

# RG322421BNHCWB

## DATA SHEET

ISSUE	VERSION	APPROVER	CHECKER	ENGINEER
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**SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY MODULE  
MODEL NO: RG322421BNHCWB**

**Records of Revision**

Rev.	Date	Contents	Written	Approved
A				

**Special notes**

Note1.	
Note2.	
Note3.	
Note4.	
Note5.	

**SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY MODULE  
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**SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY MODULE  
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**1. SCOPE**

This specification covers the engineering requirements for the RG322421BNHCWB liquid crystal module.

**2. PRODUCT SPECIFICATIONS**

2.1 General

- 320 × 240 dot matrix LCD
- STN(Blue Mode)
- Negative , Wide temperature type
- Back-light: CCFL , White
- Multiplexing driving : 1/240 duty, 1/14 bias

2.2 Mechanical Characteristics

<b>Item</b>	<b>Characteristic</b>
Dot configuration	320 × 240
Dot dimensions(mm)	0.34 × 0.34
Dot spacing (mm)	0.02
Module dimensions (Horizontal × Vertical × Thickness, mm)	167.0 × 108.6 × 11.0 max.
Viewing area (Horizontal × Vertical, mm)	120.0 × 90.0
Active area (Horizontal × Vertical, mm)	115.17 × 86.37

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2.3 Absolute Maximum Ratings (Without CCFL back-light)

Characteristic	Symbol	Unit	Value
Power Supply Voltage (logic)	V <sub>DD</sub>	V	-0.3 to +0.7
Power Supply Voltage (LCD)	V <sub>DD</sub> -V <sub>EE</sub>	V	0 to 35
Input Voltage	V <sub>I</sub>	V	-0.3 to V <sub>DD</sub> +0.3

Note 1: V<sub>DD</sub>≥V<sub>1</sub>>V<sub>3</sub>>V<sub>4</sub>>V<sub>EE</sub>

2.4 Electrical Characteristics (Without CCFL back-light)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Voltage(logic)	V <sub>DD</sub>	--	4.5	--	5.5	V
Supply Voltage(LCD)	V <sub>DD</sub> -V <sub>EE</sub>	Note 2,3	12	--	32	V
Input Voltage	V <sub>IH</sub>	--	0.8 V <sub>DD</sub>	--	--	V
	V <sub>IL</sub>	--	--	--	0.2 V <sub>DD</sub>	
Output Voltage	V <sub>OH</sub>	--	V <sub>DD</sub> -0.4	--	--	V
	V <sub>HL</sub>	--	--	--	0.4	
CP (shift clock)	f <sub>CP</sub>	CP	--	--	6.0	MHz
CP pulse width	t <sub>WC</sub>	CP	50	--	--	ns
Load pulse width	t <sub>WL</sub>	LOAD	50	--	--	ns
Setup time	t <sub>SETUP</sub>	D11 to D14→CP	30	--	--	ns
Hold time	t <sub>HOLD</sub>	D11 to D14→CP	30	--	--	ns
CP→LOAD	t <sub>CL</sub>	CP→LOAD	80	--	--	ns
LOAD→CP	t <sub>LC</sub>	LOAD→CP	110	--	--	ns
CP and LOAD rise time	t <sub>R</sub>	CP,LOAD			Note 4	ns
CP and LOAD fall time	t <sub>F</sub>	CP,LOAD			Note 4	ns

Note 2: V<sub>DD</sub>≥V<sub>1</sub>>V<sub>3</sub>>V<sub>4</sub>>V<sub>EE</sub>

Note 3: When the power is turned on ,either the logic system power must e turned on before the LCD drive system power or else they must both be turned on at the same time.  
When the power is turned off, either the LCD drive system power must be turned off before the logic system power, or else both must be turned off at the same time.

Note 4: The CP and LOAD rise time (t<sub>R</sub>) and the CP and LOAD fall time (t<sub>F</sub>) must satisfy equations ①and② below at the same time.

$$\textcircled{1} t_R, t_F < \frac{1}{2t_{CP}} - t_{WC}$$

$$\textcircled{2} t_R, t_F < 50ns$$

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2.5 Optical Characteristics Absolute maximum ratings

Item	Symbol	Rating	Unit
Operating temperature range	Top	-20~70	°C
Storage temperature range	Tst	-30~80	°C

