



LCD Module Technical Specification

First Edition
Jan 20, 2000

Final Revision
Aug 2, 2001

Type No. **DMF-50840NB-FW-AKE-AS**

Approved by (Production Div.)

Checked by (Quality Assurance Div.)

Checked by (Design Engineering Div.)

Prepared by (Production Div.)

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Revision History

Rev.	Date	Page	Comment
2	Aug 2, 2001	2, 12 7 8	Change of Operating Temperature. (0°C ~50°C→0°C ~60°C) 2.7 Lighting Specifications Change of Backlight's Average Life. (25000hrs→50000hrs) 3.1 LCD Driving Voltage The driving voltage is changed along with the temperature range change. (Ta=60°C Min.)

1. General Specifications

Operating Temp.	:	min. 0°C ~max. 60°C
Storage Temp.	:	min. -20°C ~max. 60°C
Dot Pixels	:	320 (W) × 240 (H) dots
Dot Size	:	0.33 (W) × 0.33 (H) mm
Dot Pitch	:	0.36 (W) × 0.36 (H) mm
Viewing Area	:	120.0 (W) × 90.0 (H) mm
Outline Dimensions	:	167.1 (W) × 109.0* (H) × 11.0max.* (D) mm *Without Connector **Without CFL Cable
Weight	:	230g max.
LCD Type	:	NTD-15885 (STN / Blue-mode / Transmissive)
Viewing Angle	:	6:00
Data Transfer	:	4-bit parallel data transfer
Backlight	:	Cold Cathode Fluorescent Lamp (CFL) × 1
Additional Spec.	:	Electroplated Coating of Black-Zinc on Steel Holder Type
Drawings	:	Dimensional Outline UE-36988

2. Electrical Specifications

2.1. Absolute Maximum Ratings

V_{SS}=0V

Parameter	Symbol	Conditions	Min.	Max.	Units
Supply Voltage (Logic)	V _{CC} -V _{SS}	-	-0.3	7.0	V
Supply Voltage (LCD Drive)	V _{CC} -V _{EE}	-	0	35.0	V
Input Voltage	V _I	-	-0.3	V _{CC} +0.3	V

2.2. DC Characteristics

T_a=25°C, V_{SS}=0V

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Supply Voltage (Logic)	V _{CC} -V _{SS}	-	4.5	-	5.5	V
Supply Voltage (LCD Drive)	V _{CC} -V _{EE}	-	26.4	-	30.0	V
	V _{CC} -V _{ADJ}	Shown in 3.1				V
High Level Input Voltage	V _{IH}	V _{CC} =5.0V±10%	0.8×V _{CC}	-	V _{CC}	V
Low Level Input Voltage	V _{IL}	V _{CC} =5.0V±10%	0	-	0.2×V _{CC}	V
Supply Current	I _{CC}	V _{CC} -V _{SS} =5.0V	-	5.5	15.0	mA
	I _{EE}	V _{CC} -V _{ADJ} =23.3V	-	5.0	10.0	mA

2.3.AC Characteristics

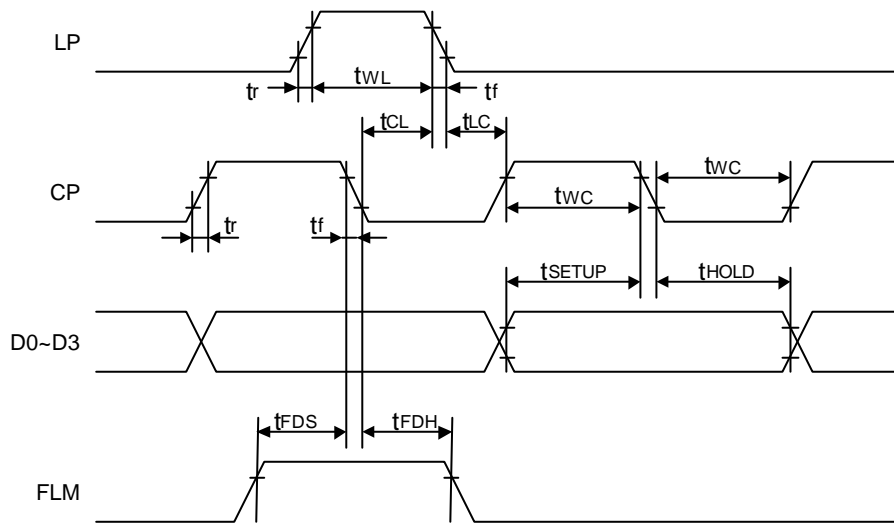
V_{CC}=5.0V±10%

Parameter	Symbol	Min.	Max.	Units
CP Frequency	f _{CP}	-	6.0	MHz
Clock Pulse Width	t _{WC}	50	-	ns
Latch Pulse Width	t _{WL}	63	-	ns
Data Setup Time	t _{SETUP}	30	-	ns
Data Hold Time	t _{HOLD}	30	-	ns
Clock Pulse Setup Time	t _{CL}	80	-	ns
Clock Pulse Hold Time	t _{LC}	0	-	ns
Rise/Fall Time	t _r , t _f	-	Note 1	ns
FLM Setup Time	t _{FDS}	100	-	ns
FLM Hold Time	t _{FDH}	100	-	ns

