LCD Module Specification

First Edition	Approved by	Production Div.
Feb 22, 1998	Checked by	Quality Assurance Div.
Final Revision	Checked by	Design Engineering Div.
*******	Prepared by	Production Div.

Type No. DMF－50887NCJU－FW－1

Table of Contents

Revision History

Rev.	Date	Page	Comment

1. General Specifications

Operating Temp.	:	min. 0℃ ～ max. 60℃
Storage Temp.	:	min. -20℃ ～ max. 70℃
Dot Pixels	:	256×3 [R.G.B] (W) × 64 (H) dots
Dot Size	:	0.097 (W) × 0.331 (H) mm
Dot Pitch	:	0.117 (W) × 0.351 (H) mm
Viewing Area	:	92.8 (W) × 25.2 (H) mm
Outline Dimensions	:	128.0 (W) × 38.5 (H) × 18.0 max. (D) mm
LCD Type	:	CTD-16303 (F-STN / Color-mode / Transmissive)
Viewing Angle	:	12:00
Data Transfer	:	8-bit parallel data transfer
Backlight	:	Cold Cathode Fluorescent Lamp (CFL) × 1
Drawings	:	Dimensional Outline UE-37502

2. Electrical Specifications

2.1. Absolute Maximum Ratings

V_{SS}=0V

Parameter	Symbol	Conditions	Min.	Max.	Units
Supply Voltage	V_{CC1}-V_{SS} V_{CC2}-V_{SS}	—	-0.3	6.0	V
Supply Voltage (Contrast)	V_{CONT}-V_{SS}	—	-0.3	6.0	V
Input Voltage	V_I	—	-0.3	V_{CC1}	V
Output Voltage	V_O	—	-0.3	V_{CC1}	V

2.2. DC Characteristics

Ta=25℃, V_{SS}=0V

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Supply Voltage	V_{CC1}-V_{SS} V_{CC2}-V_{SS}	—	4.5	5.0	5.5	V
Supply Voltage (Contrast)	V_{CONT}-V_{SS}	—	0.5	2.5	4.5	V
High Level Input Voltage	V_{IH}	V_{CC1}=5.5V	2.0	—	V_{CC1}	V
Low Level Input Voltage	V_{IL}	V_{CC1}=4.5V	—	—	0.8	V
High Level Output Voltage	V_{OH}	I_{OH}=-8mA Apply to DB0～DB15	V_{CC1}-0.4	—	—	V
Low Level Output Voltage	V_{OL}	I_{OL}=8mA Apply to DB0～DB15	0	—	0.4	V
High Level Output Voltage	V_{OH}	I_{OH}=-12mA Apply to READY	V_{CC1}-0.4	—	—	V
Low Level Output Voltage	V_{OL}	I_{OL}=12mA Apply to READY	—	—	0.4	V
Frequency	fosc	—	—	10	—	MHz
Supply Current	I_{CC} Note1	V_{CC1}-V_{SS}=5.0V V_{CC2}-V_{SS}=5.0V	—	40	60	mA

