



# LCD Module Technical Specification

First Edition  
Mar 16, 2001

Final Revision  
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Type No. **F-51320GNY-LY-AA**

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## Revision History

Rev.	Date	Page	Comment

## 1. General Specifications

Operating Temp.	:	min. 0°C ~max. 50°C
Storage Temp.	:	min. -20°C ~max. 70°C
Dot Pixels	:	128 (W) × 64 (H) dots
Dot Size	:	0.48 (W) × 0.48 (H) mm
Dot Pitch	:	0.50 (W) × 0.50 (H) mm
Viewing Area	:	66.8 (W) × 35.5 (H) mm
Outline Dimensions	:	89.7 (W) × 49.8* (H) × (11.8)** (D) mm * Without FPCUV ** Without Fook of LED Backlight
Weight	:	43.5g max.
LCD Type	:	NTD-20526 ( STN / Yellow-mode / Transmissive )
Viewing Angle	:	6:00
Data Transfer	:	8-bit parallel data transfer
Backlight	:	LED Backlight / Yellow-green
Drawings	:	Dimensional Outline UE-310360A

## 2. Electrical Specifications

### 2.1. Absolute Maximum Ratings

GND=0V

Parameter	Symbol	Conditions	Min.	Max.	Units
Supply Voltage (Logic)	V <sub>DD</sub> -GND	-	-0.3	7.0	V
Supply Voltage (Booster Circuit)	V <sub>DD</sub> -GND	With Triple (In case of 5V)	-6.0	+0.3	V
		With Quad (In case of 3V)	-4.5	+0.3	
Supply Voltage 1 (LCD Drive)	V <sub>S</sub> , V <sub>OUT</sub>	-	-18.0	+0.3	V
Input Voltage	V <sub>IN</sub>	-	-0.3	V <sub>DD</sub> +0.3	V

### 2.2. DC Characteristics

T<sub>a</sub>=25°C, GND=0V

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Supply Voltage (Logic)	V <sub>DD</sub> -GND	With Triple	4.5	-	5.5	V
		With Quad	2.8	-	3.2	
Supply Voltage (LCD Drive)	V <sub>DD</sub> -V <sub>S</sub>	Shown in 3.1				V
"High" Level Input Voltage	V <sub>IH</sub>	-	0.8×V <sub>DD</sub>	-	V <sub>DD</sub>	V
"Low" Level Input Voltage	V <sub>IL</sub>	-	GND	-	0.2×V <sub>DD</sub>	V
"High" Level Output Voltage	V <sub>OH</sub>	I <sub>OH</sub> =-0.1mA	0.8×V <sub>DD</sub>	-	V <sub>DD</sub>	V
"Low" Level Output Voltage	V <sub>OL</sub>	I <sub>OL</sub> =0.1mA	GND	-	0.2×V <sub>DD</sub>	V
Supply Current	I <sub>DD</sub>	V <sub>DD</sub> -GND=5.0V	-	1.08	1.62	MA

## 2.3.AC Characteristics

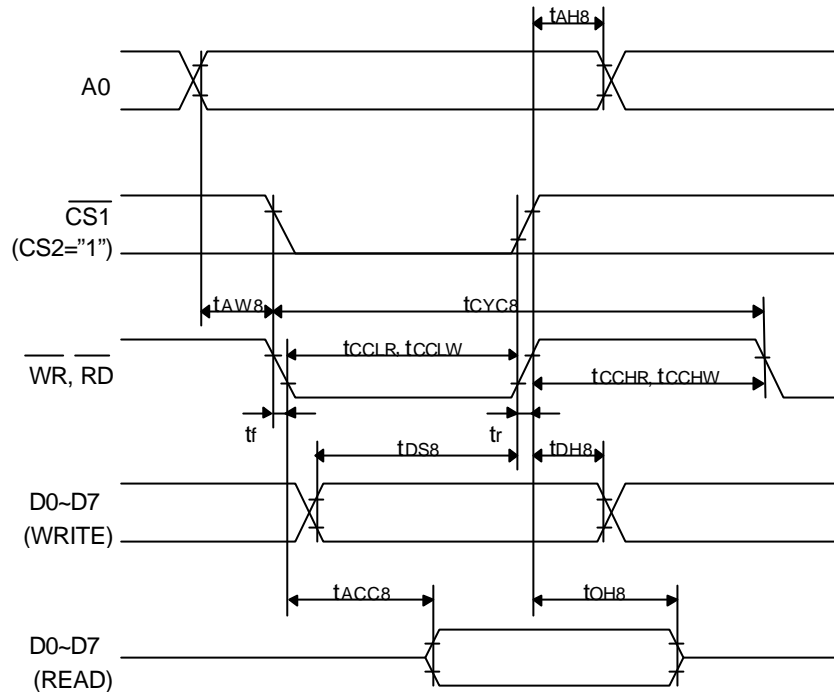
### 2.3.1.Read/Write Operation Sequence (80 series CPU)

$V_{DD}=5.0V\pm 10\%$

Parameter	Symbol	Min.	Max.	Units	
Address Setup Time	$t_{AW8}$	0	-	ns	
Address Hold Time	$t_{AH8}$	0	-	ns	
System Cycle Time	$t_{CYC8}$	166	-	ns	
Control Low Pulse Width	WRITE	$t_{CCLW}$	30	-	ns
	READ	$t_{CCLR}$	70	-	ns
Control High Pulse Width	WRITE	$t_{CCHW}$	30	-	ns
	READ	$t_{CCHR}$	30	-	ns
Data Setup Time	$t_{DS8}$	30	-	ns	
Data Hold Time	$t_{DH8}$	10	-	ns	
RD Access Time	$t_{ACC8}$	-	70	ns	
Output Disable Time	$t_{OH8}$	5	50	ns	

$V_{DD}=2.7\sim 4.5V$

Parameter	Symbol	Min.	Max.	Units	
Address Setup Time	$t_{AW8}$	0	-	ns	
Address Hold Time	$t_{AH8}$	0	-	ns	
System Cycle Time	$t_{CYC8}$	300	-	ns	
Control Low Pulse Width	WRITE	$t_{CCLW}$	60	-	ns
	READ	$t_{CCLR}$	120	-	ns
Control High Pulse Width	WRITE	$t_{CCHW}$	60	-	ns
	READ	$t_{CCHR}$	60	-	ns
Data Setup Time	$t_{DS8}$	40	-	ns	
Data Hold Time	$t_{DH8}$	15	-	ns	
RD Access Time (CL=100pF)	$t_{ACC8}$	-	140	ns	
Output Disable Time	$t_{OH8}$	10	100	ns	



