





## Product Specification

**RECORDS OF REVISIONS**

Revision No	Date	Page	DESCRIPTION
0.0	Apr. 27, 2001	-	First Draft
1.0	Jul. 31, 2001	-	Second Draft (Fixed values)
1.1	Oct. 10, 2001	22	Backlight bar-cord added
		27	9.6 Handling precautions revised (The protection film is attached to the bezel...)

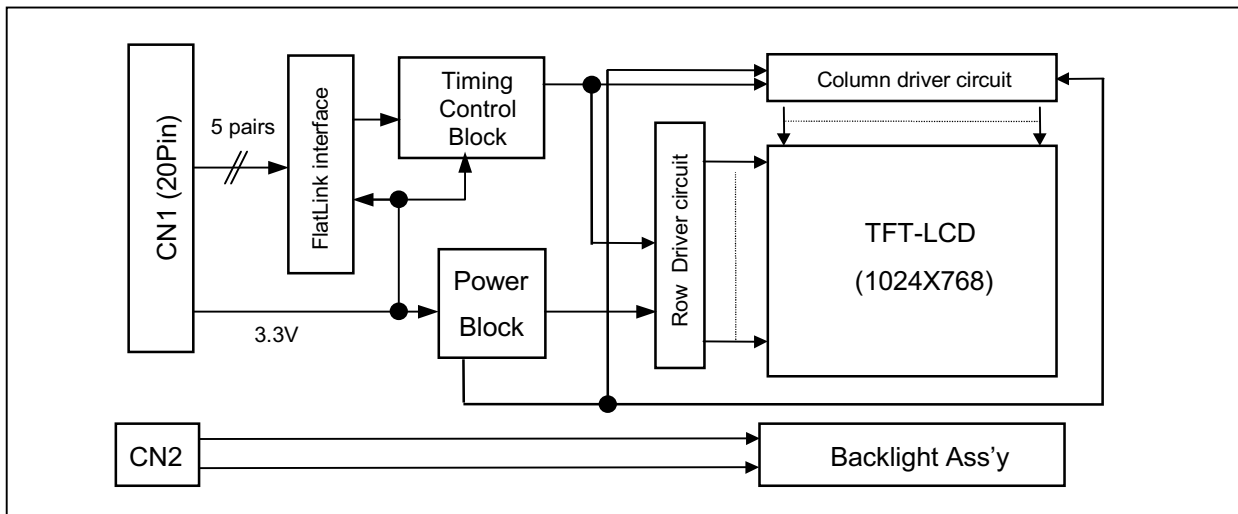
**Product Specification**

**1. General Description**

The LM150X05-C3 is a Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Fluorescent Lamp(CCFL) backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally white mode. This TFT-LCD has a 15.0 inches diagonally measured active display area with XGA resolution(768 vertical by 1024 horizontal pixel array). Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 6-bit gray scale signal for each dot, thus, presenting a palette of more than 16M colors.

The LM150X05-C3 has been designed to apply the LVDS(8-bit,1-port) interface method.

The LM150X05-C3 LCD is intended to support applications where high brightness, wide viewing angle, high color saturation, and high color depth are very important. In combination with the vertical arrangement of the sub-pixels, the LM150X05-C3 characteristics provide an excellent flat panel display for office automation products such as monitors.



[ figure 1 ] Block diagram

**General Features**

Active screen size	15.0 inches(304.1 x 228.1) diagonal
Outline Dimension	331.3(H) × 257.9(V) × 11.0(D) mm (Typ)
Pixel Pitch	0.297 mm x 0.297mm
Pixel format	1024 horiz. By 768 vert. Pixels RGB stripes arrangement
Color depth	8-bit(With FRC), 16M colors
Luminance, white	200 cd/m <sup>2</sup> (Typ.)
Power Consumption	Total 9.2 Watt(Typ.)
Weight	1030g (Typ)
Display operating mode	Transmissive mode, normally white
Surface treatments	Hard coating(3H) Anti-glare treatment of the front polarizer







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**3-2. Interface Connections**

This LCM has three interface connections, a 20 pin connector is used for the module electronics and, two three pin connectors are used for the integral back light system.

The interface pin configuration for the connector is shown in the table below.

LCD Connector :DF19K-20P-1H(Hirose Electric Co.,Ltd.)

Mating Connector : DF19G-20S-1C(Hirose Electric Co.,Ltd.)

