SPECIFICATION FOR LCD MODULE

Model No. TM78AAA6

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

TIANMA MICROELECTRONICS CO., LTD

Ver.1.0

REVISION RECORD

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

1 General Specifications:

1.1 Display type: TN

1.2 Display color*[1]:

Display color: Blue-Black

Background: Gray

1.3 Polarizer mode: Reflective/Positive

1.4 Viewing Angle: 6:00

1.5 Driving Method: 1/4 Duty 1/3 Bias

1.6 LCD Operating Voltage: 3.3V VDD: 3.3V

1.7 Without Backlight

1.8 Display Fonts: Segment

1.9 Controller: HT1621

1.10 Data Transfer: Series

1.11 Operating Temperature: 0----+50℃

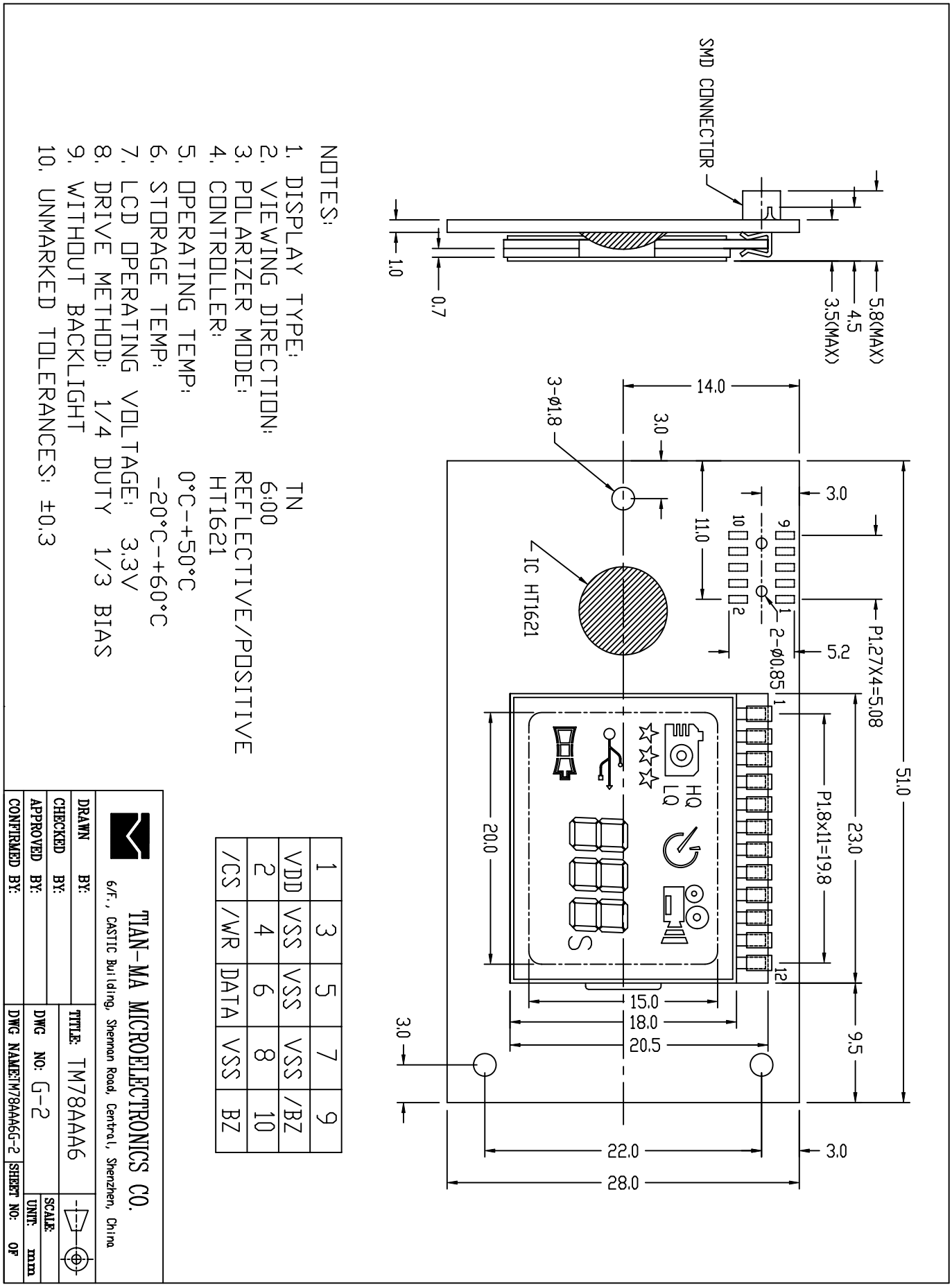
Storage Temperature: -20----+60℃

1.12 Outline Dimensions: Refer to outline drawing on next page

1.13 Weight: Approx.15g

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

2 Outline Drawing



NOTES:

1. DISPLAY TYPE: TN
2. VIEWING DIRECTION: 6:00
3. POLARIZER MODE: REFLECTIVE/POSITIVE
4. CONTROLLER: HT1621
5. OPERATING TEMP: 0°C~+50°C
6. STORAGE TEMP: -20°C~+60°C
7. LCD OPERATING VOLTAGE: 3.3V
8. DRIVE METHOD: 1/4 DUTY 1/3 BIAS
9. WITHOUT BACKLIGHT
10. UNMARKED TOLERANCES: ±0.3

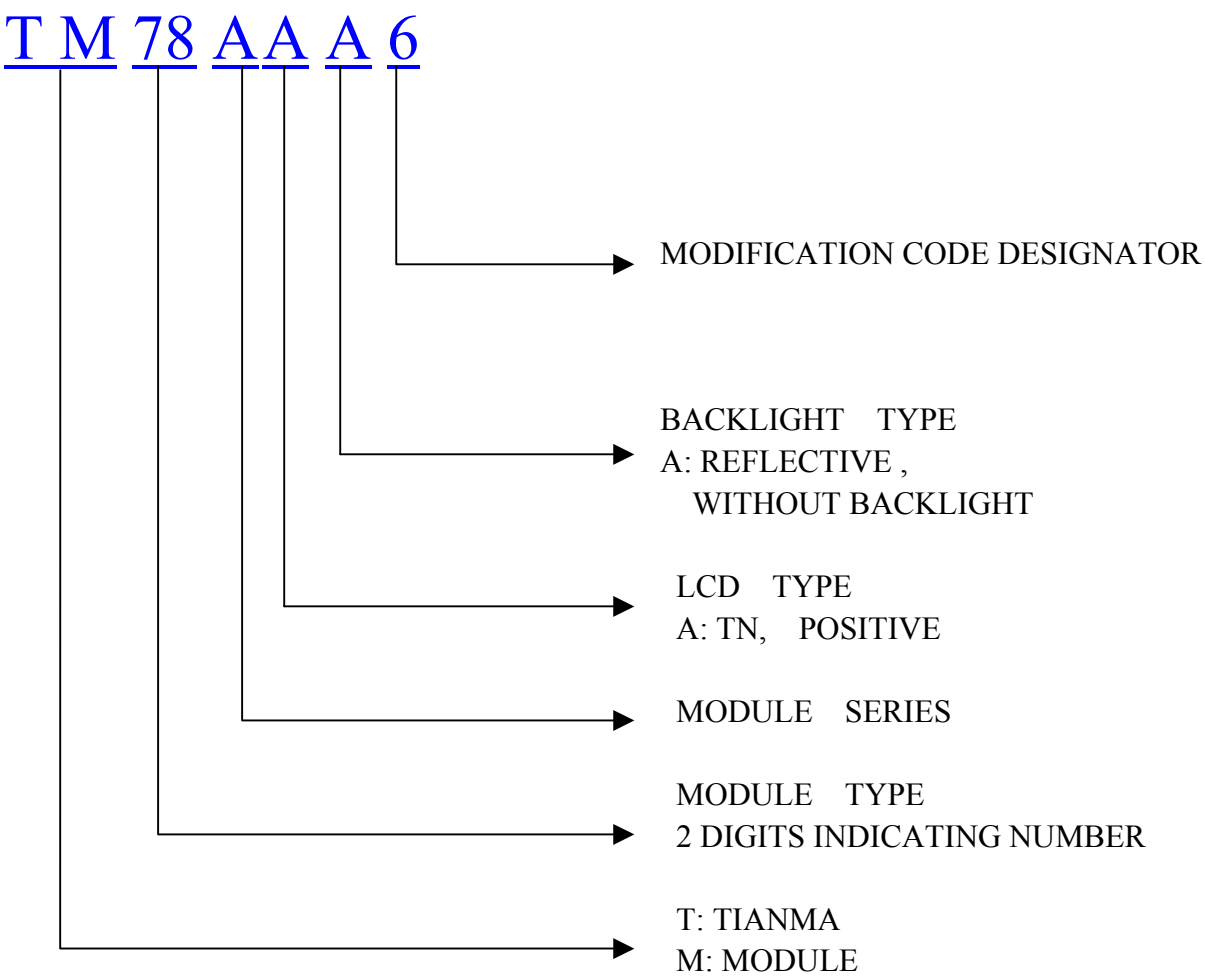
1	3	5	7	9
VDD	VSS	VSS	VSS	/BZ
2	4	6	8	10
/CS	/WR	DATA	VSS	BZ

