SPECIFICATION FOR LCD MODULE

Model No. TM402GFF8

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

TIANMA MICROELECTRONICS CO., LTD

Ver 1.0

www.DataSheet4U.com

REVISION RECORD

Date	Ver.	Ref. Page	Revision No.	Revision Item

1 General Specifications:

1.1 Display type: STN

1.2 Display color*[1]:

Display color*[2]: White

Background: Blue

1.3 Polarizer mode: Transmissive/Negative

1.4 Viewing Angle: 6:00

1.5 Driving Method: 1/16 Duty 1/5 Bias

1.6 Backlight: LED

1.7 Controller: SPLC780A1-01C-C

1.8 Display Fonts: 5 x 7 dots+Cursor (1 Character)

1.9 Data Transfer: 8 Bit Parallel

1.10 Operating Temperature: 0----+50℃

Storage Temperature: -20----+60℃

1.11 Outline Dimensions: Refer to outline drawing on next page

1.12 Dot Matrix: 40 Characters X 2 Lines

1.13 Dot Size: 0.65X0.60(mm)

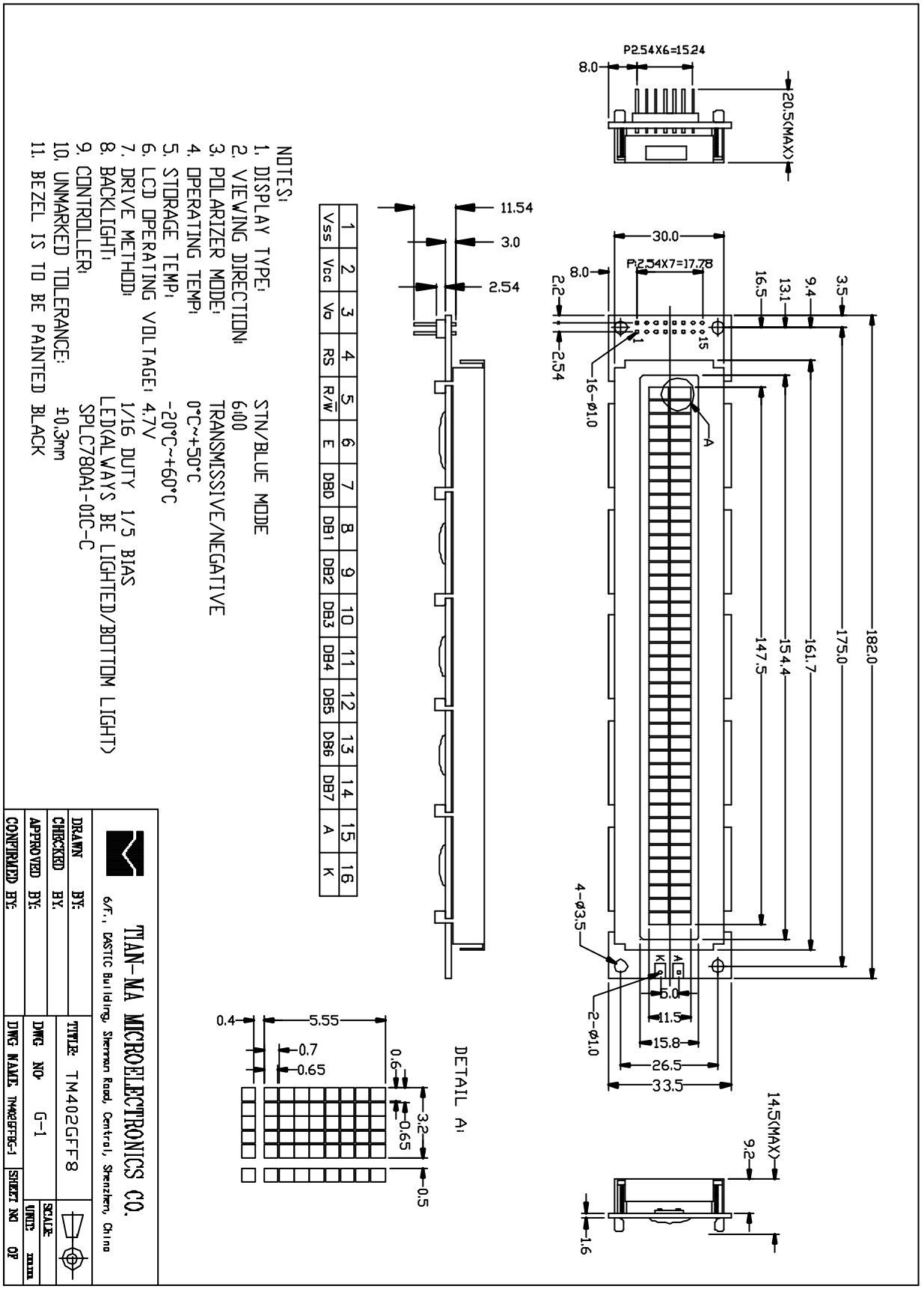
1.14 Dot Pitch: 0.70X0.65 (mm)

