		First Edition	Approved by	Production Div.
LCD Module Specification		March 27, 1997	Checked by	Quality Assurance Div.
		Final Revision	Checked by	Design Engineering Div.
		*******		
Type No.	DMF－50202N		Prepared by	Production Div.

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Revision History

Rev.	Date	Page	Comment

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1.General Specifications

    Operating Temp.   :   min. 0℃ ～ max. 50℃

    Storage Temp.   :   min. -20℃ ～ max. 60℃

    Dot Pixels   :   128 (W) × 64 (H) dots

    Dot Size   :   0.40 (W) × 0.56 (H) mm

    Dot Pitch   :   0.44 (W) × 0.60 (H) mm

    Viewing Area   :   62.0 (W) × 44.0 (H) mm

    Outline Dimensions   :   95.0 (W) × 58.0 (H) × 8.7 max. (D) mm

    LCD Type   :   NRD-7496
                                    (STN / Neutral-mode / Reflective)

    Viewing Angle   :   6:00

    Data Transfer   :   Serial data transfer

    Backlight   :   None

    Drawings   :   Dimensional Outline   UE-33929A

2. Electrical Specifications

2.1. Absolute Maximum Ratings

$V_{SS}=0V$

Parameter	Symbol	Conditions	Min.	Max.	Units
Supply Voltage (Logic)	$V_{DD}-V_{SS}$	—	-0.3	7.0	V
Supply Voltage (LCD Drive)	$V_{DD}-V_{EE}$	—	0	30.0	V
Input Voltage	V_I	—	-0.3	$V_{DD}+0.3$	V

2.2. DC Characteristics

$Ta=25℃$, $V_{SS}=0V$

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Supply Voltage (Logic)	$V_{DD}-V_{SS}$	—	4.5	—	5.5	V
Supply Voltage (LCD Drive)	$V_{DD}-V_{EE}$	Shown in 3.1				V
High Level Input Voltage	V_{IH}	$V_{DD}=5.0V\pm10\%$	$V_{DD}-0.8$	—	V_{DD}	V
Low Level Input Voltage	V_{IL}	$V_{DD}=5.0V\pm10\%$	0	—	0.8	V
High Level Output Voltage	V_{OH}	$I_{OH}=-0.5mA$	$V_{DD}-0.3$	—	V_{DD}	V
Low Level Output Voltage	V_{OL}	$I_{OL}=0.5mA$	0	—	0.3	V
Supply Current	I_{DD}	$V_{DD}-V_{SS}=5.0V$	—	1.0	1.5	mA
	I_{EE}	$V_{DD}-V_{EE}=13.2V$	—	0.8	1.2	mA

