Product Specification

(Preliminary)

Part Name: Monochrome LCD Display Module

Part No.: BGB12232-10 SERIES

Doc No.: SAS1-1020-A

Customer:
Approved by:

From: Blaze Display Technology Co., Ltd.
Approved by:

Blaze Display Technology Co., Ltd.

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Notes:

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2. The information contained herein is presented merely to indicate the characteristics and performance of our products. No responsibility is assumed by Blaze Display Technology Co., Ltd. for any intellectual property claims or other problems that may result application based on the module described herein.

Revised History

Part Number	Revision	Revision Content	Revised on
BGB2232-10-LW-SNMWD-1.0	1.0	New	Apr 20th, 2010

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Contents

1. Basic Specifications

1.1 Display Specifications

1) Display Type:	STN, Blue / Negative
2) Display Format:	122×32 Dots
3) Graphic Color (ON):	White
4) Background Color (ON):	Blue
Background Color (OFF):	Blue
5) Drive Method:	1/32Duty; 1/5Bias
6) Viewing Direction:	6:00
7) Polarizer Type:	Transmissive

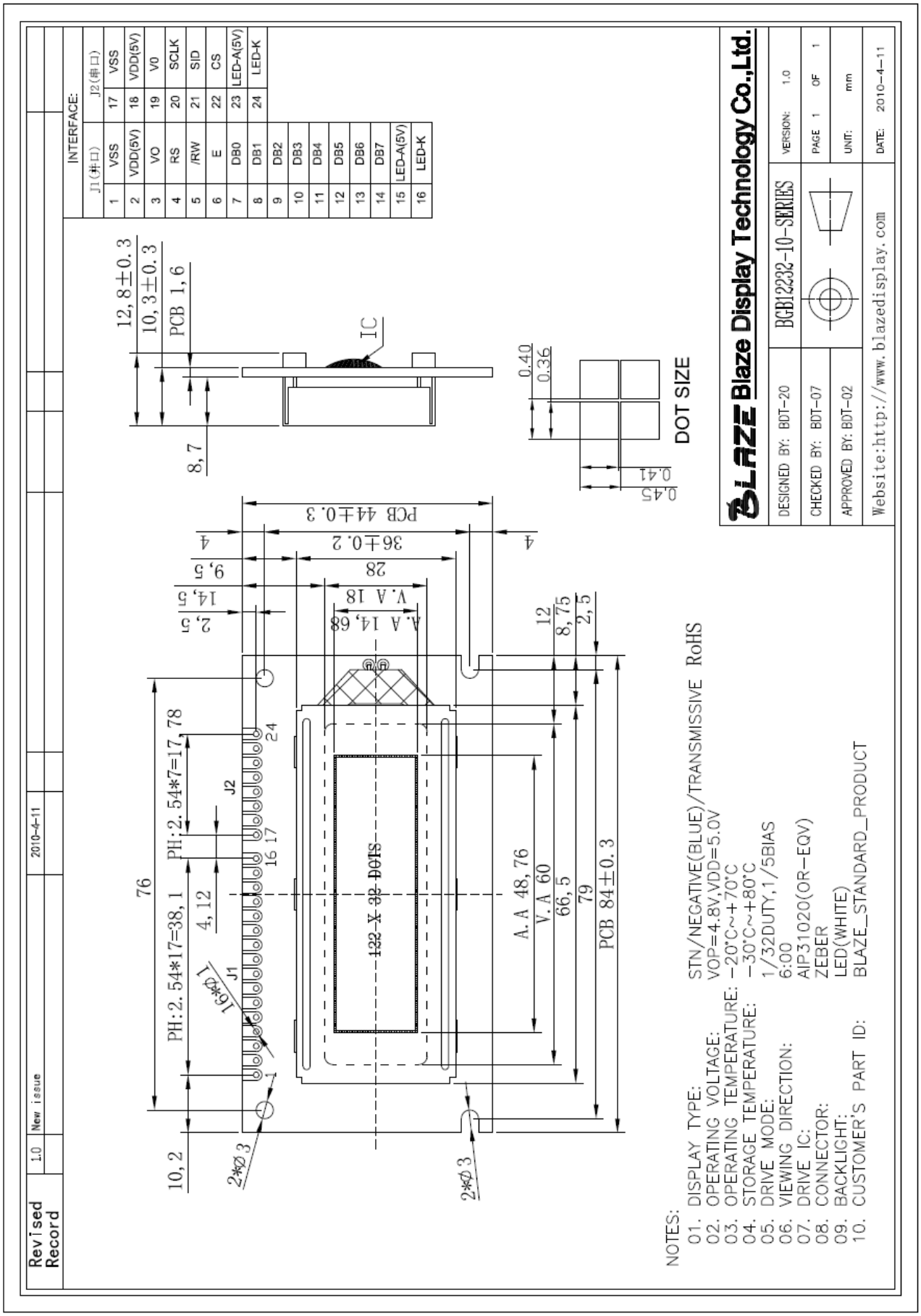
1.2 Mechanical Specifications

1) Outline Dimensions:	According to the annexed outline drawing on the next page
2) Viewing Area:	60.00 W × 18.00 H (mm)
3) Active Area:	48.76 W × 14.68 H (mm)
4) Dot Pitch:	0.40 W × 0.45H (mm)
5) Dot Size:	0.36W × 0.41H (mm)
6) Weight:	T.B.D.

1.3 Others

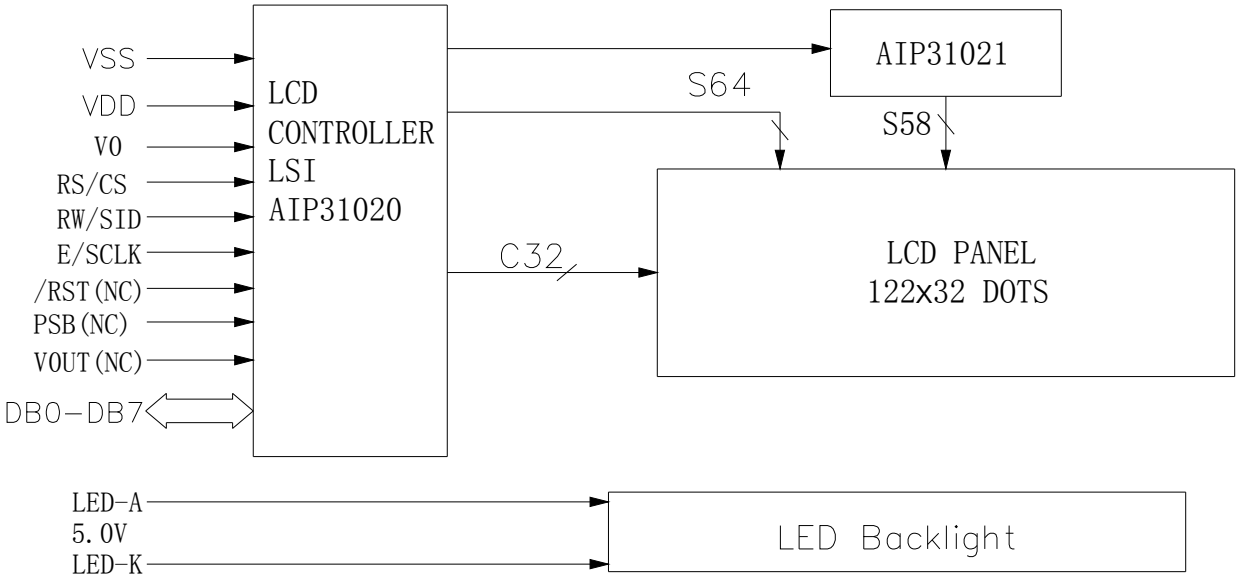
1) Driver IC:	AIP31020+AIP31021 or EQV
2) Backlight:	LED, White, If =20mA, Vf = 5.0V
3) Operating Temperature:	-20°C－ + 70°C
4) Storage Temperature:	-30°C－ + 80°C
5) RoHS Compliant:	Yes