1.15 Weight: Approx 82g

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

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

2 Outline Drawing



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Vss	Vcc	Vo	RS	R/W	E	DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7	A	K

NOTES:

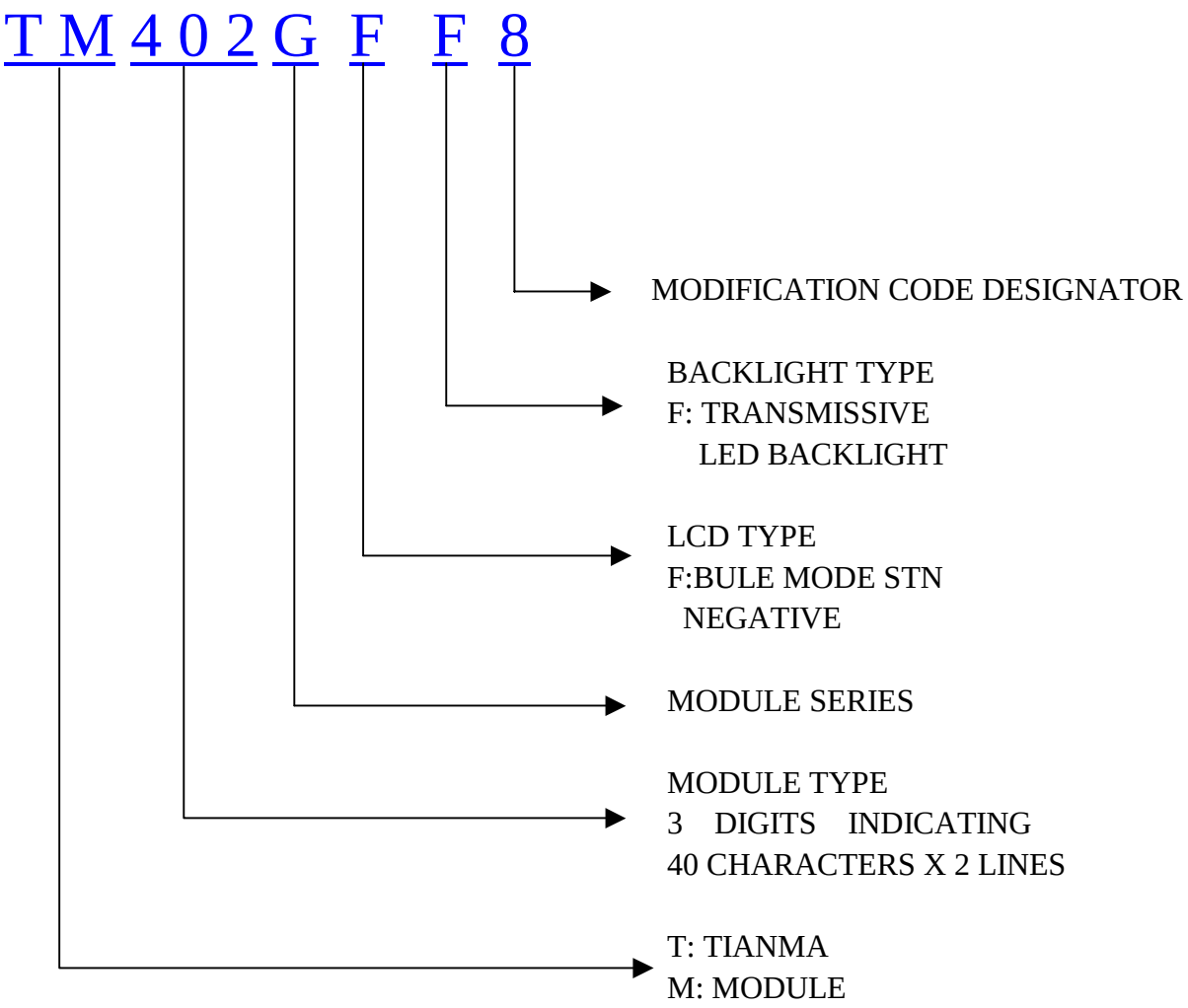
1. DISPLAY TYPE: STN/BLUE MODE
2. VIEWING DIRECTION: 6:00
3. POLARIZER MODE: TRANSMISSIVE/NEGATIVE
4. OPERATING TEMP: 0°C~+50°C
5. STORAGE TEMP: -20°C~+60°C
6. LCD OPERATING VOLTAGE: 4.7V
7. DRIVE METHOD: 1/16 DUTY 1/5 BIAS
8. BACKLIGHT: LED(ALWAYS BE LIGHTED/BOTTOM LIGHT)
9. CONTROLLER: SPLC780A1-01C-C
10. UNMARKED TOLERANCE: ±0.3mm
11. BEZEL IS TO BE PAINTED BLACK