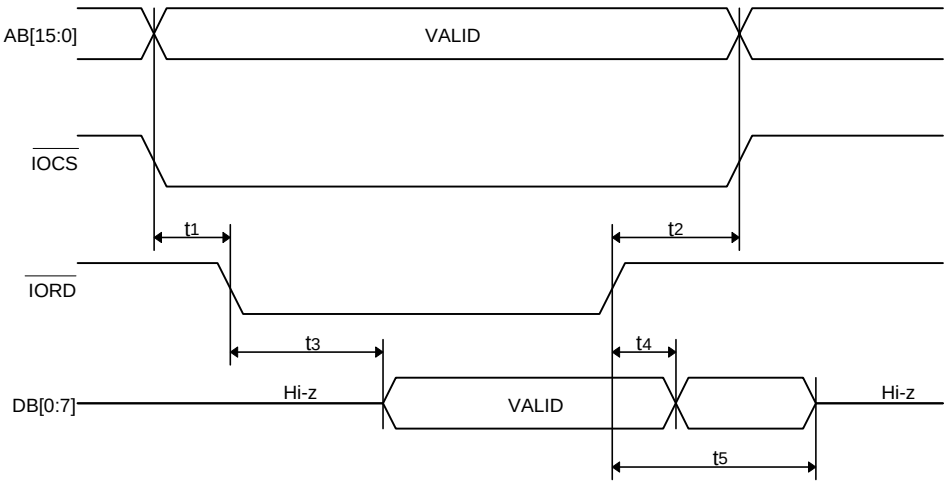
Note1: $I_{CC}=I_{CC1}+I_{CC2}$

2.3.AC Characteristics

2.3.1.Read/Write Operation Sequence

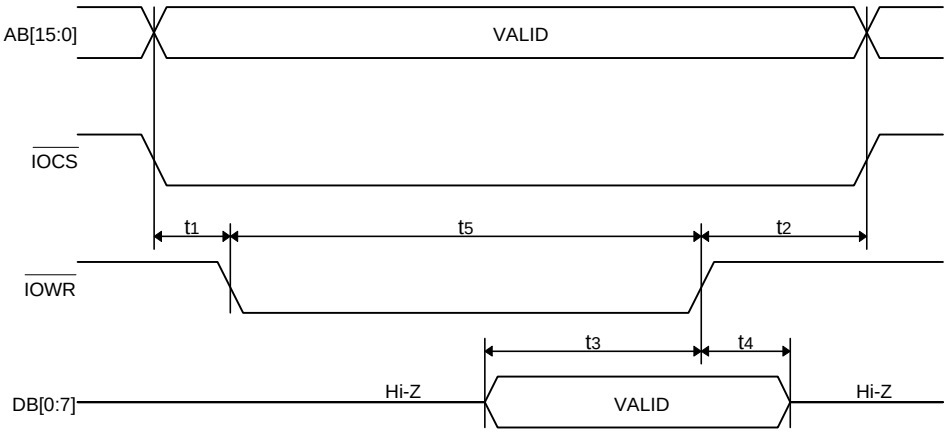
READ V_{CC1}=4.5～5.5V

Parameter	Symbol	Min.	Max.	Units
AB[15:0] and $\overline{IOCS}$ valid before $\overline{IORD}$ ↓	t_1	0	—	ns
AB[15:0] and $\overline{IOCS}$ hold from $\overline{IORD}$ ↑	t_2	10	—	ns
$\overline{IORD}$ ↓ to DB[7:0] valid	t_3	—	40	ns
DB[7:0] hold from $\overline{IORD}$ ↑	t_4	—	15	ns
$\overline{IORD}$ ↑ to DB[7:0] Hi-z delay	t_5	—	25	ns



WRITE V_{CC1}=4.5～5.5V

Parameter	Symbol	Min.	Max.	Units
AB[15:0] and $\overline{IOCS}$ valid before $\overline{IOWR}$ ↓	t_1	0	—	ns
AB[15:0] and $\overline{IOCS}$ hold from $\overline{IOWR}$ ↑	t_2	10	—	ns
DB[7:0] setup to $\overline{IOWR}$ ↑	t_3	10	—	ns
DB[7:0] hold from $\overline{IOWR}$ ↑	t_4	10	—	ns
Pulse width of $\overline{IOWR}$	t_5	20	—	ns

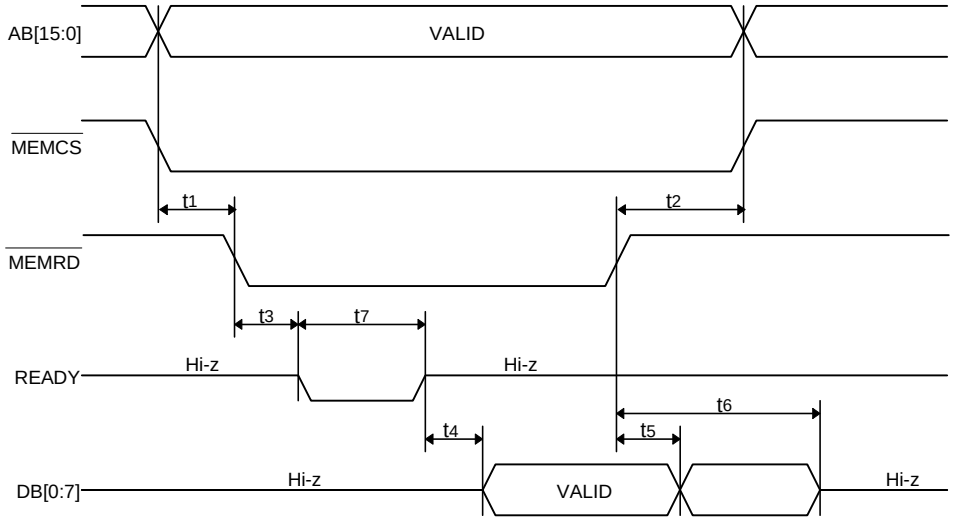


2.3.2.Read/Write Operation Sequence (VRAM)

READ V_{CC1}=4.5～5.5V

Parameter	Symbol	Min.	Max.	Units
AB[15:0] and $\overline{MEMCS}$ valid before $\overline{MEMRD}$ ↓	t_1	0	–	ns
AB[15:0] and $\overline{MEMCS}$ hold from $\overline{MEMRD}$ ↑	t_2	0	–	ns
$\overline{MEMRD}$ ↓ to READY ↓	t_3	–	20	ns
READY ↑ to DB[7:0] valid	t_4	–	10	ns
DB[7:0] hold from $\overline{MEMRD}$ ↑	t_5	–	10	ns
$\overline{MEMRD}$ ↑ to DB[7:0] Hi-z delay	t_6	–	20	ns
READY negated pluse width	t_7	–	3.5×MCLK+10	ns

