First Edition
Aug 2, 2004

LCD Module Technical Specification

Final Revision
******

Type No. **F-51824FNF-SLW-AE**

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. 70°C
Dot Pixels	:	160 (W) × 128 (H) dots
Dot Size	:	0.23 (W) × 0.23 (H) mm
Dot Pitch	:	0.24 (W) × 0.24 (H) mm
Viewing Area	:	40.8 (W) × 32.91 (H) mm
Outline Dimensions	:	53.1* (W) × 40.5 (H) × 2.0** (D) mm * Without FPC ** Without GASKET
Weight	:	9.8g max.
LCD Type	:	NSD-22800 (F-STN / Black&White-mode / Transflective)
Viewing Angle	:	6:00
Data Transfer	:	8-bit parallel data transfer
Backlight	:	LED Backlight / White
Drawings	:	Dimensional Outline UE-312624 Circuit Diagram UE-312120

2.Electrical Specifications

2.1.Absolute Maximum Ratings

GND=0V

Parameter	Symbol	Conditions	Min.	Max.	Units
Supply Voltage (Logic)	V_{CC}-GND	Note.1	-0.3	4.6	V
Input Voltage	V_I		-0.3	V_{CC}+0.3	V

Note.1: V_{CC}>GND must be maintained.

2.2.DC Characteristics

Ta=25°C, V_{CC}=3.0~3.6V

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Supply Voltage (Logic)	V_{CC}- GND	-	3.0	-	3.6	V
Supply Voltage (LCD Drive)	V_{1OUT}-GND	Shown in 3.1				V
High Level Input Voltage	V_{IH}	-	0.7×V_{CC}	-	V_{CC}	V
Low Level Input Voltage	V_{IL}	V_{CC}=3.0~3.6V	-0.3	-	0.15×V_{CC}	V
High Level Output Voltage	V_{OH1}	I_{OH}=-0.1mA	0.75×V_{CC}	-	-	V
Low Level Output Voltage	V_{OL1}	V_{CC}=3.0~3.6V I_{OL}=0.1mA	-	-	0.15×V_{CC}	V
Supply Current	I_{CC}	V_{CC}-GND=3.3V f_{OSC}=70kHz	-	2.4	3.6	mA