TIAN-MA MICROELECTRONICS CO.

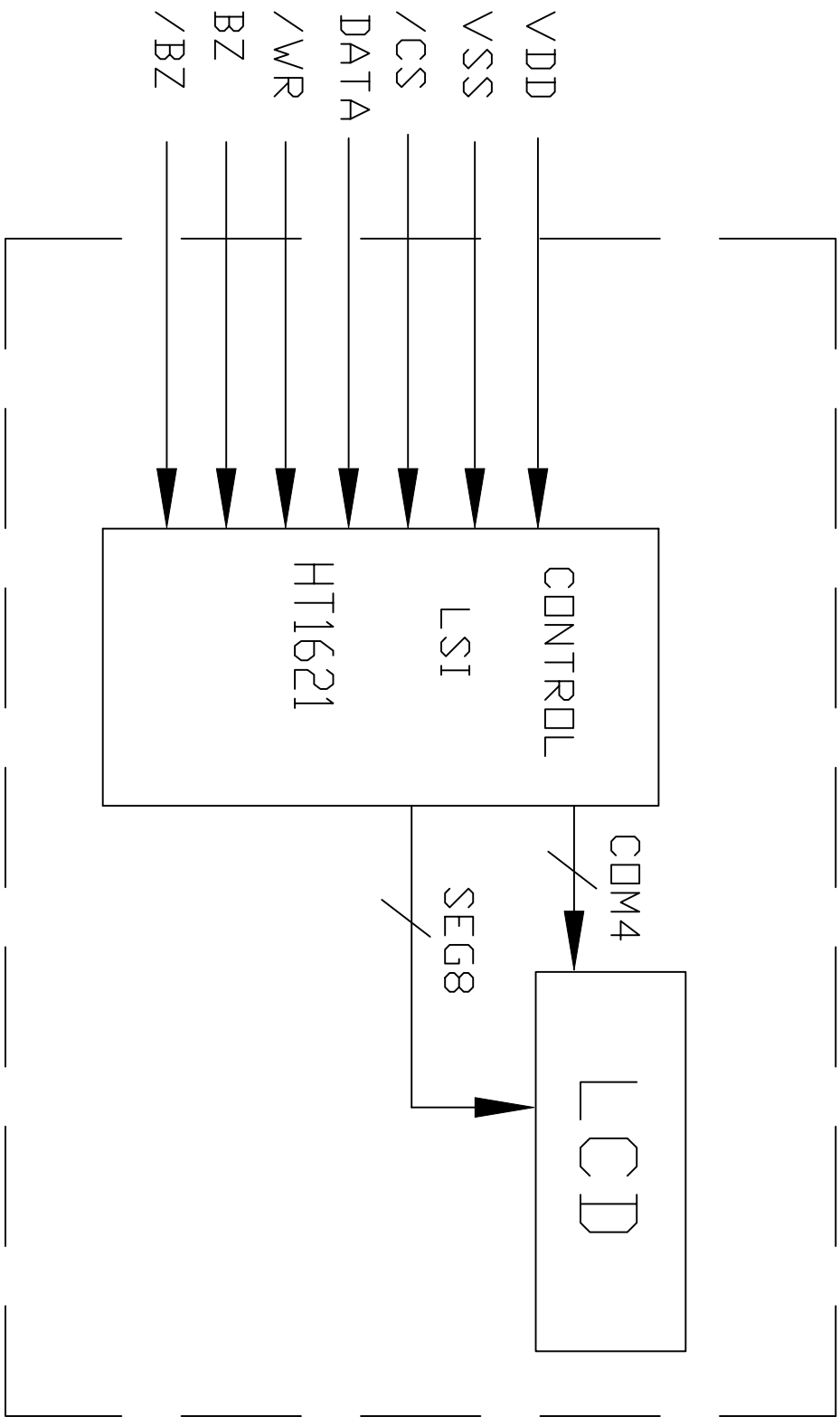
6/F., CASTIC Building, Shennan Road, Central, Shenzhen, China

