





























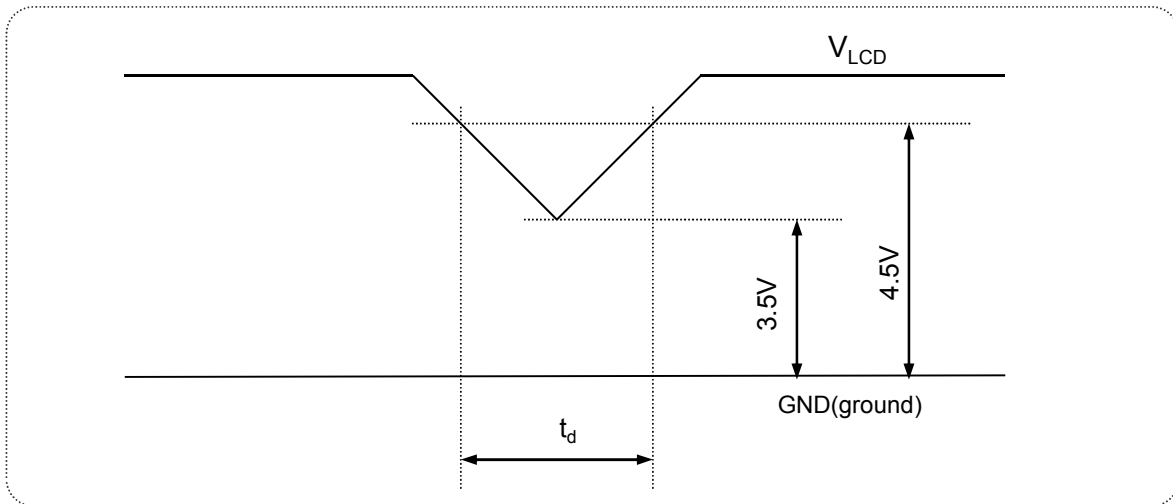






**3-8.  $V_{LCD}$  Power dip condition**

**FIG. 6 Power dip condition**



1) Dip condition

$$3.5V \leq V_{LCD} < 4.5V, t_d \leq 20ms$$

2)  $V_{LCD} < 3.5V$

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

Product Specification

4. Optical specification

Optical characteristics are determined after the unit has been 'ON' for 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°.

FIG. 7 presents additional information concerning the measurement equipment and method.