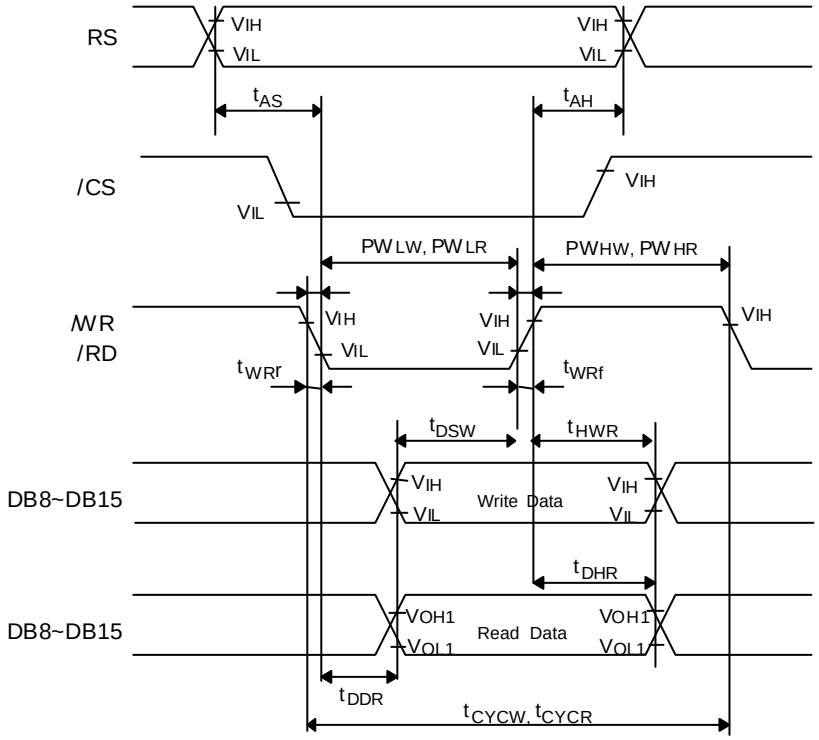
2.3. AC Characteristics

2.3.1. Timing Characteristics

80-system Bus Interface Timing Characteristics

V_{CC}=3.0~3.6V

Parameter		Symbol	Conditions	Min.	Max.	Units
Bus cycle Time	Write	t_{CYCW}	Fig.2	380	-	ns
	Read	t_{CYCR}	Fig.2	500	-	ns
Write low-level pulse width		PW_{LW}	Fig.2	70	-	ns
Read low-level pulse width		PW_{LR}	Fig.2	250	-	ns
Write High-level pulse width		PW_{HW}	Fig.2	150	-	ns
Read High-level pulse width		PW_{HR}	Fig.2	200	-	ns
Write Read Rise/Fall Time		$t_{WRr,WRf}$	Fig.2	-	25	ns
SetupTime (RS to CS*,WR*,RD*)		t_{AS}	Fig.2	50	-	ns
Address hold Time		t_{AH}	Fig.2	20	-	ns
Write Data Setup Time		t_{DSW}	Fig.2	60	-	ns
Write Data Hold Time		t_H	Fig.2	20	-	ns
Read Data Delay Time		t_{DDR}	Fig.2	-	200	ns
Read Data Hold Time		t_{DHR}	Fig.2	5	-	ns



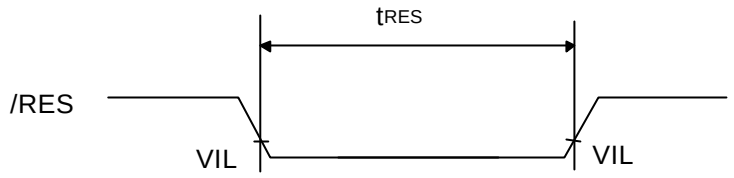
PW_{LW} and PW_{LR} are specified in the overlapped period when CS is low and WR* or RD* is low.

Fig 2. Read Write Operation Timing

2.3.2. Reset Timing Characteristics

V_{CC}=3.0~3.6V

Parameter	Symbol	Min.	Max.	Units
Reset Low Level Width	t_{RES}	1	-	ms

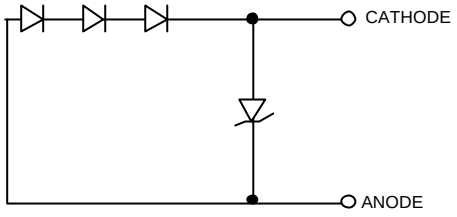


2.4. Lighting Specifications

2.4.1. Absolute Maximum Ratings (Only 1 chip)

Ta=25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Foward Current	I_F	-	-	-	30	mA
Reverse Voltage	V_R	-	-	-	5.0	V
LED Power Dissipation	P_D	-	-	-	120	mW



2.4.2. Operating Characteristics

(Only LED) Ta=25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Foward Current Note.1	I_F	V_F=10.0V	-	15	-	mA
Luminance of Backlight Surface	L	V_F=10.0V Note.1	-	900	-	cd/m^2

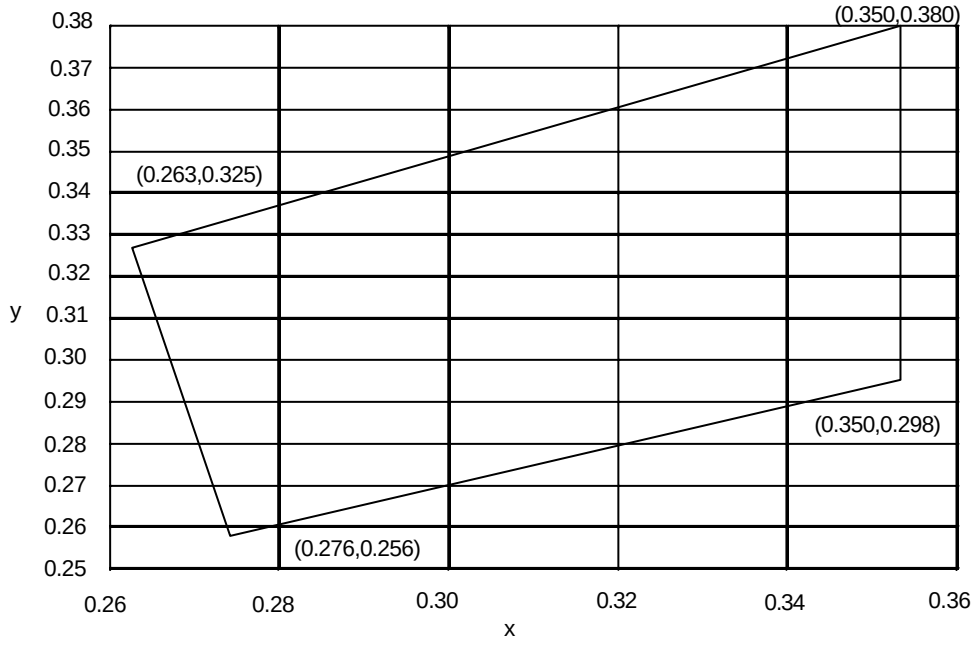
Note.1: Backlight(Center)