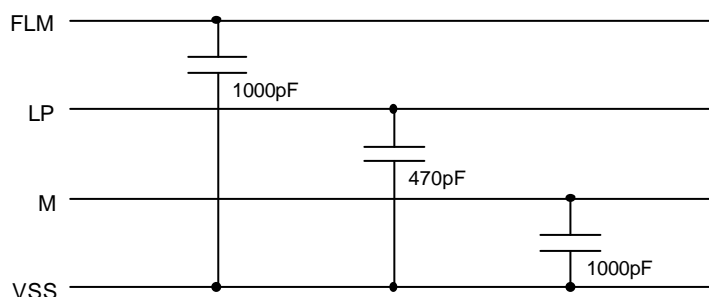
Note 1: The rise and fall times (t_r, t_f) must satisfy the following relationships.

$$t_r, t_f \leq \frac{1}{2f_{CP}} - t_{WC}$$

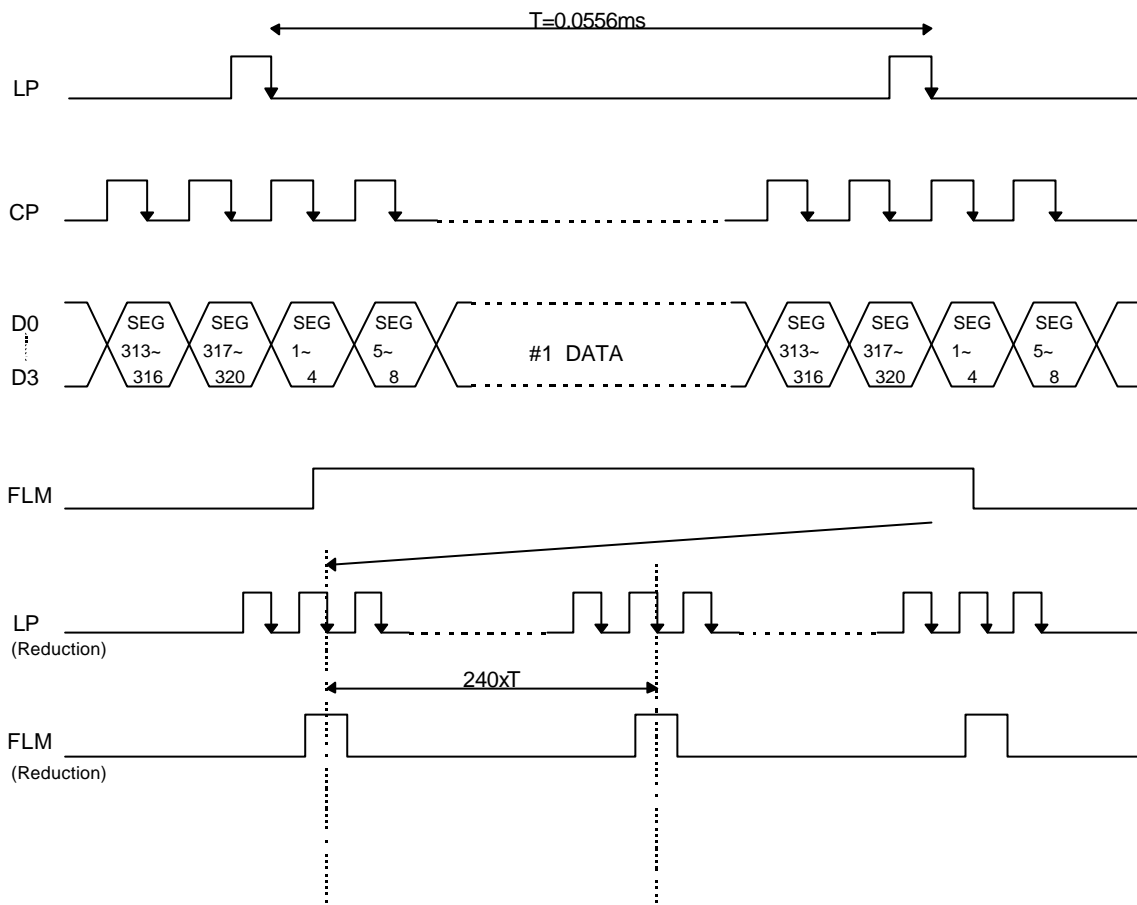
$$t_r, t_f \leq 50 \text{ ns}$$



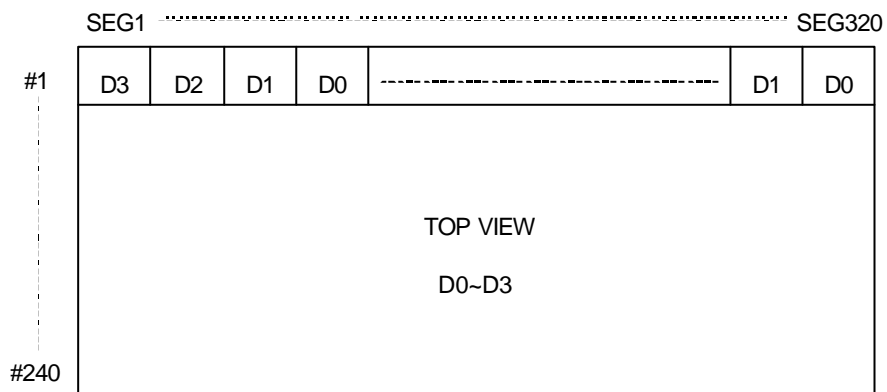
This module contains these capacitors. Please be careful about timing characteristics.



