SPECIFICATION
FOR
LCD MODULE
MODULE NO.: BG-12864A-FBWA-J-G-B00
Doc.Version: 00

Filled in by customer:

Check list item:

1.Viewing area:	☐ OK	☐ NG
2.Module dimension:	☐ OK	☐ NG
3.Module thickness:	☐ OK	☐ NG
4.Appearance:	☐ OK	☐ NG
5.Viewing angle:	☐ OK	☐ NG
6.Background color:	☐ OK	☐ NG
7.Backlight brightness:	☐ OK	☐ NG
8.Backlight color:	☐ OK	☐ NG
9.Backlight electronic characteristic	☐ OK	☐ NG
10.Pattern:	☐ OK	☐ NG
11.Contrast:	☐ OK	☐ NG
12.Function:	☐ OK	☐ NG
13.Characteristic:	☐ OK	☐ NG
14.Vlcd:	☐ OK	☐ NG
15.Module operation current:	☐ OK	☐ NG
16.Reliability Test:	☐ OK	☐ NG
17.Test Result:	☐ OK	☐ NG
18.Others	☐ OK	☐ NG

DOCUMENT REVISION HISTORY

Sample Version	DOC. Version	DATE	DESCRIPTION	CHANGED BY
B00	00	2005-08-19	First issue	

CONTENTS

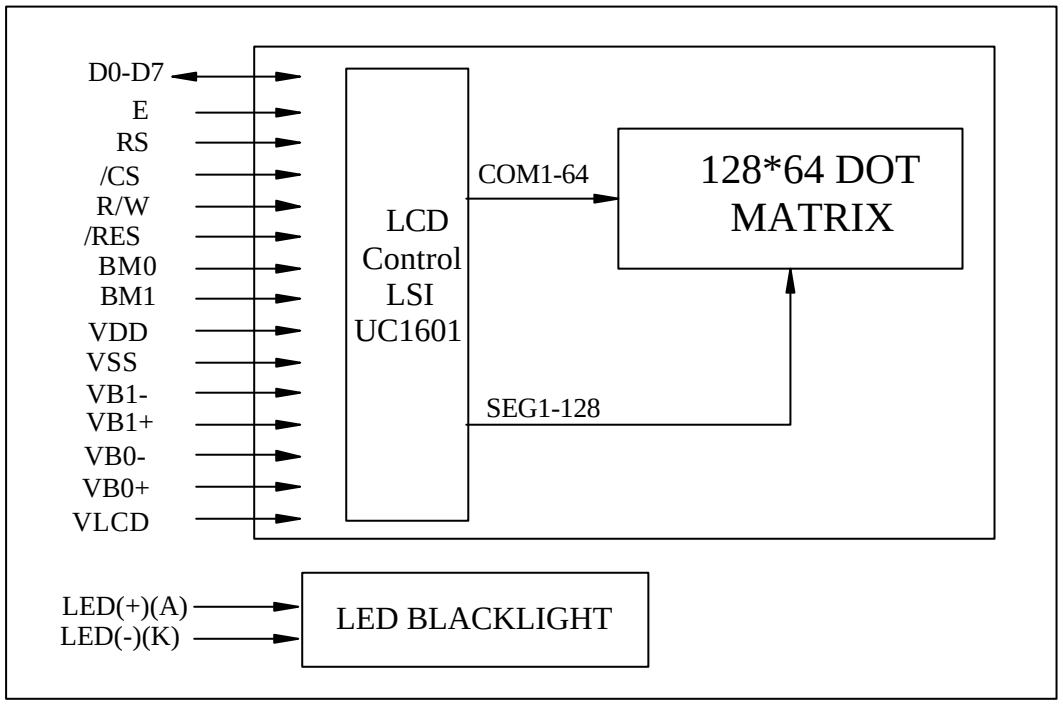
1.FUNCTIONS & FEATURES

1-1.Format	: 128*64 Dots Graphic
1-2. LCD mode	: FSTN/B-W /Positive/Transflective
1-3. Viewing direction	: 6 o' clock
1-4.Driving scheme	: 1/65 duty, 1/9 bias, 10.2V Vlcd