2.6 Optical Characteristics

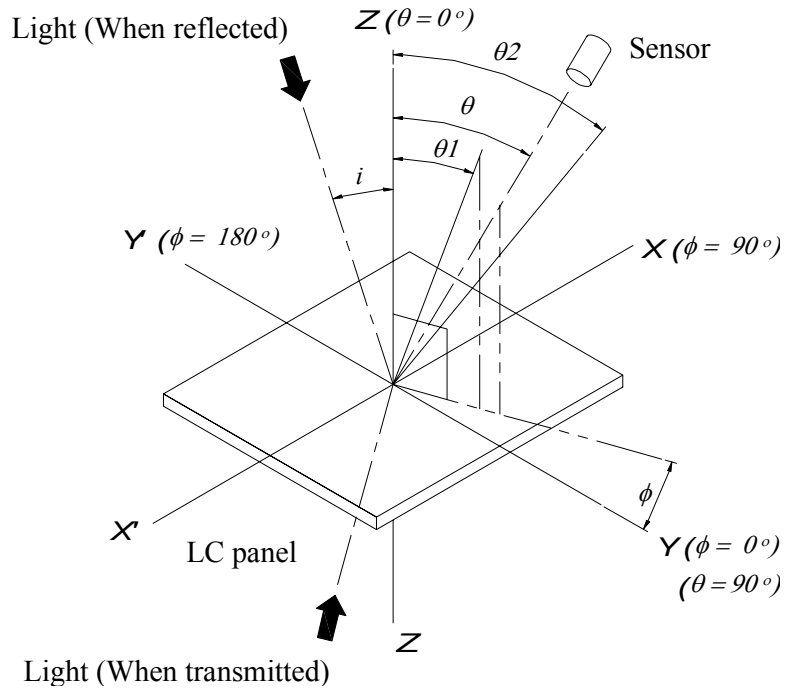
1/240 duty, 1/14 bias, Vopr=23.5V

Item	Symbol	Temp.	Min.	Typ.	Max.	Unit
Driving voltage	Vop	0 °C	23.6	24.3	25.0	V
		25 °C	22.8	23.5	24.2	
		50 °C	21.9	22.6	23.3	
Contrast ratio	CR	$\theta=0^\circ$ $\phi=0^\circ$	4.3	5.4	--	--
Frame freq.	fF	--	--	70	--	Hz
Viewing angle*	$\theta_1$	25 °C	--	43	--	deg.
	$\theta_2$		--	29	--	
Response time	$t_{on}$	25 °C	--	157	--	ms
	$t_{off}$		--	255	--	

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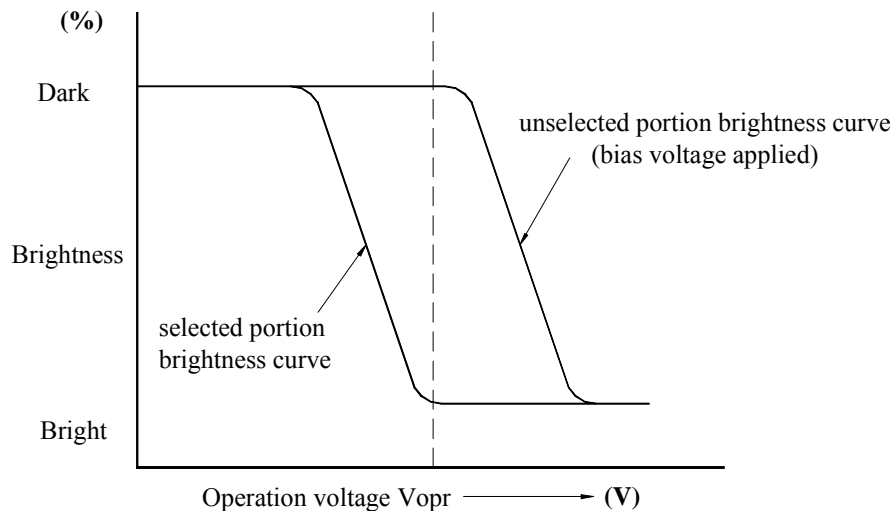
2.6.1 Definition of optical characteristics

\*Definition of angles  $\phi$  and  $\theta$



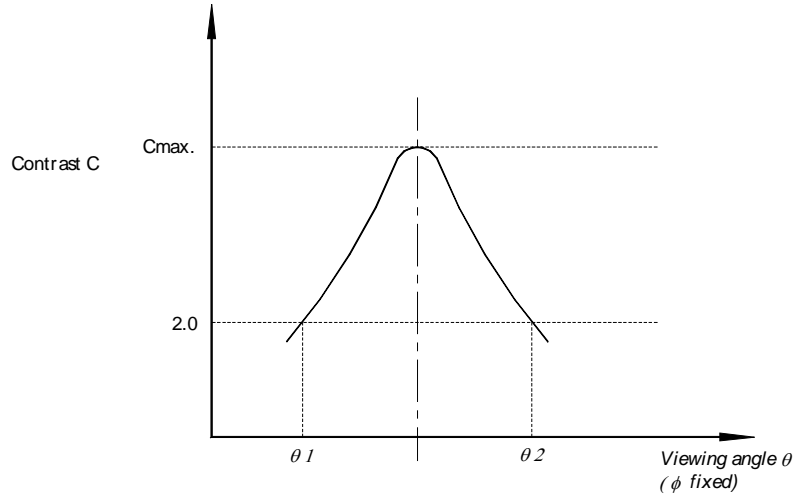
\*Definition of contrast C

$$C = \frac{B1}{B2} = \frac{\text{Brightness of selected portion}}{\text{Brightness of unselected portion}}$$



