First Edition
Jan 18, 2006

LCD Module Technical Specification

Final Revision
******

Type No. **F-51900NCU-FW-ACN**

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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	:	320× 3 [R.G.B] (W) × 240 (H) dots
Dot Size	:	0.1 (W) × 0.34 (H) mm
Dot Pitch	:	0.12 (W) × 0.36 (H) mm
Viewing Area	:	120.0 (W) × 90.0 (H) mm
Outline Dimensions	:	168.0* (W) × 111.0 (H) × 9.4 max. (D) mm * Without CFL Cable
Weight	:	276g max.
Viewing Angle	:	12:00
Data Transfer	:	8-bit parallel data transfer
Backlight	:	Cold Cathode Fluorescent Lamp (CFL) × 1
Drawings	:	Dimensional Outline UE-312546
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	V_{CC1}-V_{SS} V_{CC2}-V_{SS}	-	-0.3	6.5	V
Contrast Adjust Voltage	V_{vadj}	-	-0.3	2.5	V

2.2.DC Characteristics

Ta=25°C, Vss=0V

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Supply Voltage	V_{CC1}-V_{SS}	-	4.5	5.0	5.5	V
	V_{CC2}-V_{SS}		2.5	3.0	3.5	
Contrast Adjust Voltage	V_{vadj}	-	1.5	-	2.5	V
High Level Input Voltage	V_{IH}	V_{CC1}=3.0/5.0V±10%	$0.8V_{CC1}$	-	V_{CC1}	V
Low Level Input Voltage	V_{IL}	V_{CC1}=3.0/5.0V±10%	0	-	$0.2V_{CC1}$	V
Supply Current	I_{CC1}	V_{CC1}-V_{SS}=3.0V V_{vadj}=2.0V Checker Board pattern	-	100	120	mA
		V_{CC1}-V_{SS}=5.0V V_{vadj}=2.0V Checker Board pattern		55	82.5	mA

2.3. Characteristics of Touch Screen

Parameter	Conditions	Min.	Typ.	Max.	Units
Applied Rating Voltage	-	-	-	7.0	V
Resistance of Terminal Electrodes	X Electrode	300	-	900	Ω
	Y Electrode	200	-	650	
Linearity	-	-	-	1.5	%
Insulation Resistance	$V_{DC}=25V$	10	-	-	$M\Omega$
Surface Hardness	According to JIS-K5400	3	-	-	H
Chattering	At connector Pin	-	-	10	mS

Test condition : Touch screen is placed horionally in a vessel and no power is supplied to T/P.

Normal state is temperatire : 2.5±10°C, relative humidity : 60±25°C
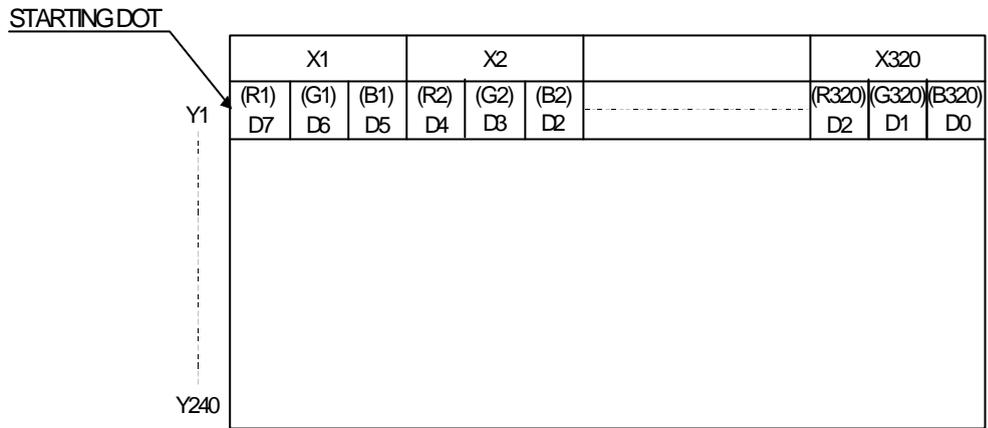
2.4. AC Characteristics