2.4. Timing Chart

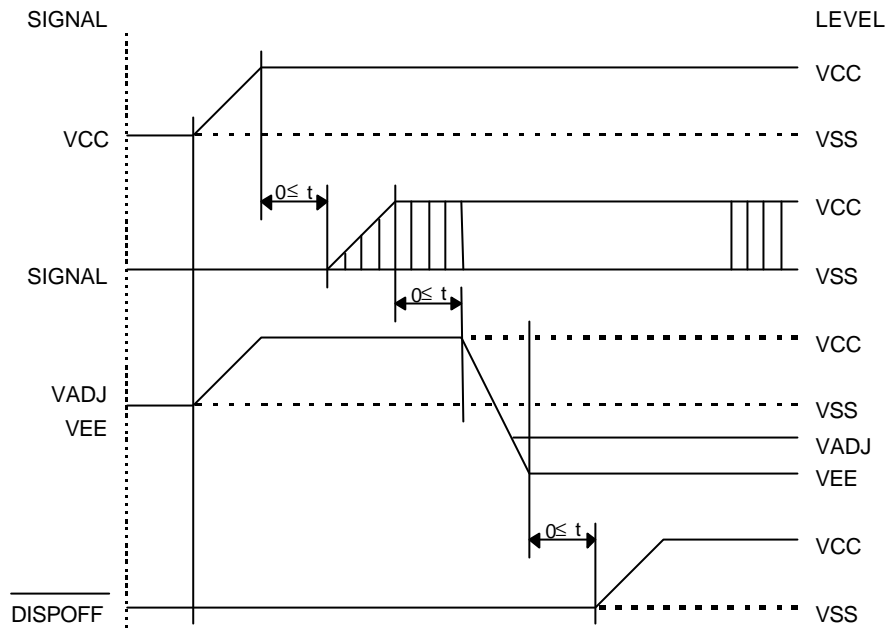


2.5. Comparison of Display and Data

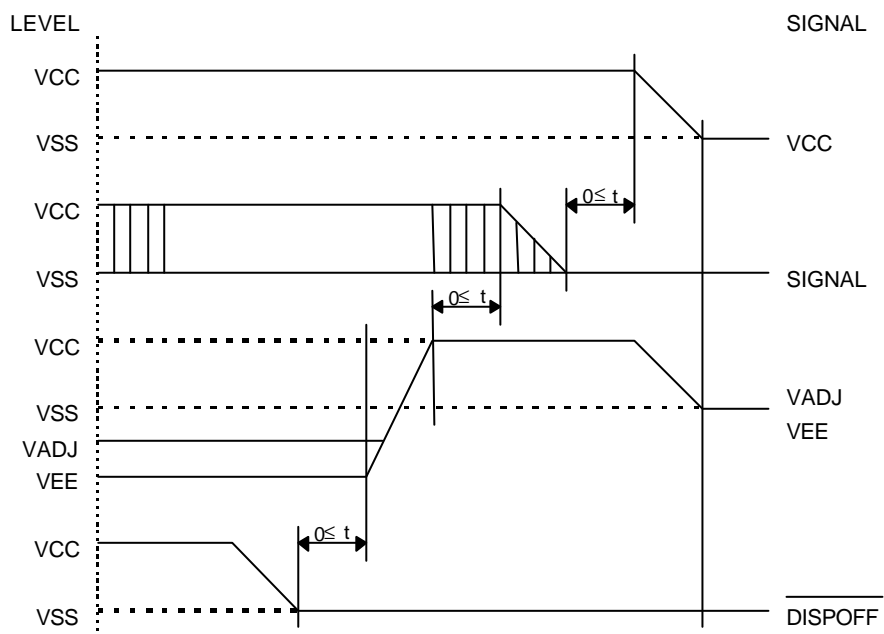


2.6. Power Supply ON/OFF Sequence

2.6.1. ON Sequence



2.6.2. OFF Sequence



Please maintain the above sequence when turning on and off the power supply of the module.

If DISPOFF is supplied to the module while internal alternate signal for LCD driving (M) is unstable, DC component will be supplied to the LCD panel. This may cause damage the LCD module.

2.7. Lighting Specifications

Ta=25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units	Notes
Lamp Voltage	V _L	-	-	340	-	V _{rms}	1
Lamp Current	I _L	-	3.0	4.0	5.0	mArms	2
Starting Voltage	V _s	-	850	-	-	V _{rms}	3
Surface Luminance	L	I _L =4.0mA	-	60	-	cd/m ²	4
Average Life	T _{AL}	I _L =4.0mA	50000	-	-	hrs	5
Brightne Ratio	B	I _L =4.0mA	70	-	-	%	

Note 1 :The voltage (r.m.s.) to maintain the electric discharge of the lamp. It is measured after lighting for 3 minutes .

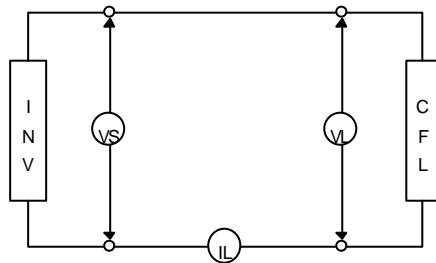
Note 2 :The current (r.m.s.) to flow through the lamp with the electric discharge. It is measured after lighting for 3 minutes.

Note 3 :The voltage at starting the electric discharge when the voltage is increased gradually from 0V.