FIG. 7 Optical characteristic measurement equipment and method

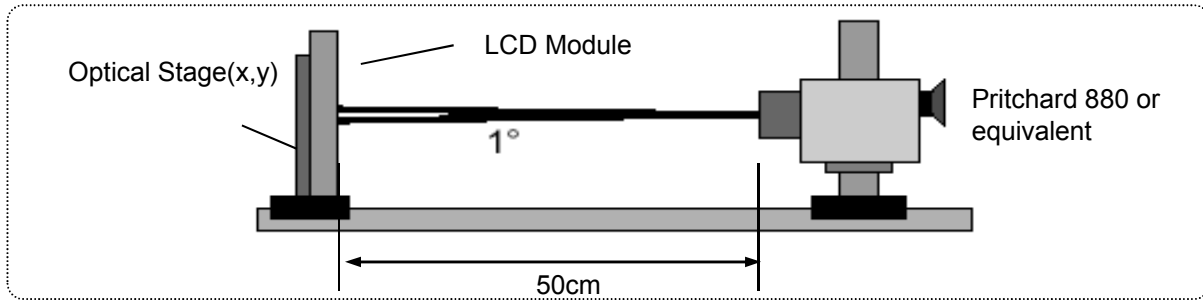


Table 10. Optical characteristics

Ta= 25°C, V<sub>LCD</sub>=5.0V, fv=60Hz f<sub>CLK</sub>=119MHz

Parameter	Symbol	Values			Units	Notes	
		Min	Typ	Max			
Contrast Ratio	CR	700	1000	-		1	
Surface Luminance, white	L <sub>WH</sub>	200	250	-	cd/m <sup>2</sup>	2	
Luminance Variation	$\delta_{\text{WHITE}}$ 9P	75			%	3	
Response Time	Rise Time	Tr <sub>R</sub>	-	1.3	2.6	ms	4
	Decay Time	Tr <sub>D</sub>	-	3.7	7.4	ms	4
Color Coordinates [CIE1931]	RED	Rx	Typ -0.03	0.633	Typ +0.03		
		Ry		0.344			
	GREEN	Gx		0.330			
		Gy		0.620			
	BLUE	Bx		0.154			
		By		0.062			
	WHITE	Wx		0.313			
Wy	0.329						
Viewing Angle (CR>5)							
	x axis, right( $\phi=0^\circ$ )	$\theta_r$	75	88		Degree	5
	x axis, left ( $\phi=180^\circ$ )	$\theta_l$	75	88			
	y axis, up ( $\phi=90^\circ$ )	$\theta_u$	70	85			
	y axis, down ( $\phi=270^\circ$ )	$\theta_d$	70	85			
Viewing Angle (CR>10)							
	x axis, right( $\phi=0^\circ$ )	$\theta_r$	70	85		Degree	5
	x axis, left ( $\phi=180^\circ$ )	$\theta_l$	70	85			
	y axis, up ( $\phi=90^\circ$ )	$\theta_u$	60	75			
	y axis, down ( $\phi=270^\circ$ )	$\theta_d$	70	85			
Crosstalk				1.5	%	8	
Luminance uniformity - Angular dependence (TCO'03)	LR	-	-	1.7		6	

**Product Specification**

Notes :

1. Contrast ratio(CR) is defined mathematically as :It is measured at center point(1)

$$\text{Contrast ratio} = \frac{\text{Surface luminance with all white pixels}}{\text{Surface luminance with all black pixels}}$$

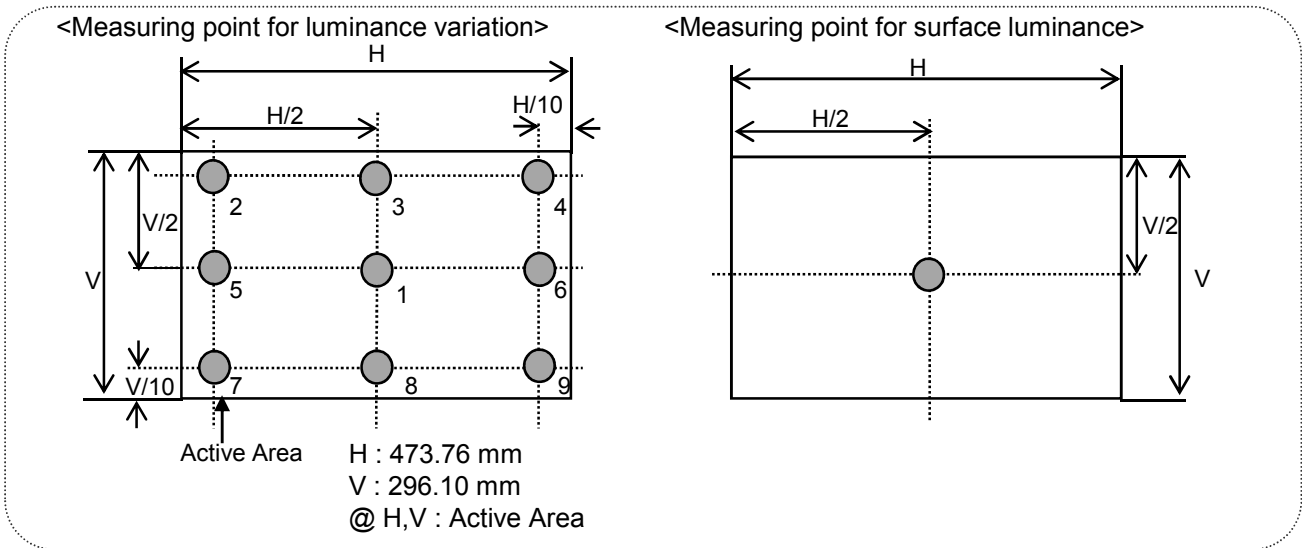
2. Surface luminance is the luminance value at center 1 point(1) across the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG 8.

3. The variation in surface luminance ,  $\delta_{\text{WHITE}}$  is defined as

$$\delta_{\text{WHITE}} = \frac{\text{Minimum (P1,P2 .....P9)}}{\text{Maximum (P1,P2 .....P9)}} * 100$$

For more information see Figure 8.

