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

Acceptance

Approved and Checked by

Approved by	Checked by		Made by
			
			



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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	:	122.0 (W) x 92.0 (H) mm
Display Area	:	115.15(W)x 86.39(H) mm
Outline Dimensions	:	167.1* (W) x 109.0** (H) x 11 max.*** (D) mm

\* Without FFC Cable

\*\* Without LED Cable

Weight	:	N/A
LCD Type	:	STN/ Negative, Blue mode/ Transmissive
Viewing Direction	:	6 O'clock
Data Transfer	:	8-bit parallel data transfer
Controller LSI	:	RA8835
Backlight	:	With LED B/L
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	$I_{DD}$	$V_{DD} = 5.0V$	--	50	80	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

#### 2.3.1 8080 family interface timing

Ta = -20 to 75°C

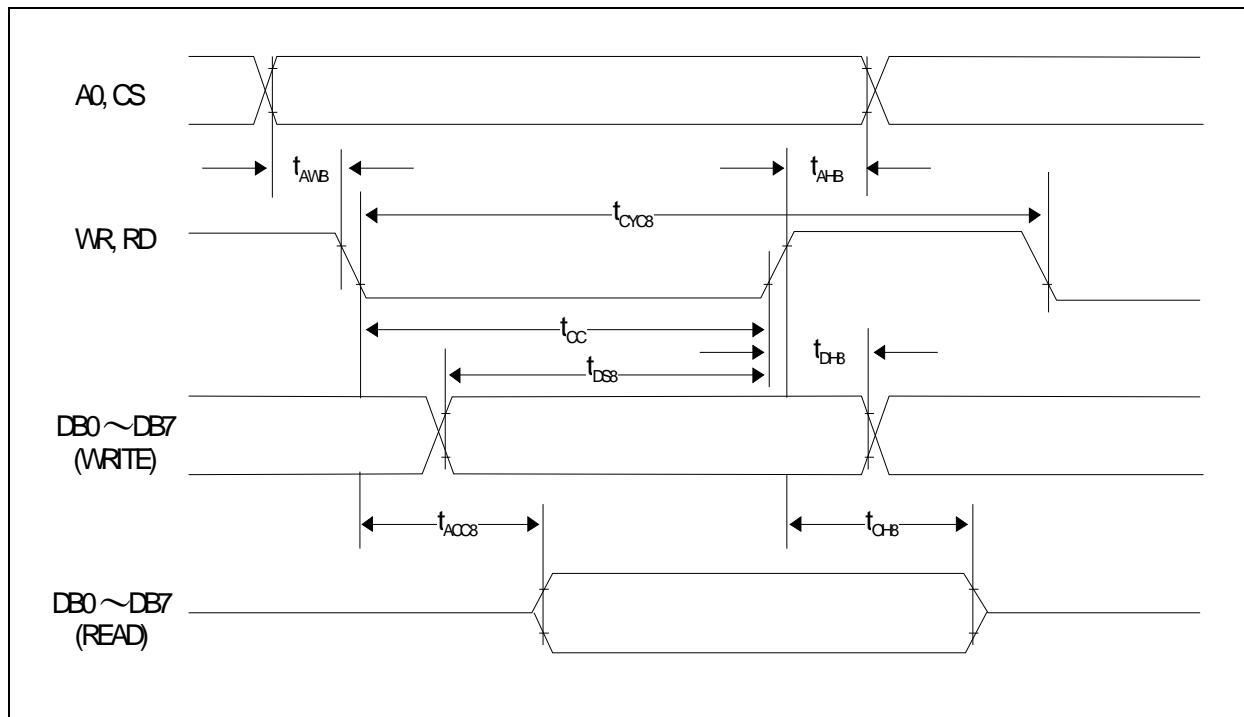
Signal	Symbol	Parameter	V <sub>DD</sub> = 4.5 to 5.5		V <sub>DD</sub> = 2.7 to 4.5		Units	Condition
			Min.	Max.	Min.	Max.		
A0, CS	t <sub>AH8</sub>	Address hold time	10	--	10	--	ns	CL=100pF
	t <sub>AW8</sub>	Address setup time	0	--	0	--	ns	
WR, RD	t <sub>CYC8</sub>	System cycle time	See note	--	See note	--	ns	
	t <sub>CC</sub>	Strobe pulse width	120	--	150	--	ns	
DB0 to DB7	t <sub>DS8</sub>	Data setup time	120	--	120	--	ns	
	t <sub>DH8</sub>	Data hold time	5	--	5	--	ns	
	t <sub>ACC8</sub>	RD access time	--	50	--	80	ns	
	t <sub>OH8</sub>	Output disable time	10	50	10	55	ns	

