

PRODUCT SPECIFICATIONS

For Customer: _____

Module No. : MC28G03G

Date: 2003.10.15

Version : 1

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For Customer's Acceptance :

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Please verify this is the latest information. E&OE

This specification is proposed by Arima Display Corporation.

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Arima Display Corporation

Module No. : **MC28G03G**

Date: 2003.10.15

Ver.: 1

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2. History of Specification Revision

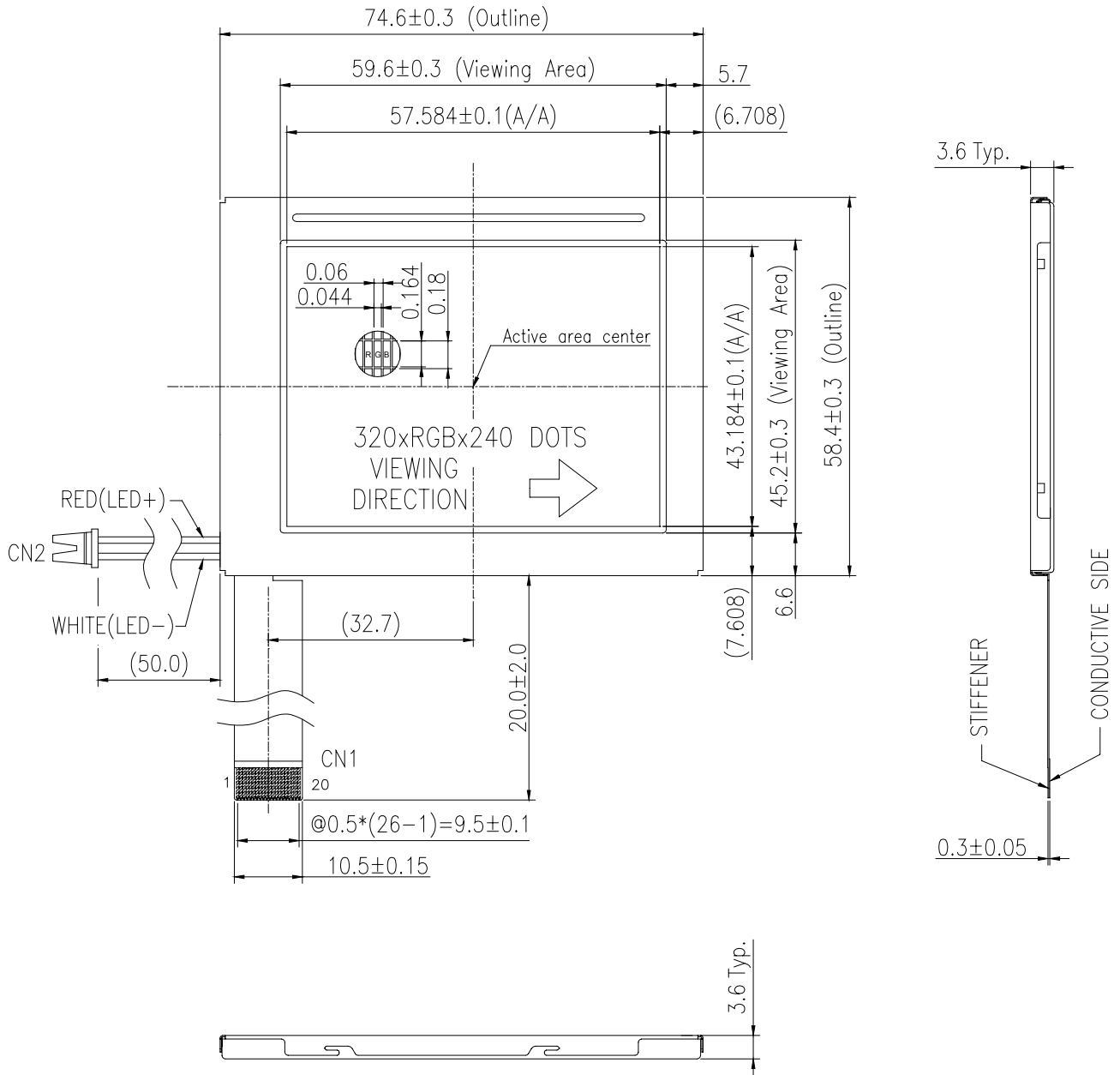
Date	Rev.	Page	Contents
2003.10.15	1	-	NEW

3. LCD Module

3.1 Main Data

No.	Item	Contents	Unit
(1)	Module size	74.6(W) x 58.4(H) x 3.6(D)	mm
(2)	Viewing area	59.6 (W) x 45.2 (H)	mm
(3)	Dot Number	320 x 3 (R.G.B) (W) x 240 (H)	dots
(4)	Dot Size	0.044(W) x 0.164(H)	mm
(5)	Dot pitch	0.06(W) x 0.18(H)	mm
(6)	LCD type	<ul style="list-style-type: none">•Color-STN (Negative type)• with glare upper polarizer and transmissive rear polarizer .	-
(7)	Contrast ratio	30	-
(8)	Duty	1/242	-
(9)	Viewing direction	9 o'clock	-
(10)	Operating temperature	-10 ~ +70	°C
(11)	Storage temperature	-20 ~ +80	°C
(12)	Backlight	LED x 4	pcs
(13)	Power Supply Voltage	3.3V	-
(14)	Weight	24	g

3.2 Outline Dimension



CN1 : FPC - Pitch 0.5mm, width 10.5mm

CN2 : BHSR-02VS-1(JST); (PIN1-(+), PIN2-GND)