Vcc=3.0/5.0V±10%

Parameter	Symbol	Min.	Max.	Units
Clock Pulse Cycle Time	t_{WCK}	66/40	-	ns
Clock Pulse High Level Width	t_{WCKH}	23/12	-	ns
Clock Pulse Low Level Width	t_{WCKL}	23/14	-	ns
Latch Pulse High Level Width	t_{WLPH}	30/15	-	ns
CP → LP Rise Time	t_{LD}	10/5	-	ns
CP → LP Fall Time	t_{SL}	30/25	-	ns
LP → CP Rise Time	t_{LS}	30/25	-	ns
LP → CP Fall Time	t_{LH}	30/25	-	ns
Clock Pulse Rise/Fall Time	t_r, t_f	-	50	ns
Data Setup Time	t_{DS}	10/5	-	ns
Data Hold Time	t_{DH}	25/15	-	ns
DISPOFF Low Level Width	t_{WDL}	1.2	-	μs
DISPOFF Cancellation Time	t_{SD}	100	-	ns
FLM Setup Time	t_{SU}	30	-	ns
FLM Hold Time	t_H	50	-	ns

2.5. Timing Chart

CPX(320X3)/8 Pulse
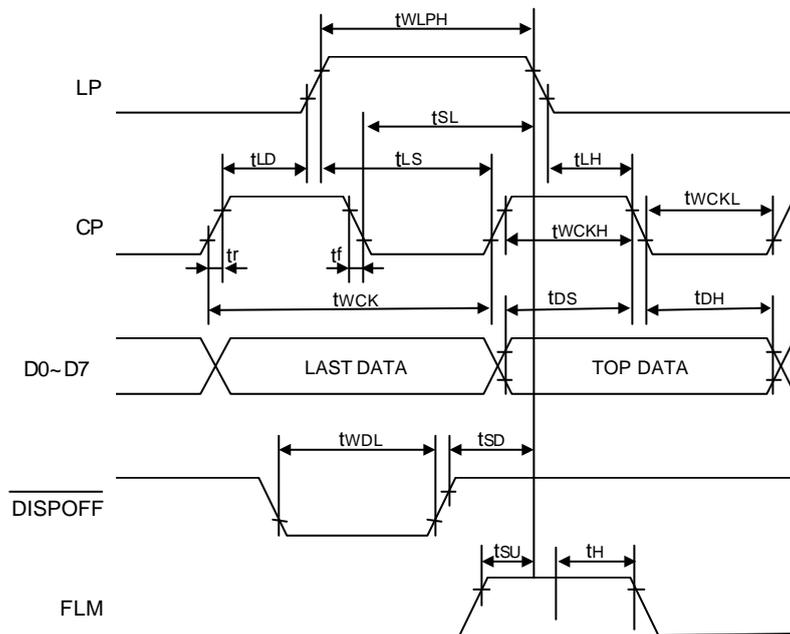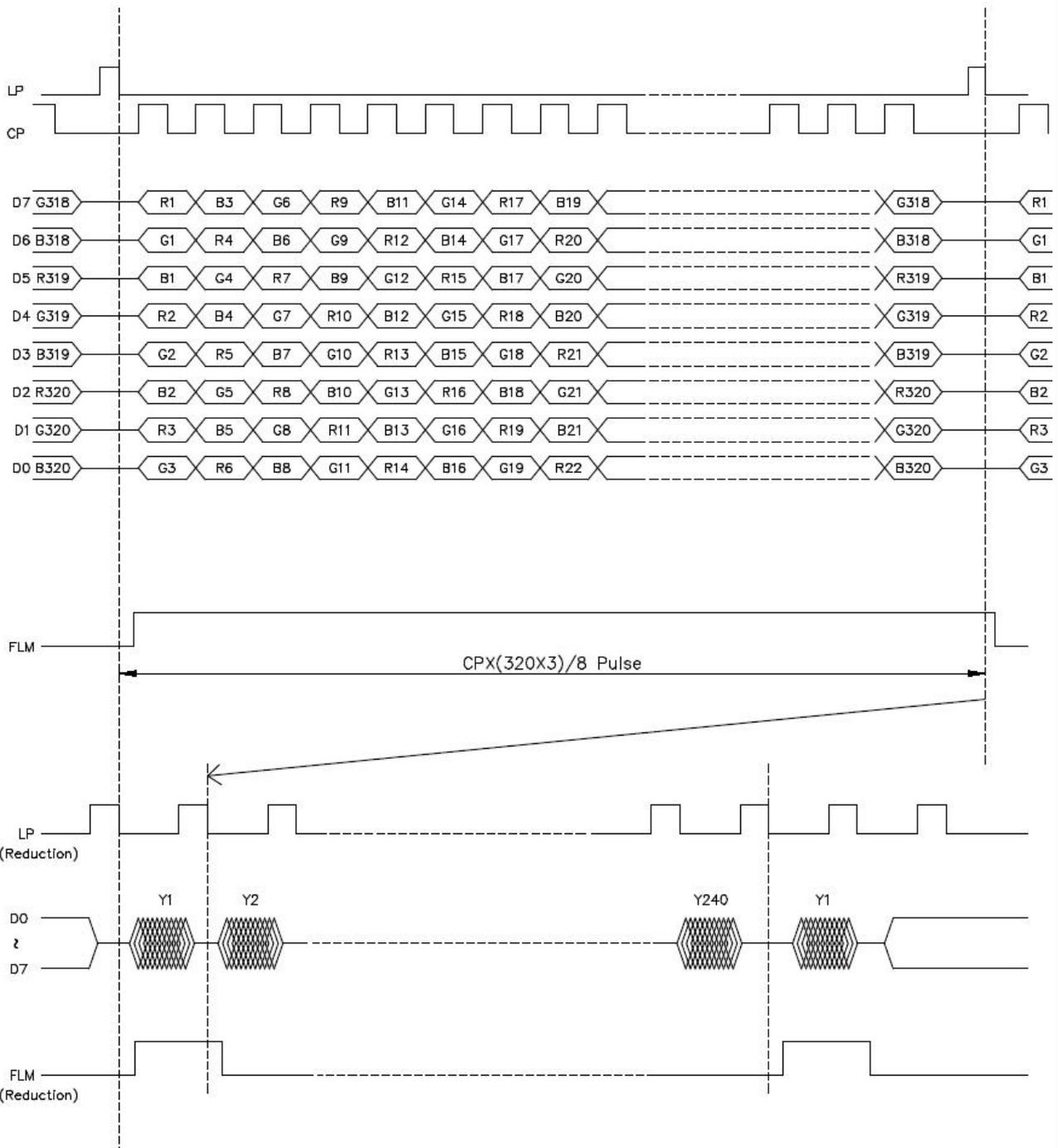
2.6. Comparison of Display and Data