DRAWN BY:		TITLE: TM78AAA6	SCALE:
CHECKED BY:			UNIT: mm
APPROVED BY:		DWG NO: G-2	
CONFIRMED BY:		DWG NAME:TM78AAA6G-2	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	5.5	V	
LCD Driving Voltage	V_{LCD}	-0.3	5.5		
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)		$V_{DD}-V_{SS}$	2.7	3.3	5.2	V
Supply Voltage (LCD Drive)		V_{LCD}	3.0	3.3	3.6	V
Input Signal Voltage	High	V_{IH} （V_{DD}=3.3V）	2.4	-	3.3	V
	Low	V_{IL} （V_{DD}=3.3V）	0	-	0.6	V
Supply current (Logic)		I_{DD} ($V_{DD}-V_{SS}$ =3.3V)	-	-	1.0	mA

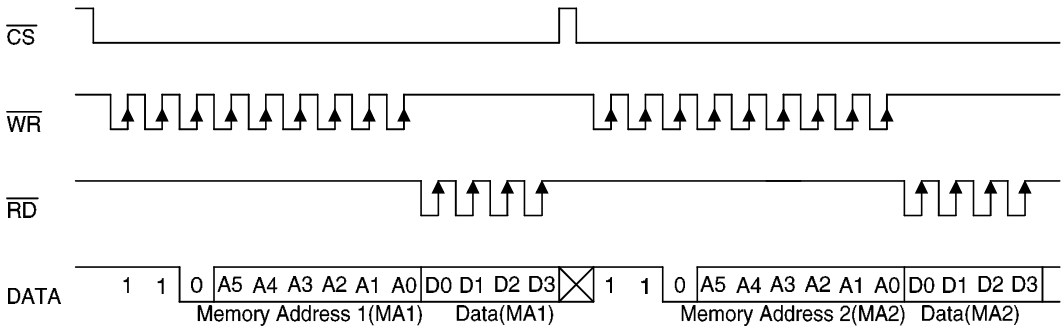
6.2 Interface Signals

Pin No.	Symbol	Level	Description
1	VDD	3.3V	Logic Voltage Input for LCD Drive Circuit
2	/CS	H/L	Chip Select signal
3	VSS	0V	Logic GND for LCD Drive Circuit
4	/WR	H/L	Write signal
5	VSS	0V	Logic GND for LCD Drive Circuit
6	DATA	H/L	Data signal
7	VSS	0V	Logic GND for LCD Drive Circuit
8	VSS	0V	Logic GND for LCD Drive Circuit
9	/BZ	-	Tone frequency output pad
10	BZ	-	Tone frequency output pad

