LCD Module Technical Specification

Type No. **F-51543NFU-LW-AGN**

OPTREX CORPORATION

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PRELIMINARY

APPROVED

By

Signature :

Date :

Please return this specification within two month with your signature.
If not returned within two month ,specification will be considered
as having been accepted.

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 : 0.28 (W) × 0.28 (H) mm

Dot Pitch : 0.30 (W) × 0.30 (H) mm

Viewing Area : 99.98 (W) × 73.5 (H) mm

Outline Dimensions : 146.98* (W) × 107.98** (H) × 15.36 * (D) mm
* Without Flat Cable and Ferrite
** Without Flat Cable

Weight : 303g max.

LCD Type : NTD-21622 (4 Level Gray Scale)
(F-STN / Black&White-mode / Transmissive / Negative)

Viewing Angle : 12:00

Data Transfer : 4-bit parallel data transfer

Touch Panel : Pet-Glass / Analog Type

Backlight : LED Backlight / White

UL Recognition : PWB rated "UL : OPCV0" and Marked with Supplier Recognized Logo.

Packing : Parts will be shipped in ESD packaging.

Drawings : Dimensional Outline   F-51543AG base

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

Vss=0V

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

2.2. DC Characteristics

Ta=25°C, Vss=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_{DD}-V_0	Shown in 3.1				V
High Level Input Voltage	V_{IH}	V_{DD}=5.0V±10%	$0.8 \times V_{DD}$	-	V_{DD}	V
Low Level Input Voltage	V_{IL}	V_{DD}=5.0V±10%	0	-	$0.2 \times V_{DD}$	V
Supply Current	I_{DD}	V_{DD}-V_{SS}=5.0V	-	4.6	6.9	mA
	I_{EE}	V_{DD}-V_0=20.8V	-	4.4	6.6	mA