STARTING DOT

	X1			X2					X320		
Y1	(R1) D7	(G1) D6	(B1) D5	(R2) D4	(G2) D3	(B2) D2		- - - - - - -		(R320) D2	(G320) D1	(B320) D0
Y240												

1) The eight (8) bit data transfer interface
2) The D0 is for LSB and the D7 is for MSB.

2.7. Power Supply ON/OFF Sequence

2.7.1. ON Sequence
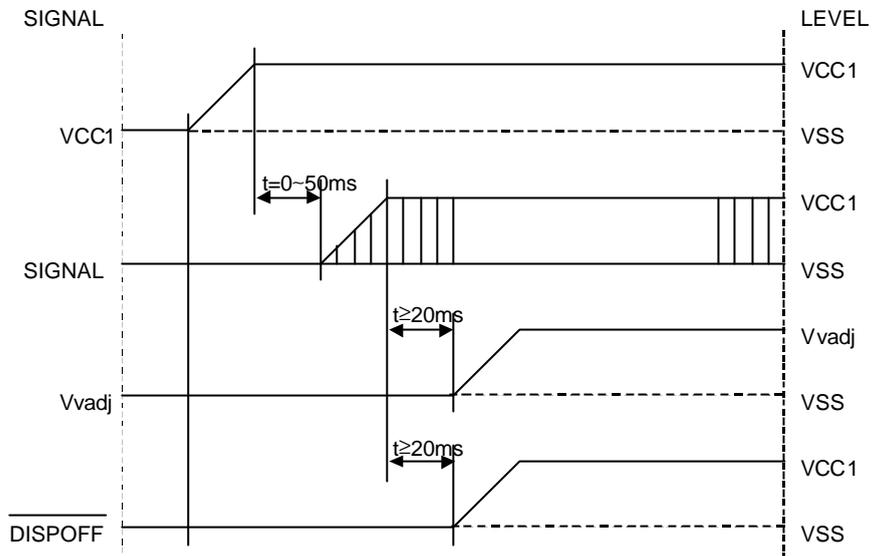
2.7.2. OFF Sequence
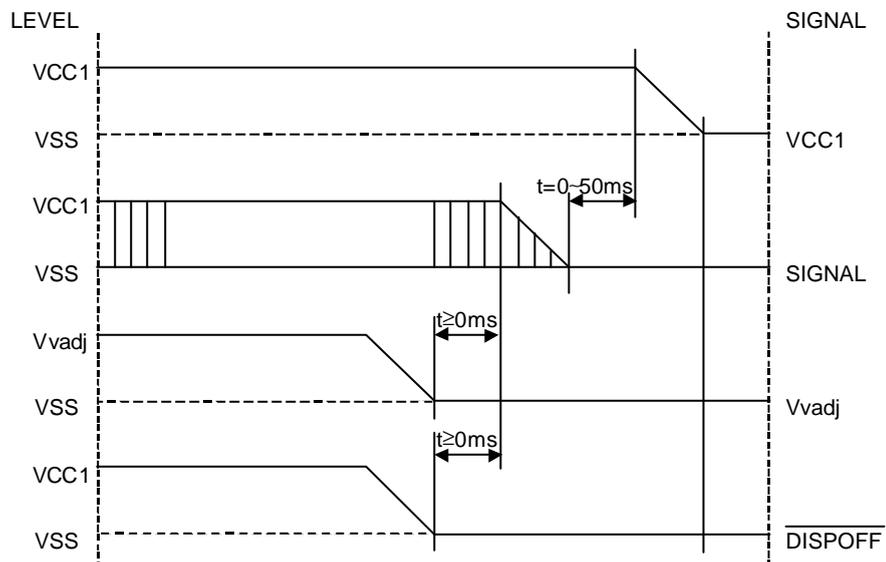
Please maintain the above sequence when turning on and off the power supply of the module.