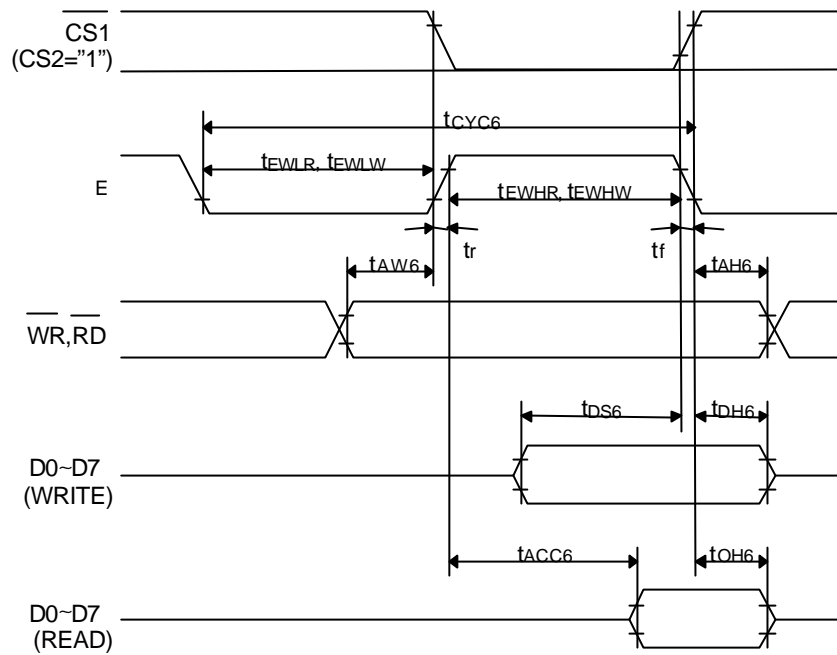
### 2.3.2. Read/Write Operation Sequence (68 series CPU)

$V_{DD}=5.0V\pm 10\%$

Parameter	Symbol	Min.	Max.	Units	
Address Setup Time	$t_{AH6}$	0	-	ns	
Address Hold Time	$t_{AW6}$	0	-	ns	
System Cycle Time	$t_{CYC6}$	166	-	ns	
Data Setup Time	$t_{DS6}$	30	-	ns	
Data Hold Time	$t_{DH6}$	10	-	ns	
Access Time (CL=100pF)	$t_{ACC6}$	-	70	ns	
Output Disable Time	$t_{OH6}$	10	50	ns	
Enable High Pulse Width	READ	$t_{EWHR}$	70	-	ns
	WRITE	$t_{EWHW}$	30	-	ns
Enable Low Pulse Width	READ	$t_{EWLR}$	30	-	ns
	WRITE	$t_{EWLW}$	30	-	ns

$V_{DD}=2.7\sim 4.5V$

Parameter	Symbol	Min.	Max.	Units	
Address Setup Time	$t_{AH6}$	0	-	ns	
Address Hold Time	$t_{AW6}$	0	-	ns	
System Cycle Time	$t_{CYC6}$	300	-	ns	
Data Setup Time	$t_{DS6}$	40	-	ns	
Data Hold Time	$t_{DH6}$	15	-	ns	
Access Time (CL=100pF)	$t_{ACC6}$	-	140	ns	
Output Disable Time	$t_{OH6}$	10	100	ns	
Enable High Pulse Width	READ	$t_{EWHR}$	120	-	ns
	WRITE	$t_{EWHW}$	60	-	ns
Enable Low Pulse Width	READ	$t_{EWLR}$	60	-	ns
	WRITE	$t_{EWLW}$	60	-	ns



### 2.3.3. Display Control Timing Characteristics

#### Reset Input Timing

$V_{DD}=5.0\pm 10\%$

Parameter	Symbol	Min.	Typ.	Max.	Units
Reset time	$t_R$	-	-	0.5	ns
Reset "L" Pulse Width	$t_{RW}$	0.5	-	-	$\mu s$

#### Reset Input Timing

$V_{DD}=2.7\sim 4.5V$

Parameter	Symbol	Min.	Typ.	Max.	Units
Reset time	$t_R$	-	-	1	ns
Reset "L" Pulse Width	$t_{RW}$	1	-	-	$\mu s$

#### Output Timing

$V_{DD}=5.0\pm 10\%$

Parameter	Symbol	Min.	Typ.	Max.	Units
FR Delay Time	$t_{DFR}$	-	10	40	ns

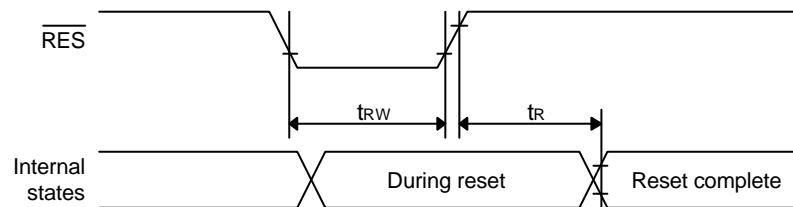
#### Output Timing

$V_{DD}=2.7\sim 4.5V$

Parameter	Symbol	Min.	Typ.	Max.	Units
FR Delay Time	$t_{DFR}$	-	20	80	ns

Note 1 :Valid only when the master mode is selected.

Note 2:All timing is based on 20% and 80% of Vss.