2.3.AC Characteristics

$V_{DD}=5.0V\pm10\%$

| 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.
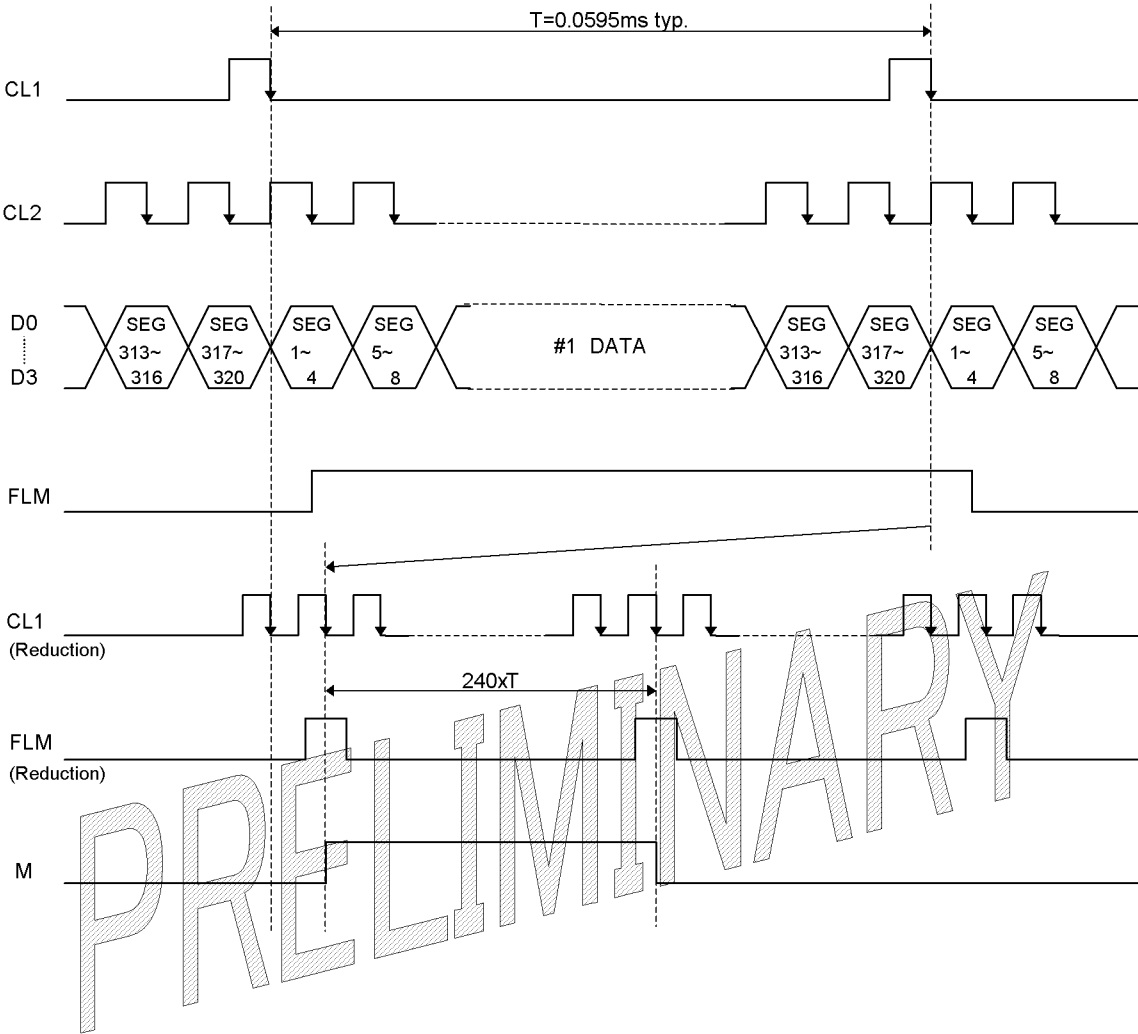
$$t_r, t_f \leq \frac{1}{2f_{CP}} - t_{WC}$$
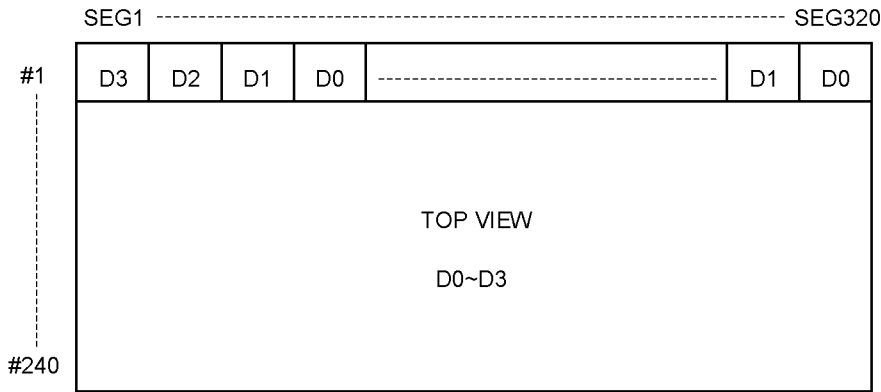
$$t_r, t_f \leq 50 \text{ ns}$$
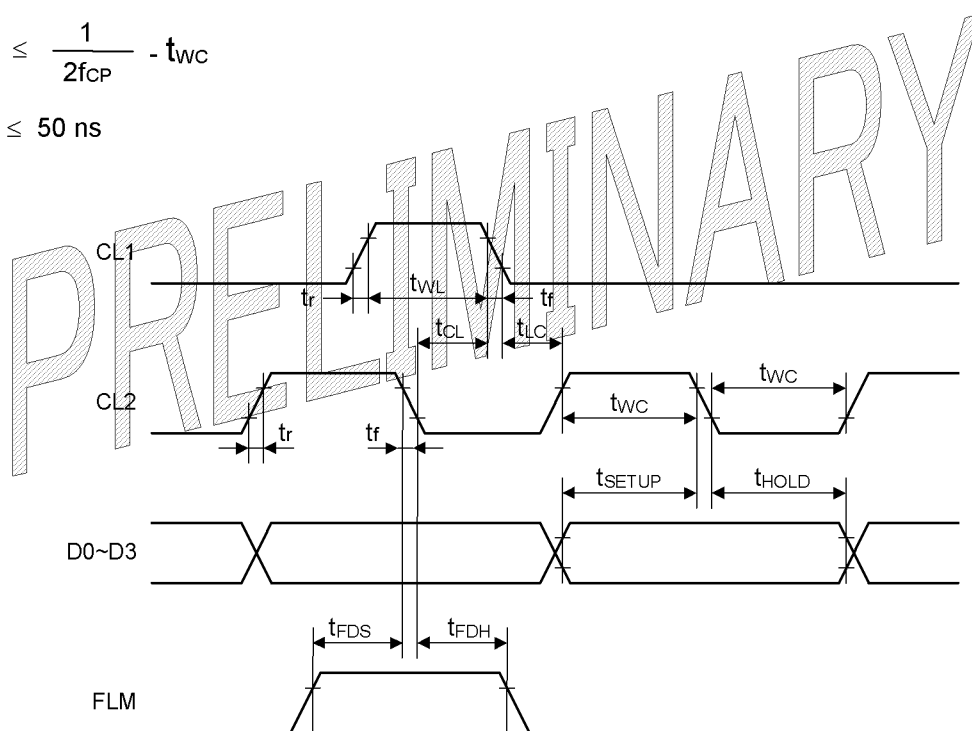
This module contains these capacitors. Please be careful about timing characteristics.
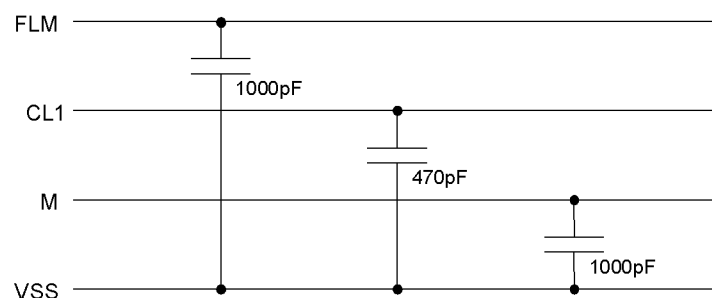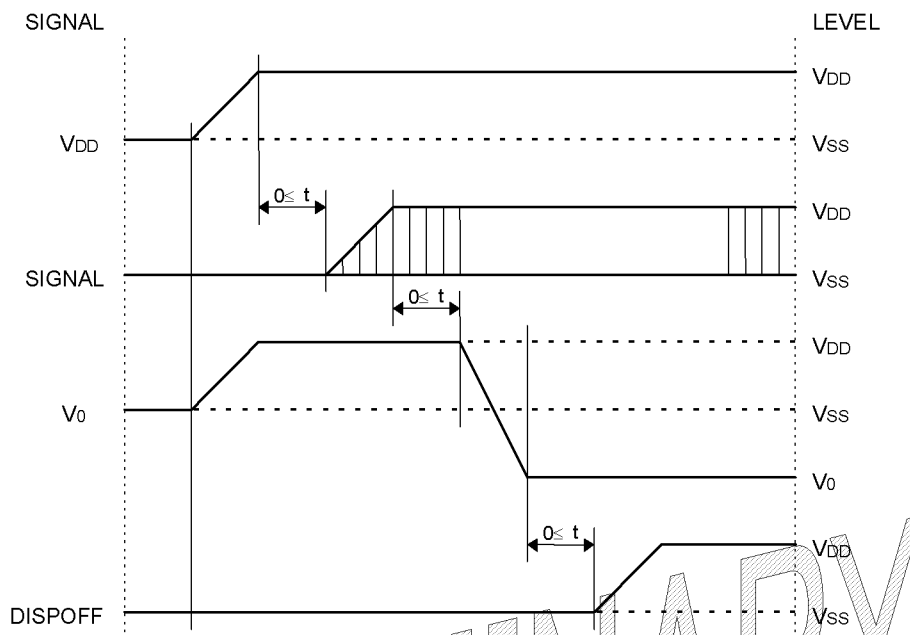
2.4.Timing Chart

