First Edition
Mar 7, 2005

LCD Module Technical Specification

Final Revision
******

Type No. **F-51854GNFJ-SLW-ABN**

Approved by (Quality Assurance Division)

Checked by (ACI Engineering Division)

T.Yuchi
Prepared by (ACI Engineering Division)

Table of Contents

Revision History

Rev.	Date	Page	Comment

1.General Specifications

Operating Temp.	:	min. -20°C ~max. 70°C
Storage Temp.	:	min. -20°C ~max. 70°C
Dot Pixels	:	160 (W) × 128 (H) dots
Dot Size	:	0.54 (W) × 0.54 (H) mm
Dot Pitch	:	0.58 (W) × 0.58 (H) mm
Viewing Area	:	108.6 (W) × 82.55 (H) mm
Outline Dimensions	:	129.0 (W) × 102.0* (H) × 13.5max. (D) mm * Without FPC
Weight	:	160g max.
LCD Type	:	NSD-22808 (F-STN / Black&White-mode / Transflective)
Viewing Angle	:	6:00
Data Transfer	:	8-bit parallel data transfer Serial data transfer
Backlight	:	LED Backlight / White
Additional Spec.	:	Winter White Display (Highly Reflective Type Transflective Display)
Drawing	:	Dimensional Outline UE-211023
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	6.0	V
Supply Voltage (LCD Drive)	V_3, V_{OUT}	-	-0.3	+18.0	V
Supply Voltage (LCD Drive)	V_1, V_2, VC, MV_1, MV_2	-	-0.3	V_3	V
Input Voltage	V_{IN}	-	-0.3	V_{DD}+0.3	V
Output Voltage	V_{OUT}	-	-0.3	V_{DD}+0.3	V

*1:Voltages V_3, V_2, V_1, VC, MV_1, MV_2 and MV_3(V_{SS}) must always meet the conditions of $V_3 \geq V_2 \geq V_1 \geq VC \geq MV_1 \geq MV_2 \geq MV_3$($V_{SS}$).

*2:Voltage V_{OUT} must always meet the conditions of $V_{OUT} \geq V_{DD2} \geq V_{DD}$.
When inputting V_{OUT} from outside, maintain the condition of $V_{OUT} \geq V_3$+0.2V.

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)	V_{OUT} V_3	-	V_{DD2} 5.6	- -	16.2 16.2	V
Supply Voltage (Booster Circuit)	V_{DD2}	With Triple(Based on V_{DD})	4.5	-	5.3	V
Booster Output Voltage	V_{OUT}	-	-	-	16.2	V
Voltage Regulator Operating Voltage	V_3	*1	5.6	-	16.2	V
"High" Level Input Voltage	V_{IH}	V_{DD}=4.5~5.5V *2	0.8×V_{DD}	-	V_{DD}	V
"Low" Level Input Voltage	V_{IL}	V_{DD}=4.5~5.5V *2	V_{SS}	-	0.2×V_{DD}	V
"High" Level Output Voltage	V_{OH}	V_{DD}=4.5~5.5V I_{OH}=-25µA *3	0.8×V_{DD}	-	V_{DD}	V
"Low" Level Output Voltage	V_{OL}	V_{DD}=4.5~5.5V I_{OL}=25µA *3	V_{SS}	-	0.2×V_{DD}	V
Supply Current	I_{DD}	V_{DD}-V_{SS}=5.0V	-	1.2	1.8	mA
Oscillation Frequency	f_{CL}		92	100	108	kHz

*1: The V_3 voltage adjusting circuit is adjusted within the electronic volume operating range.
These ranges are applied when using the external power supply.

*2: A0, D0~D5, D6(SCL), D7(SI), RD(E), WR(R/W), CS1, CS2, CLS, CL, FR, M/S, C86, P/S, DOF, RES, IRS and HPM pins

*3: D0~D7, FR, FRS, DOF and CL pins

2.3. AC Characteristics

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

V_{DD}=4.5~5.5V

Parameter		Symbol	Min.	Max.	Units
Address Hold Time		t_{AH8}	0	-	ns
Address Setup Time		t_{AW8}	0	-	ns
System Write Cycle Time		t_{WCYC8}	500		ns
System Read Cycle Time		t_{RCYC8}	7000	-	ns
Control Low Pulse Width	WRITE	t_{CCLW}	200	-	ns
	READ	t_{CCLR}	3000	-	ns
Control High Pulse Width	WRITE	t_{CCHW}	200	-	ns
	READ	t_{CCHR}	200	-	ns
Data Setup Time		t_{DS8}	200	-	ns
Data Hold Time		t_{DH8}	30	-	ns
$\overline{RD}$ Access Time(CL=100pF)		t_{ACC8}	-	3500	ns
Output Disable Time		t_{OH8}	5	200	ns