If $\overline{\text{DISPOFF}}$ 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.

2.8. Lighting Specifications

Ta=25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units	Notes
Lamp Voltage	V_L	-	-	297	-	Vrms	1
Lamp Current	I_L	-	4	5	6	mArms	2
Starting Voltage	V_S	-	-	-	570	Vrms	3
Surface Luminance	L	I_L=5mA	80	100	-	cd/m^2	4
Average Life	T_{AL}	I_L=5mA	20000	-	-	hrs	5

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)
Surface Luminance is Through Touch Screen.

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.
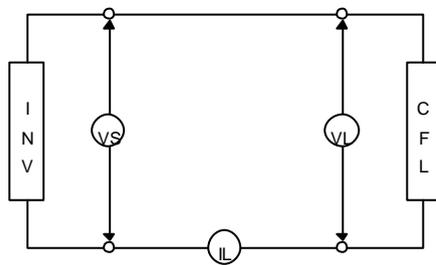
CFL Testing Circuit
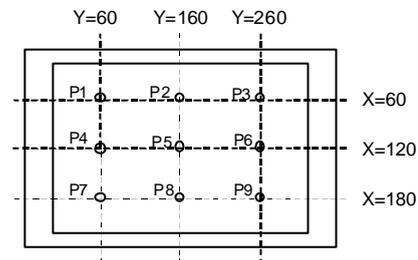
Measurement Points

Recommended Inverter : TBD086N-4
CXA-L10L (DC 12.0V, Produced by TDK)

3. Optical Specifications

3.1. Optical Characteristics

Ta=25°C, 1/240 Duty, 1/13 Bias, Vvadj=1.7 V (Note 4), θ= 0°, φ=-°

Parameter		Symbol	Conditions	Min.	Typ.	Max.	Units
Contrast Ratio Note 1		CR	θ= 0°,φ =-°	17	25	-	
Chromaticity(White)		x	-	-	0.30	-	
		y	-	-	0.31	-	
Viewing Angle			Shown in 3.2				
Response	Rise Note 2	T_{ON}	-	-	300	450	ms
Time	Decay Note 3	T_{OFF}	-	-	100	150	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

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 90% 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 10% of the saturation level in the luminance at the segment which the OFF signal is applied to.
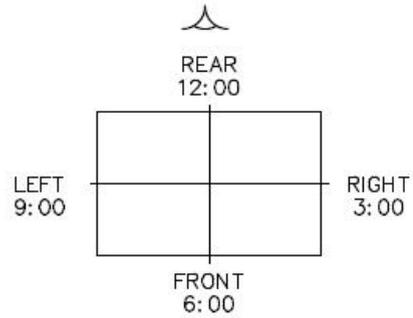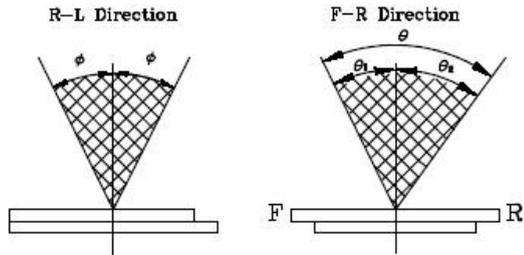
Vo-p