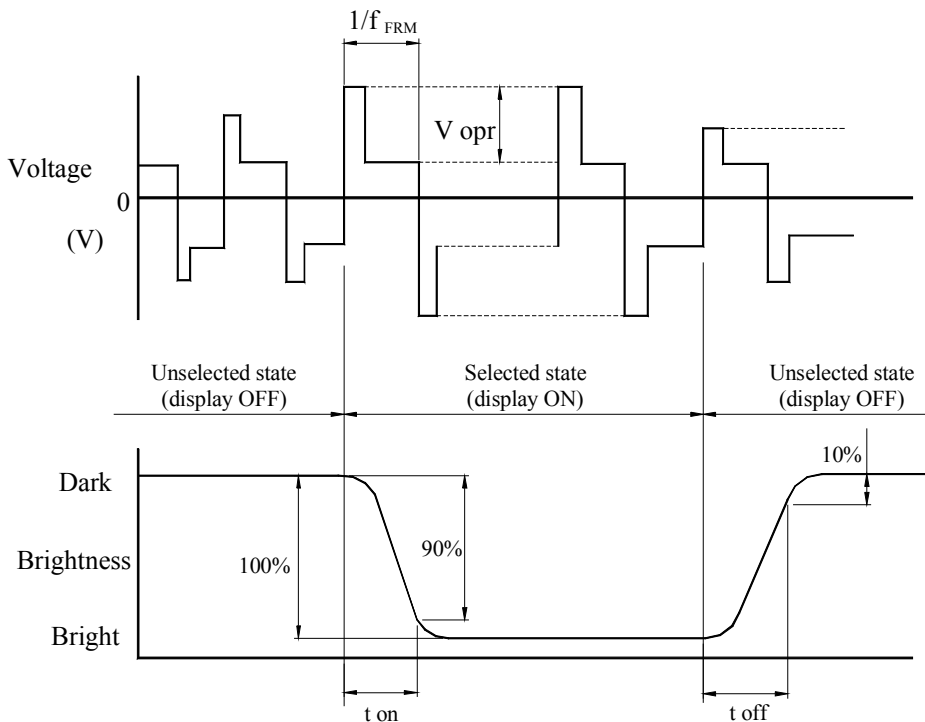
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\*Definition of viewing angles  $\theta_1$  and  $\theta_2$



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

\*Definition of response time



$V_{opr}$  : Operating voltage (V)

$t_{on}$  : Response time (rise) (ms)

$f_{FRM}$  : Frame frequency (Hz)

$t_{off}$  : Response time (fall) (ms)



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**2.7 CCFL Electrical Specifications**

**2.7.1 Absolute maximum Conditions**

The half-brightness life of the back light shall be kept as specified under the following absolute maximum conditions.

Power Consumption	2.5W
Ta=25°C, fL=30KHz	
Tube current	
Ta=25°C, fL=30KHz	6.0mArms max.

**2.7.2 Electrical characteristics**

The following operating conditions are recommended for the back light unit.

Start Voltage	400Vrms	at Ta=25°C
Tube Voltage	350Vrms	at Ta=25°C
Tube Current	5.0mArms	at Ta=25°C
Drive frequency	30KHz typ	at Ta=25°C

**2.7.3 Initial Optical Characteristics**

The unit shall satisfy the following criteria at 25±2°C ambient temperature, 30%-85% relative humidity, no air flow and with applying rating input voltage and input current by using TDK CXA-L10L inverter.

Brightness Uniformity	80%	
Average Brightness	200cd/m <sup>2</sup> min.	at Ta=25°C
(Measurement shall be continuous on for 30 minutes)		
Chromaticity	x=0.300min. 0.320typ. 0.340max.	
	y=0.355min. 0.375typ. 0.395max.	

**2.7.4 Life**

the unit shall satisfy the following criteria at 25±5°C ambient temperature, with 5mA tube current by using TDK CXA-L10L inverter.

Half-Brightness Life of Unit            10,000 Hours min.

The definition of half-brightness life is either average brightness reach to 50% of initial average brightness or lamp stopping light emission.

**2.7.5 Operating Conditions**

Temperature	0 to 50°C	Humidity	20 to 90%RH
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**2.7.6 Storage Conditions**

Temperature	-20 to 70°C	Humidity	5 to 90%RH
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**3. OPERATING INSTRUCTIONS**