Note 1 : All dimensional tolerance unless otherwise specified +/-0.5

Note 2 : Scale : NTS , Unit : mm

3.3 Interface Pin Connection

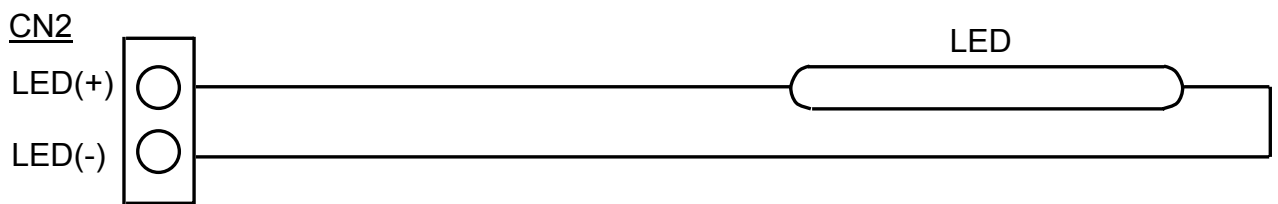
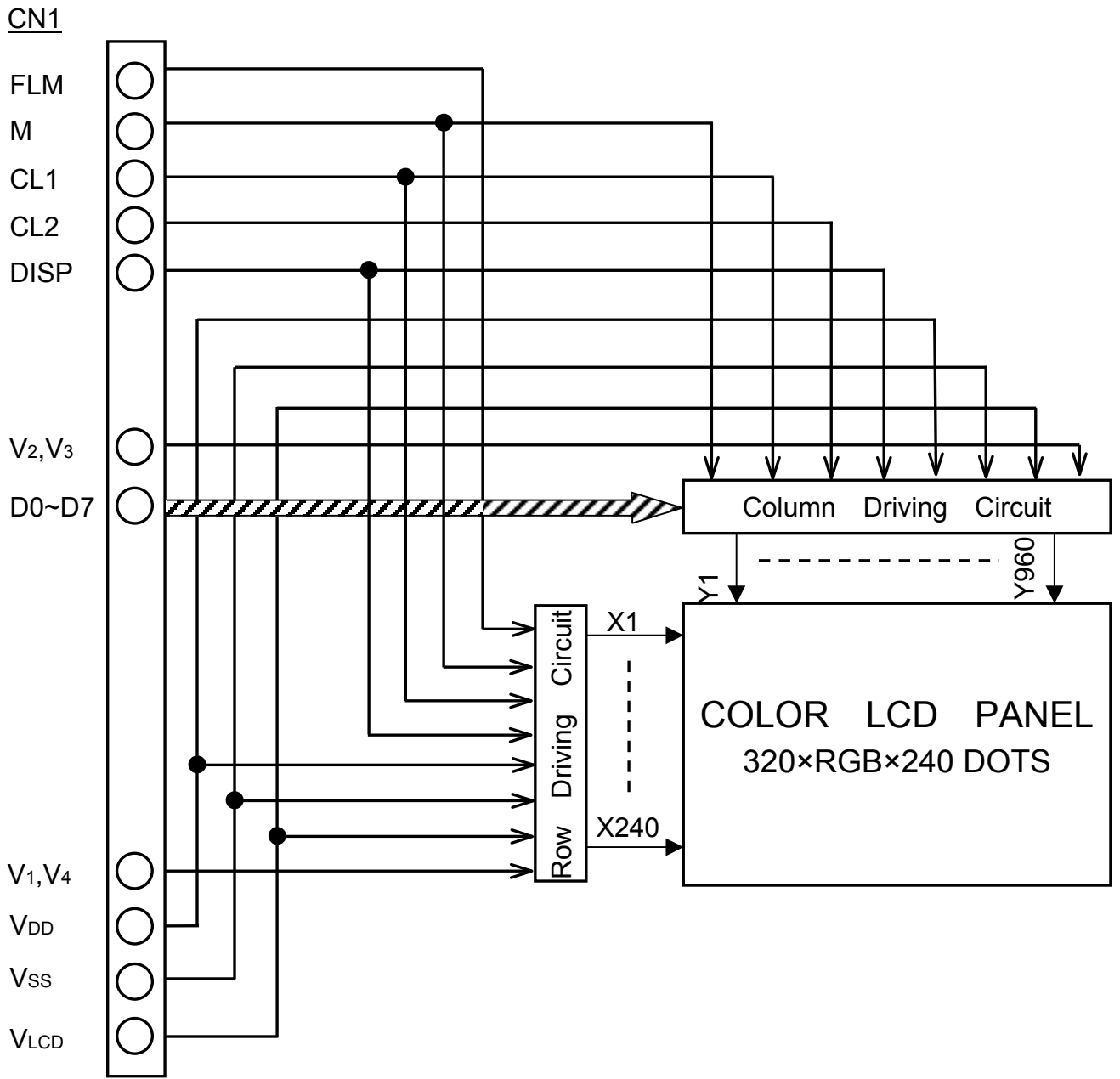
CN1 : FPC : Pitch 0.5mm, width 10.5mm / Suitable connector : 52893-2090(MOLEX)

Pin No.	Signal	Pin Function
1	V _{SS}	GND
2	D0	Display data
3	D1	Display data
4	D2	Display data
5	D3	Display data
6	D4	Display data
7	D5	Display data
8	D6	Display data
9	D7	Display data
10	V _{DD}	Logic supply voltage
11	V _{LCD}	Power supply for LCD driver
12	V ₁	Power supply for LCD driver
13	V ₂	Power supply for LCD driver
14	V ₃	Power supply for LCD driver
15	V ₄	Power supply for LCD driver
16	DISP	Display control signal H:ON , L:OFF
17	CL2	Data shift clock
18	M	Control signal for AC driving
19	CL1	Input data latch signal
20	FLM	Scan start-up signal

CN2 : BHSR-02VS-1(JST) / Suitable connector : SM02B-BHSS-1-TB(JST)

Pin No.	Signal	Pin Function
1	LED(+)	Power supply voltage for LED
2	LED(-)	LED GND

4. Block Diagram



5. Maximum Ratings

5.1 Electrical Absolute Maximum Ratings. (VSS=0V)

Item	Symbol	Min.	Max.	Unit
Power supply for Logic	V _{DD} -V _{SS}	-0.3	7.0	V
Power supply for LCD driver	V _{LCD} -V _{SS}	0	40.0	V
Input voltage (Note 1)	V _i	-0.3	V _{DD} +0.3	V
LED voltage	V _{led}	-	5.0	VDC
Current of LED	I _{LED}	0	120	mA

Note 1. FLM,M,CL1,CL2,DISP,D0~D7.

Note 2. Ta=25°C

Note 3. Make certain you are grounded when handling LCM.

5.2 Environmental Absolute Maximum Ratings

Item	Storage		Operating		Remark
	MIN.	MAX.	MIN.	MAX.	
Ambient Temperature	-20°C	80°C	-10°C	70°C	Note1,2
Humidity	Note 3		Note3		No Condensation
Vibration	-	-	-	-	Depend on using design
Shock	-	-	-	-	

Note 1. Ta at -20°C -----<48hours, at 80°C -----<168 hours.

Note 2. Background color changes slightly depending on ambient temperature.
The phenomenon is reversible.

Note 3. Ta<=40°C : 85%RH MAX.

Ta> 40°C : Absolute humidity must be lower than the humidity of 85% RH at 40°C.

Note 4. The module should be operated normally after the test is finished.

