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LIQUID CRYSTAL DISPLAY MODULE  
MODEL: AWG-S32240AMBHSGWH-A  
Customer's No.:

Acceptance
Empty space for acceptance

Approved and Checked by
Empty space for approval and checking

Approved by	Checked by		Made by
<div> 樺 叡  2008/10/06  NICK </div>	<div> 樺 叡  2008/10/06  JOE </div>		<div> 樺 叡  2008/10/06  TOM </div>



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## 1. General Specifications

Operating Temperature	:	Min. -20°C ~ Max. 70°C
Storage Temperature	:	Min. -30°C ~ Max. 80°C
Dot Pixels	:	320 (W) x 240 (H) dots
Dot Size	:	0.33 (W) x 0.33 (H) mm
Dot Space	:	0.03 (W) x 0.03 (H) mm
Viewing Area	:	120.0 (W) x 90.0 (H) mm
Display Area	:	115.17(W)x 86.37(H) mm
Outline Dimensions	:	167.1* (W) x 109.0** (H) x 12.4 max.*** (D) mm
		* Without FFC
		** Without LED Cable
Weight	:	N/A
LCD Type	:	STN/ Negative, Blue mode/ Transmissive
Viewing Direction	:	6 O'clock
Data Transfer	:	4-bit parallel data transfer
Backlight	:	With LED Backlight (White)
Drawings	:	As attached drawings

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## 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)	$V_{LCD} - V_{SS}$	--	0	35.0	V
Input Voltage	$V_I$	--	- 0.3	$V_{DD} + 0.3$	V

### 2.2 DC Characteristics

$T_a = 25^{\circ}C$ ,  $V_{SS} = 0V$

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Supply Voltage (Logic)	$V_{DD} - V_{SS}$	--	4.5	5.0	5.5	V
Supply Voltage (LCD Drive)	$V_{DD} - V_{EE}$	--	12.0	--	32.0	V
	$V_{DD} - V_O$	Shown in 3.1				V
High Level (Input Voltage)	$V_{IH}$	--	$0.8 \times V_{DD}$	--	$V_{DD}$	V
Low Level (Input Voltage)	$V_{IL}$	--	$V_{SS}$	--	$0.2 \times V_{DD}$	V
High Level (Output Voltage)	$V_{OH}$	$I_{OH} = -0.5mA$	2.4	--	--	V
Supply Current	$I_{DD}$	$V_{DD} = 5.0V$	--	20	30	mA
	$I_{EE}$	$V_{DD} = 5.0V$	--	3.0	5.0	mA
Frame	$f_F$	Duty = 50%	32	64	128	Hz