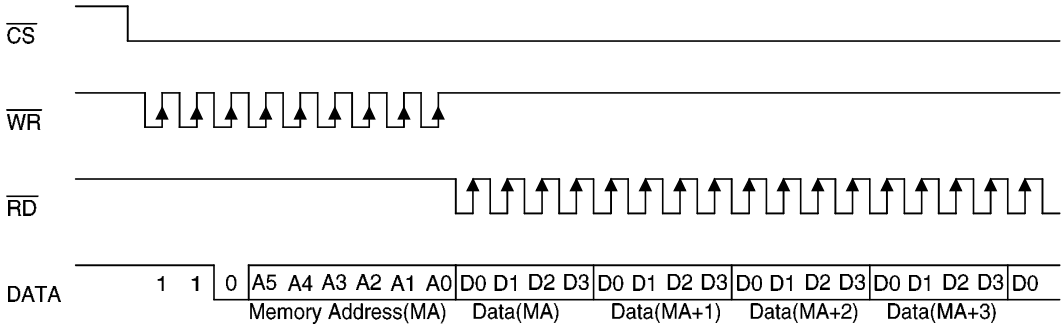
6.3 Interface Timing Chart

AC Characteristics

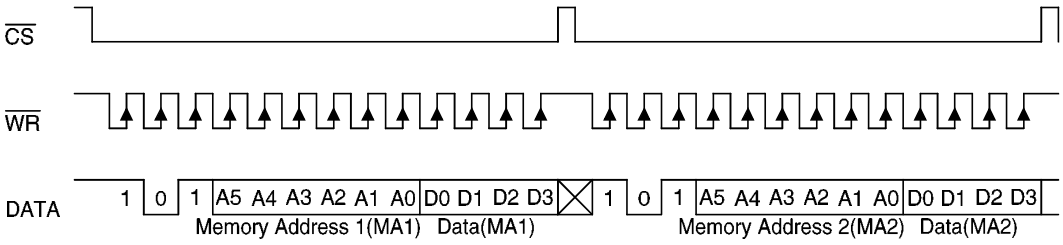
READ mode (command code : 1 1 0)



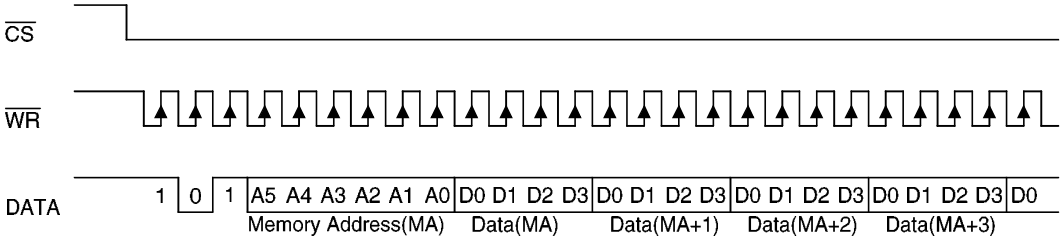
READ mode(successive address reading)



WRITE mode (command code : 1 0 1)



WRITE mode(successive address writing)