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2.3. AC Characteristics

| Parameter	Symbol	Min.	Max.	Units
Clock Pulse High Level Width	t_{CWH}	95	—	ns
Clock Pulse Low Level Width	t_{CWL}	95	—	ns
Clock Pulse Rise/Fall Time	t_r, t_f	—	30	ns
Latch Pulse High Level Width	t_{LW}	40	—	ns
Latch Pulse Rise Time	t_{LRP}	20	—	ns
Latch Pulse Fall Time	t_{LFP}	40	—	ns
Data Setup Time	t_{DSU}	20	—	ns
Data Hold Time	t_{DHD}	40	—	ns
Frame Data Setup Time	t_{FDS}	30	—	ns
Frame Data Hold Time	t_{FDH}	50	—	ns
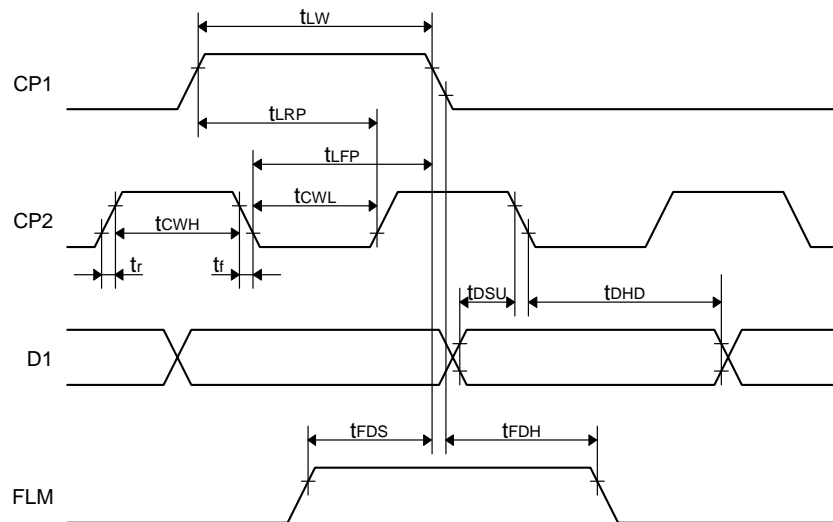
2.4.Timing Chart
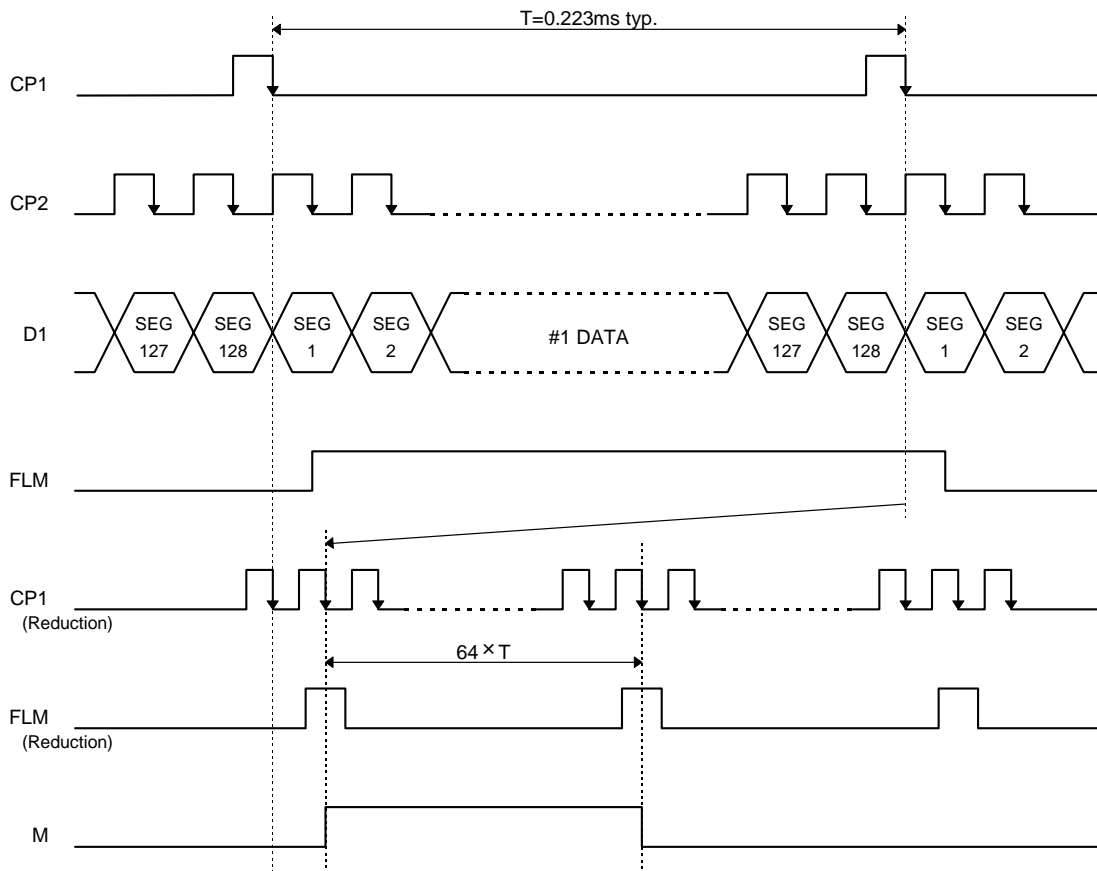
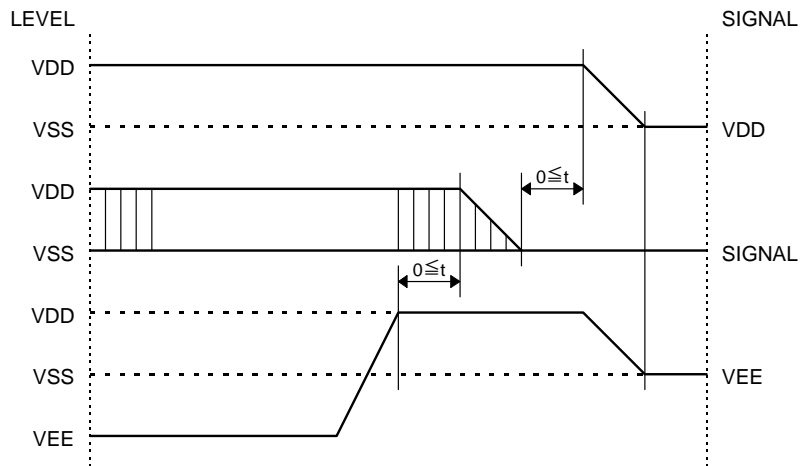## 2.5.Comparison of Display and Data
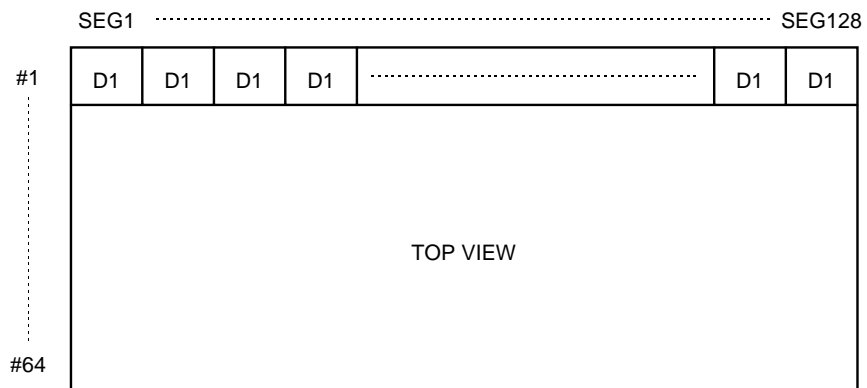
2.6.Power Supply ON/OFF Sequence