### 2.3 AC Characteristics

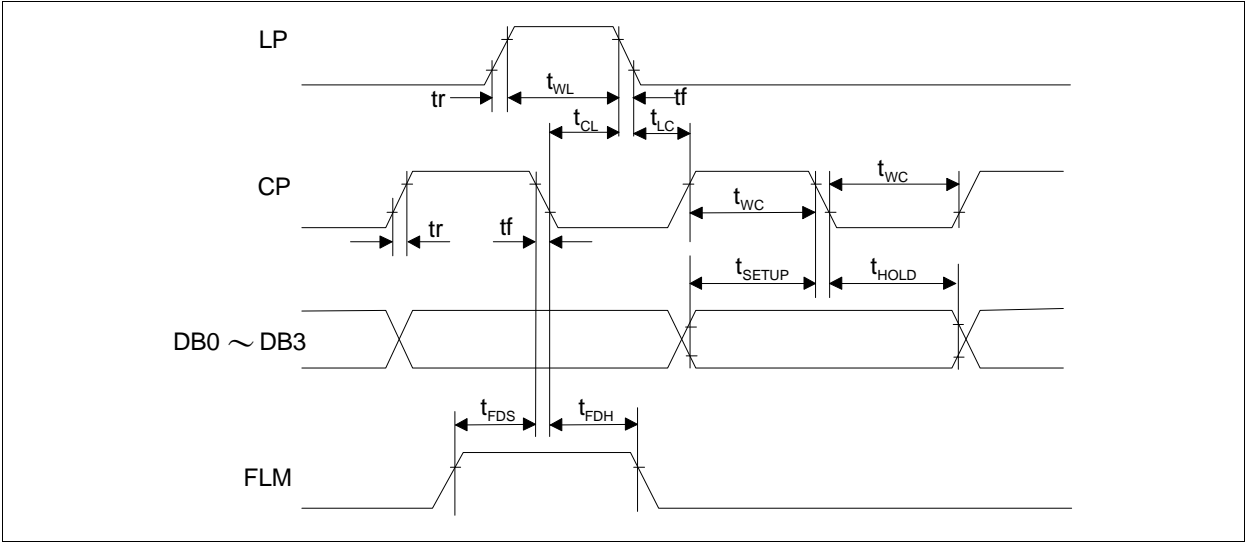
$V_{DD} = 5.0V \pm 10\%$

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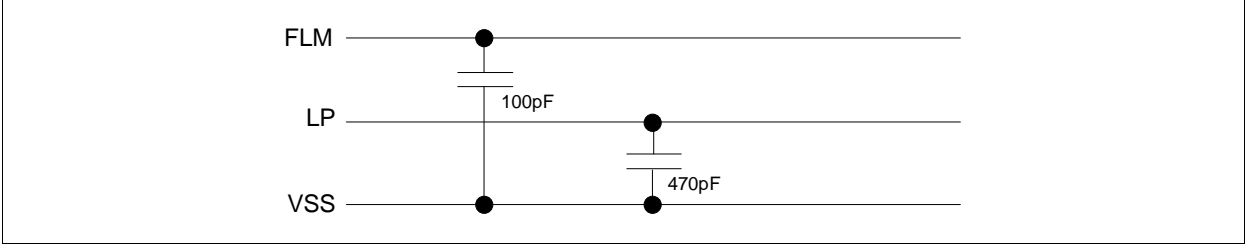
Parameter	Symbol	Min.	Max.	Units
CP Pulse Time	f <sub>CP</sub>	--	6.0	MHz
Clock Pulse Width	t <sub>WC</sub>	50	--	ns
Load Pulse Width	t <sub>WL</sub>	63	--	ns
Data Setup Time	t <sub>SEPUP</sub>	30	--	ns
Data Hold Time	t <sub>HOLD</sub>	30	--	ns
Clock Pulse Setup Time	t <sub>CL</sub>	80	--	ns
Clock Pulse Hold Time	t <sub>LC</sub>	110	--	ns
Rise/Fall Time	tr, tf	--	Note1	ns
FLM Setup Time	t <sub>FDS</sub>	100	50	ns
FLM Hold Time	t <sub>FDH</sub>	100	--	ns

Note1:     The rise and fall times (tr, tf) must satisfy the following relationship (a. and b.).