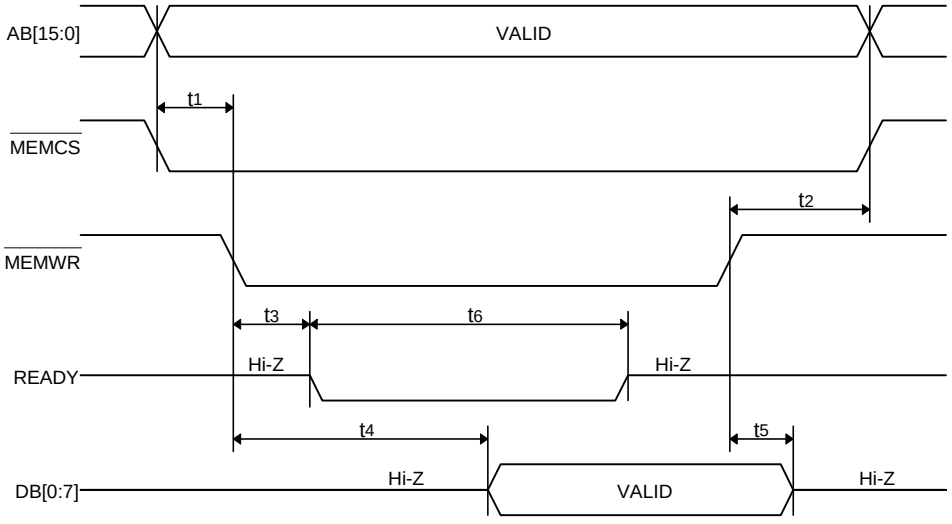
Where MCLK=1/fosc or 2/fosc depending on which display mode the chip is in. (See section 2.3.3.)



WRITE V_{CC1}=4.5～5.5V

Parameter	Symbol	Min.	Max.	Units
AB[15:0] and $\overline{MEMCS}$ valid before $\overline{MEMWR}$ ↓	t_1	0	–	ns
AB[15:0] and $\overline{MEMCS}$ hold from $\overline{MEMWR}$ ↑	t_2	0	–	ns
$\overline{MEMWR}$ ↓ to READY ↓	t_3	–	20	ns
$\overline{MEMWR}$ ↓ to DB[7:0] valid	t_4	–	MCLK-20	ns
DB[7:0] hold from $\overline{MEMWR}$ ↑	t_5	0	–	ns
READY negated pluse width	t_6	–	3.5×MCLK+10	ns

Where MCLK=1/fosc or 2/fosc depending on which display mode the chip is in. (See section 2.3.3.)



2.3.3.SRAM Access Time

8-bit Display Memory Interface

Display Mode	Access time
16-level colors	Access time≦1/fosc-25ns
4-level colors	Access time≦2/fosc-25ns
Black-and-White(BW)	Access time≦2/fosc-25ns

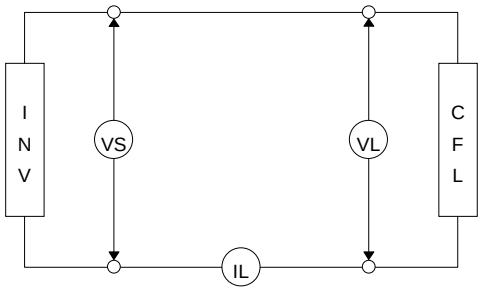
2.4. Lighting Specifications

Ta=25℃

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units	Notes
Surface Luminance	L	I_L=5mA	—	150	—	cd/㎡	1
Average Life	T_{AL}	I_L=5mA	—	25000	—	hrs	2

Note 1 : Surface Luminance is specified by the initial data of luminance measured at the center of display surface after 20 minutes power on. (All ON pattern)

Note 2 : CFL life is defined as the time for which the initial luminance is attenuated by 50% of the luminance value. Average Life represented the time elapsed at the point of time when the residual ratio becomes below 50% when plural lamps are lighted in comparison with the definition of life mentioned above.