6. Electrical Characteristics

6.1 Electrical Characteristics of LCD

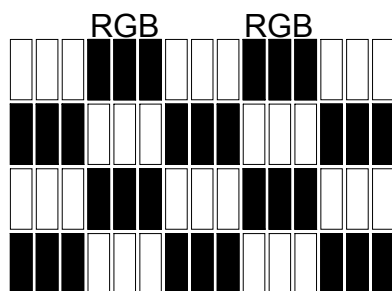
Item	Symbol	Condition	MIN.	Typ.	Max.	Unit
Power Supply for Logic	VDD	—	2.5	3.3	4.5	V
Power supply for LCD driver Voltage Note (1)	VLCD-Vss	Ta=0°C	—	26.2	—	V
		Ta=25°C	24.5	25.0	25.5	
		Ta=50°C	—	24.8	—	
Power supply for LCD driver Voltage Note (1)	V1	—	—	23.44	—	V
Power supply for LCD driver Voltage Note (1)	V2	—	—	21.87	—	V
Power supply for LCD driver Voltage Note (1)	V3	—	—	3.13	—	V
Power supply for LCD driver Voltage Note (1)	V4	—	—	1.56	—	V
Input Signal Voltage Note (2)	VIH	“H” Level	0.8VDD	—	—	V
	VIL	“L” Level	—	—	0.2VDD	
Power supply current Note (3)	IDD	VDD=3.3V	—	1.0	2.0	mA
	ILCD	VLCD=25.0V	—	1.5	2.0	mA
	IIN	VIN=VDD or VSS	—	—	10.0	μA
Frame Frequency Note (4)	fFLM	—	120	150	180	Hz

Note (1) In proportion as the VLCD decrease the brightness will increase.

The value is specified as the voltage at which the optimum contrast is obtained.

Note (2) FLM,M,CL1,CL2,DISP,D0~D7

Note (3) fFLM=150Hz,Ta=25°C,Display pattern is Black/White cross pattern as below.



Note (4) Need to make sure that there is no flicker and ripple phenomenon when setting the Frame Frequency in your set.

6.2 Electrical Characteristics of Backlight

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Starting Voltage	VS		3.3	3.8	VDC	Ta=25°C
LED Current	IL	-	80	88	mA	Ta=25°C

7. Optical Characteristics

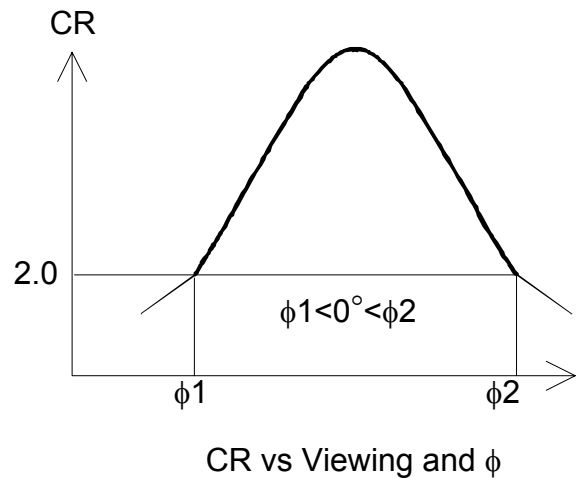
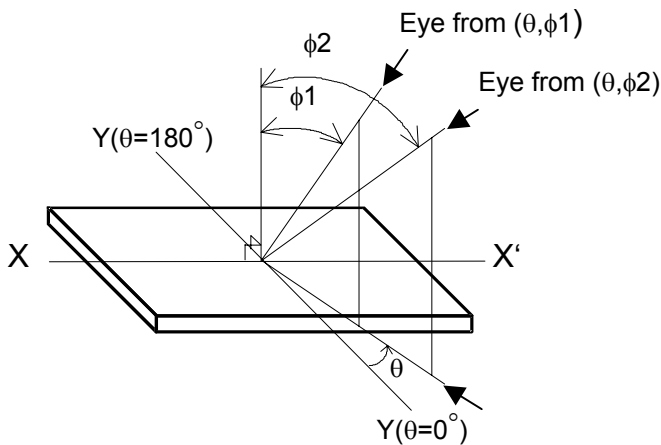
7.1 Optical Characteristics of LCD

Ta= 25°C.(Backlight On)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	
Viewing Angle Range	$\phi 1, \phi 2$	CR ≥ 2	X axle	-	60	-	Deg.	Note 1,2
			Y axle	-	35	-		
Contrast Ratio	CR	$\phi = 0^\circ$	-	50	-	-	Note 3,4	
Response Time	Rise	tr	$\theta = 0^\circ, \phi = 0^\circ$	-	190	-	ms	Note 5
	Fall	tf	$\theta = 0^\circ, \phi = 0^\circ$	-	110	-	ms	
Color Tone (CIE Coordinate)	R	x	$\theta = 0^\circ, \phi = 0^\circ$	0.51	0.56	0.61	-	
		y		0.30	0.35	0.40	-	
	G	x		0.25	0.30	0.35	-	
		y		0.48	0.53	0.58	-	
	B	x		0.10	0.15	0.20	-	
		y		0.16	0.21	0.26	-	
	W	x		0.27	0.32	0.37	-	
		y		0.30	0.35	0.40	-	

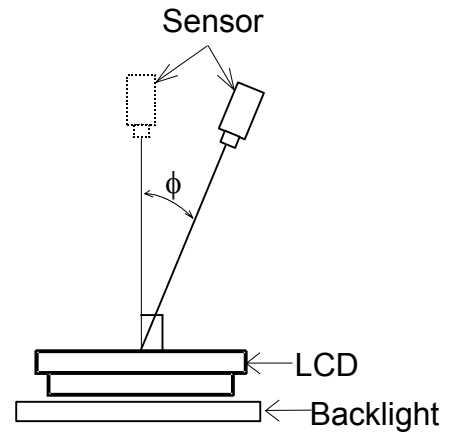
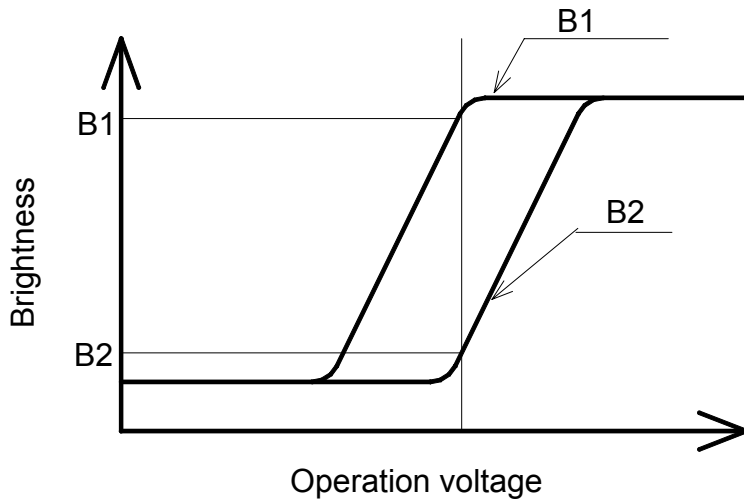
Note 1. Definition of θ and ϕ

Note 2. Definition of Viewing angle $\phi 1$ and $\phi 2$



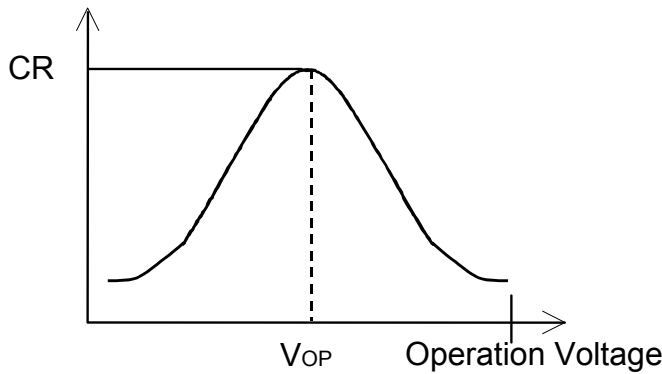
Note 3. Definition of Contrast Ratio "CR"

$$CR = \frac{\text{Brightness at selected dot (B1)}}{\text{Brightness at non-selected dot (B2)}}$$

