SPECIFICATION FOR LCD MODULE

Model No. _TM13264ECAG__

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

TIANMA MICROELECTRONICS CO., LTD

REVISION RECORD

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

1. General Specifications:

1.1 Display type: STN/B-W

1.2 Display color*:

Display color: Blue-Black

Background: White

1.3 Polarizer mode: Reflective/Positive

1.4 Viewing Angle: 6:00

1.5 Driving Method: 1/65Duty 1/9 Bias

1.6 Without Backlight

1.7 Operating Temperature: 0----+50℃

Storage Temperature: -20----+60℃

1.8 Outline Dimensions: Refer to outline drawing on next page

1.9 Dot Matrix: 132 X64

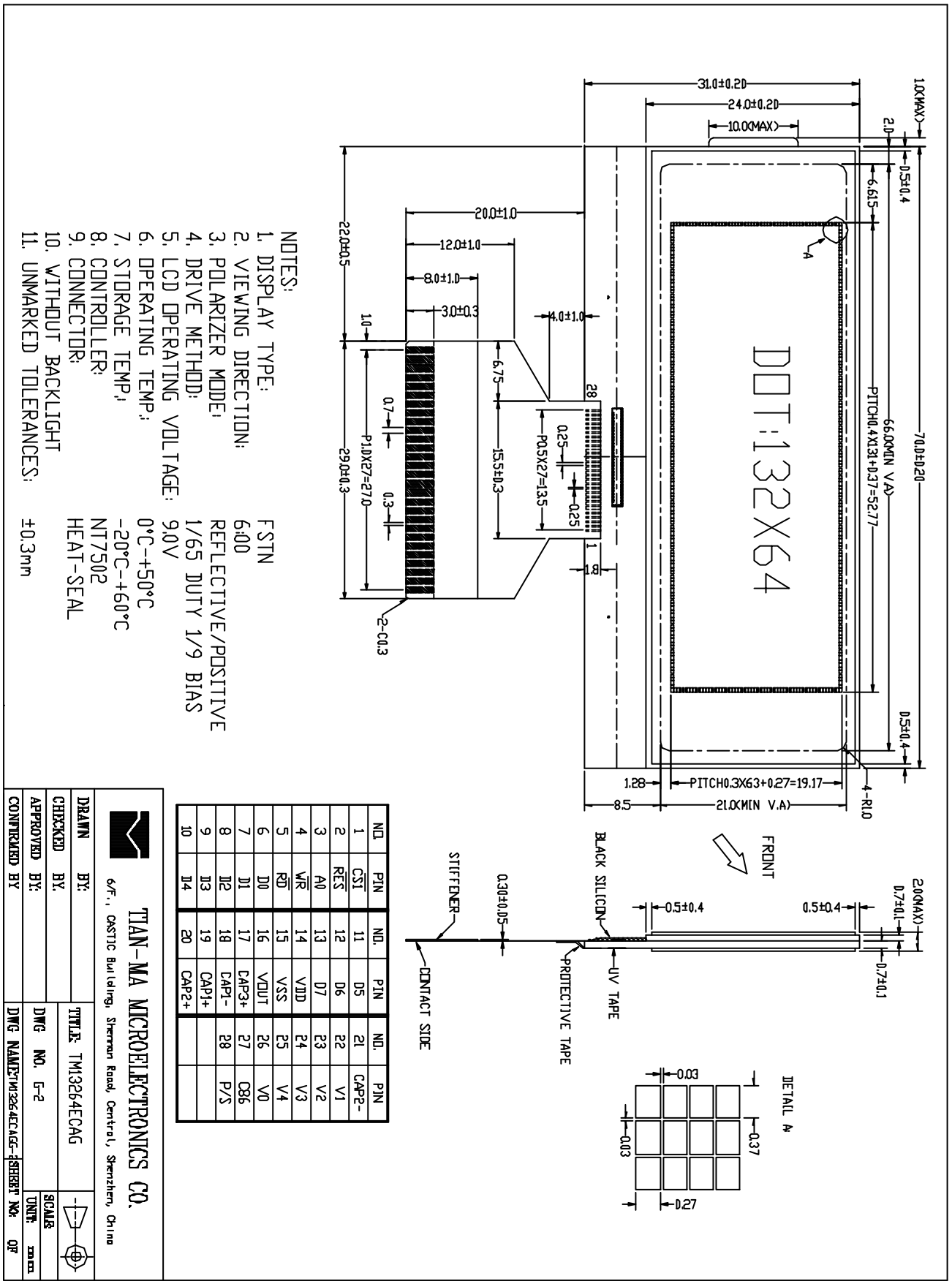
1.10 Dot Size: 0.37X0.27(mm)