2.6.1.ON Sequence
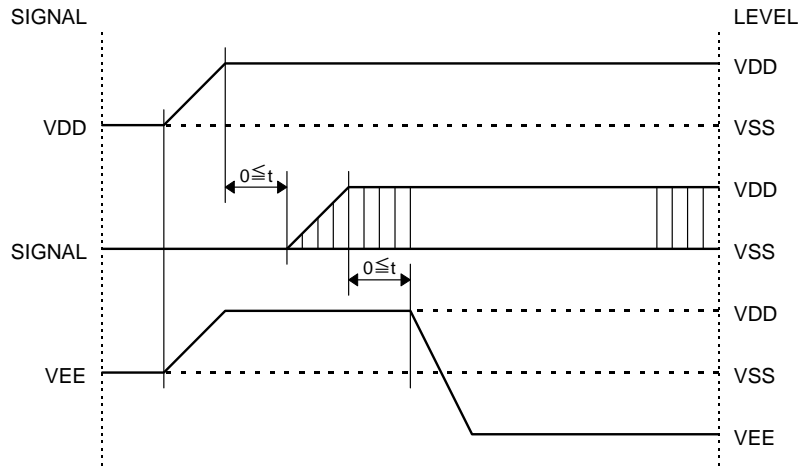
2.6.2.OFF Sequence

Please maintain the above sequence when turning on and off the power supply of the module. If V_{EE} is supplied to the module while alternate signal for LCD driving (M) is unstable, DC component will be supplied to the LCD panel. This may cause damage the LCD module.