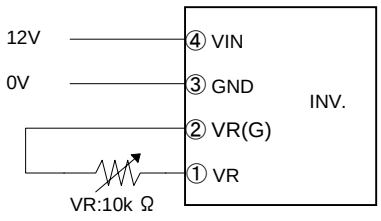
CFL Testing Circuit

2.5. CFL Inverter Specifications

Ta=25℃

Parameter	Symbol	Min.	Typ.	Max.	Units	Notes
Input Voltage	Vin	11.4	12.0	13.2	V	—
Input Current	Iin	140	170	200	mA	Vin=12.0V
Cube Current	IL	4.0	5.0	6.0	mArms	Note1
Frequency	f	55	65	75	kHz	Note1
Adjustment Ratio (IL)	—	—	1:3	—	—	IL(min.):IL(max.)
Note2 (Luminance)	—	—	1:3	—	—	L(min.):L(max.)

Note1:A value when luminance is maximum.



Note2:Testing Circuit

3. Optical Specifications

3.1. Optical Characteristics

Ta=25℃, 1/64 Duty, 1/9 Bias, V_D=14.7V (Note 4), $\theta = 0^\circ$, $\phi = -^\circ$

Parameter		Symbol	Conditions	Min.	Typ.	Max.	Units
Contrast Ratio Note 1		CR	$\theta = 0^\circ$, $\phi = -^\circ$	20	30	–	
Chromaticity (white)		x	–	0.273	0.303	0.333	
Note 2		y	–	0.311	0.341	0.371	
Viewing Angle			Shown in 3.3				
Response	Rise Note 3	T_{ON}	–	–	120	200	ms
Time	Decay Note 4	T_{OFF}	–	–	80	160	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

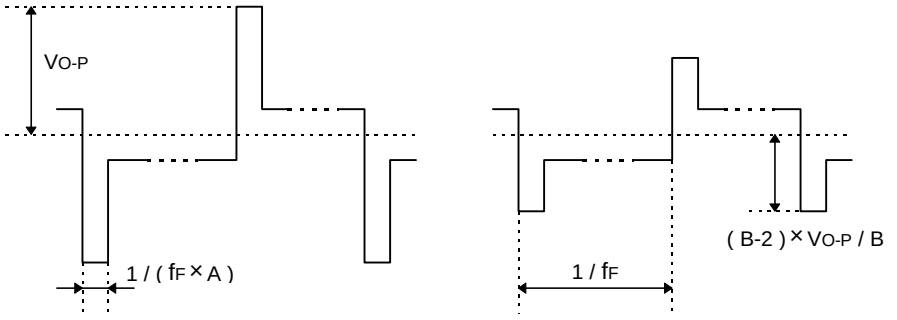
Note 2 : Chromaticity at Backlight Sarface: x=0.345, y=0.330

Note 3 : The time that the luminance level reaches 90% of the saturation level from 0% when ON signal is applied.

Note 4 : The time that the luminance level reaches 10% of the saturation level from 100% when OFF signal is applied.

Note 5 : Definition of Driving Voltage V_D

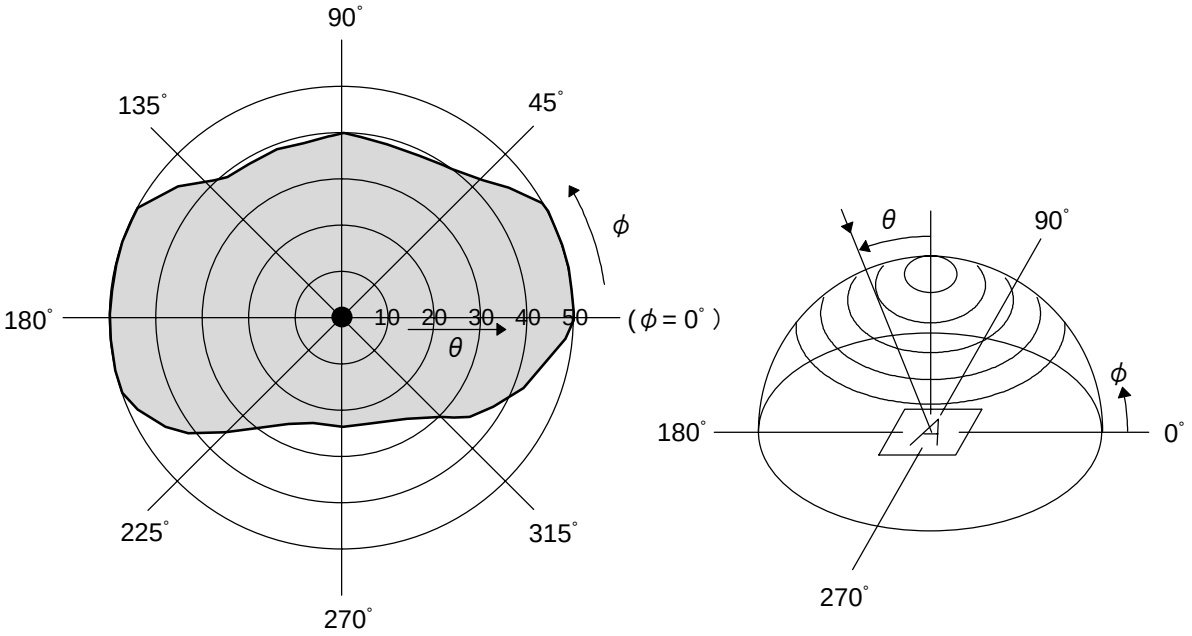
Assuming that the typical driving waveforms shown below are applied to the LCD Panel at 1/A Duty - 1/B Bias (A : Duty Number, B : Bias Number). Driving voltage V_D is definded as the voltage V_{O-P} when the contrast ratio ($CR=L_{ON} / L_{OFF}$) is at its maximum.