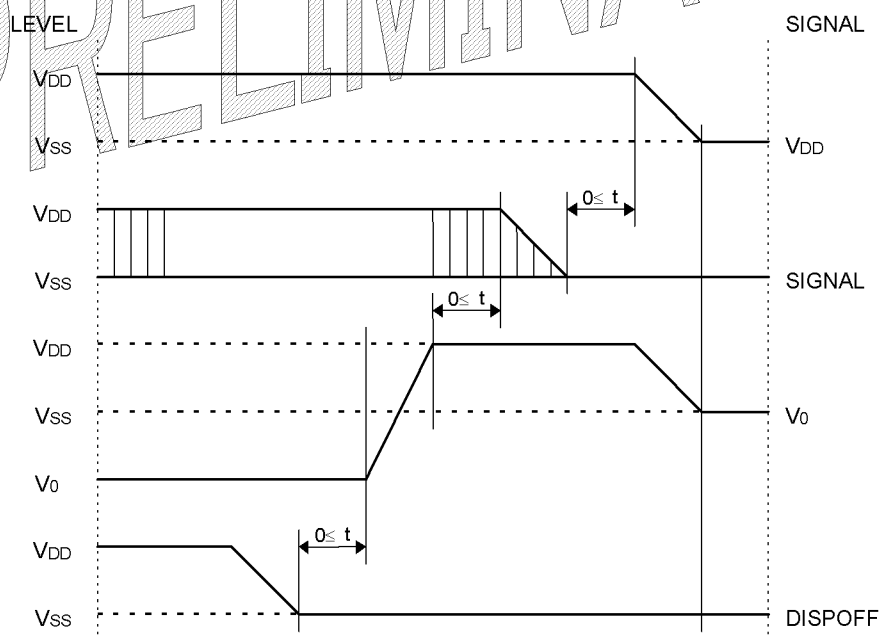## 2.5.Comparison of Display and Data

2.6.Power Supply ON/OFF Sequence

2.6.1.ON Sequence

SIGNAL

LEVEL

V_{DD}

V_{DD}

V_{SS}

$0 \leq t$

V_{DD}

SIGNAL

V_{SS}

$0 \leq t$

V_{DD}

V_0

V_{SS}

V_0

$0 \leq t$

V_{DD}

DISPOFF

V_{SS}

2.6.2.OFF Sequence

LEVEL

SIGNAL

V_{DD}

V_{SS}

V_{DD}

$0 \leq t$

V_{DD}

V_{SS}

SIGNAL

$0 \leq t$

V_{DD}

V_{SS}

V_0

V_0

V_{DD}

$0 \leq t$

V_{SS}

DISPOFF

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.Touch Panel Specifications

2.7.1.Electrical Characteristics

Parameter	Specification
Terminal Resistance	Rx-x = 250 ± 100Ω, Ry-y = 650 ± 150Ω
Linearity	≤1.5%
Insulation	20M Ω or over (Dc25V)
Chattering Time	10 msed or less @ 100kΩ pull-up

