SPECIFICATION FOR LCD MODULE

Model No. TM132128ABCWG

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

TIANMA MICROELECTRONICS CO., LTD

Rev. 1.0

REVISION RECORD

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

1 General Specifications:

1.1 Display type: STN

1.2 Display color*[1]:

Display color: Blue-Black

Background*[2]: Yellow-Green

1.3 Polarizer mode: Transflective/Positive

1.4 Viewing Angle: 6:00

1.5 Driving Method: 1/64 Duty 1/9 Bias

1.6 Backlight: LED

1.7 Controller: SSD1815BZ×2

1.8 Data Transfer: 8 Bit Parallel

1.9 Operating Temperature: -25----+70℃

Storage Temperature: -35----+80℃

1.10 VDD: 2.6~3.0V

1.11 LCD Operating Voltage: 10.0V

1.12 Outline Dimensions: Refer to outline drawing on next page

1.13 Dot Matrix: 132×128 Dots

1.14 Dot Size: 0.42×0.42(mm)

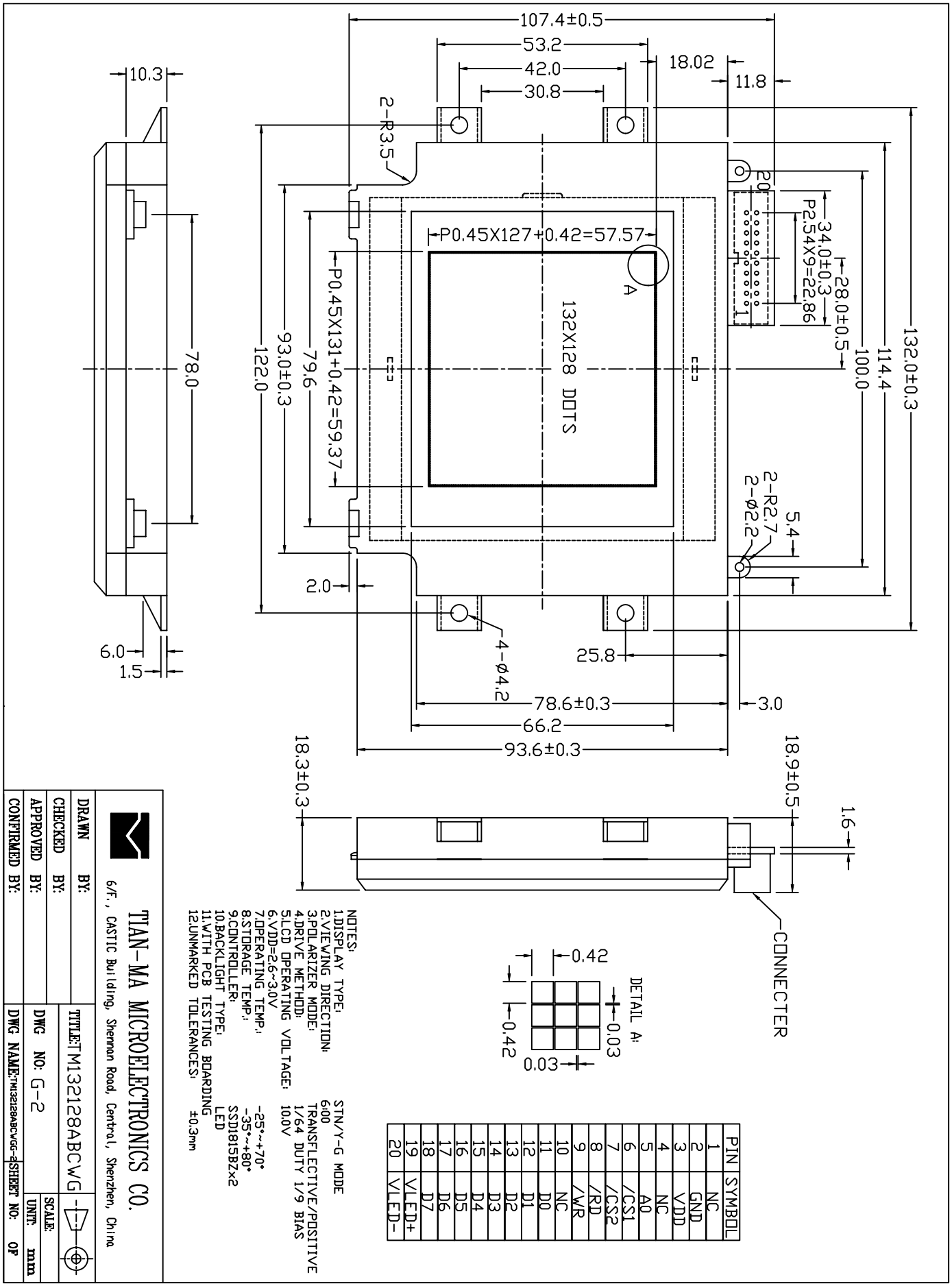
1.15 Dot Pitch: 0.45×0.45 (mm)

1.16 Weight: about 140g

*[1] Color Tone is slightly changed by temperature and driving voltage.