TIAN-MA MICROELECTRONICS CO.

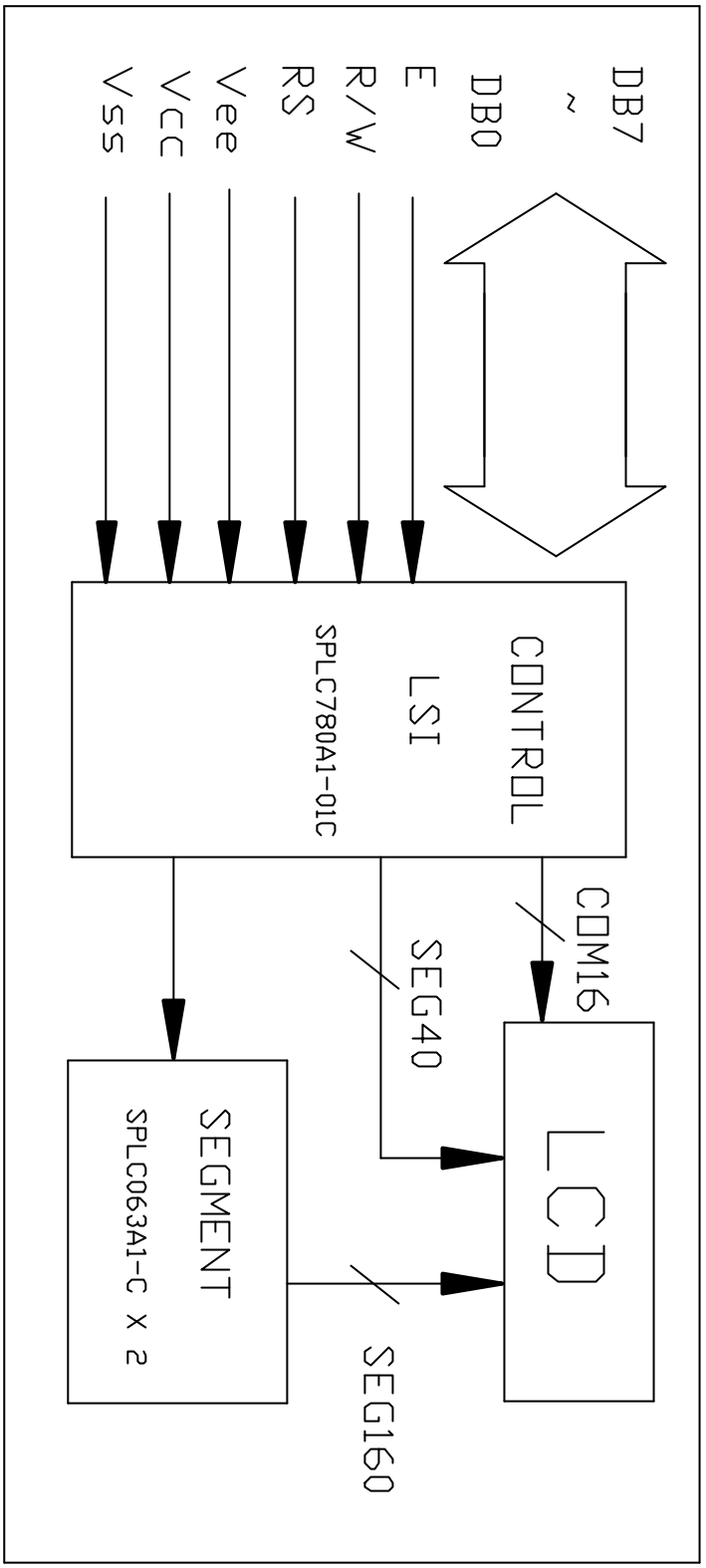
6/F., PASTIC Building, Sherman Road, Central, Shenzhen, China