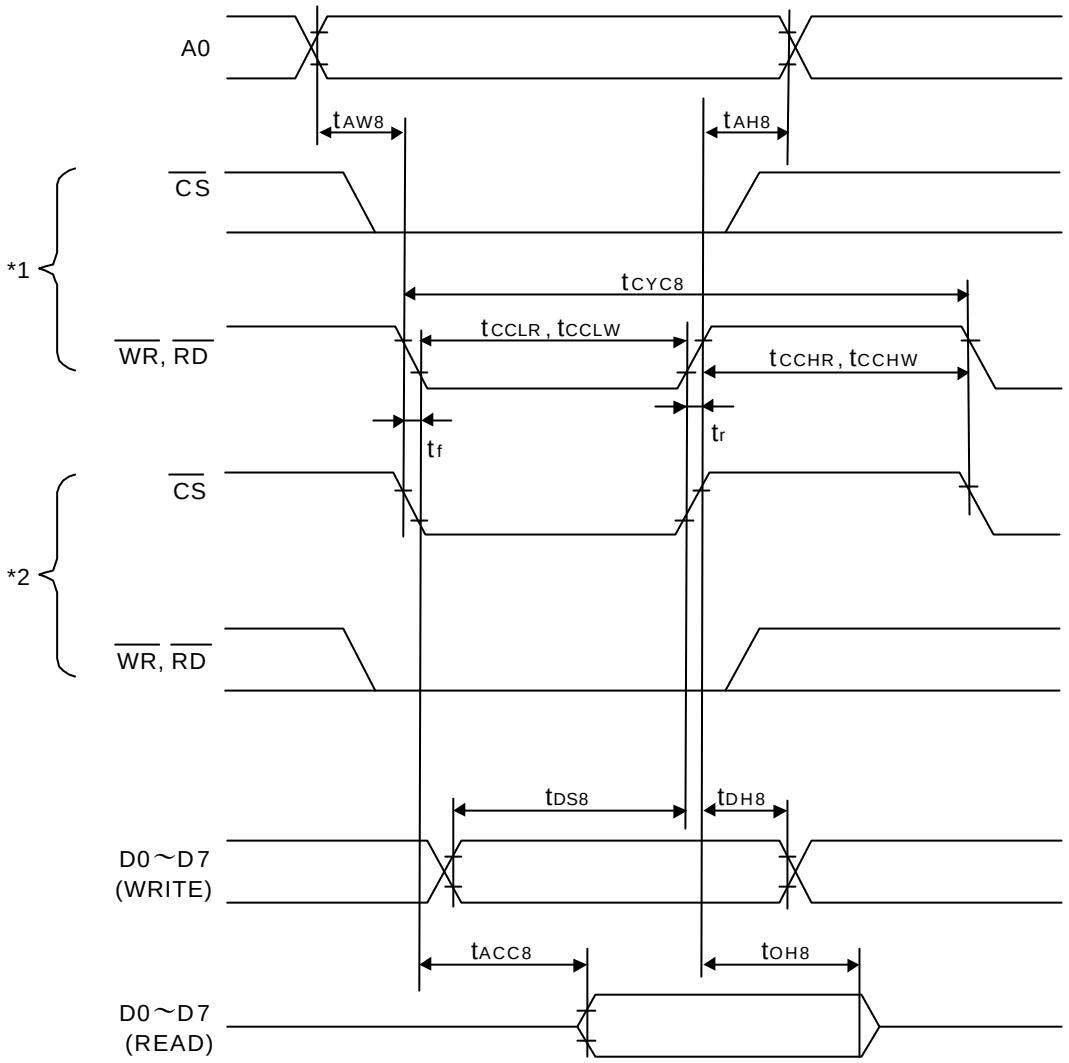
*1:This is in case of making the access by $\overline{WR}$ and $\overline{RD}$, setting the $\overline{CS}$=LOW.

*2:This is in case of making the access by $\overline{CS}$, setting the $\overline{WR}$, $\overline{RD}$=LOW.

*3: Input signal rise and fall time (tr, tf) must not exceed 15 ns.
When the system cycle time is used at a high speed, it is specified by (tr+tf)≤(t_{CYC8}-t_{CCLW}-t_{CCHW}) or (tr+tf)≤(t_{CYC8}-t_{CCLR}-t_{CCHR}).

*4:Timing is entirely specified with reference to 20% or 80 % of V_{DD}.

*5:t_{CCLW} and t_{CCLR} are specified in terms of the overlapped period when $\overline{CS}$ is at LOW level and $\overline{WR}$ and $\overline{RD}$ are at LOW level.