3.2.Definition of Viewing Angle and Optimum Viewing Area

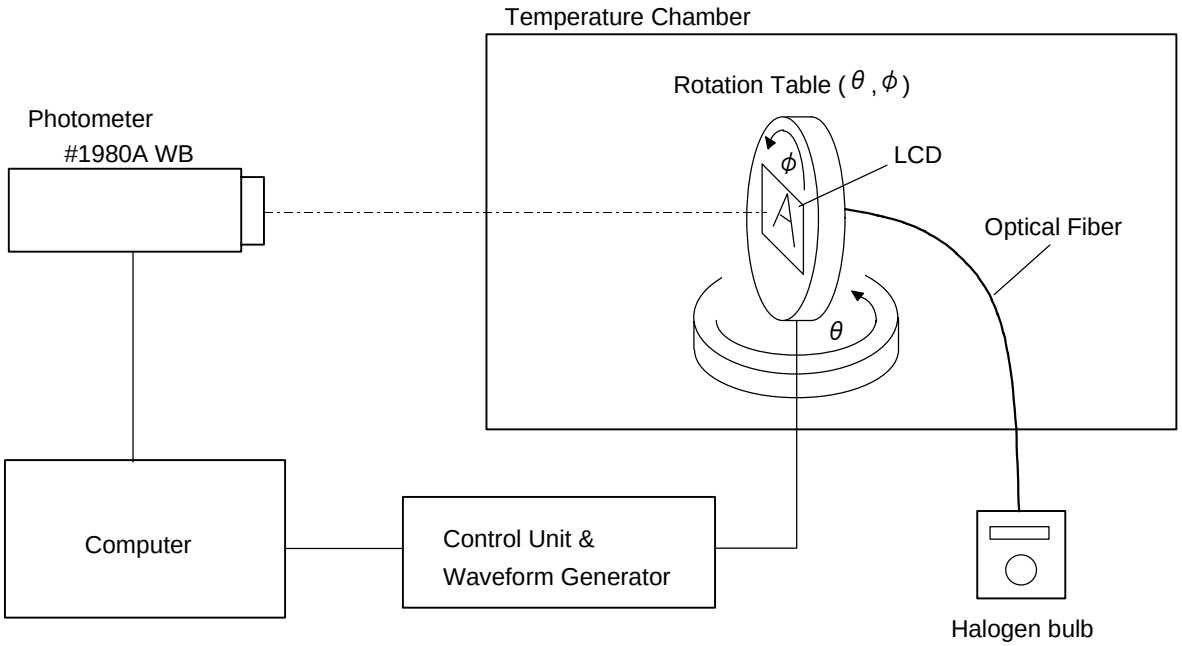
・Point ● shows the point where contrast ratio is measured. : $\theta = 0^\circ$, $\phi = -^\circ$