- a.    $tr, tf < \frac{1}{2fcp} - t_{wc}$
- b.    $tr, tf < 50ns$

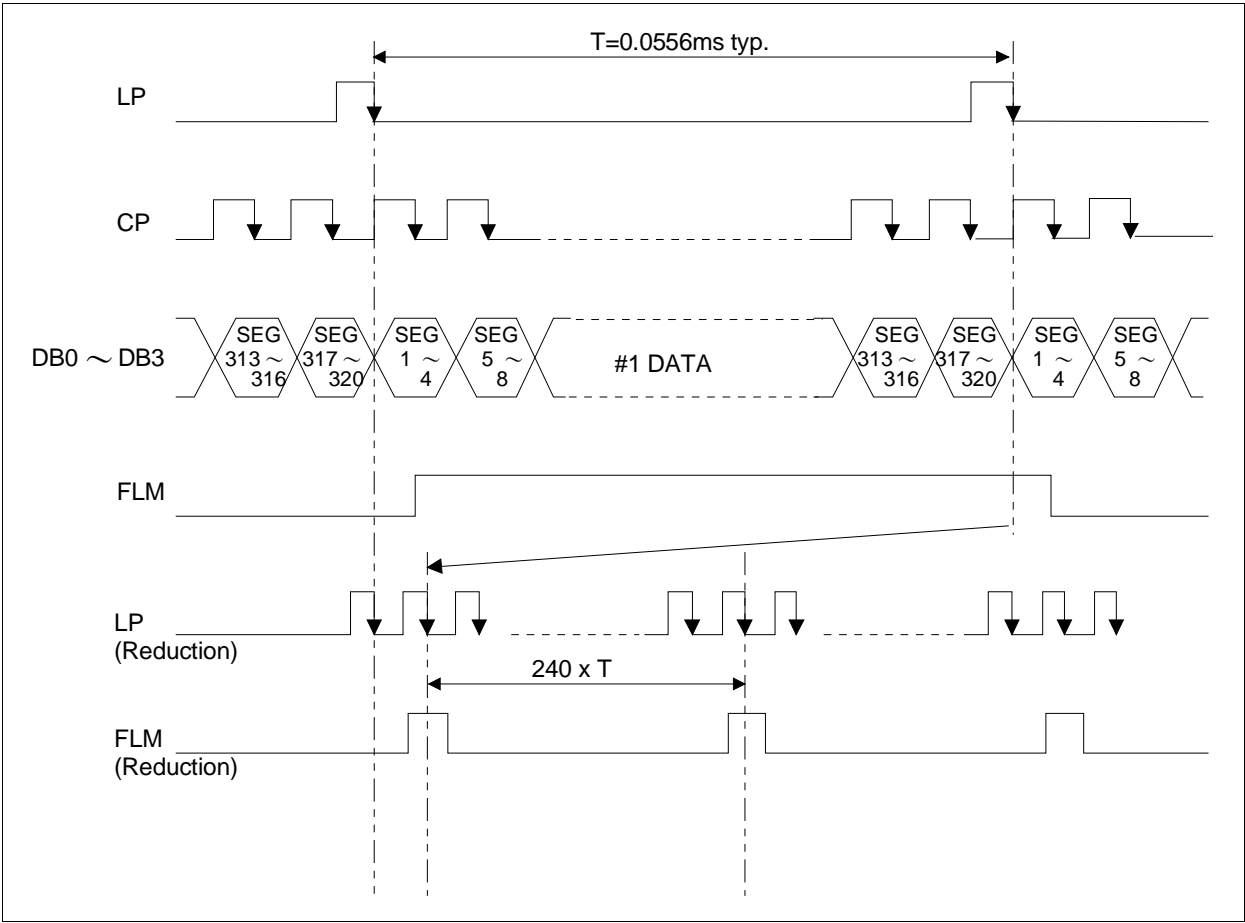


This module contains these capacitors. Please be careful about timing characteristics.



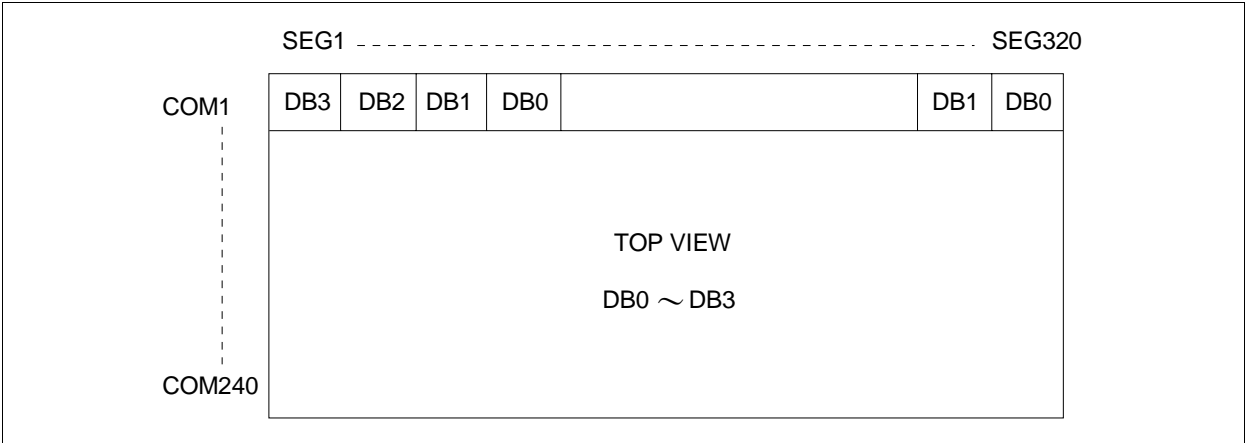
2.4 Timing Chart

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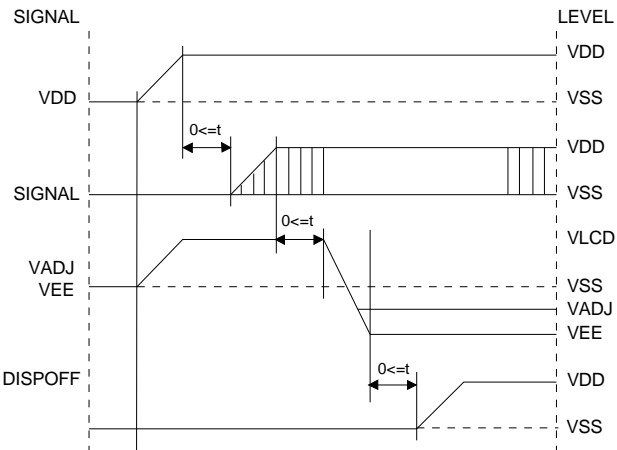
2.5 Comparison of Display and Data

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## 2.6 Power Supply ON/OFF Sequence