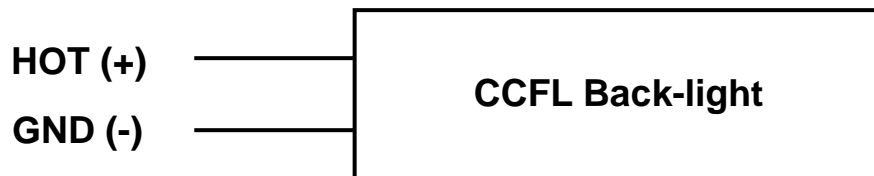
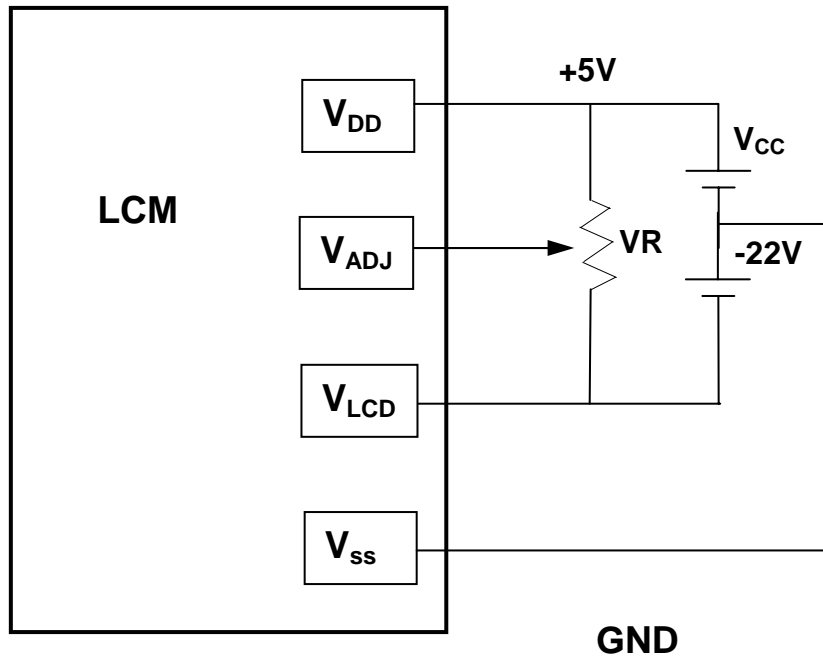
3.1 Input signal Function

NO.	Symbol	Function
1-4	D0-D3	Display Data
5	/DISPOFF	H: on L: off
6	FLM	First line market
7	M	Frame reverse signal
8	LP	Data latch
9	CP	Data shift
10	VDD	Power supply for Logic circuit (+)
11	VSS	Ground (0V)
12	VLCD	Power supply for LCD
13	VADJ	Contrast adjust for LCD
14	FGND	Front panel ground

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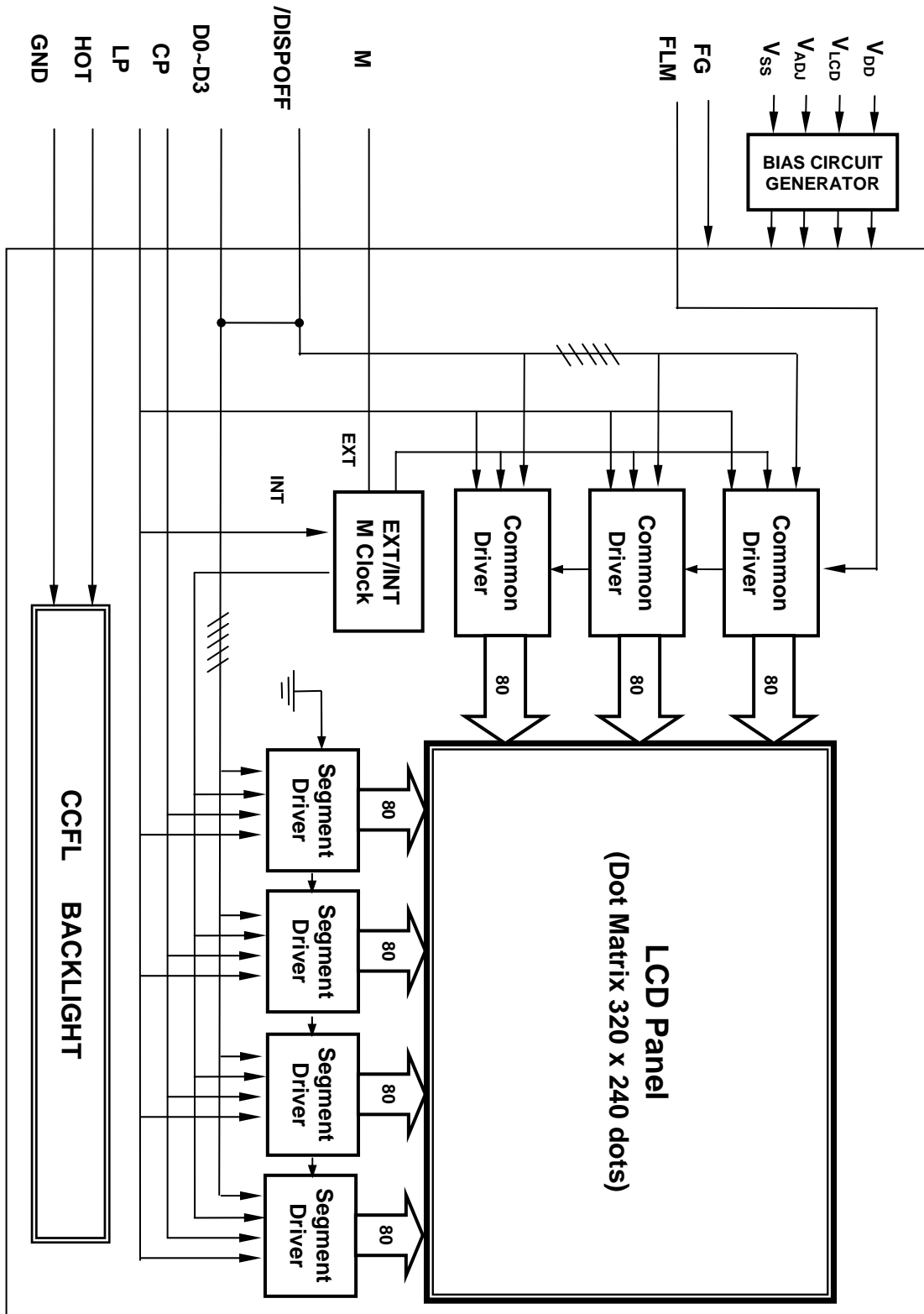
3.2 Voltage Generator Circuit