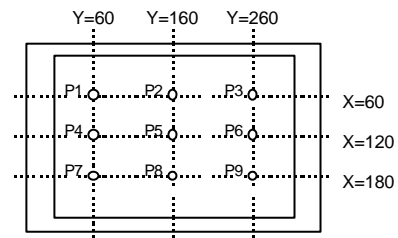
Note 4 :Surface Luminance is specified by the average of 9 luminance values measured at each point shown above after 20 minutes power on with the all ON pattern adjusted to maximum contrast and the dimming control of 100%. (maximum brightness)

Note 5 : CFL Life is defined as time period that the actual luminance becomes 50% or lower of its initial value.

The Average life time of CFL is defined as the time when half or more of the testing CFLs have become less bright than 50% of the initial brightness at continuous operation.



CFL Testina Circuit



Measurement Points

Recommended Inverter : S-12561 (Produced by ELEVAM)

CXA-L10L (DC 12.0V, Produced by TDK)

3. Optical Specifications

3.1. LCD Driving Voltage

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Recommended LCD Driving Voltage Note 1	$V_{CC}-V_{ADJ}$	$T_a=0^{\circ}\text{C}$	-	-	26.4	V
		$T_a=25^{\circ}\text{C}$	21.7	23.3	24.9	V
		$T_a=60^{\circ}\text{C}$	20.0	-	-	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

$T_a=25^{\circ}\text{C}$, 1/240 Duty, 1/14 Bias, $V_{OD}=22.7\text{V}$ (Note 4), $\theta=0^{\circ}\text{C}$, $\phi=-^{\circ}$

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Contrast Ratio Note 1	CR	$\theta=0^{\circ}\text{C}$, $\phi=-^{\circ}$	-	5	-	
Viewing Angle		Shown in 3.3				
Response Time	Rise Note 2	T_{ON}	-	250	380	ms
	Decay Note 3	T_{OFF}	-	280	420	ms

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

L_{ON} : Luminance of the ON segments

L_{OFF} : Luminance of the OFF segments

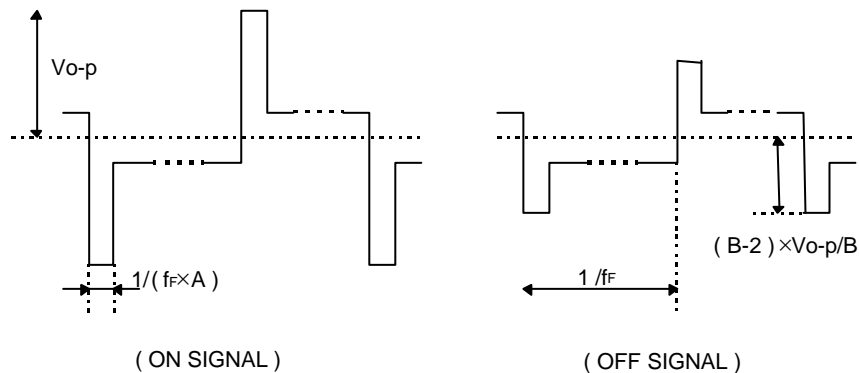
Note 2 : The time that the luminance level reaches 90% of the saturation level from 0% when ON signal is applied.

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}

$$V_{OD} = V_{CC} - V_{ADJ} - V_{BE}$$

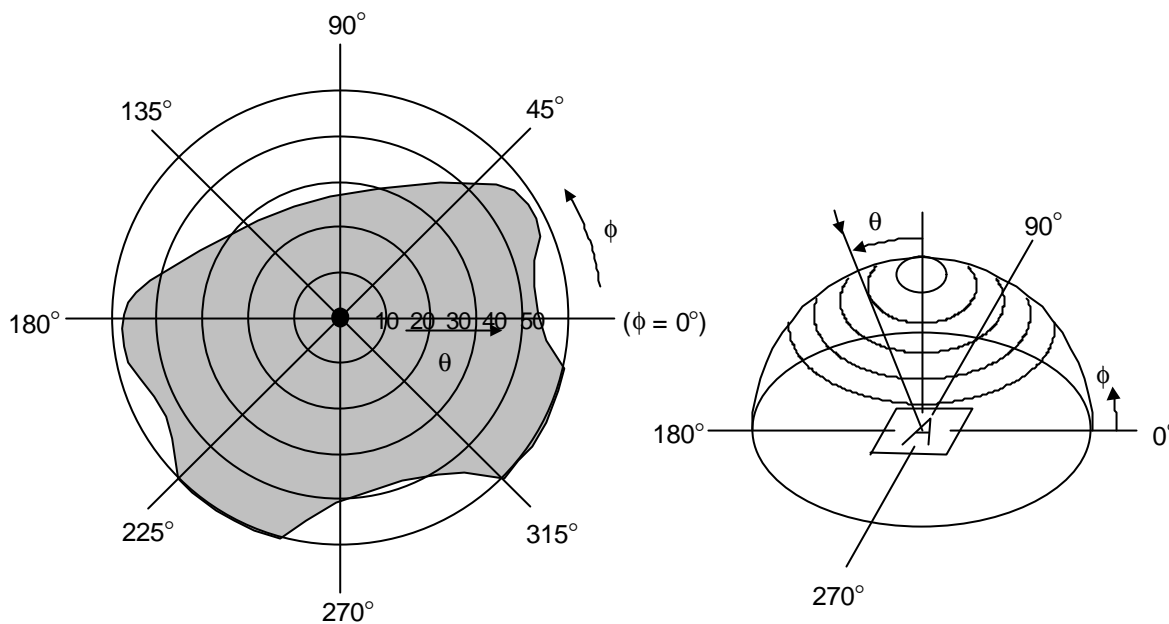
Assuming that the typical driving waveforms shown below are applied to the LCD Panel at 1/A Duty - 1/B Bias (A: Duty Number, B: Bias Number). Driving voltage V_{OD} is defined as the voltage V_{O-P} when the contrast ratio ($CR=L_{ON} / L_{OFF}$) is at its maximum.