(MDL) Ta=25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Luminance of Backlight Surface	L	I_F=15mA Note.2	70	90	-	cd/m^2

Note.2: Active Area Center

2.4.3. Color tone range



3.Optical Specifications

3.1. LCD Driving Voltage

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Recommended		Ta= 0°C	-	-	13.4	V
LCD Driving Voltage	V_{1OUT}-GND	Ta=25°C	11.9	12.8	13.7	V
Note 1		Ta=50°C	11.6	-	-	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, 1/128 Duty, 1/7 Bias, V_{OD}=12.8V (Note 4), θ= 0°, ϕ=285°

Parameter		Symbol	Conditions	Min.	Typ.	Max.	Units
Contrast Ratio Note 1		CR	θ= 0°,ϕ=285°	3.0	5.0	-	
Viewing Angle			Shown in 3.3				
Response	Rise Note 2	T_{ON}	-	-	200	300	ms
Time	Decay Note 3	T_{OFF}	-	-	270	410	ms

Note 1 :Contrast ratio is definded 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.

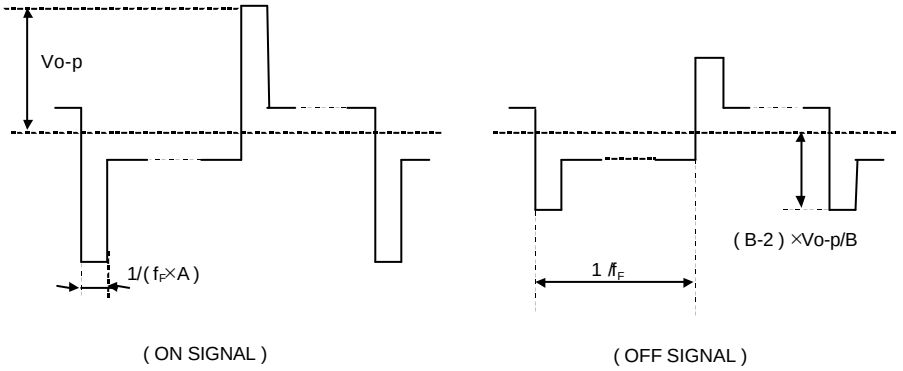
Note 4 :Definition of Driving Voltage V_{OD}

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 definded 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.

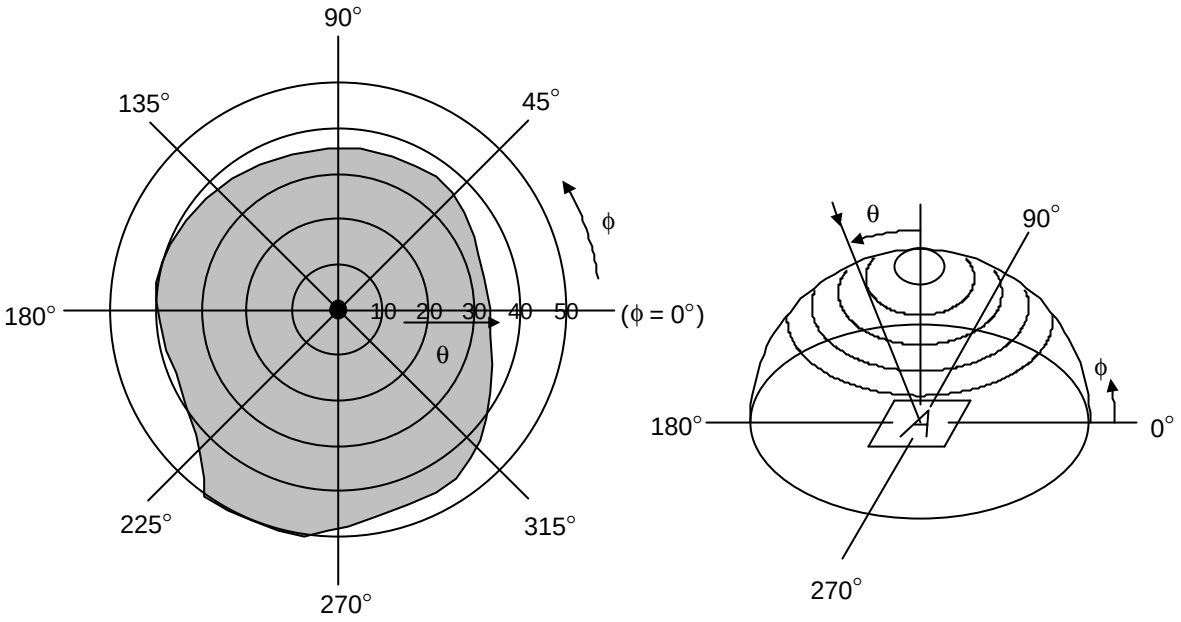
Vth2: The voltage V_{O-P} that should provide 20% of the saturation level in the luminance at the segment which the OFF signal is applied to.