6.4 Instruction Code

Name	Command Code	D/C	Function	Power On Reset Default
READ	**1 1 0** a5 a4 a3 a2 a1 a0 d0 d1 d2 d3	D	Read data in the RAM	
WRITE	**1 0 1** a5 a4 a3 a2 a1 a0 d0 d1 d2 d3	D	Write data to the RAM	
READ MODIFY WRITE	**1 0 1** a5 a4 a3 a2 a1 a0 d0 d1 d2 d3	D	READ and WRITE to the RAM	
SYS DIS	**1 0 0** 0 0 0 0 0 0 0 0 0 X	C	Turn off both system oscillator and LCD bias generator	√
SYS EN	**1 0 0** 0 0 0 0 0 0 0 0 1 X	C	Turn on system oscillator	
LCD OFF	**1 0 0** 0 0 0 0 0 0 0 1 0 X	C	Turn off LCD bias generator	√
LCD ON	**1 0 0** 0 0 0 0 0 0 0 1 1 X	C	Turn on LCD bias generator	
TIMER DIS	**1 0 0** 0 0 0 0 0 1 0 0 X	C	Disable time base output	
WDT DIS	**1 0 0** 0 0 0 0 0 1 0 1 X	C	Disable WDT time-out flag output	
TIMER EN	**1 0 0** 0 0 0 0 0 1 1 0 X	C	Enable time base output	
WDT EN	**1 0 0** 0 0 0 0 0 1 1 1 X	C	Enable WDT time-out flag output	
TONE OFF	**1 0 0** 0 0 0 0 1 0 0 0 X	C	Turn off tone outputs	√
TONE ON	**1 0 0** 0 0 0 0 1 0 0 1 X	C	Turn on tone outputs	
CLR TIMER	**1 0 0** 0 0 0 0 1 1 X X X	C	Clear the contents of time base generator	
CLR WDT	**1 0 0** 0 0 0 0 1 1 1 X X	C	Clear the contents of WDT stage	
XTAL 32K	**1 0 0** 0 0 0 1 0 1 X X X	C	System clock source, crystal oscillator	
RC 256K	**1 0 0** 0 0 0 1 1 0 X X X	C	System clock source, on-chip RC oscillator	√
EXT 256K	**1 0 0** 0 0 0 1 1 1 X X X	C	System clock source, external clock source	
BIAS 1/2	**1 0 0** 0 0 1 0 a b X 0 X	C	LCD 1/2 bias option ab=00: 2 commons option ab=01: 3 commons option ab=10: 4 commons option	

Name	Command Code	D/C	Function	Power On Reset Default
BIAS 1/3	**1 0 0** 0 0 1 0 a b X 1 X	C	LCD 1/3 bias option ab=00: 2 commons option ab=01: 3 commons option ab=10: 4 commons option	
TONE 4K	**1 0 0** 0 1 0 X X X X X X	C	Tone frequency, 4kHz	
TONE 2K	**1 0 0** 0 1 1 X X X X X X	C	Tone frequency, 2kHz	
$\overline{\text{IRQ}}$ DIS	**1 0 0** 1 0 0 X 0 X X X X	C	Disable $\overline{\text{IRQ}}$ output	√
$\overline{\text{IRQ}}$ EN	**1 0 0** 1 0 0 X 1 X X X X	C	Enable $\overline{\text{IRQ}}$ output	
F1	**1 0 0** 1 0 1 X X 0 0 0 X	C	Time base/WDT clock output 1Hz	
F2	**1 0 0** 1 0 1 X X 0 0 1 X	C	Time base/WDT clock output 2Hz	
F4	**1 0 0** 1 0 1 X X 0 1 0 X	C	Time base/WDT clock output 4Hz	
F8	**1 0 0** 1 0 1 X X 0 1 1 X	C	Time base/WDT clock output 8Hz	
F16	**1 0 0** 1 0 1 X X 1 0 0 X	C	Time base/WDT clock output 16Hz	
F32	**1 0 0** 1 0 1 X X 1 0 1 X	C	Time base/WDT clock output 32Hz	
F64	**1 0 0** 1 0 1 X X 1 1 0 X	C	Time base/WDT clock output 64Hz	
F128	**1 0 0** 1 0 1 X X 1 1 1 X	C	Time base/WDT clock output 128Hz	√
TOPT	**1 0 0** 1 1 1 0 0 0 0 0 X	C	Test mode	
TNORMAL	**1 0 0** 1 1 1 0 0 0 1 1 X	C	Normal mode	√

Note:

X : Don't care

a5~a0 : RAM addresses

d3~d0 : RAM data

D/C : Data/command mode

All the bold forms, namely **1 1 0**, **1 0 1**, and **1 0 0**, are mode commands. Of these, **1 0 0** indicates the command mode ID. If successive commands have been issued, the command mode ID except the first command will be omitted. The source of the tone frequency and of the time base/WDT clock frequency can be derived from an on-chip 256kHz RC oscillator, a 32.768kHz crystal oscillator, or an external 256kHz clock. Calculation of the frequency is based on the system frequency sources as stated above. It is suggested that the host controller should initialize the HT1621 after power on reset, for power on reset may fail, which in turn leads to the malfunctioning of the HT1621.

