SPECIFICATION FOR LCD MODULE

Model No. TM10481ACAWG2

Prepared by:	**Date:**
Checked by :	**Date:**
Verified by :	**Date:**
Approved by:	**Date:**

TIANMA MICROELECTRONICS CO., LTD

www.DataSheet4U.com

REVISION RECORD

Date	Ref. Page	Revision No.	Revision Items	Check & Approval

1 General Specifications:

1.1 Display type: FSTN

1.2 Display color*:

Display color: Black

Background: White

1.3 Polarizer mode: Reflective/Positive

1.4 Viewing Angle: 6:00

1.5 Driving Method: 1/81 Duty 1/10 Bias

1.6 Backlight: None

1.7 Controller: S6B0718X01-B0CZ

1.8 Data Transfer: 8 Bit Parallel

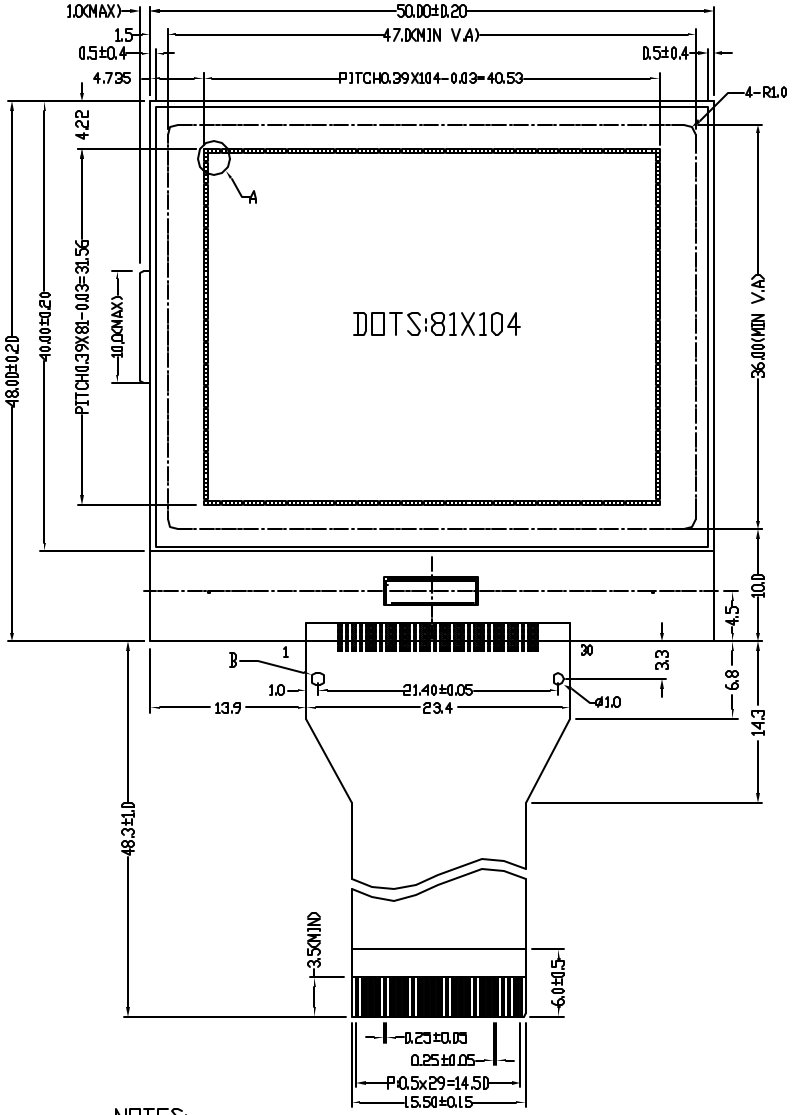
1.9 Operating Temperature: -20----+70℃

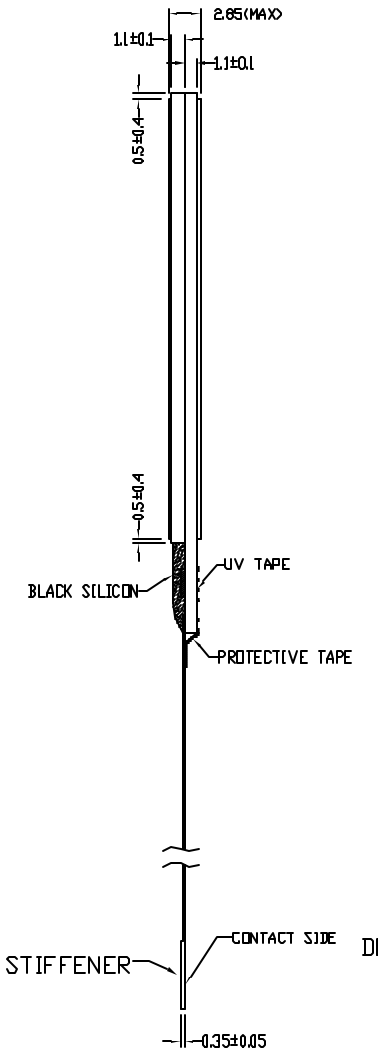
Storage Temperature: -30----+80℃

1.10 Outline Dimensions: Refer to outline drawing on next page

1.11 Weight: Approx. 10g

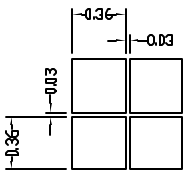
* Color tone is slightly changed by temperature and driving voltage.