2.7.2.Mechanical Characteristics

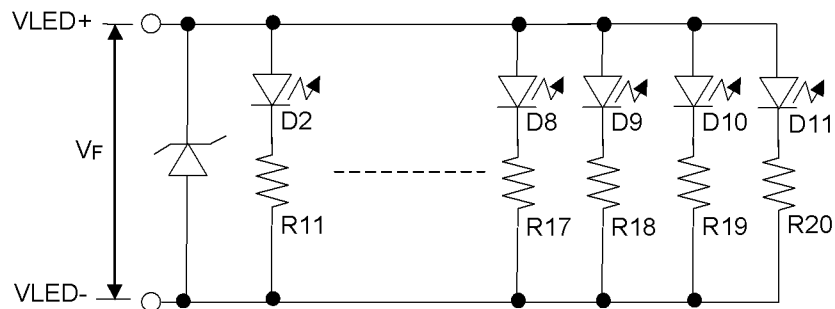| Parameter	Specification
Operation Force	80g or less(Tip R0.8mm plastic pen opration or tip R3.75mm, hardness 40 deg, silicone rubber operation)
Impact Resistance	No damage when φ9mm steel nail is dropped on the surface from 30cm height at 1 time.
Package Drop	No damage to the product.(drop from 50cm height)

2.7.3.Structure

FILM (t=0.18mm)

GLASS (t=1.1mm)
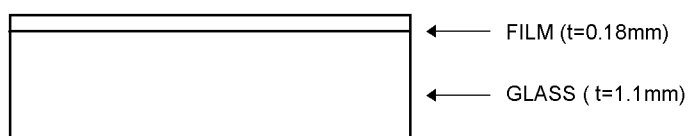
2.8.Lighting Specifications

2.8.1.Absolute Maximum Ratings (1 Chip)

Ta=25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Reverse Voltage	V_R	Note 1	-	-	5.0	V
LED Power Dissipation	P_D	-	-	-	750	mW

Note 1 : V_F is defined as the voltage between ANODE and CATHODE as shown below.

2.8.2.Operating Characteristics

Ta=25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Foward Current	I_F	V_F=5.0V	-	100	120	mA
Luminance of Backlight Surface	L	V_F=5.0V	180	-	-	cd/m^2

3. Optical Specifications

3.1. LCD Driving Voltage

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Recommended		Ta= 0°C	-	-	23.9	V
LCD Driving Voltage	$V_{DD}-V0$	Ta=25°C	19.3	20.8	22.2	V
Note 1		Ta=50°C	17.9	-	-	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, 1/11.5 Bias, V_{OD}=20.2V (Note 4), θ= 0°C, ϕ=-°

Parameter		Symbol	Conditions	Min.	Typ.	Max.	Units
Contrast Ratio Note 1		CR	θ= 0°C , ϕ=-°	-	30	-	
Viewing Angle			Shown in 3.3				
Response	Rise Note 2	T_{ON}	-	-	390	590	ms
Time	Decay Note 3	T_{OFF}	-	-	160	240	ms

Note 1 :Contrast ratio is definded as follows. (CR = L_{ON} / L_{OFF})
　　　　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}
　　　　$V_{OD}=V_{DD}-V0-V_{BE}$
　　　　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 definded as the voltage V_{O-P} when the contrast ratio (CR=L_{ON} / L_{OFF}) is at its maximum.