*[2] Color Tone will be changed by backlight.

2 Outline Drawing



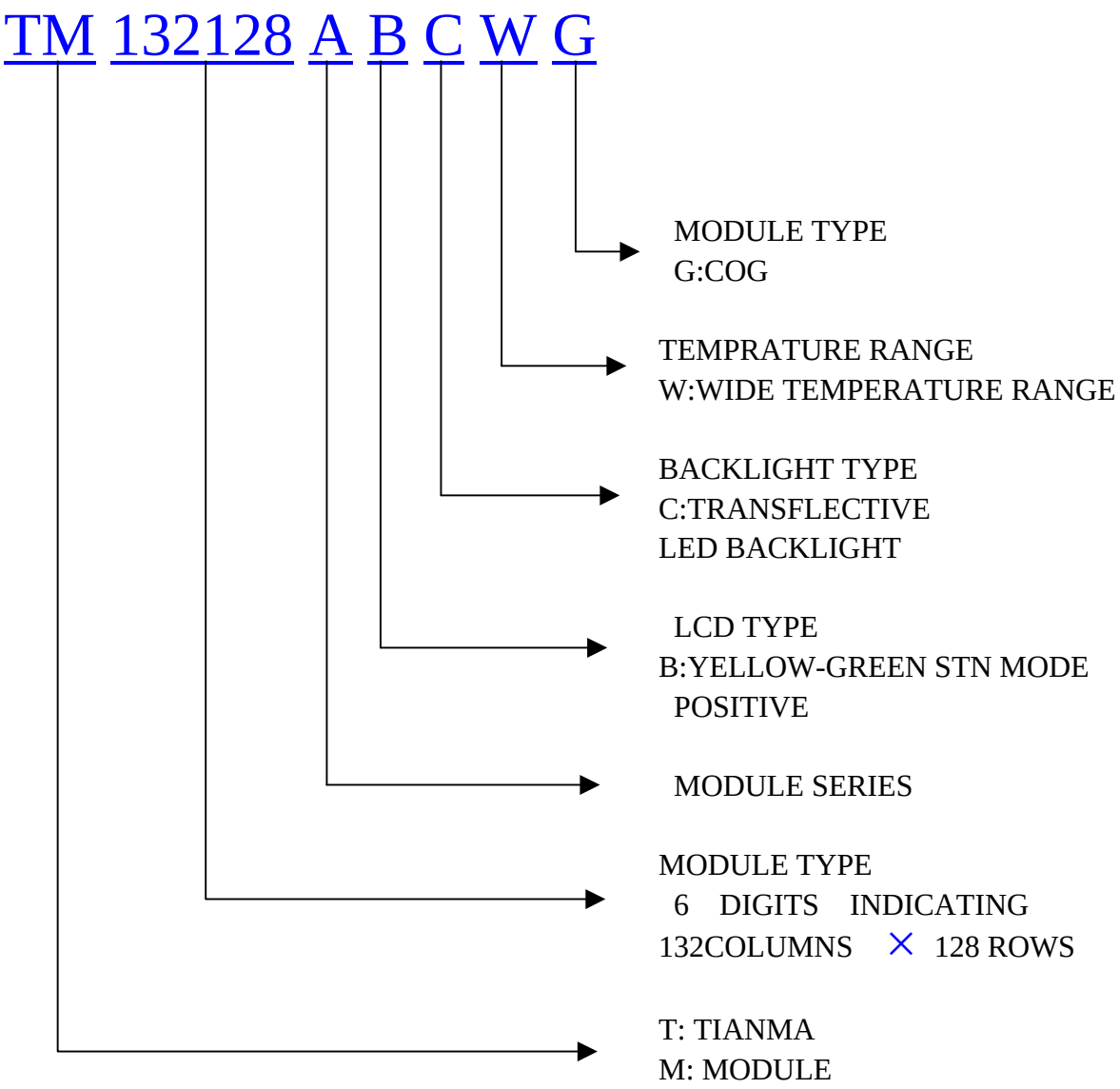
PIN	SYMBOL
1	NC
2	GND
3	VDD
4	NC
5	A0
6	/CS1
7	/CS2
8	/RD
9	/WR
10	NC
11	D0
12	D1
13	D2
14	D3
15	D4
16	D5
17	D6
18	D7
19	VLED+
20	VLED-

NOTES:
1.DISPLAY TYPE: STN/Y-G MODE
2.VIEWING DIRECTION: 6:00
3.POLARIZER MODE: TRANSFLECTIVE/POSITIVE
4.DRIVE METHOD: 1/64 DUTY 1/9 BIAS
5.LCD OPERATING VOLTAGE: 10.0V
6.VDD=2.6~3.0V
7.OPERATING TEMP.: -25°~+70°
8.STORAGE TEMP.: -35°~+80°
9.CONTROLLER: SSD1815BZx2
10.BACKLIGHT TYPE: LED
11.WITH PCB TESTING BOARDING
12.UNMARKED TOLERANCES: ±0.3mm