1.11 Dot Pitch: 0.40X0.30 (mm)

1.12 Weight: 20g

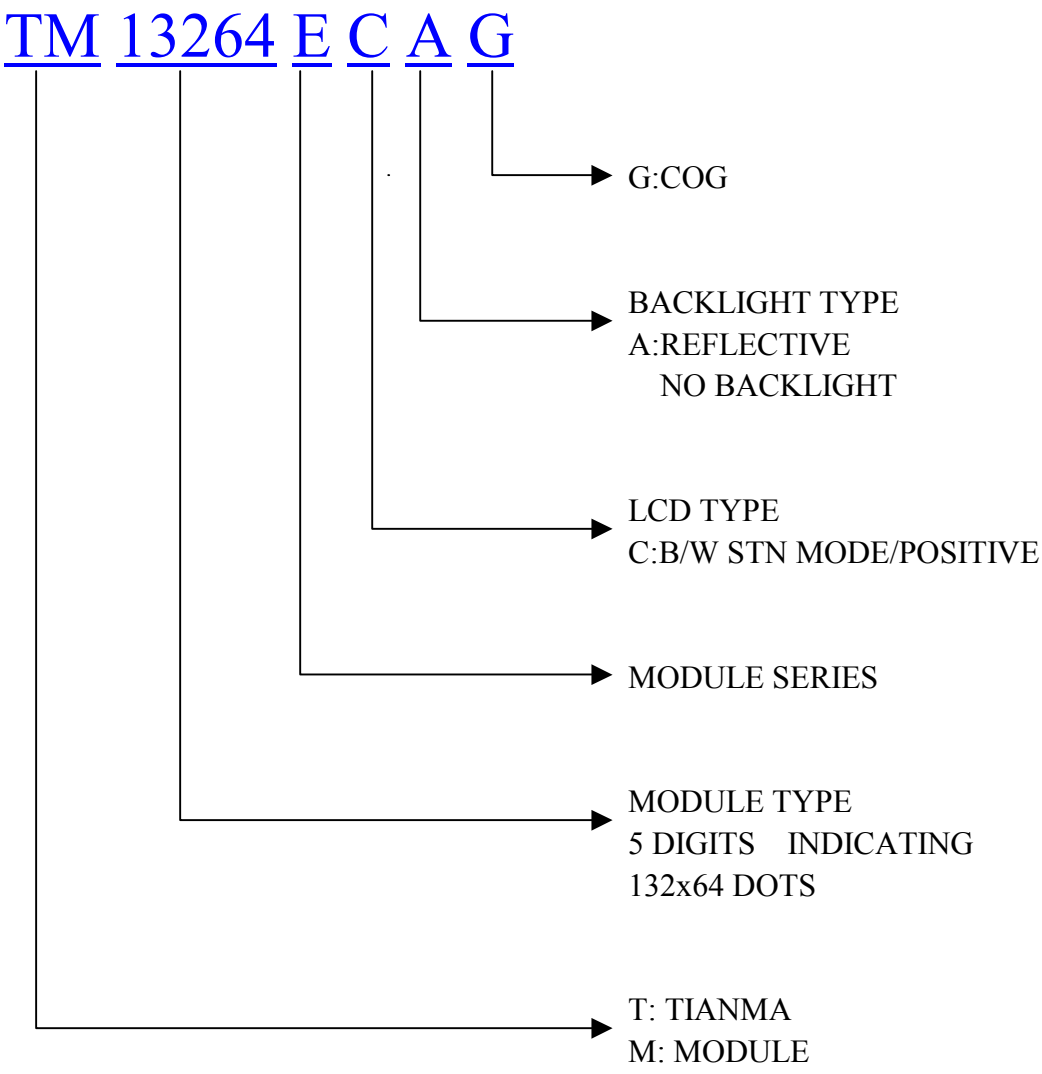
* Color tone is slightly changed by temperature and driving voltage.