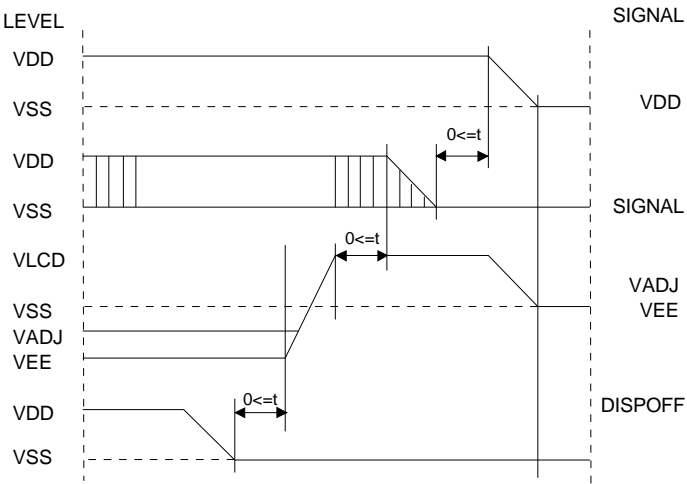
### 2.6.1 ON Sequence



### 2.6.2 OFF Sequence



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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 to the LCD module.

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## 2.7 Spec. for LED back-light

### 2.7.1 Absolute Maximum Ratings

Parameter	Symbol	Conditions	Max	Units
Forward Current	$I_F$	--	180	mA
Reverse Voltage	$V_R$	--	5.0	V
LED Power Dissipation	$P_D$	--	0.9	W
Operation Temperature	$T_{OPR}$		-20 to 70	°C
Storage Temperature	$T_{STG}$		-40 to 80	°C

### 2.7.2 Operating Characteristics

$T_a = 25^\circ\text{C}$

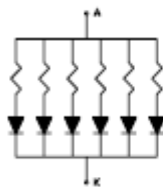
Parameter	Symbol	Conditions	Min	Typ.	Max	Units
Forward Voltage*	$V_F$	$I_F=175\text{mA}$	--	5		V
Reverse Current	$I_R$	$V_R=5.0\text{V}$	--	--	0.3	mA
Luminance of Backlight Surface	L	$I_F=175\text{mA}$	400	--	--	$\text{cd/m}^2$
Uniformity**			75	80	--	%
AVG. x of 1931 C.I.E.	X		0.27	0.30	0.33	--
	Y		0.25	0.28	0.31	--

\*Measured between A,K (see the figure below)

\*\*Uniformity = (Min./Max.) x 100%

### 2.7.3 Schematics Related

## Typical Internal Equivalent Circuit



1X6=6 (SMD Numbers)

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### 3. Optical Specifications

#### 3.1 LCD Driving Voltage Recommended

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
LCD Driving Voltage (Note 1)	$V_{DD}-V_O$	Ta = -20 °C	24.7	25.2	25.7	V
		Ta = 25 °C	20.8	21.2	21.6	V
		Ta = 70 °C	19.5	20.0	20.5	V

Note 1 : Voltage (Applied actual waveform to LCD panel) 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, 1/13 Bias,  $V_{DD}=5.0V$  (Note 4)

Parameter		Symbol	Conditions	Min.	Typ.	Max.	Units
Contrast Ratio (Note 1)		CR	Ta=25 °C	3	4.5	6	--
Viewing Angle (Shown in 3.3)		F-R	$\theta$ Ta=25 °C	--	65	--	deg.
		R-L	$\phi$ Ta=25 °C	--	-30 +30	--	deg.
Response Time	Rise (Note 2)	T <sub>ON</sub>	Ta = 25 °C	200	250	375	msec
	Fall (Note 3)	T <sub>OFF</sub>	Ta = 25 °C	120	150	225	msec

Note 1 : Contrast ratio is defined as follows.

$$CR = L_{OFF} / L_{ON}$$

$L_{ON}$  : Luminance of the ON segments,  $L_{OFF}$  : Luminance of the OFF segments

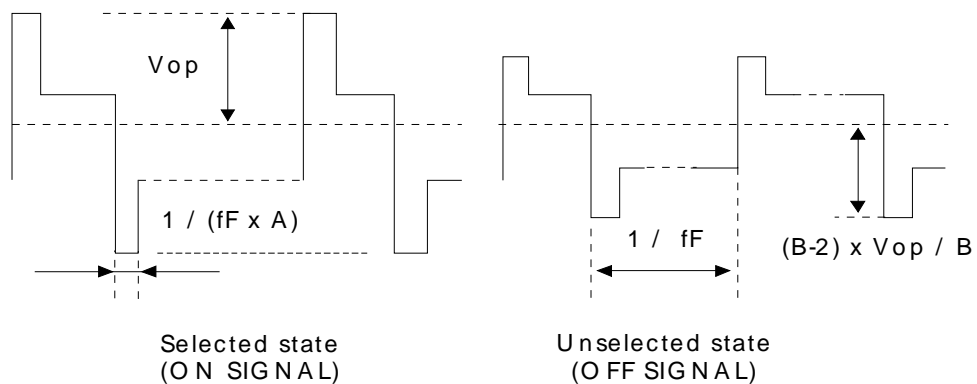
Note 2 : The time that the luminance level reaches 90% of the saturation level from 0% when ON signal is applied.