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3.Optical Specifications

3.1.LCD Driving Voltage

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Recommended		Ta= 0℃	—	—	15.4	V
LCD Driving Voltage	V_{DD}-V_{EE}	Ta=25℃	12.3	13.2	14.1	V
Note 1		Ta=50℃	10.9	—	—	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℃, 1/64 Duty, 1/9 Bias, V_D=13.2V (Note 4), $\theta = 0°$, $\phi = -°$

Parameter		Symbol	Conditions	Min.	Typ.	Max.	Units
Contrast Ratio	Note 1	CR	$\theta = 0°$, $\phi = -°$	—	4	—	
Viewing Angle			Shown in 3.3				
Response	Rise Note 2	τr	—	—	160	240	ms
Time	Decay Note 3	τd	—	—	160	240	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
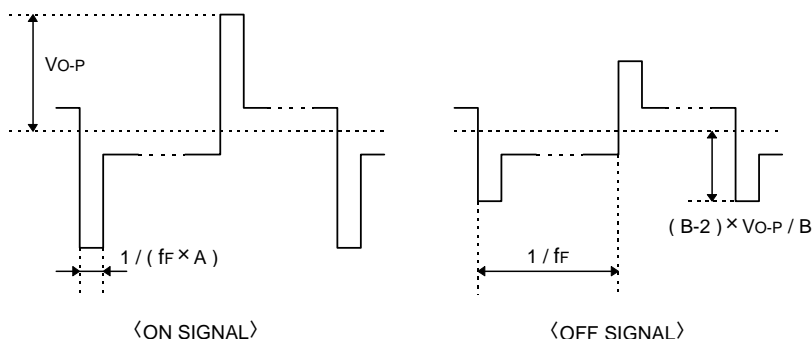signal is applied.

Note 4 : Definition of Driving Voltage V_D

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_D is definded
as follows.

$$V_D = (Vth1+Vth2) / 2$$

Vth1 : The voltage V_{O-P} that should provide 50% of the satulation level in the luminance at
the segment which the ON signal is applied to.

Vth2 : The voltage V_{O-P} that should provide 50% of the satulation level in the luminance at
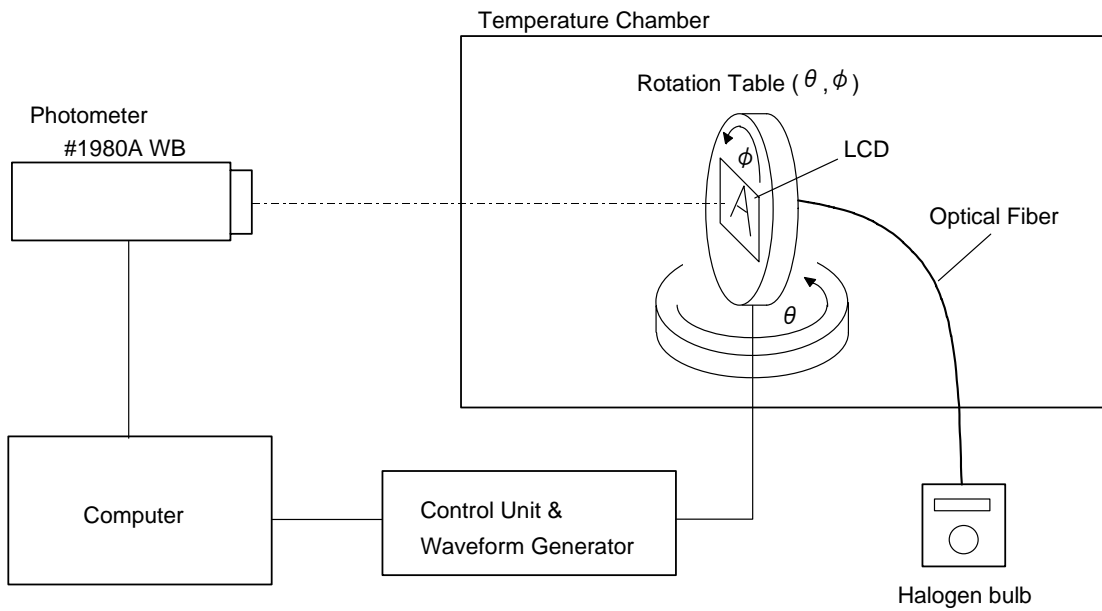the segment which the OFF signal is applied to.