2 Outline Drawing

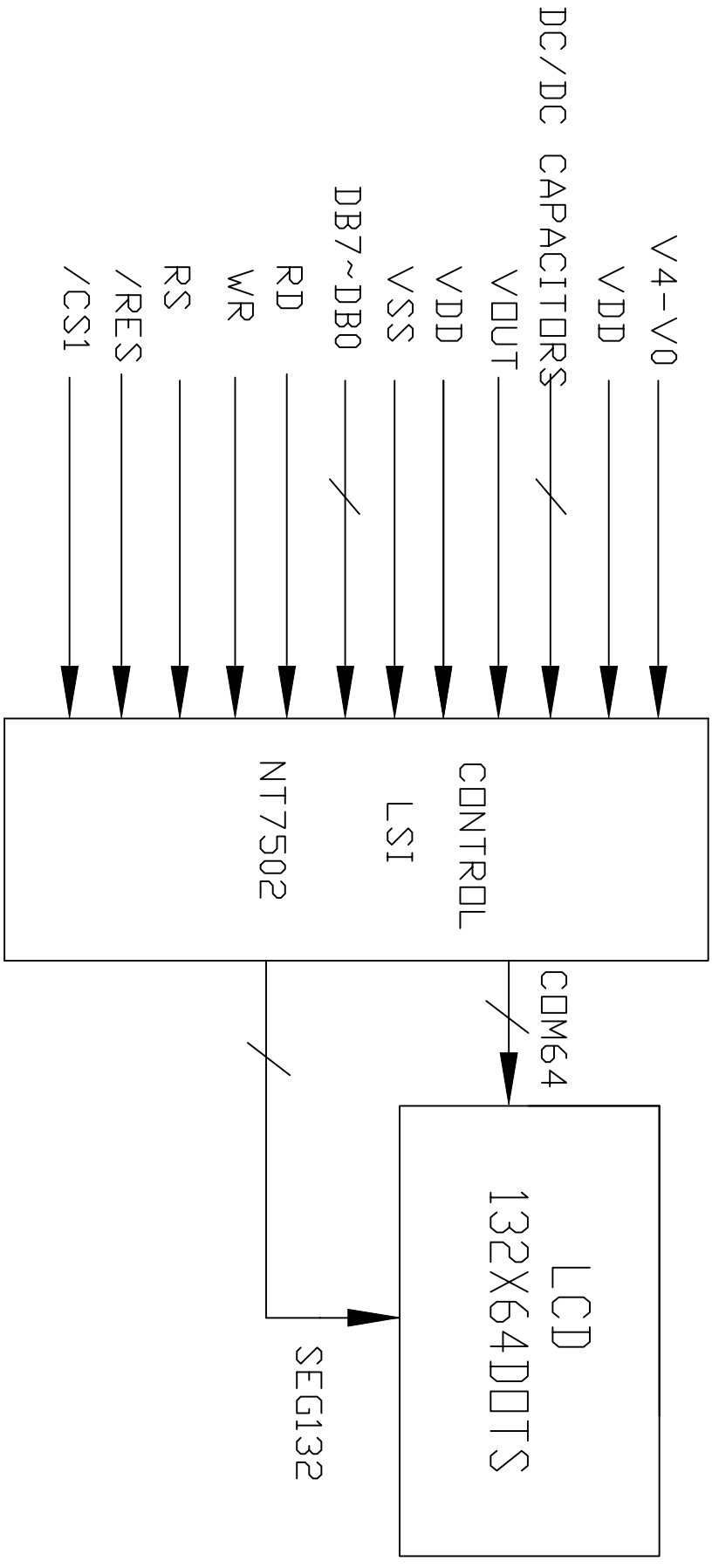


NO.	PIN	NO.	PIN	NO.	PIN
1	CS1	11	D5	21	CAP2-
2	RES	12	D6	22	V1
3	A0	13	D7	23	V2
4	WR	14	VDD	24	V3
5	RD	15	VSS	25	V4
6	D0	16	VOUT	26	V0
7	D1	17	CAP3+	27	C86
8	D2	18	CAP1-	28	P/S
9	D3	19	CAP1+		
10	D4	20	CAP2+		

3 LCD Module Part Numbering System



4 Circuit Block Diagram



5 Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	$V_{DD}-V_{SS}$	2.4	3.5	V	
LCD Driving Voltage	V_{LCD}	4.5	11.5		
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)		$V_{DD}-V_{SS}$	2.4	2.85	3.5	V
Supply Voltage (LCD Drive)		V_{LCD}	-	9.0	-	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)	-	-	160	uA