・Driving condition : 1/64 Duty, 1/9 Bias, V_D=14.7V, f_F=70Hz



・Area ▭ shows typ. CR≧2

3.3.System Block Diagram



4.I/O Terminal

4.1.Pin Assignment

CN1

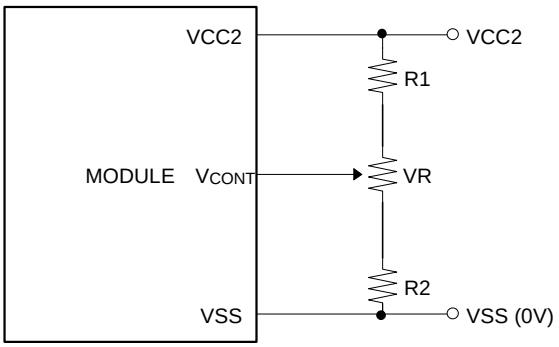
No.	Symbol	Level	Function
1	FG	—	Frame GND
2	V_{SS}	—	Power Supply (0V, GND)
3	V_{SS}	—	Power Supply (0V, GND)
4	V_{CC1}	—	Power Supply for Logic
5	V_{CC1}	—	Power Supply for Logic
6	V_{CC2}	—	Power Supply for LCD
7	V_{CC2}	—	Power Supply for LCD
8	V_{CONT}	—	Voltage Level for LCD Contrast Adjustment
9	$\overline{IOCS}$	H / L	Control Register Chip Select Signal L : Active
10	$\overline{IOWR}$	H / L	Control Register Write Signal L : Active
11	$\overline{IORD}$	H / L	Control Register Read Signal L : Active
12	$\overline{MEMCS}$	H / L	Memory Chip Select Signal L : Active
13	$\overline{MEMWR}$	H / L	Memory Write Signal L : Active
14	$\overline{MEMRD}$	H / L	Memory Read Signal L : Active
15	READY	H / L	Ready Signal
16	RESET	H / L	Reset Signal H : Reset
17	AB0	H / L	Address Bus Line
18	AB1	H / L	Address Bus Line
19	AB2	H / L	Address Bus Line
20	AB3	H / L	Address Bus Line
21	AB4	H / L	Address Bus Line
22	AB5	H / L	Address Bus Line
23	AB6	H / L	Address Bus Line
24	AB7	H / L	Address Bus Line
25	AB8	H / L	Address Bus Line
26	AB9	H / L	Address Bus Line
27	AB10	H / L	Address Bus Line
28	AB11	H / L	Address Bus Line
29	AB12	H / L	Address Bus Line
30	AB13	H / L	Address Bus Line
31	AB14	H / L	Address Bus Line
32	AB15	H / L	Address Bus Line
33	DB0	H / L	Data Bus Line
34	DB1	H / L	Data Bus Line
35	DB2	H / L	Data Bus Line
36	DB3	H / L	Data Bus Line
37	DB4	H / L	Data Bus Line
38	DB5	H / L	Data Bus Line
39	DB6	H / L	Data Bus Line
40	DB7	H / L	Data Bus Line

CN2

No.	Symbol	Level	Function
1	VR	－	CFL Compensation Terminal (10kΩ)
2	VR(G)	－	CFL Compensation Terminal (G)
3	GND	－	Power Supply for CFL Inverter (GND)
4	VIN(12V)	－	Power Supply for CFL Inverter (+12V)