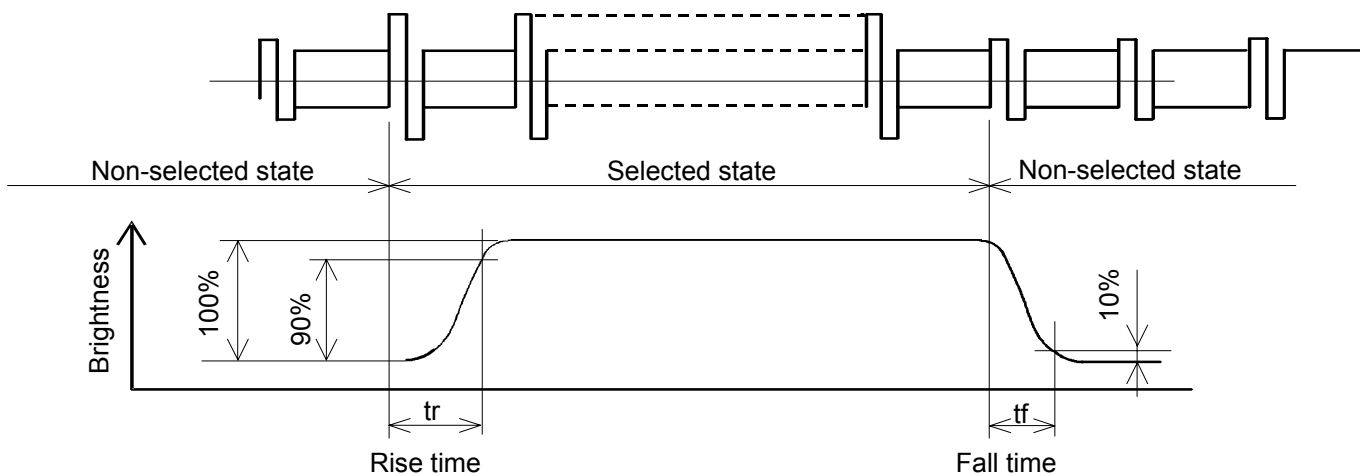


Sensor : BM-7
Aperture : 1°
Distance : 50 cm

Note 4. Definition of "CR" and "V_{OP}"



Note 5. Definition of optical response time



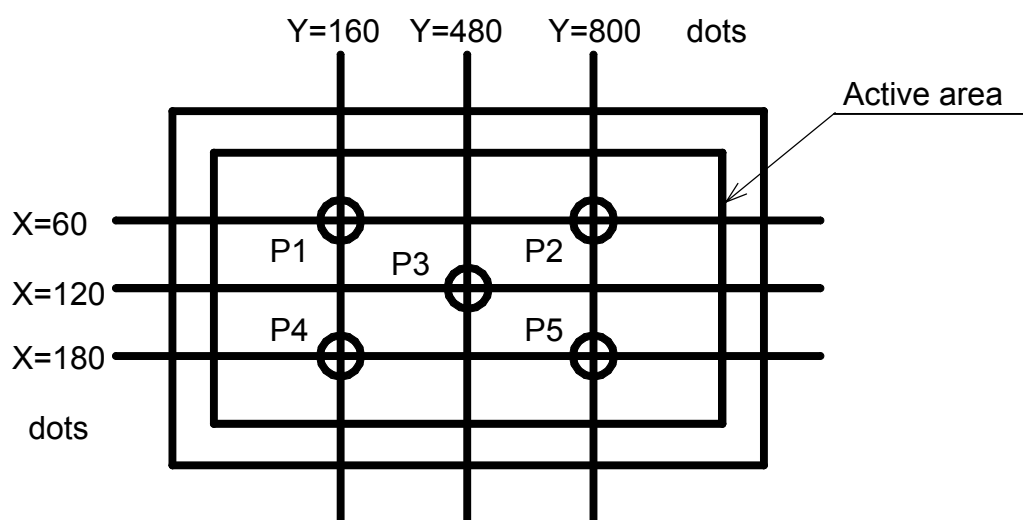
7.2 Optical Characteristics of Backlight

Item	Min,	Typ.	Max.	Unit	Remark
Brightness	37	45	-	cd/m ²	Note 1,2,3
Brightness Uniformity	-	-	+/-30	%	Note 2,3,4

Note 1. Measurement Condition:

- Display data should be all “ON” (D0~D7=HIGH).
- Vled=3.3V, IL=80mA, V_{LCD} should be adjusted at the voltage where the peak contrast is obtained by naked eyes as the “ALL Q” pattern.
- Start measuring after LED working 3 minutes.

Note 2. Measurement of the following 5 points on the display.