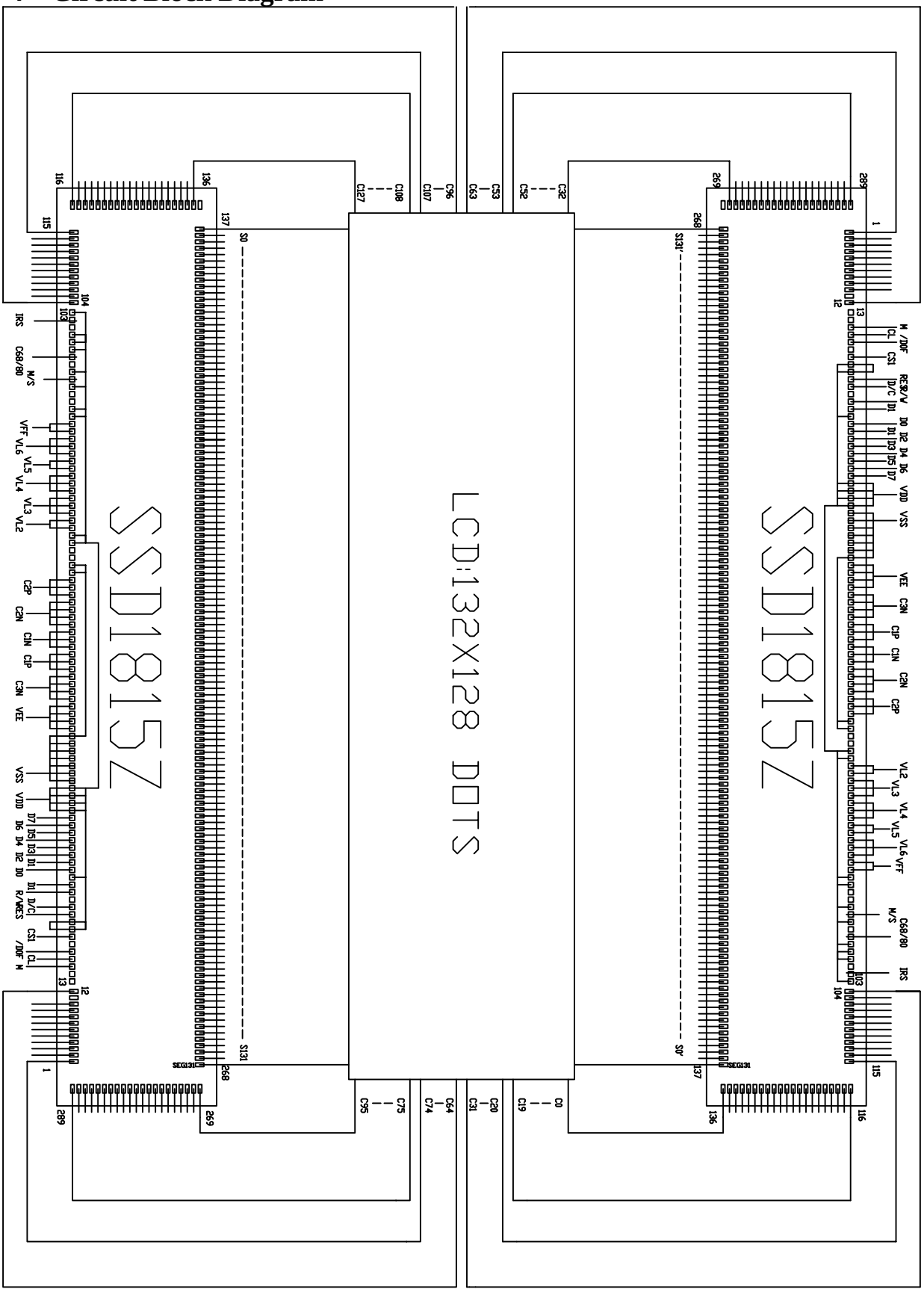
TIAN-MA MICROELECTRONICS CO.
6/F., CASTIC Building, Shennan Road, Central, Shenzhen, China.