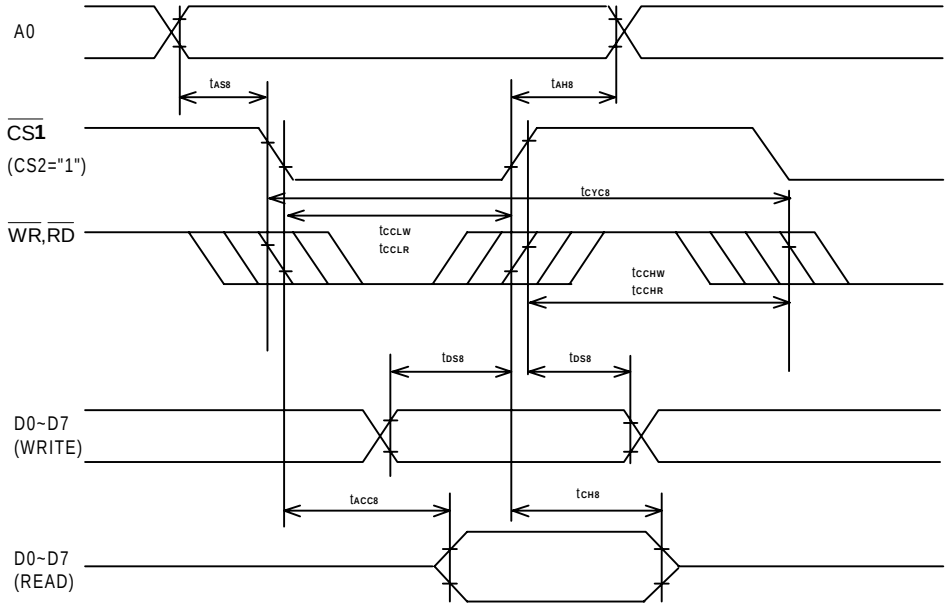
6.2 Interface Signals

Pin No.	Symbol	Level	Description
1	$\overline{CS1B}$	H/L	Chip select signal
2	$\overline{RES}$	H/L	Reset signal input
3	A0	H/L	Instruction/Data select
4	$\overline{WR}$	H/L	Read/Write control signal
5	$\overline{RD}$	H/L	Chip enable signal
6	D0	H/L	Data bits 0
7	D1	H/L	Data bits 1
8	D2	H/L	Data bits 2
9	D3	H/L	Data bits 3
10	D4	H/L	Data bits 4
11	D5	H/L	Data bits 5
12	D6	H/L	Data bits 6
13	D7	H/L	Data bits 7
14	VDD	2.85V	Power supply voltage for logic
15	VSS	0V	Ground
16	VOUT	-	DC/DC voltage converter output
17	CAP3+	-	Capacitor pin for voltage converter
18	CAP1-	-	Capacitor pin for voltage converter
19	CAP1+	-	Capacitor pin for voltage converter
20	CAP2+	-	Capacitor pin for voltage converter
21	CAP2-	-	Capacitor pin for voltage converter
22	V1	-	Power supply voltage for LCD
23	V2	-	Power supply voltage for LCD
24	V3	-	Power supply voltage for LCD
25	V4	-	Power supply voltage for LCD
26	V0	9.0V	Power supply voltage for LCD
27	C86	-	MPU Interface switch terminal
28	P/S	-	Parallel data input/serial data input switch terminal