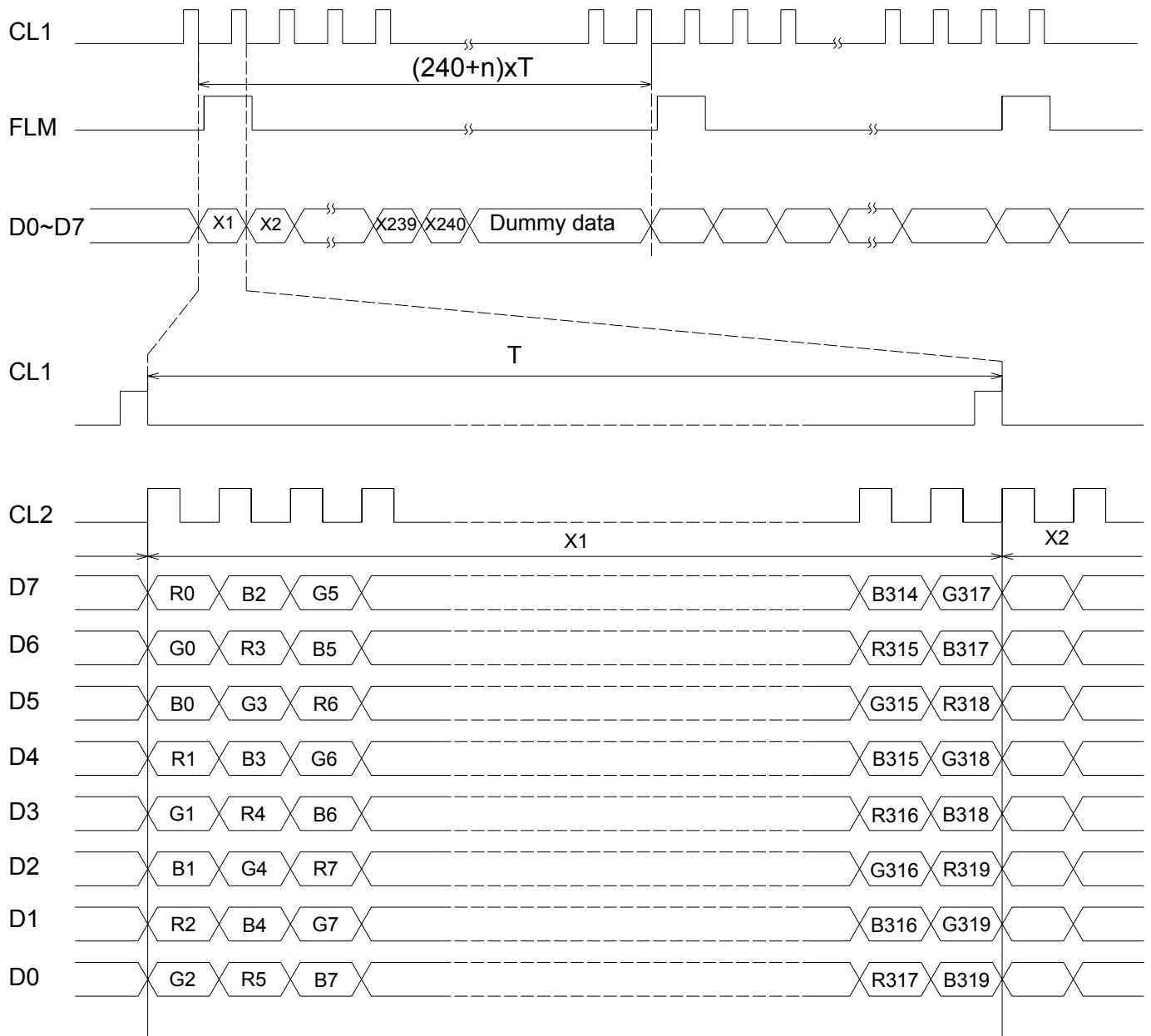
Note 3. The brightness shall be the average of P1~P5 point.

Note 4. Definition of the brightness Uniformity

$$\left(\frac{\text{Max brightness or Min brightness} - \text{Average brightness}}{\text{Average brightness}} \right) \times 100\%$$

8. Interface Timing Chart

8.1 Timing Chart



8.2. Electrical Characteristics

8.2.1 AC Characteristics

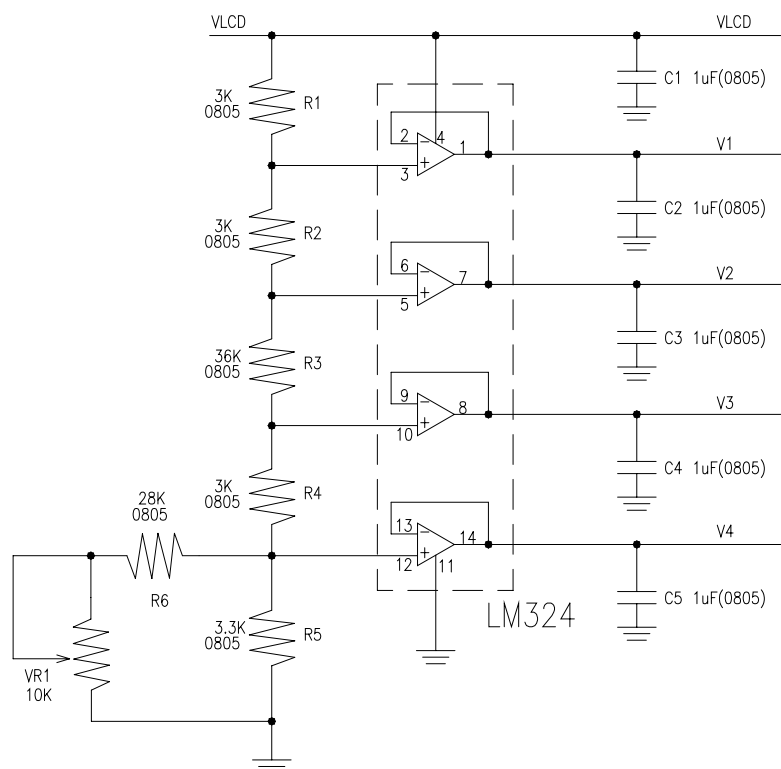
($V_{DD}=3.0\sim 4.5V$, $V_{SS}=0V$, $T_a=-20^{\circ}C\sim +85^{\circ}C$)

Item	Symbol	Min.	Typ.	Max.	Unit
Shift clock period	t_{WCK}	66	-	-	ns
Shift clock "H" pulse wide	t_{WCKH}	23	-	-	ns
Shift clock "L" pulse wide	t_{WCKL}	23	-	-	ns
Data setup time	t_{DS}	15	-	-	ns
Data hold time	t_{DH}	23	-	-	ns
Latch pulse "H" pulse wide	t_{WLPH}	30	-	-	ns
Shift clock rise to latch pulse rise time	t_{LD}	0	-	-	ns
Shift clock fall to latch pulse fall time	t_{SL}	50	-	-	ns
Latch pulse rise to shift clock rise time	t_{LS}	30	-	-	ns
Latch pulse fall to shift clock fall time	t_{LH}	30	-	-	ns
Enable setup time	t_S	15	-	-	ns
Input signal rise time	t_R	-	-	50	ns
Input signal fall time	t_F	-	-	50	ns
Out delay time (1)	t_D	-	-	41	ns
Out delay time (2)	t_{PD1}	-	-	1.2	μs
Out delay time (3)	t_{PD2}	-	-	1.2	μs
/DISPOFF removal time	t_{SD}	100	-	-	ns
/DISPOFF "L" pulse width	t_{WDL}	1.2	-	-	μs

NOTES:

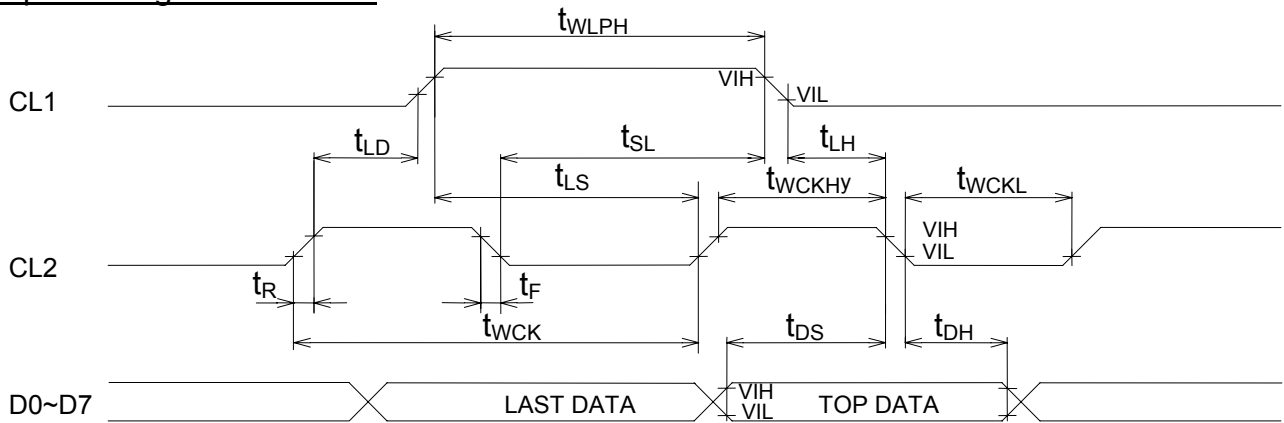
1. Takes the cascade connection into consideration
2. $(t_{WCK}-t_{WCKH}-t_{WCKL})/2$ is maximum in the case of high speed operation