Note: For memory control and system control commands:

$$t_{CYC8} = 2t_c + t_{CC} + t_{CEA} + 75 > t_{ACV} + 245$$

For all other commands:

$$t_{CYC8} = 2t_c + t_{CC} + 30$$



#### 2.3.2 6800 family interface timing

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Ta=-20 to 75°C

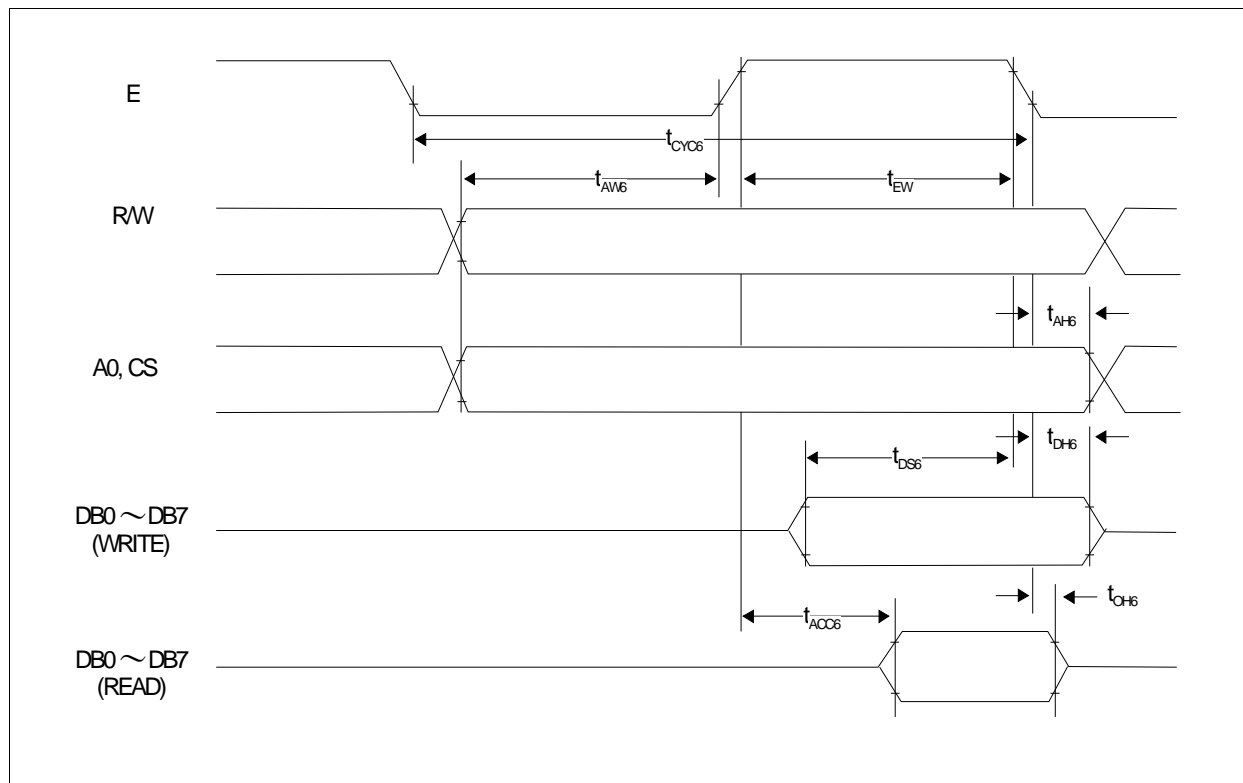
Signal	Symbol	Parameter	V <sub>DD</sub> = 4.5 to 5.5		V <sub>DD</sub> = 2.7 to 4.5		Units	Condition
			Min.	Max.	Min.	Max.		
A0, CS, R/W	t <sub>CYC6</sub>	System cycle time	See note	--	See note	--	ns	CL=100pF
	t <sub>AW6</sub>	Address setup time	0	--	10	--	ns	
	t <sub>AH6</sub>	Address hold time	0	--	0	--	ns	
DB0 to DB7	t <sub>DS6</sub>	Data setup time	100	--	120	--	ns	
	t <sub>DH6</sub>	Data hold time	0	--	0	--	ns	
	t <sub>OH6</sub>	Output disable time	10	50	10	75	ns	
	t <sub>ACC6</sub>	Access time	--	85	--	130	ns	
WR, RD	t <sub>EW</sub>	Enable pulse width	120	--	150	--	ns	

Note: For memory control and system control commands:

$$t_{CYC6} = 2t_C + t_{EW} + t_{CEA} + 75 > t_{ACV} + 245$$

For all other commands:

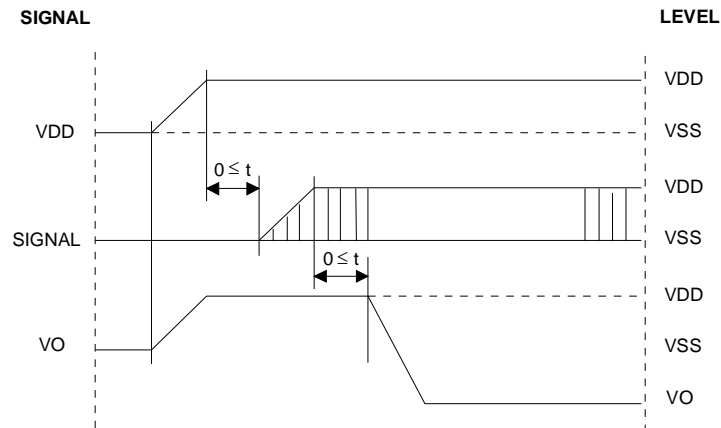
$$t_{CYC6} = 4t_C + t_{EW} + 30$$



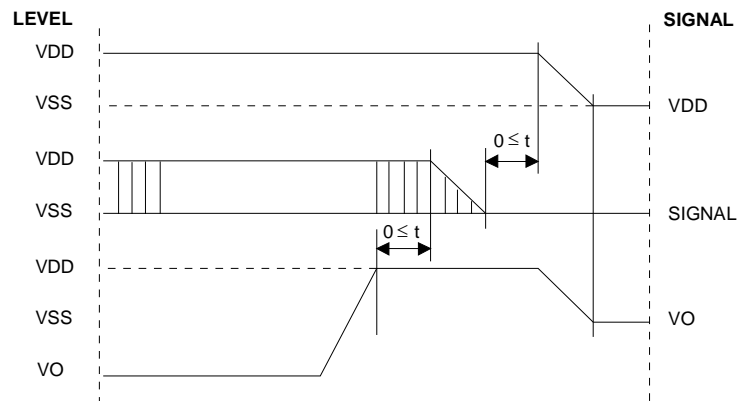
## 2.4 Power Supply ON/OFF Sequence

### 2.4.1 ON Sequence

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#### 2.4.2 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 internal alternate signal for LCD driving (M) is unstable or RESET is active, DC component will be supplied to the LCD panel. This may cause damage to the LCD module.

## 2.5 Spec. for LED back-light

### 2.5.1 Absolute Maximum Ratings

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Parameter	Symbol	Conditions	Max	Units
Forward Current	I <sub>AF</sub>	--	180	mA
Reverse Voltage	V <sub>R</sub>	--	5.0	V
LED Power Dissipation	P <sub>D</sub>	--	0.9	W
Operation Temperature	T <sub>OPR</sub>		-20 to 70	°C
Storage Temperature	T <sub>STG</sub>		-40 to 80	°C

### 2.5.2 Operating Characteristics

T<sub>a</sub> = 25°C

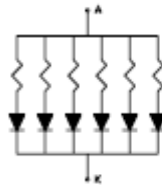
Parameter	Symbol	Conditions	Min	Typ.	Max	Units
Forward Current*	I <sub>F</sub>	V <sub>F</sub> =5V			175	mA
Reverse Current	I <sub>R</sub>	V <sub>R</sub> =5.0V	--	--	0.3	mA
Luminance of Backlight Surface	L	V <sub>F</sub> =5V	400	--	--	cd/m <sup>2</sup>
Uniformity**			75	80	--	%
AVG. x of 1931 C.I.E.	X		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%

### 2.5.3 Schematics Related

#### Typical Internal Equivalent Circuit



1X6=6 (SMD Numbers)

## 3. Optical Specifications

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### 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, 1/11.5 Bias,  $V_{DD} = 5.0V$  (Note 4)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Contrast Ratio (Note 1)	C	$\theta = 0^\circ, \phi = 0^\circ$	3	5.0	--	--
Viewing Angle (Shown in 3.3)	Front-Back	$\theta_F - \theta_B$	25	to	65	deg.
	Left-Right	$\theta_L - \theta_R$	25	to	-30 +30	deg.
Response Time	Rise (Note 2)	$T_{ON}$	--	300	450	msec
	Fall (Note 3)	$T_{OFF}$	--	120	180	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

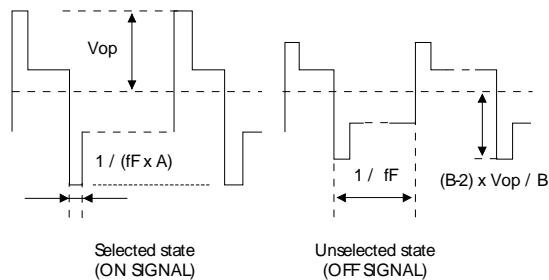
Note 2 : The time that the luminance level reaches 90% of the saturation level from 0% when ON signal is applied.