**Power Supply Circuit Diagram**



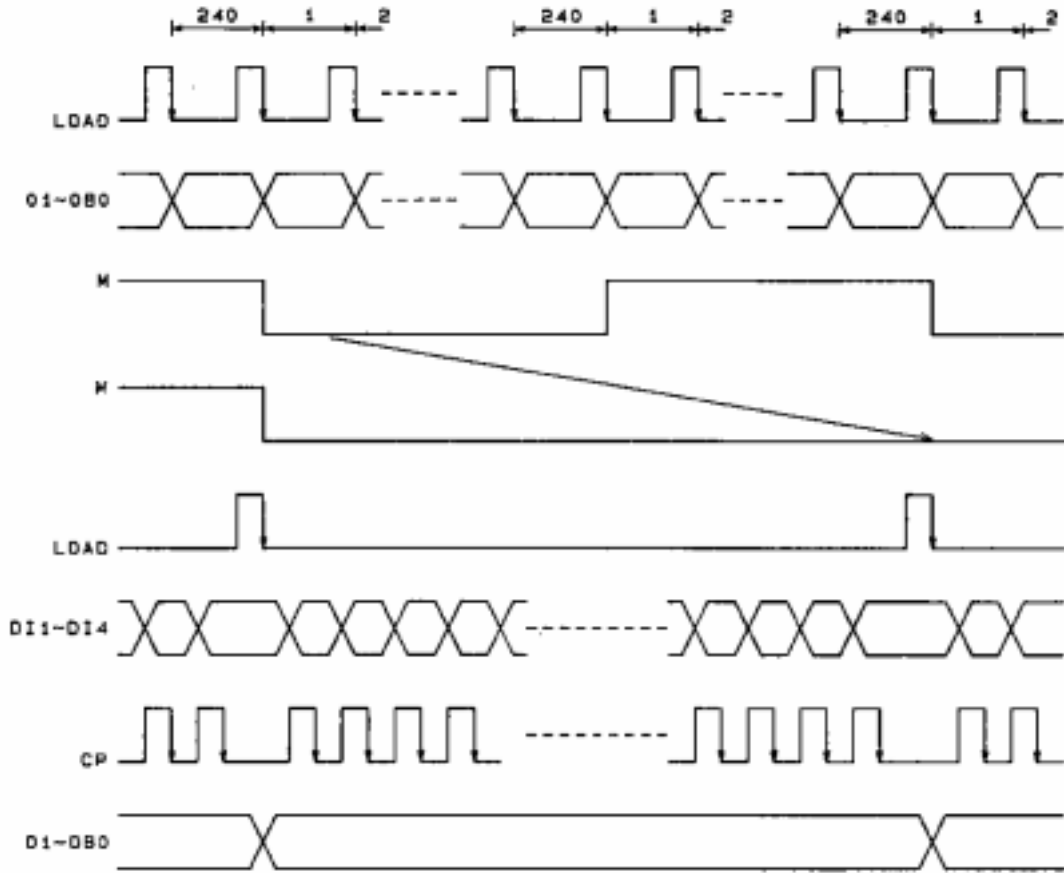
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3.3 Circuit Block Diagram



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3.4 Timing Characteristics



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**4. Unit driving method**

4.1 Ration Circuit configuration

Fig. 8-1 shows the block diagram of the unit circuitry.

4.2 Input data and control signal

The LCD driver is 48 bits LSI, consisting of shift registers, latch circuits and LCD driver circuits.

Display data which are externally divided into data for each row (48 dots) will be sequentially transferred in the from of serial data .