A0
tAW8
tAH8
CS
*1
tCYC8
WR, RD
tCCLR , tCCLW
tCCHR , tCCHW
tf
tr
CS
*2
WR, RD
tDS8
tDH8
D0～D7
(WRITE)
tACC8
tOH8
D0～D7
(READ)

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

V_{DD}=4.5~5.5V

Parameter		Symbol	Min.	Max.	Units
Address Hold Time		t_{AH6}	20	-	ns
Address Setup Time		t_{AW6}	0	-	ns
System Write Cycle Time		t_{WCYC6}	500	-	ns
System Read Cycle Time		t_{RCYC6}	7000	-	ns
Enable High Pulse Width	READ	t_{EWHR}	3000	-	ns
	WRITE	t_{EWHW}	200	-	ns
Enable Low Pulse Width	READ	t_{EWLR}	200	-	ns
	WRITE	t_{EWLW}	200	-	ns
Data Setup Time		t_{DS6}	200	-	ns
Data Hold Time		t_{DH6}	60	-	ns
Access Time (CL=100pF)		t_{ACC6}	-	3500	ns
Output Disable Time		t_{OH6}	5	200	ns

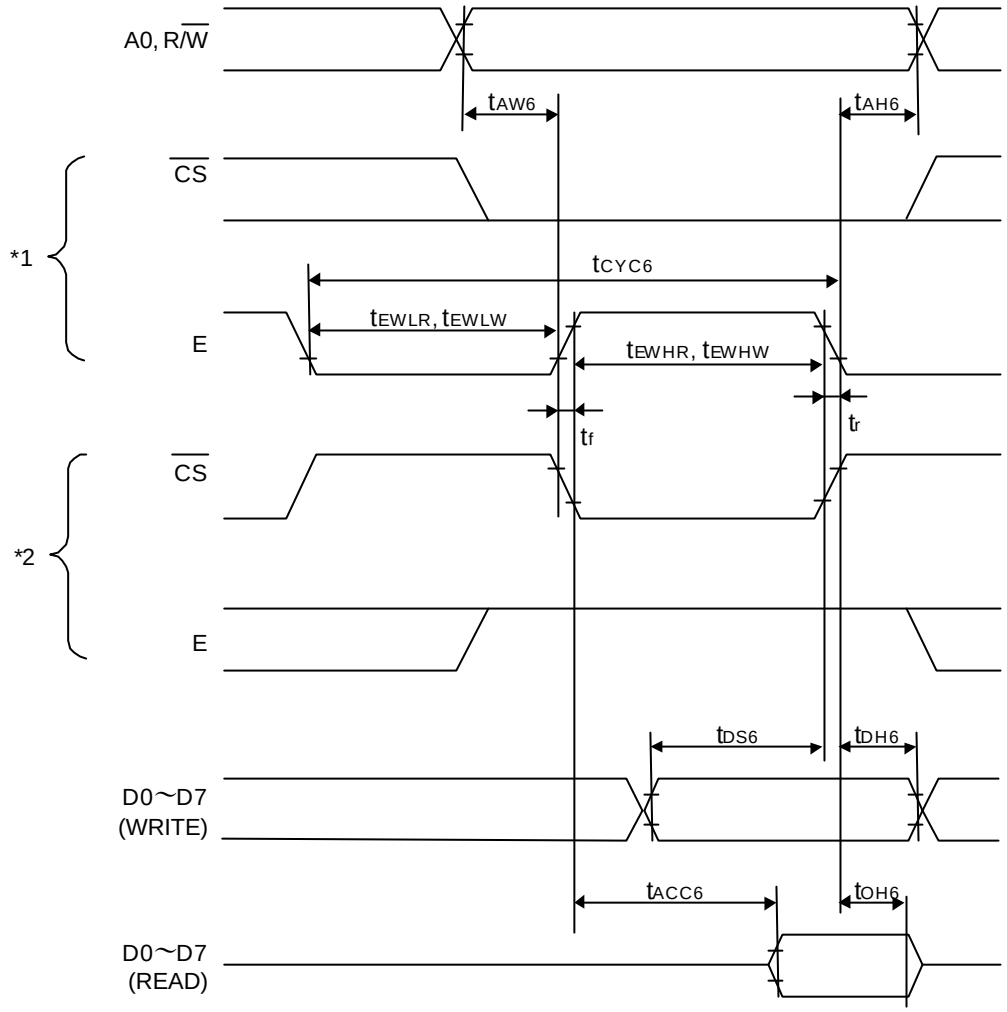
*1:This is in case of making the access by E, setting the $\overline{CS}$=LOW.

*2:This is in case of making the access by $\overline{CS}$, setting the E=HIGH.

*3: The rise time and the fall time (tr, tf) of the iput signal should be set to 15 ns or less.
When it is necessary to use the system cycle time at high speed, the rise time and the fall time should be so set to conform to $(tr+tf) \leq (t_{CYC6}-t_{EWLW}-t_{EWHW})$ or $(tr+tf) \leq (t_{CYC6}-t_{EWLR}-t_{EWHR})$.