7 Optical Characteristics

7.1 Optical Characteristics

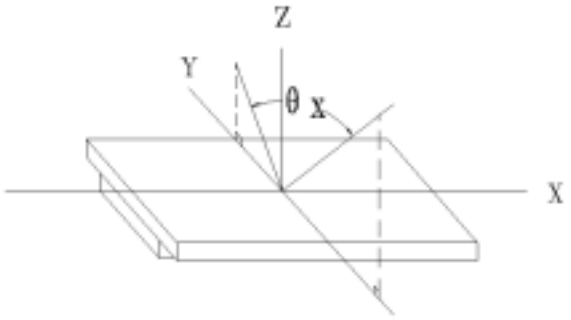
Ta=25℃

Item		Symbol	Condition		Min.	Typ.	Max.	Unit
Viewing Angle		θ_x	$C_r \geq 2$	$\theta_y=0°$	-35	--	10	Deg
		θ_y		$\theta_x=0°$	-30	--	30	
Contrast Ratio		C_r	$\theta_x=0°$ $\theta_y=0°$		3	-	-	
Response Time	Turn on	T_{on}	$\theta_x=0°$ $\theta_y=0°$		-	-	150	ms
	Turn off	T_{off}			-	-	150	

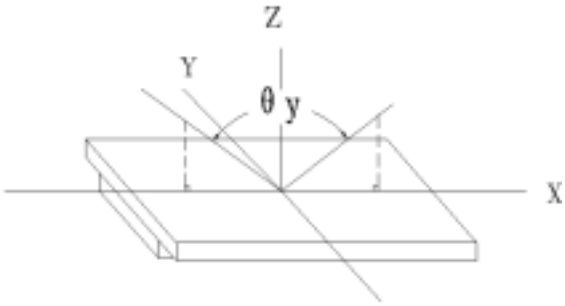
7.2 Definition of Optical Characteristics