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

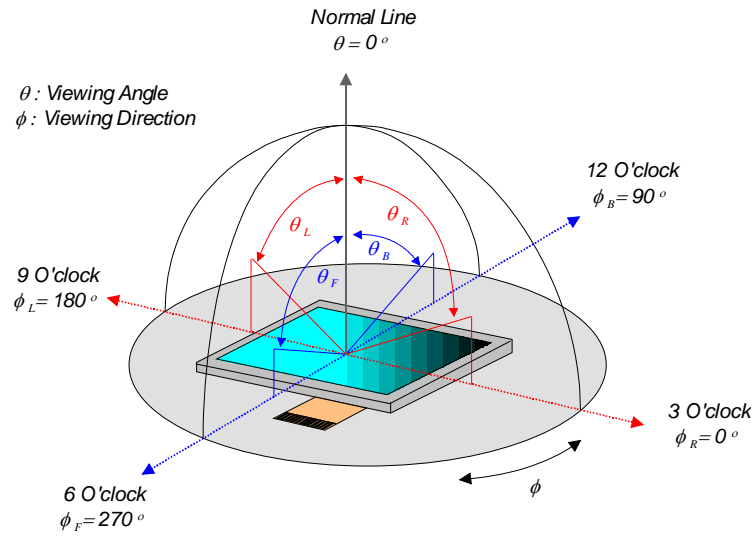
$V_{th1}$  : The voltage VO-P that should provide 50% of the saturation level in the luminance at the segment which the ON signal is applied to.

$V_{th2}$  : 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.

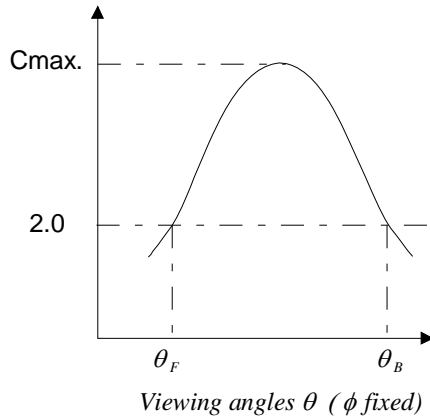


### 3.3 Definition of Viewing Angle and Optimum Viewing Area

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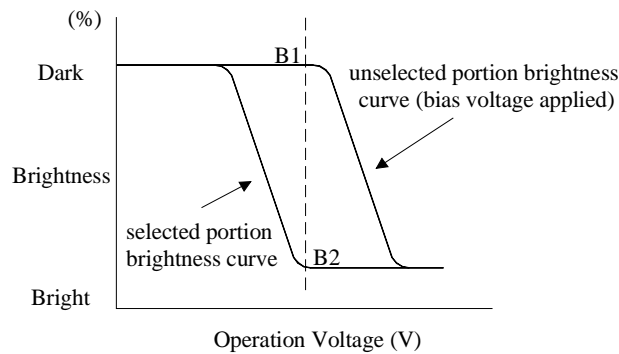
3.4 Definition of Viewing Angle  $\theta_F$  and  $\theta_B$



Optimum viewing angle with the naked eye and viewing angle  $\theta$  at  $C_{max}$ .  
Above are not always the same.

3.5 Definition of Contrast C

$C = \text{Brightness of selected dot (B1)} / \text{Brightness of unselected dot (B2)}$



4. I/O Terminal

- 4.1 Pin Assignment
- CON2

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Pin No.	Symbol	Level	Function					
1	V <sub>SS</sub>	--	Power supply (0V, GND)					
2	V <sub>DD</sub>	--	Power supply for logic					
3	V <sub>0</sub>	--	Voltage level for LCD contrast adjustment					
4	A0	H/L	VRAM address bus					
5	/WR	H/L	VRAM write signal, 8080 family : Write signal 6800 family : R/W signal					
6	/RD	H/L	VRAM read signal, 8080 family : Read signal 6800 family : Enable clock					
7~14	DB0~DB7	H/L	Display data					
15	/CS	H/L	Chip Select, This active-LOW input enables the RA8835. It is usually connected to the output of an address decoder device that maps the RA8835 into the memory space of the controlling microprocessor.					
16	/RST	H/L	Reset, This active-LOW input performs hardware reset on the RA8835. It is a Schmitt-trigger input for enhanced noise immunity; however, care should be taken to ensure that it is not triggered if the supply voltage is lowered.					
17	V <sub>EE</sub>	--	Power Supply for LCD Drive					
18	SEL1	Input	SEL1	Interface	A0	RD	WR	CS
			0	8080 family	A0	RD	WR	CS
			1	6800 family	A0	E	R/W	CS
19	NC	--						
20	NC	--						
21	NC	--						
22	NC	--						