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 defined as follows:  $V_D = (V_{th1} + V_{th2}) / 2$

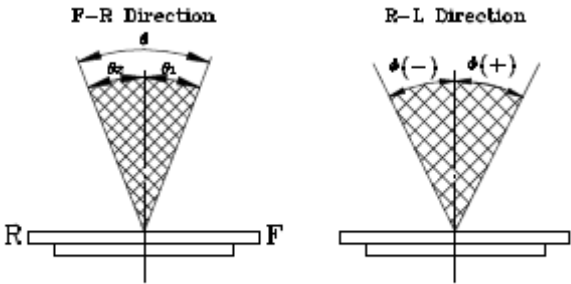
$V_{th1}$  : The voltage VO-P that should provide 50% of the saturation level in the luminance at the segment which the ON signal is applied to.

$V_{th2}$  : The voltage VO-P that should provide 50% of the saturation level in the luminance at the segment which the OFF signal is applied to.



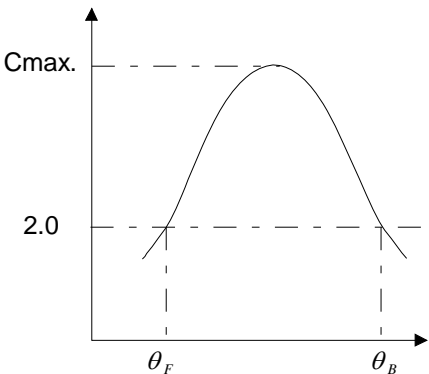
#### 3.3 Definition of Viewing Angle

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\*Conditions  
 Operating Voltage : Vop  
 Frame Frequency : 70Hz  
 Applying Waveform : 1/N duty 1/a bias  
 Contrast Ratio : larger than 2  
 $\theta = \theta_1 + \theta_2$

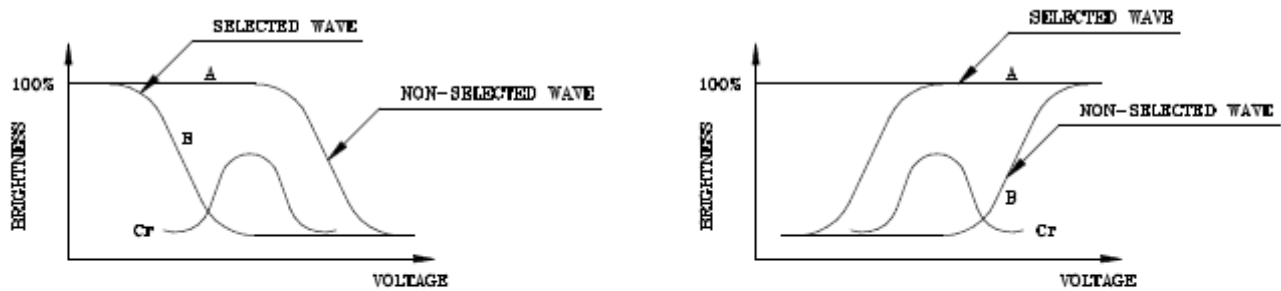
3.4 Definition of Viewing Angle  $\theta_F$  and  $\theta_B$



Viewing angles  $\theta$  ( $\phi$  fixed)

Optimum viewing angle with the naked eye and viewing angle  $\theta$  at Cmax.  
 Above are not always the same.