3.3. Definition of Viewing Angle and Optimum Viewing Area

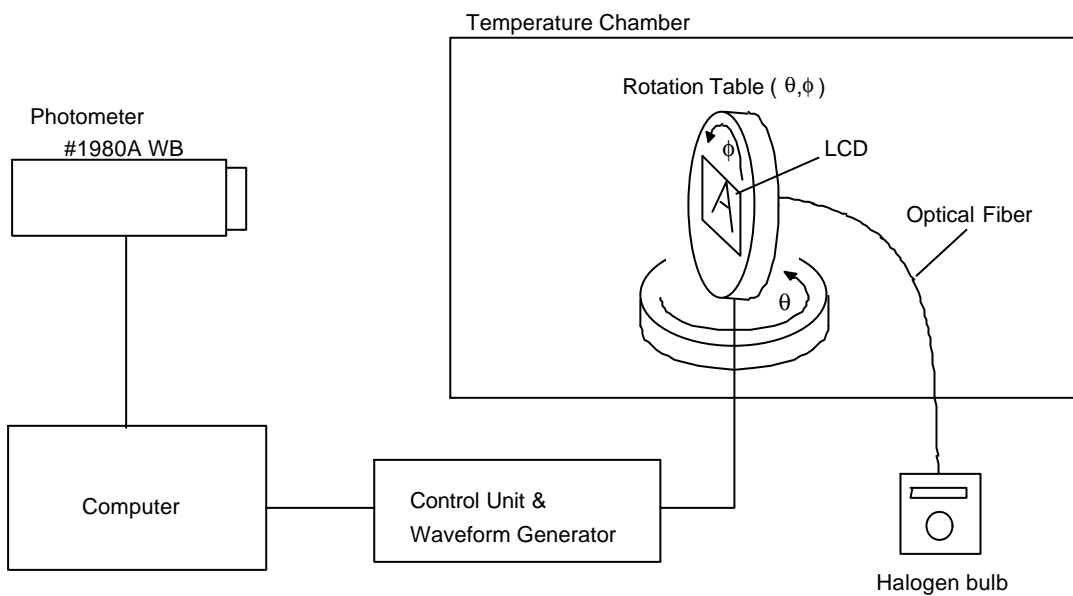
*Point ● shows the point where contrast ratio is measured. : $\theta = 0^\circ$, $\phi = 0^\circ$

*Driving condition : 1/240 Duty, 1/14 Bias, $V_{OD}=22.7V$, $f_F=75Hz$



*Area  shows typ. $CR \geq 2$

3.4. System Block Diagram



4.I/O Terminal

4.1.Pin Assignment

CN1

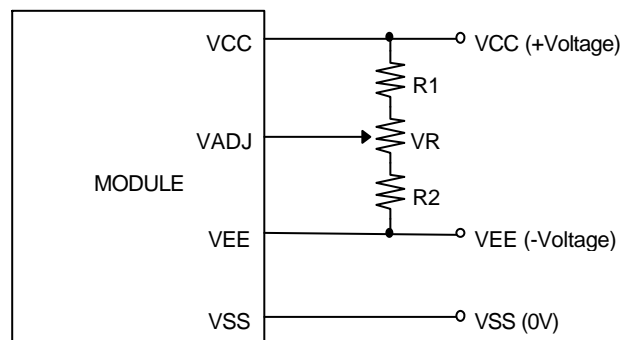
No.	Symbol	Level	Function
1.	D0	H / L	Display Data
2.	D1	H / L	Display Data
3.	D2	H / L	Display Data
4.	D3	H / L	Display Data
5.	$\overline{\text{DISPOFF}}$	H / L	H : Display on L : Display off (Pull up Resister)
6.	FLM	H / L	First Line Marker
7.	NC	-	Non-connection
8.	LP	H→L	Data Latch Signal
9.	CP	H→L	Clock Signal for Shifting Data
10.	V _{CC}	-	Power Supply for Logic
11.	V _{SS}	-	Power Supply (0V, GND)
12.	V _{EE}	-	Power Supply for LCD Drive
13.	V _{ADJ}	-	Voltage Level for LCD Contrast Adjustment
14.	FG	-	Frame Ground

CN2

No.	Symbol	Level	Function
1	CFL HOT	-	Power Supply for CFL (HOT)
2	NC	-	Non-connection
3	NC	-	Non-connection
4	CFL GND	-	Power Supply for CFL (GND)