$1/(f_F \times A)$

(ON SIGNAL)

$1 /f_F$

$(B-2) \times Vo\text{-}p/B$

(OFF SIGNAL)
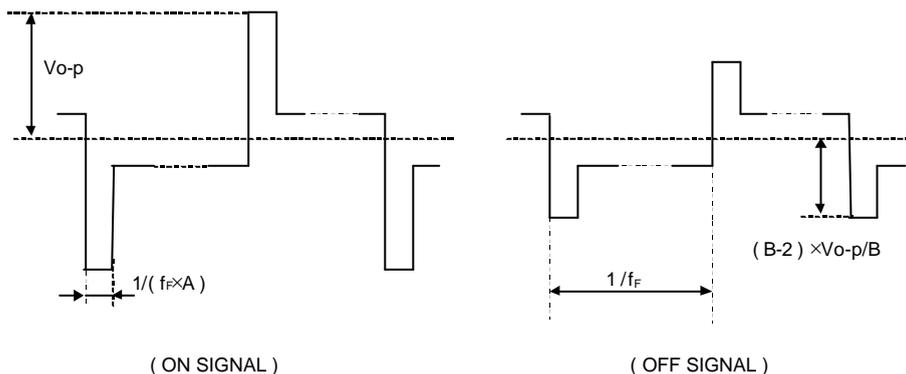
3.2. Definition of Viewing Angle and Optimum Viewing Area

*Driving condition: 1/240 Duty, 1/13Bias, V_{vadj}=1.7 V, f_F= 70Hz

CR$\geq$2

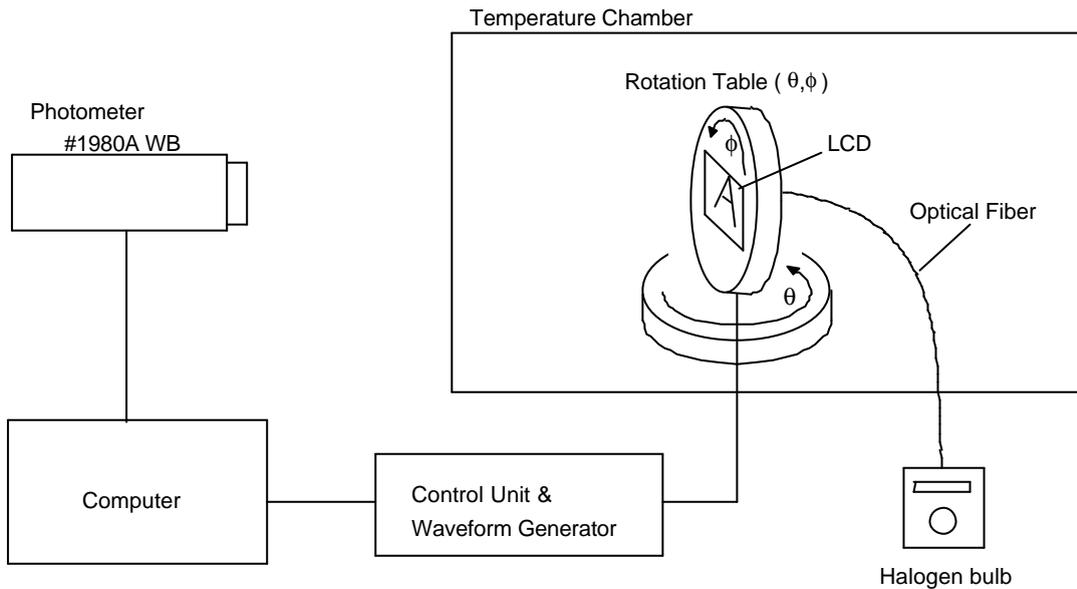ϕ =L:46 R:42° θ= F:20° R:37°

R—L Direction

ϕ ϕ

F—R Direction

θ

θ_1 θ_2

F   R

REAR
12:00

LEFT
9:00

RIGHT
3:00

FRONT
6:00

*For This Product
The Viewing Direction Is 12 O'clock
So $\theta_1 < \theta_2$

3.3. System Block Diagram

Temperature Chamber

Rotation Table (θ,ϕ)

