First Edition
Feb 17, 2005

LCD Module Technical Specification

Final Revision
******

Type No. **F-51477GNF-SLY-ALN**

Approved by (Quality Assurance Division)

Checked by (ACI Engineering Division)

Prepared by (ACI Engineering Division)

Table of Contents

Revision History

Rev.	Date	Page	Comment

1.General Specifications

Operating Temp.	:	min. 0°C ~max. 50°C
Storage Temp.	:	min. -20°C ~max. 60°C
Dot Pixels	:	320 (W) × 240 (H) dots
Dot Size	:	0.285 (W) × 0.285 (H) mm
Dot Pitch	:	0.3 (W) × 0.3 (H) mm
Viewing Area	:	99.85 (W) × 77.0 (H) mm
Outline Dimensions	:	116.4* (W) × 94.0 (H) × 6.0 max. (D) mm * Without FPC
Weight	:	102g max.
LCD Type	:	NSD-21295 (F-STN / Black&White-mode / Transflective)
Viewing Angle	:	6:00
Data Transfer	:	4-bit parallel data transfer
Backlight	:	LED Backlight / Yellow-green
Drawings	:	Dimensional Outline UE-310885C
RoHS regulation	:	To our best knowledge, this product satisfies material requirement of RoHS regulation. Our company is doing the best efforts to obtain the equivalent certificate from our suppliers.

2.Electrical Specifications

2.1.Absolute Maximum Ratings

V_{SS}=0V

Parameter	Symbol	Conditions	Min.	Max.	Units
Supply Voltage (Logic)	V_{DD}-V_{SS}	-	-0.3	7.0	V
Supply Voltage (LCD Drive)	V0-V5	-	-0.3	30.0	V
Input Voltage	V_I	-	-0.3	V_{DD}+0.3	V

2.2.DC Characteristics

Ta=25°C, V_{SS}=0V

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Supply Voltage (Logic)	V_{DD}-V_{SS}	-	4.5	-	5.5	V
Supply Voltage (LCD Drive)	V0-V5	Shown in 3.1				V
High Level Input Voltage	V_{IH}	V_{DD}=4.5~5.5V	0.8×V_{DD}	-	-	V
High Level output Voltage	V_{OH}	I_{OH}=-0.4mA	V_{DD}-0.4	-	-	V
Low Level Input Voltage	V_{IL}	V_{DD}=4.5~5.5V	0	-	0.2×V_{DD}	V
Low Level output Voltage	V_{OL}	I_{OH}=0.4mA	-	-	0.4	V
Supply Current	I_{DD}	V_{DD}-V_{SS}=5.0V	-	0.10	0.15	mA
	I_0	V0-V5=22.4V	-	0.80	1.20	mA