8.2.2 Recommend bias circuit :

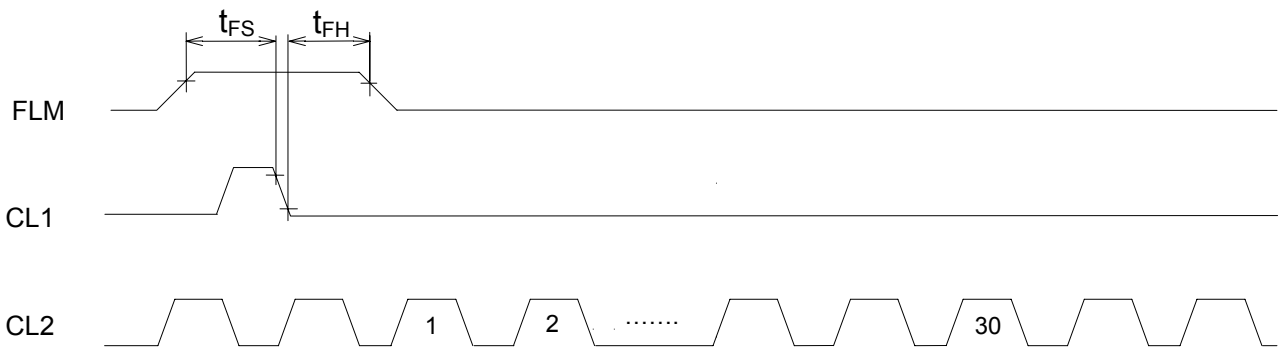


8.2.3 Timing Diagrams

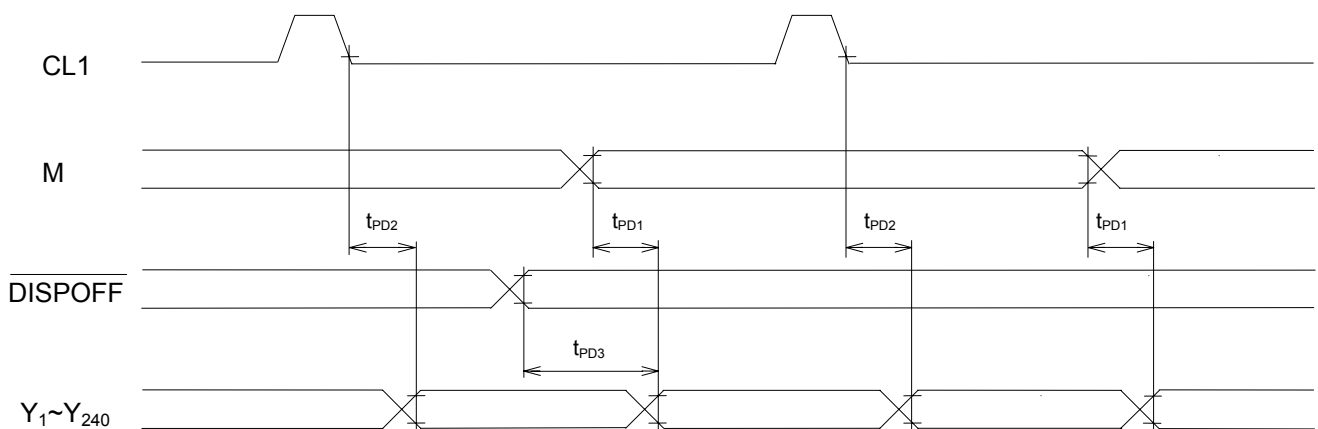
Input Timing Characteristic



Input/Output Timing Characteristic

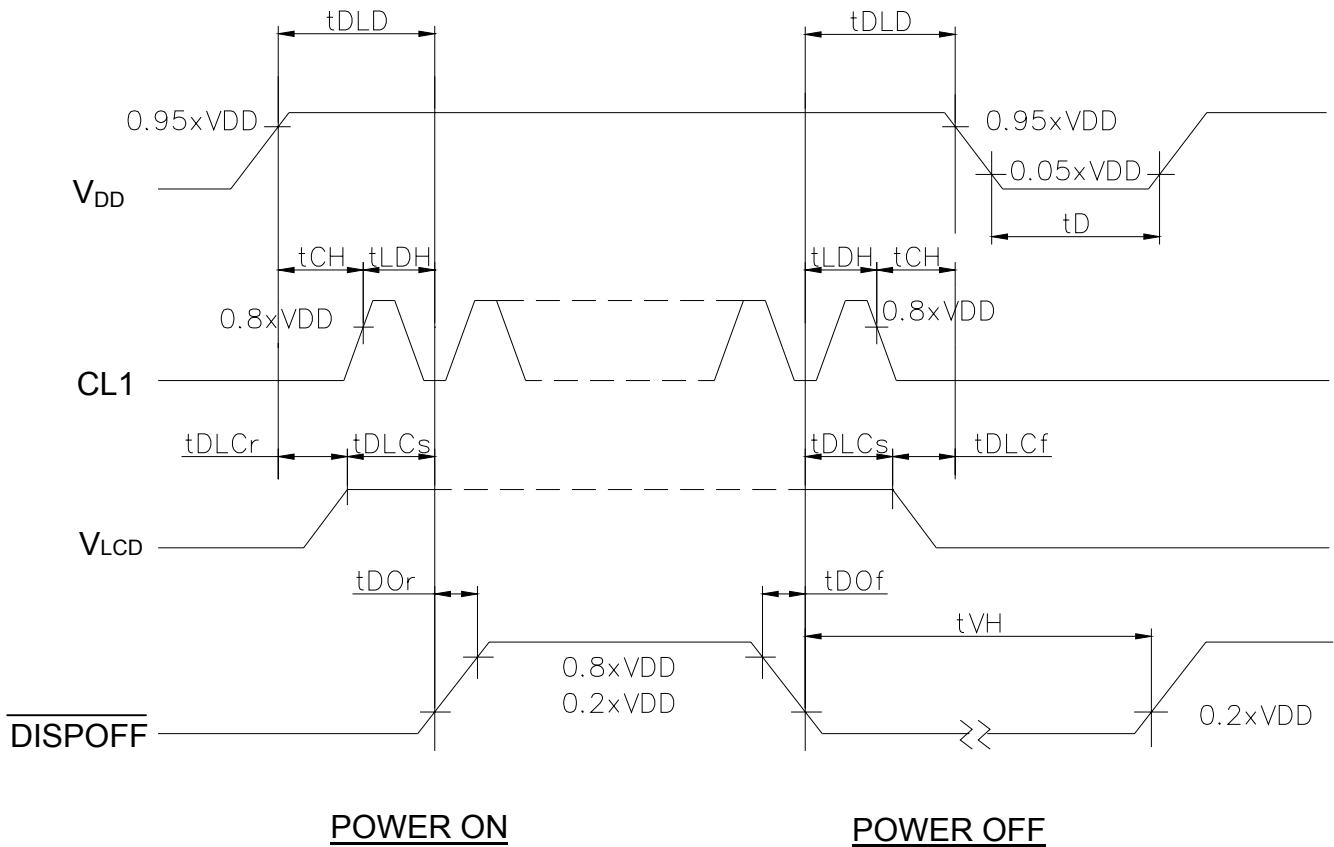


Input/Output Timing Characteristic



8.3 Power Supply and Signal Sequence

Do not apply DC voltage to the LCD panel because it will induce the electrochemical reaction and reduce its life time. Please follow the power supply ON/OFF sequence to prevent DC driving of LCD or latch-up of LCD driver, as shown below.



SYMBOL	MIN.	MAX.	UNIT	COMMENT
t _{DLD}	200	-	ms	Note 1
t _D	400	-	ms	
t _{CH}	0	-	ms	
t _{LDH}	20	-	ms	
t _{DOr}	-	100	ns	Note 2
t _{DOf}	-	100	ns	
t _{DLCr}	0	-	ms	
t _{DLCf}	0	-	ms	Note 2,3
t _{DLCs}	20	-	ms	
t _{VH}	200	-	ms	Note 4

Note 1. Please keep the specified sequence because wrong sequence may cause permanent damage to the LCD panel.

Note 2. Please use DISPOFF function. Switching by other than the DISPOFF function may cause display deterioration.

Note 3. V_{LCD} voltage should be set up to adjusted voltage before DISPOFF signal arises. Otherwise, when DISPOFF signal arises, adjusted contrast image may not be generated.

Note 4. Please keep the specified sequence of DISPOFF signal because if the t_{VH} is short enough, LCD panel may not be restarted.

8.4 Input Data Allocation Table