7.2.1 Definition of Viewing Angle

Top



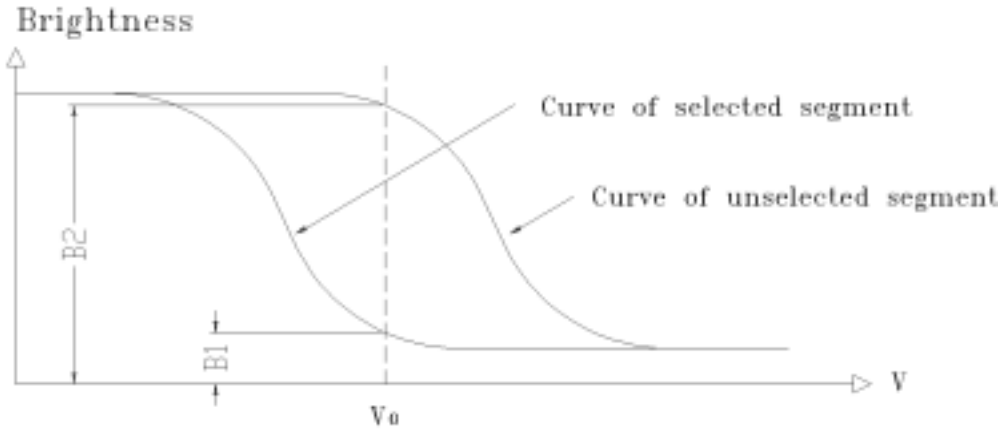
Top



Bottom

Bottom

7.2.2 Definition of Contrast Ratio

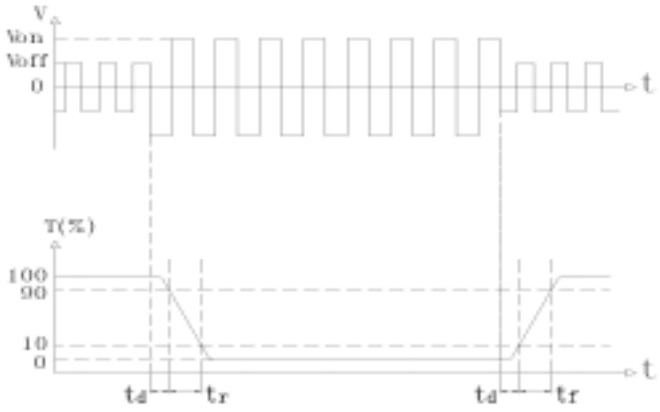


$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

1) Ambient Temperature: 25℃ ; 2) Frame frequency: 64.0Hz

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: 3.3V 2) Frame frequency: 64.0Hz

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 Restore 4H at 25℃
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	-20℃ 96H 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	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 Restore 4H at 25℃
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 Restore 4H at 25℃
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 Restore 2H

8.2 Failure Judgment Criterion

Criterion Item	Test Item No.									Failure Judgment 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_{op}=25℃ (unless otherwise stated)	Inspection				
		Min.	Max.	Unit	IL	AQL
External Visual Inspection	Under normal illumination and eyesight condition, the distance between eyes and LCD is 25cm.	See Appendix A			II	Major 1.0 Minor 2.5
Display Defects	Under normal illumination 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 Minor 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.

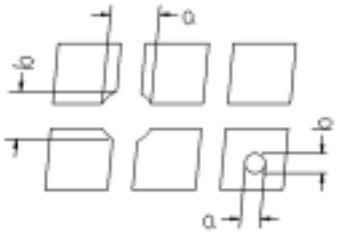
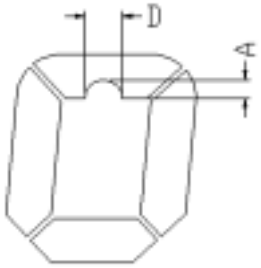
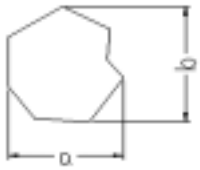
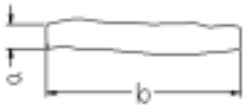
Appendix A

Inspection items and criteria for appearance defects

<table>
<tr><th>Items</th><th>Contents</th><th colspan="3">Criteria</th></tr>
<tr><td colspan="2">Leakage</td><td colspan="3">Not permitted</td></tr>
<tr><td colspan="2">Rainbow</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 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<0.20mm</td><td>0.20mm≤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="2">Not permitted</td><td></td></tr>
</table>

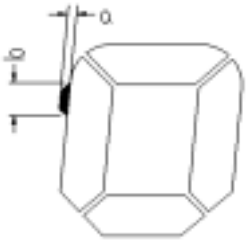
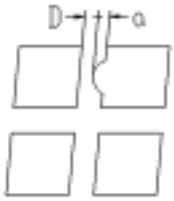
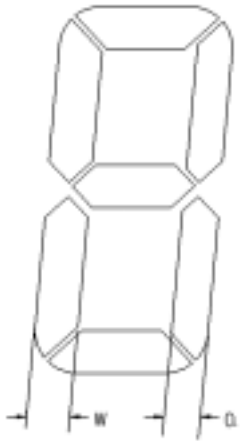
Appendix B

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 rowspan="2">  </td><td>Not counted</td><td>Max.2 dots allowed</td></tr>
<tr><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><th>Items</th><th>Content</th><th colspan="3">Critera</th></tr>
<tr><td rowspan="4">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></tr>
<tr><td>a＜0.1mm</td><td>0.1mm≦a≦0.2mm
D>0</td><td></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>