6.3 Interface Timing Chart

AC Characteristics

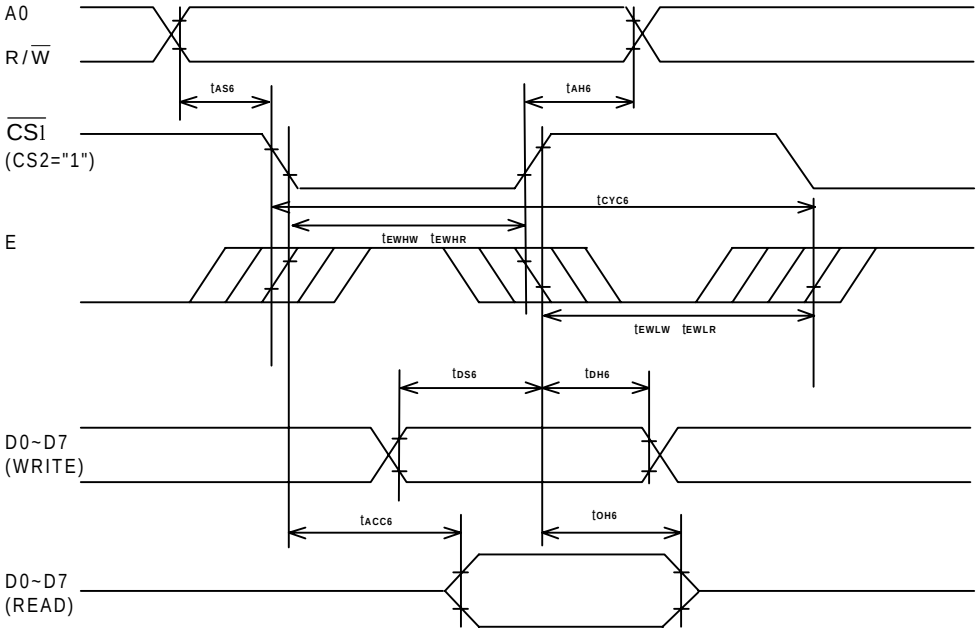
(1) System buses Read/Write characteristics 1 (For the 8080 Series MPU)



(V_{DD}=2.7 – 3.3V, T_A = -40 - 85°C)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
T_{AH8}	Address hold time	0			ns	
T_{AS8}	Address setup time	0			ns	
T_{CYC8}	System cycle time	300			ns	
T_{CCLW}	Control L pulse width (WR)	60			ns	
T_{CCLR}	Control L pulse width (RD)	120			ns	
T_{CCHW}	Control H pulse width (WR)	60			ns	
T_{CCHR}	Control H pulse width (RD)	60			ns	
T_{DS8}	Data setup time	40			ns	
7T_{DH8}	Data hold time	15			ns	
T_{ACC8}	$\overline{RD}$ access time			140	ns	C_L=100pF
T_{CH8}	Output disable time	10		100	ns	C_L=100pF

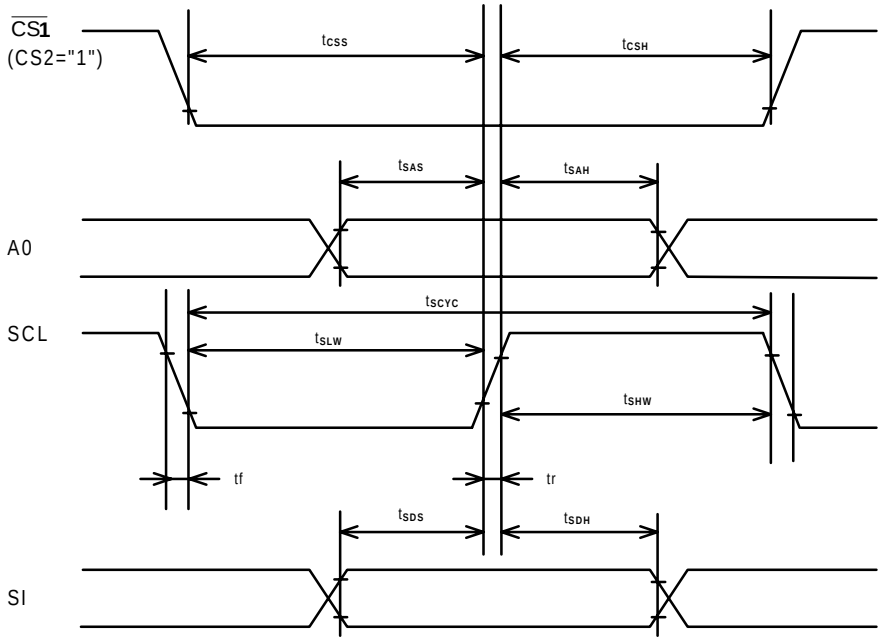
(2) System buses Read/Write Characteristics 2 (6800 Series MPU)



(V_{DD}=2.7 – 3.3V, T_A = -40 - 85°C)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
T_{CYC6}	System cycle time	300			nS	
T_{AS6}	Address setup time	0			nS	
T_{AH6}	Address hold time	0			nS	
T_{DS6}	Data setup time	40			nS	
T_{DH6}	Data hold time	15			nS	
T_{OH6}	Output disable time	10		100	nS	C_L=100pF
T_{ACC6}	Access time			140	nS	C_L=100pF
T_{EWHR}	Enable H pulse width (Read)	120			nS	
T_{EWHW}	Enable H pulse width (Write)	60			nS	
T_{EWLR}	Enable L pulse width (Read)	60			nS	
T_{EWLW}	Enable L pulse width (Write)	60			nS	