**Table 3. MODULE CONNECTOR PIN CONFIGURATION**

Pin	Symbol	Description	Notes
1	Vcc	3.3V(typical)	<b>Interface chips</b> LCD : THC63LVDF84A System : DS90C385 or SN75LVDS83 or TH63LVDM83A  *Pin to Pin compatible with TI and Thine *Pin assign is shown in the Table 4.  Caution : NS LVDS Tx has unstable current by the change screen pattern.
2	Vcc	3.3V(typical)	
3	GND	GND	
4	GND	GND	
5	Rx0-	LVDS signal(-)	
6	Rx0+	LVDS signal(+)	
7	GND	GND	
8	Rx1-	LVDS signal(-)	
9	Rx1+	LVDS signal(+)	
10	GND	GND	
11	Rx2-	LVDS signal(-)	
12	Rx2+	LVDS signal(+)	
13	GND	GND	
14	RxC-	LVDS signal(-)	
15	RxC+	LVDS signal(+)	
16	GND	GND	
17	Rx3-	LVDS signal(-)	
18	Rx3+	LVDS signal(+)	
19	GND	GND	
20	NC	No Connection	

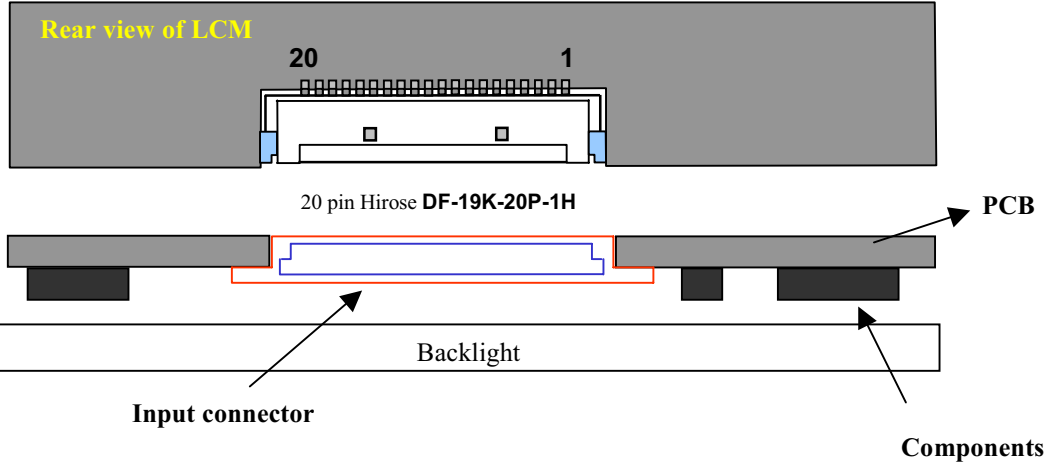
Note 1. All GND(ground) pins should be connected together and to Vss which should also be connected to the LCD's metal frame.

2. All Vcc(power input) pins should be connected together.





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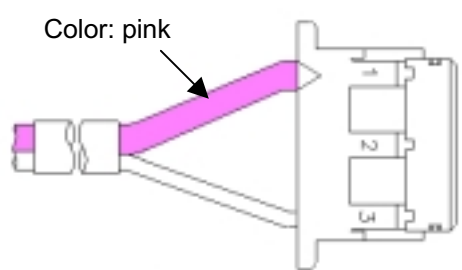
[ figure 4 ] Connector diagram

The backlight interface connector is a model BHR-03VS-1, manufactured by JST. The mating connector part number is SM02(8.0)B-BHS-1-TB or equivalent. The pin configuration for the connector is shown in the table 5.

Table 5. BACKLIGHT CONNECTOR PIN CONFIGURATION

Pin	Symbol	Description	Notes
1	HV	Power supply for lamp (High voltage side)	1
2	NC	No Connect	
3	LV	Power supply for lamp (Low voltage side)	

Notes : 1. The high voltage side terminal is colored pink.



[ figure 5 ] Backlight connector view

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**3-3. Signal Timing Specifications**

This is the signal timing required at the input of the LVDS Transmitter. All of the interface signal timing should be satisfied with the following specifications for its proper operation.