(ON SIGNAL) (OFF SIGNAL)

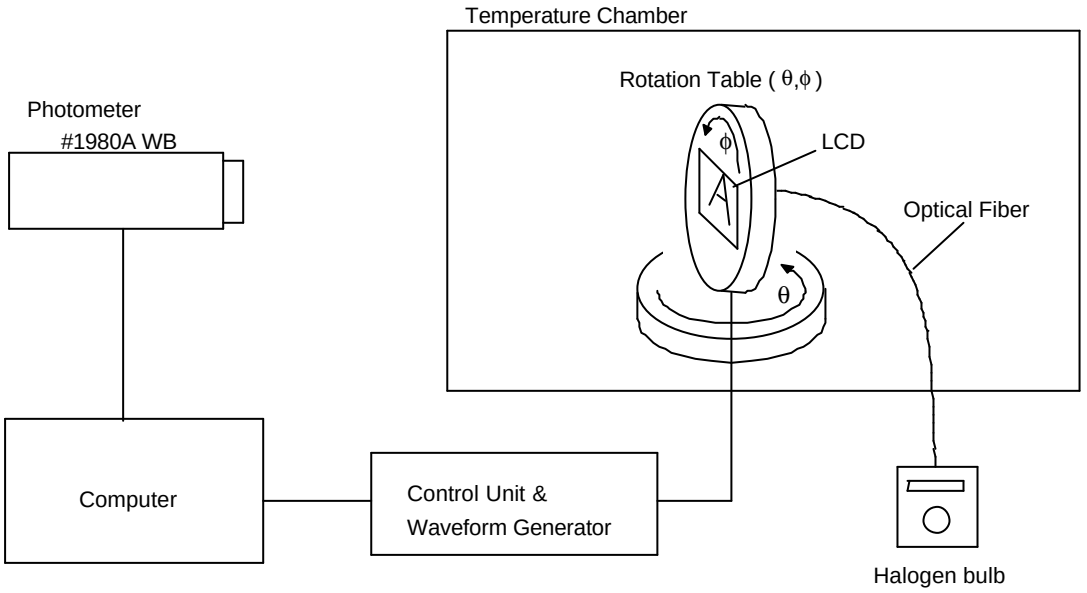
3.3. Definition of Viewing Angle and Optimum Viewing Area

*Point • shows the point where contrast ratio is measured. : θ= 0°, ϕ=285°
*Driving condition: 1/128 Duty, 1/7 Bias, V_{OD}=12.8V, f_F=80Hz



*Area ▭ shows typ. CR≥2.0(Measuring Spot : 3mmϕ)