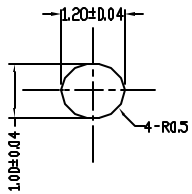


NO.	PIN
1	V0
2	V1
3	V2
4	V3
5	V4
6	C2-
7	C2+
8	C1+
9	C1-
10	C3+
11	VOUT
12	VSS
13	VSS
14	VDD
15	VDD
16	DB7
17	DB6
18	DB5
19	DB4
20	DB3
21	DB2
22	DB1
23	DB0
24	E/RD
25	RW/WR
26	RS
27	RESETB
28	CS1B
29	C68
30	PS

DETAIL A:



DETAIL B:



NOTES:

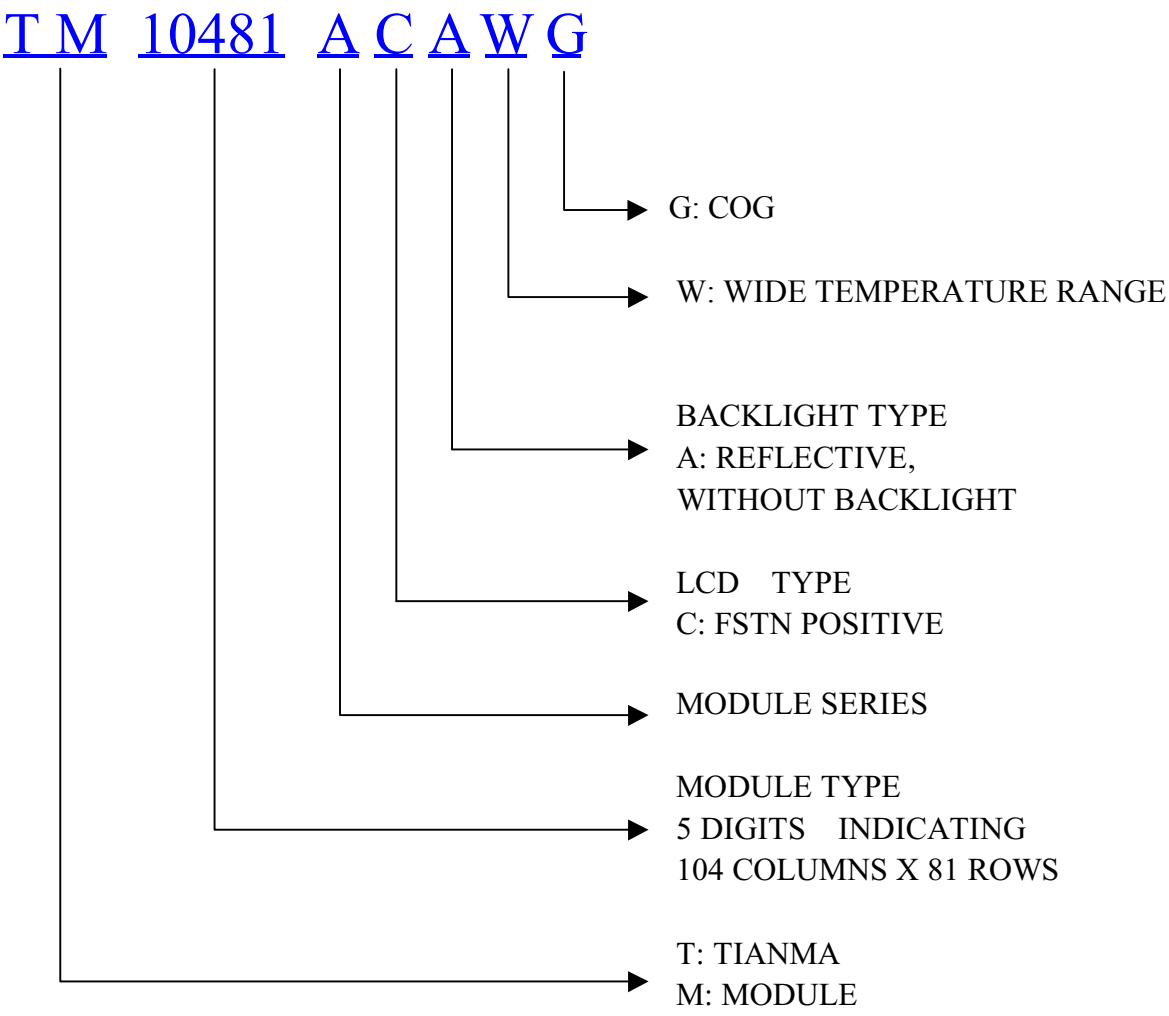
1. DISPLAY TYPE: FSTN
2. VIEWING DIRECTION: 6:00
3. POLARIZER MODE: REFLECTIVE/POSITIVE
4. DRIVE METHOD: 1/81 DUTY 1/10 BIAS
5. LCD OPERATING VOLTAGE: 9.0V
6. OPERATING TEMP.: -20°C~+70°C
7. STORAGE TEMP.: -30°C~+80°C
8. CONTTROLLER: S6B0718X01-B0CZ(KS0718UM-L0CC)
9. CONNECTOR: FPC
10. WITHOUT BACKLIGHT
11. UNMARKED TOLERANCES: ±0.3mm

TIAN-MA MICROELECTRONICS CO.