V_{O-P}

$(B-2)× V_{O-P} / B$

$1 / (f_F × A)$

$1 / f_F$

〈ON SIGNAL〉

〈OFF SIGNAL〉

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3.3.Definition of Viewing Angle and Optimum Viewing Area

・Point ● shows the point where contrast ratio is measured. : $\theta = 0°$, $\phi = -°$
・Driving condition : 1/64 Duty, 1/9 Bias, V_D=13.2V, f_F=70Hz
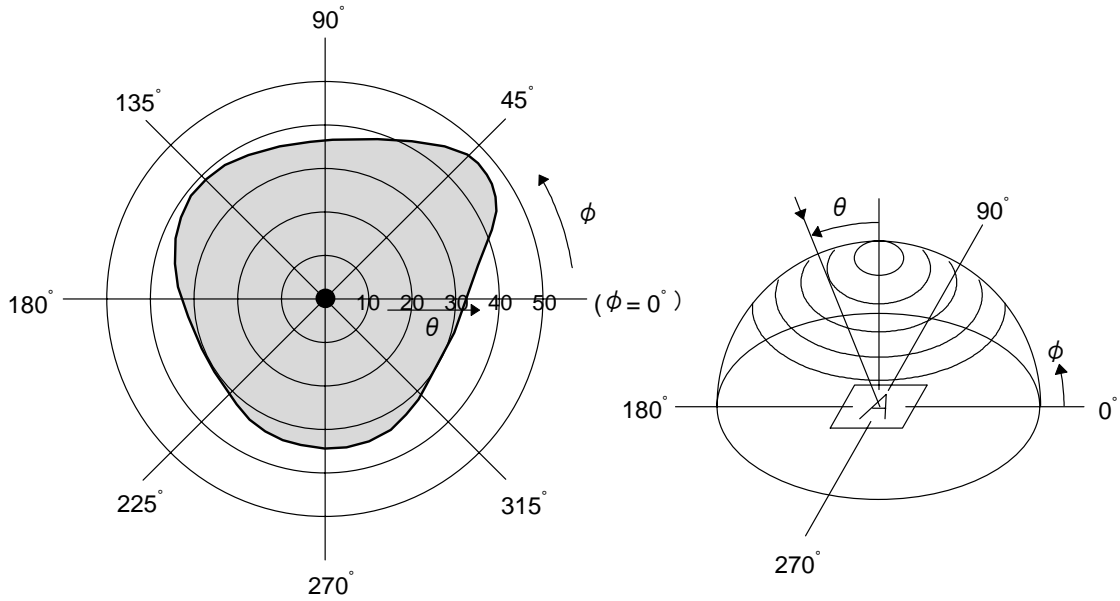
・Area □ shows typ. CR$\geqq$2