*4:All the timing should basically be set to20% and 80 % of the V_{DD}.

*5:t_{EWLW} , t_{EWLR} should be set to the overlapping zone where the $\overline{CS}$ is on the LOW level and where the E is on the HIGH level.


A0, R/W
tAW6
tAH6
CS
*1
tCYC6
tEWLR, tEWLW
E
tEWHR, tEWHW
tf
tr
CS
*2
E
tDS6
tDH6
D0～D7
(WRITE)
tACC6
tOH6
D0～D7
(READ)

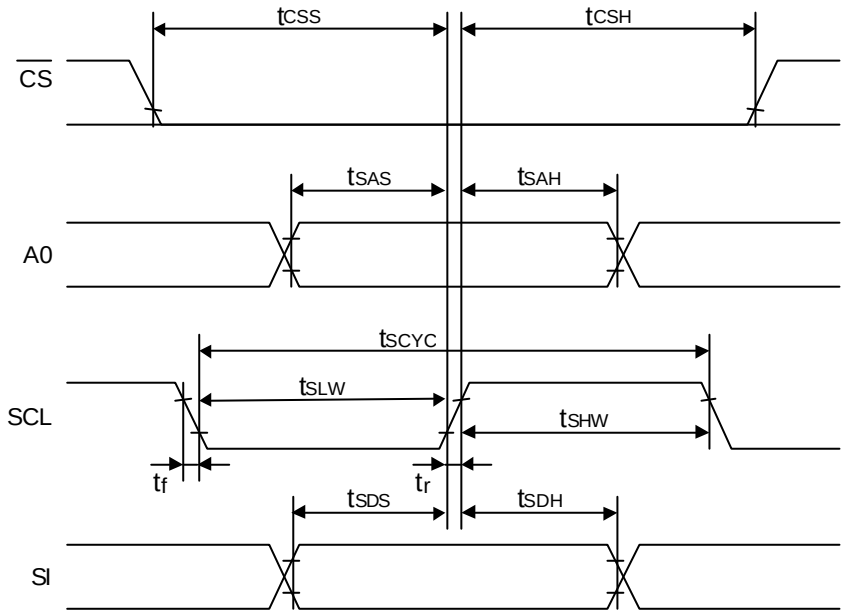
2.3.3. Serial Interface Sequence

V_{DD}=4.5~5.5V

Parameter	Symbol	Min.	Max.	Units
Serial Clock Cycle	t_{SCYC}	250	-	ns
SCL High Pulse Width	t_{SHW}	100	-	ns
SCL Low Pulse Width	t_{SLW}	100	-	ns
Address Setup Time	t_{SAS}	150	-	ns
Address Hold Time	t_{SAH}	150	-	ns
Data Setup Time	t_{SDS}	200	-	ns
Data Hold Time	t_{SDH}	100	-	ns
CS-SCL Time	t_{CSS}	150	-	ns
CS-SCL Time	t_{CSH}	150	-	ns

*1:Input signal rise and fall time (tr, tf) must not exceed 15ns.

*2:Timing is entirely specified with reference to 20% or 80% of V_{DD}.

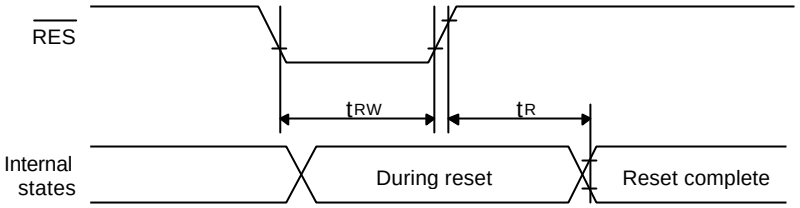


2.3.4. Display Control Timing Characteristics

Reset Input Timing V_{DD}=4.5~5.5V

Parameter	Symbol	Min.	Typ.	Max.	Units
Reset time	t_R	-	-	1000	µs
Reset "L" Pulse Width	t_{RW}	1000	-	-	

*1: Timing is entirely specified with reference to 20% or 80% of V_{DD}.