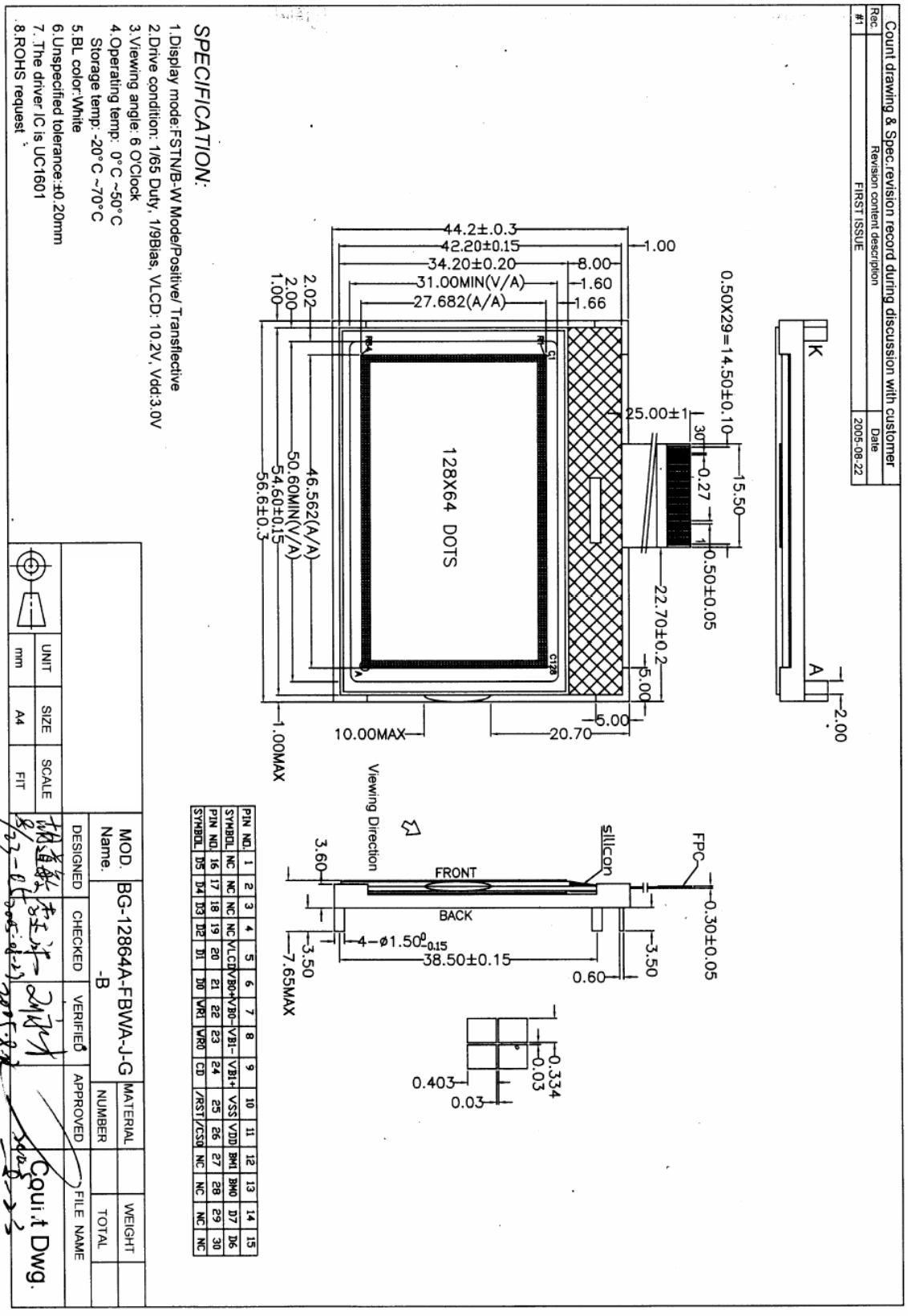
2.MECHANICAL SPECIFICATIONS

2-1. Module size	: 56.6(W)*44.2(H)* 7.65MAX (T)
2-2. Viewing area	: 50.6(W)* 31(H)
2-3. Dot pitch	: 0.364(W)*0.433(H)
2-4. Dot size	: 0.334(W) * 0.403(H)