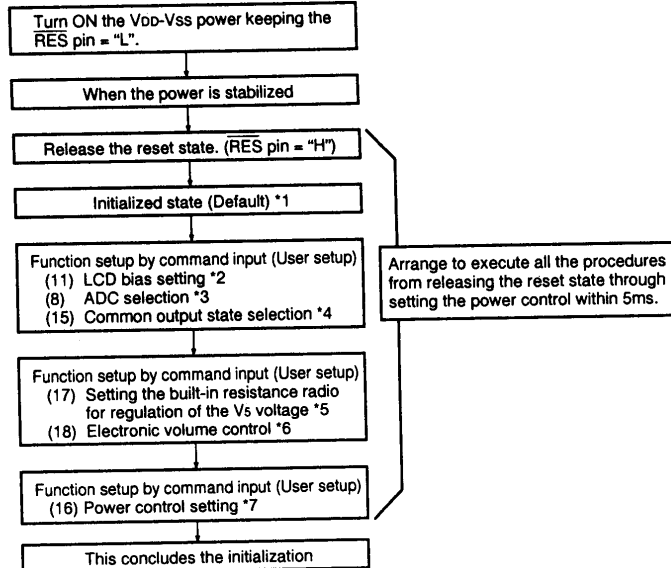


## Instruction Setup: Reference (reference)

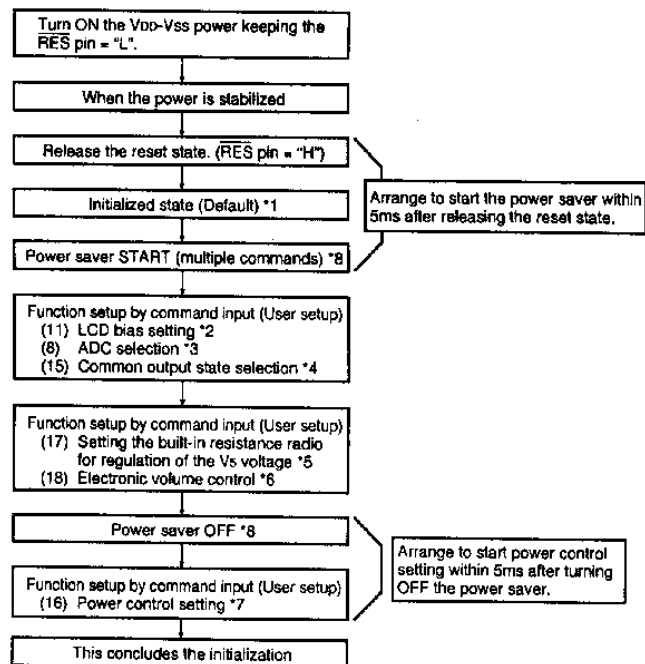
### (1) Initialization

Note: With this IC, when the power is applied, LCD driving non-selective potentials V<sub>2</sub> and V<sub>3</sub> (SEG pin) and V<sub>1</sub> and V<sub>4</sub> (COM pin) are output through the LCD driving output pins SEG and COM. When electric charge is remaining in the smoothing capacitor connecting between the LCD driving voltage output pins (V<sub>1</sub> ~ V<sub>5</sub>) and the V<sub>DD</sub> pin, the picture on the display may become totally dark instantaneously when the power is turned on. To avoid occurrence of such a failure, we recommend the following flow when turning on the power.

① When the built-in power is being used immediately after turning on the power:



② When the built-in power is not being used immediately after turning on the power:

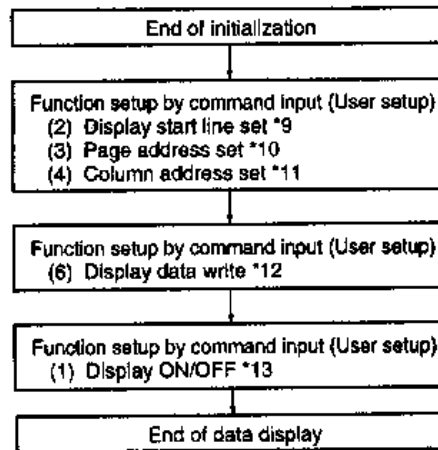


\* The target time of 5ms will result to vary depending on the panel characteristics and the capacitance of the smoothing capacitor. Therefore, we suggest you to conduct an operation check using the actual equipment.

Notes: Refer to respective sections or paragraphs listed below.

- \*1: Description of functions; Resetting circuit
- \*2: Command description; LCD bias setting
- \*3: Command description; ADC selection
- \*4: Command description; Common output state selection
- \*5: Description of functions; Power circuit & Command description; Setting the built-in resistance ratio for regulation of the V<sub>5</sub> voltage
- \*6: Description of functions; Power circuit & Command description; Electronic volume control
- \*7: Description of functions; Power circuit & Command description; Power control setting
- \*8: The power saver ON state can either be in sleep state or stand-by state.  
Command description; Power saver START (multiple commands)

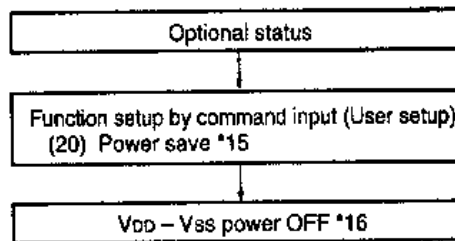
(2) Data Display



Notes: Reference items

- \*9: Command Description; Display start line set
- \*10: Command Description; Page address set
- \*11: Command Description; Column address set
- \*12: Command Description; Display data write
- \*13: Command Description; Display ON/OFF

(3) Power OFF \*14

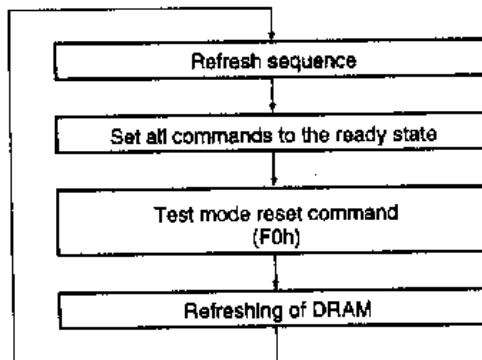


Notes: Reference items

- \*14: After turning OFF the internal power supply, turn OFF the power supply of this IC. (Function Description — Power Supply Circuit)  
When the power of this IC is turned OFF with the internal power supply is held in the ON status, since the status where the voltage is supplied, even though an only little, to the internal LCD drive circuit is still continued, it is feared to ill affect the display quality of the LCD panel. To avoid this, be sure to observe the power OFF sequence strictly.
- \*15: Command Description; Power save
- \*16: Do not hold RESET in the ON status when power supply is off.

**Refresh**

It is recommended to turn on the refresh sequence regularly at a specified interval.