1.4 Mechanical Drawing



2. Electrical Specification

2.1 Block Diagram



2.2 Absolute Maximum Ratings

Item	Symbol	Min.	Typ.	Max.	Unit
Power Supply for Logic	V_{DD}-V_{SS}	−0.3	—	+5.5	V
Power supply for LCD Drive	V_{DD}-V_0	−0.3	—	5.0	V
Input Voltage	V_I	V_{SS}	—	V_{DD}	V
Operating Temperature	T_{OP}	−20	—	+70	°C
Storage Temperature	T_{ST}	−30	—	+80	°C
Static Electricity	Be sure that you are grounded when handing LCM				

2.3 Electrical Characteristics

Ta = 25°C; Vdd = 4.5～5.0V, otherwise specified

Item	Symbol	Standard Value			Test Condition	Unit
		Min.	Typ.	Max.		
Supply Current for Logic	V_{DD}	+4.8	+5.0	+5.2	—	V
Supply Current for Logic	I_{DD}	—	TBD	—	—	mA
Supply Current for LCD	V_{LCD}	+4.8	+5.0	+5.2	25	°C

2.4 Pin Definition

J1(Parallel interface)

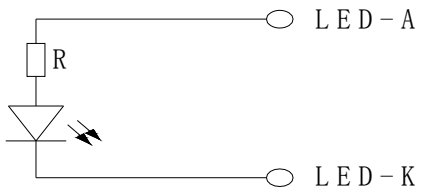
Pin No.	Symbol	Function
1	VSS	Ground (0V)
2	VDD	Power supply input for driver IC (+5.0V)
3	V0	LCD driver supply voltages
4	RS(CS)	Register select input pin Serial mode: - RS = "H": D0 to D7 are display data CS=1 :chip enable - RS = "L": D0 to D7 are control data CS=0 :chip enable
5	RW(SID)	Read write control 0:write 1:read (serial data input)
6	E(SCLK)	Enable trigger (serial clock)
7—14	DB0—DB7	Data bus line
15	LED-A	BACKLIGHT+ （5.0V）
16	LED-K	BACKLIGHT- （0V）

J2(SPI)

Pin No.	Symbol	Function
17	VSS	Ground (0V)
18	VDD	Power supply (+5.0V)
19	V0	LCD driver supply voltages
20	SCLK	Serial clock signal
21	SID	Serial data input
22	CS	Register select input pin
23	LED-A	BACKLIGHT+ （5.0V）
24	LED-K	BACKLIGHT- （0V）