DRAWN BY:	TITTLE: TM132128ABCWG-2		
CHECKED BY:			
APPROVED BY:	DWG NO: G-2	SCALE:	
CONFIRMED BY:	DWG NAME: TM132128ABCWG-2	SHEET NO: OF	UNIT: mm

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	6.0	V	
LCD Driving Voltage	V_{LCD}	-	25.0		
Operating Temperature Range	T_{OP}	-25	+70	℃	No Condensation
Storage Temperature Range	T_{ST}	-35	+80		

6 Electrical Specifications and Instruction Code

6.1 Electrical characteristics

Item		Symbol	Min.	Typ.	Max.	Unit
Supply Voltage (Logic)		$V_{DD}-V_{SS}$	2.75	3.0	3.25	V
Supply Voltage (LCD Drive)		V_{LCD}	-	10.0	-	V
Input Signal Voltage	High	V_{IH} (V_{DD}=3.0)	0.8V_{DD}	-	V_{DD}+0.3	V
	Low	V_{IL} (V_{DD}=3.0)	0	-	0.2 V_{DD}	V
Supply current (Logic)		I_{DD} (V_{DD}- V_{SS}=3.0V)	-	-	750	mA
Supply current (LCD Drive)		I_{EE}	-	-	300	mA
Supply current (LED Drive)		I_{LED} (V_{LED} =3.6V DC)	-	-	90.0	mA

6.2 Interface Signals

Pin No.	Symbol	Level	Description
1	NC	--	No Signal
2	GND	0V	Ground
3	VDD	3.0V	Power supply voltage for logic and LCD(+)
4	NC	--	No Signal
5	A0	H/L	Data type(H:Instruction;L:Data)
6	$\overline{CS1}$	H/L	Chip Enable Signal (Active at low)
7	$\overline{CS2}$	H/L	Chip Enable Signal (Active at high)
8	$\overline{RD}$	H/L	Read Signal (Active at low)
9	$\overline{WR}$	H/L	Write Signal (Active at low)
10	NC	--	No Signal
11	DB0	H/L	Data bit0
12	DB1	H/L	Data bit1
13	DB2	H/L	Data bit2
14	DB3	H/L	Data bit3
15	DB4	H/L	Data bit4
16	DB5	H/L	Data bit5
17	DB6	H/L	Data bi6
18	DB7	H/L	Data bit7
19	VLED+	3.6V	Backlight power supply pin （+）
20	VLED-	0V	Backlight power supply pin （-）

6.3 Interface Timing Chart

Parallel Timing Characteristics (T_A=25°C, V_{DD}=2.7V, V_{SS}=0V)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	300	-	-	ns
t_{AS}	Address Setup Time	0	-	-	ns
t_{AH}	Address Hold Time	0	-	-	ns
t_{DSW}	Write Data Setup Time	40	-	-	ns
t_{DHW}	Write Data Hold Time	15	-	-	ns
t_{DHR}	Read Data Hold Time	20	-	-	ns
t_{OH}	Output Disable Time	-	-	70	ns
t_{ACC}	Access Time	-	-	140	ns
PW_{CSL}	Chip Select Low Pulse Width (read) Chip Select Low Pulse Width (write)	120 60	- -	- -	ns ns
PW_{CSH}	Chip Select High Pulse Width (read) Chip Select High Pulse Width (write)	60 60	- -	- -	ns ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns

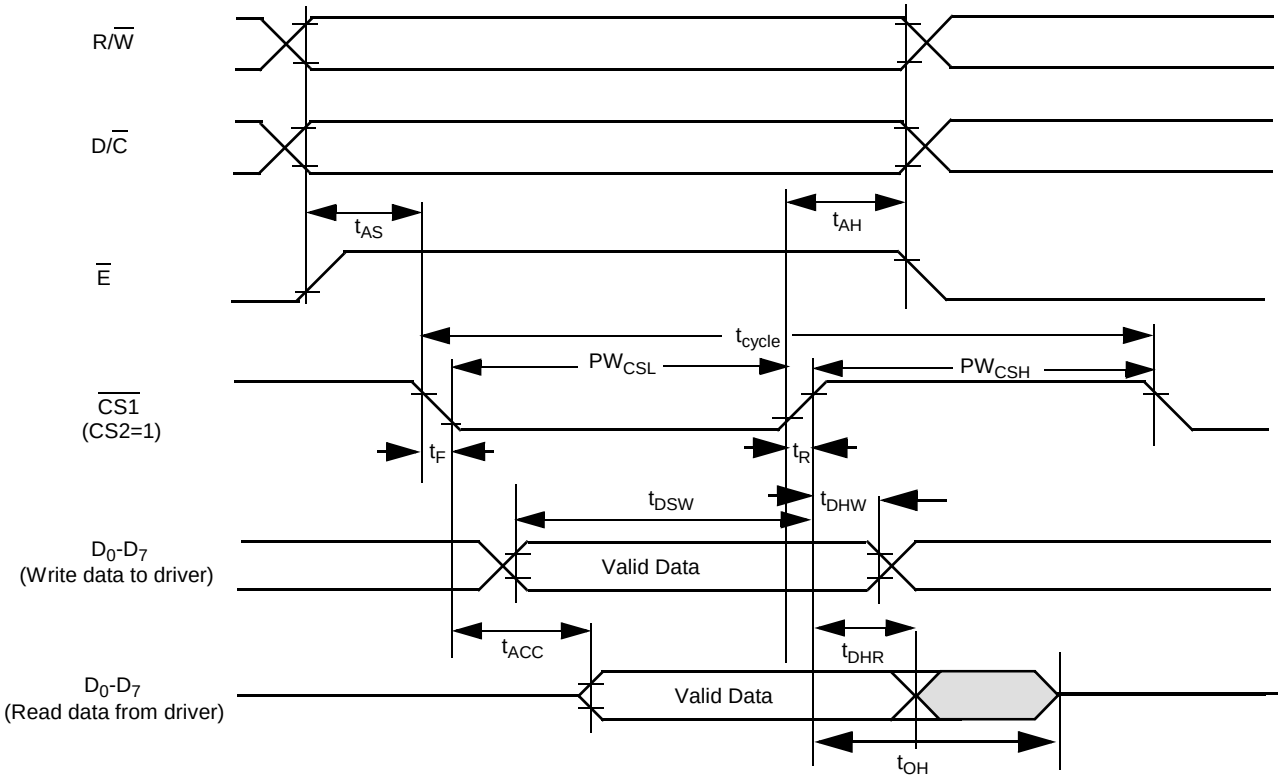


Figure 1. Parallel 6800-series Interface Timing Characteristics

Parallel Timing Characteristics (T_A=25°C, V_{DD}=2.7V, V_{SS}=0V)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	300	-	-	ns
t_{AS}	Address Setup Time	0	-	-	ns
t_{AH}	Address Hold Time	0	-	-	ns
t_{DSW}	Write Data Setup Time	20	-	-	ns
t_{DHW}	Write Data Hold Time	40	-	-	ns
t_{DHR}	Read Data Hold Time	20	-	-	ns
t_{OH}	Output Disable Time	-	-	70	ns
t_{ACC}	Access Time	-	-	140	ns
PW_{CSL}	Chip Select Low Pulse Width (read) Chip Select Low Pulse Width (write)	120 60	- -	- -	ns ns
PW_{CSH}	Chip Select High Pulse Width (read) Chip Select High Pulse Width (write)	60 60	- -	- -	ns ns
t_R	Rise Time	-	-	15	ns
t_F	Fall Time	-	-	15	ns