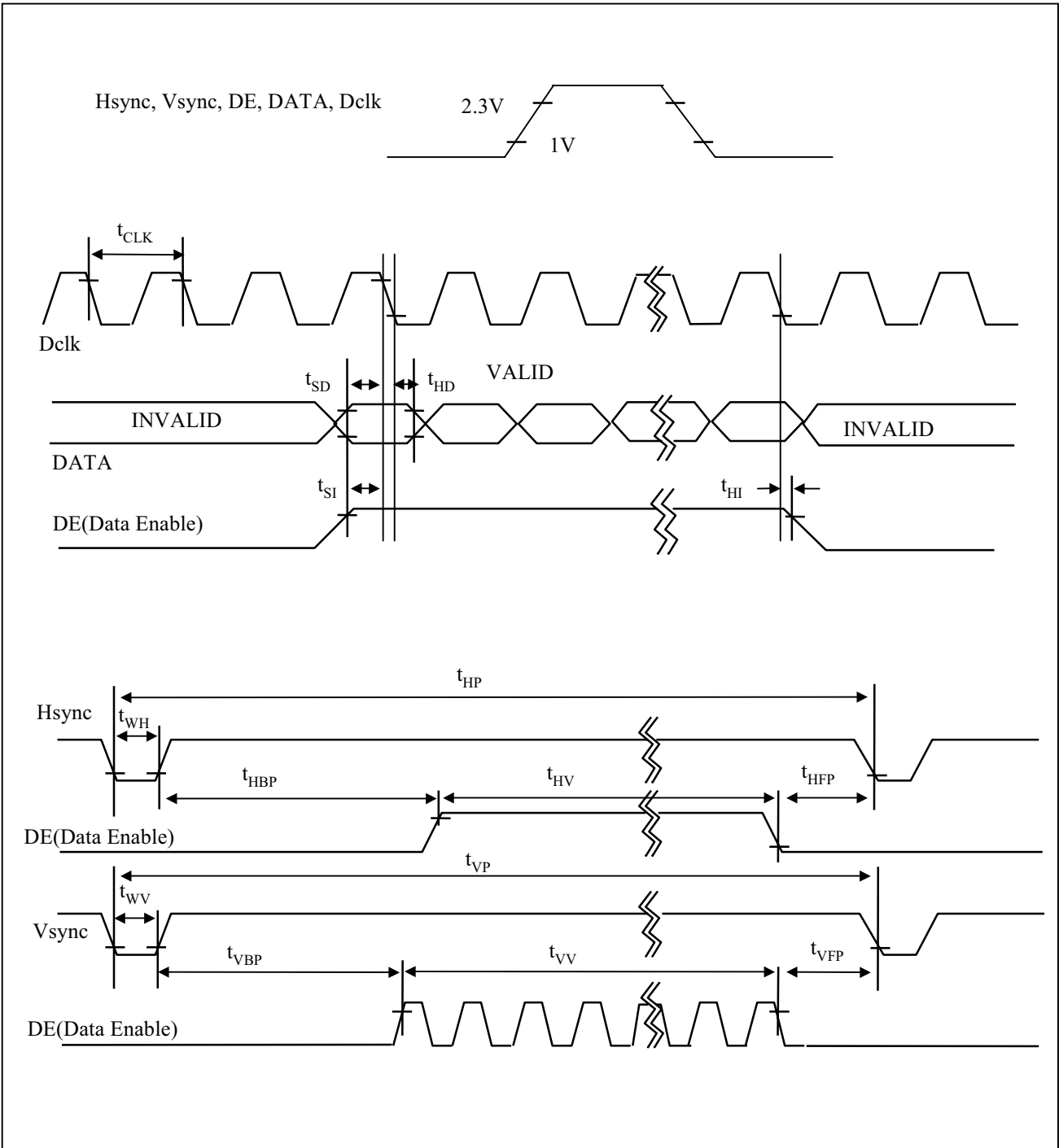
**Table 6. Timing Table**

Parameter		Symbol	Min.	Typ.	Max.	Unit	Notes		
Dclk	Period	$t_{CLK}$	14.29	15.4	20	ns			
	Frequency	$f_{CLK}$	50	65	70	MHz			
Hsync	Period	$t_{HP}$	1208	1344	1360	$t_{CLK}$			
	Width	$t_{WH}$	16	136	240				
Vsync	Period	$t_{VP}$	780	806	830	$t_{HP}$			
	Frequency	$f_V$	50	60	75	Hz			
	Width	$t_{WV}$	2	6	24	$t_{HP}$			
DE (Data Enable)	Horizontal Valid	$t_{HV}$	1024	1024	1024	$t_{CLK}$			
	Horizontal Back Porch	$t_{HBP}$	16	24	-				
	Horizontal Front Porch	$t_{HFP}$	24	160	-				
	Horizontal Blank	-	56	320	$t_{HP} - t_{HV}$		$t_{WH} + t_{HBP} + t_{HFP}$		
	Vertical Valid	$t_{VV}$	768	768	768	$t_{HP}$			
	Vertical Back Porch	$t_{VBP}$	2	29	-				
	Vertical Front Porch	$t_{VFP}$	1	3	-				
	Vertical Blank	-	5	38	$t_{VP} - t_{VV}$		$t_{WV} + t_{VBP} + t_{VFP}$		
	Data	Set up time	$t_{SI}$	3	-	-	ns	For Dclk	
Hold time		$t_{HI}$	3	-	-				
Data	Set up time	$t_{SD}$	3	-	-				
	Hold time	$t_{HD}$	3	-	-				

Notes : 1. Do not change the period of Hsync during Vertical Back Porch and Valid, because LCM inner control signals are made by the Hsync.

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3-4. Signal Timing Waveforms



[ figure 6 ] Signal Timing Waveforms

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### 3-5. Color Input Data Reference

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 below provides a reference for color versus data input.