**5. Quality level**

5.1 Inspection conditions

5.1.1 The environmental conditions for inspection shall be as follows.

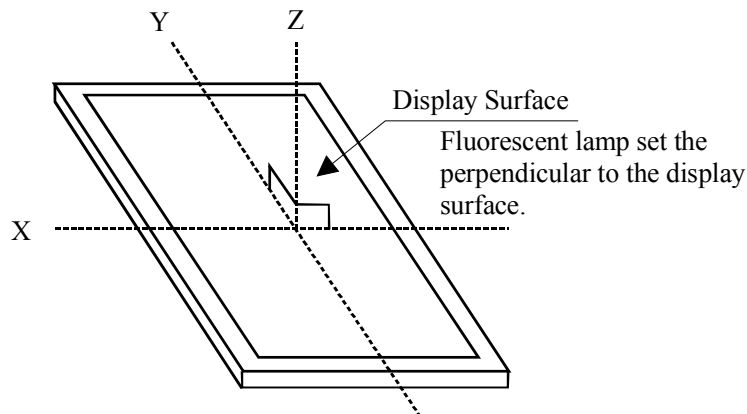
Room temperature :  $20 \pm 3$  °C

Humidity :  $65 \pm 20$ %RH

5.1.2 The external visual inspection

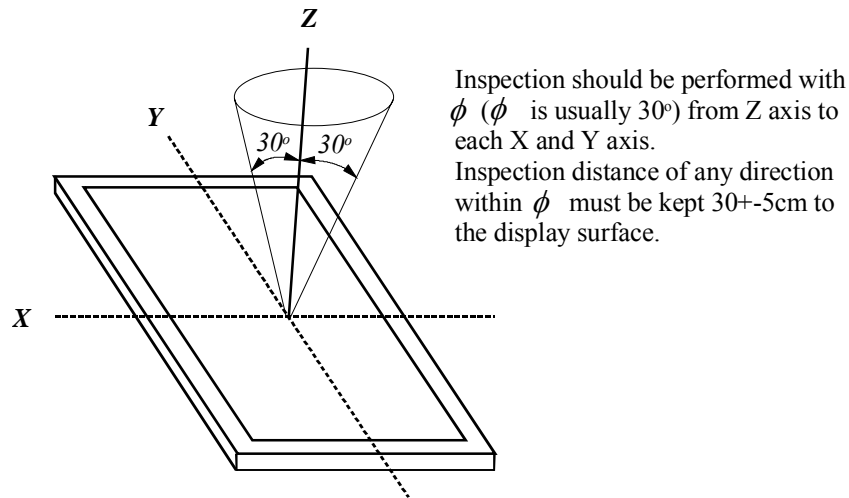
The inspection shall be performed by suing a single 20W fluorescent lamp for illumination and the distance from LCD to eyes of the inspector should be 30cmj or more.

5.1.3 (1) Light method



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(2) Inspection distance and angle



5.2 Sampling procedures for each item's acceptance level table.

Defect type	Sampling procedures	AQL
Major defect	MIL-STD-105D Inspection level I Normal inspection Single sample inspection	1.0
Minor defect	MIL-STD-105D Inspection level I Normal inspection Single sample inspection	2.5

5.3 Classification of defects

5.3.1 Major defect

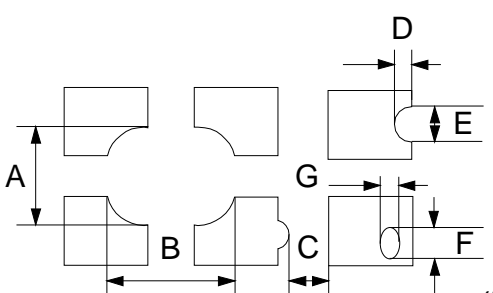
A major defect refers to a defect which is not considered to substantially degrade usability for project applications.

5.3.2 Minor defect

A minor defect refers to a defect which is not considered to substantially degrade usability applications, or a defect which deviates from existing standards almost unrelated to the effective use of the product or its operations.

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5.4 Incoming Inspection standards

Item	Criterion for defects		Defect type		
(1) Display on inspection	(1) Non display (2) Vertical line is deficient (3) Horizontal line is deficient (4) Cross line is deficient		Major		
(2) Black/ White spot	Size $\phi$ (mm)	Acceptable number	Minor		
	$\phi \leq 0.15$	Ignore (note)			
	$0.15 < \phi \leq 0.20$	3			
	$0.20 < \phi \leq 0.30$	1			
	$0.30 < \phi$	0			
(Note) If more than 4 spot all together : NG					
(3) Black/ White line	Length (mm)	Width (mm)	Acceptable number		
	$L \leq 10$	$W \leq 0.03$	Ignore (note)		
	$10 < L \leq 5.0$	$0.03 < W \leq 0.06$	3		
	$5.0 < L \leq 3.0$	$0.06 < W \leq 0.08$	2		
Defects separate at interval if 30mm each other			Minor		
Item	Criterion for defects		Defect type		
(4) Display pattern	 <p align="right">(Unit: mm)</p>		Minor		
	$\frac{A+B}{2} \leq 0.3$	$\theta < C$		$\frac{D+E}{2} \leq 0.2$	$\frac{F+G}{2} \leq 0.2$
	Note: 1) Up to 3 damages acceptable 2) NG if there are two or more pin holes per one digit				
(5) Spot-like contrast irregularity	Size $\phi$ (mm)	Acceptable number	Minor		
	$0.5 < \phi \leq 0.5$				
	$0.5 < \phi \leq 0.8$				
	$0.8 < \phi \leq 1.2$				
	$1.2 < \phi$				
Note: 1) Conformed to limit samples. 2) Defects separate at intervals of 50mm each other					
(6) Bubble in polarizer	Size (mm)	Acceptable number	Minor		
	$< \phi \leq 0.20$	Ignore			
	$0.20 < \phi \leq 0.50$	3			
	$0.50 < \phi \leq 0.80$	2			
	$\phi$	0			
Note: 1) Conformed to limit samples. 2) Defects separate at intervals of 50mm each other					