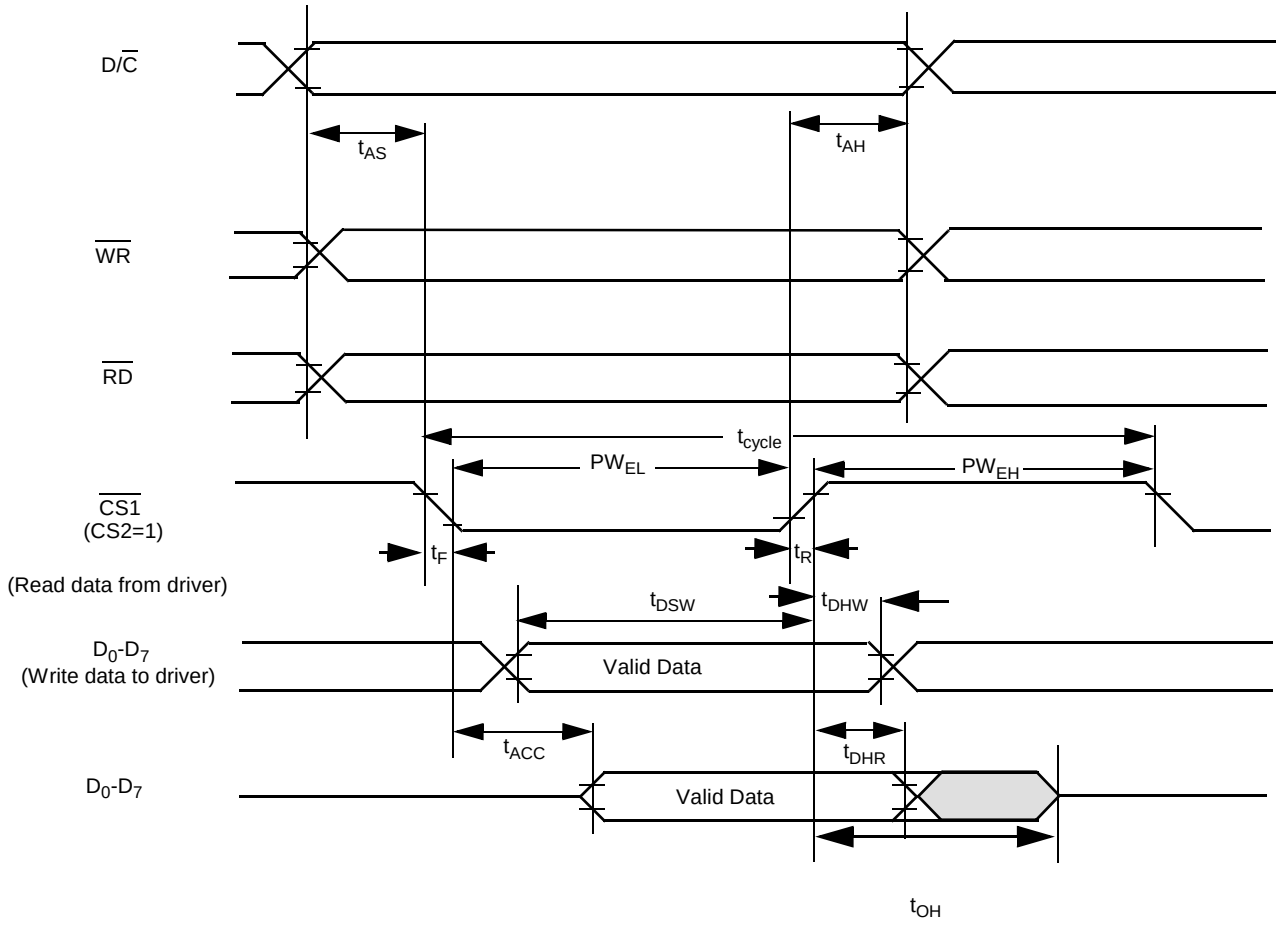


Figure 2. Parallel 8080-series Interface Timing Characteristics

6.4 Instruction Code

Bit Pattern	**Write Command** (D/$\overline{C}$=0, R/$\overline{W}$($\overline{WR}$)=0, $\overline{E}$($\overline{RD}$)=1)	**Comment**
1010111X_0	Set Display On/Off	X_0=0: turns off LCD panel (POR) X_0=1: turns on LCD panel
01$X_5X_4X_3X_2X_1X_0$	Set Display Start Line	Set display RAM display start line register from 0-63 using $X_5X_4X_3X_2X_1X_0$. Display start line register is reset to 000000 during POR.
1011$X_3X_2X_1X_0$	Set Page Address	Set GDDRAM Page Address (0-8) using $X_3X_2X_1X_0$
0001$X_3X_2X_1X_0$	Set Higher Column Address	Set the higher nibble of the colume address register using $X_3X_2X_1X_0$ as data bits. The initial display line register is reset to 0000 during POR.
0000$X_3X_2X_1X_0$	Set Lower Column Address	Set the lower nibble of the colume address register using $X_3X_2X_1X_0$ as data bits. The initial display line register is reset to 0000 during POR.
1010000X_0	Set Segment Re-map	X_0=0: column address 00H is mapped to SEG0 (POR) X_0=1: column address 83H is mapped to SEG0 Refer to Fig. 5 for details.
1010011X_0	Set Normal/Reverse Display	X_0=0: normal display (POR) X_0=1: reverse display
1010010X_0	Set Entire Display On/Off	X_0=0: normal display (POR) X_0=1: entire display on
1010001X_0	Set LCD Bias	X_0=0: 1/9 bias (POR) X_0=1: 1/7 bias For setting bias ratio to 1/4, 1/5, 1/6 or 1/8, see Extended Command Table.
11100000	Set Read-Modify-Write Mode	Read-modify-write mode will be entered in which the column address will not be incremented during display data read
11101110	Set End of Read-Modify-Write Mode	Exit Read-modify-write mode. Column address before entering the mode will be restored
11100010	Software Reset	Initialize the internal status
1100X_3 * * *	Set COM Output Scan Direction	X_3=0: normal mode (POR) X_3=1: remapped mode. COM0 to COM[N-1] becomes COM[N-1] to COM0 in Multiplex ratio is equal to N. See Fig.5 as an example for N equal to 64.
00101$X_2X_1X_0$	Set Power Control Register	X_0=0: turns off the output op-amp buffer (POR) X_0=1: turns on the output op-amp buffer X_1=0: turns off the internal regulator (POR) X_1=1: turns on the internal regulator X_2=0: turns off the internal voltage booster (POR) X_2=1: turns on the internal voltage booster
00100$X_2X_1X_0$	Set Internal Regulator Resistor Ratio	Internal regulator gain increases as $X_2X_1X_0$ increased from 000b to 111b.
10000001 * * $X_5X_4X_3X_2X_1X_0$	Set Contrast Control Register	Set Contrast level from 64 contrast steps. Contrast increases as $X_5X_4X_3X_2X_1X_0$ is increased. $X_5X_4X_3X_2X_1X_0$ = 100000b (POR)
1010110X_0 * * * * * * X_1X_0	Set Indicator On/Off Indicator Display Mode, This second byte command is required ONLY when “Set Indicator On” command is sent.	X_0 = 0: indicator off (POR, no need of second command byte) X_0 = 1: indicator on (second command byte required) X_1X_0 = 00: indicator off X_1X_0 = 01: indicator on and blinking at ~1 second interval X_1X_0 = 10: indicator on and blinking at ~1/2 second interval X_1X_0 = 11: indicator on constantly
* * * * * * * *	Set Power Save Mode	Standby or sleep mode will be entered with compound commands
11100011	NOP	Command for No Operation
1111 * * * *	Set Test Mode	Reserved for IC testing. Do NOT use.
11110000	Test Mode Reset	Reserved for IC testing. Do NOT use.