**FIG. 8 Luminance measuring point**



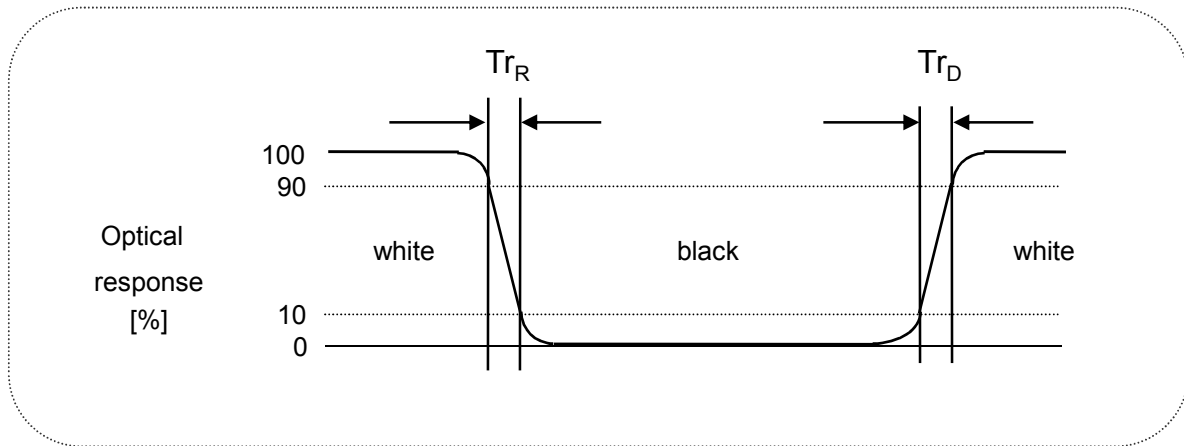
**Product Specification**

Notes :

- 4. Response time is the time required for the display to transition from black to white (Decay Time,  $T_{rD}$ ) and from white to black (Rise Time,  $T_{rR}$ )  
The sampling rate is 2,500 sample/sec. For additional information see FIG. 9.

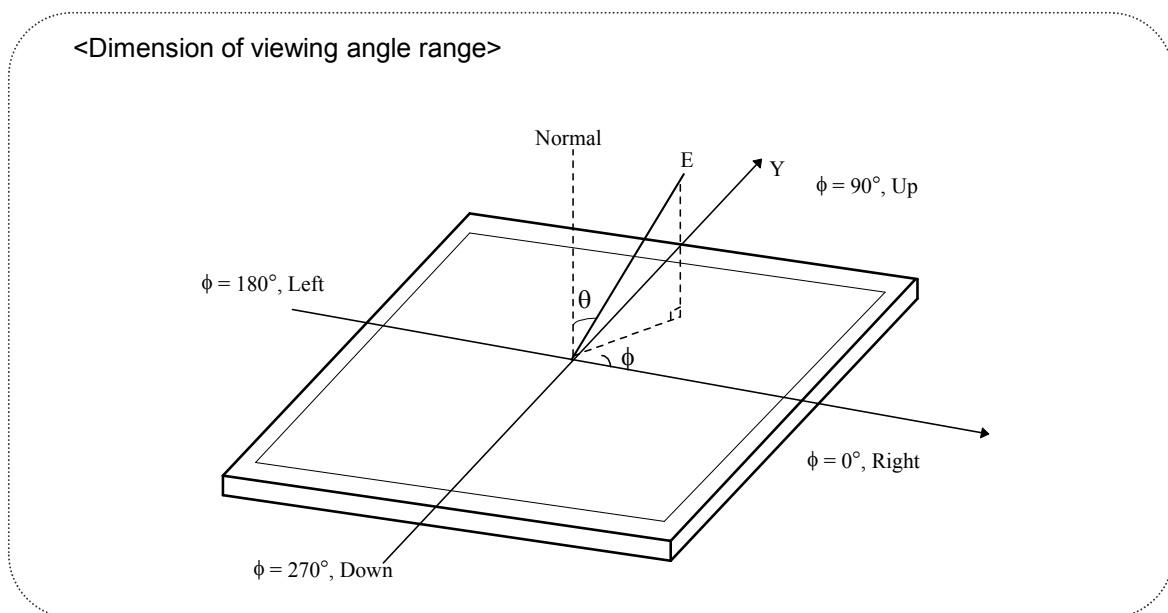
The response time is defined as the following figure and shall be measured by switching the input signal for each gray to gray.

**FIG. 9 Response time**



- 5. Viewing angle is the angle at which the contrast ratio is greater than 10 or 5. 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 FIG. 10 .