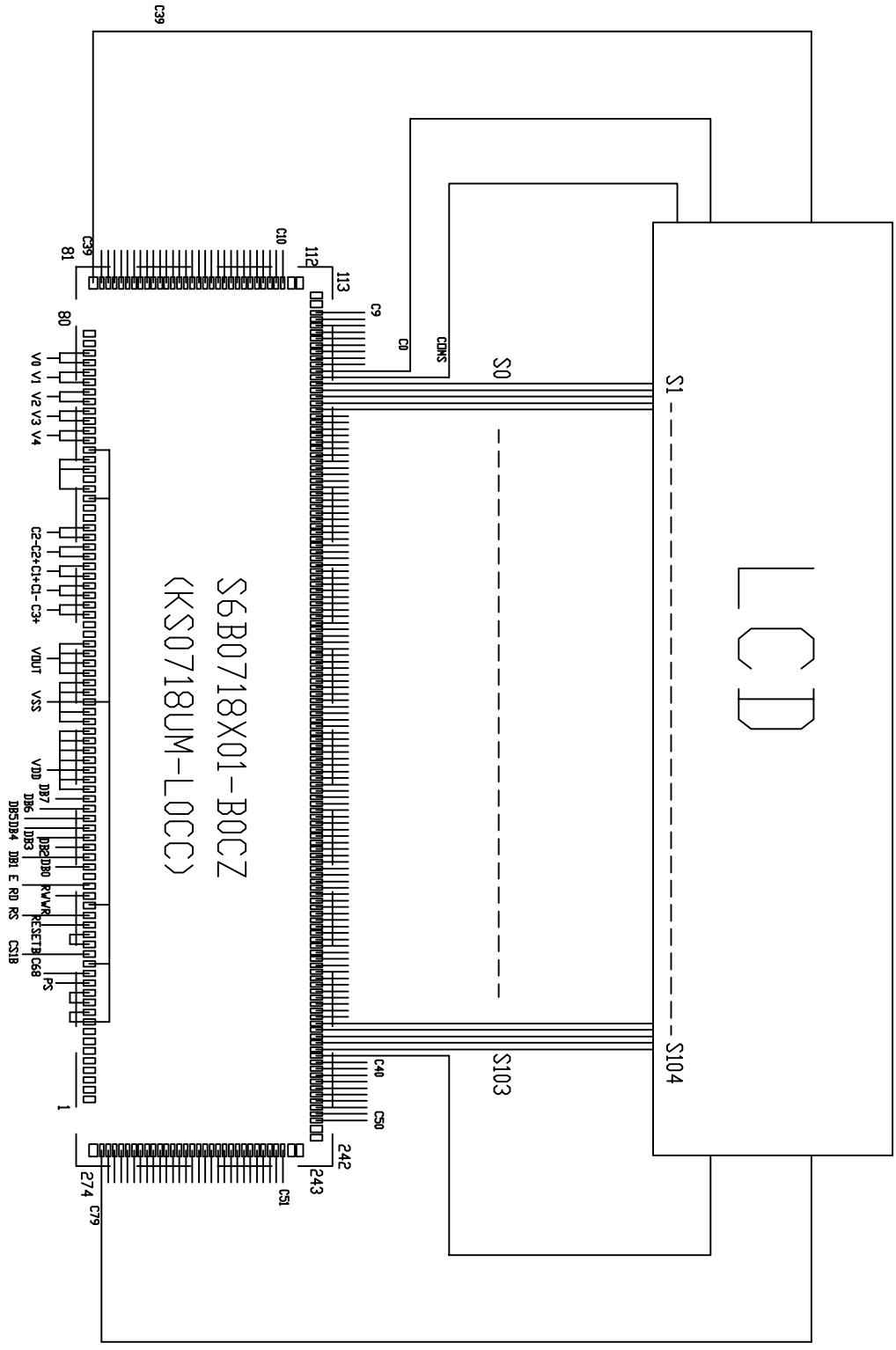
6/F., CASTIC Building, Shennan Road, Central, Shenzhen, China

DRAWN BY:	TITLE: TM10481ACAWG2	
CHECKED BY:		SCALE:
APPROVED BY:	DWG NO: G-1	UNIT: mm
CONFIRMED BY:	DWG NAME: TM10481ACAWG2G	SHEET NO: OF

3 LCD Module Part Numbering System



4 Circuit Block Diagram



5 Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	$V_{DD}-V_{SS}$	-0.3	3.6	V	
LCD Driving Voltage	V_{LCD}	-	25.0		
Operating Temperature Range	T_{OP}	-20	+70	℃	No Condensation
Storage Temperature Range	T_{ST}	-30	+80		