V_{O-P}

$1 / (f_F \times A)$

<ON SIGNAL>

$1 / f_F$

$(B-2) \times V_{O-P} / B$

<OFF SIGNAL>
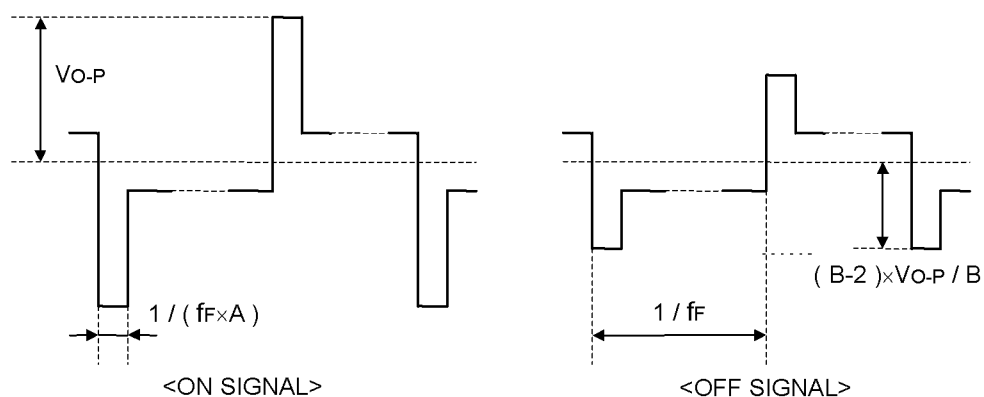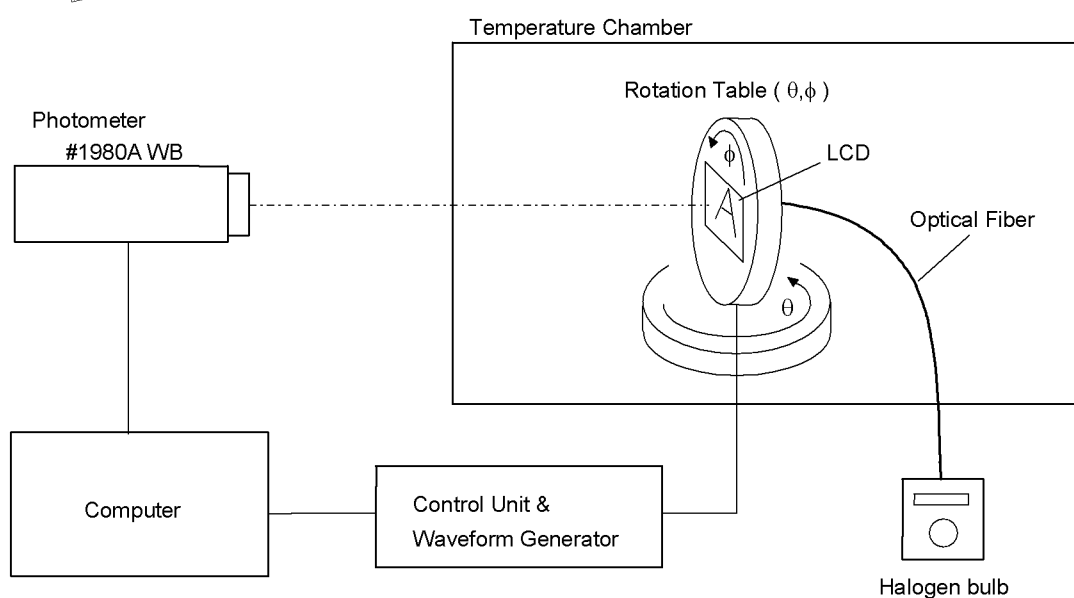
3.3.Definition of Viewing Angle and Optimum Viewing Area

*Point • shows the point where contrast ratio is measured. : θ= 0°, ϕ= -°
*Driving condition: 1/240 Duty, 1/11.5 Bias, V_{OD}=20.2V, f_F=70Hz
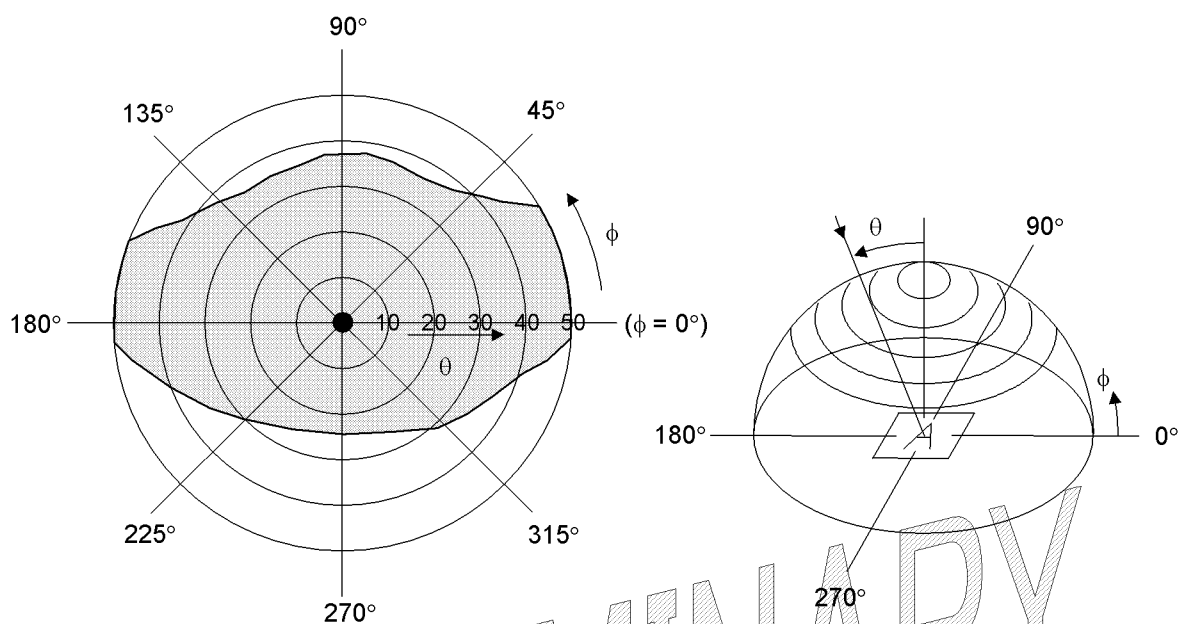
*Area ☐ shows typ. CR≥2 (Measuring Spot: 3.0mmϕ)