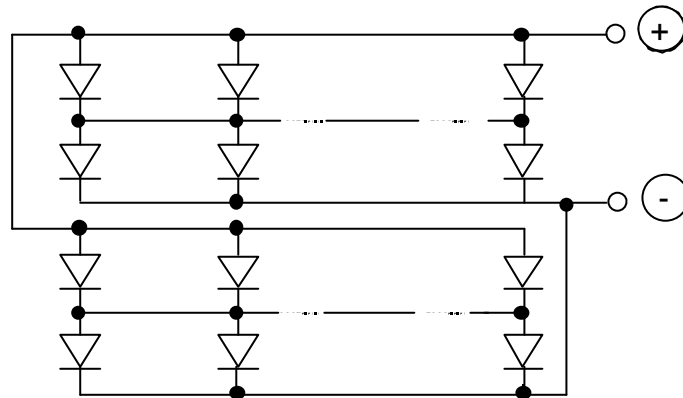
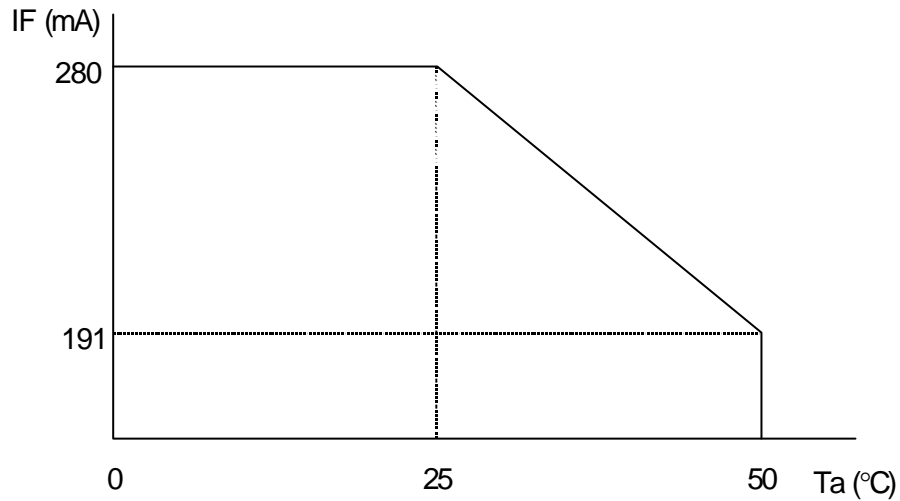


## 2.4. Lighting Specifications

### 2.4.1. Absolute Maximum Ratings

Ta=25°C (1Unit)						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Foward Current	$I_F$	Note 1	-	-	280	mA
Reverse Voltage	$V_R$	-	-	-	10	V
LED Power Dissipation	$P_D$	-	-	-	1.34	W

Note 1 : Refer to the foward current derating curve.



### 2.4.2. Operating Characteristics

Ta=25°C						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Foward Voltage	$V_F$	$I_F=10\text{mA}$	-	4.3	4.8	V
Luminance of Backlight Surface	L	$I_F=10\text{mA}$	60.0	-	-	$\text{cd/m}^2$

### 3. Optical Specifications

#### 3.1. LCD Driving Voltage

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Recommended LCD Driving Voltage Note 1	V <sub>DD-V5</sub>	Ta= 0°C	-	-	9.7	V
		Ta=25°C	8.4	9.0	9.6	V
		Ta=50°C	8.2	-	-	V

Note 1 : Voltage (Applied actual waveform to LCD Module) for the best contrast. The range of minimum and maximum shows tolerance of the operating voltage. The specified contrast ratio and response time are not guaranteed over the entire range.

#### 3.2. Optical Characteristics

Ta=25°C, 1/65 Duty, 1/7 Bias, V<sub>D</sub>=9.0V (Note 4), θ= 0°, φ= - °

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Contrast Ratio Note 1	CR	θ= 0°, φ= - °	-	4.5	-	
Viewing Angle		Shown in 3.3				
Response Time	Rise Note 2	T <sub>ON</sub>	-	200	300	ms
	Decay Note 3	T <sub>OFF</sub>	-	90	180	ms

Note 1 : Contrast ratio is defined as follows.

$$CR = L_{OFF} / L_{ON}$$

L<sub>ON</sub> : Luminance of the ON segments

L<sub>OFF</sub> : Luminance of the OFF segments

Mesuring Spot=3mmφ

Note 2 : The time that the luminance level reaches 90% of the saturation level from 0% when ON signal is applied.

Note 3 : The time that the luminance level reaches 10% of the saturation level from 100% when OFF signal is applied.

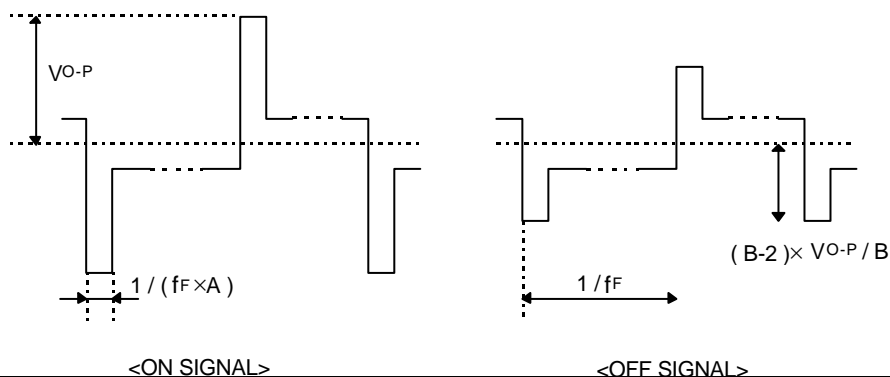
Note 4 : Definition of Driving Voltage V<sub>D</sub>

Assuming that the typical driving waveforms shown below are applied to the LCD Panel at 1/A Duty - 1/B Bias ( A : Duty Number, B : Bias Number ). Driving voltage V<sub>D</sub> is defined as follows.

$$V_D = (V_{th1} + V_{th2}) / 2$$

V<sub>th1</sub> : The voltage V<sub>O-P</sub> that should provide 50% of the saturation level in the luminance at the segment which the ON signal is applied to.

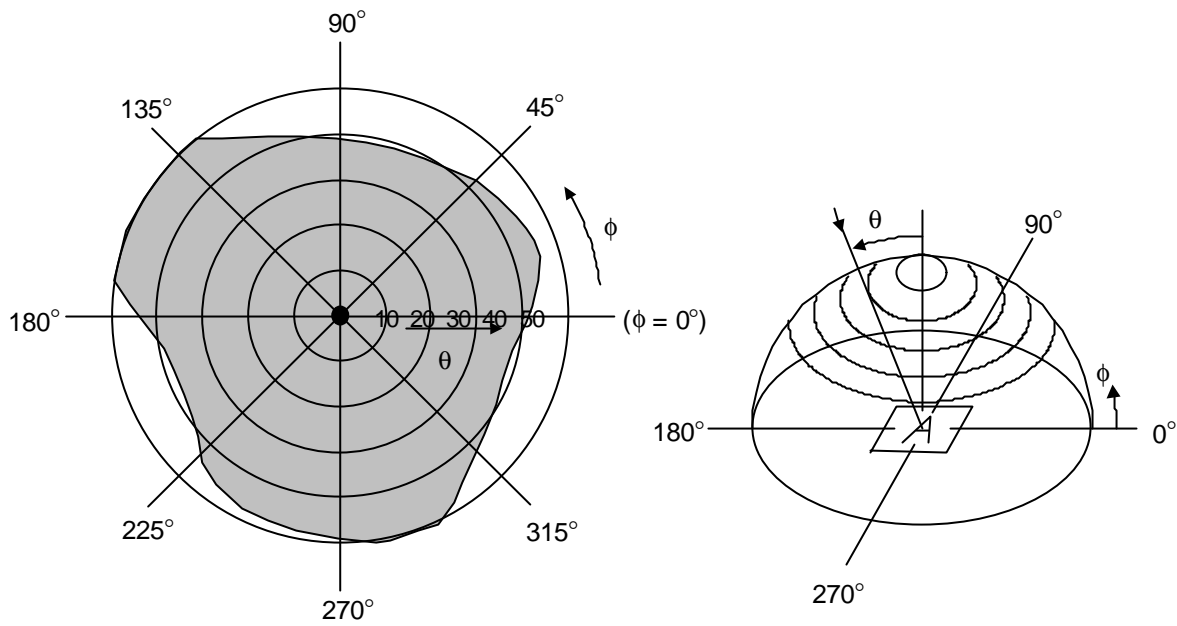
V<sub>th2</sub> : The voltage V<sub>O-P</sub> that should provide 50% of the saturation level in the luminance at the segment which the OFF signal is applied to.