3.BLOCK DIAGRAM



4.DIMENSIONAL OUTLINE



5.POWER SUPPLY

6. PIN DESCRIPTION

Pin no.	Symbol	Function
1	NC	NO Connection
2	NC	NO Connection
3	NC	NO Connection
4	NC	NO Connection
5	Vout	Power supply for LCD drive circuit
6	VB0+	LCD bias Voltages.
7	VB0-	LCD bias Voltages.
8	VB1-	LCD bias Voltages.
9	VB1+	LCD bias Voltages.
10	VSS	Ground
11	VDD	Power supply for Logic circuit and LCD
12	BM1	Bus mode:"HL":8080 "HH":6800
13	BM0	
14	D7	Bi-directional bus for both serial and parallel host interfaces
15	D6	
16	D5	
17	D4	
18	D3/SDA	
19	D2	
20	D1	
21	D0/SCK	
22	WR1	WR[1:0] control the read/write operation of the host interface
23	WR0	
24	CD	Signal to select control/data instruction
25	RST	Reset signal
26	/CS	Chip select signal
27	NC	NO Connection
28	NC	NO Connection
29	NC	NO Connection
30	NC	NO Connection

7.MAXIMUM ABSOUTE LIMIT (T=25°C)

Item	Symbol	Standard value	Unit
Power supply voltage for logic	V_{DD}	-0.3~+4.0	V
Input voltage	V_I	V_{SS}-0.4~V_{DD} +0.3	V
Operating temperature	Topr	-0~+50	°C
Storage temperature	Tstg	-20~+70	°C

Note: Voltage greater than above may damage the module
All voltages are specified relative to V_{SS}=0V

8.ELECTRICAL CHARACTERISTICS

8-1-1 DC Characteristics (V_{DD}=+3V, V_{SS}=0V, Ta=-0~+50°C)

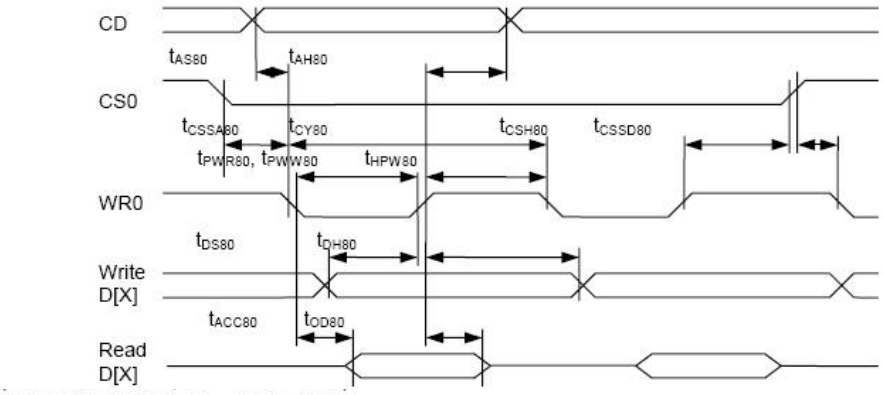
Item	Symbol	Min	Type	Max	Unit	Test condition
Operating voltage	V_{DD}		3		V	-
Supply current	I_{DD}	-	-	1.5	mA	During display
Input voltage	V_{IL}	V_{SS}	-	0.2 V_{DD}	V	-
	V_{IH}	0.8VDD	-	V_{DD}	V	
Output voltage	V_{OL}	V_{SS}	-	0.2 V_{DD}	V	
	V_{OH}	0.8V_{DD}	-	V_{DD}	V	
Input leakage current	I_{LKG}	-	-	1.5	uA	
LCD driving voltage	V_{LCD}	9.9	10.2	10.5	V	VLCD- V_{SS}

8-1-2.Backlight Specifications Absolute maximum rating(Ta=25°C)

Item	Symbol	Min	Typ	Max	Unit	Condition
Forward voltage	Vf		3.1		V	If=30mA
Reverse Current	Ir			15	uA	Vr=5V
Power Dissipation	Pd			95	mw	If=30mA
Peak wave length	λ ρ		-		nm	If=30mA
Spectral Line half width	△λ		-		nm	If=30mA
Luminance	Lv	65	80		cd/m*m	If=30mA
Luminance with the LCD	Lv	15	18		cd/m*m	If=30mA
Color	White					