3.4.System Block Diagram
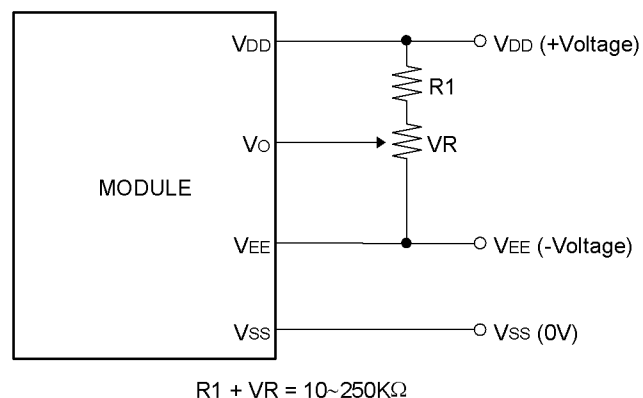
4.I/O Terminal

4.1.Pin Assignment

CN1

No.	Symbol	Function
1	V LED -	LED Terminal
2	V LED +	LED Terminal
3	DISPOFF	Display Control Signal H : Display on L : Display off
4	D3	Display Data
5	D2	Display Data
6	D1	Display Data
7	D0	Display Data
8	V_{EE}	Power Supply for LCD Drive
9	V_{SS}	Power Supply (0V, GND)
10	V_{DD}	Power Supply for Logic
11	V0	Voltage Level for LCD Contrast Adjustment
12	M	Alternate Signal for LCD Drive
13	CL2	Input for Display Clock
14	CL1	Input for Display Clock
15	FLM	First Line Marker

CN2

No.	Symbol	Function
1	xL	X Coordinate Electrode
2	yU	Y Coordinate Electrode
3	xR	X Coordinate Electrode
4	yL	Y Coordinate Electrode