### 3.3. Definition of Viewing Angle and Optimum Viewing Area

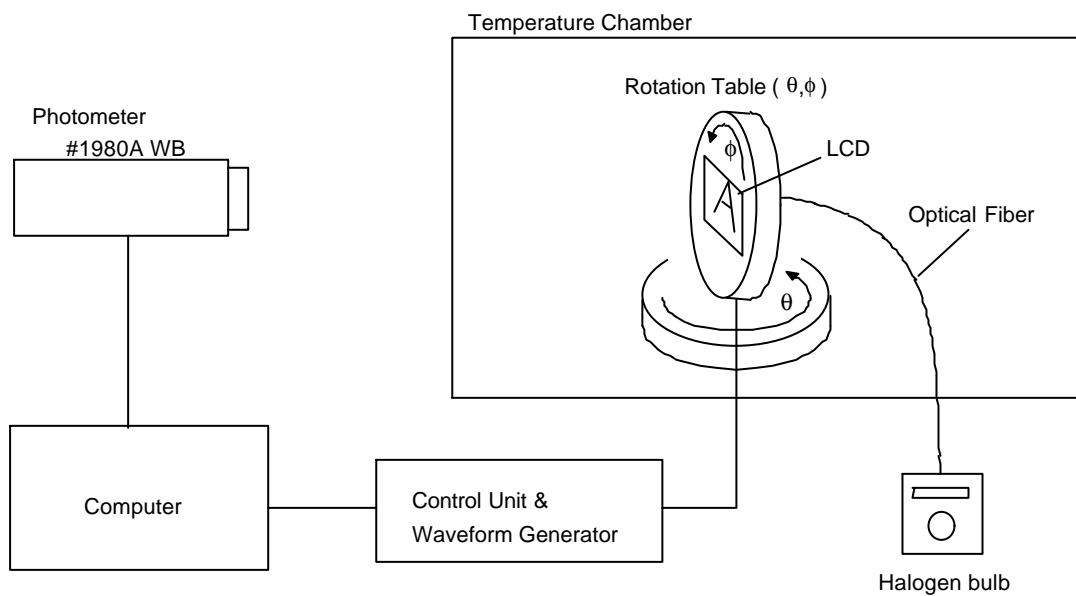
\*Point ● shows the point where contrast ratio is measured. :  $\theta = 0^\circ$ ,  $\phi = 0^\circ$

\*Driving condition : 1/65 Duty, 1/7 Bias,  $V_D = 9.0V$ ,  $f_F = 80Hz$



\*Area  shows typ.  $CR \geq 2$  (Measuring Spot = 3mm $\phi$ )