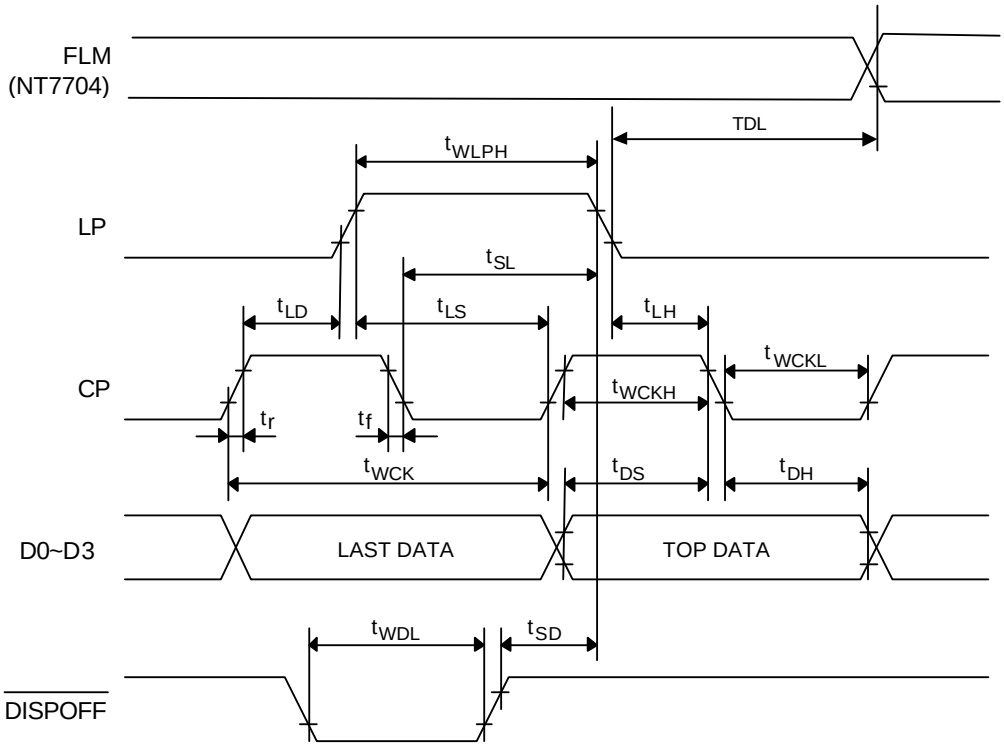
2.3.AC Characteristics

V_{DD}=4.5~5.5V

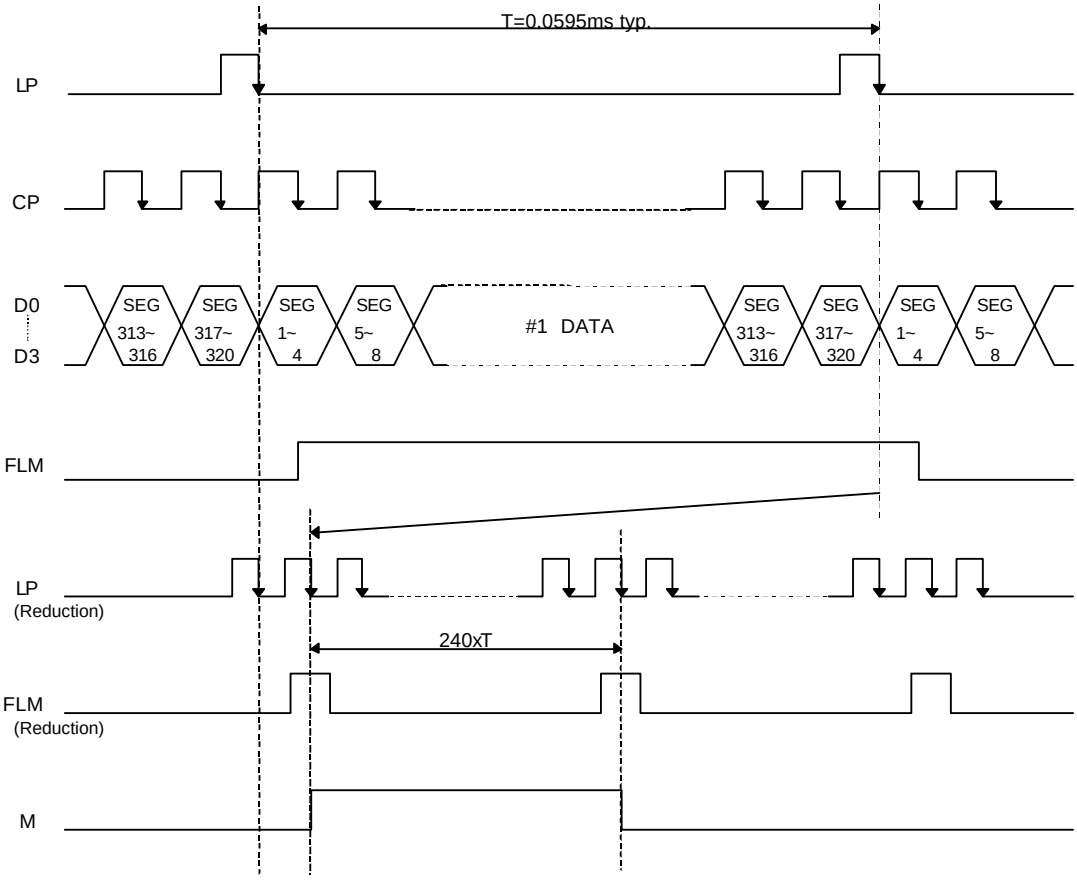
Parameter	Symbol	Min.	Max.	Units
Shift Clock Period	t_{WCK}	71	-	ns
Shift Clock “H” Pulse Width	t_{WCKH}	23	-	ns
Shift Clock “L” Pulse Width	t_{WCKL}	23	-	ns
Data Setup Time	t_{DS}	10	-	ns
Data Hold Time	t_{DH}	20	-	ns
Latch Pulse “H” Pulse Width	t_{WLPH}	15	-	ns
Shift Clock Rise to Latch Pulse Rise Time	t_{LD}	0	-	ns
Shift Clock Fall to Latch Pulse Fall Time	t_{SL}	25	-	ns
Latch Pulse Rise to Shift Clock Rise Time	t_{LS}	25	-	ns
Latch Pulse Fall to Shift Clock Rise Time	t_{LH}	25	-	ns
Input Signal Rise,Fall Time	t_r, t_f	-	50 Note.1	ns
$\overline{\text{DISPOFF}}$ Removal Time	t_{SD}	100	-	ns
$\overline{\text{DISPOFF}}$ Enable Pulse Width	t_{WDL}	1.2	-	µs
Output Delay Time	t_{DL}	-	200 Note.2	ns