3.4. System Block Diagram



4.I/O Terminal

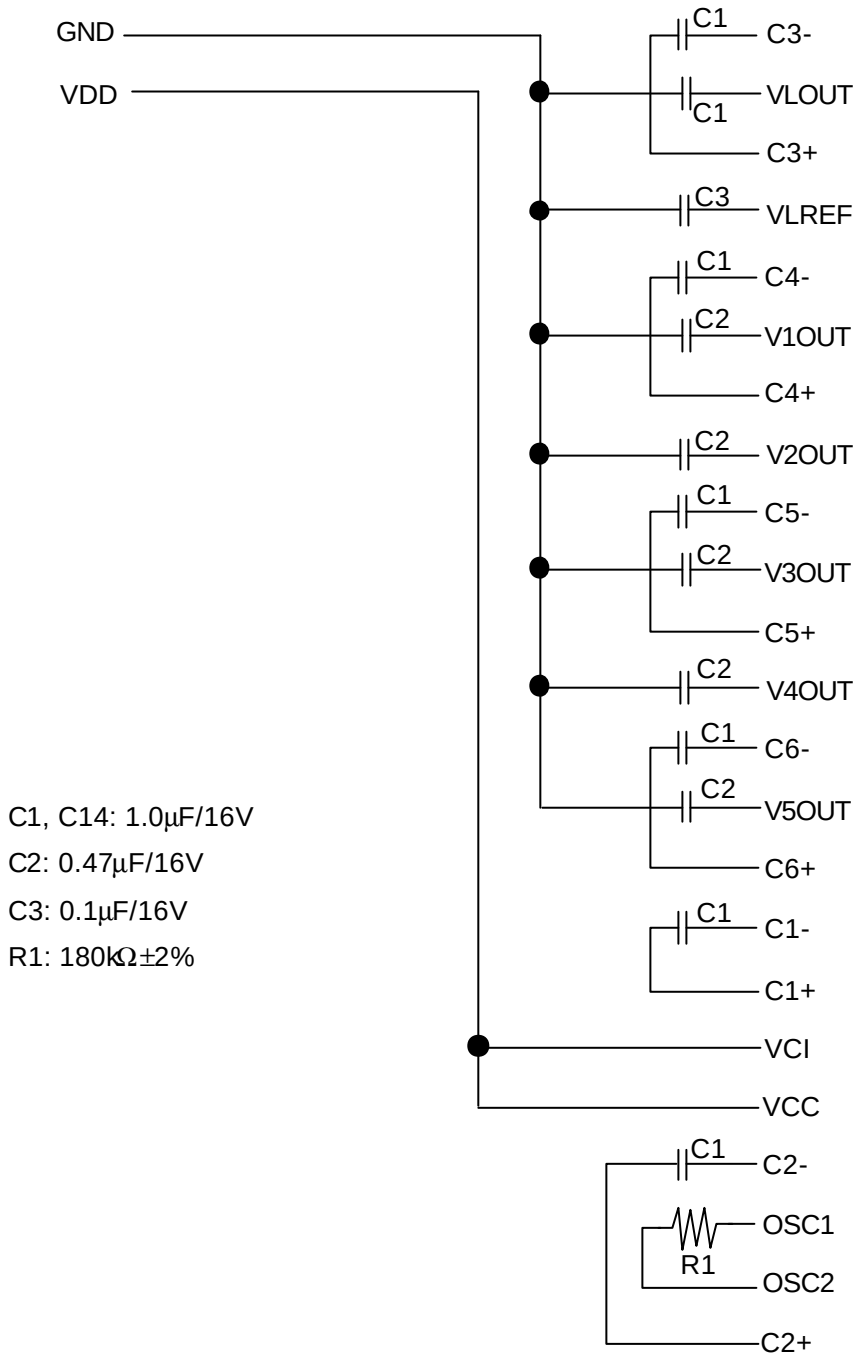
4.1. Pin Assignment

CN1

No.	Symbol	Function
1	LED-A	LED Anode Terminal
2	LED-K	LED Cathode Terminal
3	GNDDUM	Power Supply (0V, GND)
4	DB15	Display Data
5	DB14	Display Data
6	DB13	Display Data
7	DB12	Display Data
8	DB11	Display Data
9	DB10	Display Data
10	DB9	Display Data
11	DB8	Display Data
12	/RESET	Reset Signal L : Reset
13	/CS	Chip Select Signal L : Active
14	RS	Register Select Signal H:RAM Write/Read, L:Instraction
15	/WR	Write Signal L : Active
16	/RD	Read Signal L : Active
17	GND	Power Supply (0V, GND)
18	OSC2	Input for External Clock
19	OSC1	Connecting Pins for Oscillation Resistor
20	VCC	Power Supply for Logic
21	VCI	Power Supply for booster
22	C6+	DC/DC Voltage Converter Capacitor 6 Positive
23	C6-	DC/DC Voltage Converter Capacitor 6 Negative
24	C5+	DC/DC Voltage Converter Capacitor 5 Positive
25	C5-	DC/DC Voltage Converter Capacitor 5 Negative
26	C4+	DC/DC Voltage Converter Capacitor 4 Positive
27	C4-	DC/DC Voltage Converter Capacitor 4 Negative
28	C3+	DC/DC Voltage Converter Capacitor 3 Positive
29	C3-	DC/DC Voltage Converter Capacitor 3 Negative
30	C2+	DC/DC Voltage Converter Capacitor 2 Positive
31	C2-	DC/DC Voltage Converter Capacitor 2 Negative
32	C1+	DC/DC Voltage Converter Capacitor 1 Positive
33	C1-	DC/DC Voltage Converter Capacitor 1 Negative
34	VLOUT	DC/DC Voltage Converter Output
35	VLREF	LCD Drive Voltage regulator Pin to Capacitor