6 Electrical Specifications and Instruction Code

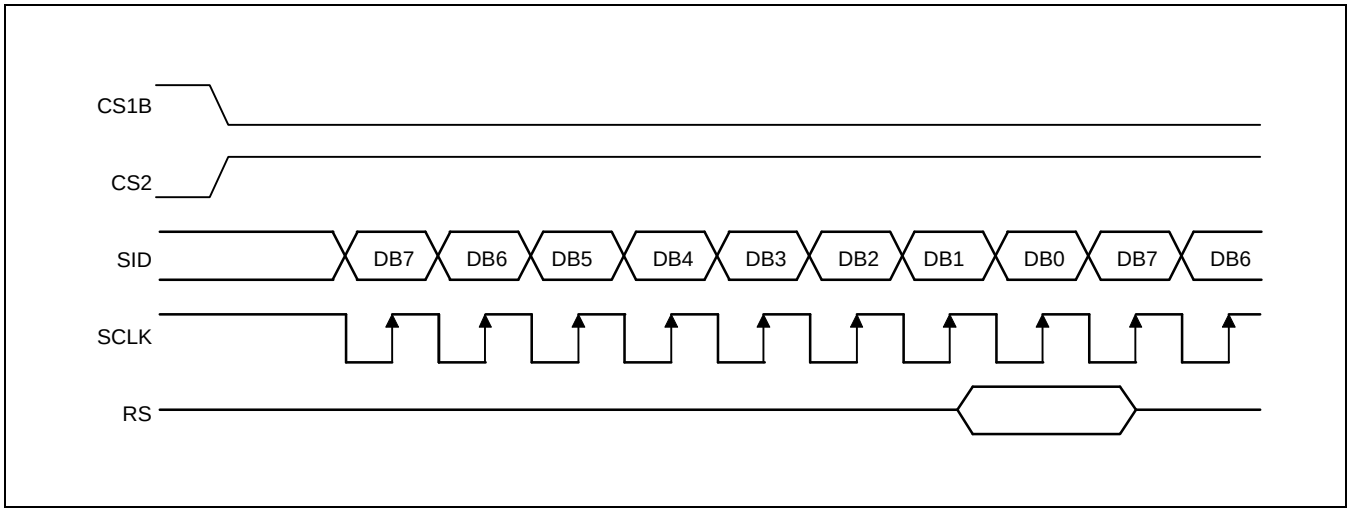
6.1 Electrical characteristics

Item		Symbol	Min.	Typ.	Max.	Unit
Supply Voltage (Logic)		$V_{DD}-V_{SS}$	2.4	3.0	3.6	V
Supply Voltage (LCD Drive)		V_{LCD}	-	9.0	-	V
Input Signal Voltage	High	V_{IH} （V_{DD}=3.0V）	0.8V_{DD}	-	V_{DD}+0.3	V
	Low	V_{IL} （V_{DD}=3.0V）	0	-	0.2 V_{DD}	V
Supply current (Logic)		I_{DD} （V_{DD}-V_{SS}=3.0V）	-	-	100.0	uA

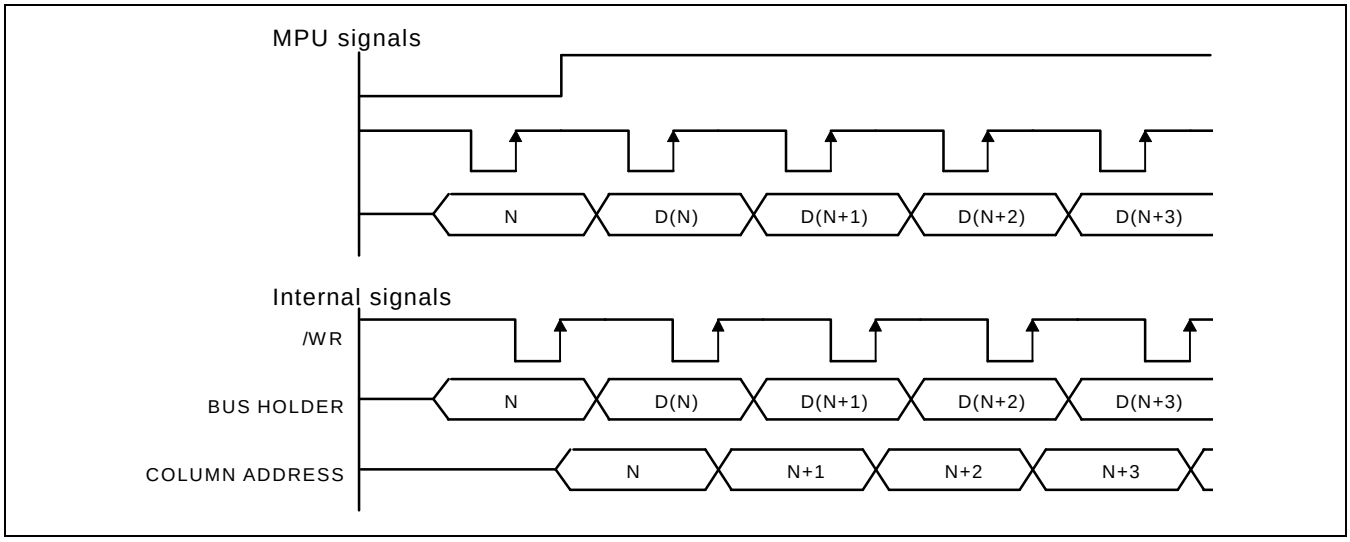
6.2 Interface Signals

Pin No.	Symbol	Level	Description
1	V0	-	Power supply voltage for LCD
2	V1	-	Power supply voltage for LCD
3	V2	-	Power supply voltage for LCD
4	V3	-	Power supply voltage for LCD
5	V4	-	Power supply voltage for LCD
6	C2-	-	Capacitor pin for voltage converter
7	C2+	-	Capacitor pin for voltage converter
8	C1+	-	Capacitor pin for voltage converter
9	C1-	-	Capacitor pin for voltage converter
10	C3+	-	Capacitor pin for voltage converter
11	VOUT	-	Voltage convert I/O port
12	VSS	0V	Ground
13	VSS	0V	Ground
14	VDD	3.0V	Power supply voltage for logic
15	VDD	3.0V	Power supply voltage for logic
16	DB7	H/L	Data bit 7
17	DB6	H/L	Data bit 6
18	DB5	H/L	Data bit 5
19	DB4	H/L	Data bit 4
20	DB3	H/L	Data bit 3
21	DB2	H/L	Data bit 2
22	DB1	H/L	Data bit 1
23	DB0	H/L	Data bit 0
24	E/RD	H/L	6800-series MPU:Enable Clock Input 8080-series MPU:Enable Clock Input
25	RW/WR	H/L	Read/Write execution control pin
26	RS	H/L	Selects registers input
27	RESETB	H/L	Reset Signal
28	CS1B	H/L	Chip select input
29	C68	H/L	H:6800 MPU BUS L:8080 MPU BUS
30	PS	H/L	H:Parallel Data Transfer L:Serial Data Transfer