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 + VR = 10~250KΩ

4.3.Block Diagram

```
FLM ──────────────────────►┌──────────────┐          ┌──────────────┐
                           │  Row Driver  │   240    │    L C D P    │
                           │ LC79431D × 3 │──/──────►│              │
                           │ or equivalent│          │ 320 × 240 dots│
                           └──────────────┘          └──────────────┘
CL1 ───────────●──────────────────────────┐                 ▲
               │                           │               /320
               ●──────────────────────────┼──►┌──────────────┐
DISPOFF ────────────────────────●─────────┼──►│ Column Driver│
CL2 ────────────────────────────┼─────────┼──►│ LC79401D × 4 │
                                │         │   │ or equivalent│
D0~D3 ──────────┐      /4       │         │   └──────────────┘
                │              ┌──────────────┐      ▲   ▲
                └─────────────►│              │      │   │
M ──────────────────────────► │   M Circuit  │──────●───┘
                               └──────────────┘
VDD ─────────────────────────────────────────
Vss ────────┬──────────────────┌──────────────┐
            ▼                  │ Bias Circuit │──────► To LSI
           ⏚                   └──────────────┘
V0 ──────────────────────────────┘
VEE ─────────────────────────────┘

V LED - ──────────────┌──────────────┐
                      │ LED Backlight│
V LED + ──────────────└──────────────┘
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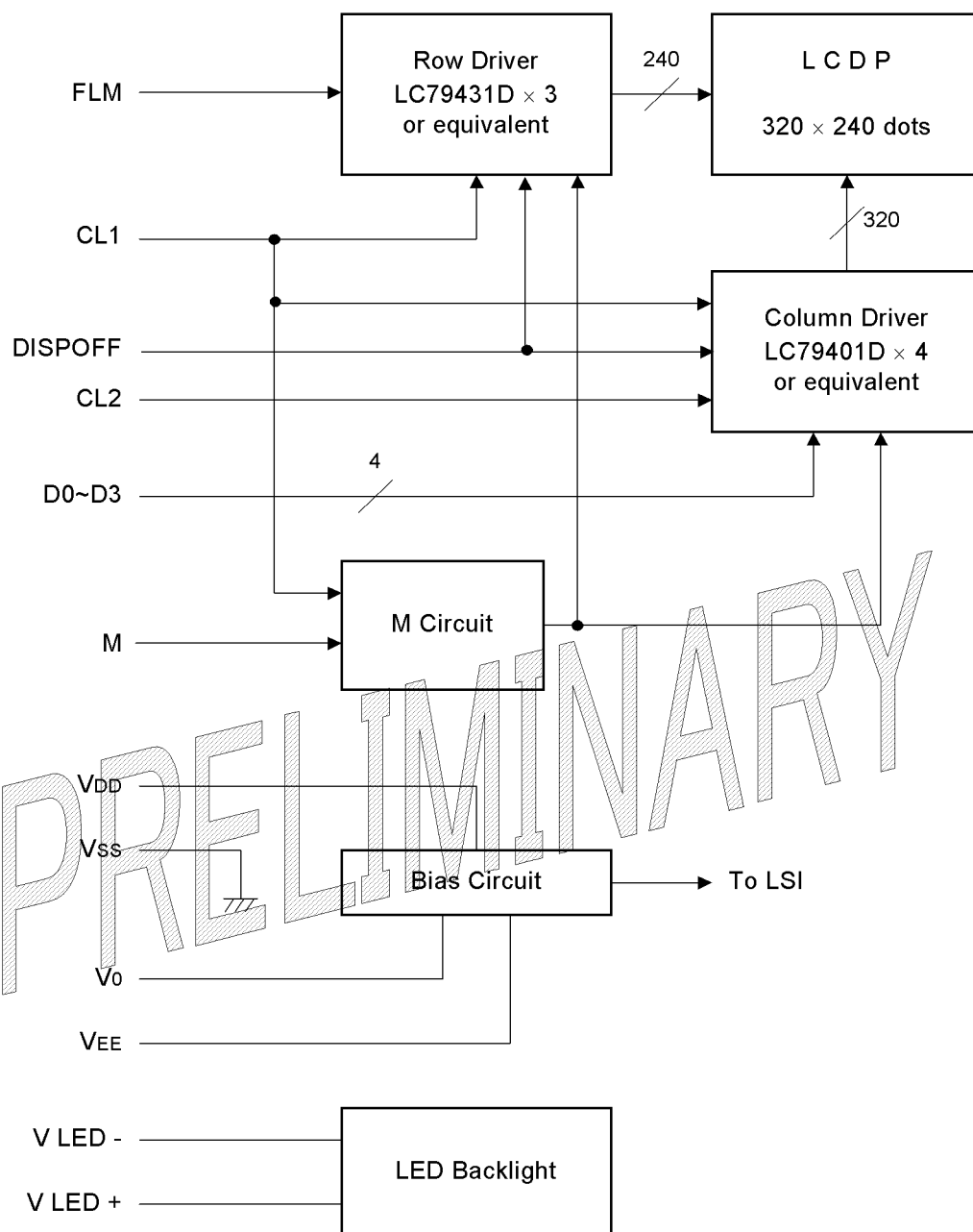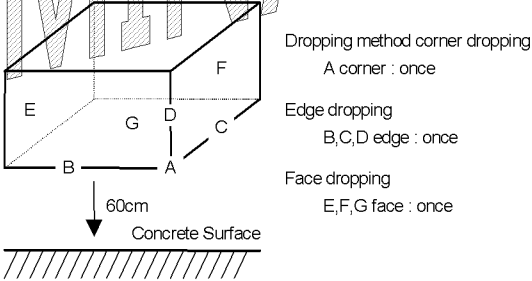
5. Test

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 : 10~300Hz One cycle 60 seconds to 3 directions of X, Y, Z each 1.0 hr.	3
7	Shock Test	To be measured after dropping from 60cm high the concrete surface in packing state. Dropping method corner dropping A corner : once Edge dropping B,C,D edge : once Face dropping E,F,G face : once 60cm Concrete Surface	
8	ESD	Air Discharge : ±2kV, ±4kV, ±8lkV Contact Discharge : ±2kV, ±4kV	

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.