DRAWN BY:	TITLE: TM402GFF8		
CHECKED BY:		SCALE:	
APPROVED BY:	DWG NO: G-1	UNIT:	mm
CONFIRMED BY:	DWG NAME: TM402GFFG-1	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	7.0	V	
LCD Driving Voltage	V_{LCD}	-0.3	13.0		
Operating Temperature Range	T_{OP}	0	+50	℃	No Condensation
Storage Temperature Range	T_{ST}	-20	+60		

6 Electrical Specifications and Instruction Code

6.1 Electrical characteristics

Item		Symbol	Min.	Typ.	Max.	Unit
Supply Voltage (Logic)		$V_{DD}-V_{SS}$	4.5	5.0	5.5	V
Supply Voltage (LCD Drive)		V_{LCD}	-	4.7	-	V
Input Signal Voltage	High	V_{IH} (V_{DD}=5.0)	0.7V_{DD}	-	V_{DD}+0.3	V
	Low	V_{IL} (V_{DD}=5.0)	-0.3	-	0.2 V_{DD}	V
Supply current (Logic)		I_{DD} (V_{DD}- V_{SS}=5.0V)	-	1.4	-	mA
Supply current (LCD Drive)		I_{EE}	-	0.85	-	mA
Supply current (LED)		I_{LED}			410.3	mA

6.2 Interface Signals

Pin No.	Symbol	Level	Description
1	Vss	0V	Ground
2	Vcc	5.0V	Power supply voltage for logic and LCD(+)
3	Vo	0.3V	Power supply voltage for LCD(-)
4	RS	H/L	Selects registers
5	R/W	H/L	Read/Write Signal
6	E	H/L	Chip enable Signal
7	DB0	H/L	Data bit0
8	DB1	H/L	Data bit1
9	DB2	H/L	Data bit2
10	DB3	H/L	Data bit3
11	DB4	H/L	Data bit4
12	DB5	H/L	Data bit5
13	DB6	H/L	Data bit6
14	DB7	H/L	Data bit7
15	LED+	4.2V	Backlight Power Supply(+)
16	LED-	0v	Backlight Power Supply(-)

6.3 Interface Timing Chart

AC CHARACTERISTICS (T_A = 25℃, VDD = 4.5 to 5.5V)