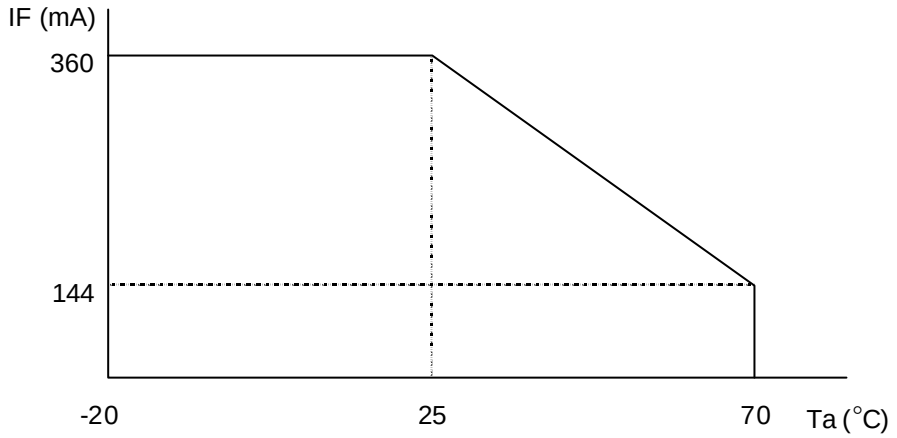
2.4. Lighting Specifications

2.4.1. 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	-	-	-	5	V
LED Power Dissipation	P_D	-	-	-	1440	mW

Note 1 : Refer to the foward current derating curve.



2.4.2. Operating Characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Foward Voltage	V_F	I_F=180mA	-	3.5	4.0	V
Luminance of Module Surface	L	I_F=180mA	28	40	-	cd/m^2

3.Optical Specifications(MLA Driving)

3.1.Optical Characteristics

Ta=25°C, 1/65 Duty, 1/8 Bias, V_{OD}=10.1V (Note 4), θ= 0°, ϕ=- °

Parameter		Symbol	Conditions	Min.	Typ.	Max.	Units
Contrast Ratio Note 1		CR	θ= 0°, ϕ=- °	-	5.0	-	
Viewing Angle			Shown in 3.2				
Response Time	Rise Note 2	T_{ON}	-	-	125	200	ms
	Decay Note 3	T_{OFF}	-	-	200	300	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.

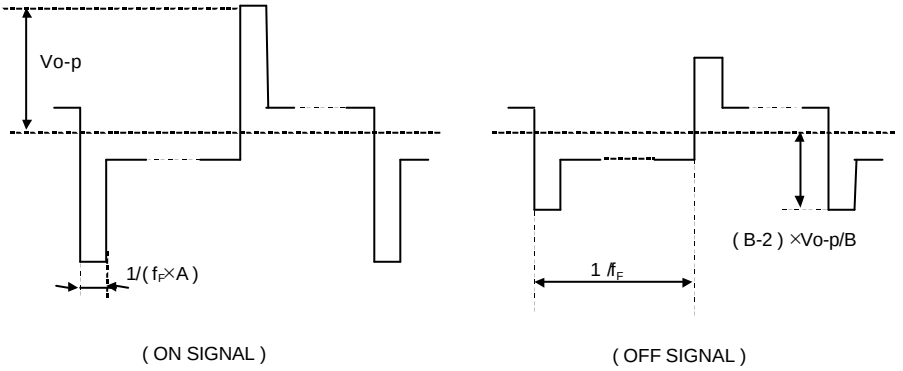
Note 4 :Definition of Driving Voltage V_{OD}

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

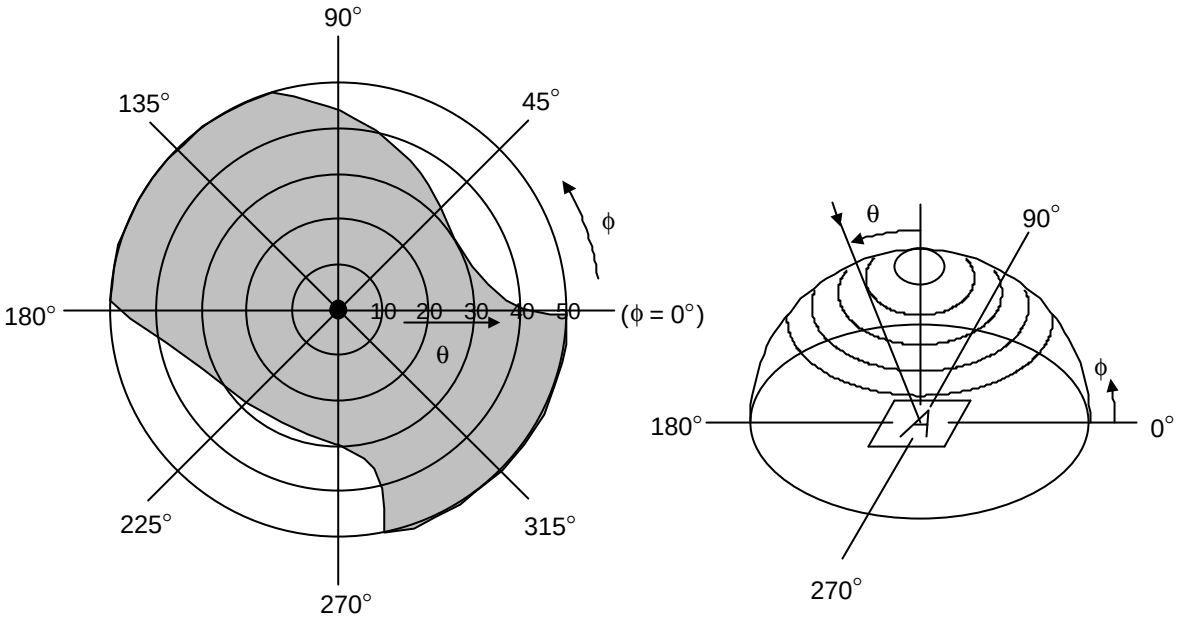
Vth1: The voltage V_{O-P} that should provide 70% of the saturation level in the luminance at the segment which the ON signal is applied to.