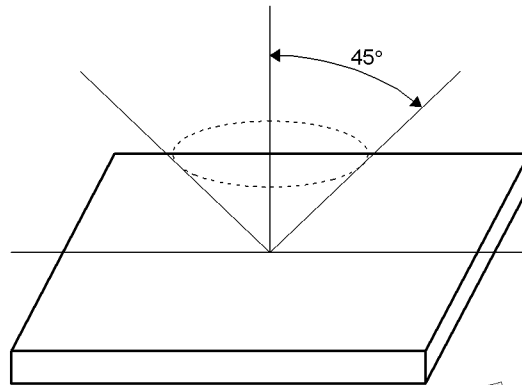
6. Appearance Standards
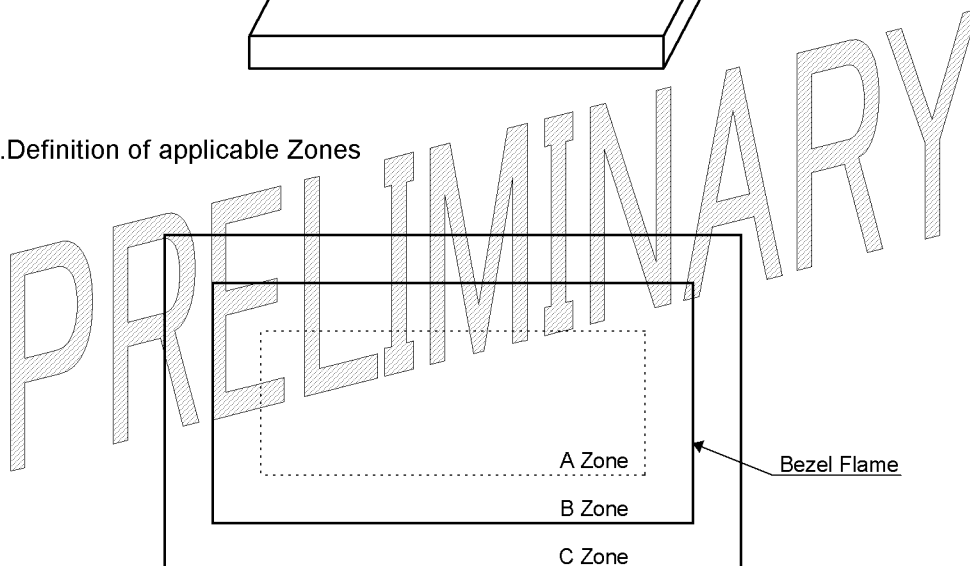
6.1. Inspection conditions

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
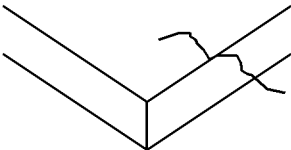

A Zone : Active display area
B Zone : Area from outside of "A Zone" to validity viewing area
C Zone : Rest parts

A Zone + B Zone = Validity viewing area

6.3.Standards

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

No.	Parameter	Criteria		
1	Black and White Spots, Foreign Substances	(1) Round Shape		

(1) Round Shape

Dimension / Zone	Acceptable Number	
	A	B
D ≤ 0.20	*	*
0.20< D ≤ 0.40	Note1	*
D > 0.40	0	2

Note1 : 1 defect per D40mm is acceptable.

(2) Line Shape

Length	Width / Zone	Acceptable Number	
		A	B
L ≤ 3.0	W≤0.03	*	*
L ≤ 3.0	0.03<W≤0.05	1(D 40mm)	*
L > 3.0	W>0.05	0	*

No more than 6pcs as total.

No.	Parameter	Criteria
2	Scratches	

Length	Width / Zone	Acceptable Number	
		A	B
L ≤ 5.0	W ≤ 0.03	*	*
5 < L ≤ 15	W ≤ 0.05	1(D 40mm)	*
L > 15	W > 0.05	0	*

No.	Parameter	Criteria
3	Newton Ling	Based on Limit Sample.
4	Crack	Cracks are not allowed.

11	Chipped Glass	(2) Corner Areas

1.Other than electrode pad Areas
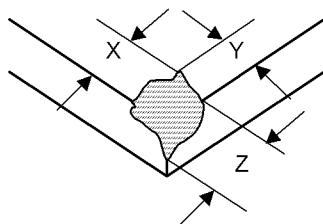
	X	Y	Z
A	≤ 3.0	≤ 3.0	≤ t
B	≤ 5.0	≤ 3.0	≤ 2/3 t

A or B=OK

2.Lead Areas
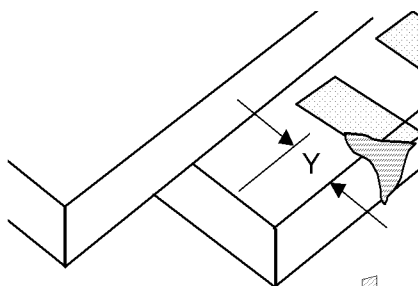
$Y \leq 1$

(1) Other than electrode pad areas and corner areas
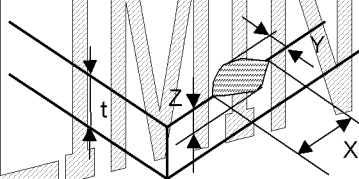
	X	Y	Z
A	≤ 3.0	≤ 3.0	≤ t
B	≤ 5.0	≤ 1.0	≤ t
C	≤ 5.0	≤ 3.0	≤ 2/3 t

A or B or C=OK

7. Code System of Production Lot

The production lot of module is specified as follows.

☐☐ ☐ ☐ ☐ ☐ — ☐ ☐☐

└─ Factory Control Number (0~99)
└─ Date of the week (A~G)
└─ Factory Number (0~9)
└─ Factory Code (Alphabet)
└─ Production Week (1~5)
└─ Production Month (1~9, X, Y, Z)
└─ Production Year (Lower 2 digits)
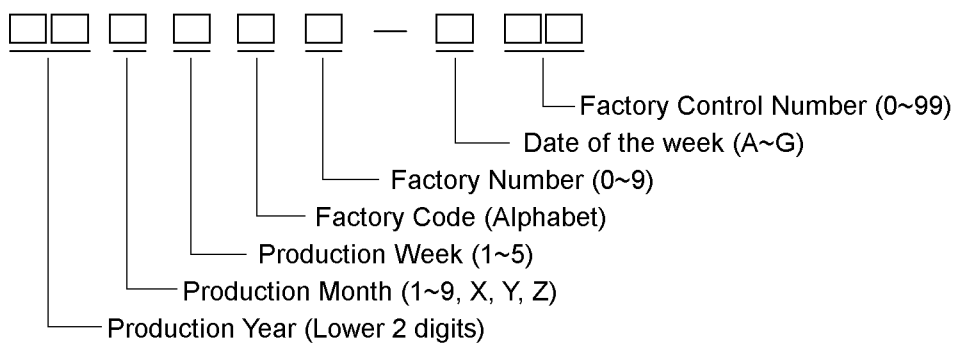
8. Type Number

The type number of module is specified as follows.

F-51543NFU-LW-AGN

9. Applying Precautions

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

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.