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(7) Scratches and dent on the polarizer	Scratches and dent on the polarizer shall be in the accordance with “2) Black/White spot, 3) Black/White line”.	Minor
(8) Stains on LCD panel surface	Stains which cannot be removed even when wiped lightly with a soft cloth or similar cleaning too.	Minor
(9) Rainbow color	No rainbow color is allowed in the optimum contrast on state within the active area.	Minor
(10) Viewing area encroachment	Polarizer edge or line is visible in the opening viewing area due to polarizer shortness or sealing line.	Minor
(11) Bezel appearance	Rust and deep damage which are visible in the bezel is rejectable.	Minor
(12) Defect of land surface contact (Poor soldering)	Evident crevices which is visible are rejectable	Minor
(13) Part mounting	<ol style="list-style-type: none"> <li>1. Failure to mount parts</li> <li>2. Parts not in the specifications are mounted</li> <li>3. Polarity, for example, is reversed</li> </ol>	Major
(14) Parts alignment	<ol style="list-style-type: none"> <li>1. LSI, IC lead width is more then 50% beyond pad outline.</li> <li>2. Chip component is off center and more then 50% of the leads is off the pad outline.</li> </ol>	Minor
(15) Conductive foreign matter (Solder ball, Solder chips)	<ol style="list-style-type: none"> <li>1. <math>0.45 &lt; \phi, N \geq 1</math></li> <li>2. <math>0.30 &lt; \phi \leq 0.45, N \geq 1, \phi</math>: Average diameter of solder ball (Unit: mm)</li> <li>3. <math>0.50 &lt; L, N \geq 1, L</math>: Average length of solder chip (Unit: mm)</li> </ol>	Major Minor Minor
(16) PWB pattern correction	<ol style="list-style-type: none"> <li>1. Deep damage is found on copper foil and the pattern is nearly broken.</li> <li>2. Damage on copper foil other than 1. above</li> </ol>	Major Minor
(17) Faulty PWB correction	<ol style="list-style-type: none"> <li>1. Due to PWB copper foil pattern burnout, the pattern is connected, using a jumper wire for repair; 2 or more places are corrected per PWB.</li> <li>2. Short circuited part is cut, and no resist coating has been performed.</li> </ol>	Minor
(18) Bezel Claw	Bezel claw missing or not bent	Minor
(19) Indication of name plate (sampling indication label)	Rust and deep damage which are visible in the bezel is reflect able.	Minor

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**6. Reliability**

6.1 Life time

50,000 Hrs (25 °C in the room without ray of sun)

6.2 Items of reliability

Item	Condition	Criterion
1. High temperature operating	50 °C, 96 hrs	No cosmetic failure are allowable.
2. Low temperature operating	0 °C, 96 hrs	Contrast ratio should be between initial value ± 10% Total current consumption should be below double of initial value.
3. Humidity	40 °C, 90%RH, 96 hrs	
4. High temperature storage	70 °C, 96 hrs	No cosmetic failure are allowable.
5. Low temperature storage	-20 °C, 96 hrs	Contrast ratio should be between initial value ± 20% Total current consumption should be below double of initial value.
6. Thermal shock storage	25 °C → 20 °C → 25 °C → 70 °C 5(min) 30(min) 5(min) 30(min) 5 cycle, 55 ~ 60%RH	
7. Vibration	10 ~ 55 ~ 10hz amplitude ; 1.5mm 2hrs for each direction (X, Y, Z)	No cosmetic failure are allowable. Total current consumption should be below double of initial value.

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**7. Handling Precautions**

**7.1 Mounting Method**

The LCD panel of LCD module consists of two thin glass plates with polarizer which easily get damaged and the module is so constructed as to be fixed by utilizing fitting holes in the plastic cases. Extreme care should be used when handling the LCD modules.

**7.2 Caution of LCD handling are cleaning**

When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.

- ◆ Isopropyl alcohol
- ◆ Ethyl alcohol
- ◆ Trichlorotrifluoroethane

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvent:

- ◆ Water
- ◆ Ketone
- ◆ Aromatic

**7.3 Caution against static charge**

The LCD module use C-MOS LSI drivers, so we recommended that you; Connect any unused input terminal to  $V_{DD}$  or  $V_{SS}$ , do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

**7.4 Packing**

Module employ LCD elements, and must be treated as such. Avoid intense shock and falls from a height.

To prevent modules from degradation, Do not operate or store them exposed direct to sunshine or high temperature/ humidity.

**7.5 Caution for operation**

It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage then the limit cause the shorter LCD life.

Response time will be extremely delayed at lower temperature then the operating temperature range and on the other hand at higher temperature LCD's show dark color in them.

However those phenomena do not mean malfunction or out of order with LCD's, which will come back in the specified operating temperature.

If the display area is pushed hard during operation, Some font will be abnormally displayed but it resumes normal condition after turning off once.

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A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.

**7.6 Storage**

In the case of storing for a long period of time (for instance, for years) for the purpose or replacement use, the following ways are recommended.

- ◆ Storage in a polyethylene bag with the opening sealed so as not to enter fresh air outside in it. And with no desiccant.
- ◆ Placing in a dark place where neither exposure to direct sunlight nor light is, keeping the storage temperature.
- ◆ Storing with no touch on polarizer surface by the anything else. (It's recommended to store them as they have been contained in the inner container at the time of delivery from use.)

**7.7 Safety**

- ◆ It is recommendable to crash damaged or unnecessary LCD's into pieces and wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.
- ◆ When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.