3.5 Definition of Contrast Ratio(Cr)



Contrast Ratio :  $Cr = A/B$

\*Conditions  
 Operating Voltage : Vop  
 Temperature : 25°C  
 Viewing Angle ( $\theta, \phi$ ) : (0,0)  
 Frame Frequency : 70Hz  
 Applying Waveform : 1/N duty 1/a bias

4. I/O Terminal

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#### 4.1 Pin Assignment

##### CON1

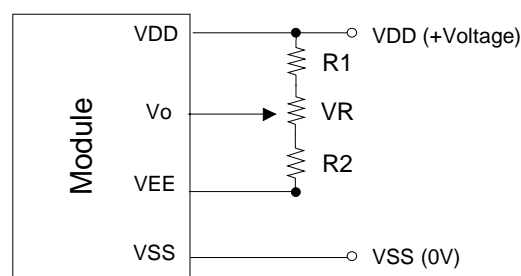
Pin No.	Symbol	Level	Function
1	DB0	I/O	Display data
2	DB1	I/O	Display data
3	DB2	I/O	Display data
4	DB3	I/O	Display data
5	/DISPOFF	H/L	Display control signal H: Display on L: Display off
6	FLM	H/L	Fist line marker
7	N/C	--	Non-connection
8	LP	H/L	Data latch signal
9	CP	H/L	Clock signal for shifting data
10	V <sub>DD</sub>	--	Power supply for logic
11	V <sub>SS</sub>	--	Power supply (0V, GND)
12	V <sub>EE</sub>	--	Power supply for LCD drive
13	V <sub>o</sub>	--	Voltage level for LCD contrast adjustment
14	FGND	--	Frame Ground

##### CCFL B/L

Pin No.	Symbol	Level	Function
1.	HOT	--	Power supply for CCFL Backlight (HOT)
2.	NC	--	No-connection
3.	NC	--	No-connection
4.	GND	--	Power supply for CCFL Backlight (GND)

#### 4.2 Example of Power Supply

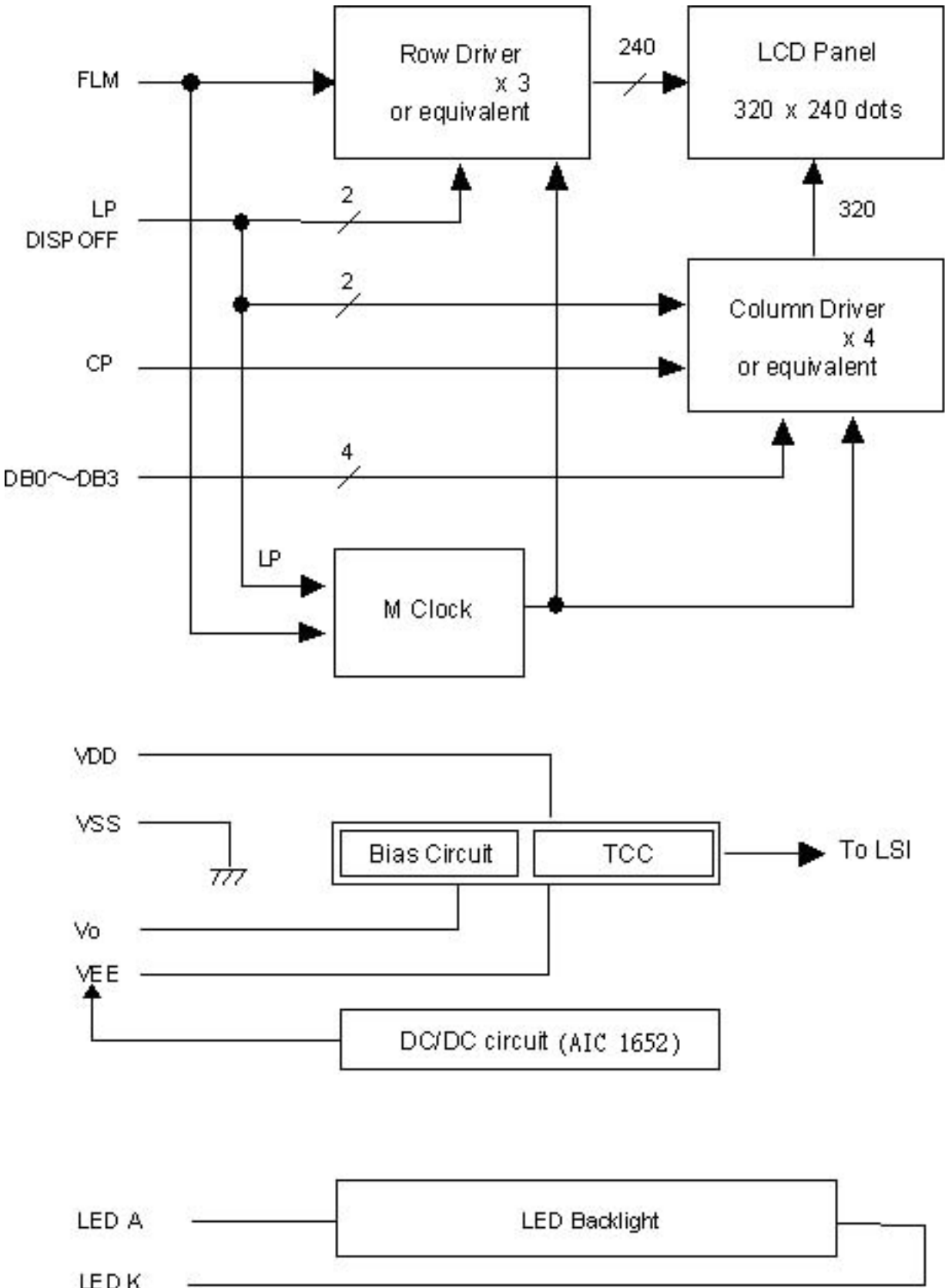
It is recommended to apply a potentiometer for the contrast adjust due to the tolerance of the driving voltage and its temperature dependence.