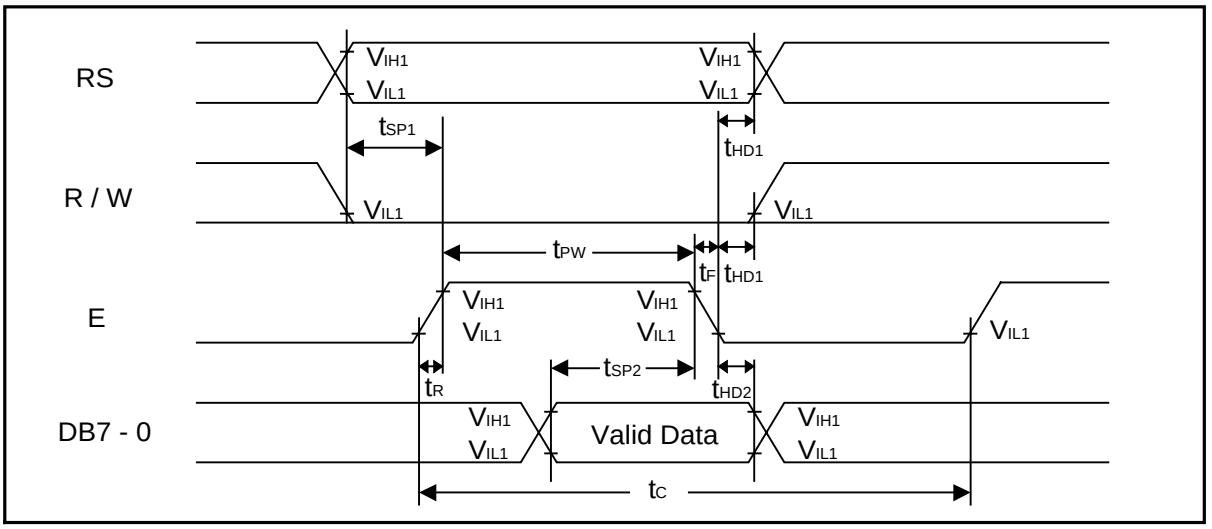
■ WRITE MODE (Writing data from MPU to SPLC780A1)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
E Cycle Time	t_C	400	-	-	ns	Pin E
E Pulse Width	t_{PW}	150	-	-	ns	Pin E
E Rise/Fall Time	t_R, t_F	-	-	25	ns	Pin E
Address Setup Time	t_{SP1}	30	-	-	ns	Pins: RS, R/W, E
Address Hold Time	t_{HD1}	10	-	-	ns	Pins: RS, R/W, E
Data Setup Time	t_{SP2}	40	-	-	ns	Pins: DB7 – 0
Data Hold Time	t_{HD2}	10	-	-	ns	Pins: DB7 – 0

