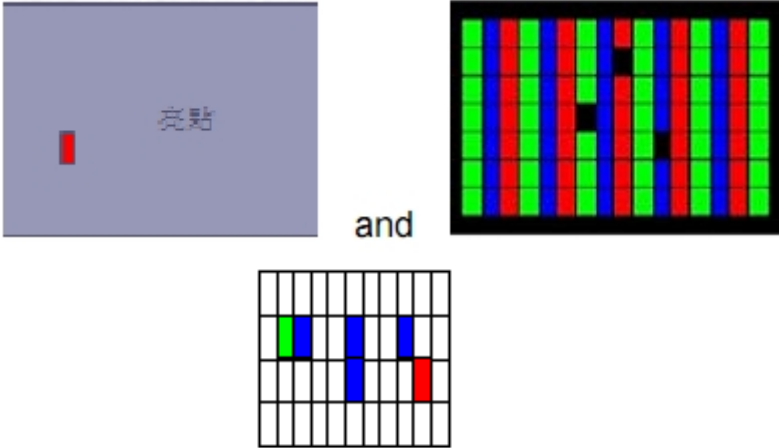
Defects are classified as major defects and minor defects according to the degree of Defectiveness defined herein.

**9.5.1 Major defect**

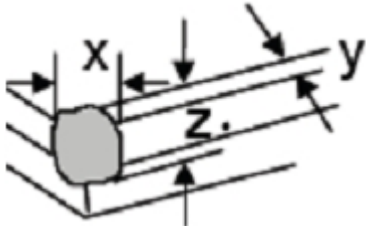
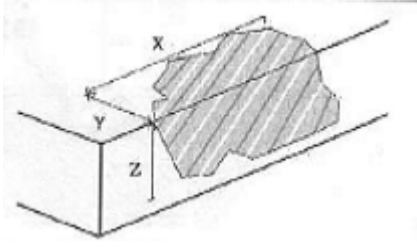
Item No	Items to be inspected	Inspection Standard
5.1.1	All functional defects	1) No display 2) Display abnormally 3) Short circuit 4) line defect
5.1.2	Missing	Missing function component
5.1.3	Crack	Glass Crack

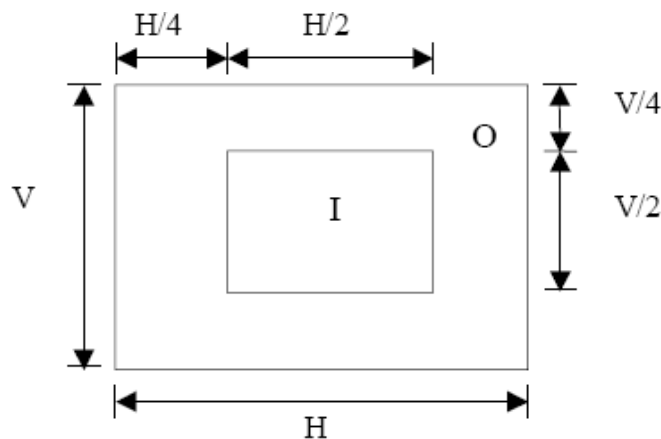
**9.5.2 Minor defect**

Item No	Items to be inspected	Inspection standard	
5.2.1	Spot Defect Including Black spot White spot Pinhole Foreign particle Polarizer dirt	For dark/white spot is defined $\phi = (x+y) / 2$ 	
		Size $\phi$ (mm)	Acceptable Quantity
		$\phi \leq 0.2$	Ignore
		$0.2 < \phi \leq 0.35$	3
		$0.35 < \phi$	Not allowed

5.2.2	Line Defect Including Black line White line Scratch	Define: 				
		Width(mm) Length(mm)		Acceptable Quantity		
		$W \leq 0.03$		Ignore		
		$0.03 < W \leq 0.04$ $L \leq 5.0$		4		
		$0.04 < W$ , or $L > 5.0$		Not allowed		
5.2.3	Polarizer Dent/Bubble	Size $\phi$ (mm)		Acceptable Quantity		
		$\phi \leq 0.25$		Ignore		
		$0.25 < \phi \leq 0.5$		3		
		$0.35 < \phi$		Not allowed		
		Total QTY		3		
5.2.4	Electrical Dot Defect	Bright and Black dot define: 				
		Two Adjacent Dot				
		Inspection pattern: Full white、 Full black、 Red、 green and blue screens				
		Item		Acceptable Quantity		
				I	O	Total
		Black dot defect		2	3	4
Bright dot defect		0	3	3		
Total Dot		2	4	5		
3% Bright Dot is allowed						



5.2.5	Glass defect		
		<b>1. Corner Fragment:</b>	
		<b>Size(mm)</b>	<b>Acceptable Quantity</b>
		$X \leq 3\text{mm}$ $Y \leq 1\text{mm}$ $Z \leq T$	Ignore T: Glass thickness X: Length Y: Width Z: thickness
			
		<b>2. Side Fragment:</b>	
<b>Size(mm)</b>	<b>Acceptable Quantity</b>		
$X \leq 5.0\text{mm}$ $Y \leq 1\text{mm}$ $Z \leq T$	T: Glass thickness X: Length Y: Width Z: thickness		



**I area & O area**

- 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 two bright dot defects (red, green, blue, and white) should be larger than 15mm.
  - 3). The distance between black dot defects or black and bright dot defects should be more than 5mm apart.

- 4). 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.

## **9.6 Mechanics specification**

As for the outside dimension, weight of the modules, please refer to product specification  
For more details

## **10. Precautions for Use of LCD modules**

### **10.1 Handling Precautions**

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

10.1.2. 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.

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

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

10.1.5. 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
- Ketene

10.1.6. Do not attempt to disassemble the LCD Module.

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

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

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

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

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

10.1.8.4. 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.

### **10.2 Storage Precautions**

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

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

Temperature : 0℃ ~ 40℃      Relatively humidity: ≤80%

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

### **10.3 Transportation Precautions**

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