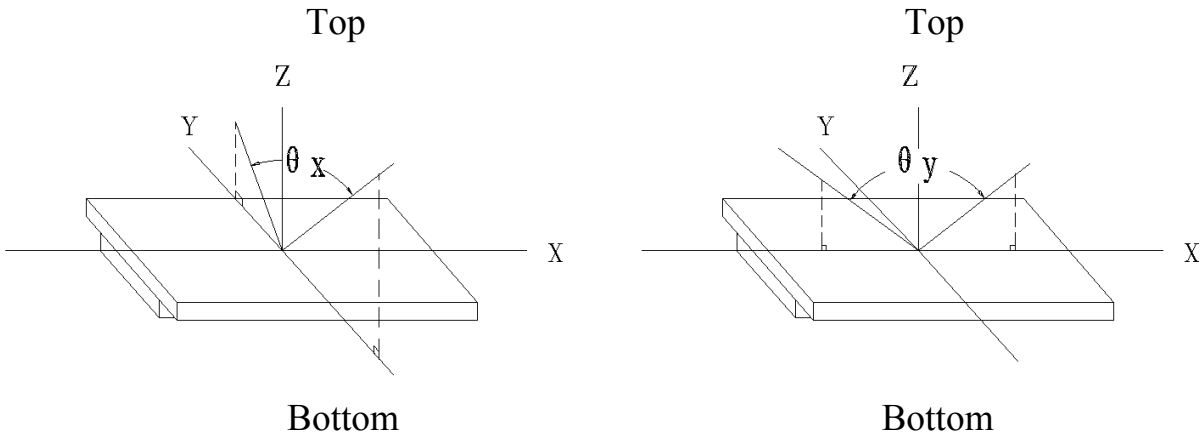
7 Optical Characteristics

7.1 Optical Characteristics Ta=25℃

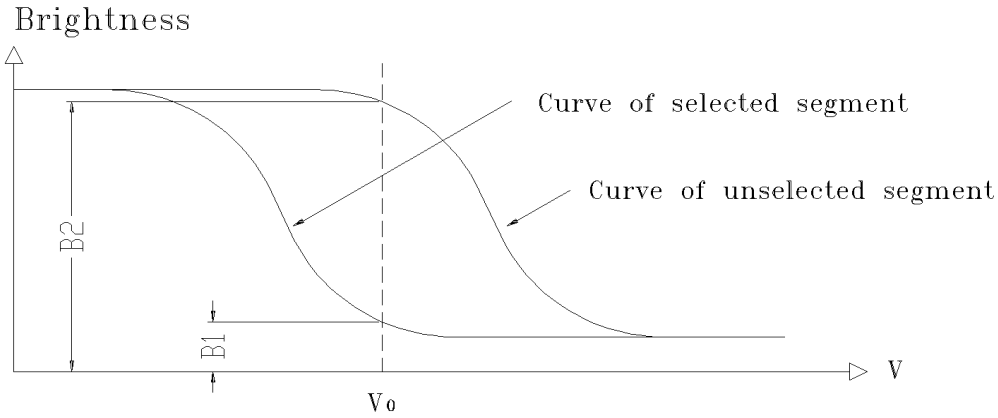
Item		Symbol	Condition		Min.	Typ.	Max.	Unit
Viewing Angle		θ_x	$C_r \geq 2$	$\theta_y=0°$	-30 -- 20			Deg
		θ_y		$\theta_x=0°$	-30 -- 30			
Contrast Ratio		C_r	$\theta_x=0°$ $\theta_y=0°$		3.0	-	-	
Response Time	Turn on	T_{on}	$\theta_x=0°$ $\theta_y=0°$		-	-	300	ms
	Turn off	T_{off}			-	-	300	

7.2 Definition of Optical Characteristics

7.2.1 Definition of Viewing Angle



7.2.2 Definition of Contrast Ratio

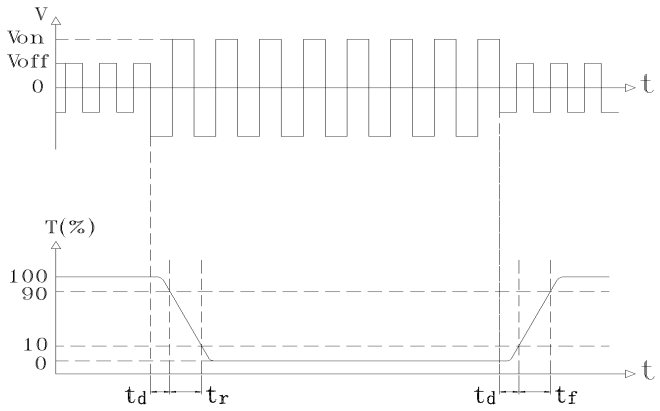


$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

1) Ambient Temperature: 25℃ ; 2) Frame frequency: 84Hz

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:10.0V 2) Frame frequency: 84Hz