3.4.System Block Diagram

4.I/O Terminal
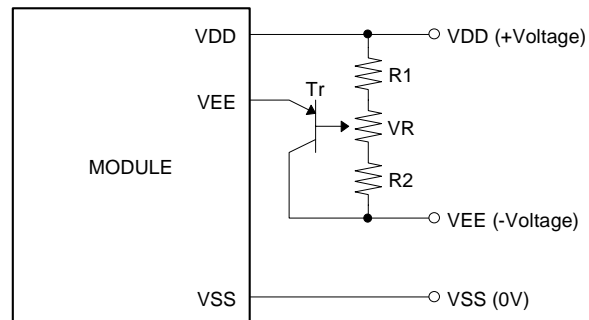
4.1.Pin Assignment

CN1

No.	Symbol	Level	Function
1	FLM	H / L	First Line Marker
2	CP1	H→L	Data Latch Signal
3	CP2	H→L	Clock Signal for Shifting Data
4	M	H / L	Alternate Signal for LCD Drive
5	D1	H / L	Display Data
6	V_{DD}	—	Power Supply for Logic
7	V_{SS}	—	Power Supply (0V, GND)
8	V_{EE}	—	Power Supply for LCD Drive

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.
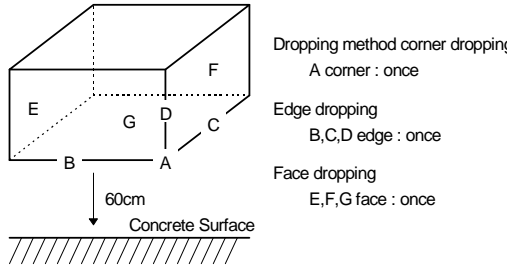
R1+R2+VR=10～20K Ω
Tr=2SA1202 or equivalent

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4.3.Block Diagram

FLM ————————→ Row Driver
                 T6A40 × 1
                 or equivalent ——64/—→ L C D P

                                        128 × 64 dots

                      /2   /128

CP1, M ——————●————2/——————→ Column Driver
                                  T6A39 × 2
CP2 ——————————————————→   or equivalent

D1 ——————————————————————————↑

VDD ———————————————
                          FG
VSS ——————⊏│⊐——
         ⏚   Bias Circuit ——→ To LSI