3. LED Backlight

3.1 Power Supply for LED Backlight



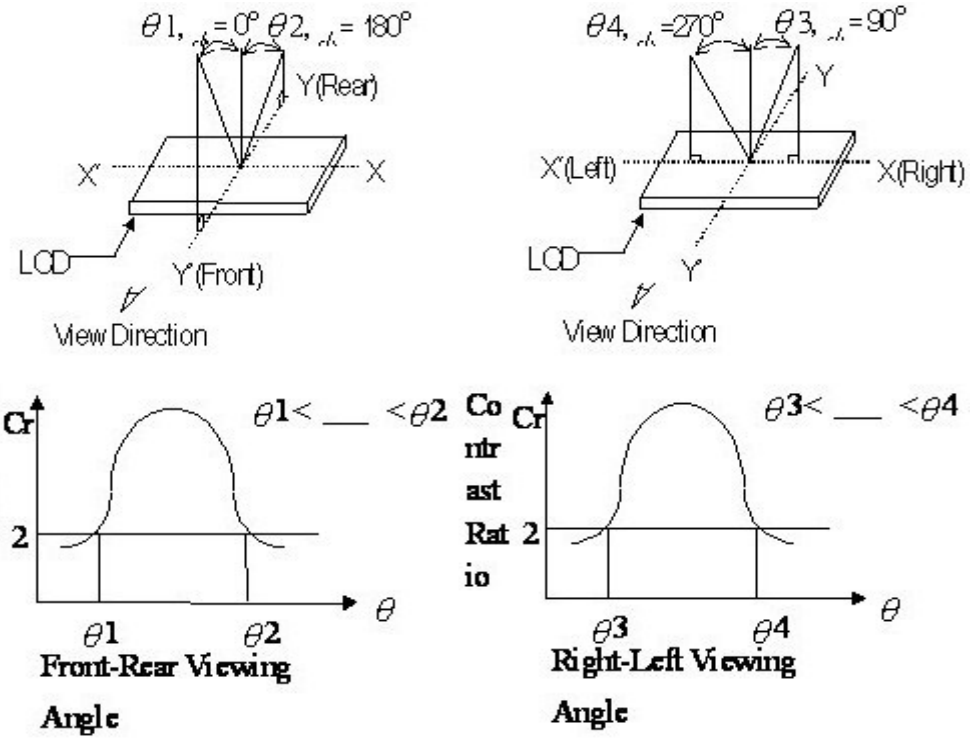
3.2 Electrical Optical Characteristics

Ta = 25°C; Vdd = 4.5～5.0V, otherwise specified

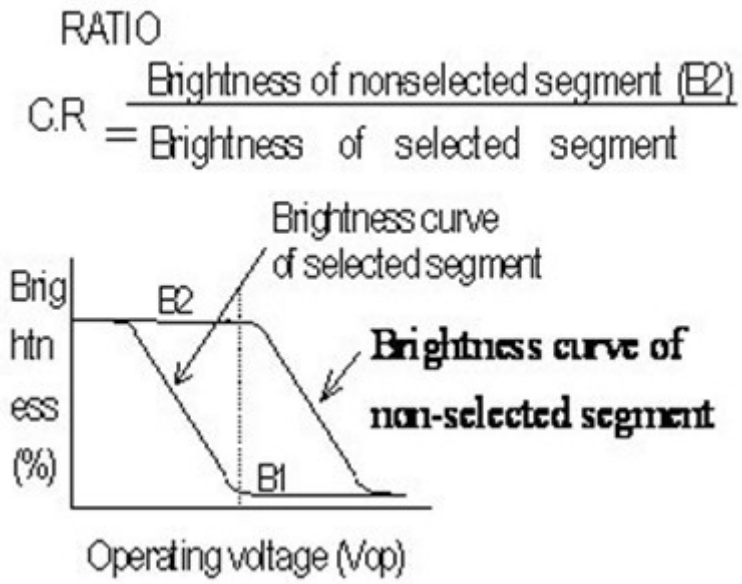
Item	Symbol	Conditions	Standard Value			Unit
			Min.	Typ.	Max.	
Forward Voltage	Vf	If = 20mA	4.8	5.0	5.2	V
Reverse Current	Ir	Vr = 5V	–	–	100	uA
Spectral Line Half Width	△λ	IF = 20mA T = 25℃	–	–	–	nm
Peak Wave Length	λp		–	–	–	nm
Luminance	Lv	IF = 20mA	60	-	–	Cd/m^2
Uniformity	△	Min / Max = 100%	70%	–	-	%

4. Optical Characteristics

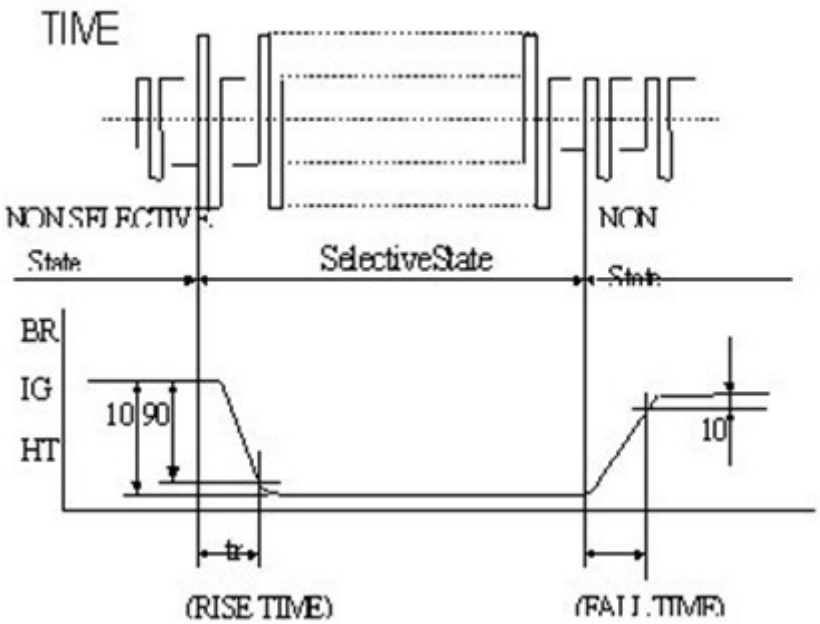
4.1 Definition of Viewing Angle



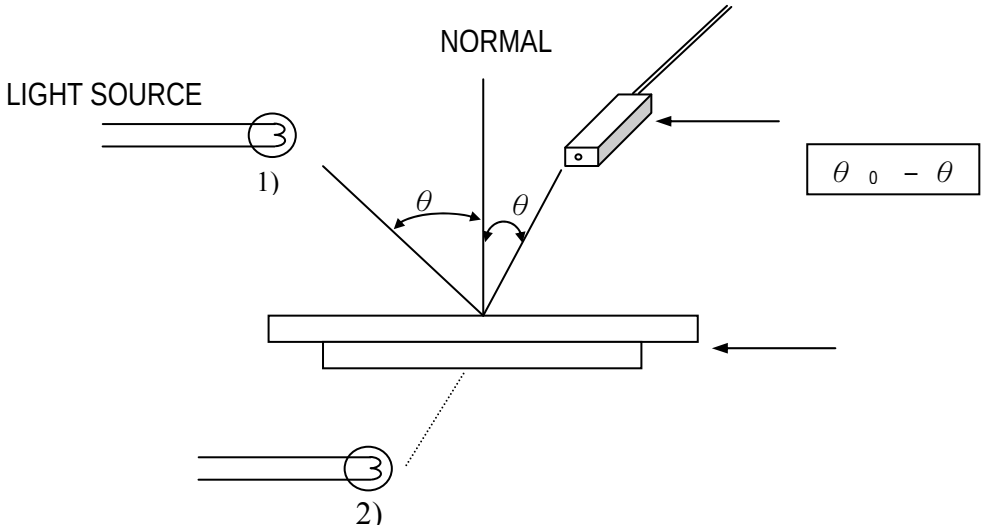
4.2 Definition of Contrast



4.3 Definition of Response



4.4 Measuring Instruments For Electro-optical Characteristics



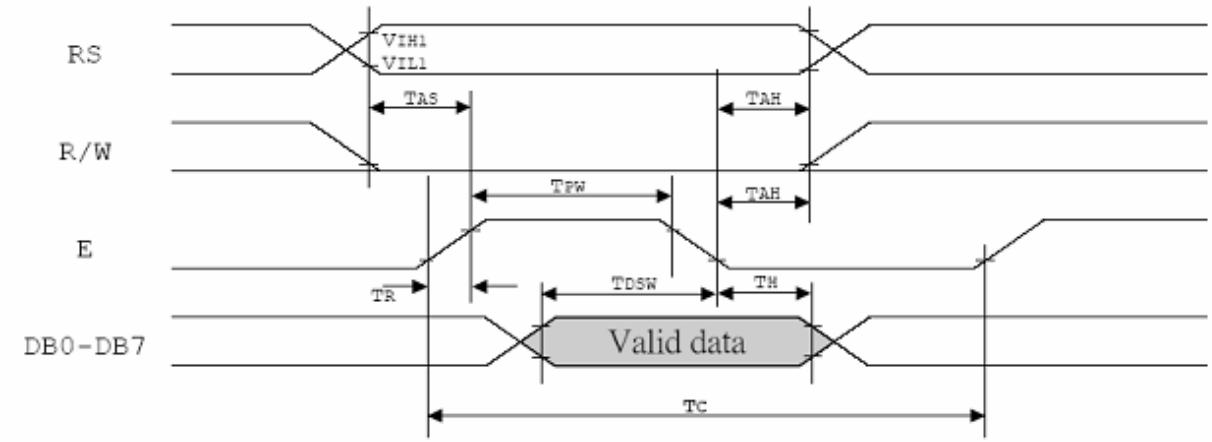
*** Note:**

1) Light source position for measuring the reflective type of LCD panel;
2) Light source position for measuring the transflective / transmissive types of LCD panel.