**FIG. 10 Viewing angle**



**Product Specification**

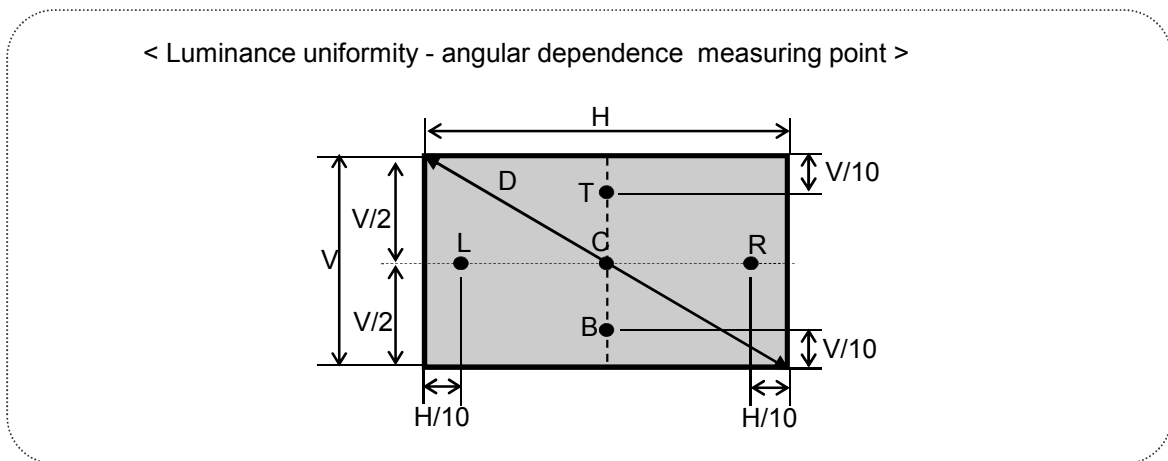
Notes :

6. Luminance Uniformity - angular – dependence (LR & TB)

TCO '03 Luminance uniformity – angular dependence, is the capacity of the VDU to present the same Luminance level independently of the viewing direction. The angular-dependent luminance uniformity is calculated as the ratio of maximum luminance to minimum luminance in the specified measurement areas.

- Test pattern : 80% white pattern
- Test point : 2-point
- Test distance :  $D * 1.5 = 83.82\text{cm}$
- Test method :  $L_R = ((L_{\text{max.}+30\text{deg.}} / L_{\text{min.}+30\text{deg.}}) + (L_{\text{max.}-30\text{deg.}} / L_{\text{min.}-30\text{deg.}})) / 2$   
 $T_B = ((L_{\text{max.}+15\text{deg.}} / L_{\text{min.}+15\text{deg.}})$

**FIG. 11 Luminance Uniformity angular dependence**



7. Gray scale specification

**Table 11. Gray scale**

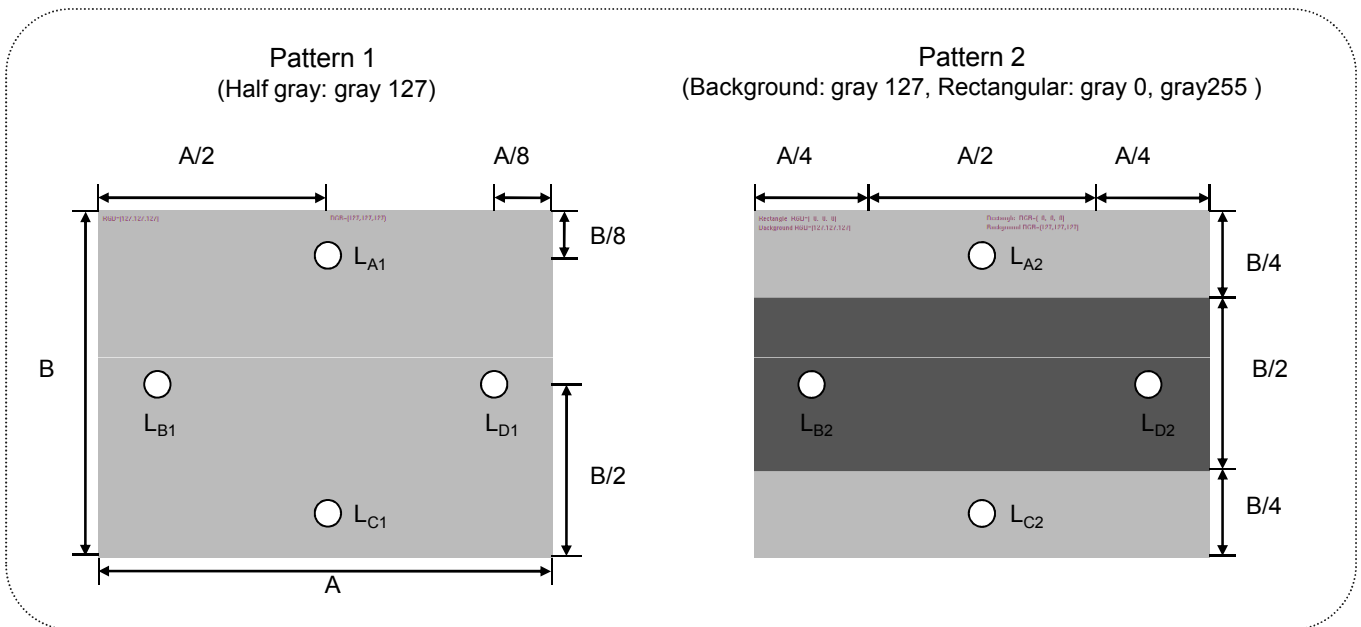
Gray level	Luminance [%] (Typ)
L0	0.14
L31	1.23
L63	4.98
L95	12.30
L127	23.58
L159	40.03
L191	61.30
L223	84.03
L255	100