#### LED B/L

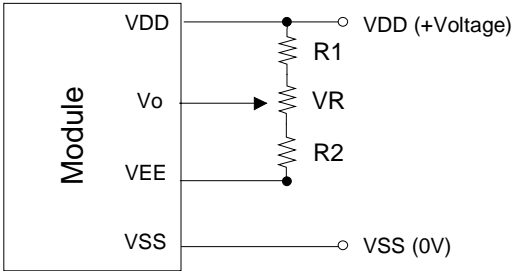
Pin No.	Symbol	Level	Function			
1.	LEDA	--	Power Supply for LED Backlight Anode (+)			
2.	N/C	--	No-connection			
3.	N/C	--	No-connection			
4.	LEDK	--	LED Backlight Power Supply Cathode (-)			

#### 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

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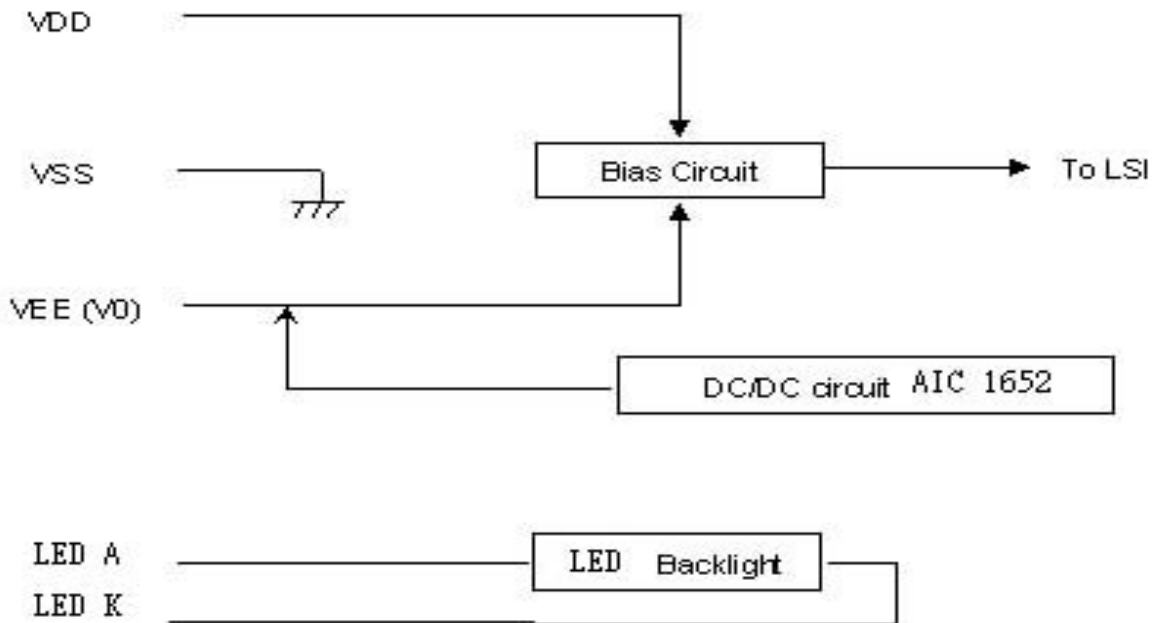
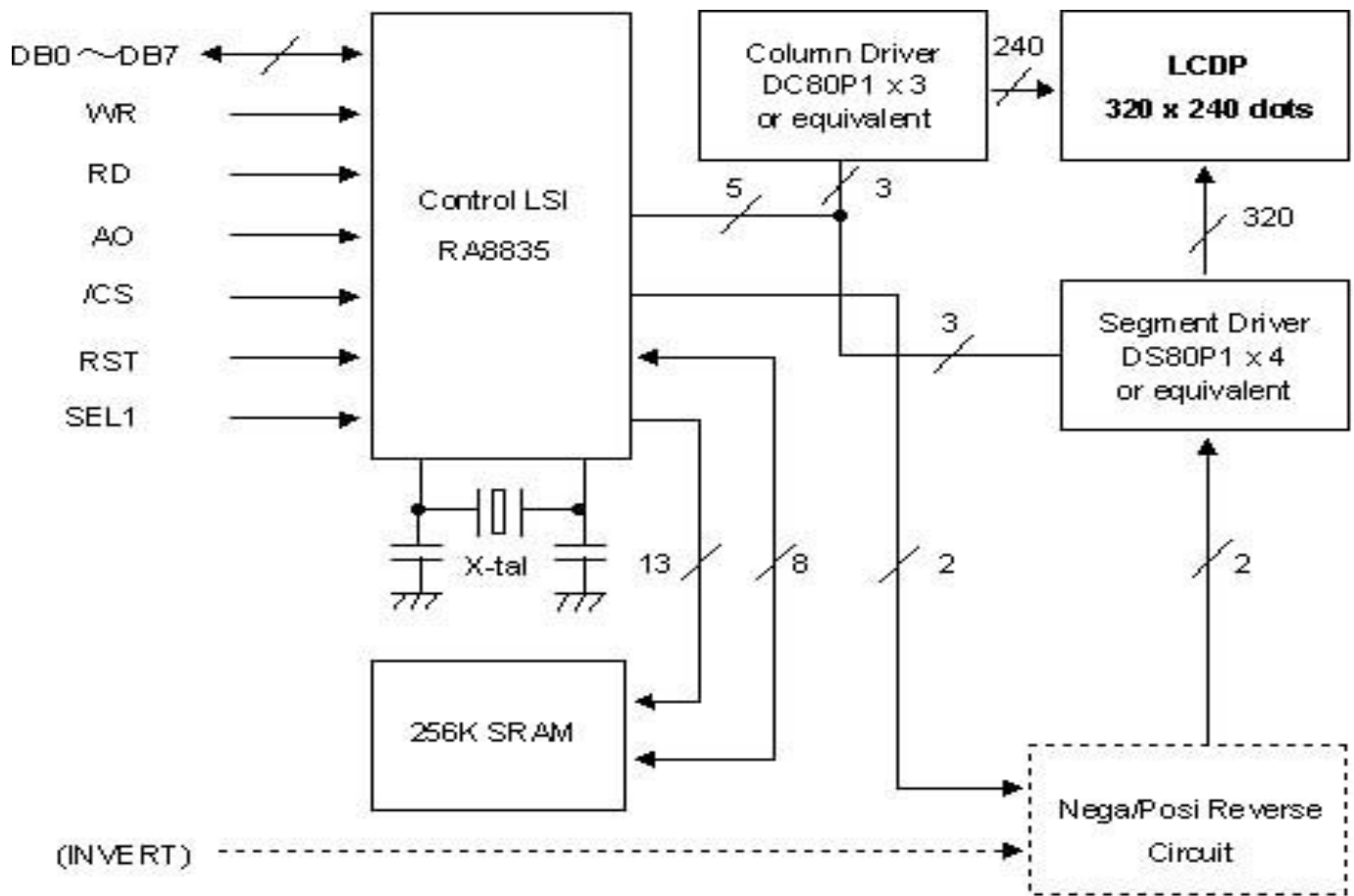
temperature dependence.