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.



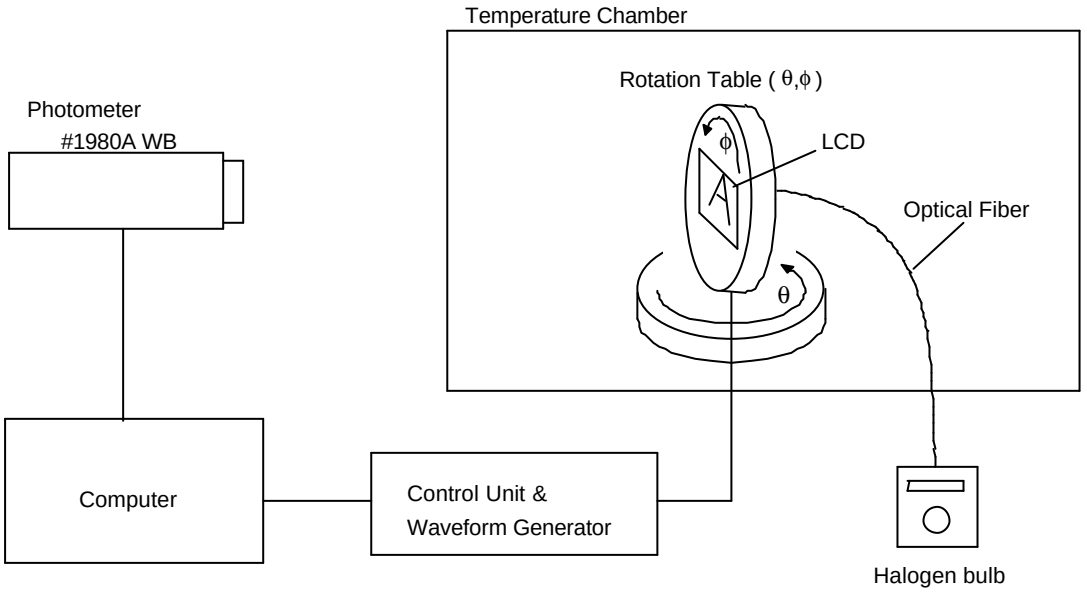
3.2. Definition of Viewing Angle and Optimum Viewing Area

*Point • shows the point where contrast ratio is measured. : θ= 0°, ϕ=-°
*Driving condition: 1/65 Duty, 1/8 Bias, V_{OD}=10.1V, f_F=72Hz



*Area ▭ shows typ. CR≥2.5(Measuring Spot : 3.0mmϕ)