Data Signal	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	D 7	D 6	D 5	D 4		D 4	D 3	D 2	D 1	D 0
Y 1	2	3	4	5	6	7	8	9	10	11	12	-----	9 5 6	9 5 7	9 5 8	9 5 9	9 5 0	
X 1	R	G	B	R	G	B	R	G	B	R	G	B		G	B	R	G	B
2	R	G	B	R	G	B	R	G	B	R	G	B		G	B	R	G	B
3	R	G	B	R	G	B	R	G	B	R	G	B		G	B	R	G	B
4	R	G	B	R	G	B	R	G	B	R	G	B		G	B	R	G	B
5	R	G	B	R	G	B	R	G	B	R	G	B		G	B	R	G	B
6	R	G	B	R	G	B	R	G	B	R	G	B		G	B	R	G	B
7	R	G	B	R	G	B	R	G	B	R	G	B		G	B	R	G	B
8	R	G	B	R	G	B	R	G	B	R	G	B		G	B	R	G	B
9	R	G	B	R	G	B	R	G	B	R	G	B		G	B	R	G	B
10	R	G	B	R	G	B	R	G	B	R	G	B		G	B	R	G	B
238	R	G	B	R	G	B	R	G	B	R	G	B		G	B	R	G	B
239	R	G	B	R	G	B	R	G	B	R	G	B		G	B	R	G	B
240	R	G	B	R	G	B	R	G	B	R	G	B		G	B	R	G	B

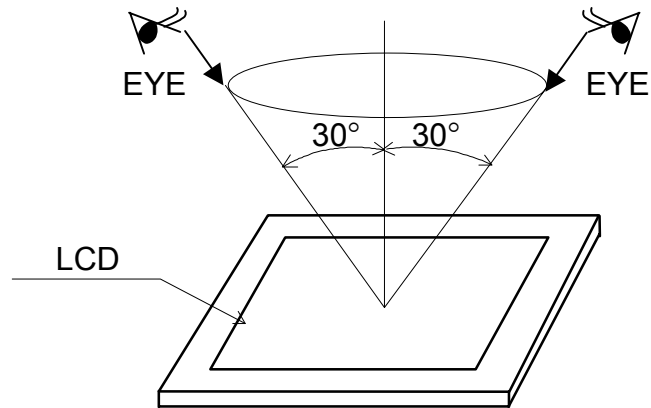
R : RED
 G : GREEN
 B : BLUE

9. Quality Assurance

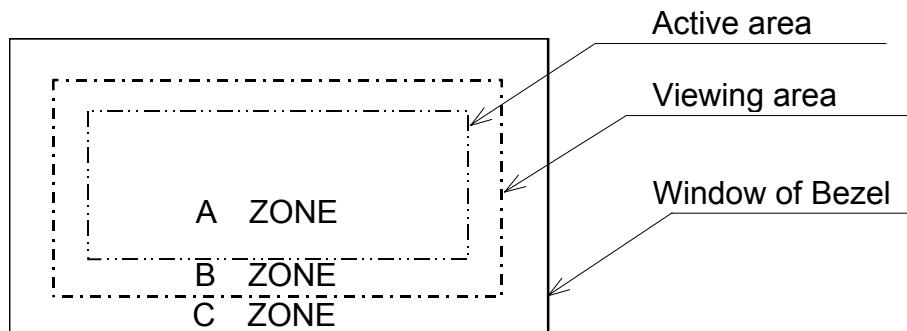
9.1 Appearance Inspection

Appearance inspection should be done under the following condition.

- (1) In the dark room. The CFL should be lighted with the prescribed inverter.
- (2) The distance from eyes to LCD must be 30 cm.
- (3) Viewing direction must be within 30 degrees to vertical line of LCD center.



9.2 Definition of A zone, B zone and C zone

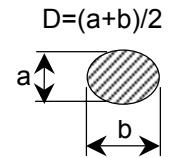
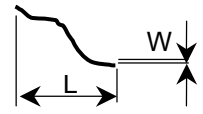


9.3 Appearance Criterion

Customer and supplier should hold a discussion when there is any problem about standard quality assurance or special quality assurance is needed.