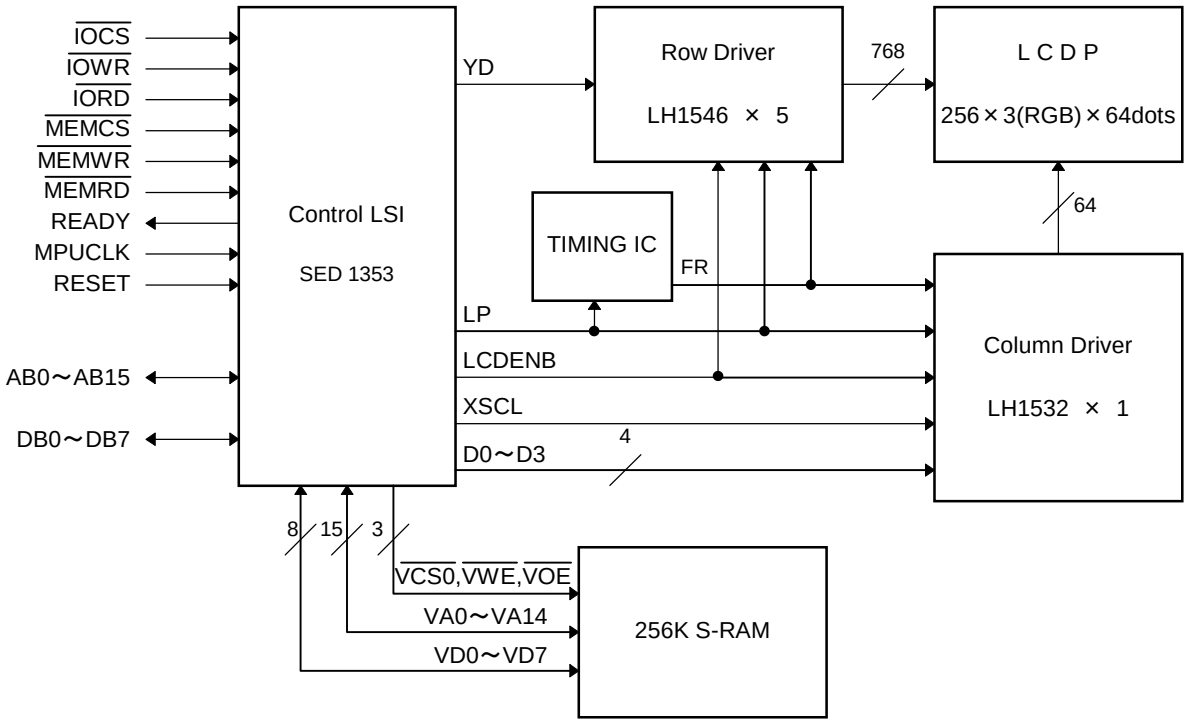
4.2.Example of Power Supply

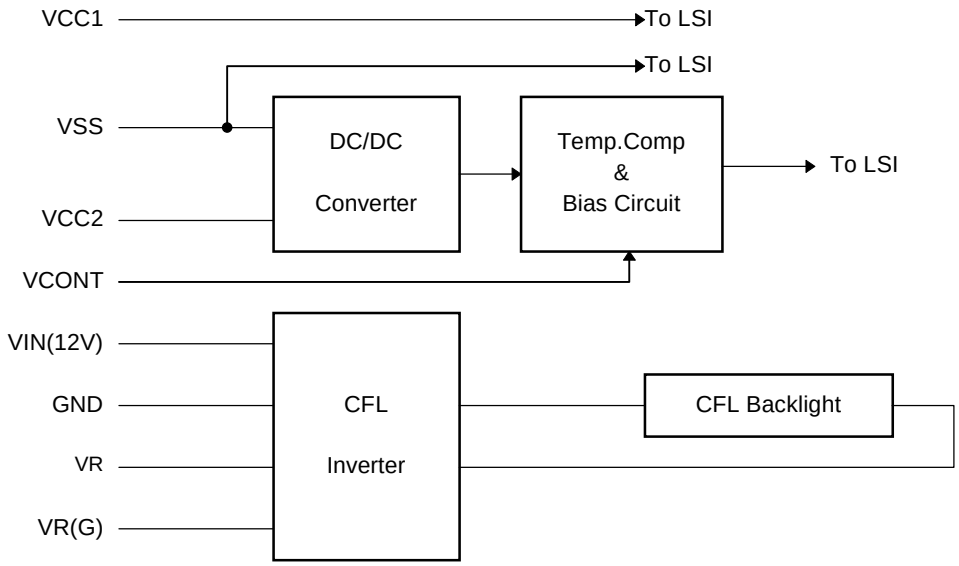
It is recommended to apply a potentiometer for the contrast adjust due to the tolerance of the driving voltage and its temperature dependence.



R1+R2+VR=10～20KΩ

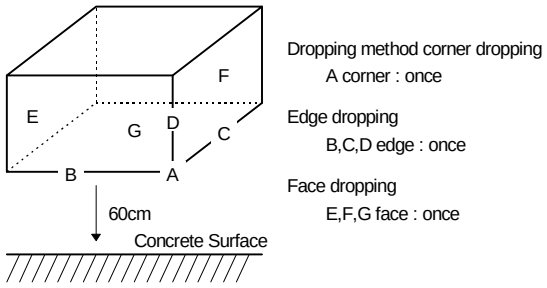
4.3.Block Diagram





5. Test

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

No.	Parameter	Conditions	Notes
1	High Temperature Operating	60℃±2℃, 96hrs (operation state)	
2	Low Temperature Operating	0℃±2℃, 96hrs (operation state)	3
3	High Temperature Storage	70℃±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. 	

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.

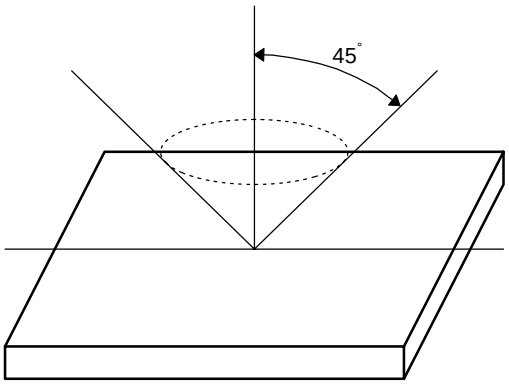
Note 4 : The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.

Note 5 : Vibration test will be conducted to the product itself without putting it in a container.