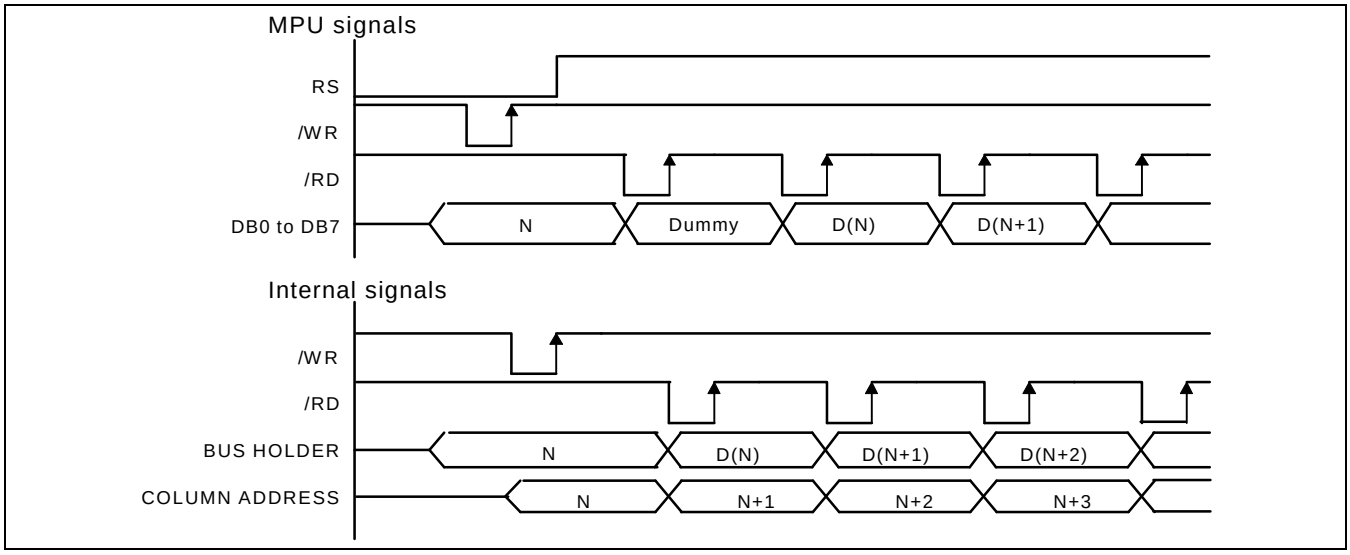
6.3 Interface Timing Chart



Serial Interface Timing



Write Timing



Read Timing

6.4 Instruction Code:

×: Don't care

Instruction	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
Read display data	1	1	Read data								Read data from DDRAM
Write display data	1	0	Write data								Write data into DDRAM
Read status	0	1	BUSY	ADC	ON	RES	0	0	0	0	Read the internal status
Set page address	0	0	1	0	1	1	P3	P2	P1	P0	Set page address
Set column address MSB	0	0	0	0	0	1	0	Y6	Y5	Y4	Set column address MSB
Set column address LSB	0	0	0	0	0	0	Y3	Y2	Y1	Y0	Set column address LSB
Set modify-read	0	0	1	1	1	0	0	0	0	0	Set modify-read mode
Reset modify-read	0	0	1	1	1	0	1	1	1	0	Release modify-read mode
Display ON / OFF	0	0	1	0	1	0	1	1	1	D	D = 0: display OFF D = 1: display ON
Set initial display line register	0	0	0	1	0	0	0	0	×	×	2-byte instruction to specify the initial display line to realize vertical scrolling
	0	0	×	S6	S5	S4	S3	S2	S1	S0	
Set initial COM0 register	0	0	0	1	0	0	0	1	×	×	2-byte instruction to specify the initial COM0 to realize window scrolling
	0	0	×	C6	C5	C4	C3	C2	C1	C0	
Set partial display duty ratio	0	0	0	1	0	0	1	0	×	×	2-byte instruction to set partial display duty ratio
	0	0	×	D6	D5	D4	D3	D2	D1	D0	
Set n-line inversion	0	0	0	1	0	0	1	1	×	×	2-byte instruction to set n-line inversion register
	0	0	×	×	×	N4	N3	N2	N 1	N0	
Release n-line inversion	0	0	1	1	1	0	0	1	0	0	Release n-line inversion mode
Reverse display ON / OFF	0	0	1	0	1	0	0	1	1	REV	REV = 0: normal display REV = 1: reverse display
Entire display ON / OFF	0	0	1	0	1	0	0	1	0	EON	EON = 0: normal display EON = 1: entire display ON
Power control	0	0	0	0	1	0	1	VC	VR	VF	Control power circuit operation
Select DC-DC step-up	0	0	0	1	1	0	0	1	DC1	DC0	Select the step-up of the internal voltage converter
Select regulator resistor	0	0	0	0	1	0	0	R2	R1	R0	Select internal resistance ratio of the regulator resistor
Set electronic volume register	0	0	1	0	0	0	0	0	0	1	2-byte instruction to specify the electronic volume register
	0	0	×	×	EV5	EV4	EV3	EV2	EV1	EV0	
Select LCD bias	0	0	0	1	0	1	0	B2	B1	B0	Select LCD bias
SHL select	0	0	1	1	0	0	SHL	×	×	×	COM bi-directional selection SHL = 0: normal direction SHL = 1: reverse direction
ADC select	0	0	1	0	1	0	0	0	0	ADC	SEG bi-directional selection ADC = 0: normal direction ADC = 1: reverse direction
Set static indicator mode	0	0	1	0	1	0	1	1	0	SM	2-byte instruction to specify the static indicator mode
Set static indicator register	0	0	×	×	×	×	×	×	S1	S0	
Oscillator ON start	0	0	1	0	1	0	1	0	1	1	Start the built-in oscillator
Set power save mode	0	0	1	0	1	0	1	0	0	P	P = 0: standby mode P = 1: sleep mode
Release power save mode	0	0	1	1	1	0	0	0	0	1	Release power save mode
Reset	0	0	1	1	1	0	0	0	1	0	Initialize the internal functions
NOP	0	0	1	1	1	0	0	0	1	1	***No operation***
Test instruction	0	0	1	1	1	1	×	×	×	×	***Don't use this instruction.***