**Product Specification**

Notes :

8. The equation of crosstalk :  $(|L_{A[or\ C]2} - L_{A[or\ C]1}| / L_{A[or\ C]1}) \times 100(\%)$  [Vertical],  
 $(|L_{B[or\ D]2} - L_{B[or\ D]1}| / L_{B[or\ D]1}) \times 100(\%)$  [Horizontal]

**FIG. 12 Crosstalk**



**Product Specification**

**5. Mechanical characteristics**

The contents provide general mechanical characteristics. In addition the figures in the next page are detailed mechanical drawing of the LCD.

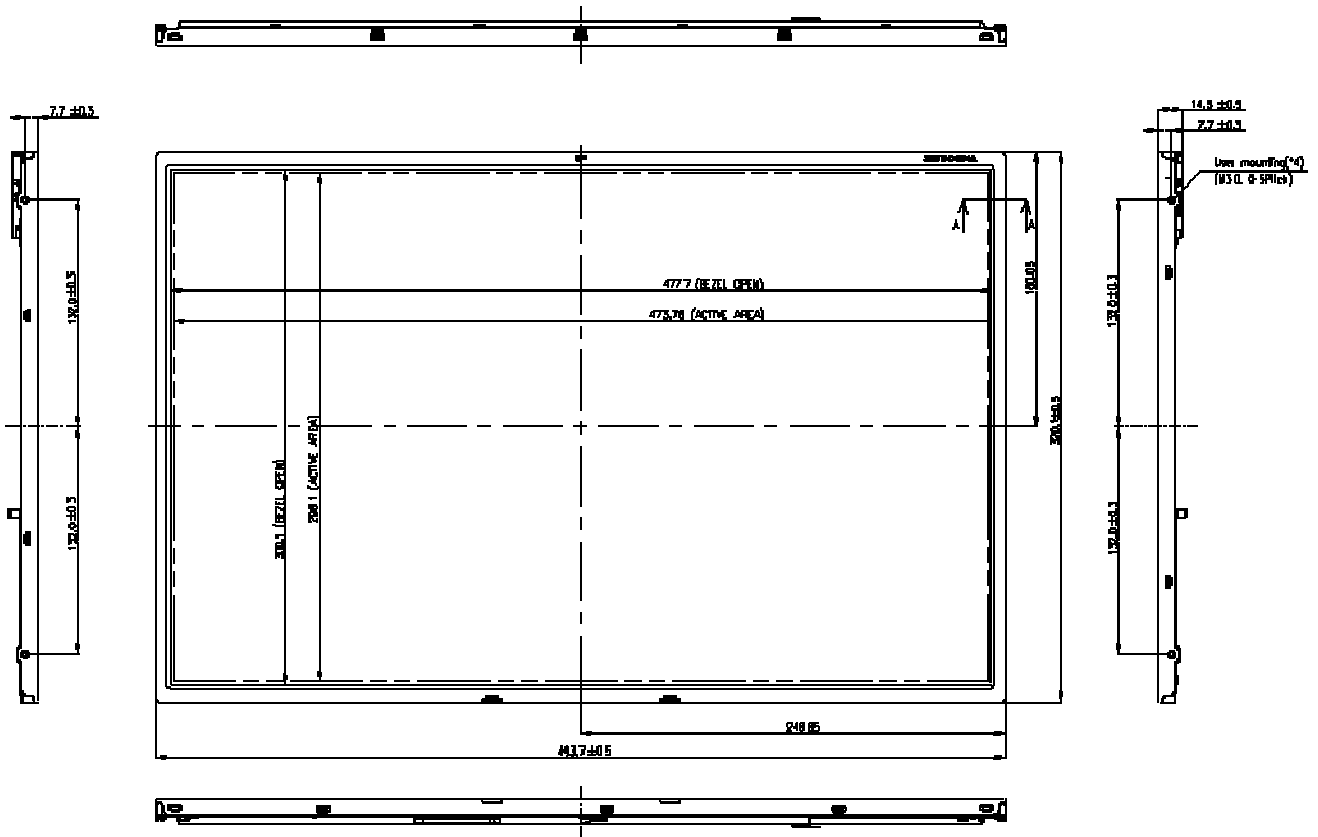
**Table 12. Mechanical characteristics**