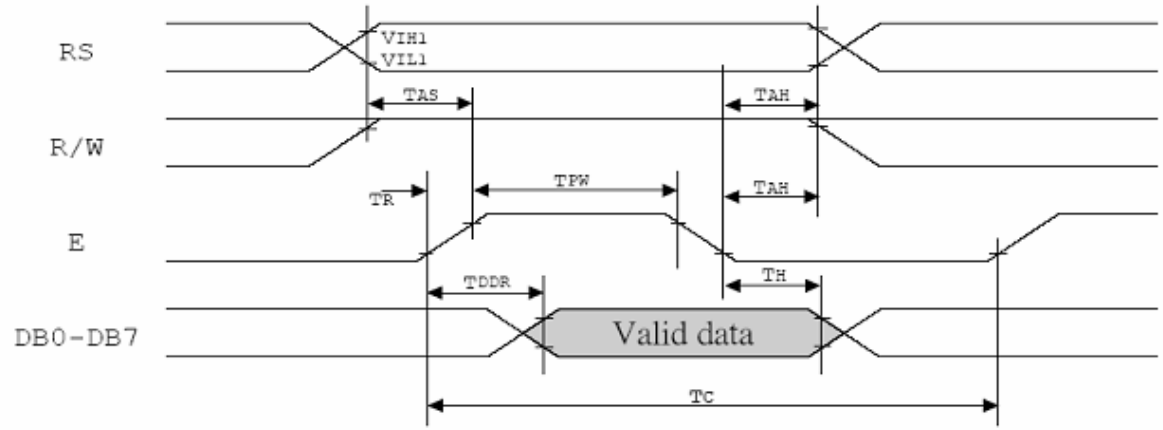
5. Timing Diagrams

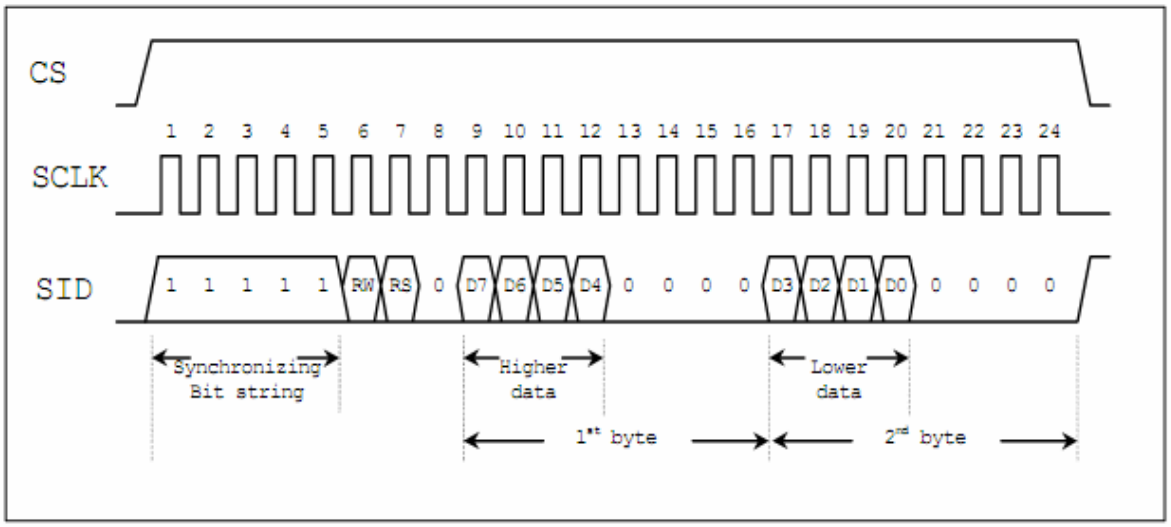
5.1 8 bit Interface Timing

- **MPU write data to AIP31020**



- **MPU read data from AIP31020**





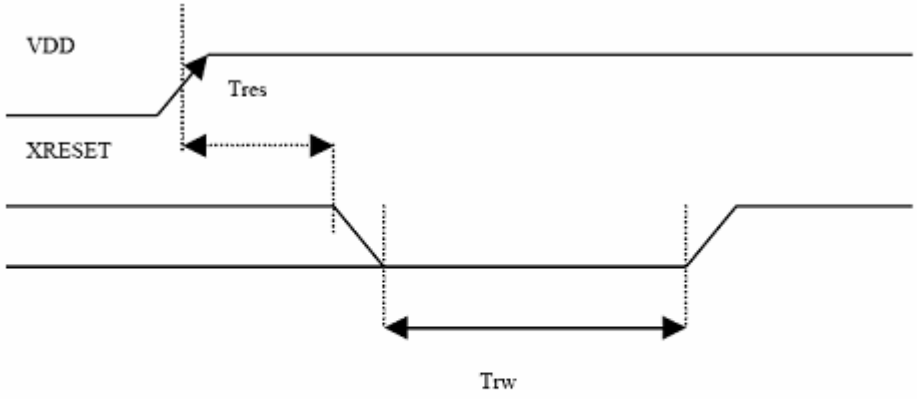
Timing Diagram of Serial Mode Data Transfer

Characteristics	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Internal Clock Operation						
OSC Frequency	fosc	R = 33KΩ	480	540	600	KHz
External Clock Operation						
External Frequency	fEX	-	480	540	600	KHz
Duty Cycle		-	45	50	55	%
Rise/Fall Time	TR,TF	-	-	-	0.2	μs
Write Mode (Writing data from MPU to AIP31020)						
Enable Cycle Time	TC	Pin E	1200	-	-	ns
Enable Pulse Width	TPW	Pin E	140	-	-	ns
Enable Rise/Fall Time	TR,TF	Pin E	-	-	25	ns
Address Setup Time	TAS	Pins: RS,RW,E	10	-	-	ns
Address Hold Time	TAH	Pins: RS,RW,E	20	-	-	ns
Data Setup Time	TDSW	Pins: DB0 - DB7	40	-	-	ns
Data Hold Time	TH	Pins: DB0 - DB7	20	-	-	ns
Read Mode (Reading Data from AIP31020 to MPU)						
Enable Cycle Time	TC	Pin E	1200	-	-	ns
Enable Pulse Width	TPW	Pin E	140	-	-	ns
Enable Rise/Fall Time	TR,TF	Pin E	-	-	25	ns
Address Setup Time	TAS	Pins: RS,RW,E	10	-	-	ns
Address Hold Time	TAH	Pins: RS,RW,E	20	-	-	ns
Data Delay Time	TDDR	Pins: DB0 - DB7	-	-	100	ns
Data Hold Time	TH	Pins: DB0 - DB7	20	-	-	ns
Interface Mode with LCD Driver(AIP31021)						
Clock Pulse with High	TCWH	Pins: CL1, CL2	800	-	-	ns
Clock Pulse with Low	TCWL	Pins: CL1, CL2	800	-	-	ns
Clock Setup Time	TCST	Pins: CL1, CL2	500	-	-	ns
Data Setup Time	TSU	Pin: D	300	-	-	ns
Data Hold Time	TDH	Pin: D	300	-	-	ns
M Delay Time	TDM	Pin: M	-1000	-	1000	ns