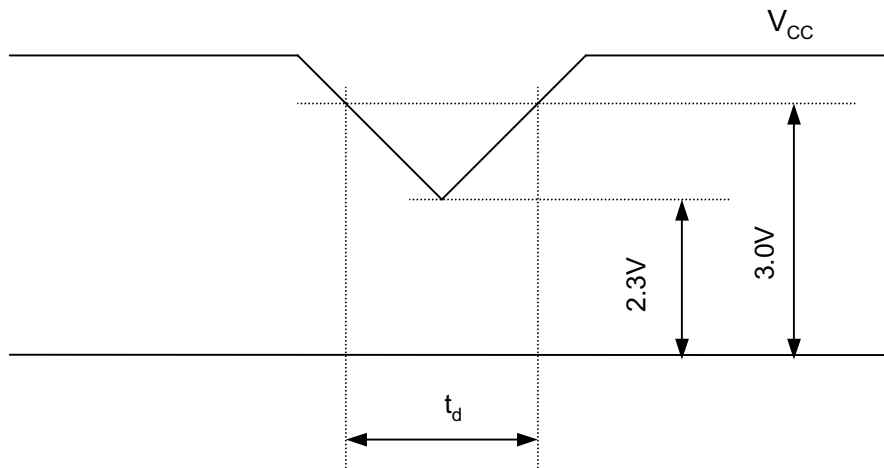
**Table 7. COLOR DATA REFERENCE**

Color	Input Color Data																							
	Red								Green								Blue							
	MSB				LSB				MSB				LSB				MSB				LSB			
	R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
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(255)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(255)	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	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	1
	Cyan	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	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
Red	Red(000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red(001)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red(002)	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) Bright	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Green	Green(000)Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Green(001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
	Green(002)	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	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	
	Green(254)	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	
	Green(255)Bright	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	
Blue	Blue(000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Blue(001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
	Blue(002)	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) Bright	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	



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**3-7. V<sub>CC</sub> Power Dip Condition**



**[ figure 8 ] Power Dip condition**

1) Dip condition

$$2.3V \leq V_{CC} < 3.0V, t_d \leq 20ms$$

2)  $V_{CC} < 2.3V$

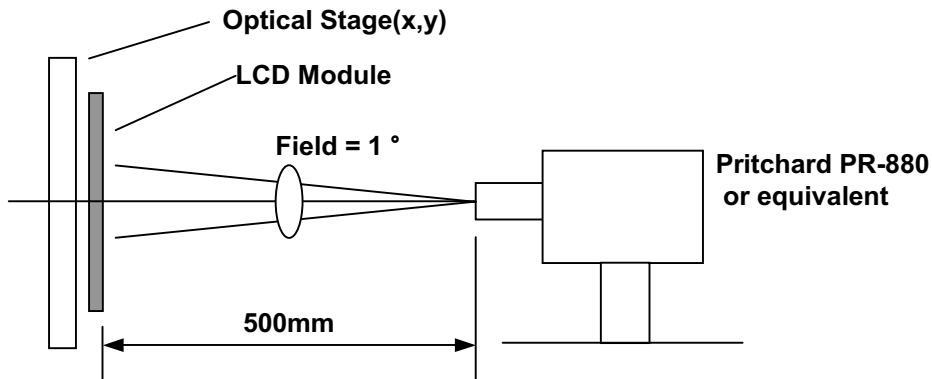
$V_{CC}$ -dip conditions should also follow the Power On/Off conditions for supply voltage.

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### 4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25 °C. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of  $\Phi$  and  $\theta$  equal to 0 °.

[ Figure 9 ] presents additional information concerning the measurement equipment and method.



[Figure 9] Optical Characteristic Measurement Equipment and Method

(Ta=25 °C, V<sub>CC</sub>=3.3V, f<sub>V</sub>=60Hz  
Dclk=65MHz, I<sub>BL</sub>=8mA)

Table 9. OPTICAL CHARACTERISTICS

Parameter	Symbol	Values			Units	Notes
		Min.	Typ.	Max.		
Contrast Ratio	CR	200	300	-		1
Surface Luminance, white	L <sub>WH</sub>	170	200	-	cd/m <sup>2</sup>	2
Luminance Variation	$\delta_{\text{WHITE}}$	-	-	1.3		3
Response Time	Tr		30	50	ms	4
Rise Time	Tr <sub>R</sub>	-	10	15		
Decay Time	Tr <sub>D</sub>	-	20	35		
CIE Color Coordinates						
Red	XR	0.596	0.626	0.656		
	YR	0.317	0.347	0.377		
Green	XG	0.278	0.308	0.338		
	YG	0.558	0.588	0.618		
Blue	XB	0.116	0.146	0.176		
	YB	0.089	0.119	0.149		
White	XW	0.283	0.313	0.343		
	YW	0.299	0.329	0.359		
Viewing Angle					degree	5
x axis, right( $\phi=0^\circ$ )	$\theta_r$	55	60	-		
x axis, left ( $\phi=180^\circ$ )	$\theta_l$	55	60	-		
y axis, up ( $\phi=90^\circ$ )	$\theta_u$	40	45	-		
y axis, down ( $\phi=270^\circ$ )	$\theta_d$	40	45	-		
Gray Scale		-	2.2	-		6
Flicker		-	-	-20	dB	7



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Notes : 1. Contrast Ratio(CR) is defined mathematically as :

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

2. Surface luminance is the center point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see [ Figure 10 ].  
When  $I_{BL}=8\text{mA}$ ,  $L_{WH}=170\text{cd/m}^2(\text{Min.})$   $200\text{cd/m}^2(\text{Typ.})$

3. The variation in surface luminance,  $\delta \text{ WHITE}$  is determined by measuring  $L_{ON}$  at each test position 1 through 5, and then dividing the maximum  $L_{ON}$  of 5 points luminance by minimum  $L_{ON}$  of 5 points luminance. For more information see [ Figure 10 ].

$$\delta \text{ WHITE} = \text{Maximum}(L_{ON1}, L_{ON2}, \dots, L_{ON5}) \div \text{Minimum}(L_{ON1}, L_{ON2}, \dots, L_{ON5})$$

4. Response time is the time required for the display to transition from to black(Rise Time,  $Tr_R$ ) and from black to white(Decay Time,  $Tr_D$ ). For additional information see [ Figure 11 ].