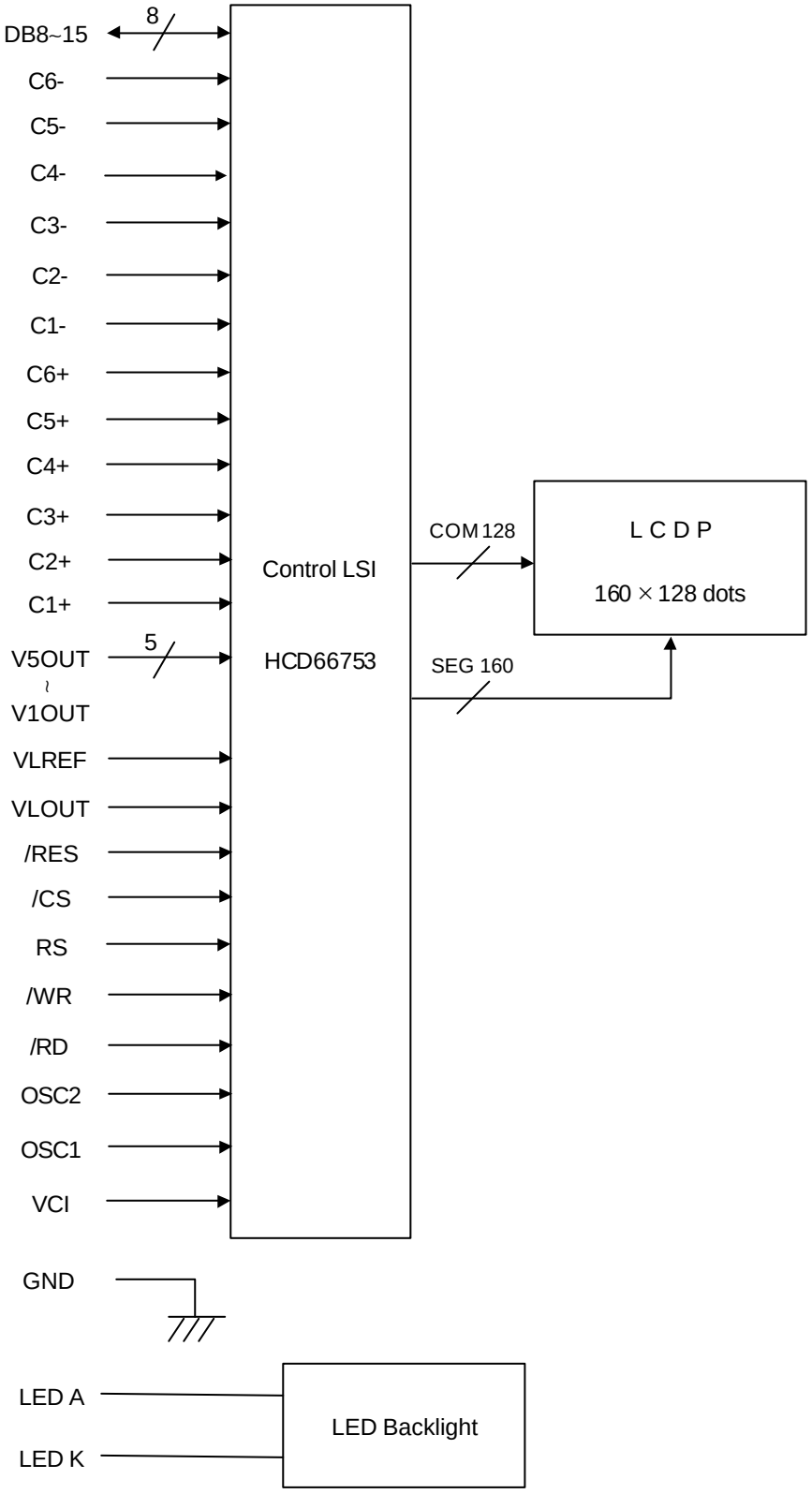
36	V1OUT	Power Supply for LCD Drive V_1 = VLCD
37	V2OUT	Power Supply for LCD Drive V_2 = 5/6,V_1
38	V3OUT	Power Supply for LCD Drive V_3 = 4/6,V_1
39	V4OUT	Power Supply for LCD Drive V_4 = 2/6,V_1
40	V5OUT	Power Supply for LCD Drive V_5, 1/6,V_1