Inspection Standard: MIL-STD-105E normal inspection level 2

No.	Item	Criterion	Zone	AQL											
1	Stains Scratches Black spots White spots Foreign particles	Line shape:	A	2.5											
		<table border="1"> <thead> <tr> <th>Length</th> <th>Width</th> <th>Acceptable Q'ty</th> </tr> </thead> <tbody> <tr> <td>L≤4.0</td> <td>W≤0.03</td> <td>Disregard</td> </tr> <tr> <td>L≤3.0</td> <td>0.03<W≤0.05</td> <td>2</td> </tr> <tr> <td>L≤2.5</td> <td>0.05<W≤0.1</td> <td>1</td> </tr> <tr> <td>-</td> <td>0.1<W</td> <td>As round shape</td> </tr> </tbody> </table>			Length	Width	Acceptable Q'ty	L≤4.0	W≤0.03	Disregard	L≤3.0	0.03<W≤0.05	2	L≤2.5	0.05<W≤0.1
Length	Width	Acceptable Q'ty													
L≤4.0	W≤0.03	Disregard													
L≤3.0	0.03<W≤0.05	2													
L≤2.5	0.05<W≤0.1	1													
-	0.1<W	As round shape													
		Round shape:													
		<table border="1"> <thead> <tr> <th>Diameter</th> <th>Acceptable Q'ty</th> </tr> </thead> <tbody> <tr> <td>D≤0.10</td> <td>Disregard</td> </tr> <tr> <td>0.10<D≤0.20</td> <td>5</td> </tr> <tr> <td>0.20<D≤0.25</td> <td>3</td> </tr> <tr> <td>0.25<D</td> <td>0</td> </tr> </tbody> </table>	Diameter	Acceptable Q'ty	D≤0.10	Disregard	0.10<D≤0.20	5	0.20<D≤0.25	3	0.25<D	0			
Diameter	Acceptable Q'ty														
D≤0.10	Disregard														
0.10<D≤0.20	5														
0.20<D≤0.25	3														
0.25<D	0														
		The total number of "Line"+"Round" is 5 max. Any defect wiped out easily is acceptable.													
2	Bubbles	<table border="1"> <thead> <tr> <th>Diameter</th> <th>Acceptable Q'ty</th> </tr> </thead> <tbody> <tr> <td>D≤0.30</td> <td>Disregard</td> </tr> <tr> <td>0.30<D≤0.60</td> <td>3</td> </tr> <tr> <td>0.60<D≤1.0.</td> <td>1</td> </tr> <tr> <td>1.0<D</td> <td>0</td> </tr> </tbody> </table>	Diameter	Acceptable Q'ty	D≤0.30	Disregard	0.30<D≤0.60	3	0.60<D≤1.0.	1	1.0<D	0	A	2.5	
Diameter	Acceptable Q'ty														
D≤0.30	Disregard														
0.30<D≤0.60	3														
0.60<D≤1.0.	1														
1.0<D	0														
		The total number of bubbles is 3 max.													
3	Display quality	<ul style="list-style-type: none"> Viewing angle defect. Missing dots or missing lines. Malfunction. Contrast ratio defect. Power consumption exceeds specification. 	A	0.65											
4	Color tone Color uniformity	To be judged by Arima Display Corporation.	A	2.5											



(2) LED Backlight Appearance

No	Test Item	Test Condition		Zone	AQL	
1	Dark Spots White Spots Foreign Material (Spot)	Average Diameter D(mm)	Maximum Acceptable Number	A	2.5	
		$D \leq 0.4$	Ignored			
		$0.4 < D$	None			
2	Foreign Materials (Line)	Width W (mm)	Length L (mm)	Maximum Acceptable Number	A	2.5
		$W \leq 0.2$	$L \leq 2.5$	1		
			$2.5 < L$	None		
$0.2 < W$	-	None				
3	Scratches	Width W (mm)	Length L (mm)	Maximum Acceptable Number	A	2.5
		$W \leq 0.1$	-	Ignored		
			$L \leq 11.0$	1		
		$0.1 < W \leq 0.2$	$11.0 < L$	None		
$0.2 < W$	-	None				

10. Reliability Tests

This standard reliability test is done only for the first lot of MP products. Customer and supplier must hold a discussion if other reliability test is requested by customer.

No	Test Item	Test Condition
1	High temperature and high humidity Under storage	40°C, 90% RH 120hrs
2	High temperature and high humidity Under operation	40°C, 90% RH 72hrs
3	High temperature under storage	70°C, 120hrs
4	Low temperature under storage	-20°C, 120hrs
5	Thermal shock (under storage)	<p style="text-align: center;"> -20°C ← 25°C ← 60°C 30min → 5min → 30min ← 1 cycle → total 5 cycles </p>
6	Drop test (Packing box with full samples inside)	(X,Y,Z) x2 total 6 directions drop from 1 meter to ground

•Operation: Supply 3.3V for logic system and V_{LCD} voltage for LCD module.

11. Precautions for Operation and Storage

11.1 Precautions for Operation

- (1) Since LCD panel is made of glass, in order to prevent from glass broken or color tone change, please do not apply any mechanical shock or impact or excessive force to it when installing the LCD module.
- (2) If LCD panel is broken and liquid crystal substance leaks out and contact your skin or clothes, please immediately wash it off by using soap and water.
- (3) The polarizer on the LCD surface is soft and easily scratched. Please be careful when handling.
- (4) If LCD surface becomes contaminated, please wipe it off gently by using moisten soft cloth with normal hexane, do not use acetone, ketone, ethanol, isopropyl alcohol or water. If there is saliva or water on the LCD surface, please wipe it off immediately.
- (5) When handling LCD module, please be sure that the body and the tools are properly grounded. And do not touch I/F pins with bare hands or contaminate I/F pins.
- (6) Do not attempt to disassemble or process the LCD module.
- (7) LCD module should be used under recommended operating conditions shown in chapter 6 and 7.
- (8) Response time will be extremely slower at lower temperature than at specified temperature and LCD will show different color when at higher temperature. The phenomenon will disappear when returning to specified condition.
- (9) Foggy dew, moisture condensation or water droplets deposited on surface and contact terminals will cause polarizer stain or damage, the deteriorated display quality and electrochemical reaction then leads to the shorter life time and permanent damage to the module probably. Please pay attention to the environmental temperature and humidity.

11.2 Precautions for Storage

- (1) Please store LCD module in a dark place, avoid exposure to sunlight, the light of fluorescent lamp or any ultraviolet ray.
- (2) Keep the environment temperature at between 10°C and 35°C and at normal humidity. Avoid high temperature, high humidity or temperature below 0°C.
- (3) That keeps the LCD modules stored in the container shipped from supplier before using them is recommended.
- (4) Do not leave any article on the LCD module surface for an extended period of time.

11.3 Warranty Period

Arima Display Corp. warrants for a period of 12 months from the shipping date when stored or used under normal condition.

12. Printing

12.1 Printing (on product)

Module No., Lot No., manufactory and the place of production will be printed on the rear of product as below.

MC28G03G 3A11
ARIMA DISPLAY CORP.
MADE IN TAIWAN

12.2 Lot No. Definition