5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see [ Figure 12 ].

6. Gray scale specification

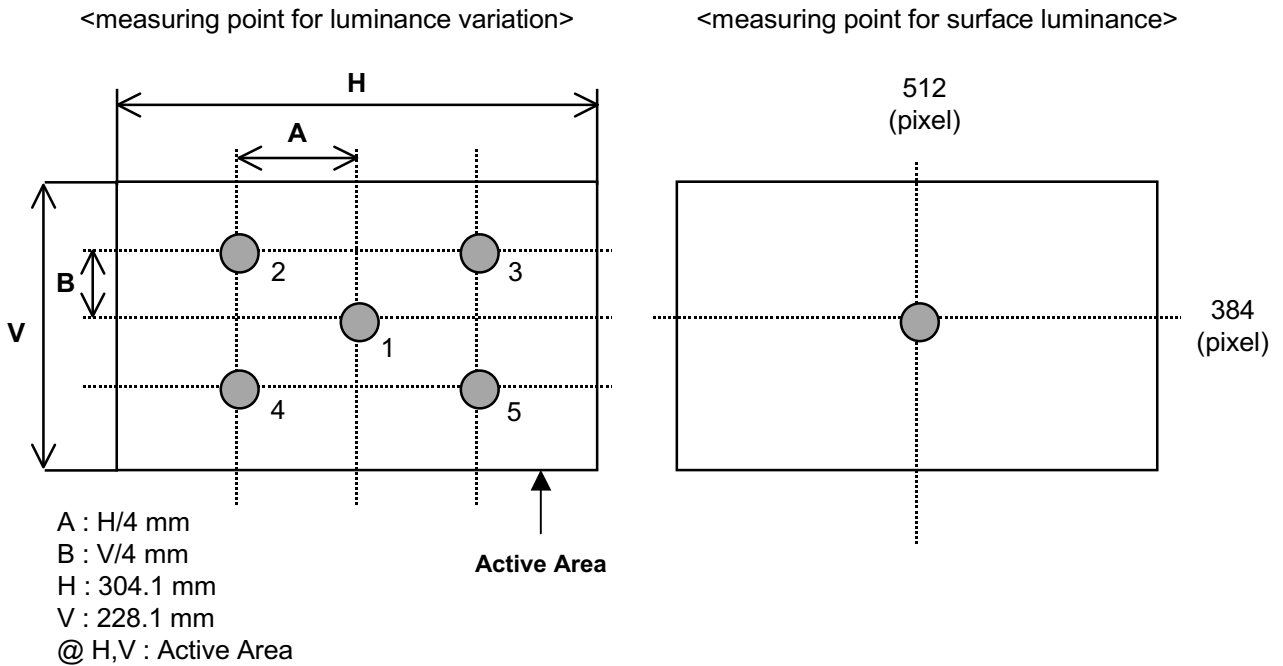
**Table 10. GRAY SCALE**

<b>Gray Level</b>	<b>Luminance(%) (Typ.)</b>
L000	0.22
L031	0.81
L063	4.29
L095	11.4
L127	22.1
L159	36.4
L191	55.4
L223	78.0
L255	100

7. Flicker is measured at cyan dot pattern of Forground RGB(0,0,0) and Background RGB(0,127,127).

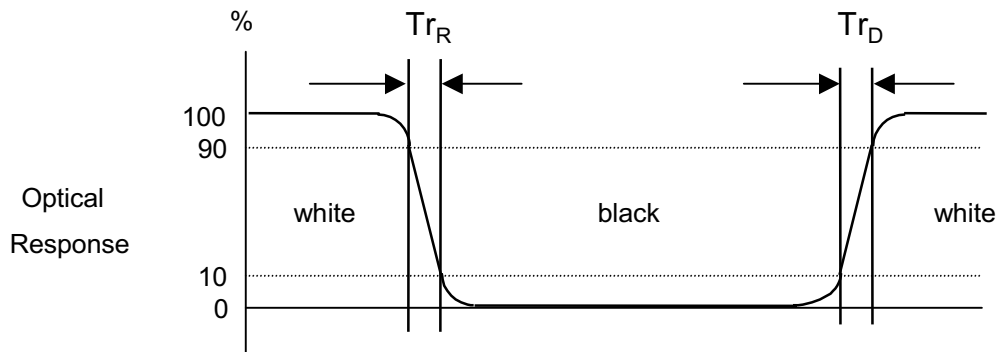
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[ Figure 10 ] Luminance measuring point