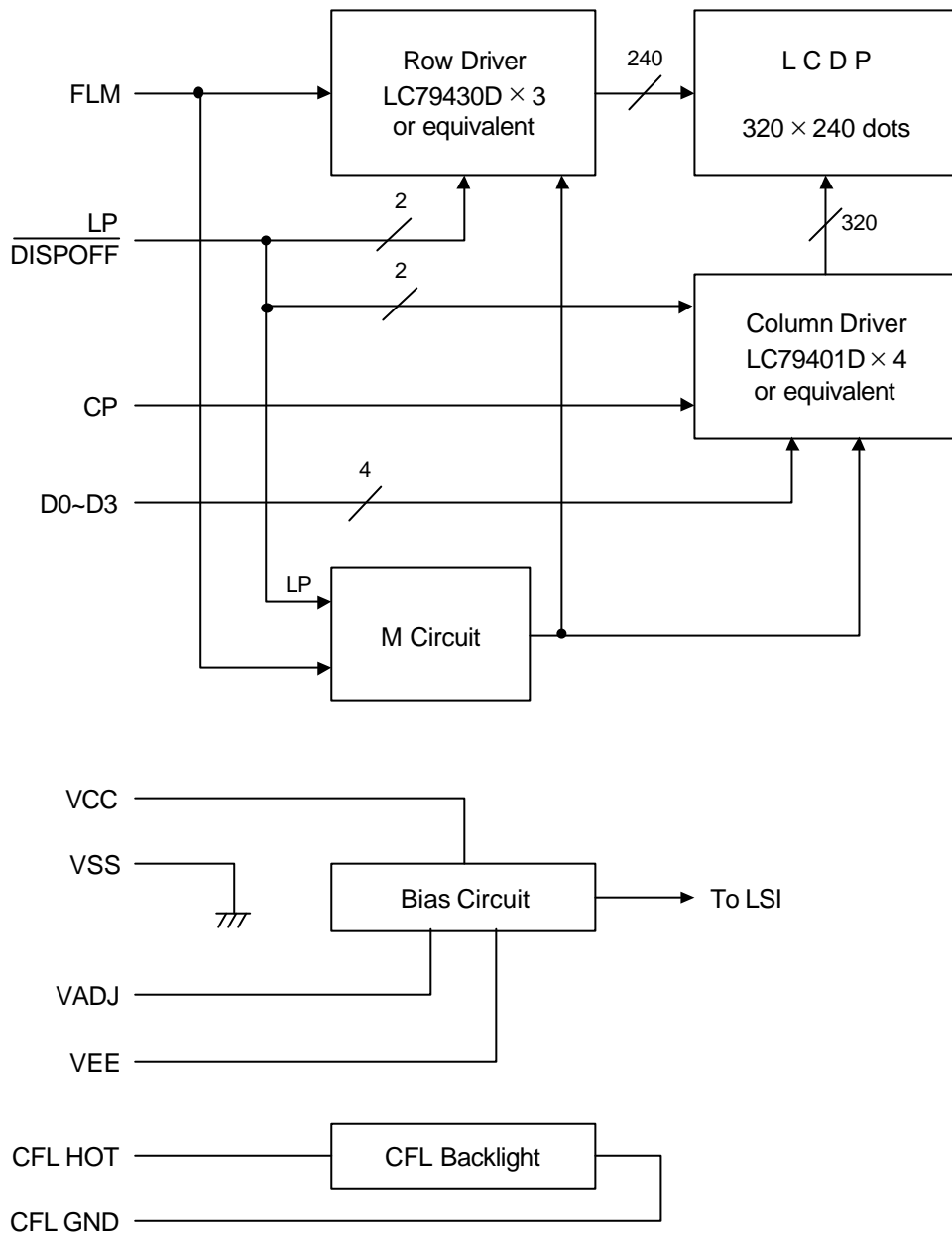
4.2.Example of Power Supply

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



$$R1+R2+VR=10\sim 20K\Omega$$

4.3. Block Diagram



5. Test

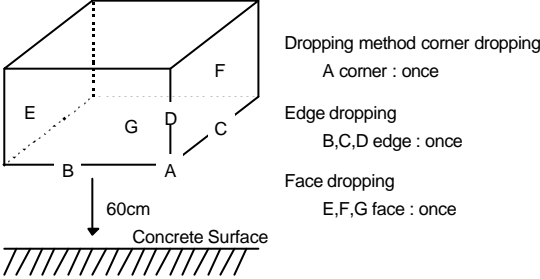
No change on display and in operation under the following test condition.

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

Temperature: $20 \pm 5^\circ\text{C}$

Humidity : $65 \pm 5\% \text{RH}$

tests will be not conducted under functioning state.

No.	Parameter	Conditions	Notes
1	High Temperature Operating	$60^\circ\text{C} \pm 2^\circ\text{C}$, 96hrs (operation state)	
2	Low Temperature Operating	$0^\circ\text{C} \pm 2^\circ\text{C}$, 96hrs (operation state)	1
3	High Temperature Storage	$60^\circ\text{C} \pm 2^\circ\text{C}$, 96hrs	2
4	Low Temperature Storage	$-20^\circ\text{C} \pm 2^\circ\text{C}$, 96hrs	1,2
5	Damp Proof Test	$40^\circ\text{C} \pm 2^\circ\text{C}$, 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.