Outline dimension	Horizontal	493.7 mm
	Vertical	320.1 mm
	Depth	14.5 mm
Bezel area	Horizontal	477.7 mm
	Vertical	300.1 mm
Active display area	Horizontal	473.76 mm
	Vertical	296.10 mm
Weight	1950g (Typ.), 2050g (Max.)	
Surface treatment	Hard coating(3H) Anti-glare treatment of the front polarizer	

Notes : Please refer to a mechanic drawing in terms of tolerance at the next page.

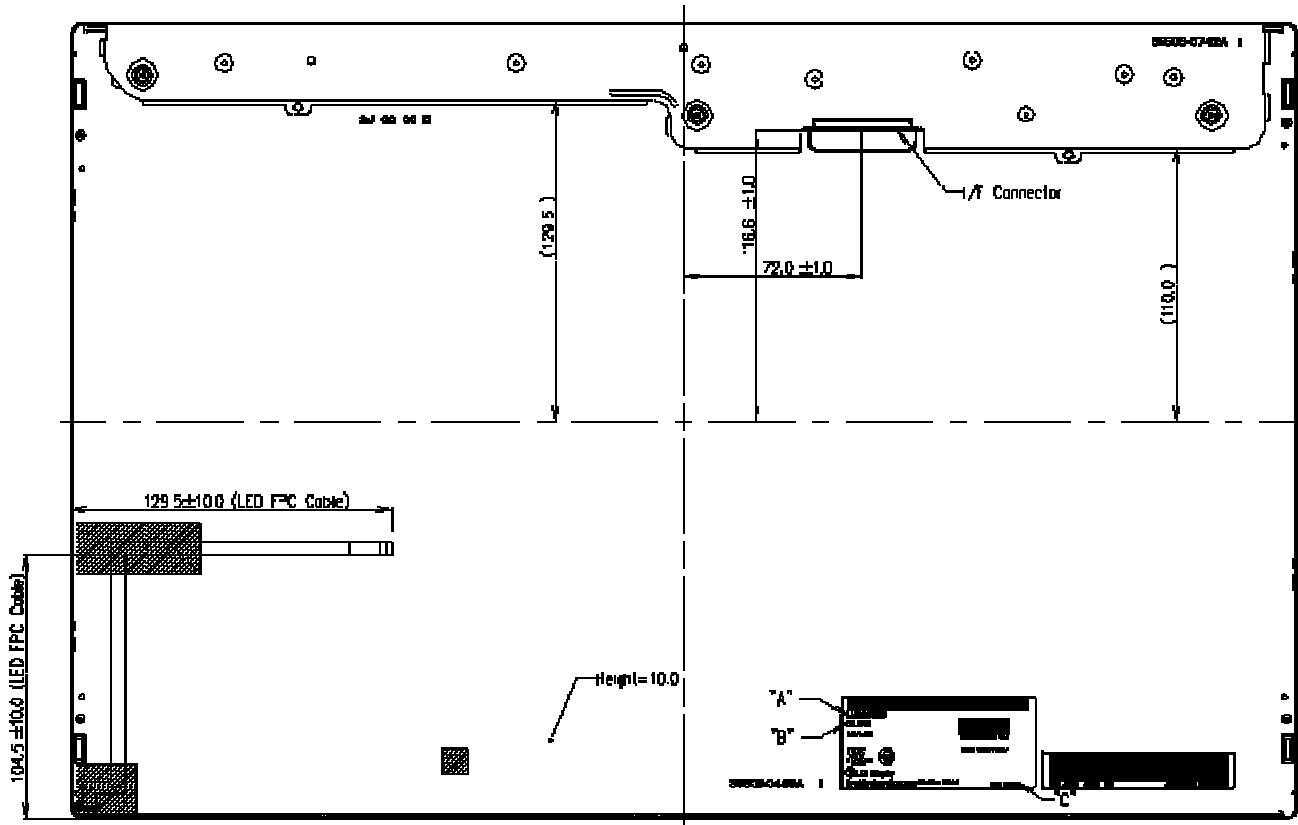
**Product Specification**

**< FRONT VIEW >**



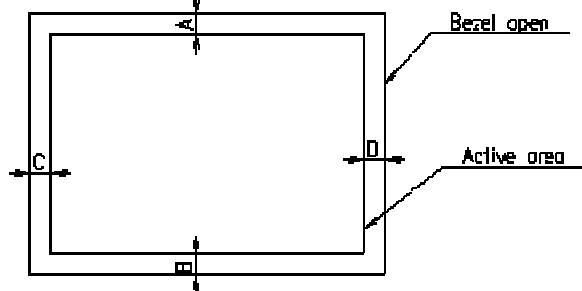
Product Specification

< REAR VIEW >



Notes

1. Backlight has 1 LED PKG ASS'Y.
2. I/F Connector Specification  
- 18/A024-30091(P-1W0), 1S100-L30E-C23(LJU)
3. Torque of user role : 3.0~4.0 kgf-cm
4. Tilt and partial disposition tolerance of display area as following  
(1) Y-Direction : IA-BI ≤ 1.0  
(2) X-Direction : IC-DI ≤ 1.0



5. Unspecified tolerances to be ± 0.5mm
6. Weight : 1950g(Typ.), 2050g(Max.)

**Product Specification**
**6. Reliability**
**Table 13. Environment test conditions**

No	Test Item	Condition
1	High temperature storage test	Ta= 60°C 240hrs
2	Low temperature storage test	Ta= -20°C 240hrs
3	High temperature operation test	Ta= 50°C 50%RH 240hrs
4	Low temperature operation test	Ta= 0°C 240hrs
5	Vibration test (non-operating)	Wave form : random Vibration level : 1.0GRMS Bandwidth : 10-300Hz Duration : X,Y,Z, 20 min One time each direction
6	Shock test (non-operating)	Shock level : 120G Waveform : half sine wave, 2msec Direction : ±X, ±Y, ±Z One time each direction
7	Altitude operating storage / shipment	0 - 10,000 feet(3,048m) 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.

**Product Specification****7. International standards****7-1. Safety**

- a) UL 60950-1:2003, First Edition, Underwriters Laboratories, Inc., Standard for Safety of Information Technology Equipment.
- b) CAN/CSA C22.2, No. 60950-1-03 1st Ed. April 1, 2003, Canadian Standards Association, Standard for Safety of Information Technology Equipment.
- c) EN 60950-1:2001, First Edition, European Committee for Electro-technical Standardization(CENELEC) European Standard for Safety of Information Technology Equipment.
- d) RoHS, Directive 2002/95/EC of the European Parliament and of the council of 27 January 2003

**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 Electro-technical Standardization.(CENELEC), 1998 ( Including A1: 2000 )

**Product Specification**

**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 (Inch)  
E : Month

D : Year  
F ~ M : Serial No.

Note:

1. Year

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Mark	1	2	3	4	5	6	7	8	9	0

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

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 : 8pcs

b) Box size : 550mm X 314mm X 401mm

**Product Specification****9. Precautions**

Please pay attention to the followings 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 the surface 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 desirable 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 detrimental 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 higher.) 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 minimize the interference.
- (7) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can not be operated its full characteristics perfectly.
- (8) A screw which is fastened up the steels should be a machine screw (if not, it causes metal foreign material and deal LCM a fatal blow)
- (9) Please do not set LCD on its edge.

**Product Specification****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 surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.