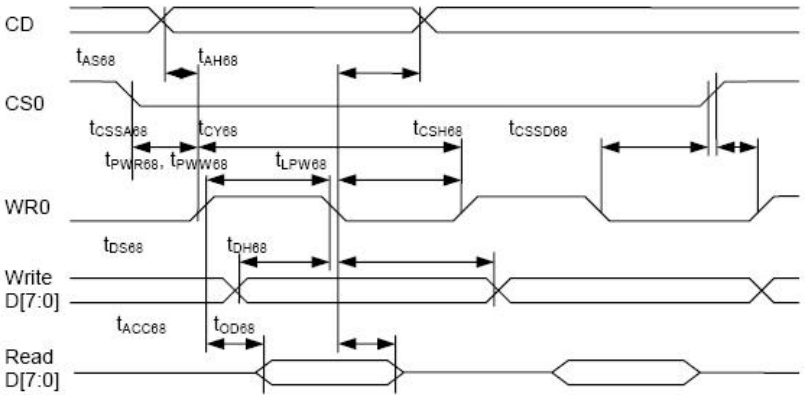
8-2 AC Characteristics

Parallel Bus Timing Characteristics (for 8080 MCU)



Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{AS80} t_{AH80}	CD	Address setup time Address hold time		0 40	–	ns
t_{CY80}		System cycle time		135	–	ns
t_{PWR80}	WR1	Pulse width (read)		65	–	ns
t_{PWW80}	WR0	Pulse width (write)		65	–	ns
t_{HPW80}	WR0, WR1	High pulse width		65	–	ns
t_{DS80} t_{DH80}	D0~D7	Data setup time Data hold time		30 10	–	ns
t_{ACC80} t_{OD80}		Read access time Output disable time	C_L = 100pF	– 10	50 50	ns
t_{CSSA80} t_{CSSD80} t_{CSH80}	CS1/CS0	Chip select setup time		10 10 20		ns

. Parallel Bus Timing Characteristics (for 6800 MCU)



Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{AS68} t_{AH68}	CD	Address setup time Address hold time		0 40	–	ns
t_{CY68}		System cycle time		135	–	ns
t_{PWR68}	WR1	Pulse width (read)		65	–	ns
t_{PWW68}		Pulse width (write)		65	–	ns
t_{LPW68}		Low pulse width		65	–	ns
t_{DS68} t_{DH68}	D0~D7	Data setup time Data hold time		30 10	–	ns
t_{ACC68} t_{OD68}		Read access time Output disable time	C_L = 100pF	– 10	50 50	ns
T_{CSSA68} T_{CSSD68} T_{CSH68}	CS1/CS0	Chip select setup time		10 10 20		ns

9.CONTROL AND DISPLAY COMMAND

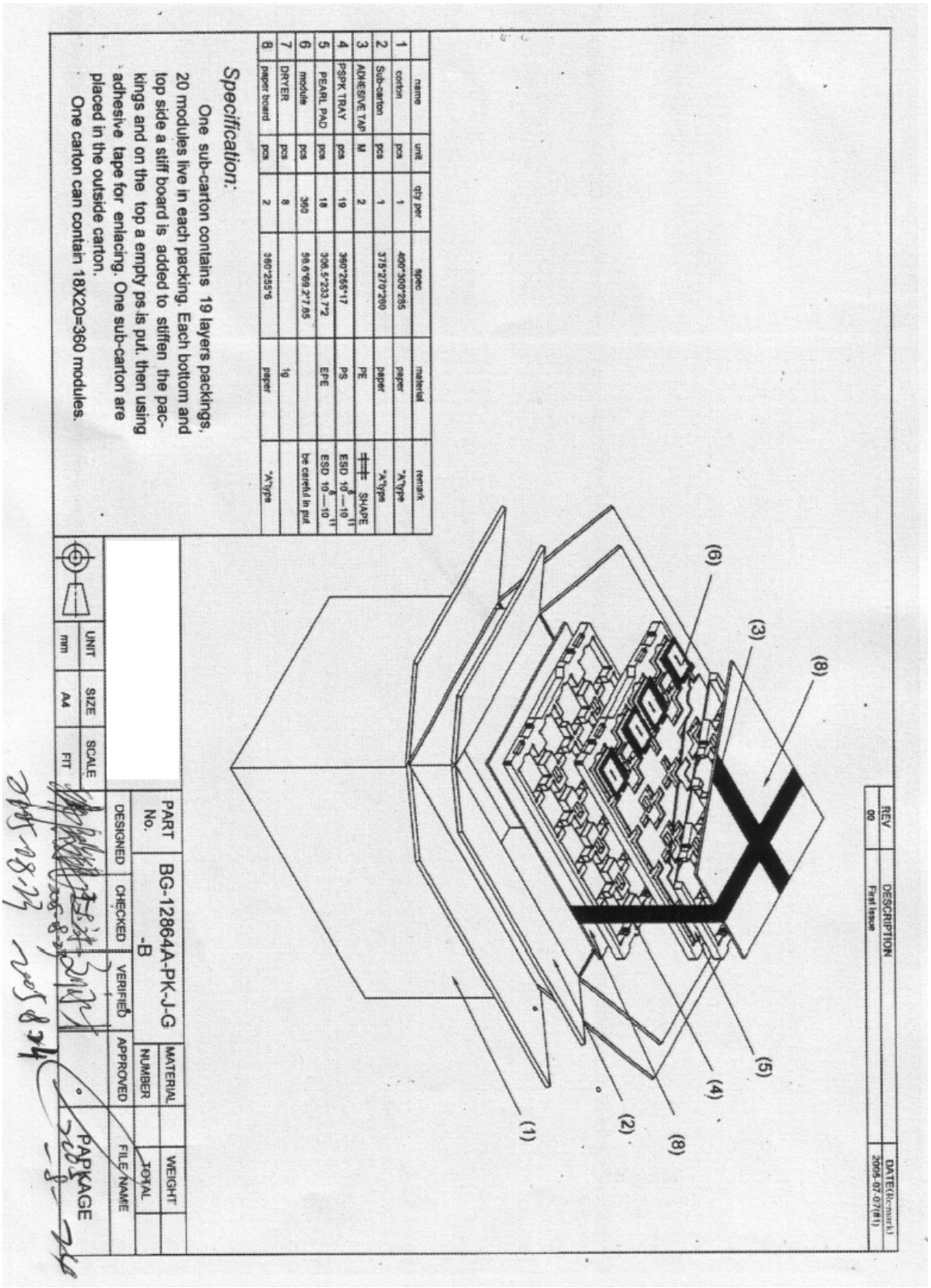
C/D: 0: Control, 1: Data
W/R: 0: Write Cycle, 1: Read Cycle