4.2. Example of Power Supply



C1, C14: 1.0μF/16V
C2: 0.47μF/16V
C3: 0.1μF/16V
R1: 180kΩ±2%

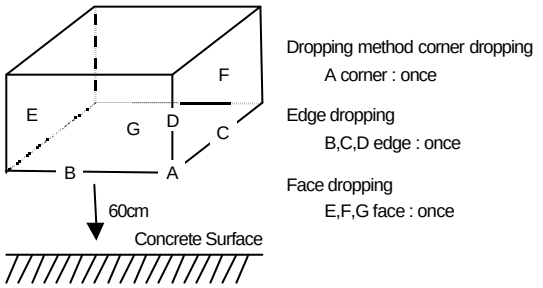
4.3. Block Diagram



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.

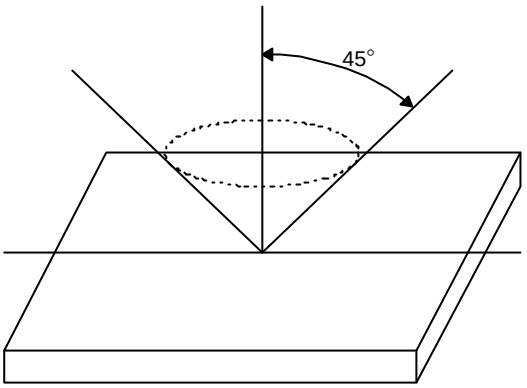
No.	Parameter	Conditions	Notes
1	High Temperature Operating	50°C±2°C, 96hrs (operation state)	
2	Low Temperature Operating	0°C±2°C, 96hrs (operation state)	1
3	High Temperature Storage	70°C±2°C, 96hrs	2
4	Low Temperature Storage	-20°C±2°C, 96hrs	1,2
5	Damp Proof Test	40°C±2°C,90~95%RH, 96hrs	1,2
6	Vibration 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.

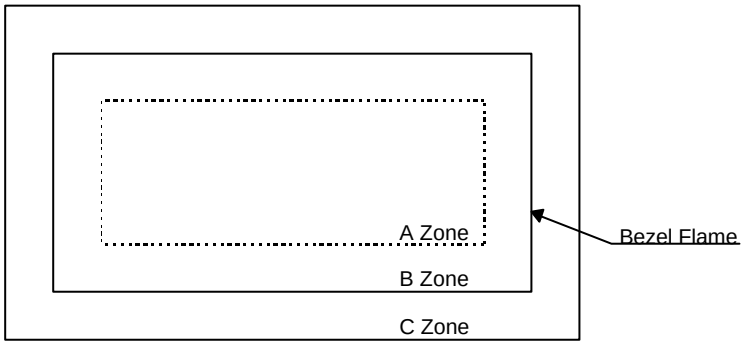
6.Appearance Standards

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

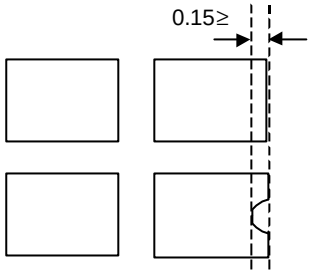


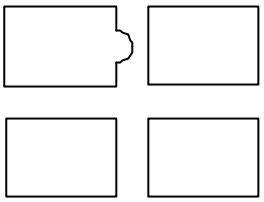
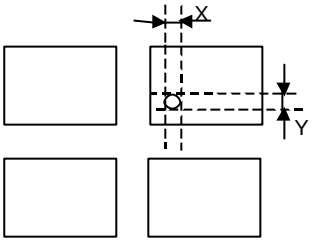
A Zone : Active display area
B Zone : Area from outside of "A Zone" to validity viewing area
C Zone : Rest parts