5.2 DC Characteristics

Characteristics	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Operating Voltage	VDD	-	4.5	-	5.5	V
LCD Voltage	VLCD	V0-VSS	3.0	-	7	V
Power Supply Current	ICC	fOSC= 540KHz, VDD=5V Rf=33KΩ	-	0.45	0.75	mA
Input High Voltage (Except OSC1)	VIH1	-	0.7VDD	-	VDD	V
Input Low Voltage (Except OSC1)	VIL1	-	-0.3	-	0.6	V
Input High Voltage (OSC1)	VIH2	-	VDD-1	-	VDD	V
Input Low Voltage (OSC1)	VIL2	-	-	-	1.0	V
Output High Voltage (DB0 - DB7)	VOH1	IOH= -0.1mA	0.8VDD	-	VDD	V
Output Low Voltage (DB0 - DB7)	VOL1	IOL = 0.1mA	-	-	0.4	V
Output High Voltage (Except DB0 - DB7)	VOH2	IOH = -0.04mA	0.8VDD	-	VDD	V
Output Low Voltage (Except DB0 - DB7)	VOL2	IOL= 0.04mA	-	-	0.1VDD	V
Input Leakage Current	ILEAK	VIN= 0V to VDD	-1	-	1	μA
Pull Up MOS Current	IPUP	VDD= 5V	75	80	85	μA

5.3 External reset Timing



XRESET pulse width	Trw	10us
RESET start time	Tres	50ns

6. Instruction Table

AIP31020 offers basic instruction set and extended instruction set :

- **Instruction set 1: (RE=0: basic instruction)**

Ins	code										Description	Exec time (540KHZ)
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
CLEAR	0	0	0	0	0	0	0	0	0	1	Fill DDRAM with "20H", and set DDRAM address counter (AC) to "00H"	1.6 ms
HOME	0	0	0	0	0	0	0	0	1	X	Set DDRAM address counter (AC) to "00H", and put cursor to origin : the content of DDRAM are not changed	72us
ENTRY MODE	0	0	0	0	0	0	0	1	I/D	S	Set cursor position and display shift when doing write or read operation	72us
DISPLAY ON/OFF	0	0	0	0	0	0	1	D	C	B	D=1: display ON C=1: cursor ON B=1: blink ON	72 us
CURSOR DISPLAY CONTROL	0	0	0	0	0	1	S/C	R/L	X	X	Cursor position and display shift control : the content of DDRAM are not changed	72 us
FUNCTION SET	0	0	0	0	1	DL	X	0 RE	X	X	DL=1 8-BIT interface DL=0 4-BIT interface **RE=1: extended instruction** **RE=0: basic instruction**	72 us
SET CGRAM ADDR.	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address to address counter (AC) **Make sure that in extended instruction SR=0(scroll or RAM address select)**	72 us
SET DDRAM ADDR.	0	0	1	0 AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address to address counter (AC) AC6 is fixed to 0	72 us
READ BUSY FLAG (BF) & ADDR.	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Read busy flag (BF) for completion of internal operation, also Read out the value of address counter (AC)	0 us
WRITE RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data to internal RAM (DDRAM/CGRAM/GDRAM)	72 us
READ RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM/GDRAM)	72 us

- **Instruction set 2: (RE=1: extended instruction)**

Ins	code										Description	Exec time (540KHZ)
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
STAND BY	0	0	0	0	0	0	0	0	0	1	Enter stand by mode, any other instruction can terminate (Com1～32 halted)	72 us
SCROLL or RAM ADDR. SELECT	0	0	0	0	0	0	0	0	1	SR	SR=1: enable vertical scroll position SR=0: enable CGRAM address(**basic instruction**)	72 us
REVERSE	0	0	0	0	0	0	0	1	R1	R0	Select 1 out of 4 line (in DDRAM) and decide whether to reverse the display by toggling this instruction **R1,R0 initial value is 00**	72 us
EXTENDED FUNCTION SET	0	0	0	0	1	DL	X	1 RE	G	0	DL=1 8-BIT interface DL=0 4-BIT interface **RE=1: extended instruction set** **RE=0: basic instruction set** G=1 :graphic display ON G=0 :graphic display OFF	72 us
SET IRAM or SCROLL ADDR	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	SR=1: AC5~AC0 the address of vertical scroll	72 us
SET GRAPHIC RAM ADDR.	0	0	1	0 0	0 AC5	0 AC4	AC3 AC3	AC2 AC2	AC1 AC1	AC0 AC0	Set GDRAM address to address counter (AC) First set vertical address and the horizontal address by consecutive writing Vertical address range AC5...AC0 Horizontal address range AC3...AC0	72 us

Note：

1. Make sure that AIP31020 is not in busy state by reading the busy flag before sending instruction or data. If use delay loop instead please make sure the delay time is enough. Please refer to the instruction execution time.

2. "RE" is the selection bit of basic and extended instruction set. Each time when altering the value of RE it will remain. There is no need to set RE every time when using the same group of instruction set.

- **Initial setting(Register flag) (RE=0: basic instruction)**

Ins	code										Description
	RS	RW	DB 7	DB 6	DB 5	DB 4	DB 3	DB 2	DB 1	DB 0	
ENTRY MODE SET	0	0	0	0	0	0	0	1	I/D	S	Cursor move to right ,DDRAM address counter（AC）plus 1
									1	**0**	
DISPLAY TATUS	0	0	0	0	0	0	1	D	C	B	Display, cursor and blink ALL OFF
								0	0	0	
CURSOR DISPLAY SHIFT	0	0	0	0	0	1	S/C	R/L	X	X	No cursor or display shift operation
							X	**X**			
FUNCTION SET	0	0	0	0	1	DL	X	0 RE	X	X	**8 BIT**MPU interface , basic instruction set
						1		**0**			

- **Initial setting(Register flag) (RE=1: extended instruction set)**

Ins	code										Description
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
SCROLL OR RAM ADDR. SELECT	0	0	0	0	0	0	0	0	1	SR	Allow IRAM address or set CGRAM address
										0	
REVERSE	0	0	0	0	0	0	0	1	R1	R0	Begin with normal and toggle to reverse
									0	**0**	
EXTENDED FUNCTION SET	0	0	0	0	1	DL	X	1 RE	G	0	Graphic display OFF
									0		

Description of basic instruction set

- **CLEAR**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	0	0	1

Fill DDRAM with "20H"(space code). And set DDRAM address counter （AC）to"00H". Set entry mode I/D bit to be "1".Cursor moves right and AC adds 1 after write or read operation.

- **HOME**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	0	1	X

Set DDRAM address counter（AC）to "00H". Cursor moves to origin. Then content of DDRAM is not changed.

- **ENTRY MODE SET**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	1	I/D	S

Set the cursor movement and display shift direction when doing write or read operation.

I/D :address counter increase / decrease

When I/D = "1", cursor moves right, DRAM address counter （AC） add by 1.

When I/D = "0", cursor moves left, DRAM address counter （AC） subtract by 1.

S: Display shift

S	I/D	DESCRIPTION
H	H	Entire display shift left by 1
H	L	Entire display shift right by 1

- **DISPLAY STATUS**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	1	D	C	B

Controls display, cursor and blink ON/OFF.