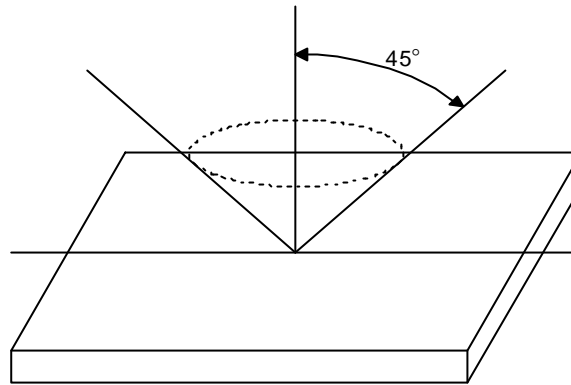
6.Appearance Standards

6.1.Inspection conditions

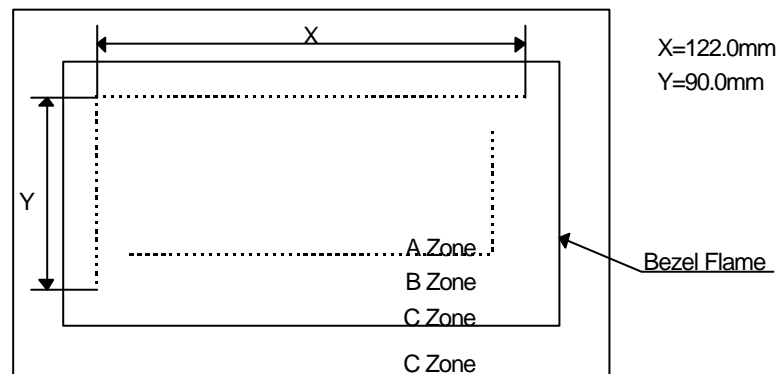
The LCD shall be inspected under 40W white fluorescent light.

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

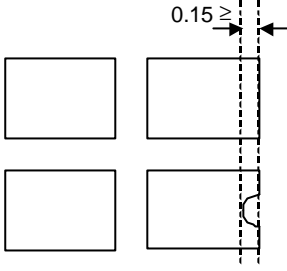
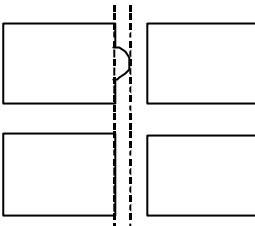
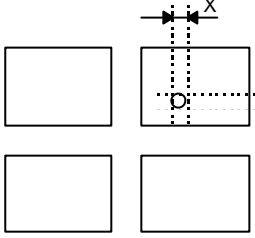
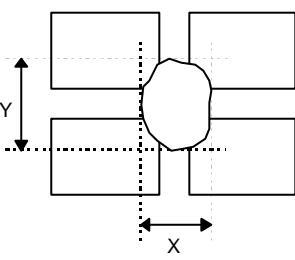
B Zone : Area from outside of "A Zone" to validity viewing area