A Zone + B Zone = Validity viewing area

6.3. Standards

<table>
<tr><th>No.</th><th>Parameter</th><th>Criteria</th></tr>
<tr><td>1</td><td>Black and White Spots, Foreign Substances</td><td>(1) Round Shape
<table>
<tr><th rowspan="2">Zone / Dimension (mm)</th><th colspan="2">Acceptable Number</th></tr>
<tr><th>A+B</th><th>C</th></tr>
<tr><td>D ≤ 0.10</td><td>*</td><td>*</td></tr>
<tr><td>0.10 < D ≤ 0.25</td><td>5</td><td>*</td></tr>
<tr><td>0.25 < D ≤ 0.30</td><td>1</td><td>*</td></tr>
<tr><td>0.30 < D</td><td>0</td><td>*</td></tr>
</table>
D = (Long + Short) / 2 * : Disregard
(2) Line Shape
<table>
<tr><th rowspan="2">X(mm) / Zone / Y(mm)</th><th colspan="2">Acceptable Number</th></tr>
<tr><th>A+B</th><th>C</th></tr>
<tr><td>-</td><td>0.02≥W</td><td>*</td><td>*</td></tr>
<tr><td>2.0≥L</td><td>0.03≥W</td><td>3</td><td>*</td></tr>
<tr><td>1.0≥L</td><td>0.04≥W</td><td>2</td><td>*</td></tr>
<tr><td>1.0<L</td><td>0.04<W</td><td>0</td><td>*</td></tr>
</table>
X : Length Y : Width * : Disregard
Total defects shall not exceed 5.</td></tr>
<tr><td>2</td><td>Air Bubbles (between glass & polarizer)</td><td>
<table>
<tr><th rowspan="2">Zone / Dimension (mm)</th><th colspan="2">Acceptable Number</th></tr>
<tr><th>A+B</th><th>C</th></tr>
<tr><td>D < 0.15</td><td>*</td><td>*</td></tr>
<tr><td>0.15≤ D ≤0.3</td><td>3</td><td>*</td></tr>
<tr><td>0.3 < D ≤0.5</td><td>2</td><td>*</td></tr>
<tr><td>0.5 < D</td><td>0</td><td>*</td></tr>
</table>
* : Disregard
Total defects shall not exceed 3.</td></tr>
<tr><td>3</td><td>Maximim allowable Number of Visual defects</td><td>Total defects shall not exceed 8.</td></tr>
</table>

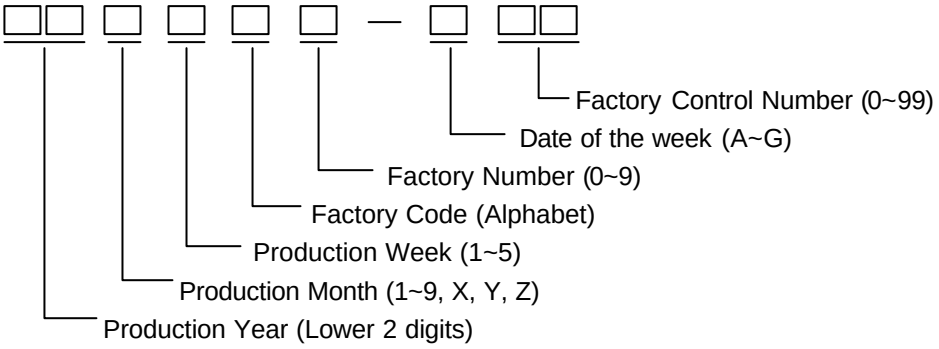
<table>
<tr><th>No.</th><th>Parameter</th><th>Criteria</th></tr>
<tr><td>4</td><td>The Shape of Dot</td><td>(1) Dot Shape (with Dent)
 

As per the sketch of left hand.
(2) Dot Shape (with Projection)
 
Should not be connected to next dot.
(3) Pin Hole
 

(X+Y) / 2≤0.2mm
(Less than 0.1mm is no counted.)
Total defects shall not exceed 5.</td></tr>
<tr><td>5</td><td>Polarizer Scratches</td><td><table>
<tr><th rowspan="2">X(mm) \ Y(mm) \ Zone</th><th colspan="2">Acceptable Number</th></tr>
<tr><th>A+B</th><th>C</th></tr>
<tr><td>3.0≥L</td><td>0.05≥W</td><td>2</td><td>*</td></tr>
<tr><td>3.0<L</td><td>0.05<W</td><td>0</td><td>*</td></tr>
</table></td></tr>
<tr><td>6</td><td>Polarizer Dirts</td><td>If the stains are removed easily from LCDP surface, the module is not not defective.</td></tr>
<tr><td>7</td><td>Color Variation</td><td>Not to be conspicuous defects.</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-51824FNF-SLW-AE

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) 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.