Photometer
#1980A WB

ϕ

LCD

Optical Fiber

θ

Computer

Control Unit &
Waveform Generator

Halogen bulb

4.I/O Terminal

4.1. Pin Assignment

CN1

No.	Symbol	LEVEL	Function
1 ≀ 8	D0 ≀ D7	H/L	Display Data
9	$\overline{\text{DISPOFF}}$	H/L	Display Control Signal H : Display on L : Display off
10	FLM	H/L	First Line Marker
11	LP	H→L	Data Latch Signal
12	CP	H→L	Clock Signal for Shifting Data
13	M	H/L	Alternate Signal for LCD Drive
14	V_{cc1}	-	Power Supply for LCD Drive
15	V_{SS}	-	Power Supply (0V, GND)
16	V_{SS}	-	Power Supply (0V, GND)
17	V_{cc2}	-	Power Supply for LCD Drive
18	V_{VADJ}	-	Voltage Level for LCD Contrast Adjustment

CN2

No.	Symbol	LEVEL	Function
1	VCFL	-	Power Supply for CFL (HOT)
2	NC	-	No connection
3	NC	-	No connection
4	VSS	-	Power Supply for CFL (GND)

CN3

No.	Symbol	LEVEL	Function
1	DOWN	-	Down Direction
2	LEFT	-	Left Direction
3	UP	-	Up Direction
4	RIGHT	-	Right Direction

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.

```
                              o  3.3V
                        ⧠
                        ⧠ R1
   ┌──────────┐         ⧠
   │          │        ┌─┐
   │   V VADJ ├──────▶ │ │ VR
   │          │        └─┘
   │  MODULE  │         ⧠
   │          │         ⧠ R2
   │          │         ⧠
   │      VSS ├─────────●────o  VSS
   │     VCC1 ├──────────────o  VCC1
   │     VCC2 ├──────────────o  VCC2
   └──────────┘
```
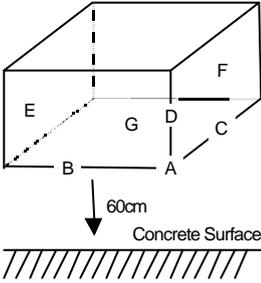
R1+R2+VR=10~ 20KΩ