**8. Precautions for use**

8.1 A limit sample should be provided by the both parties on an occasion when the both parties agreed its necessity.

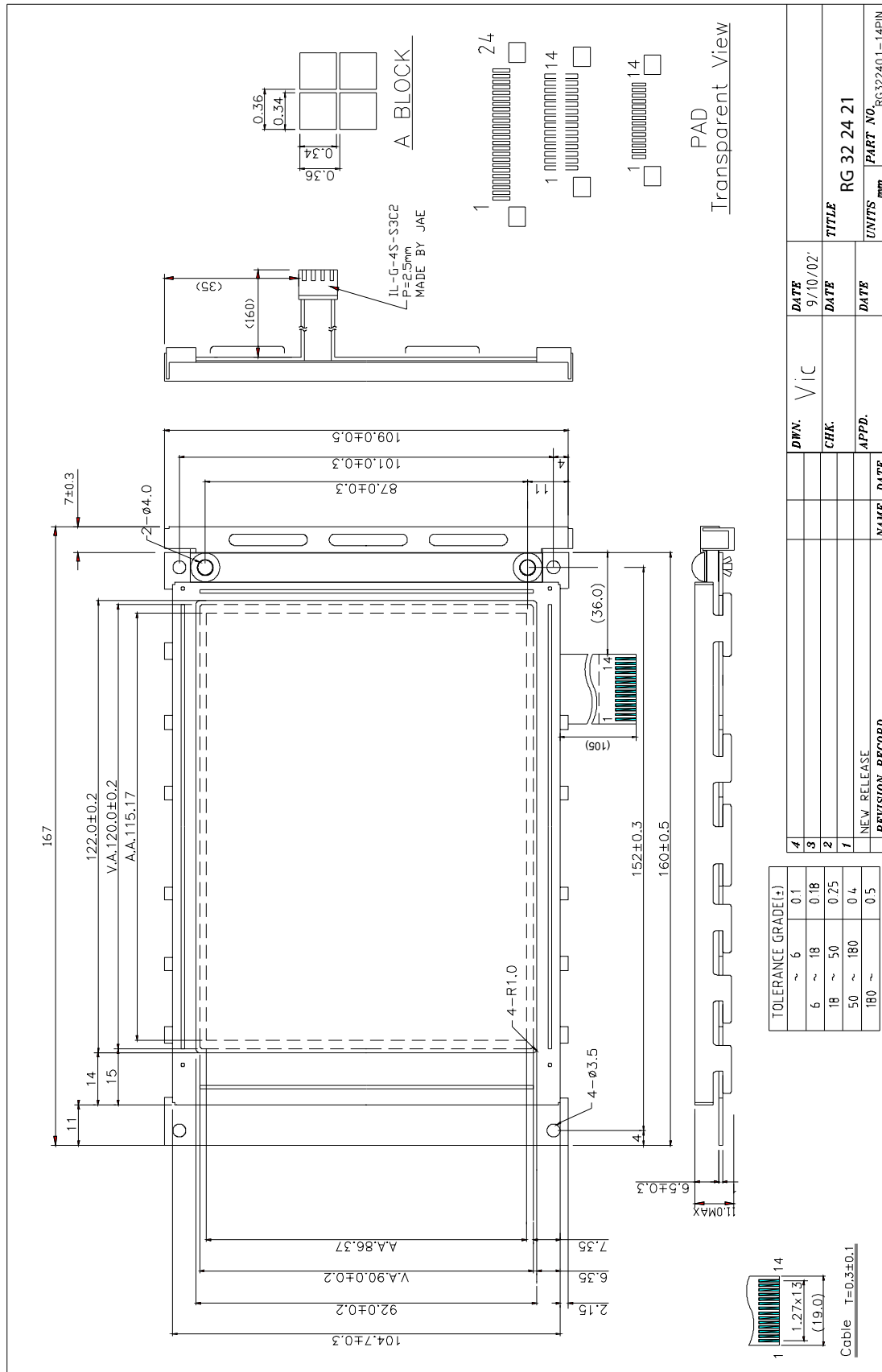
Judgement by a limit sample shall take effect after the limit sample has been established and confirmed by the both parties.

8.2 On the following occasions, the handling of problem should be decided through discussion and agreement between responsible of the both parties.

- ◆ When a question is arisen in this specifications.
- ◆ When a new problem is arisen which is not specified in this specifications.
- ◆ When an inspection specification change or operating condition change in customer is reported to APEX, and some problem is arisen in this specification due to the change.
- ◆ When a new problem is arisen at the customer's operating set for sample evaluation in the customer site.

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**9. LCM Dimension**



PAD  
Transparent View

TOLERANCE GRADE(±)	0.1	0.18	0.25	0.4	0.5
~ 6					
6 ~ 18					
18 ~ 50					
50 ~ 180					
180 ~					

DATE	DATE	DATE	DATE
9/10/02			

TITLE	UNITS	mm
RG 32 24 21		
PART NO.	RG322401-14PIN	

DWN.	CHK.	APPD.	NAME	DATE

NEW RELEASE  
REVISION RECORD

Cable T=0.3±0.1