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

#### 4.3 Block Diagram

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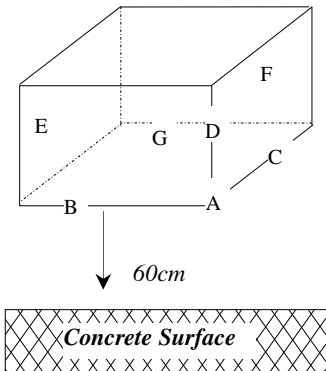


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## 5. Reliability Test

### 5.1 Test Item

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

No.	Test Item	Description	Condition	Note
1.	High Temperature (Operation)	Durability test under long time high temperature with electrical stress (voltage, current)	70°C ± 2°C 96hrs	
2.	High Temperature (Storage)	Durability test under long time high temperature storage	80°C ± 2°C 96hrs	4
3.	Low Temperature (Operation)	Durability test under long time low temperature with electrical stress (voltage, current)	-20°C ± 2°C, 96hrs	3
4.	Low Temperature (Storage)	Durability test under long time low temperature storage	-30°C ± 2°C, 96hrs	3, 4
5.	Damp Proof Test	Durability test under long time high temperature and high humidity	40°C ± 2°C, 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.	Drop Test	<p>To be measured after dropping from 60cm high on the concrete surface in packing state.</p>  <p><i>Dropping method corner dropping</i> A corner: once</p> <p><i>Edge dropping</i> B, C, D edge: once</p> <p><i>Face dropping</i> E, F, G face: once</p>		

Note 1: Unless otherwise specified, tests will be conducted under the following condition,

Temperature : 25°C ± 2°C

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.

### 5.2 Judgment Standard

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Failure Mode	Test Item							Judgment Standard
	1	2	3	4	5	6	7	
Orientation	*	*	*	*	*			No remarkable degradation of appearance under bias/ non-bias condition
Current Value (IAC)	*	*	*	*	*			No remarkable increase
Contrast	*		*	*	*			No remarkable poor contrast
Domain	*	*	*	*	*			Less than 20% of all dots have reverse tilt of more than on third of one dot area.
Bubble (Inside Cell)	*	*	*	*	*	*		As per “Appearance Standard” (Note. Including one which disappear after 25°C 2H)
Polarizer	*				*	*		As per “Appearance Standard” no remarkable appearance change
Glass Damage							*	As per “Appearance Standard”

- Note. 1. \* is strong linkage between Failure Mode and Test Item.  
2. Number of Test Item should be referred to former page.  
3. Judgment and Standard value should be fixed by other inspection standard and criteria samples.

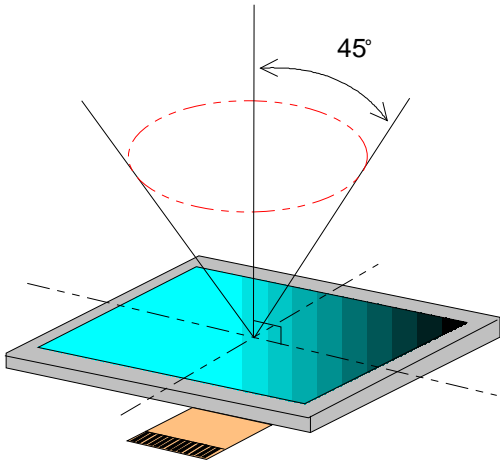
## 6. Appearance Standards



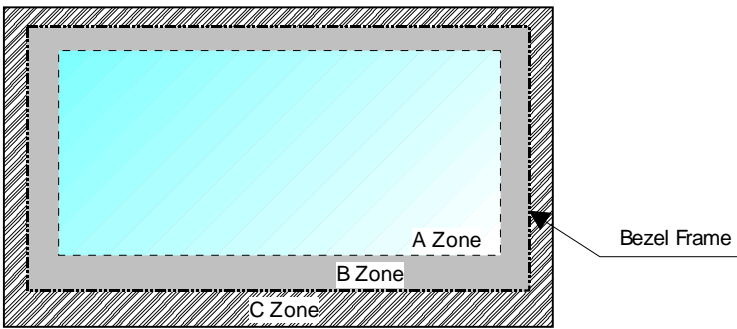
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6.1 Inspection Conditions