Note.1 : (t_{CK} – twckll - twckl)/2 is the maximum in case of high speed operation.

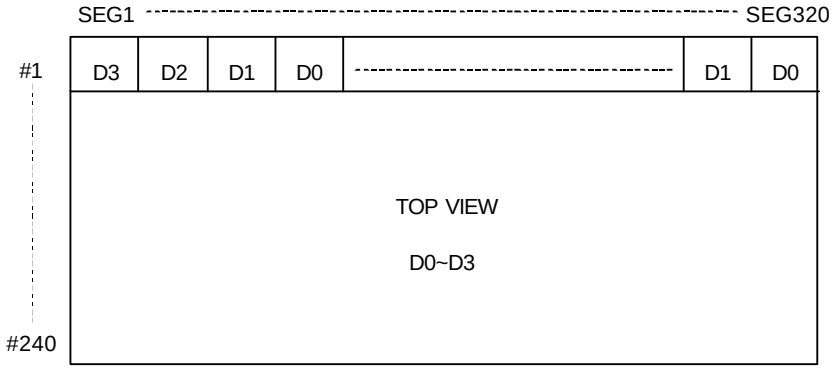
Note.2 : C_L=15pF



2.4. Timing Chart



2.5. Comparison of Display and Data



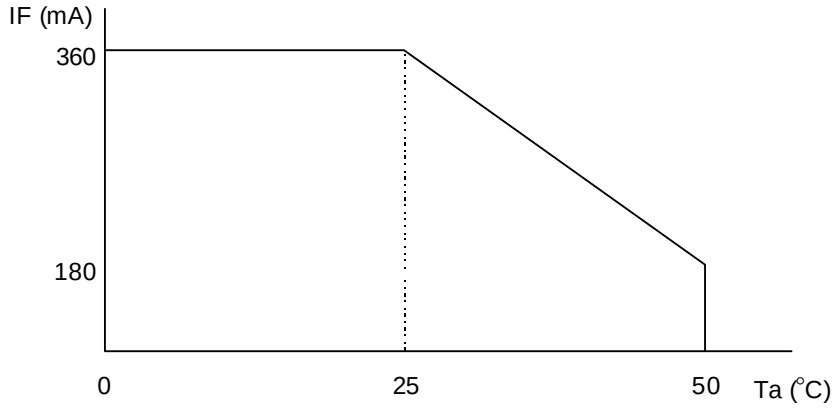
2.6. Lighting Specifications

2.6.1. Absolute Maximum Ratings

Ta=25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Foward Current	I_F	Note 1	-	-	360	mA
Reverse Voltage	V_R	-	-	-	8.0	V
LED Power Dissipation	P_D	-	-	-	1.872	W

Note 1 : Refer to the foward current derating curve.



2.6.2. Operating Characteristic

Ta=25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Foward Voltage	V_F	I_F=180mA	-	4.4	5.2	V
Luminance of Backlight Surface	L	I_F=180mA	150	-	-	cd/m^2

3.Optical Specifications

3.1. LCD Driving Voltage

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Recommended	V0-V5	Ta= 0°C	-	-	25.4	V
LCD Driving Voltage		Ta=25°C	20.8	22.4	23.9	V
Note 1		Ta=50°C	19.4	-	-	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, 1/240 Duty, 1/14 Bias, V_{OD}=22.4V (Note 4), θ= 0°, ϕ=-°

Parameter		Symbol	Conditions	Min.	Typ.	Max.	Units
Contrast Ratio Note 1		CR	θ= 0°,ϕ=-°	-	3.5	-	
Viewing Angle			Shown in 3.3				
Response	Rise Note 2	T_{ON}	-	-	360	540	ms
Time	Decay Note 3	T_{OFF}	-	-	280	420	ms