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

4.3 Block Diagram

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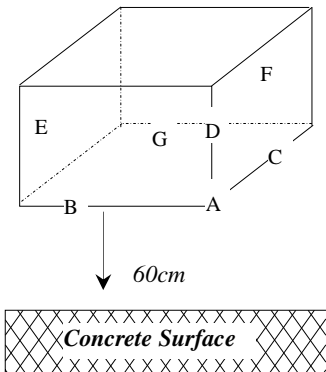


## 5. Reliability Test

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### 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	To be measured after dropping from 60cm high on the concrete surface in packing state.  <i>Dropping method corner dropping</i> <i>A corner: once</i> <i>Edge dropping</i> <i>B, C, D edge: once</i> <i>Face dropping</i> <i>E, F, G face: once</i>		

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”

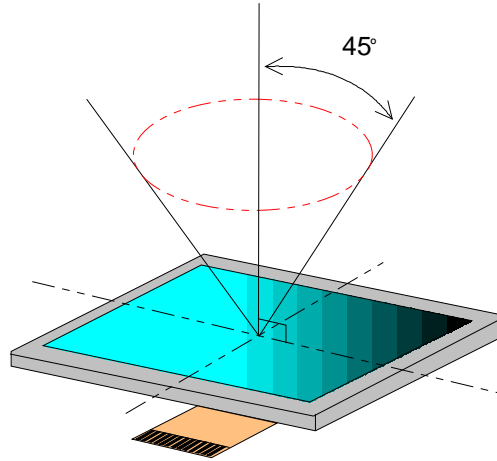
- Note. 1. \* is strong linkage between Failure Mode and Test Item.  
2. Number of Test Item should be referred to former page.  
3. Judgment and Standard value should be fixed by other inspection standard and criteria samples.