C Zone : Rest parts

A Zone + B Zone = Validity viewing area

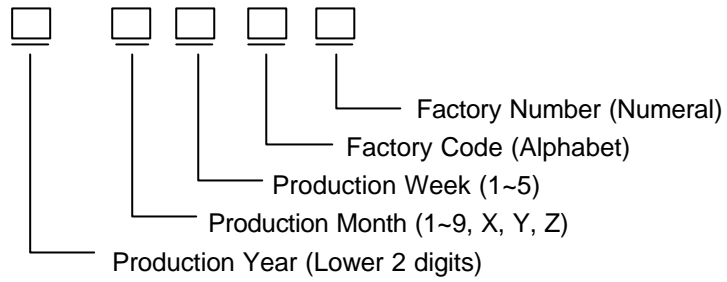
6.3. Standards

No.	Parameter	Criteria																																																										
1	Black and White Spots, Foreign Substances	<p>(1) Round Shape</p> <table border="1" data-bbox="603 320 1364 660"> <thead> <tr> <th data-bbox="603 320 906 365">Zone</th> <th colspan="3" data-bbox="906 320 1364 365">Acceptable Number</th> </tr> <tr> <th data-bbox="603 365 906 421">Dimension (mm)</th> <th data-bbox="906 365 1061 421">A</th> <th data-bbox="1061 365 1216 421">B</th> <th data-bbox="1216 365 1364 421">C</th> </tr> </thead> <tbody> <tr> <td data-bbox="603 421 906 470">D ≤ 0.1</td> <td data-bbox="906 421 1061 470">*</td> <td data-bbox="1061 421 1216 470">*</td> <td data-bbox="1216 421 1364 470">*</td> </tr> <tr> <td data-bbox="603 470 906 519">0.1 < D ≤ 0.2</td> <td data-bbox="906 470 1061 519">3</td> <td data-bbox="1061 470 1216 519">5</td> <td data-bbox="1216 470 1364 519">*</td> </tr> <tr> <td data-bbox="603 519 906 568">0.2 < D ≤ 0.25</td> <td data-bbox="906 519 1061 568">2</td> <td data-bbox="1061 519 1216 568">3</td> <td data-bbox="1216 519 1364 568">*</td> </tr> <tr> <td data-bbox="603 568 906 618">0.25 < D ≤ 0.3</td> <td data-bbox="906 568 1061 618">0</td> <td data-bbox="1061 568 1216 618">1</td> <td data-bbox="1216 568 1364 618">*</td> </tr> <tr> <td data-bbox="603 618 906 660">0.3 < D</td> <td data-bbox="906 618 1061 660">0</td> <td data-bbox="1061 618 1216 660">0</td> <td data-bbox="1216 618 1364 660">*</td> </tr> </tbody> </table> <p data-bbox="603 672 1364 705">D = (Long + Short) / 2 * : Disregard</p> <p>(2) Line Shape</p> <table border="1" data-bbox="603 750 1364 1041"> <thead> <tr> <th colspan="2" data-bbox="603 750 906 795">Zone</th> <th colspan="3" data-bbox="906 750 1364 795">Acceptable Number</th> </tr> <tr> <th data-bbox="603 795 758 851">X (mm)</th> <th data-bbox="758 795 906 851">Y (mm)</th> <th data-bbox="906 795 1061 851">A</th> <th data-bbox="1061 795 1216 851">B</th> <th data-bbox="1216 795 1364 851">C</th> </tr> </thead> <tbody> <tr> <td data-bbox="603 851 758 900">-</td> <td data-bbox="758 851 906 900">0.03 ≥ W</td> <td data-bbox="906 851 1061 900">*</td> <td data-bbox="1061 851 1216 900">*</td> <td data-bbox="1216 851 1364 900">*</td> </tr> <tr> <td data-bbox="603 900 758 949">2.0 ≥ L</td> <td data-bbox="758 900 906 949">0.05 ≥ W</td> <td data-bbox="906 900 1061 949">3</td> <td data-bbox="1061 900 1216 949">3</td> <td data-bbox="1216 900 1364 949">*</td> </tr> <tr> <td data-bbox="603 949 758 999">1.0 ≥ L</td> <td data-bbox="758 949 906 999">0.1 ≥ W</td> <td data-bbox="906 949 1061 999">3</td> <td data-bbox="1061 949 1216 999">3</td> <td data-bbox="1216 949 1364 999">*</td> </tr> <tr> <td data-bbox="603 999 758 1041">-</td> <td data-bbox="758 999 906 1041">0.1 < W</td> <td colspan="3" data-bbox="906 999 1364 1041">In the same way (1)</td> </tr> </tbody> </table> <p data-bbox="603 1052 1364 1086">X : Length Y : Width * : Disregard</p> <p data-bbox="603 1097 1364 1131">Total defects shall not exceed 5.</p>	Zone	Acceptable Number			Dimension (mm)	A	B	C	D ≤ 0.1	*	*	*	0.1 < D ≤ 0.2	3	5	*	0.2 < D ≤ 0.25	2	3	*	0.25 < D ≤ 0.3	0	1	*	0.3 < D	0	0	*	Zone		Acceptable Number			X (mm)	Y (mm)	A	B	C	-	0.03 ≥ W	*	*	*	2.0 ≥ L	0.05 ≥ W	3	3	*	1.0 ≥ L	0.1 ≥ W	3	3	*	-	0.1 < W	In the same way (1)		
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-	0.1 < W	In the same way (1)																																																										
2	Air Bubbles (between glass & polarizer)	<table border="1" data-bbox="603 1182 1364 1473"> <thead> <tr> <th data-bbox="603 1182 906 1227">Zone</th> <th colspan="3" data-bbox="906 1182 1364 1227">Acceptable Number</th> </tr> <tr> <th data-bbox="603 1227 906 1283">Dimension (mm)</th> <th data-bbox="906 1227 1061 1283">A</th> <th data-bbox="1061 1227 1216 1283">B</th> <th data-bbox="1216 1227 1364 1283">C</th> </tr> </thead> <tbody> <tr> <td data-bbox="603 1283 906 1332">D ≤ 0.3</td> <td data-bbox="906 1283 1061 1332">*</td> <td data-bbox="1061 1283 1216 1332">*</td> <td data-bbox="1216 1283 1364 1332">*</td> </tr> <tr> <td data-bbox="603 1332 906 1382">0.3 < D ≤ 0.4</td> <td data-bbox="906 1332 1061 1382">3</td> <td data-bbox="1061 1332 1216 1382">*</td> <td data-bbox="1216 1332 1364 1382">*</td> </tr> <tr> <td data-bbox="603 1382 906 1431">0.4 < D ≤ 0.6</td> <td data-bbox="906 1382 1061 1431">2</td> <td data-bbox="1061 1382 1216 1431">3</td> <td data-bbox="1216 1382 1364 1431">*</td> </tr> <tr> <td data-bbox="603 1431 906 1473">0.6 < D</td> <td data-bbox="906 1431 1061 1473">0</td> <td data-bbox="1061 1431 1216 1473">0</td> <td data-bbox="1216 1431 1364 1473">*</td> </tr> </tbody> </table> <p data-bbox="603 1485 1364 1518">* : Disregard</p> <p data-bbox="603 1529 1364 1563">Total defects shall not exceed 3.</p>	Zone	Acceptable Number			Dimension (mm)	A	B	C	D ≤ 0.3	*	*	*	0.3 < D ≤ 0.4	3	*	*	0.4 < D ≤ 0.6	2	3	*	0.6 < D	0	0	*																																		
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0.4 < D ≤ 0.6	2	3	*																																																									
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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>$(X+Y) / 2 \leq 0.2\text{mm}$ (Less than 0.1mm is no counted.)</p> <p>(4) Deformation</p>  <p>$(X+Y) / 2 \leq 0.2\text{mm}$</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

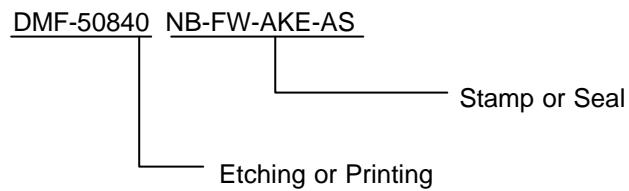
7.Code System of Production Lot

The production lot of module is specified as follows.



8.Type Number

The type number of module is specified on the back of module 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.