3.3. System Block Diagram



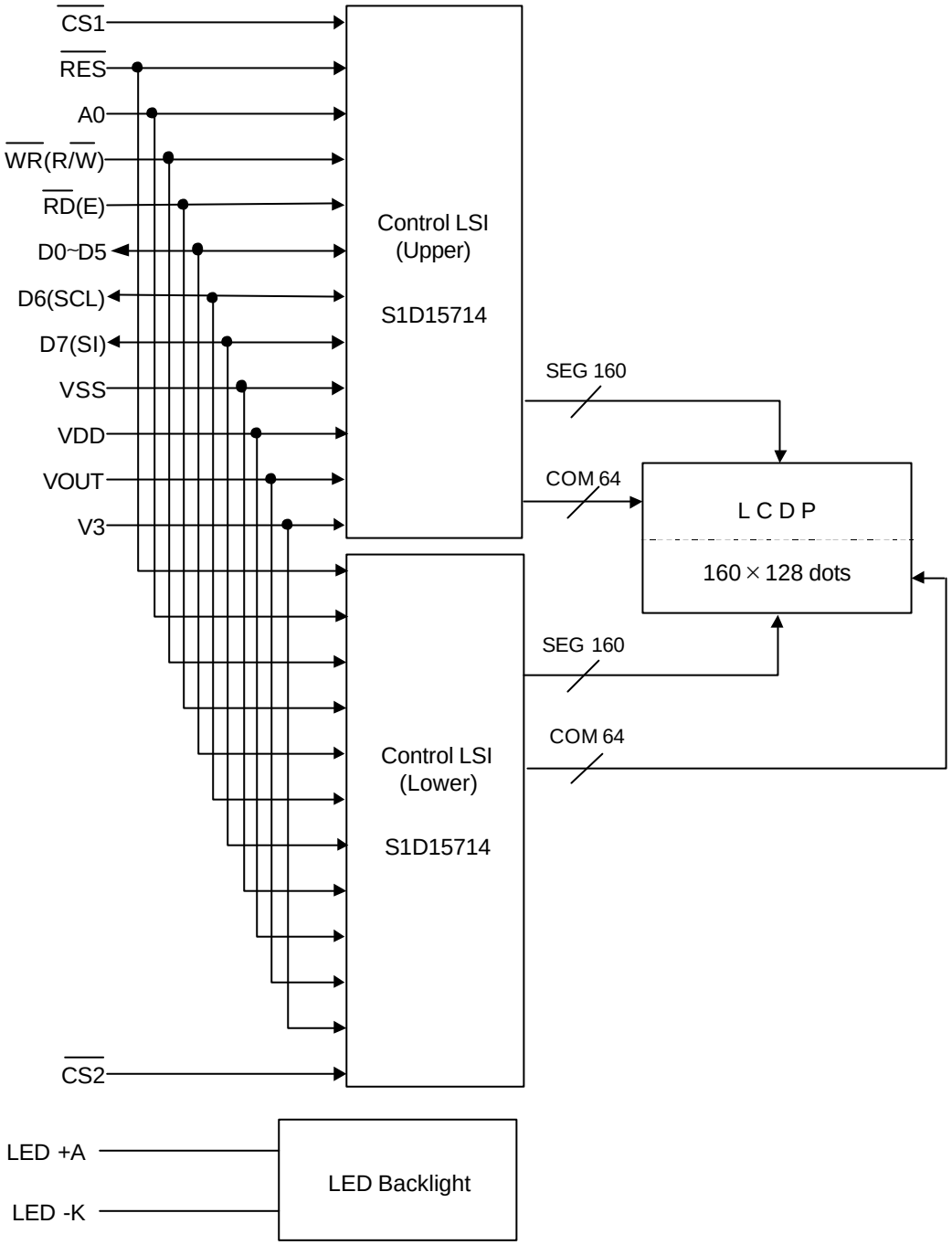
4.I/O Terminal

4.1. Pin Assignment

CN1

No.	Symbol	Function
1	$\overline{CS1}$	Chip Select Signal L : Active(Upper Display)
2	$\overline{CS2}$	Chip Select Signal L : Active(Lower Display)
3	$\overline{RES}$	Reset Signal L : Reset
4	A0	H : D0~D7 are Display Data L : D0~D7 are Instructions
5	$\overline{WR}$ (R/$\overline{W}$)	80 family CPU : Write Signal L : Active 68 family CPU : Read/Write Select Signal H : Read
6	$\overline{RD}$ (E)	80 family CPU : Read Signal L : Active 68 family CPU : Enable Signal H : Active
7	D0	Display Data
8	D1	Display Data
9	D2	Display Data
10	D3	Display Data
11	D4	Display Data
12	D5	Display Data
13	D6(SCL)	Display Data
14	D7(SI)	Display Data
15	V_{SS}	Power Supply (0V, GND)
16	V_{DD}	Power Supply for Logic
17	V_{OUT}	DC/DC Voltage Converter Output
18	V_3	Power Supply for LCD Drive
19	LED +A	LED Anode Terminal
20	LED -K	LED Cathode Terminal

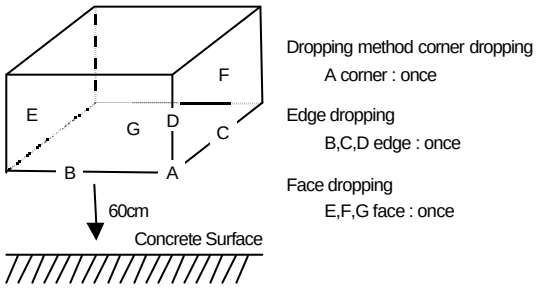
4.2. Block Diagram



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.