## 6. Appearance Standards

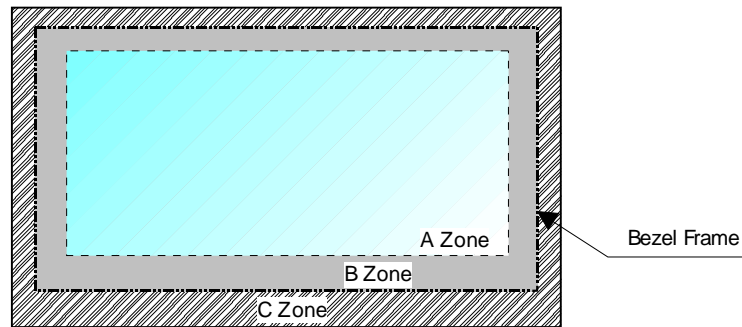
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### 6.1 Inspection Conditions

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	<p>(1) Round Shape</p> <table border="1"> <thead> <tr> <th rowspan="2">Dimension (mm)</th> <th rowspan="2">Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>D \leq 0.2</math></td> <td></td> <td>*</td> <td>*</td> <td>*</td> </tr> <tr> <td><math>0.2 &lt; D \leq 0.3</math></td> <td></td> <td>3</td> <td>5</td> <td>*</td> </tr> <tr> <td><math>0.3 &lt; D \leq 0.4</math></td> <td></td> <td>2</td> <td>3</td> <td>*</td> </tr> <tr> <td><math>0.4 &lt; D \leq 0.5</math></td> <td></td> <td>0</td> <td>1</td> <td>*</td> </tr> <tr> <td><math>0.5 &lt; D</math></td> <td></td> <td>0</td> <td>0</td> <td>*</td> </tr> </tbody> </table> <p><math>D = (\text{Long} + \text{Short})/2</math> *: Disregard</p> <p>(2) Line Shape</p> <table border="1"> <thead> <tr> <th rowspan="2">X (mm)</th> <th rowspan="2">Zone</th> <th rowspan="2">Y (mm)</th> <th rowspan="2">Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>--</td> <td></td> <td><math>0.03 \geq W</math></td> <td></td> <td>*</td> <td>*</td> <td>*</td> </tr> <tr> <td><math>2.0 \geq L</math></td> <td></td> <td><math>0.05 \geq W</math></td> <td></td> <td>3</td> <td>3</td> <td>*</td> </tr> <tr> <td><math>1.0 \geq L</math></td> <td></td> <td><math>0.1 \geq W</math></td> <td></td> <td>3</td> <td>3</td> <td>*</td> </tr> <tr> <td>--</td> <td></td> <td><math>0.1 &lt; W</math></td> <td></td> <td colspan="3">In the same way (1)</td> </tr> </tbody> </table> <p>X : Length Y: Width *: Disregard</p> <p>Total defects shall not exceed 5.</p>	Dimension (mm)	Zone	Acceptable Number			A	B	C	$D \leq 0.2$		*	*	*	$0.2 < D \leq 0.3$		3	5	*	$0.3 < D \leq 0.4$		2	3	*	$0.4 < D \leq 0.5$		0	1	*	$0.5 < D$		0	0	*	X (mm)	Zone	Y (mm)	Zone	Acceptable Number			A	B	C	--		$0.03 \geq W$		*	*	*	$2.0 \geq L$		$0.05 \geq W$		3	3	*	$1.0 \geq L$		$0.1 \geq W$		3	3	*	--		$0.1 < W$		In the same way (1)		
Dimension (mm)	Zone	Acceptable Number																																																																							
		A	B	C																																																																					
$D \leq 0.2$		*	*	*																																																																					
$0.2 < D \leq 0.3$		3	5	*																																																																					
$0.3 < D \leq 0.4$		2	3	*																																																																					
$0.4 < D \leq 0.5$		0	1	*																																																																					
$0.5 < D$		0	0	*																																																																					
X (mm)	Zone	Y (mm)	Zone	Acceptable Number																																																																					
				A	B	C																																																																			
--		$0.03 \geq W$		*	*	*																																																																			
$2.0 \geq L$		$0.05 \geq W$		3	3	*																																																																			
$1.0 \geq L$		$0.1 \geq W$		3	3	*																																																																			
--		$0.1 < W$		In the same way (1)																																																																					
2.	Air Bubbles (between glass & polarizer)	<table border="1"> <thead> <tr> <th rowspan="2">Dimension (mm)</th> <th rowspan="2">Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>D \leq 0.3</math></td> <td></td> <td>*</td> <td>*</td> <td>*</td> </tr> <tr> <td><math>0.3 &lt; D \leq 0.4</math></td> <td></td> <td>3</td> <td>*</td> <td>*</td> </tr> <tr> <td><math>0.4 &lt; D \leq 0.6</math></td> <td></td> <td>2</td> <td>3</td> <td>*</td> </tr> <tr> <td><math>0.6 &lt; D</math></td> <td></td> <td>0</td> <td>0</td> <td>*</td> </tr> </tbody> </table> <p>*: Disregard</p> <p>Total defects shall not exceed 3.</p>	Dimension (mm)	Zone	Acceptable Number			A	B	C	$D \leq 0.3$		*	*	*	$0.3 < D \leq 0.4$		3	*	*	$0.4 < D \leq 0.6$		2	3	*	$0.6 < D$		0	0	*																																											
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$0.6 < D$		0	0	*																																																																					