Note 1 :Contrast ratio is defined as follows.(CR = L_{OFF} / L_{ON})

L_{ON} : Luminance of the ON segments

L_{OFF}: Luminance of the OFF segments

Measuring Spot : 3.0mmϕ

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_{OD}

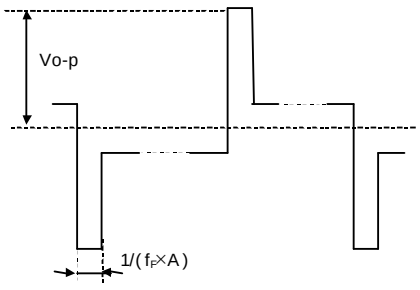
$V_{OD}=V_0-V5$

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_{OD} is defined as follows.

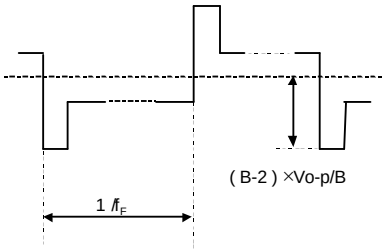
V_{OD} = (Vth1+Vth2) / 2

Vth1: The voltage V_{O-P} that should provide 70% of the saturation level in the luminance at the segment which the ON signal is applied to.

Vth2: The voltage V_{O-P} that should provide 20% of the saturation level in the luminance at the segment which the OFF signal is applied to.



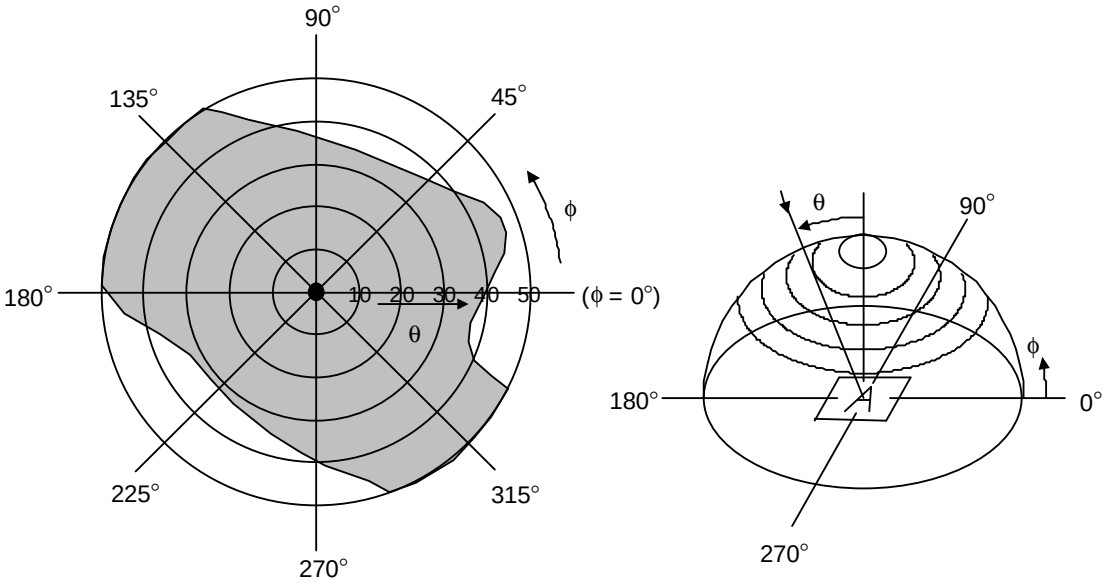
(ON SIGNAL)



(OFF SIGNAL)