4.3. Block Diagram

```
                    ┌──────────────┐   240   ┌──────────────────┐
  FLM ──────●─────▶ │  Row Driver  ├──/────▶ │      L C D P      │
            │       │     ×2       │         │                  │
            │       └──────────────┘         │ 320×R.G.B. ×240  │
            │         ▲   ▲   ▲               │      dots        │
   LP ──────┼───●─────┘   │   │               └──────────────────┘
            │   │         │   │                      ▲
            │   ●─────────┼───┼──────────────▶┌──────┴───────────┐
  DISPOFF ──┼───┼─────────●───┼──────────────▶│  Column Driver   │
   CP ──────┼───┼─────────────┼──────────────▶│       ×4         │
            │   │             │               └──────────────────┘
  D0~D7 ────┼───┼──8─/──      │                   ▲   ▲
            │   │    ┌────────┴───┐               │   │
            │   └───▶│ M Circuit  ├──⧠────────────┘   │
            └───────▶│            ├──⧠────────────────┘
                     └────────────┘ ──⧠
                                      │
   M ────────────────────────────────┘

  VCC2 ──────────────┐
                     │
  V VADJ ──┌─────────┴──────┐      ┌──────────────┐
           │ DC/DC Circuit  ├─────▶│ Bias Circuit ├──────▶ To LSI
           └────────┬───────┘      └──────────────┘
  V SS ─────────────●
                   ╪╪╪

  VCC1 ──────────────────────────────────────────▶ To LSI Logic

  VCFL ──────────┌──────────────┐
                 │ CFL Backlight │
  GND  ──────────└──────────────┘
```
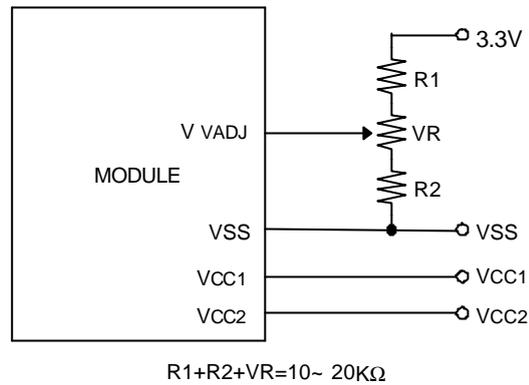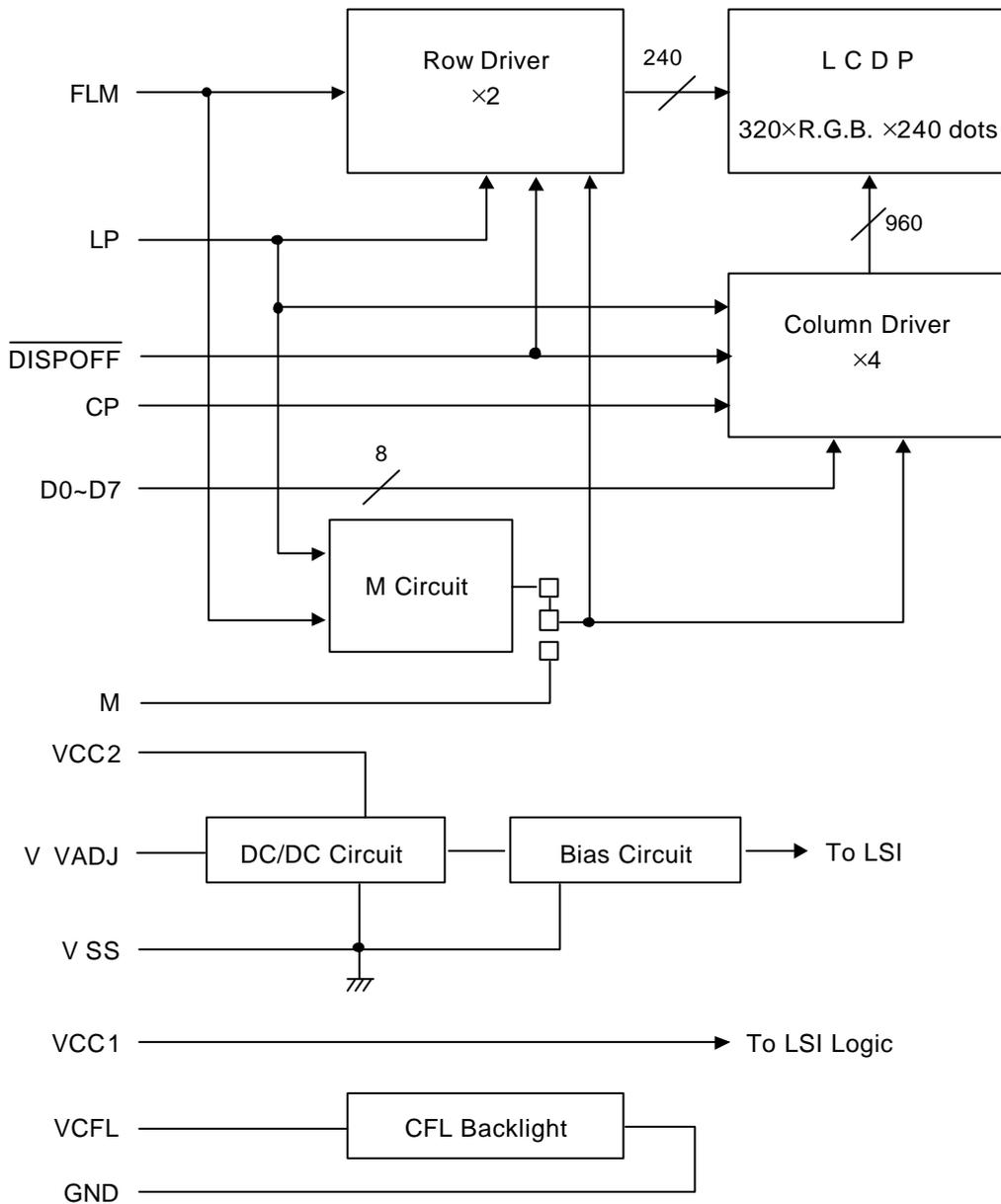
5.Test

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

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

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

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.