D : Display ON/OFF control bit

When D = "1", display ON

When D = "0",display OFF , the content of DDRAM is not changed

C : Cursor ON/OFF control bit

When C = "1", cursor ON.

When C = "0", cursor OFF.

B : Blink ON/OFF control bit

When B = "1", cursor position blink ON. Then display data in cursor position will blink.

When B = "0", cursor position blink OFF

- **CURSOR AND DISPLAY SHIFT CONTROL**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	1	S/C	R/L	X	X

Instruction to move the cursor or shift the entire display. The content of DDRAM is not changed.

S/C	R/L	Description	AC Value
L	L	Cursor moves left by 1	AC=AC-1
L	H	Cursor moves right by 1	AC=AC+1
H	L	Display shift left by 1, cursor also follows to shift.	AC=AC
H	H	Display shift right by 1, cursor also follows to shift.	AC=AC

- **FUNCTION SET**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	1	DL	X	RE	X	X

DL : 4/8 BIT interface control bit

When DL = "1", **8 BIT** MPU bus interface

When DL = "0", **4 BIT** MPU bus interface

RE : extended instruction set control bit

When RE = "1", extended instruction set

When RE = "0", basic instruction set

In same instruction cannot alter DL and RE at once. Make sure that change DL first then RE.

- **SET CGRAM ADDRESS**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0

Set CGRAM address to address counter（AC）

AC range is 00H..3FH

Make sure that in extended instruction SR=0 (scroll address or RAM address select)

- **SET DDRAM ADDRESS**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0

Set DDRAM address to address counter（AC）.

First line AC range is 80H..8FH

Second line AC range is 90H..9FH

Third line AC range is A0H..AFH

Fourth line AC range is B0H..BFH

Please note that only 2 lines can be display at a time.

- **READ BUSY FLAG（BF）AND ADDRESS**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0

Read busy flag（BF）can check whether internal operation is finished. At the same time the value of address counter （AC）is also read. When BF = "1" new instruction will not be accepted. Must wait for BF = "0" for new instruction.

- **WRITE DATA TO RAM**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	1	0	D7	D6	D5	D4	D3	D2	D1	D0

Write data to internal RAM and alter the (AC) by 1

Each RAM address (CGRAM,DDRAM,IRAM.....) must write 2 consecutive bytes for 16 bit data. After the second byte the address counter will add or subtract by 1 according to the entry mode set control bit.

- **READ RAM DATA**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	1	1	D7	D6	D5	D4	D3	D2	D1	D0

Read data from internal RAM and alter the (AC) by 1

After address set to read (CGRAM,DDRAM,IRAM.....)a DUMMY READ is required.

There is no need to DUMMY READ for the following bytes unless a new address set instruction is issued.

Description of extended instruction set

- **STAND BY**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	0	0	1

Instruction to enter stand by mode. Any other instruction follows this instruction can terminate stand by. The content of DDRAM remain the same.

- **VERTICAL SCROLL OR RAM ADDRESS SELECT**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	0	1	SR

When SR = "1", the vertical scroll address set is enabled.
When SR = "0", the IRAM address set **(extended instruction)** and CGRAM address set**(basic instruction)** is enabled.

- **REVERSE**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	1	R1	R0

Select 1 out of 4 lines to reverse the display and to toggle the reverse condition by repeating this instruction. R1,R0 initial vale is 00. When set the first time the display is reversed and set the second time the display become normal.

R1	R0	Description
L	L	First line normal or reverse
L	H	Second line normal or reverse
H	L	Third line normal or reverse
H	H	Fourth line normal or reverse

Please note that only 2 lines out of 4 line display data can be displayed.

- **EXTENED FUNCTION SET**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	1	DL	X	RE	G	X

DL : 4/8 BIT interface control bit
When DL = "1", **8 BIT** MPU interface
When DL = "0", **4 BIT** MPU interface
RE : extended instruction set control bit
When RE = "1", extended instruction set
When RE = "0", basic instruction set
G : Graphic display control bit
When G = "1", graphic display ON
When G = "0", Graphic display OFF

In same instruction cannot alter DL, RE and G at once. Make sure that change DL or G first and then RE.

- **SET SCROLL ADDRESS**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0

SR=1: AC5~AC0 is vertical scroll displacement address

- **SET GRAPHIC RAM ADDRESS**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	1	0	AC5	AC4	AC3	AC2	AC1	AC0

Set GDRAM address to address counter（AC）.

First set vertical address and then horizontal address(write 2 consecutive bytes to complete vertical and horizontal address set)

Vertical address range is AC5...AC0

Horizontal address range is AC3…AC0

The address counter（AC）of graphic RAM(GRAM) only increment after write for horizontal address. After horizontal address =0FH it will automatically back to 00H. However, the vertical address will not increase as the result of the same action.

7. Reliability Specification

7.1 Contents of Reliability Tests

No.	Test Item	Content of Test	Test Condition
1	High Temperature Storage	Endurance test applying the high storage temperature for a long time	+80°C 96H
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	−30°C 96H
3	High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the thermal stress to the element for a long time	+70°C 96H
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time	−20°C 96H
5	High Temperature/ Humidity Storage	Endurance test applying the high temperature and humidity storage for a long time	40°C 90%RH 96H
6	Temperature Cycle	Endurance test applying the low and high temperature cycle −20°C ⟷ 25°C ⟷ 70°C ⟷ 25°C 30min 5min 30min 5min ⟷ 1 cycle	−20°C/70°C 10 cycles
7	Vibration Test (Package State)	Endurance test applying the vibration during transportation	10Hz－55Hz, 50m/s, 15min
8	Shock Test (Package State)	Endurance test applying the shock during transportation	Half-sinewave, 100m/s, 11ms
9	Atmospheric Pressure Test	Endurance test applying the atmospheric pressure during transportation by air	40 kPa 16 H

7.2 Life Time

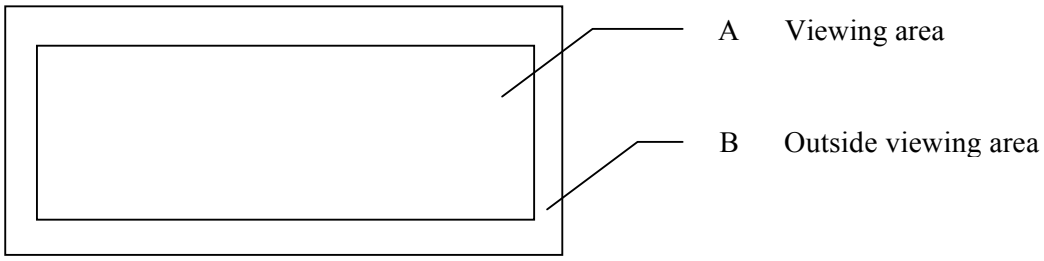
Item	Description
1	Function, performance, appearance, etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions of room temperature (25±10°C), normal humidity (45±20% RH), and in area not exposed to direct sunlight.