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℃ 240H Restore 4H at 25℃
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	-35℃ 240H Restore 4H at 25℃
3	High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the thermal stress to the element for a long time	70℃ 240H
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time	-25℃ 240H
5	High Temperature /Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time	60℃ 95%RH 240H Restore 4H at 25℃
6	Temperature Cycle	Endurance test applying the low and high temperature cycle -35℃⟷25℃⟷80℃⟷25℃ 30min 5min 30min 5min ←——————————→ 1 cycle	-35℃/80℃ 10 cycles
7	Vibration Test (package state)	Endurance test applying the vibration during transportation	10Hz~500Hz, 100m/s^2, 120min
8	Shock Test (package state)	Endurance test applying the shock during transportation	Half- sine wave, 300m/s^2, 18ms
9	Atmospheric Pressure Test	Endurance test applying the atmospheric pressure during transportation by air	25kPa 16H Restore 2H

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℃

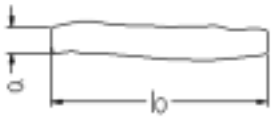
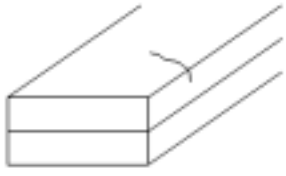
Relatively humidity: ≤80%

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.

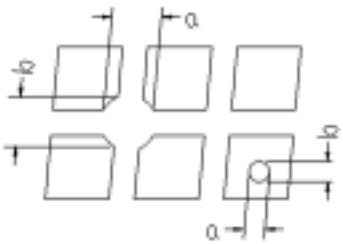
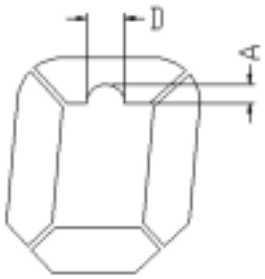
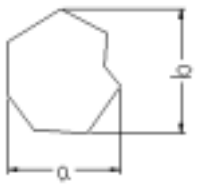
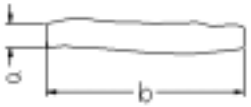
Appendix A

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="4">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>Black spot (in viewing area)</td><td>  </td><td>Not counted</td><td>Max. 3 spots allowed</td><td rowspan="3">Max. 3 spots (lines) allowed</td></tr>
<tr><td></td><td>X<0.2mm</td><td>0.2mm≤X≤0.5mm</td></tr>
<tr><td></td><td colspan="2">X=(a+b)/2</td></tr>
<tr><td>Black line (in viewing area)</td><td>  </td><td>Not counted</td><td>Max. 3 lines allowed</td><td></td></tr>
<tr><td></td><td>a<0.02mm</td><td>0.02mm≤a≤0.05mm
b≤2.0mm</td><td></td></tr>
<tr><td>Progressive cracks</td><td>  </td><td colspan="3">Not permitted</td></tr>
</table>

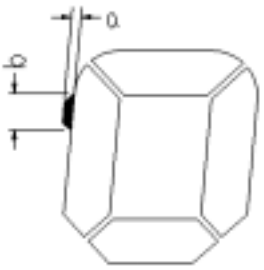
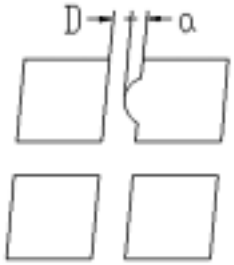
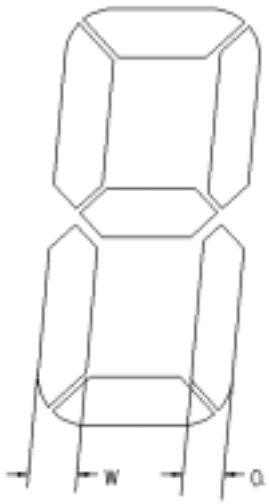
Appendix B

Inspection items and criteria for display defects

<table>
<tr><td colspan="2">Items</td><td>Contents</td><td colspan="4">Critera</td></tr>
<tr><td colspan="3">Open segment or open common</td><td colspan="4">Not permitted</td></tr>
<tr><td colspan="3">Short</td><td colspan="4">Not permitted</td></tr>
<tr><td colspan="3">Wrong viewing angle</td><td colspan="4">Not permitted</td></tr>
<tr><td colspan="3">Contrast radio uneven</td><td colspan="4">According to the limit specimen</td></tr>
<tr><td colspan="3">Crosstalk</td><td colspan="4">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></td><td>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><td>Items</td><td>Content</td><td colspan="3">Critera</td></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">Max.3
defects
allowed</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>