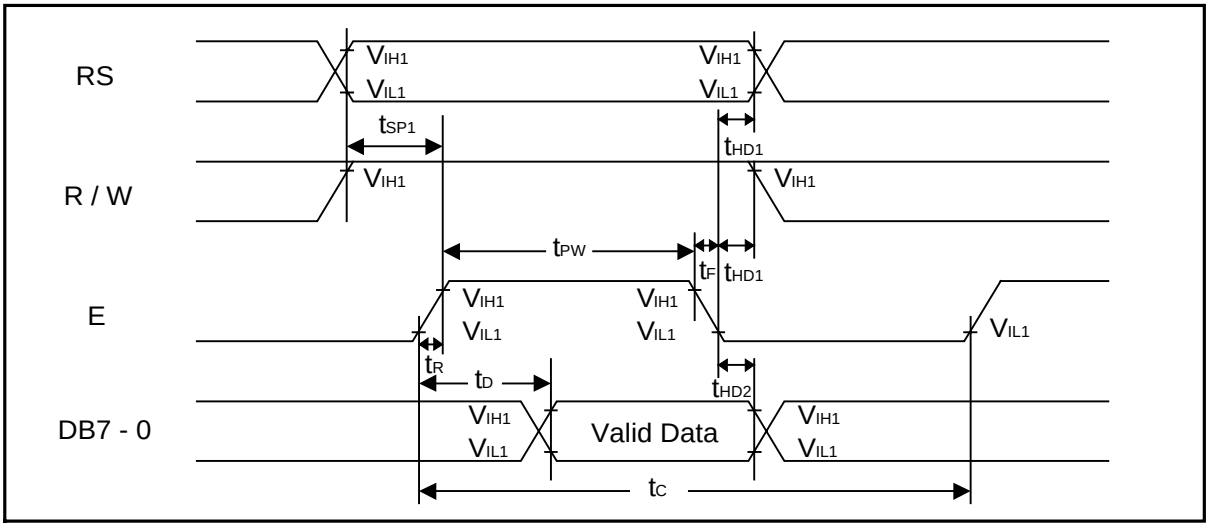
■ READ MODE (Reading data from SPLC780A1 to MPU)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
E Cycle Time	t_C	400	-	-	ns	Pin E
E Pulse Width	t_W	150	-	-	ns	Pin E
E Rise/Fall Time	t_R, t_F	-	-	25	ns	Pin E
Address Setup Time	t_{SP1}	30	-	-	ns	Pins: RS, R/W,E
Address Hold Time	t_{HD1}	10	-	-	ns	Pins: RS, R/W,E
Data Output Delay Time	t_D	-	-	100	ns	Pins: DB7 - 0
Data hold time	t_{HD2}	20	-	-	ns	Pin DB7 - 0

■ **WRITE MODE TIMING DIAGRAM (Writing data from MPU to SPLC780A1)**



■ **READ MODE TIMING DIAGRAM (Reading data from SPLC780A1 to MPU)**



6.4 Instruction Code

8-Bit operation and 8-digit 2-line display (using internal reset)

No.	Instruction	Display	Operation
1	Power on . (SPLC780A1 starts initializing)		Power on reset . No display .
2	Function set RS R/W DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0 0 0 0 0 1 1 1 0 X X		Set to 8-bit operation and select 2-line display line and 5 x 7 dot character font .
3	Display on / off control 0 0 0 0 0 0 1 1 1 0	_	Display on . Cursor appear .
4	Entry mode set 0 0 0 0 0 0 0 1 1 0	_	Increase address by one . It will shift the cursor to the right when writing to the DD RAM / CG RAM . Now the display has no shift .
5	Write data to CG RAM / DD RAM 1 0 0 1 0 1 0 1 1 1	W_	Write " W " . The cursor is incremented by one and shifted to the right .
6	⋮	⋮	
7	Write data to CG RAM / DD RAM 1 0 0 1 0 0 0 1 0 1	WELCOME_	Write " E " . The cursor is incremented by one and shifted to the right .
8	Set DD RAM address 0 0 1 1 0 0 0 0 0 0	WELCOME _	It sets DD RAM's address . The cursor is moved to the beginning position of the 2nd line .
9	Write data to CG RAM / DD RAM 1 0 0 1 0 1 0 1 0 0	WELCOME T_	Write " T " . The cursor is incremented by one and shifted to the right .
10	⋮	⋮	
11	Write data to CG RAM / DD RAM 1 0 0 1 0 1 0 1 0 0	WELCOME TO PART_	Write " T " . The cursor is incremented by one and shifted to the right .
12	Entry mode set 0 0 0 0 0 0 0 1 1 1	WELCOME TO PART_	When writing , it sets mode for the display shift .
13	Write data to CG RAM / DD RAM 1 0 0 1 0 1 1 0 0 1	ELCOME O PARTY_	Write " Y " . The cursor is incremented by one and shifted to the right .
14	⋮	⋮	
15	Return home 0 0 0 0 0 0 0 0 1 0	WELCOME TO PARTY	Both the display and the cursor return to the original position (address 0) .