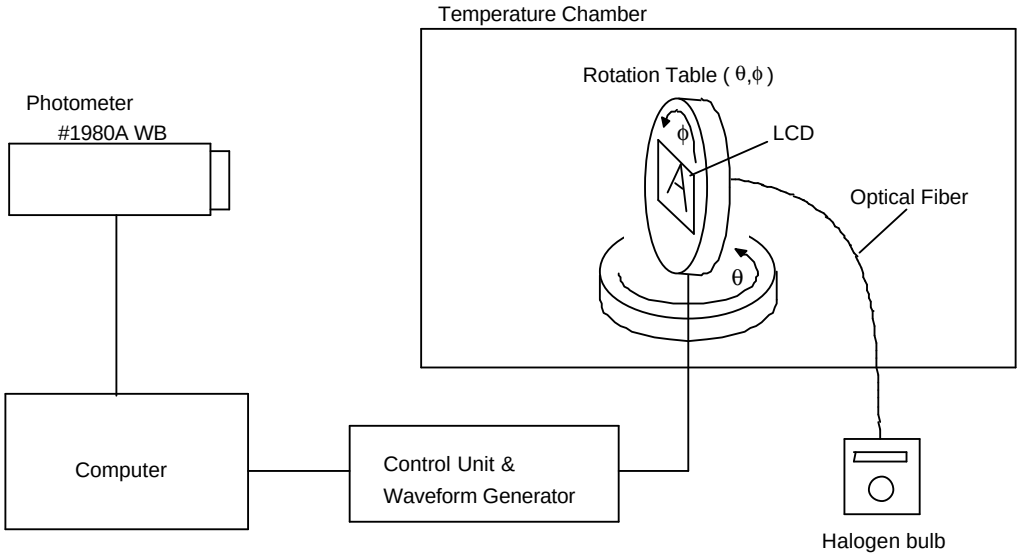
3.3. Definition of Viewing Angle and Optimum Viewing Area

*Point • shows the point where contrast ratio is measured. : θ= 0°, ϕ= -°
*Driving condition: 1/240 Duty, 1/14 Bias, V_{OD}=22.4V, f_F=70Hz



*Area ▭ shows typ. CR≥1.5 (Measuring Spot : 3.0mmϕ)