\# Useful Data bits
– Don't Care

	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default
1	Write Data Byte	1	0	#	#	#	#	#	#	#	#	Write 1 byte	N/A
2	Read Data Byte	1	1	#	#	#	#	#	#	#	#	Read 1 byte	N/A
3	Get Status	0	1	ID	MX	MY	RS	WA	DE	XX		N/A	
4	Set Column Address LSB	0	0	0	0	0	0	#	#	#	#	Set CA [3:0]	0
	Set Column Address MSB	0	0	0	0	0	1	#	#	#	#	Set CA [7:4]	0
5	Set Multiplexing Rate	0	0	0	0	1	0	0	0	#	#	Set MR [1:0]	11b: 65
6	Set Temp. Compensation.	0	0	0	0	1	0	0	1	#	#	Set TC[1:0]	00b: -0.05%/°C
7	Set Panel Loading	0	0	0	0	1	0	1	0	0	#	Set PC[0]	00b: < 15nF
8	Set Pump Control	0	0	0	0	1	0	1	1	#	#	Set PC[2:1]	11b
9	Set Adv. Program Control (double byte command)	0	0	0	0	1	1	0	0	0	R	Set APC[R][7:0], R = 0, or 1	N/A
		0	0	#	#	#	#	#	#	#	#		
10	Set Scroll Line	0	0	0	1	#	#	#	#	#	#	Set SL[5:0]	0
11	Set Page Address	0	0	1	0	1	0	#	#	#	#	Set PA[3:0]	0
12	Set V_{BIAS} Potentiometer (double-byte command)	0 0	0 0	1 #	0 #	0 #	0 #	0 #	0 #	0 #	1 #	Set PM[7:0]	C0H
13	Set RAM Address Control	0	0	1	0	0	0	1	#	#	#	Set AC[2:0]	001b
14	Set Frame Rate	0	0	1	0	1	0	0	0	0	#	Set LC[3]	0b
15	Set All-Pixel-ON	0	0	1	0	1	0	0	1	0	#	Set DC[1]	0
16	Set Inverse Display	0	0	1	0	1	0	0	1	1	#	Set DC[0]	0
17	Set Display Enable	0	0	1	0	1	0	1	1	1	#	Set DC[2]	0
18	Set LCD Control	0	0	1	1	0	0	0	#	#	#	Set LC[2:0]	0
19	System Reset	0	0	1	1	1	0	0	0	1	0	System Reset	N/A
20	NOP	0	0	1	1	1	0	0	0	1	1	No operation	N/A
21	Set Test Control (double byte command)	0	0	1	1	1	0	0	1	TT		For testing only. Do not use.	N/A
		0	0	#	#	#	#	#	#	#	#		
22	Set LCD Bias Ratio	0	0	1	1	1	0	1	0	#	#	Set BR[1:0]	11b: 9
23	Reset Cursor Update Mode	0	0	1	1	1	0	1	1	1	0	AC[3]=0, CA=CR	N/A
24	Set Cursor Update Mode	0	0	1	1	1	0	1	1	1	1	AC[3]=1, CR=CA	N/A

Other than commands listed above, all other bit patterns result in NOP (No Operation).