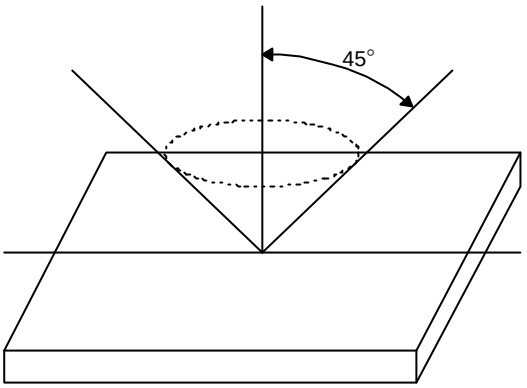
No.	Parameter	Conditions	Notes
1	High Temperature Operating	70°C±2°C, 96hrs (operation state)	
2	Low Temperature Operating	-20°C±2°C, 96hrs (operation state)	1
3	High Temperature Storage	70°C±2°C, 96hrs	2
4	Low Temperature Storage	-20°C±2°C, 96hrs	1,2
5	Damp Proof Test	40°C±2°C,90~95%RH, 96hrs	1,2
6	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.

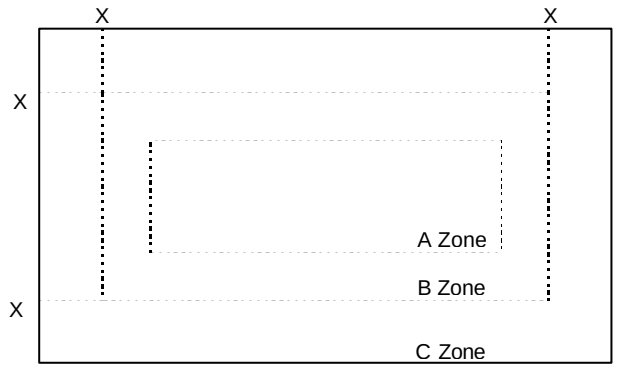
6.Appearance Standards

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



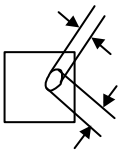
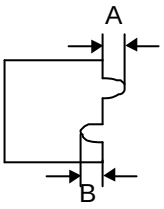
X : Maximum Seal Line

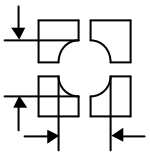
A Zone : Active display area
B Zone : Out of active display area ~ Maximum seal line
C Zone : Rest parts

A Zone + B Zone = Validity viewing area

6.3. Standards(middle scale, LED)

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

<table>
<tr><th>No.</th><th>Parameter</th><th>Criteria</th></tr>
<tr><td>1</td><td>The Shape of Dot</td><td>
(1) Pin Hole

<table>
<tr><th>Dimension</th><th>Acceptable Number</th></tr>
<tr><td>D ≤ 0.10</td><td>*</td></tr>
<tr><td>0.10 < D ≤ 0.20</td><td>1 pc / dot(only segment)or less
5 pcs / cell or less</td></tr>
</table>
(2) Breakage or Chips / Deformation
1.Dot Type


<table>
<tr><th>Dimension</th><th>Acceptable Number</th></tr>
<tr><td>A≤0.10</td><td>*
(Should not be connected to next dot)</td></tr>
<tr><td>0.10<A≤0.15</td><td>1 pc / dot(only segment)or less
5 pcs / cell or less
(Should not be connected to next dot)</td></tr>
<tr><td>B ≤ 0.15</td><td>*</td></tr>
</table>
2.Defective type extends over multiple numbers of dots

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

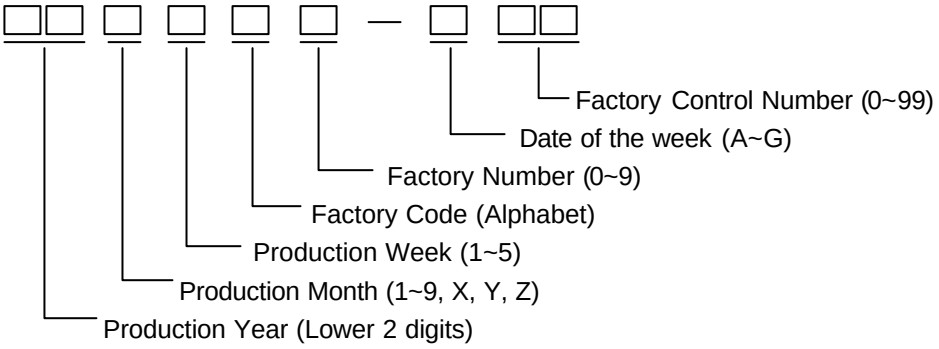
D = (Long + Short) / 2 * : Disregard Units : mm

<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>Zone / Dimension</th><th>Acceptable Number</th><th></th><th></th></tr>
<tr><td></td><td>A</td><td>B</td><td>C</td></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>Length \ Zone / Width</th><th></th><th>Acceptable Number</th><th></th><th></th></tr>
<tr><td></td><td></td><td>A</td><td>B</td><td>C</td></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>Zone / Dimension</th><th>Acceptable Number</th><th></th><th></th></tr>
<tr><td></td><td>A</td><td>B</td><td>C</td></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>

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-51854GNFJ-SLW-ABN

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.