### 3.4. System Block Diagram



## 4.I/O Terminal

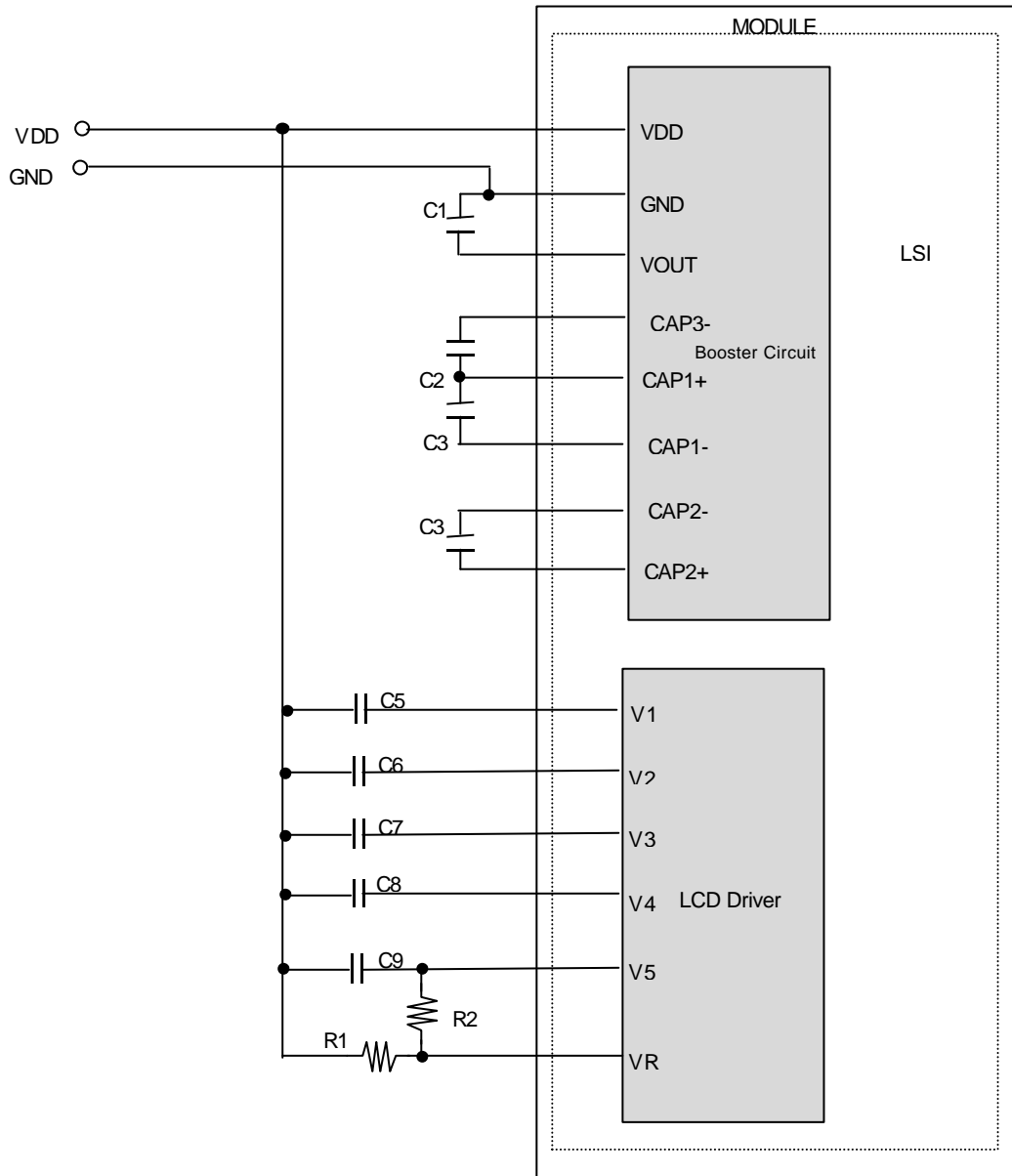
### 4.1.Pin Assignment

#### CN1

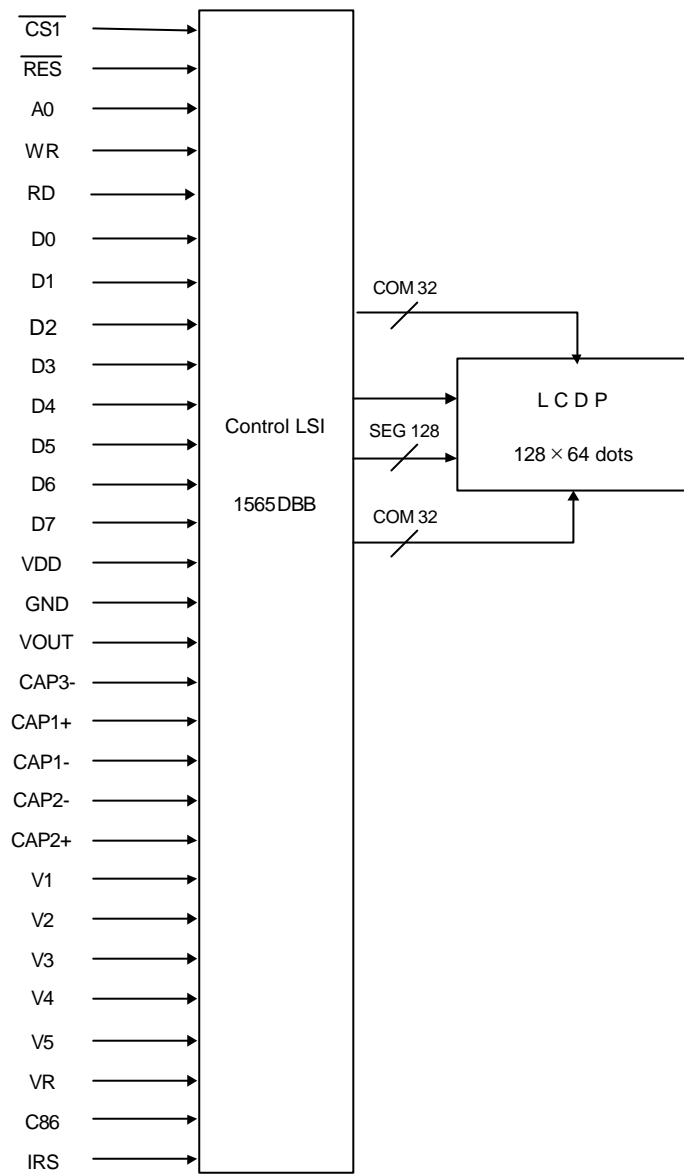
No.	Symbol	Level	Function
1.	NC	-	Non-connection
2.	$\overline{\text{CS1}}$	H / L	Chip Select Signal L : Active
3.	$\overline{\text{RES}}$	H / L	Reset Signal L : Reset
4.	A0	H / L	H : D0~D7 are Display Data L : D0~D7 are Instructions
5.	$\overline{\text{WR}}$	H / L	Write Signal L : Active
6.	$\overline{\text{RD}}$	H / L	Read Signal L : Active
7.	D0	H / L	Data Bus Line
8.	D1	H / L	Data Bus Line
9.	D2	H / L	Data Bus Line
10.	D3	H / L	Data Bus Line
11.	D4	H / L	Data Bus Line
12.	D5	H / L	Data Bus Line
13.	D6	H / L	Data Bus Line
14.	D7	H / L	Data Bus Line
15.	V <sub>DD</sub>	-	Power Supply for Logic
16.	GND	-	Power Supply ( 0V, GND )
17.	V <sub>OUT</sub>	-	DC/DC Voltage Converter Output
18.	CAP3-	-	DC/DC Voltage Converter Capacitor 1 Negative Connection
19.	CAP1+	-	DC/DC Voltage Converter Capacitor 1 Positive Connection
20.	CAP1-	-	DC/DC Voltage Converter Capacitor 1 Negative Connection
21.	CAP2-	-	DC/DC Voltage Converter Capacitor 2 Negative Connection
22.	CAP2+	-	DC/DC Voltage Converter Capacitor 2 Positive Connection
23.	V <sub>1</sub>	-	Power Supply for LCD Drive V <sub>1</sub> = 1/7, V <sub>5</sub>
24.	V <sub>2</sub>	-	Power Supply for LCD Drive V <sub>2</sub> = 2/7, V <sub>5</sub>
25.	V <sub>3</sub>	-	Power Supply for LCD Drive V <sub>3</sub> = 5/7, V <sub>5</sub>
26.	V <sub>4</sub>	-	Power Supply for LCD Drive V <sub>4</sub> = 6/7, V <sub>5</sub>
27.	V <sub>5</sub>	-	Power Supply for LCD Drive V <sub>5</sub> , V <sub>OUT</sub>
28.	VR	-	Voltage Adjustment Pin
29.	C86	H / L	Interface Mode Select Signal H : 68 series L : 80 series

30.	IRS	H / L	<p>This terminal selects the resistors for the V5 voltage level adjustment.</p> <p>IRS="H" :Use the internal resistors</p> <p>IRS="L" :Do not use the internal resistors. The V5 voltage level is regulated by an external resistive voltage divider</p>
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4.2. Example of Power Supply