6.5 Character generator ROM(SPLC780A1-01)

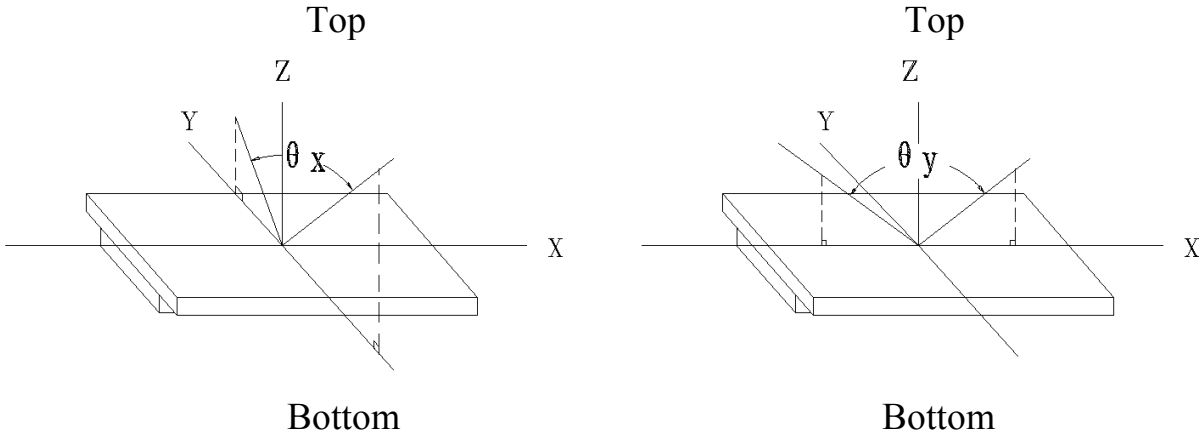
7 Optical Characteristics

7.1 Optical Characteristics Ta=25℃

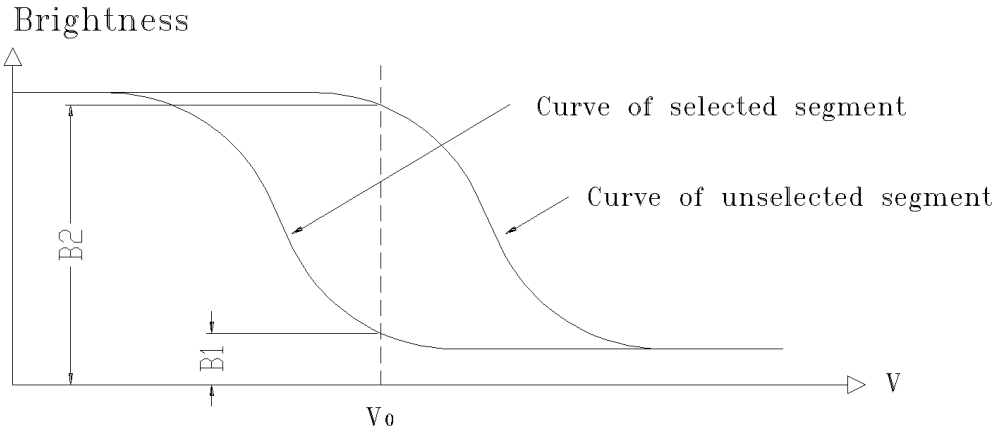
Item		Symbol	Condition		Min.	Typ.	Max.	Unit
Viewing Angle		θ_x	$C_r \geq 2$	$\theta_y=0°$	-35	--	20	Deg
		θ_y		$\theta_x=0°$	-30	--	30	
Contrast Ratio		C_r	$\theta_x=0°$ $\theta_y=0°$		4.0	-	-	
Response Time	Turn on	T_{on}	$\theta_x=0°$ $\theta_y=0°$		-	-	250	ms
	Turn off	T_{off}			-	-	250	