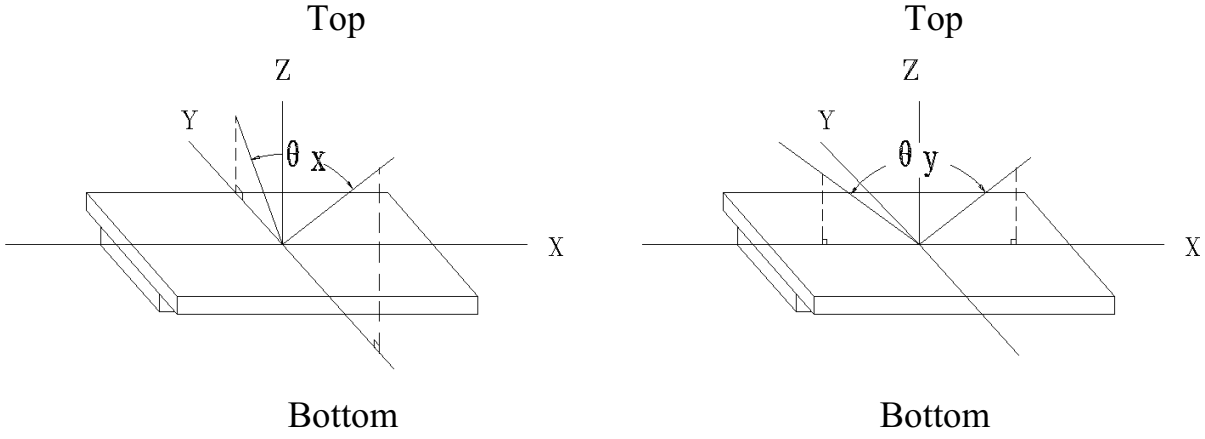
7 Optical Characteristics

7.1 Optical Characteristics Ta=25℃

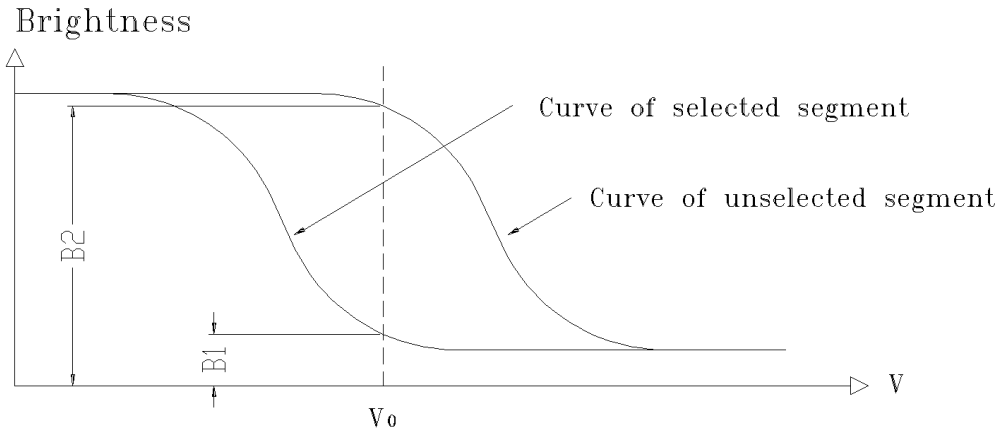
Item		Symbol	Condition		Min.	Typ.	Max.	Unit
Viewing Angle		θ_x	$C_r \geq 2$	$\theta_y=0°$	-30	--	20	Deg
		θ_y		$\theta_x=0°$	-30	--	30	
Contrast Ratio		C_r	$\theta_x=0°$ $\theta_y=0°$		3.0	-	-	
Response Time	Turn on	T_{on}	$\theta_x=0°$ $\theta_y=0°$		-	-	300	ms
	Turn off	T_{off}			-	-	300	

7.2 Definition of Optical Characteristics

7.2.1 Definition of Viewing Angle



7.2.2 Definition of Contrast Ratio

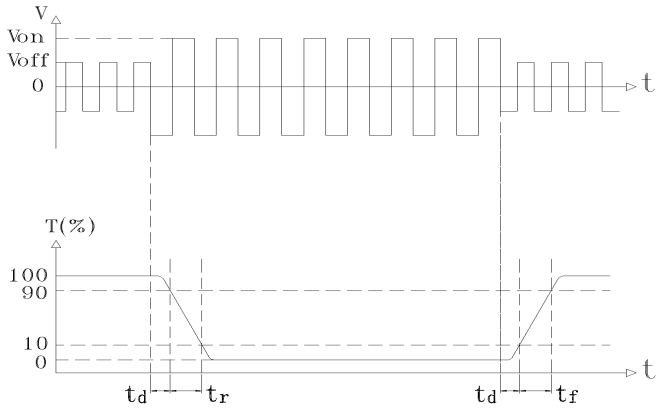


$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

1) Ambient Temperature: 25℃ ; 2) Frame frequency: 85Hz

7.2.3 Definition of Response time



Turn on time: $t_{on} = t_d + t_r$ Turn off time: $t_{off} = t_d + t_f$

Measuring Condition:

1) Operating Voltage: 9.0V 2) Frame frequency: 85Hz

8 Reliability

8.1 Content of Reliability Test Ta=25℃

No.	Test Item	Content of Test	Test condition
1	High Temperature Storage	Endurance test applying the high storage temperature for a long time	80℃ 96H
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	-30℃ 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℃ 96H
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time	-20℃ 96H
5	High Temperature /Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time	40℃ 90%RH 96H
6	Temperature Cycle	Endurance test applying the low and high temperature cycle -30℃←→25℃←→80℃←→25℃ 30min 5min 30min 5min ←——————————→ 1 cycle	-30℃/80℃ 10 cycles
7	Vibration Test (package state)	Endurance test applying the vibration during transportation	10Hz~150Hz, 50m/s^2, 40min
8	Shock Test (package state)	Endurance test applying the shock during transportation	Half- sine wave, 100m/s^2, 11ms
9	Atmospheric Pressure Test	Endurance test applying the atmospheric pressure during transportation by air	40kPa 16H