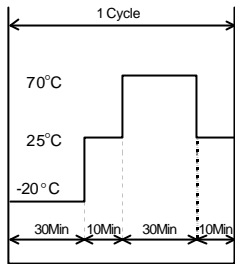
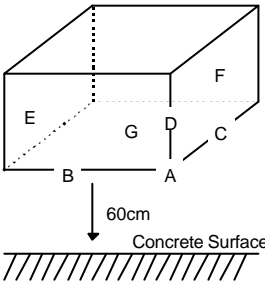
### 4.3. Block Diagram





## 5. Test

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

No.	Parameter	Conditions	Notes
1	High Temperature Operating	50°C±2°C, 96hrs (operation state)	3
2	Low Temperature Operating	0°C±2°C, 96hrs (operation state)	4
3	High Temperature Storage	70°C±2°C, 96hrs	5
4	Low Temperature Storage	-20°C±2°C, 96hrs	4, 5
5	Damp Proof Test	40°C±2°C, 90~95%RH, 96hrs	4, 5
6	Temperature Cycle Test	5 Cycle  <p>The function test shall be conducted after 1 hours storage at the normal temperature and</p>	4
7	Shock Test	To be measured after dropping from 60cm high on the concrete surface in packing state.  <p>Dropping method corner dropping A corner : once Edge dropping B,C,D edge : once Face dropping E,F,G face : once</p>	

Note 1 : Unless otherwise specified, tests will be conducted under the following condition.

Temperature : 20±5°

Humidity : 65±5%RH

Note 2 : Unless otherwise specified, tests will be not conducted under functioning state.

Note 3 : It should be checked at the actual driving condition under the high temperature.

Note 4 : No dew condensation to be observed.

Note 5 : The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.

Note 6 : Vibration test will be conducted to the product itself without putting it in a ontainer.

Note 7 : No air bubbles and no color variation on display more than 24 hours after the test.

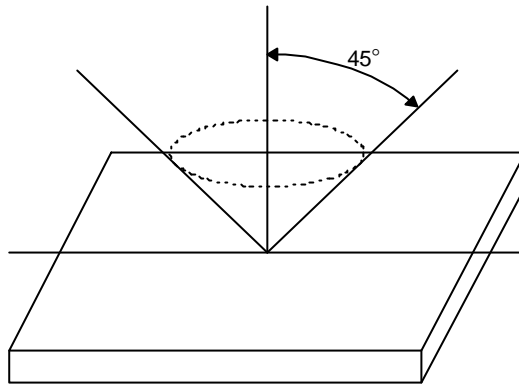
## 6.Appearance Standards

### 6.1.Inspection conditions

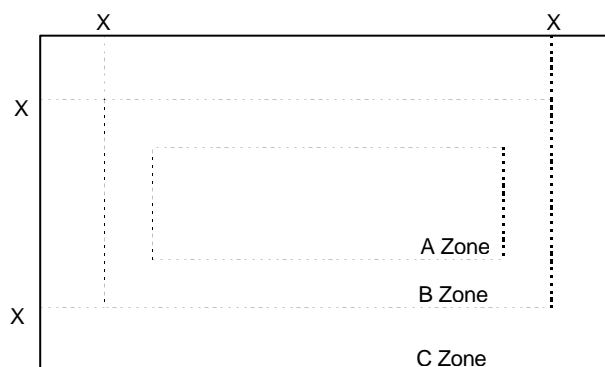
The LCD shall be inspected under 40W white fluorescent light.

The distance between the eyes and the sample shall be more than 30cm.

All directions for inspecting the sample should be within 45°against perpendicular line.



### 6.2.Definition of applicable Zones



X : Maximum Seal Line

A Zone : Active display area

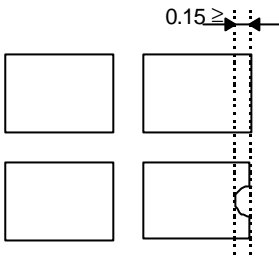
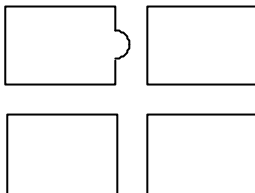
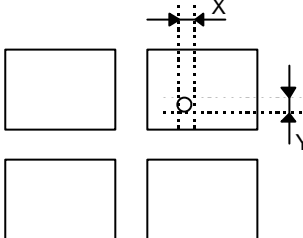
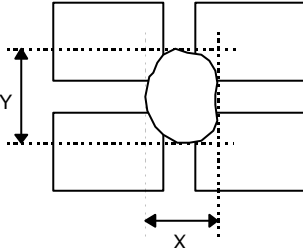
B Zone : Out of active display area ~ Maximum seal line