(3) Serial interface



(VDD=2.7 – 3.3V, TA = -40 - 85°C)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
TSCYC	Serial clock cycle	250			nS	
TSHW	Serial clock H pulse width	100			nS	
TSLW	Serial clock L pulse width	100			nS	
TSAS	Address setup time	150			nS	
TSAH	Address hold time	150			nS	
TSDS	Data setup time	100			nS	
TSDH	Data hole time	100			nS	
TCSS	$\overline{cs}$ serial clock time	150			nS	
TCSH	$\overline{cs}$ serial clock time	150			nS	

6.4 Instruction Code

Command	Code											Function
	A0	$\overline{RD}$	$\overline{WR}$	D7	D6	D5	D4	D3	D2	D1	D0	
(1) Display ON/OFF	0	1	0	1	0	1	0	1	1	1	D	Turns on LCD panel when goes high, and turns off when goes low
(2) Set Display Start Line	0	1	0	0	1	Display start address						Specifies RAM display line for COM0
(3) Set Page Address	0	1	0	1	0	1	1	Page address				Sets the display RAM page in Page Address register
(4) Set Column Address 4 higher bits	0	1	0	0	0	0	1	Higher column address				Sets 4 higher bits of column address of display RAM in register
(4) Set column Address 4 lower bits	0	1	0	0	0	0	0	Lower column address				Sets 4 lower bits of column address of display RAM in register
(5) Read Status	0	0	1	Status				0	0	0	0	Reads the status information
(6) Write Display Data	1	1	0	Write data								Writes data in display RAM
(7) Read Display Data	1	0	1	Read data								Reads data from display RAM
(8) ADC select	0	1	0	1	0	1	0	0	0	0	D	Sets the display RAM address SEG output correspondence
(9) Normal/Reverse Display	0	1	0	1	0	1	0	0	1	1	D	Normal indication when low, but full indication when high
(10) Entire Display ON/OFF	0	1	0	1	0	1	0	0	1	0	0 1	Selects normal display (0) or Entire Display ON (1)
(11) Set LCD Bias	0	1	0	1	0	1	0	0	0	1	D	Sets LCD drive voltage bias ratio
(12) Read-Modify-Write	0	1	0	1	1	1	0	0	0	0	0	Increments Column Address counter during each write
(13) End	0	1	0	1	1	1	0	1	1	1	0	Releases the Read-Modify-Write
(14) Reset	0	1	0	1	1	1	0	0	0	1	0	Resets internal functions
(15) Common output mode select	0	1	0	1	1	0	0	D	*	*	*	Selects COM output scan direction. * Invalid data
(16) Set Power Control	0	1	0	0	0	1	0	1	Operation status			Selects the power circuit operation mode
(17) V0 voltage regulator internal resistor ratio set	0	1	0	0	0	1	0	0	Resistor ratio			Select internal resistor ratio (Rb / Ra) mode
(18) Electronic volume mode set	0	1	0	1	0	0	0	0	0	0	1	Set the V0 output voltage electronic volume register
Electronic Volume Register set	0	1	0	*	*	Electronic control value						
(19) Set static indicator On/Off	0	1	0	1	0	1	0	1	1	0	D	Set static indicator On/Off 0: OFF 1: ON
Set Static indicator register	0	1	0	*	*	*	*	*	*	Mode		Set the flashing mode
(20) Power Save	-	-	-	-	-	-	-	-	-	-	-	Compound command of display OFF and entire display ON
(21) NOP	0	1	0	1	1	1	0	0	0	1	1	Command for non-operation
(22) Test Command	0	1	0	1	1	1	1	*	*	*	*	IC Test command. Do not use!
(23) Test Mode Reset	0	1	0	1	1	1	1	0	0	0	0	Command of test mode reset

Note: Do not use any other command, or the system malfunction may result.