8.2 Failure Judgment Criterion

Criterion Item	Test Item No.									Failure Judgement Criterion
	1	2	3	4	5	6	7	8	9	
Basic Specification	√	√	√	√	√	√	√	√	√	Out of the basic Specification
Electrical specification	√	√	√	√	√					Out of the electrical specification
Mechanical Specification							√	√		Out of the mechanical specification
Optical Characteristic	√	√	√	√	√	√			√	Out of the optical specification
Note	For test item refer to 8.1									
Remark	Basic specification = Optical specification + Mechanical specification									

9 QUALITY LEVEL

Examination or Test	At T_a=25℃ (unless otherwise stated)	Inspection				
		Min.	Max.	Unit	IL	AQL
External Visual Inspection	Under normal illumi-nation and eyesight condition, the dis-tance between eyes and LCD is 25cm.	See Appendix A			II	Major 1.0 Minor 2.5
Display Defects	Under normal illumi-nation and eyesight condition, display on inspection.	See Appendix B			II	Major 1.0 Minor 2.5
Note: Major defects: Open segment or common, Short, Serious damages, Leakage Miner defects: Others Sampling standard conforms to GB2828						

10 Precautions for Use of LCD Modules

10.1 Handling Precautions

10.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

10.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

10.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

10.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

10.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Water
- Ketone
- Aromatic solvents

10.1.6 Do not attempt to disassemble the LCD Module.

10.1.7 If the logic circuit power is off, do not apply the input signals.

10.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

a. Be sure to ground the body when handling the LCD Modules.

b. Tools required for assembly, such as soldering irons, must be properly ground.

c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

d. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

10.2 Storage precautions

10.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

10.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0℃ ～ 40℃

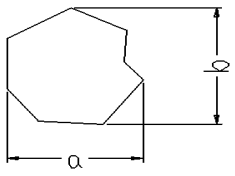
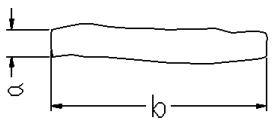
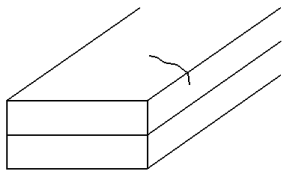
Relatively humidity: ≤80%

10.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

10.3 The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.

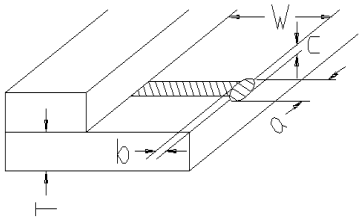
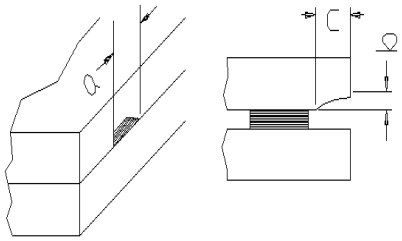
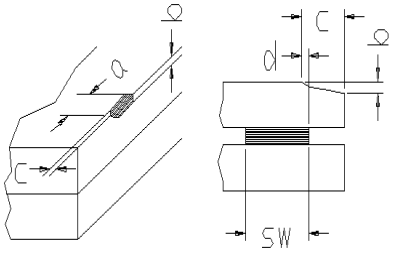
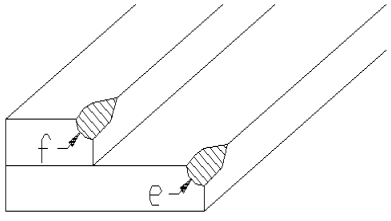
Appendix A

Inspection items and criteria for appearance defects

<table>
<tr><td>Items</td><td>Contents</td><td colspan="3">Criteria</td></tr>
<tr><td>Leakage</td><td></td><td colspan="3">Not permitted</td></tr>
<tr><td>Rainbow</td><td></td><td colspan="3">According to the limit specimen</td></tr>
<tr><td rowspan="3">Polarizer</td><td>Wrong polarizer attachment</td><td colspan="3">Not permitted</td></tr>
<tr><td rowspan="2">Bubble between polarizer and glass</td><td>Not counted</td><td colspan="2">Max. 3 defects allowed</td></tr>
<tr><td>ϕ<0.3mm</td><td colspan="2">0.3mm≤ϕ≤0.5mm</td></tr>
<tr><td>Scratches of polarizer</td><td colspan="3">According to the limit specimen</td></tr>
<tr><td rowspan="3">Black spot (in viewing area)</td><td rowspan="3">  </td><td>Not counted</td><td>Max. 3 spots allowed</td><td rowspan="4">Max. 3 spots (lines) allowed</td></tr>
<tr><td>X<0.2mm</td><td>0.2mm≤X≤0.5mm</td></tr>
<tr><td colspan="2">X=(a+b)/2</td></tr>
<tr><td rowspan="2">Black line (in viewing area)</td><td rowspan="2">  </td><td>Not counted</td><td>Max. 3 lines allowed</td></tr>
<tr><td>a<0.02mm</td><td>0.02mm≤a≤0.05mm
b≤2.0mm</td></tr>
<tr><td>Progressive cracks</td><td>  </td><td colspan="3">Not permitted</td></tr>
</table>