3.4. System Block Diagram



4.I/O Terminal

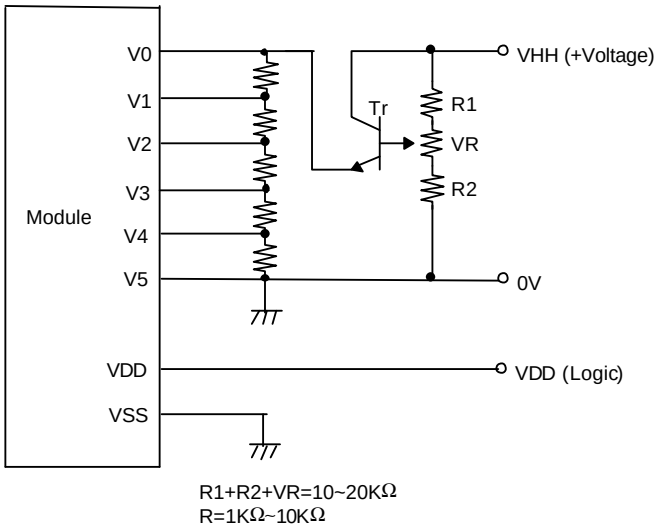
4.1. Pin Assignment

CN1

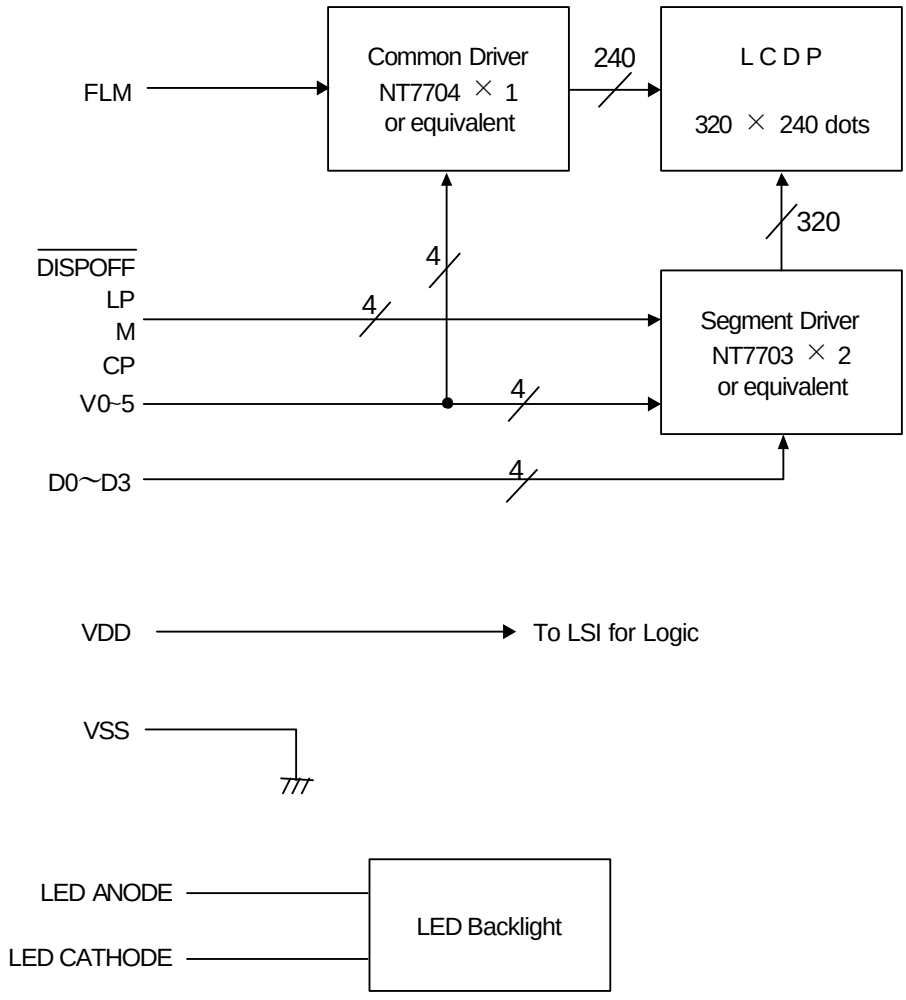
No.	Symbol	Function
1	NC	Non-connection
2	V_0	Power Supply for LCD Drive
3	V_1	Power Supply for LCD Drive V_1 = 13/14,V_5
4	V_2	Power Supply for LCD Drive V_2 = 12/14,V_5
5	V_3	Power Supply for LCD Drive V_3 = 2/14,V_5
6	V_4	Power Supply for LCD Drive V_4 = 1/14,V_5
7	V_5	Power Supply for LCD Drive V_5,V_{OUT}
8	V_{SS}	Power Supply (0V, GND)
9	M	Alternate Signal for LCD Drive
10	FLM	First Line Marker
11	LP	Data Latch Signal
12	$\overline{\text{DISPOFF}}$	Display Control Signal H : Display on L : Display off
13	CP	Clock Signal for Shifting Data
14	D0	Data Bus Line
15	D1	Data Bus Line
16	D2	Data Bus Line
17	D3	Data Bus Line
18	V_{DD}	Power Supply for Logic
19	V_{SS}	Power Supply (0V, GND)
20	NC	Non-connection
21	NC	Non-connection
22	LED ANODE	LED Anode Terminal
23	LED CATHODE	LED Cathode Terminal

4.2. Example of Power Supply

It is recommended to apply a potentiometer for the contrast adjust due to the tolerance of the driving voltage and its temperature dependence.



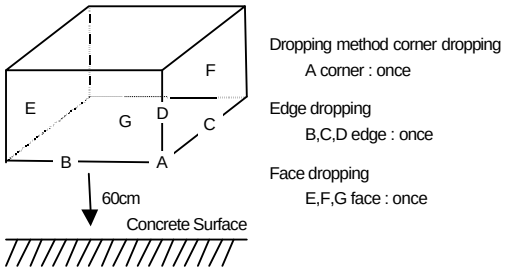
4.3. Block Diagram



5.Test

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

Conditions: Unless otherwise specified, tests will be conducted under the following condition.
Temperature: 20±5°C
Humidity : 65±5%RH
tests will be not conducted under functioning state.

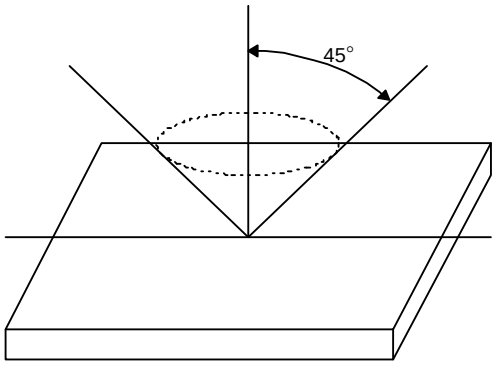
No.	Parameter	Conditions	Notes
1	High Temperature Operating	50°C±2°C, 96hrs (operation state)	
2	Low Temperature Operating	0°C±2°C, 96hrs (operation state)	1
3	High Temperature Storage	60°C±2°C, 96hrs	2
4	Low Temperature Storage	-20°C±2°C, 96hrs	1,2
5	Damp Proof Test	40°C±2°C,90~95%RH, 96hrs	1,2
6	Vibration Test	Total fixed amplitude : 1.5mm Vibration Frequency : 10~55Hz One cycle 60 seconds to 3 directions of X, Y, Z for each 15 minutes	3
7	Shock Test	To be measured after dropping from 60cm high on the concrete surface in packing state. 	