7 Optical Characteristics

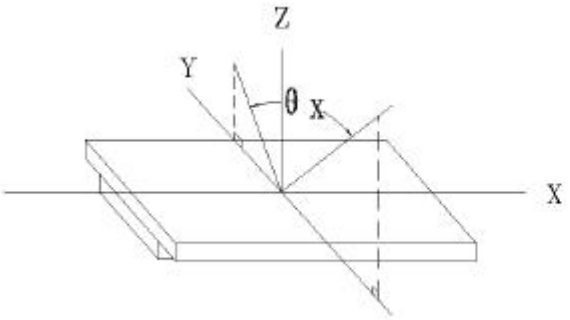
7.1 Optical Characteristics Ta=25℃

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

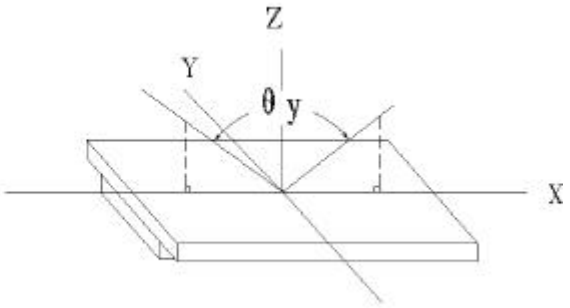
7.2 Definition of Optical Characteristics

7.2.1 Definition of Viewing Angle

Top



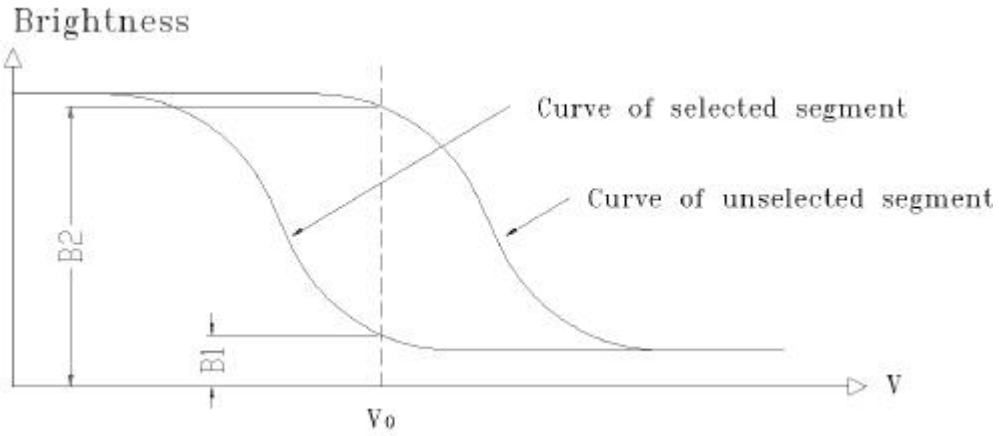
Top



Bottom

Bottom

7.2.2 Definition of Contrast Ratio

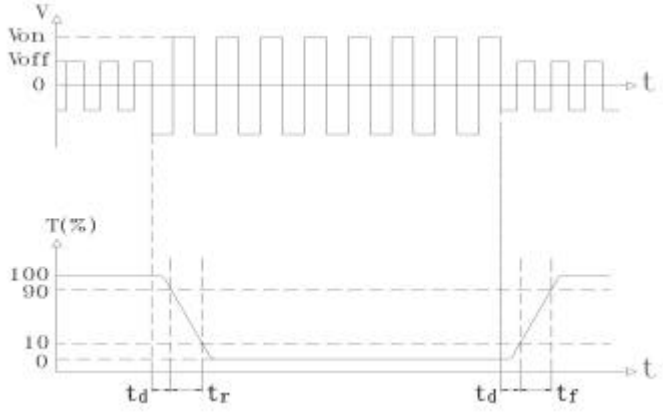


$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

1) Ambient Temperature: 25℃ ; 2) Frame frequency: 64Hz

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: 64Hz

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 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 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℃

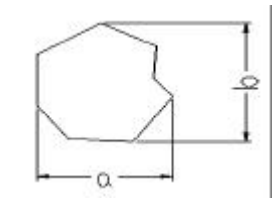
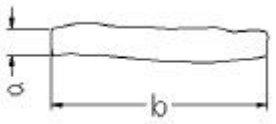
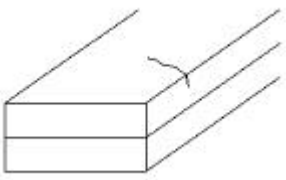
Relatively humidity: ≤80%

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.