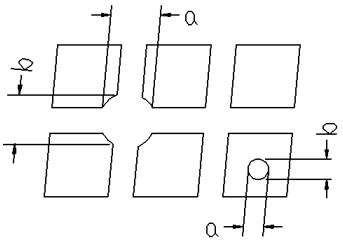
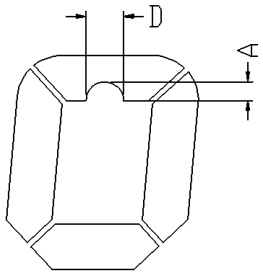
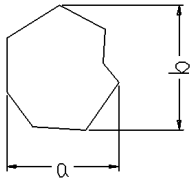
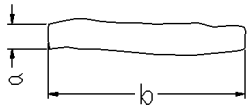
Appendix A

Inspection item and criteria for appearance defects (continued)

<table>
<tr><th>Items</th><th>Contents</th><th colspan="4">Criteria</th></tr>
<tr><td rowspan="5">Glass Cracks</td><td>Cracks on pads
 
</td><td>a
≦3mm
≦2mm</td><td>b
≦W/5
≦W/5</td><td>c
≦T/2
T/2<C<T</td><td>Max. 2 cracks allowed</td><td rowspan="5">Max. 5 cracks allowed</td></tr>
<tr><td>Cracks on contact side
 
</td><td colspan="2">a
≦3mm
≦2mm
C shall be not reach the seal area</td><td>b
≦T/2
T/2<b<T</td><td rowspan="3">Max. 2 cracks allowed</td></tr>
<tr><td>Cracks on non-contact side
 
</td><td colspan="2">a
≦3mm
≦2mm
C≦0.5mm
d≦SW/3</td><td>b
≦T/2
T/2<b<T</td></tr>
<tr><td>Corner cracks
 
</td><td colspan="3">e<2.0mm^2
f<2.0mm^2</td><td>Max. 3 cracks allowed</td></tr>
</table>

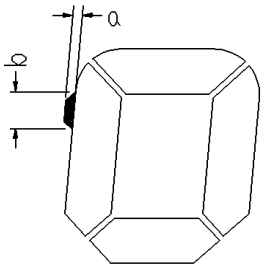
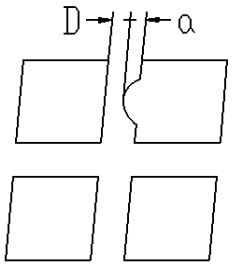
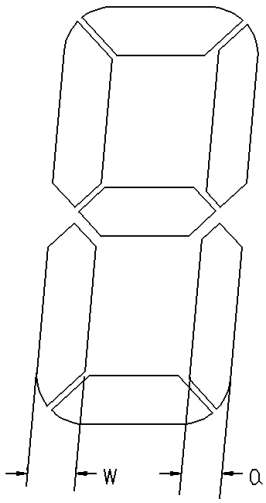
Appendix B

Inspection items and criteria for display defects

<table>
<tr><td colspan="2">Items</td><td>Contents</td><td colspan="3">Critera</td></tr>
<tr><td colspan="3">Open segment or open common</td><td colspan="3">Not permitted</td></tr>
<tr><td colspan="3">Short</td><td colspan="3">Not permitted</td></tr>
<tr><td colspan="3">Wrong viewing angle</td><td colspan="3">Not permitted</td></tr>
<tr><td colspan="3">Contrast radio uneven</td><td colspan="3">According to the limit specimen</td></tr>
<tr><td colspan="3">Crosstalk</td><td colspan="3">According to the limit specimen</td></tr>
<tr><td rowspan="4">Pin holes and cracks in segment (DOT)</td><td rowspan="2">  </td><td>Not counted</td><td>Max.3 dots allowed</td><td rowspan="4">Max.3 dots allowed</td></tr>
<tr><td>X<0.1mm</td><td>0.1mm≦X≦0.2mm</td></tr>
<tr><td colspan="2">X=(a+b)/2</td></tr>
<tr><td>  </td><td>Not counted</td><td>Max.2 dots allowed</td></tr>
<tr><td colspan="2">A<0.1mm</td><td>0.1mm≦A≦0.2mm
D<0.25mm</td></tr>
<tr><td rowspan="3">Black spot (in viewing area)</td><td rowspan="3">  </td><td>Not counted</td><td>Max.3 spots allowed</td><td rowspan="4">Max.3 spots (lines) allowed</td></tr>
<tr><td>X<0.1mm</td><td>0.1mm≦X≦0.2mm</td></tr>
<tr><td colspan="2">X=(a+b)/2</td></tr>
<tr><td rowspan="2">Black line (in viewing area)</td><td rowspan="2">  </td><td>Not counted</td><td>Max.3 lines allowed</td></tr>
<tr><td>a<0.02mm</td><td>0.02mm≦a≦0.05mm
b≦0.5mm</td></tr>
</table>

Appendix B

Inspection items and criteria for display defects (continued)

<table>
<tr><th>Items</th><th>Content</th><th colspan="3">Critera</th></tr>
<tr><td rowspan="3">Transfor-
mation
of segment</td><td rowspan="2">  </td><td>Not counted</td><td>Max. 2 defects allowed</td><td rowspan="3">Max.3
defects
allowed</td></tr>
<tr><td>x＜0.1mm</td><td>0.1mm≦x≦0.2mm</td></tr>
<tr><td colspan="2">x=(a+b)/2</td></tr>
<tr><td>  </td><td>Not counted</td><td>Max. 1 defects allowed</td><td rowspan="2"></td></tr>
<tr><td>a＜0.1mm</td><td>0.1mm≦a≦0.2mm
D>0</td></tr>
<tr><td>  </td><td colspan="3">Max.2 defects allowed
0.8W≦a≦1.2W

a=measured value of width
W=nominal value of width</td></tr>
</table>