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

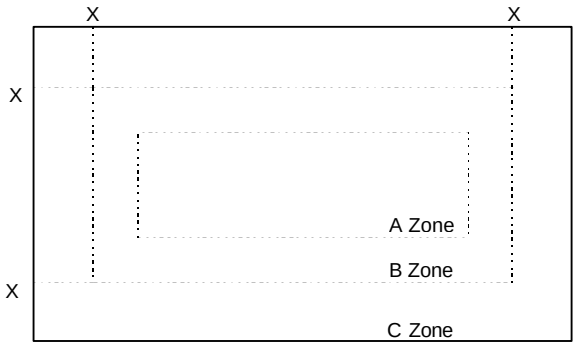
6.Appearance Standards

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

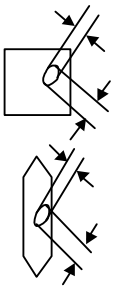
A Zone : Active display area
B Zone : Out of active display area ~ Maximum seal line
C Zone : Rest parts

A Zone + B Zone = Validity viewing area

6.3. Standards (middle scale, LED)

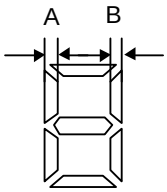
D = (Long + Short) / 2 * : Disregard Units : mm

No.	Parameter	Criteria
1	The Shape of Dot	(1) Pin Hole



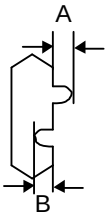
Dimension	Acceptable Number
D ≤ 0.10	*
0.10 < D ≤ 0.20	1 pc / dot(only segment)or less 5 pcs / cell or less

(2) Pattern Shift



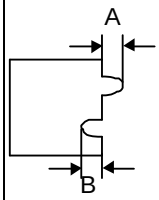
| A – B | ≤ 0.15

(3) Breakage or Chips / Deformation



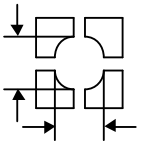
1.Segment Type

Dimension	Acceptable Number
A ≤ 0.10	*
B ≤ 0.15	*



2.Dot Type

Dimension	Acceptable Number
A≤0.10	* (Should not be connected to next dot)
0.10<A≤0.15	1 pc / dot(only segment)or less 5 pcs / cell or less (Should not be connected to next dot)
B ≤ 0.15	*



3.Defective type extends over multiple numbers of dots

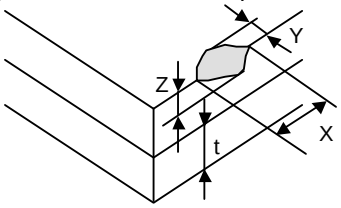
Dimension	Acceptable Number
D≤0.10	*
0.10<D≤0.20	1 pc / dot(only segment)or less 5 pcs / cell or less (Individual dot must secure 1/2 area or more)

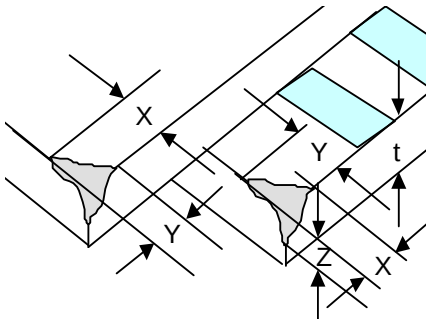
D = (Long + Short) / 2 * : Disregard Units : mm

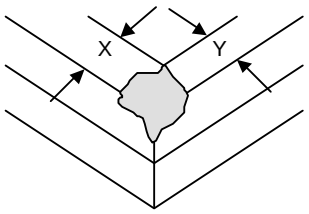
<table>
<tr><th>No.</th><th>Parameter</th><th>Criteria</th></tr>
<tr><td>2</td><td>Black and White Spots, Foreign Substances</td><td>(1) Round Shape
<table>
<tr><th rowspan="2">Dimension \ Zone</th><th colspan="3">Acceptable Number</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>D ≤ 0.10</td><td>*</td><td>*</td><td>*</td></tr>
<tr><td>0.10< D ≤ 0.20</td><td>6</td><td>6</td><td>*</td></tr>
<tr><td>0.20< D ≤ 0.30</td><td>4</td><td>4</td><td>*</td></tr>
</table>
Individual dot must secure 1/2 area or more.