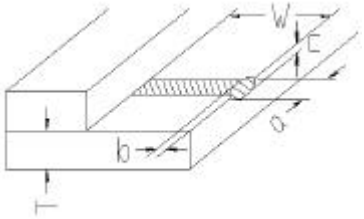
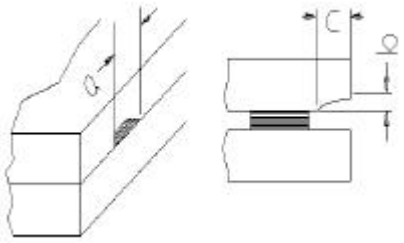
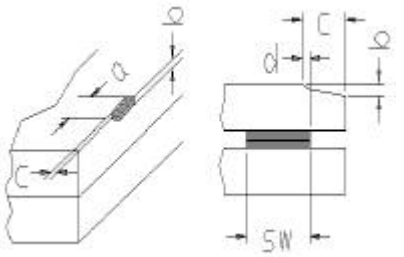
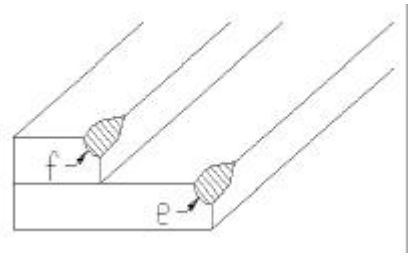
Appendix A

Inspection items and criteria for appearance defects

<table>
<tr><td>Items</td><td>Contents</td><td colspan="3">Criteria</td></tr>
<tr><td>Protective Glue</td><td></td><td colspan="3">No clear defects</td></tr>
<tr><td>Cover Tape</td><td></td><td colspan="3">Covering all of the chip and no clear crimple</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 rowspan="2"> 
</td><td>Not counted</td><td>Max. 3 spots allowed</td><td rowspan="3">Max. 3 spots (lines) allowed</td></tr>
<tr><td>X<0.2mm</td><td>0.2mm≤X≤0.5mm</td></tr>
<tr><td>Black line (in viewing area)</td><td>X=(a+b)/2</td><td colspan="2"></td></tr>
<tr><td></td><td> 
</td><td>Not counted</td><td>Max. 3 lines allowed</td><td></td></tr>
<tr><td></td><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>

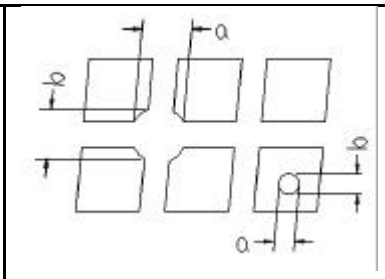
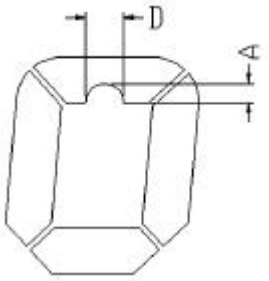
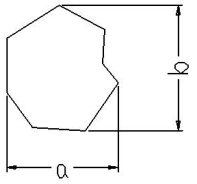
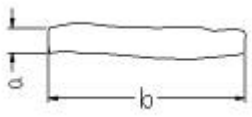
Appendix A

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>

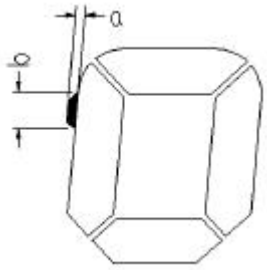
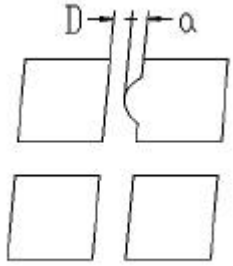
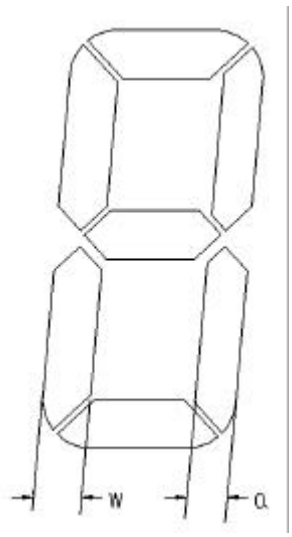
Appendix B

Inspection items and criteria for display defects

<table>
<tr><td colspan="2">Items</td><td>Contents</td><td colspan="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 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><td>Items</td><td>Content</td><td colspan="3">Critera</td></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>