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

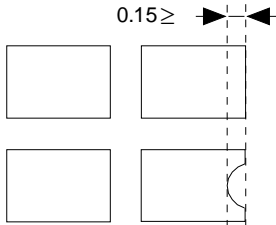
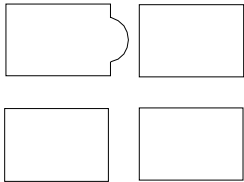
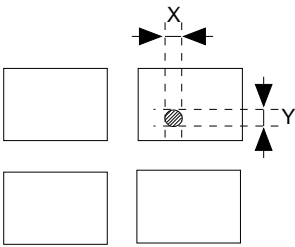
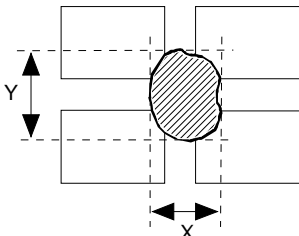
6.3 Standards

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No.	Parameter	Criteria																											
1.	Black and White Spots, Foreign Substances	(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 ≤ 0.2</td><td>*</td><td>*</td><td>*</td></tr><tr><td>0.2 &lt; D ≤ 0.3</td><td>3</td><td>5</td><td>*</td></tr><tr><td>0.3 &lt; D ≤ 0.4</td><td>2</td><td>3</td><td>*</td></tr><tr><td>0.4 &lt; D ≤ 0.5</td><td>0</td><td>1</td><td>*</td></tr><tr><td>0.5 &lt; D</td><td>0</td><td>0</td><td>*</td></tr></table>	Zone Dimension (mm)	Acceptable Number			A	B	C	D ≤ 0.2	*	*	*	0.2 < D ≤ 0.3	3	5	*	0.3 < D ≤ 0.4	2	3	*	0.4 < D ≤ 0.5	0	1	*	0.5 < D	0	0	*
		Zone Dimension (mm)		Acceptable Number																									
			A	B	C																								
		D ≤ 0.2	*	*	*																								
		0.2 < D ≤ 0.3	3	5	*																								
		0.3 < D ≤ 0.4	2	3	*																								
		0.4 < D ≤ 0.5	0	1	*																								
		0.5 < D	0	0	*																								
		D = (Long + Short)/2    *: Disregard																											
		(2) Line Shape																											
<table><tr><th rowspan="2">Zone X (mm)</th><th rowspan="2">Zone 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 &lt; W</td><td colspan="3">In the same way (1)</td></tr></table>	Zone X (mm)	Zone Y (mm)	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)			
Zone X (mm)			Zone Y (mm)	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)	<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 &lt; D ≤ 0.4</td><td>3</td><td>*</td><td>*</td></tr><tr><td>0.4 &lt; D ≤ 0.6</td><td>2</td><td>3</td><td>*</td></tr><tr><td>0.6 &lt; D</td><td>0</td><td>0</td><td>*</td></tr></table>	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	*				
		Zone Dimension (mm)		Acceptable Number																									
			A	B	C																								
		D ≤ 0.3	*	*	*																								
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		0.4 < D ≤ 0.6	2	3	*																								
		0.6 < D	0	0	*																								
*: Disregard																													
Total defects shall not exceed 3.																													

To be continued.....

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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><math>(X+Y)/2 \leq 0.2\text{mm}</math> (Less than 0.1mm is no counted.)</p> <p>(4) Deformation</p>  <p><math>(X+Y)/2 \leq 0.2\text{mm}</math></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 substance 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. Handling and Precautions

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The Following precautions will guide you in handling our product correctly.

- 1 Liquid crystal display devices
  - 1.1 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.
  - 1.2 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.
  - 2.1 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.
  - 2.2 Avoid the use of work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
  - 2.3 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:
  - 3.1 Protect the modules from high temperature and humidity.
  - 3.2 Keep the modules out of direct sunlight or direct exposure to ultra-violet rays.
  - 3.3 Protect the modules from excessive external forces.
- 4 Use the module with a power supply that is equipped with an over current 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.

## 8. Warranty:

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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 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. Acrowise-origin longer than one year from Acrowise production.

## 9. Dimensional Outlines

- Please see the next page.....