*** Note: Test Condition**

1) Temperature and humidity: If no specification, Temperature set at 25±2°C, Humidity set at 60±5%RH;
2) Operating state: Samples subject to the tests shall be in " Operating " condition.

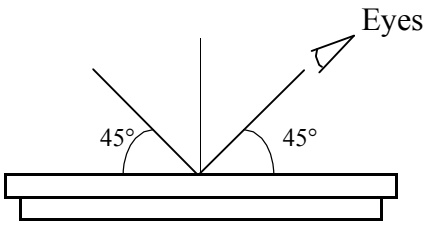
8. Quality Level

8.1 Zone Definition



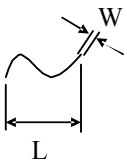
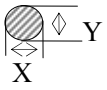
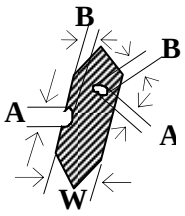
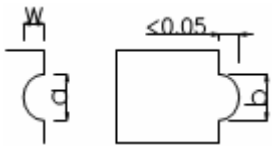
8.2 Visual Inspection

1) Inspect under 2x20W or 40W fluorescent lamp (approximately 3000 lux) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye (measuring position).
2) Appearance is inspected at the best contrast voltage (best contrast is adjusted considering clearness and crosstalk on screen).
3) Inspect the module at 45° right and left, top and bottom.
4) Use the optimum viewing angle during the contrast inspection.

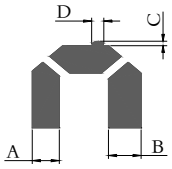


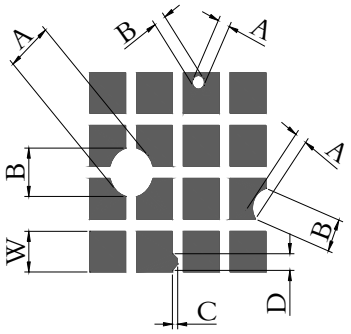
8.3 Standard of Apperance Inspection

<table>
<tr><th>No.</th><th>Item</th><th>Criteria</th></tr>
<tr><td>1</td><td>Black spot
White spot
Dust</td><td>
Round type: as per following drawing
Φ = (X+Y)/2

X
<table>
<tr><td colspan="3">Acceptable quantity</td></tr>
<tr><td>Size</td><td>Zone A</td><td>Zone B</td></tr>
<tr><td>Φ <0.1</td><td>Any number</td><td rowspan="4">Any number</td></tr>
<tr><td>0.1< Φ <0.2</td><td>2</td></tr>
<tr><td>0.2< Φ <0.25</td><td>1</td></tr>
<tr><td>0.25< Φ</td><td>0</td></tr>
</table>
Line type: as per following drawing

W
L
<table>
<tr><td colspan="4">Acceptable quantity</td></tr>
<tr><td>Length</td><td>Width</td><td>Zone A</td><td>Zone B</td></tr>
<tr><td>—</td><td>W≤0.02</td><td>Any number</td><td rowspan="4">Any number</td></tr>
<tr><td>L≤3.0</td><td>0.02<W≤0.03</td><td rowspan="2">2</td></tr>
<tr><td>L≤2.5</td><td>0.03<W≤0.05</td></tr>
<tr><td>—</td><td>0.05<W</td><td>As round type</td></tr>
</table>
Total acceptable quantity: 3
</td></tr>
<tr><td>2</td><td>Polariser scratch</td><td>Scratch on protective film is permitted
Scratch on polariser: same as No. 1</td></tr>
<tr><td>3</td><td>Polariser bubble</td><td>
Φ = (X+Y)/2

Y
X
<table>
<tr><td colspan="3">Acceptable quantity</td></tr>
<tr><td>Size</td><td>Zone A</td><td>Zone B</td></tr>
<tr><td>Φ <0.2</td><td>Any number</td><td rowspan="4">Any number</td></tr>
<tr><td>0.2< Φ <0.5</td><td>2</td></tr>
<tr><td>0.5< Φ <1.0</td><td>1</td></tr>
<tr><td>1.0< Φ</td><td>0</td></tr>
</table>
Total acceptable quantity: 3
</td></tr>
<tr><td>4</td><td>Segment deformation</td><td>
4.1 Pin hole on segmented display
W: segment width
Φ = (A+B)/2

B
B
A
A
W
<table>
<tr><td colspan="2">Acceptable quantity</td></tr>
<tr><td>Width</td><td>Quantity</td></tr>
<tr><td>W≤0.4</td><td>Φ ≤0.2 and Φ ≤1/2W</td></tr>
<tr><td>W>0.4</td><td>Φ ≤0.25 and
Φ ≤1/3W</td></tr>
<tr><td colspan="2">Total acceptable quantity: 1 defect per segment
Pin holes with Φ under 0.10 mm are acceptable</td></tr>
</table>
4.2 Pin hole on dot matrix display

W
≤0.05
a
b
<table>
<tr><td colspan="2">Acceptable quantity</td></tr>
<tr><td>Size</td><td></td></tr>
<tr><td>a, b<0.1</td><td>Any number</td></tr>
<tr><td>(a+b)/2≤0.1</td><td>Any number</td></tr>
<tr><td>0.5< Φ <1.0</td><td>3</td></tr>
</table>
Total acceptable quantity: 7

4.3 Segments / dots with different width
</td></tr>
</table>

<table>
<tr>
<td></td>
<td></td>
<td>


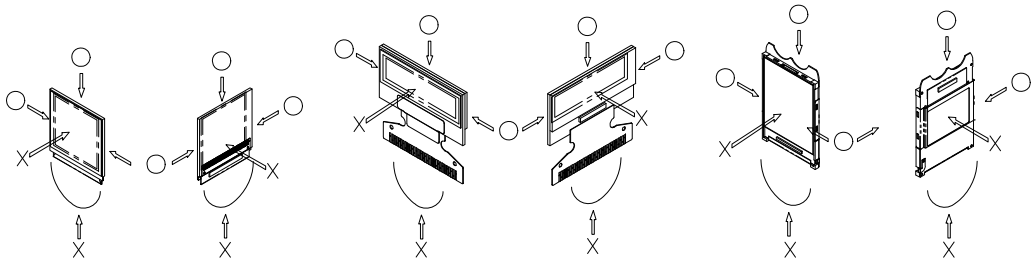
<table>
<tr><td colspan="2">Acceptable</td></tr>
<tr><td>a≥b</td><td>a/b≤4/3</td></tr>
<tr><td>a<b</td><td>a/b>4/3</td></tr>
</table>
4.4 Alignment layer defect
Φ = (A+B)/2