(2) Line Shape
<table>
<tr><th rowspan="2">Length \ Width \ Zone</th><th colspan="3">Acceptable Number</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>*</td><td>W≤0.03</td><td>*</td><td>*</td><td>*</td></tr>
<tr><td>L ≤2.0</td><td>0.03<W≤0.05</td><td>5</td><td>5</td><td>*</td></tr>
<tr><td>L ≤1.0</td><td>≤0.10</td><td>4</td><td>4</td><td>*</td></tr>
<tr><td>*</td><td>0.10<W</td><td colspan="2">In the same way (1)</td><td>*</td></tr>
</table>
No more than 9pcs as total.
(Refer to “Complex Foreign Substance Defects”)</td></tr>
<tr><td>3</td><td>Color Variation</td><td>Not to be conspicuous defects.</td></tr>
<tr><td>4</td><td>Air Bubbles (between glass & polarizer)</td><td>
<table>
<tr><th rowspan="2">Dimension \ Zone</th><th colspan="3">Acceptable Number</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>D ≤ 0.30</td><td>*</td><td>*</td><td>*</td></tr>
<tr><td>0.30< D ≤ 0.40</td><td>3</td><td>*</td><td>*</td></tr>
<tr><td>0.40< D ≤ 0.60</td><td>2</td><td>3</td><td>*</td></tr>
</table>
No more than 3pcs as total.
(Refer to “Complex Foreign Substance Defects”)</td></tr>
<tr><td>5</td><td>Polarizer Scratches</td><td>Not to be conspicuous defects.</td></tr>
<tr><td>6</td><td>Polarizer Dirts</td><td>If the stains are removed easily from LCDP surface, the module is not defective.</td></tr>
<tr><td>7</td><td>Complex Foreign Substance Defects</td><td>Black spots, line shaped foreign substances or air bubbles between glass & polarizer should be 9pcs maximum in total.</td></tr>
<tr><td>8</td><td>Distance between Different Foreign Substance Defects</td><td>20mm or more</td></tr>
</table>

D = (Long + Short) / 2 * : Disregard Units : mm

<table>
<tr><th>No.</th><th>Parameter</th><th>Criteria</th></tr>
<tr><td>11</td><td>Chipped Glass</td><td>
(1) Other than electrode pad areas and corner areas


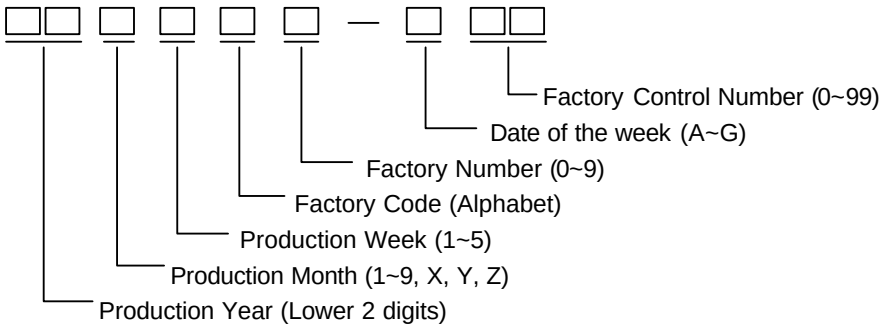
<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≤10.0</td><td>≤1.5</td><td>≤t</td></tr>
</table>
(2) Corner Areas
1.Lead Areas


<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>Half dimension till first Leads terminal</td><td>Same as terminal width</td><td>*</td></tr>
</table>
It is allowed 1 chip as total length of Z siretion
In case of 2 or more chips, Z ≤ 1/2t
2.Other than electrode pad Areas


X+Y≤8.0
If the chipped area touches the seal line, the LCD is not acceptable.
</td></tr>
</table>

7.Code System of Production Lot

The production lot of module is specified as follows.



8.Type Number

The type number of module is specified as follows.

F-51477GNF-SLY-ALN

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) In case of buffer material such as cushion / gasket is assembled into LCD module, it may have an adverse effect on connecting parts (LCD panel-TCP / HEAT SEAL / FPC / etc., PCB-TCP / HEAT SEAL / FPC etc., TCP-HEAT SEAL, TCP-FPC, HEAT SEAL-FPC, etc.,) depending on its materials.
   Please check and evaluate these materials carefully before use.

12) In case of acrylic plate is attached to front side of LCD panel, cloudiness (very small cracks) can occur on acrylic plate, being influenced by some components generated from polarizer film..
   Please check and evaluate those acrylic materials carefully before use.

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 delivery which ever comes later.