[ Figure 11 ] Response Time

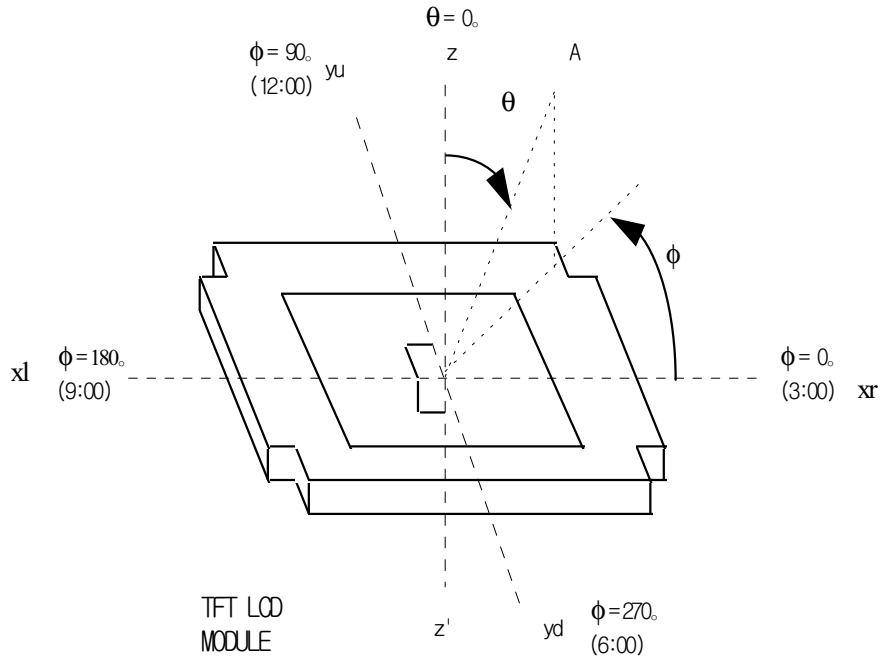
The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



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**[ Figure 12 ] Viewing angle**

<dimension of viewing angle range>



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**5. Mechanical Characteristics**

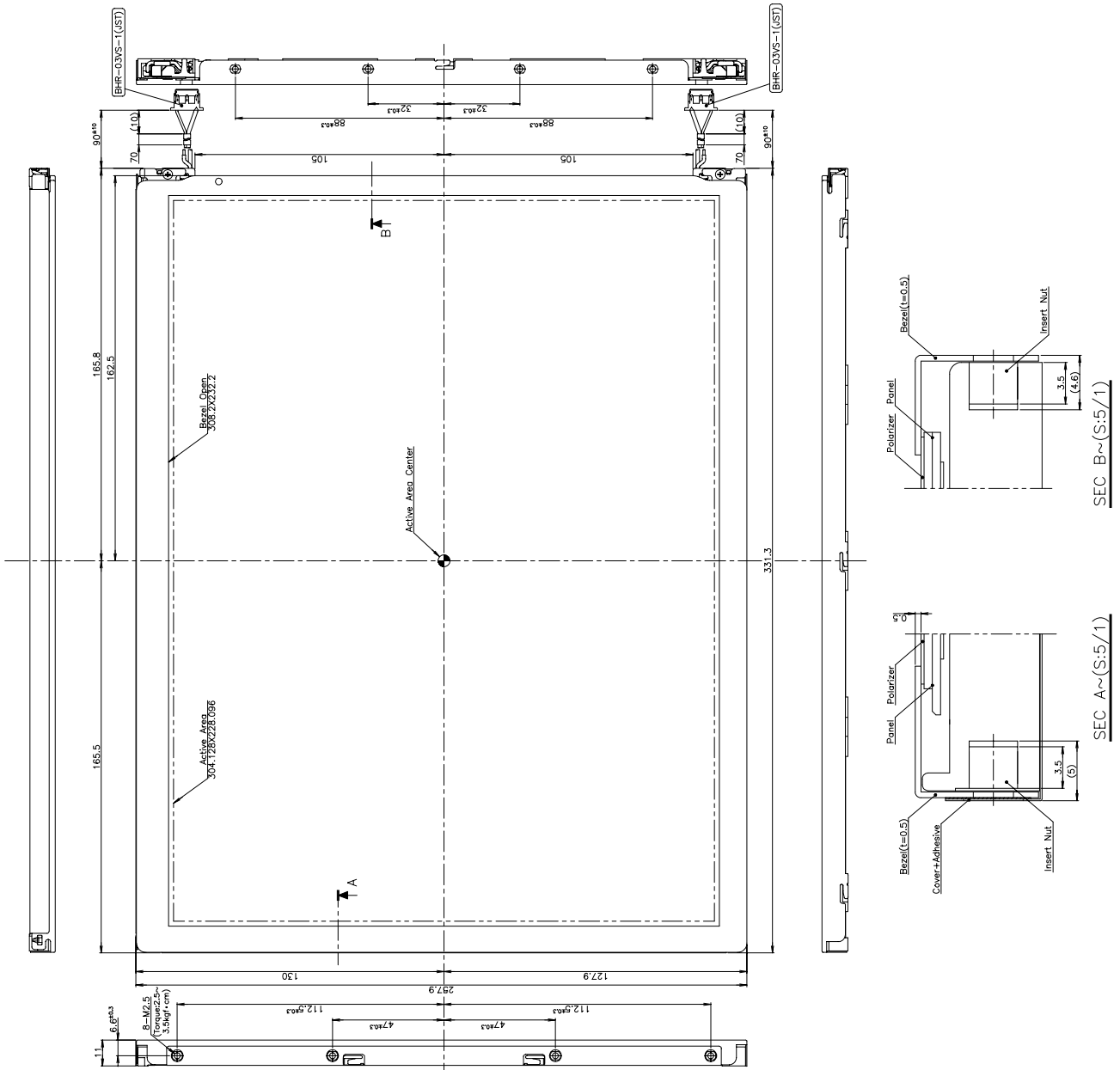
The contents provide general mechanical characteristics for the model LM150X05-C3. In addition, the figures in the next page are detailed mechanical drawing of the LCD.