<table>
<tr><td colspan="2">Acceptable quantity</td></tr>
<tr><td>Size</td><td></td></tr>
<tr><td>Φ ≤0.4</td><td>Any number</td></tr>
<tr><td>0.4< Φ ≤1.0</td><td>5</td></tr>
<tr><td>1.0< Φ ≤1.5</td><td>3</td></tr>
<tr><td>1.5< Φ ≤2.0</td><td>2</td></tr>
</table>
Total acceptable quantity: 7
</td>
</tr>
<tr>
<td>5</td>
<td>Colour uniformity</td>
<td>Level of sample for approval set as limit sample</td>
</tr>
<tr>
<td>6</td>
<td>Backlight</td>
<td>The backlight colour should correspond to the product specification
Flashing and or unlit backlight is not allowed
Dust larger than 0.25 mm is not allowed</td>
</tr>
<tr>
<td>7</td>
<td>COB</td>
<td>Exposed wire bond pad is not allowed
Insufficient covering with resin is not allowed (wire bond line exposed) Dust or bubble on the resin are not allowed</td>
</tr>
<tr>
<td>8</td>
<td>PCB</td>
<td>No unmelted solder paste should be present on PCB
Cold solder joints, missing solder connections, or oxidation are not allowed
No residue or solder balls on PCB are allowed
Short circuits on components are not allowed</td>
</tr>
<tr>
<td>9</td>
<td>Tray particles</td>
<td>
<table>
<tr><td colspan="3">Acceptable quantity</td></tr>
<tr><td></td><td>Size</td><td>Quantity</td></tr>
<tr><td rowspan="2">On tray</td><td>Φ <0.2</td><td>Any number</td></tr>
<tr><td>Φ >0.25</td><td>4</td></tr>
<tr><td rowspan="2">On display</td><td>Φ ≥0.25</td><td>2</td></tr>
<tr><td>L = 3</td><td>1</td></tr>
</table>
</td>
</tr>
</table>

9. Percautions When Using These LCD Modules

9.1 Handling Precautions

1) Since the display panel is being made of glass, do not apply mechanical impacts such us dropping from a high position.
2) If the display panel is broken by some accident and the internal organic substance leaks out, be careful not to inhale nor lick the organic substance.
3) If pressure is applied to the display surface or its neighborhood of the LCD Module, the cell structure may be damaged and be careful not to apply pressure to these sections.
4) The polarizer covering the surface of the LCD Module is soft and easily scratched. Please be careful when handling the LCD Module.
5) When the surface of the polarizer of the LCD Module has soil, clean the surface. It takes dvantage of by using following adhesion tape.
   * Scotch Mending Tape No. 810 or an equivalent.
   Never try to breathe upon the soiled surface nor wipe the surface using cloth containing solvent such as ethyl alcohol, since the surface of the polarizer will become cloudy.
   Also, pay attention that the following liquid and solvent may spoil the polarizer:
   * Water
   * Ketone
   * Aromatic Solvents
6) Hold LCD Module very carefully when palcing LCD Module into the system housing. Do not apply excessive stress or pressure to LCD Module. And, do not over bend the film with electrode pattern layouts. These stresses will influence the display performance. Also, secure sufficient rigidity for the outer cases.



7) Do not apply stress to the LSI chips and the surrounding molded sections.
8) Do not disassemble nor modify the LCD Module.
9) Do not apply input signals while the logic power is off.
10) Pay sufficient attention to the working environments when handing LCD Modules to prevent occurrence of element breakage accidents by static electricity.
    * Be sure to make human body grounding when handling LCD Modules.
    * Be sure to ground tools to use or assembly such as soldering irons.
    * To suppress generation of static electricity, avoid carrying out assembly work under dry environments.
    * Protective film is being applied to the surface of the display panel of the LCD Module. Be careful since static electricity may be generated when exfoliating the protective film.
    * Protective film is being applied to the surface of the display panel of the LCD Module. Be careful since static electricity may be generated when exfoliating the protective film.
11) Protection film is being applied to the surface of the display panel and removes the protection film before assembling it. At this time, if the LCD Module has been stored

for a long period of time, residue adhesive material of the protection film may remain on the surface of the display panel after removed of the film. In such case, remove the residue material by the method introduced in the above Section 5).

12) If electric current is applied when the LCD Module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful to avoid the above.

9.2 Storage Precautions

1) When storing LCD Modules, put them in static electricity preventive bags avoiding exposure to direct sun light nor to lights of fluorescent lamps. and, also, avoiding high temperature and high humidity environment or low temperature (less than 0°C) environments. (We recommend you to store these modules in the packaged state when they were shipped from Blaze Display Technology Co., Ltd.)
   At that time, be careful not to let water drops adhere to the packages or bags nor let dewing occur with them.
2) If electric current is applied when water drops are adhering to the surface of the LCD Module, when the LCD Module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful about the above.

9.3 Designing Precautions

1) The absolute maximum ratings are the ratings which can not be exceeded for LCD Module, and if these values are exceeded, panel damage may be happen.
2) To prevent occurrence of malfunctioning by noise, pay attention to satisfy the VIL and VIH specifications and, at the same time, to make the signal line cable as short as possible.
3) We recommend you to install excess current preventive unit (fuses, etc.) to the power circuit (VDD). (Recommend value: 0.5A)
5) Pay sufficient attention to avoid occurrence of mutual noise interference with the neighboring devices.
6) As for EMI, take necessary measures on the equipment side basically.
   When fastening the LCD Module, fasten the external plastic housing section.
7) If power supply to the LCD Module is forcibly shut down by such errors as taking out the main battery while the LCD Panel is in operation, we cannot guarantee the quality of this LCD Module.
8) The electric potential to be connected to the rear face of the IC chip should be as follows:
   * Connection (contact) to any other potential than the above may lead to rupture of the IC.

9.4 Precautions When Disposing of the LCD Modules

Request the qualified companies to handle industrial wastes when disposing of the LCD Modules. Or, when burning them, be sure to observe the environmental and hygienic laws and regulations.

9.5 Other Precautions

1) When a LCD Module is operated for a long of time with fixed pattern may remain as an after image or slight contrast deviation may occur.
   Nonetheless, if the operation is interrupted and left unused for a while, normal state can be restored. Also, there will be no problem in the reliability of the module.

2) To protect LCD Modules from performance drops by static electricity rapture, etc., do not touch the following sections whenever possible while handling the LCD Modules.
   * Pins and electrodes
   * Pattern layouts such as the TCP & FPC
3) With this LCD Module, the LCD Module driver is being exposed. Generally speaking, semiconductor elements change their characteristics when light is radiated according to the principle of the solar battery. Consequently, if this LCD Module driver is exposed to light, malfunctioning may occur.
   * Design the product and installation method so that the LCD Module driver may be shielded from light in actual usage.
   * Design the product and installation method so that the LCD Module driver may be shielded from light during the inspection processes.
4) Although this LCD Module stores the operation state data by the commands and the indication data, when excessive external noise, etc. enters into the module, the internal status may be changed to take appropriate measures to suppress noise generation or to protect from influences of noise on the system design.
5) We recommend you to construct its software to make periodical refreshment of the operation statuses (re-setting of the commands and re-transference of the display data) to cope with catastrophic noise.