C Zone : Rest parts

A Zone + B Zone = Validity viewing area

6.3. Standards

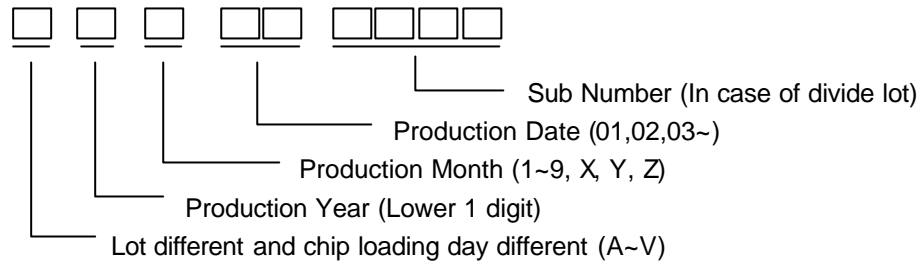
No.	Parameter	Criteria																																																									
1	Black and White Spots, Foreign Substances	<p>(1) Round Shape</p> <table border="1" data-bbox="603 320 1366 658"> <thead> <tr> <th rowspan="2">Dimension (mm) \ Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>D \leq 0.1</math></td> <td>*</td> <td>*</td> <td>*</td> </tr> <tr> <td><math>0.1 &lt; D \leq 0.2</math></td> <td>3</td> <td>5</td> <td>*</td> </tr> <tr> <td><math>0.2 &lt; D \leq 0.25</math></td> <td>2</td> <td>3</td> <td>*</td> </tr> <tr> <td><math>0.25 &lt; D \leq 0.3</math></td> <td>0</td> <td>1</td> <td>*</td> </tr> <tr> <td><math>0.3 &lt; D</math></td> <td>0</td> <td>0</td> <td>*</td> </tr> </tbody> </table> <p><math>D = ( \text{Long} + \text{Short} ) / 2</math> * : Disregard</p> <p>(2) Line Shape</p> <table border="1" data-bbox="603 748 1366 1041"> <thead> <tr> <th colspan="2">Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th>X (mm)</th> <th>Y (mm)</th> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>-</td> <td><math>0.03 \geq W</math></td> <td>*</td> <td>*</td> <td>*</td> </tr> <tr> <td><math>2.0 \geq L</math></td> <td><math>0.05 \geq W</math></td> <td>3</td> <td>3</td> <td>*</td> </tr> <tr> <td><math>1.0 \geq L</math></td> <td><math>0.1 \geq W</math></td> <td>3</td> <td>3</td> <td>*</td> </tr> <tr> <td>-</td> <td><math>0.1 &lt; W</math></td> <td colspan="3">In the same way (1)</td> </tr> </tbody> </table> <p>X : Length Y : Width * : Disregard</p> <p>Total defects shall not exceed 5.</p>	Dimension (mm) \ Zone	Acceptable Number			A	B	C	$D \leq 0.1$	*	*	*	$0.1 < D \leq 0.2$	3	5	*	$0.2 < D \leq 0.25$	2	3	*	$0.25 < D \leq 0.3$	0	1	*	$0.3 < D$	0	0	*	Zone		Acceptable Number			X (mm)	Y (mm)	A	B	C	-	$0.03 \geq W$	*	*	*	$2.0 \geq L$	$0.05 \geq W$	3	3	*	$1.0 \geq L$	$0.1 \geq W$	3	3	*	-	$0.1 < W$	In the same way (1)		
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No.	Parameter	Criteria
3	The Shape of Dot	<p>(1) Dot Shape (with Dent)</p>  <p>As per the sketch of left hand.</p> <p>(2) Dot Shape (with Projection)</p>  <p>Should not be connected to next dot.</p> <p>(3) Pin Hole</p>  <p><math>(X+Y) / 2 \leq 0.2\text{mm}</math> (Less than 0.1mm is no counted.)</p> <p>(4) Deformation</p>  <p><math>(X+Y) / 2 \leq 0.2\text{mm}</math></p> <p>Total acceptable number : 1/dot, 5/cell (Defect number of (4) : 1pc.)</p>
4	Polarizer Scratches	Not to be conspicuous defects.
5	Polarizer Dirts	If the stains are removed easily from LCDP surface, the module is not defective.
6	Complex Foreign Substance Defects	Black spots, line shaped foreign substances or air bubbles between glass & polarizer should be 5pcs maximum in total.
7	Distance between Different Foreign Substance Defects	$D \leq 0.2$ : 20mm or more $0.2 < D$ : 40mm or more

## 7.Code System of Production Lot

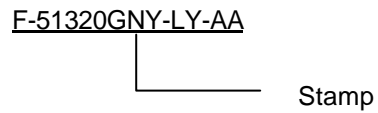
The production lot of module is specified as follows.

The production lot of module is specified some of the following.



## 8.Type Number

The type number of module is specified as follows.



## 9.Applying Precautions

Please contact us when questions and/or new problems not specified in this specifications arise.

## 10.Precautions Relating Product Handling

The Following precautions will guide you in handling our product correctly.

- 1) Liquid crystal display devices
  1. The liquid crystal display device panel used in the liquid crystal display module is made of plate glass. Avoid any strong mechanical shock. Should the glass break handle it with care
  2. The polarizer adhering to the surface of the LCD is made of a soft material. Guard against scratching it.
- 2) Care of the liquid crystal display module against static electricity discharge.
  1. When working with the module, be sure to ground your body and any electrical equipment you may be using. We strongly recommend the use of anti static mats ( made of rubber ), to protect work tables against the hazards of electrical shock.
  2. Avoid the use of work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
  3. Slowly and carefully remove the protective film from the LCD module, since this operation can generate static electricity.
- 3) When the LCD module alone must be stored for long periods of time:
  1. Protect the modules from high temperature and humidity.
  2. Keep the modules out of direct sunlight or direct exposure to ultraviolet rays.
  3. Protect the modules from excessive external forces.
- 4) Use the module with a power supply that is equipped with an overcurrent protector circuit, since the module is not provided with this protective feature.
- 5) Do not ingest the LCD fluid itself should it leak out of a damaged LCD module. Should hands or clothing come in contact with LCD fluid, wash immediately with soap.
- 6) Conductivity is not guaranteed for models that use metal holders where solder connections between the metal holder and the PCB are not used. Please contact us to discuss appropriate ways to assure conductivity.
- 7) For models which use CFL:
  1. High voltage of 1000V or greater is applied to the CFL cable connector area. Care should be taken not to touch connection areas to avoid burns.
  2. Protect CFL cables from rubbing against the unit and thus causing the wire jacket to become worn.
  3. The use of CFLs for extended periods of time at low temperatures will significantly shorten their service life.
- 8) For models which use touch panels:
  1. Do not stack up modules since they can be damaged by components on neighboring modules.
  2. Do not place heavy objects on top of the product. This could cause glass breakage.
- 9) For models which use COG, TAB, or COF:
  1. The mechanical strength of the product is low since the IC chip faces out unprotected from the rear. Be sure to protect the rear of the IC chip from external forces.
  2. Given the fact that the rear of the IC chip is left exposed, in order to protect the unit from electrical damage, avoid installation configurations in which the rear of the IC chip runs the risk of making any electrical contact.

10) Models which use flexible cable, heat seal, or TAB:

1. In order to maintain reliability, do not touch or hold by the connector area.
2. Avoid any bending, pulling, or other excessive force, which can result in broken connections.

## 11. Warranty

This product has been manufactured to your company's specifications as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment, we cannot take responsibility if the product is used in medical devices, nuclear power control equipment, aerospace equipment, fire and security systems, or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required. If the product is to be used in any of the above applications, we will need to enter into a separate product liability agreement.

1. We cannot accept responsibility for any defect, which may arise from additional manufacturing of the product (including disassembly and reassembly), after product delivery.
2. We cannot accept responsibility for any defect, which may arise after the application of strong external force to the product.
3. We cannot accept responsibility for any defect, which may arise due to the application of static electricity after the product has passed your company's acceptance inspection procedures.
4. When the product is in CFL models, CFL service life and brightness will vary according to the performance of the inverter used, leaks, etc. We cannot accept responsibility for product performance, reliability, or defect, which may arise.
5. We cannot accept responsibility for intellectual property of a third party, which may arise through the application of our product to your assembly with exception to those issues relating directly to the structure or method of manufacturing of our product.
6. Optrex will not be held responsible for any quality guarantee issue for defect products judged as Optrex-origin longer than 2 (two) years from Optrex production or 1(one) year from Optrex, Optrex America, Optrex Europe, Display LC delivery which ever comes later.