VEE ——————————————
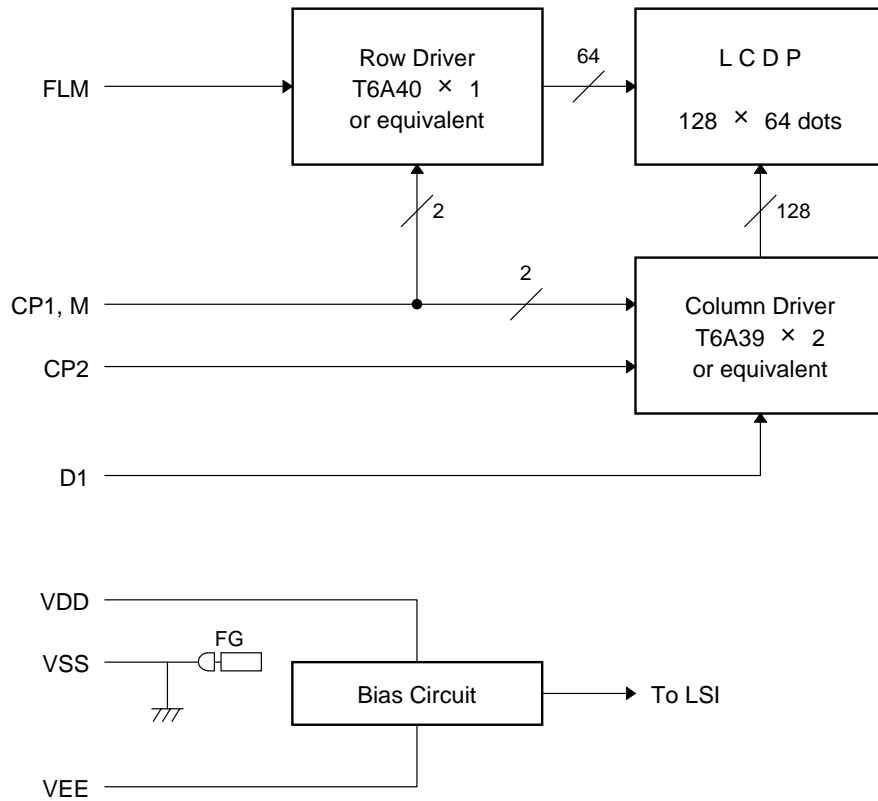
5. Test

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

No.	Parameter	Conditions	Notes
1	High Temperature Operating	50℃±2℃, 96hrs (operation state)	
2	Low Temperature Operating	0℃±2℃, 96hrs (operation state)	3
3	High Temperature Storage	60℃±2℃, 96hrs	4
4	Low Temperature Storage	-20℃±2℃, 96hrs	3, 4
5	Damp Proof Test	40℃±2℃, 90～95%RH, 96hrs	3, 4
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	5
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 60cm　Concrete Surface	

Note 1 : Unless otherwise specified, tests will be conducted under the following condition.
　　　　　Temperature : 20±5℃
　　　　　Humidity 　 : 65±5%
Note 2 : Unless otherwise specified, tests will be not conducted under functioning state.
Note 3 : No dew condensation to be observed.
Note 4 : The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.
Note 5 : 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.
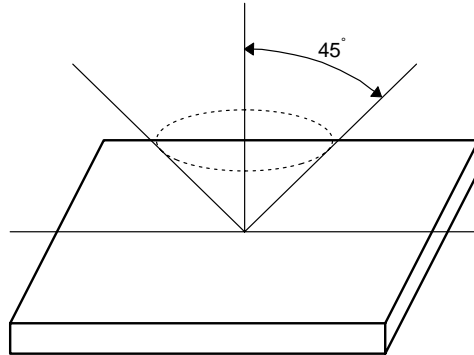
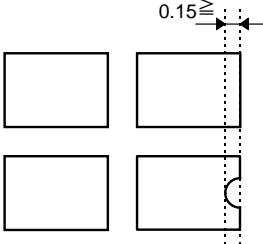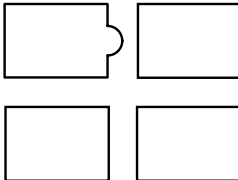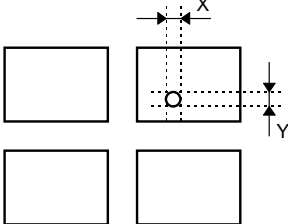### 6.2.Definition of applicable Zones
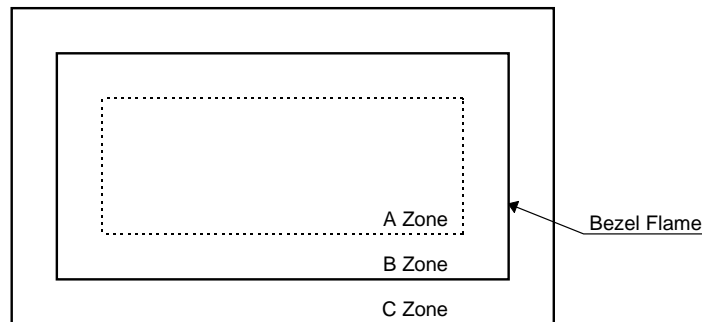
A Zone : Active display area
B Zone : Area from outside of "A Zone" to validity viewing area
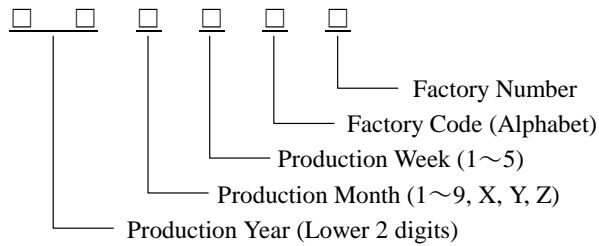C Zone : Rest parts

A Zone + B Zone = Validity viewing area

6.3.Standards

No.	Parameter	Criteria
1	Black and White Spots, Foreign Substances	(1) Round Shape
		(2) Line Shape
2	Air Bubbles (between glass & polarizer)	