10.Package Specifications

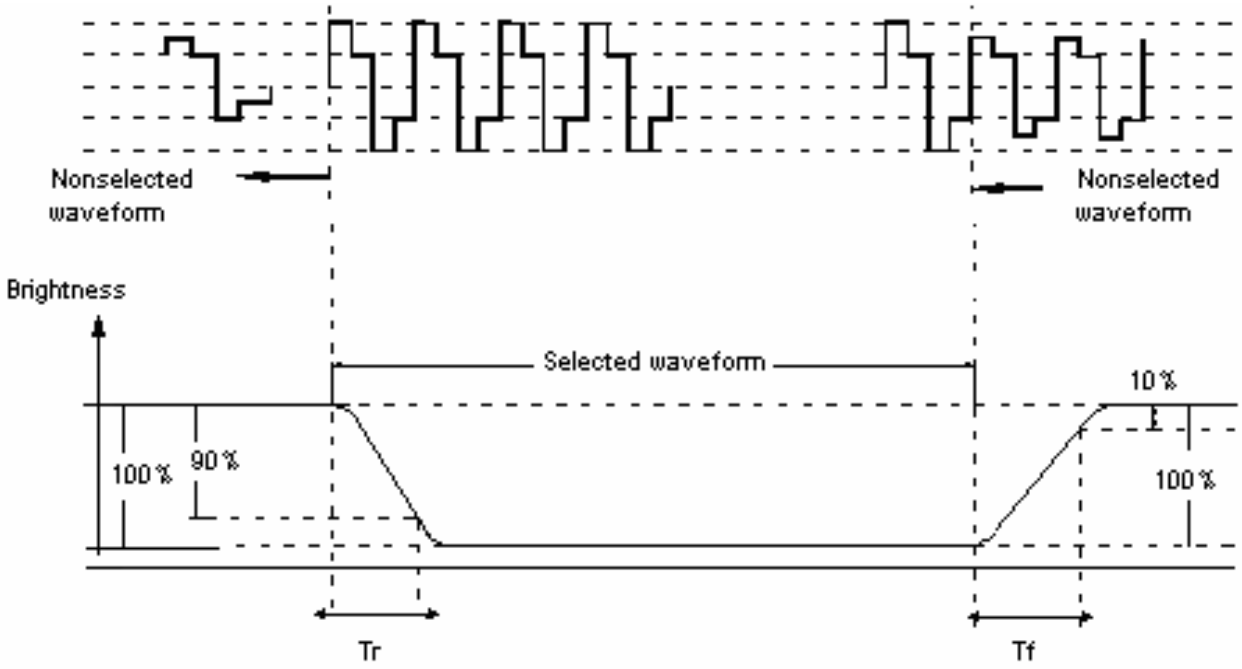


11.Quality Specifications

11-1.Electro-Optic Characteristics

NO	ITEM		Symbol	Temp℃	Rating			Unit
					Min	Typ	Max	
1	Response time	Rise time	Tr					Ms
				25	N/A	63.8	300	
		Fall time	Tf					
				25	N/A	103.9	300	
2	Operating Frequency		Ff	25		64		Hz
3	Contrast Rate		Cr	25	2	5.75	5.89	-
4	Viewing Direction		6 O'CLOCK					
5	Viewing Angle Cr≧2	12Hψ=90°	θ1	25		36		Deg
		6Hψ=270°	θ2			35		
		3Hψ=0°	θ3			27		
		9Hψ=180°	θ4			40		
6	Current Consumption		Is	25		9.6	14.4	μA
7	Capacitance		C	25		4.1		nF

Response Time



Measuring Condition:

1. Driving waveform:1/N Duty,1/a Bias selected waveform.
2. Driving Frequency: Typical value in Individual specification.
3. Operating Voltage : LCD driving voltage getting maximum contrast rate.
4. Measuring Angle : See Individual Specification.
5. Measuring Temperature :See Individual Specification .