To be continued.....

No.	Parameter	Criteria
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3.	The Shape of Dot	<p>(1) Dot Shape (with Dent)</p> <p>0.15 ≥</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

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

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- 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:

This product has been manufactured to your company's specifications as a part for use in your company's general

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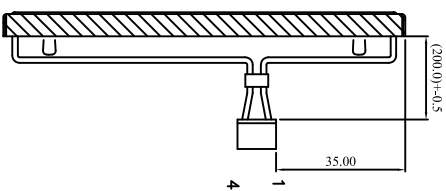
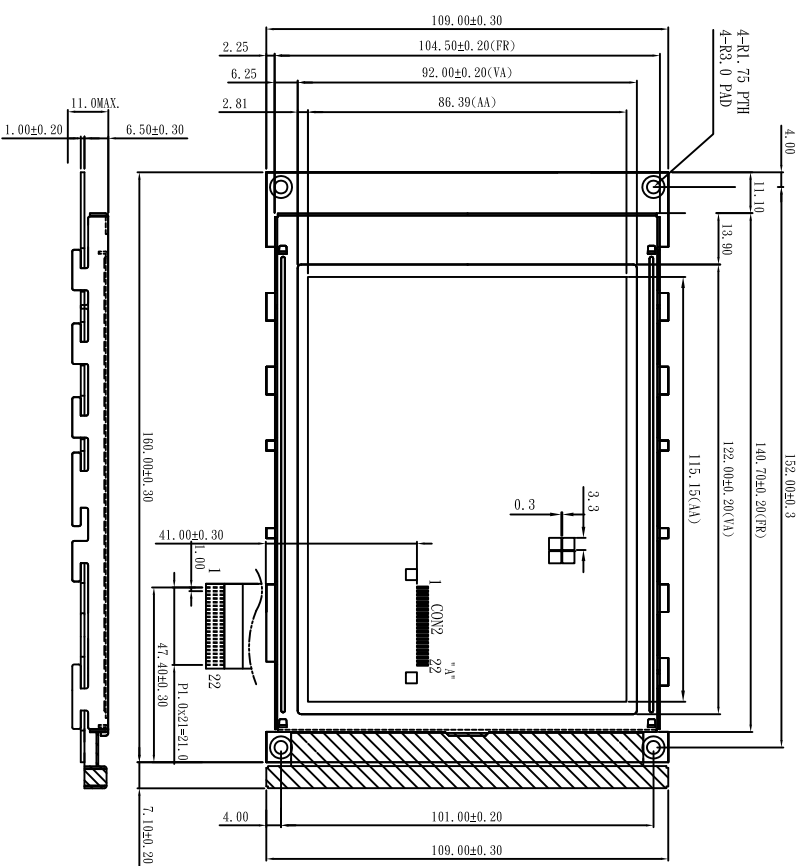
electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment, we cannot take responsibility if the product is used in medical devices, nuclear power control equipment, aerospace equipment, fire and security systems, or 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.....

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
2					
1					
0					



1.	ISS	5.	/MR	9.	DP2	12.	DB6	17.	VBE	21.	NC
2.	VCC	6.	/RD	10.	DB3	14.	DB7	18.	SE11	22.	NC
3.	VO	7.	DB0	11.	DB4	15.	/CS	19.	NC		
4.	AO	8.	DB1	12.	DB5	16.	/RST	20.	NC		

NO.		PART NAME		DATE:		MATERIAL		FINISH	
303-32240C		303-32240C							
DRAWN		CHECK		APP'D		UNIT:MM		SCALE: 1/1	
Joe		Tom		Nick		CON2		PRODUCT: 3-32240C	
FILE:		SHEET		1 / 1		Rev. A			