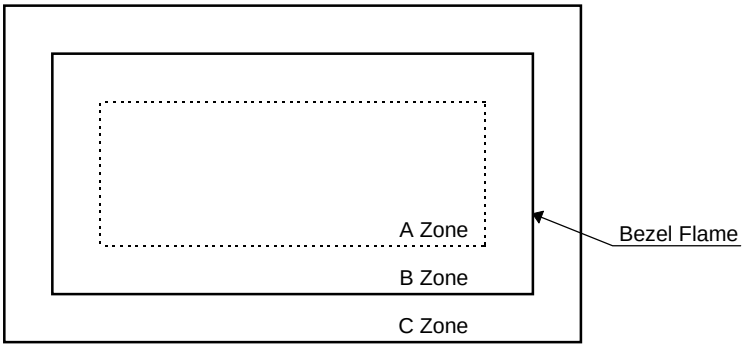
6. Appearance Standards

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

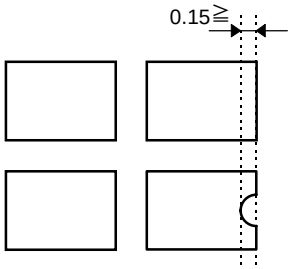
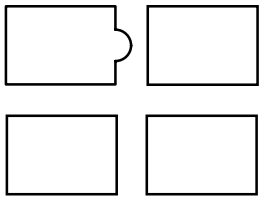
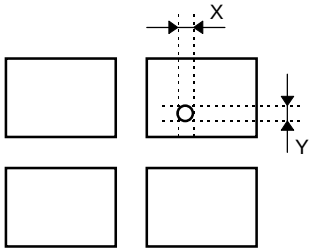
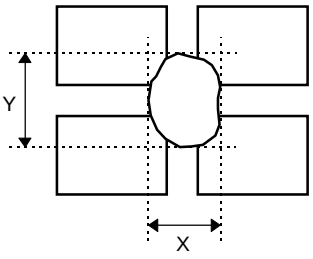


A Zone : Active display area
B Zone : Area from outside of "A Zone" to validity viewing area
C Zone : Rest parts

A Zone + B Zone = Validity viewing area

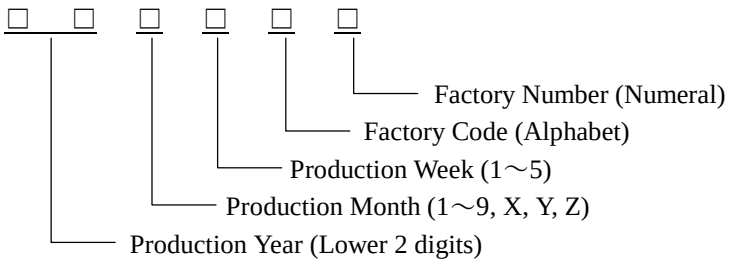
6.3.Standards

<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="3">Acceptable Number</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>D ≦0.1</td><td>*</td><td>*</td><td>*</td></tr>
<tr><td>0.1 ＜ D ≦0.2</td><td>3</td><td>5</td><td>*</td></tr>
<tr><td>0.2 ＜ D ≦0.25</td><td>2</td><td>3</td><td>*</td></tr>
<tr><td>0.25＜ D ≦0.3</td><td>0</td><td>1</td><td>*</td></tr>
<tr><td>0.3 ＜ D</td><td>0</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 rowspan="2">Y (mm)</th><th colspan="3">Acceptable Number</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>—</td><td>0.03≧W</td><td>*</td><td>*</td><td>*</td></tr>
<tr><td>2.0≧L</td><td>0.05≧W</td><td>3</td><td>3</td><td>*</td></tr>
<tr><td>1.0≧L</td><td>0.1 ≧W</td><td>3</td><td>3</td><td>*</td></tr>
<tr><td>—</td><td>0.1 ＜W</td><td colspan="3">In the same way (1)</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="3">Acceptable Number</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>D ≦ 0.3</td><td>*</td><td>*</td><td>*</td></tr>
<tr><td>0.3 ＜ D ≦ 0.4</td><td>3</td><td>*</td><td>*</td></tr>
<tr><td>0.4 ＜ D ≦ 0.6</td><td>2</td><td>3</td><td>*</td></tr>
<tr><td>0.6 ＜ D</td><td>0</td><td>0</td><td>*</td></tr>
</table>
* : Disregard
Total defects shall not exceed 3.
</td></tr>
</table>

No.	Parameter	Criteria
3	The Shape of Dot	(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.) (4) Deformation  (X+Y) / 2≦0.2mm Total acceptable number : 1/dot, 5/cell (Defect number of (4) : 1pc.)
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≦0.2 : 20mm or more 0.2＜D : 40mm or more

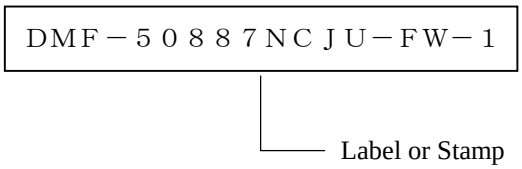
7. Code System of Production Lot

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) Conduc1tivity 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.
③The use of CFLs for extended periods of time at low temperatures will significantly shorten their service life.

8) For models which use touch panels:

①Do not stack up modules since they can be damaged by components on neighboring modules.
②Do not place heavy objects on top of the product. This could cause glass breakage.

9) For models which use COG,TAB,or COF:

①The 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.
②Given 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:

①In order to maintain reliability, do not touch or hold by the connector area.
②Avoid 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 industrial property, which may arise through the use of your product, with exception to those issues relating directly to the structure or method of manufacturing of our product.