**Table 11. MECHANICAL CHARACTERISTICS**

Outside dimensions	Horizontal	331.3 ± 0.5 m
	Vertical	257.9 ± 0.5 mm
	Depth	11.0 ± 0.5 mm
Bezel area	Horizontal	308.2 ± 0.5 mm
	Vertical	232.2 ± 0.5 mm
Active display area	Horizontal	304.128 mm
	Vertical	228.096 mm
Weight	1030g(Typ.)	
Surface Treatment	Hard coating 3H. Anti-glare, LR coating treatment of the front polarizer.	

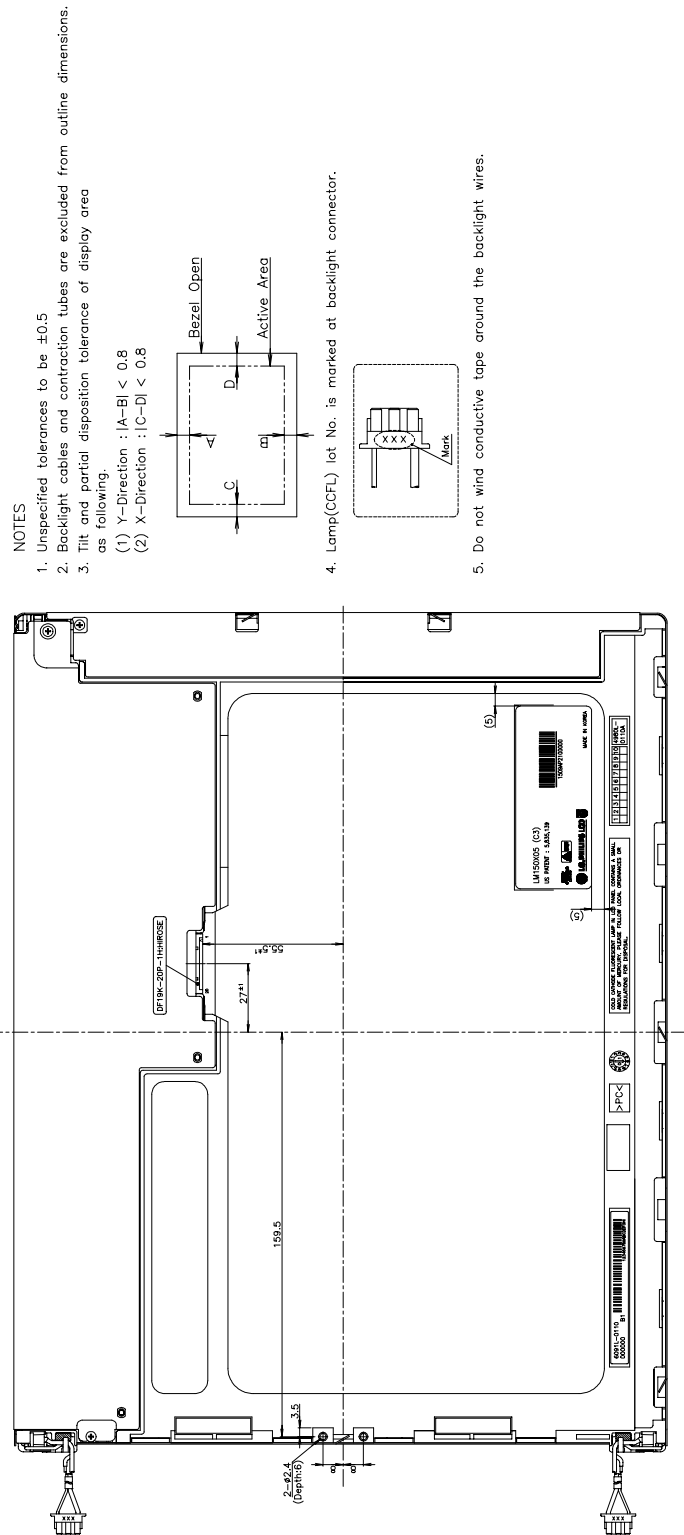
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[ Figure 13 ] LM150X05 Front View



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**[ Figure 14 ] LM150X05 Rear View**



**NOTES**

1. Unspecified tolerances to be  $\pm 0.5$
2. Backlight cables and contraction tubes are excluded from outline dimensions.
3. Tilt and partial disposition tolerance of display area as following.