45°
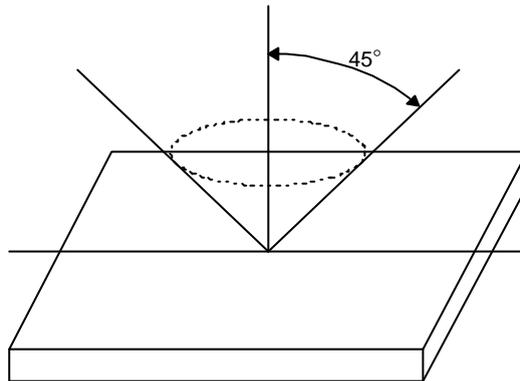
6.2.Definition of applicable Zones

A Zone

B Zone

C Zone

Bezel Frame
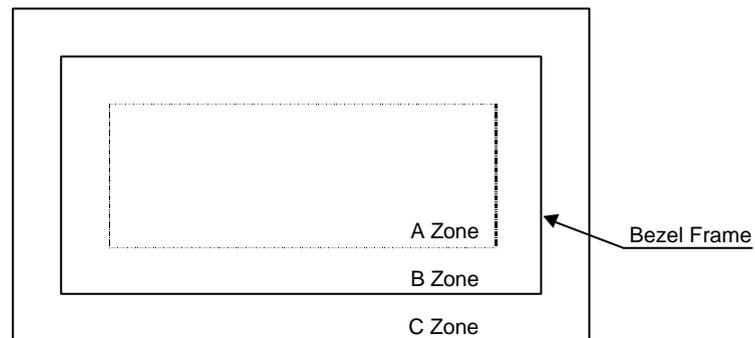
A Zone : Active display area

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

(1) Round Shape

Zone / Dimension (mm)	Acceptable Number 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	*

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

(2) Line Shape

X(mm)	Y(mm)	Zone / Acceptable Number 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)		

X : Length   Y : Width   * : Disregard
Total defects shall not exceed 5.

2 — Air Bubbles (between glass & polarizer)

Zone / Dimension (mm)	Acceptable Number A	B	C
D ≤ 0.3	*	*	*
0.3 < D ≤ 0.4	3	*	*
0.4 < D ≤ 0.6	2	3	*
0.6 < D	0	0	*

* : Disregard
Total defects shall not exceed 3.

3 — The Shape of Dot
However, each pixel shall not remain more than one-third of the original pixel size.

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 — Conplex Foreign Substabce Defects
Black spots, line shaped foreign substances or air bubbles between glass&polarizer shoud be 5pcs maxmum in total.

7 — Distance between Different Forrein Substabce Defects
D ≤ 0.2 : 20mm or more
0.2 < D : 40mm or more

No.	Parameter	Criteria		
8	Black and White Spots With Gray Scale	Judge at the voltage which can be seen easily defect mode.		
		Zone Dimension (mm)	Acceptable Number	
		$D \leq 0.3$	Disregard	
		$0.3 < D \leq 0.6$	3 (1pc within ϕ30mm)	

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)
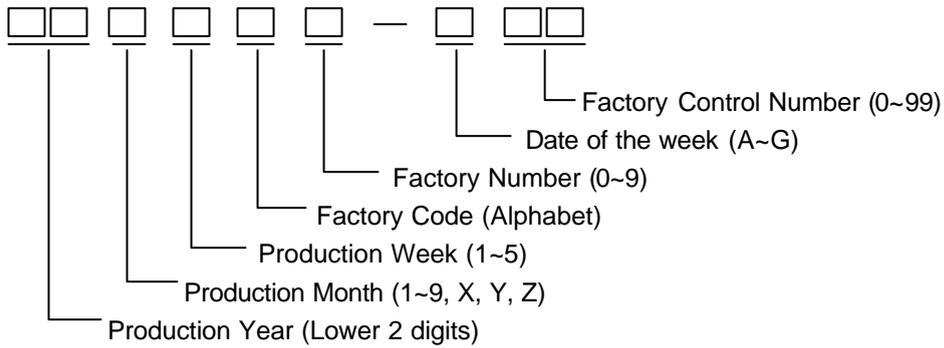
8.Type Number

The type number of module is specified as follows.

F-51900NCU-FW-ACN

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 18 (eighteen) months from Optrex production or 1(one) year from Optrex, Optrex America, Optrex Europe delivery which ever comes later.

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