Contrast Ratio Definition

Positive Type

$$\text{Contrast Ratio(Cr)} = \frac{\text{Brightness of non-selected waveform(Bns)}}{\text{Brightness of selected waveform(Bs)}}$$

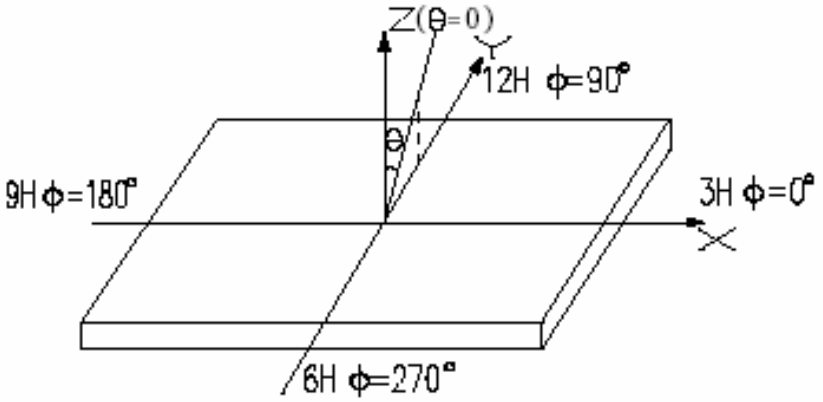
Viewing Angle

θ: Angle between Viewer Direction and Normal.

(-90°= ? = 90°)

ϕ : Angle between Projection of Viewer Direction to X-Y plane and Y axis.

(0°= ϕ= 360°)



Measuring Condition

1. Driving Voltage: Same as Vlcd.
2. Driving Frequency: Same as Frame Frequency

11-2. Specification of quality assurance

AQL inspection standard

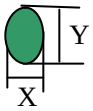
Sampling method: MIL-STD-105E, Level II, single sampling

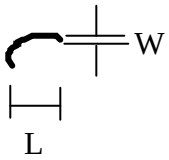
Defect classification

Classify	Item		Note	AQL
Major	Display state	Short or open circuit	1	0.65
		Contrast defect (dim, ghost)		
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction	2	
		Wrong Back-light	7	
	Non-display	Flat cable or pin reverse	9	
		Wrong or missing component	10	
Minor	Display state	Background color deviation	2	1.5
		Black spot and dust	3	
		Line defect	4	
		Scratch		
		Rainbow	5	
		Pin hole	6	
	Polarizer	Bubble and foreign material	3	
		Scratch	4	
	PCB	Scratch	4	
	Soldering	Poor connection	8	
	Wire	Poor connection	9	

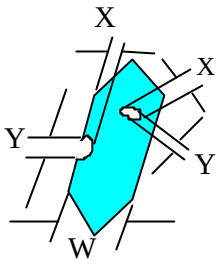
Note on defect classification

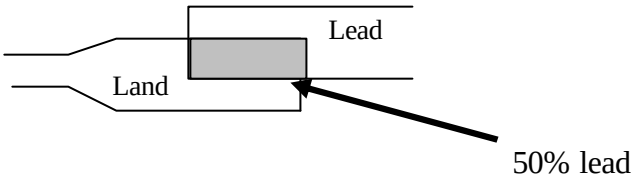
<table>
<tr><th>No.</th><th>Item</th><th>Criterion</th></tr>
<tr><td rowspan="6">1</td><td>Short or open circuit</td><td rowspan="6">Not allow</td></tr>
<tr><td>LC leakage</td></tr>
<tr><td>Flickering</td></tr>
<tr><td>No display</td></tr>
<tr><td>Wrong viewing direction</td></tr>
<tr><td>Wrong Back-light</td></tr>
<tr><td rowspan="2">2</td><td>Contrast defect</td><td rowspan="2">Refer to approval sample</td></tr>
<tr><td>Background color deviation</td></tr>
<tr><td>3</td><td>Point defect,
Black spot, dust
(incl. Polarizer)

$\phi = (X+Y)/2$</td><td> 

<table>
<tr><th>Point Size</th><th>Acceptable Qty.</th></tr>
<tr><td>$\phi \leq 0.10$</td><td>Disregard</td></tr>
<tr><td>$0.10 < \phi = 0.20$</td><td>3</td></tr>
<tr><td>$0.20 < \phi = 0.25$</td><td>2</td></tr>
<tr><td>$0.25 < \phi = 0.30$</td><td>1</td></tr>
<tr><td>$\phi > 0.30$</td><td>0</td></tr>
</table>
Unit : mm</td></tr>
<tr><td>4</td><td>Line defect</td><td> 