7.2 Definition of Optical Characteristics

7.2.1 Definition of Viewing Angle



7.2.2 Definition of Contrast Ratio

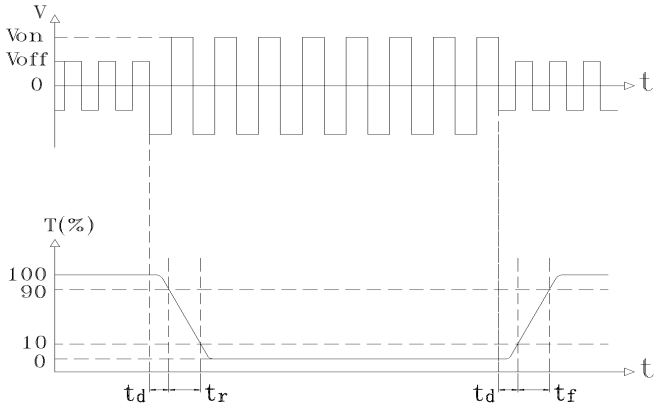


$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

1) Ambient Temperature: 25℃ ; 2) Frame frequency: 78.1Hz

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: 4.7V 2) Frame frequency: 78.1Hz

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	60℃ 96H
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	-20℃ 96H
3	High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the thermal stress to the element for a long time	50℃ 96H
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time	0℃ 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 -20℃ ⟷ 25℃ ⟷ 60℃ ⟷ 25℃ 30min 5min 30min 5min 1 cycle	-20℃/60℃ 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℃

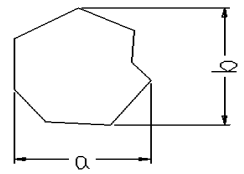
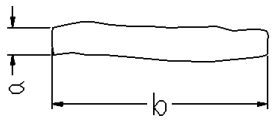
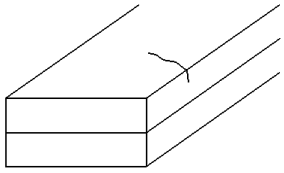
Relatively humidity: ≤80%

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.

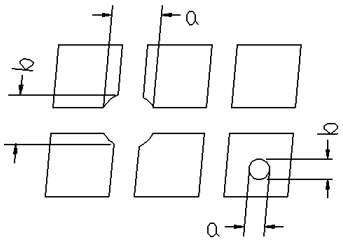
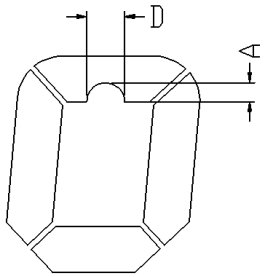
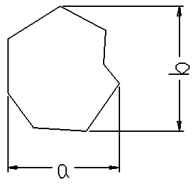
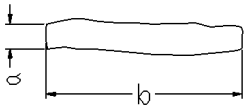
Appendix A

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="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 rowspan="2">Black line (in viewing area)</td><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">  </td><td>Not counted</td><td colspan="2">Max. 3 lines allowed</td></tr>
<tr><td>a<0.02mm</td><td colspan="2">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>

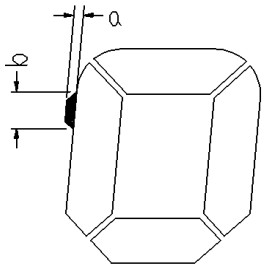
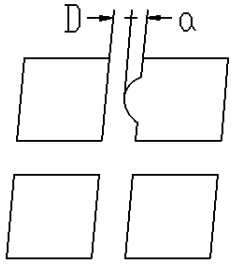
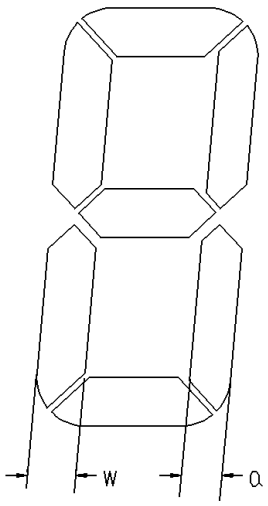
Appendix B

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="3"> 
</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="3">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 rowspan="2">  </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>