1 — Black and White Spots, Foreign Substances

(1) Round Shape

Dimension (mm) \ Zone	A	B	C
D ≦ 0.1	*	*	*
0.1 < D ≦ 0.2	5	5	*
0.2 < D ≦ 0.3	0	1	*
0.3 < D	0	0	*

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

(2) Line Shape

X(mm)	Y(mm)	A	B	C
―	0.02 ≧ W	*	*	*
2.0 ≧ L	0.03 ≧ W	3	3	*
1.0 ≧ L	0.04 ≧ W	1	2	*
1.0 ≧ L	0.05 ≧ W	0	2	*
―	0.05 < W	In the same way (1)		

X : Length   Y : Width   * : Disregard

Total defects shall not exceed 5.

2 — Air Bubbles (between glass & polarizer)

Dimension (mm) \ Zone	A	B	C
D ≦ 0.15	*	*	*
0.15 < D ≦ 0.3	2	3	*
0.3 < D ≦ 0.5	1	2	*
0.5 < D ≦ 1.0	0	1	*

* : Disregard

Total defects shall not exceed 3.

No.	Parameter	Criteria
3	The Shape of Dot	(1) Dot Shape (with Dent) 0.15≧ As per the sketch of left hand. (2) Dot Shape (with Projection) Should not be connected to next dot. (3) Pin Hole X Y $(X+Y) / 2 \leqq 0.2mm$ (Less than 0.1mm is no counted.) Total defects shall not exceed 5.
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	Color Variation	Not to be conspicuous defects.

7.Code System of Production Lot

The production lot of module is specified as follows :

□　□　□　□　□　□
```
                            Factory Number
                        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 on the back of module as follows :

D M F － 5 0 2 0 2 N
```
                  Etching or Printing
```
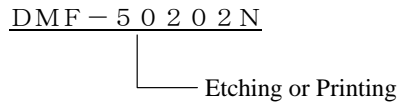
9.Applying Precautions

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

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10.Handling Precautions

Operex Products are designed for use in ordinary electronic devices such as business machines, telecommunications equipment, measurement devices and etc..
Optrex Products are not designed, intended, or authorized for use in any application in which the failure of the product could result in a situation where personal injury or death may occur. These applications include, but are not limited to, life-sustaining equipment, nuclear control devices, aerospace equipment, devices related to hazardous or flammable materials, etc. (If Buyer intends to purchase or use the Optrex Products for such unintended or unauthorized applications, Buyer must secure prior written consent to such use by a responsible officer of Optrex Corporation.) Should Buyer purchase or use Optrex Products for any such unintended or unauthorized application (without such consent), Buyer shall indemnify and hold Optrex and its officers, employees, subsidiaries, affiliates and distributors harmless against all claims, costs, damages and expenses, and reasonable attorney's fees, arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Optrex was negligent regarding the design or manufacture of the part.

1) LCD may be broken because it is made of glass.

2) Polarizer is a soft material and can easily be scratched.

3) Please avoid static electricity.

  ① Please be sure to ground human body and electric appliances during work.
  ② It is preferable to use conductive mat on table and wear cotton clothes or conduction processed fiber. Synthetic fiber is not recommended.
  ③ Please slowly peel off protective film, because static electricity may be charged.

4) If it is necessary to store LCD modules for a long time, please comply with the following procedures. If storage condition is not satisfactory, display (especially polarizer) may be deteriorated or soldering I/O terminals may become difficult (some oxide is generated at I/O terminals plating).

  ① Store as delivered by Optrex
  ② If you store as unpacked, put in anti-static bag, seal its opening and store where it is not subjected to direct sunshine nor fluorescent lamp.
  ③ Store at temperature 0 to +35℃ and at low humidity. Please refer to our specification sheets for storage temperature range and humidity condition.

5) The module does not contain excess current limiter. Please design the limiter to cut excess current in your power supply circuit.

6) Liquid crystal may be leaked when display is broken. Never taste it. If your hands or clothes touch it, please immediately wash using soap.

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