- (1) Y-Direction : |A-B| < 0.8
- (2) X-Direction : |C-D| < 0.8

4. Lamp (CCFL) lot No. is marked at backlight connector.

5. Do not wind conductive tape around the backlight wires.

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**6. Reliability**

**Table 12. ENVIRONMENT TEST CONDITION**

No.	Test Item	Conditions
1	High temperature storage test	Ta= 60°C 240h
2	Low temperature storage test	Ta= -20°C 240h
3	High temperature operation test	Ta= 50°C 50%RH 240h
4	Low temperature operation test	Ta= 0°C 240h
5	Humidity Condition operation	10%RH ~ 90%RH
6	Humidity Condition storage	10%RH ~ 90%RH
7	Vibration test (non-operating)	Wave form : random Vibration level : 1.0G RMS Bandwidth : 10-500Hz Duration : X,Y,Z, 20 min One time each direction
8	Shock test (non-operating)	Shock level : 120G Waveform : half sine wave, 2ms Direction : ±X, ±Y, ±Z One time each direction
9	Altitude storage / shipment	0 - 40,000 feet(12,192m)

{ Result Evaluation Criteria }

There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

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## 7. International Standards

### 7-1. Safety

- a) UL 1950 Third Edition, Underwriters Laboratories, Inc. Jan. 28, 1995.  
Standard for Safety of Information Technology Equipment Including Electrical Business Equipment.
- b) CAN/CSA C22.2 No. 950-95 Third Edition, Canadian Standards Association, Jan. 28, 1995.  
Standard for Safety of Information Technology Equipment Including Electrical Business Equipment.
- c) EN 60950 : 1992+A1: 1993+A2: 1993+A3: 1995+A4: 1997+A11: 1997  
IEC 950 : 1991+A1: 1992+A2: 1993+A3: 1995+A4: 1996  
European Committee for Electrotechnical Standardization(CENELEC)  
EUROPEAN STANDARD for Safety of Information Technology Equipment Including Electrical  
Business Equipment.

### 7-2. EMC

- a) ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHz to 40GHz." American National Standards Institute(ANSI), 1992
- b) C.I.S.P.R "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." International Special Committee on Radio Interference
- c) EN 55022 "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." European Committee for Electrotechnical Standardization (CENELEC), 1998



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## 8. Packing

### 8-1. Designation of Lot Mark

a) Lot Mark

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

A,B,C : SIZE  
 D : YEAR  
 E : MONTH  
 F,G : PANEL CODE  
 H : ASSEMBLY CODE  
 I,J,K,L,M : SERIAL NO.

Note:

1. YEAR

YEAR	97	98	99	2000	2001	2002	2003	2004	2005	2006	2007
Mark	7	8	9	0	1	2	3	4	5	6	7

2. MONTH

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

3. Serial No.

Serial No.	1 ~ 99999	100000 ~
Mark	00001 ~ 99999	A0001 ~ A9999,....., Z9999

b) Location of Lot Mark

Serial NO. is printed on the label. The label is attached to the backside of the LCD module.  
 This is subject to change without prior notice.

### 8-2. Packing Form

a) Package quantity in one box : 8 pcs

b) Box Size : 344mm X 315mm X 410mm.

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## 9. PRECAUTIONS

Please pay attention to the following when you use this TFT LCD module.

### 9-1. MOUNTING PRECAUTIONS

- (1) You must mount a module using holes arranged in four corners or four sides.
- (2) You should consider the mounting structure so that uneven force(ex. Twisted stress) is not applied to the module.  
And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Please attach a transparent protective plate to the surface in order to protect the polarizer.  
Transparent protective plate should have sufficient strength in order to resist external force.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not describe because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- (6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.  
Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics are determined to the polarizer.)
- (7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.

### 9-2. OPERATING PRECAUTIONS

- (1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :  
 $V = \pm 200\text{mV}$ (Over and under shoot voltage)
- (2) Response time depends on the temperature.(In lower temperature, it becomes longer.)
- (3) Brightness depends on the temperature. (In lower temperature, it becomes lower.)  
And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer.
- (4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.

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### 9-3. ELECTROSTATIC DISCHARGE CONTROL

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

### 9-4. PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

### 9-5. STORAGE

When storing modules as spares for a long time, the following precautions are necessary.

- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (2) The polarizer surface should not come in contact with any other object.  
It is recommended that they be stored in the container in which they were shipped.

### 9-6. HANDLING PRECAUTIONS FOR PROTECTION FILM

- (1) The protection film is attached to the bezel with a small masking tape.  
When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- (2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the Bezel after the protection film is peeled off.
- (3) You can remove the glue easily. When the glue remains on the Bezel or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.