<table>
<tr><th colspan="2">Line</th><th>Acceptable Qty.</th></tr>
<tr><td>L</td><td>W</td><td></td></tr>
<tr><td>---</td><td>0.015= W</td><td>Disregard</td></tr>
<tr><td>3.0= L</td><td>0.03= W</td><td rowspan="2">2</td></tr>
<tr><td>2.0= L</td><td>0.05= W</td></tr>
<tr><td>1.0= L</td><td>0.1> W</td><td>1</td></tr>
<tr><td>---</td><td>0.05<W</td><td>Applied as point defect</td></tr>
</table>
Unit: mm</td></tr>
<tr><td>5</td><td>Rainbow</td><td>Not more than two color changes across the viewing area.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Item</th><th>Criterion</th></tr>
<tr><td>6</td><td>Segment
pattern
W = Segment width
ϕ = (X+Y)/2</td><td>(1) Pin hole
ϕ < 0.10mm is acceptable.
 

<table>
<tr><th>Point Size</th><th>Acceptable Qty</th></tr>
<tr><td>ϕ= 1/4W</td><td>Disregard</td></tr>
<tr><td>1/4W< ϕ= 1/2W</td><td>1</td></tr>
<tr><td>ϕ> 1/2W</td><td>0</td></tr>
</table>
Unit: mm</td></tr>
<tr><td>7</td><td>Back-light</td><td>(1) The color of backlight should correspond its specification.
(2) Not allow flickering</td></tr>
<tr><td>8</td><td>Soldering</td><td>(1) Not allow heavy dirty and solder ball on PCB.
(The size of dirty refer to point and dust defect)
(2) Over 50% of lead should be soldered on Land.
 
</td></tr>
<tr><td>9</td><td>Wire</td><td>(1) Copper wire should not be rusted
(2) Not allow crack on copper wire connection.
(3) Not allow reversing the position of the flat cable.
(4) Not allow exposed copper wire inside the flat cable.</td></tr>
<tr><td>10</td><td>PCB</td><td>(1) Not allow screw rust or damage.
(2) Not allow missing or wrong putting of component.</td></tr>
</table>

11-3. Reliability of LCM

Reliability test condition:

Item	Condition	Time (hrs)	Assessment
High temp. Storage	70°C	240	No abnormalities in functions and appearance
High temp. Operating	50°C	240	
Low temp. Storage	-20°C	240	
Low temp. Operating	-0°C	240	
Humidity	40°C/ 90%RH	240	
Temp. Cycle	-20°C ← 25°C →70°C (1 hour← 5 min →1 hour)	10cycles	

Recovery time should be 24 hours minimum. Moreover, functions, performance and appearance shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (20±8°C), normal humidity (below 65% RH), and in the area not exposed to direct sun light.

11-4. Precaution for using LCM

LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

General Precautions:

1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isoproply alcohol, ethyl alcohol or trichl o otrifl or othane, do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not made any modification on the PCB without consulting YB.
5. When mounting a LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
6. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

Static Electricity Precautions:

1. CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.
2. Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.
3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
4. The modules should be kept in anti-static bags or other containers resistant to static for storage.
5. Only properly grounded soldering irons should be used.
6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
7. The normal static prevention measures should be observed for work clothes and working benches.
8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

Soldering Precautions:

1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature: 300°C±10°C
4. Soldering time: 3 to 4 second.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.

Operation Precautions:

1. The viewing angle can be adjusted by varying the LCD driving voltage Vo.
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.

Operation Precautions:

1. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
2. For long-term storage over 40°C is required, the relative humidity should be kept below 60%. Avoid direct sunlight.

Limited Warranty

YB LCDs and modules are not consumer products, but may be incorporated by YB's customers into consumer products or components thereof, YB does not warrant that its LCDs and components are fit for any such particular purpose.

1. The liability of YB is limited to repair or replacement on the terms set forth below. YB will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between YB and the customer, YB will only replace or repair any of its

LCD which is found defective electrically or visually when inspected in accordance with YB GENERAL LCD INSPECTION STANDARD. (Copies available on request)

2. No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.

3. In returning the LCD/LCM, they must be properly packaged; there should be detailed description of the failures or defect.

12. DESCRIBE TO THE PART NO: