SPECIFICATION FOR LCD MODULE

Model No. **TM162EBAWG1**

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/Yellow-Green

1.2 Display color*:

Display color: Blue-Black

Background: Yellow-Green

1.3 Polarizer mode: Reflective/Positive

1.4 Viewing Angle: 6:00

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

1.6 Without Backlight

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

1.7 Display Fonts: 5 x 7 dots(1 Character)

1.8 Data Transfer: 8 Bit Parallel

1.9 Front Polarizer: SHC-125U

Rear Polarizer: SHC-125M

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

Storage Temperature: -30----+90℃

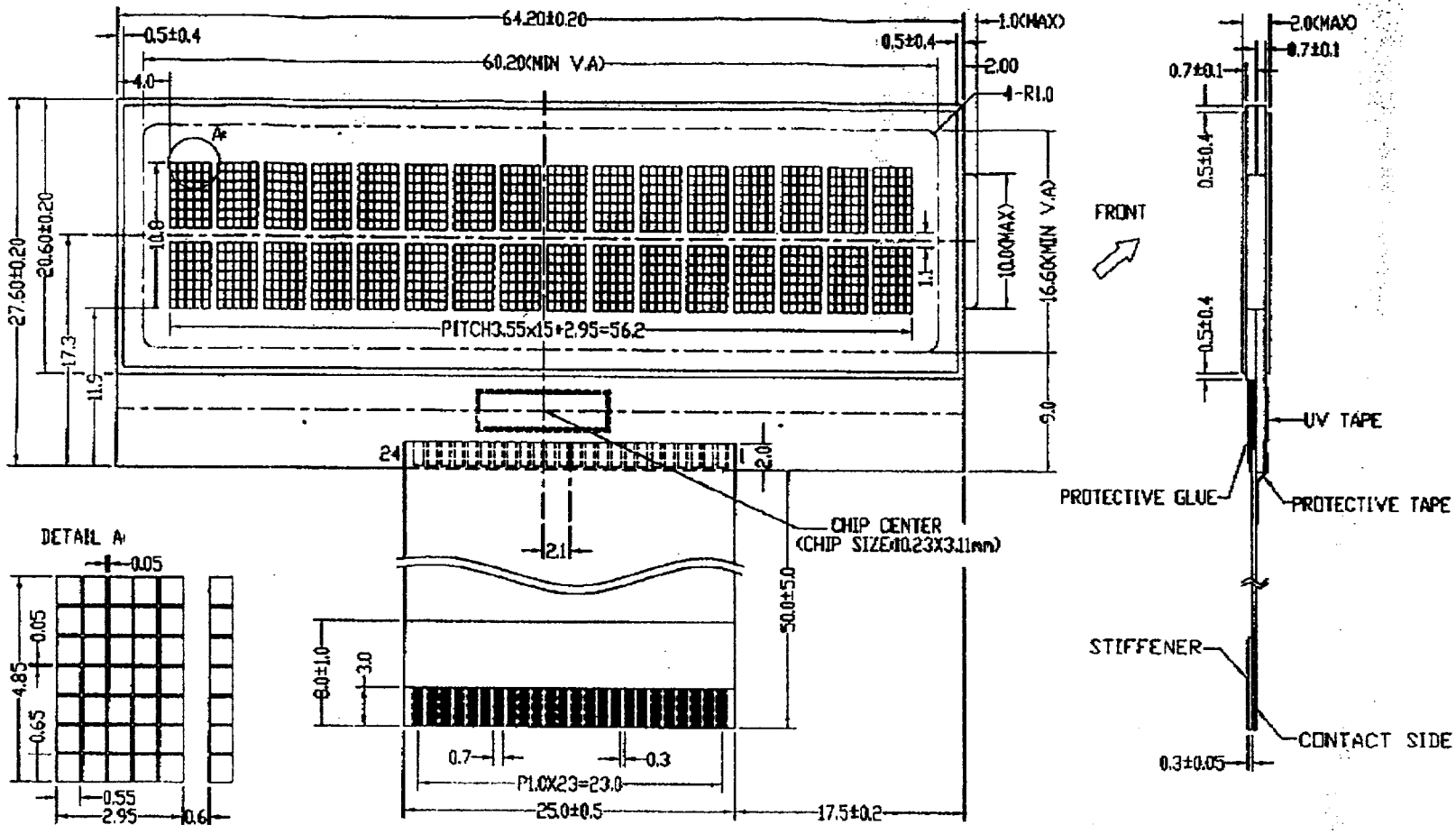
1.11 Outline Dimensions: Refer to outline drawing on next page

1.12 Dot Matrix: 16 Characters X 2

1.13 Dot Size: 0.55X0.65(mm)

1.14 Dot Pitch: 0.6X0.7 (mm)

1.15 Weight: 10g



NOTES:

1. DISPLAY TYPE:	STN/YELLOW-GREEN MODE
2. CHARACTERS:	16 X 2 LINES
3. VIEWING DIRECTION:	6:00
4. POLARIZER MODE:	REFLECTIVE/POSITIVE
5. DRIVE METHOD:	1/16 DUTY 1/5 BIAS
6. LCD OPERATING VOLTAGE:	6.5V
7. VDD=3.0V	
8. OPERATING TEMP.:	-20°C~+70°C
9. STORAGE TEMP.:	-30°C~+90°C
10. CONNECTOR:	HEAT-SEAL
11. FRONT POLARIZER:	SHC-125U
REAR POLARIZER:	SHC-125N
12. CONTROLLER:	SIB12303011B
13. UNMARKED TOLERANCES:	±0.3mm
14. IC COVERED BY SILICONE.	

PIN	1	2	3	4	5	6	7	8	9	10	11	12
SYMBOL	A0	$\overline{WR}$	$\overline{CS}$	D7	D6	D5	D4	D3	D2	D1	D0	VDD
PIN	13	14	15	16	17	18	19	20	21	22	23	24
SYMBOL	VSS	V5	V4	V3	V2	V1	VOUT	VSS	VDD	P/S	IF	RES

TIAN-MA MICROELECTRONICS CO.
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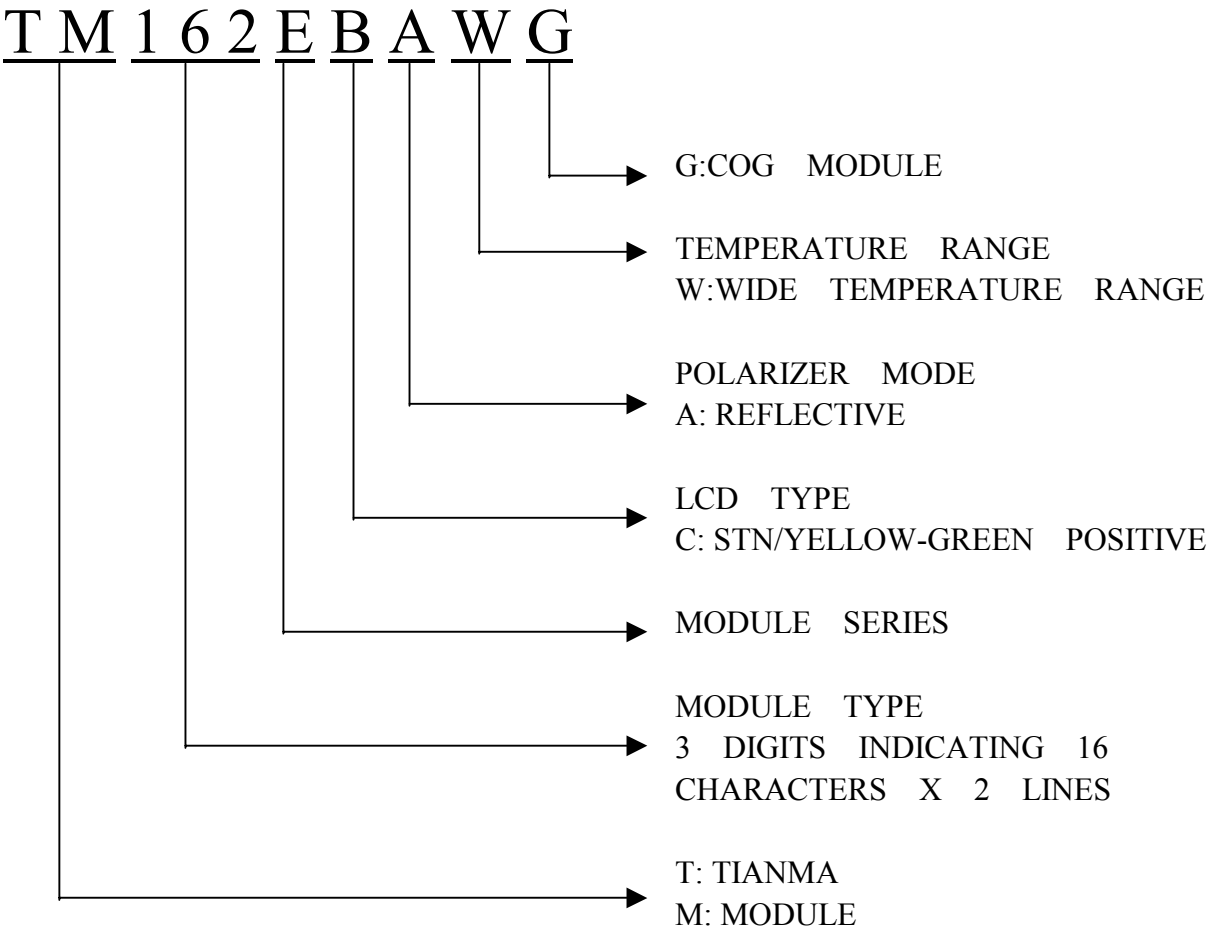
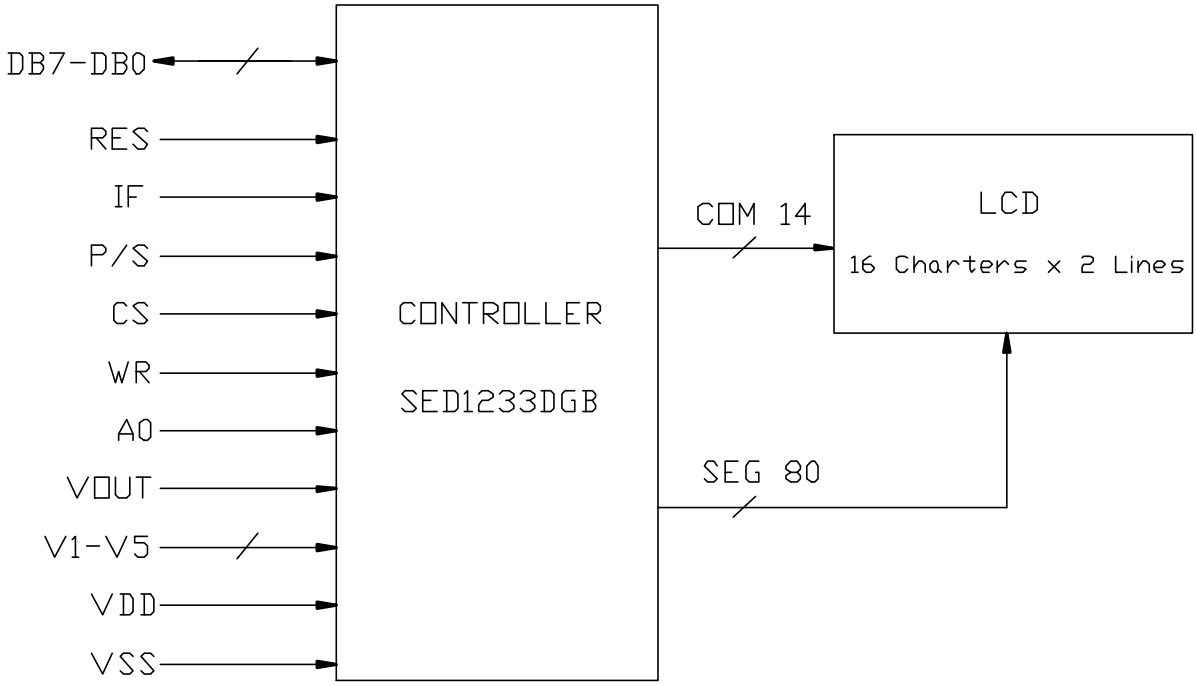
DRAWN	BY:	TITLE: TM162EBAWG1	SCALE:
CHECKED	BY:		
APPROVED	BY:	DWG NO: G-1	UNIT: mm

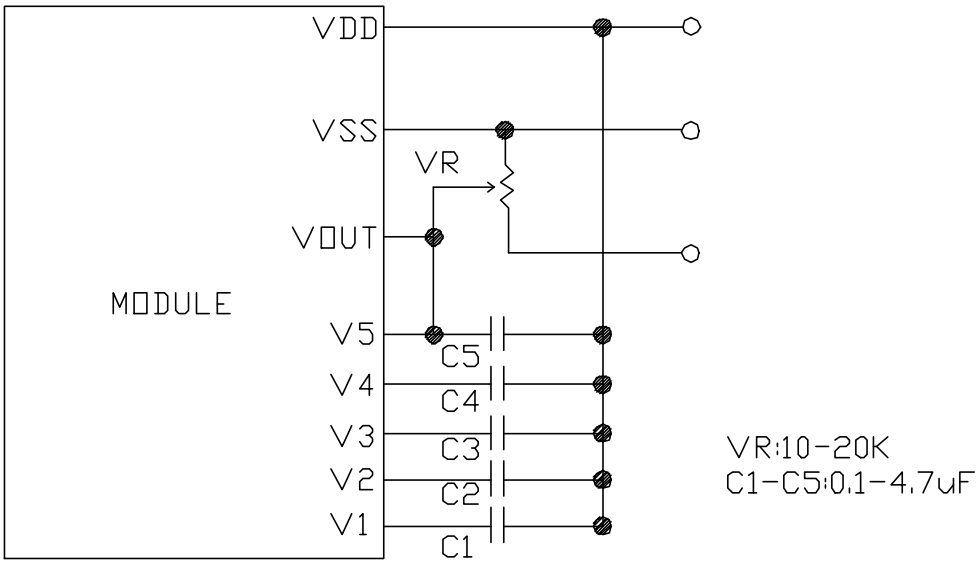
3 LCD Module Part Numbering System



4 Circuit Block Diagram



Block Diagram Example of Power Supply



Both the boosting circuit and the voltage control circuit are not used in this module.
Therefore,connect V5 pin with Vout pin and supply the LCD driving voltage from the outside.

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}	-0.3	13.0		
Operating Temperature Range	T_{OP}	-20	+70	℃	No Condensation
Storage Temperature Range	T_{ST}	-30	+90		

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}	5.5	6.5	7.5	V
Input Signal Voltage	High	V_{IH} （V_{DD}=3.0）	0.7V_{DD}	-	V_{DD}+0.3	V
	Low	V_{IL} （V_{DD}=3.0）	-0.3	-	0.2 V_{DD}	V
Supply current (Logic)		I_{DD} （$V_{DD}-V_{SS}$ =3.0）	-	50	100	uA

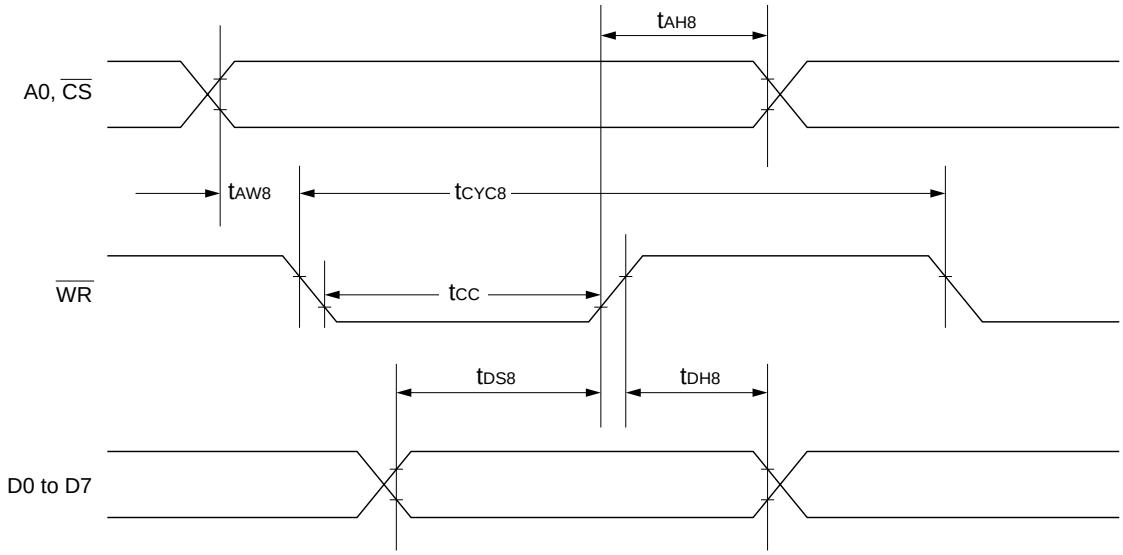
6.2 Interface Signals

Pin No.	Symbol	Level	Description	
1	A0	H/L	H:D0-D7 are display data L:D0-D7 are controller command	
2	$\overline{WR}$	H/L	80 family MPU:WR Signal Input L:Active 68 family MPU:Enable clock input	
3	$\overline{CS}$	H/L	Chip selects signal L:Active	
4	D7	H/L	Data Bus Line	
5	D6	H/L	Data Bus Line	
6	D5	H/L	Data Bus Line	
7	D4	H/L	Data Bus Line	
8	D3	H/L	Data Bus Line	No--connection at 4-bit operation
9	D2	H/L	Data Bus Line	
10	D1	H/L	Data Bus Line	
11	D0	H/L	Data Bus Line	
12	Vdd	3.0V	Supply Voltage	
13	Vss	0V	Ground	
14	V5	-	Connect to Vdd and a capacitor of 0.1－4.7 uF	
15	V4	-	Connect to a capacitor of 0.1－4.7 uF	
16	V3	-	Connect to a capacitor of 0.1－4.7 uF	
17	V2	-	Connect to a capacitor of 0.1－4.7 uF	
18	V1	-	Connect to a capacitor of 0.1－4.7 uF	
19	Vout	-	Supply Voltage(LCD Drive)	
20	Vss	-	Ground	
21	Vdd	-	Supply Voltage (+3.0V)	
22	P/S	H/L	H:Parallel Data Transfer L:Serial Data Transfer	
23	IF	H/L	Interface Data Length Select H:8-bits Parallel L:4-bit Parallel	
24	RES	H/L	Reset Signal	

6.3 Interface Timing Chart

TIMING CHARACTERISTICS

(1) System Bus Write Characteristic I (80 series MPU)

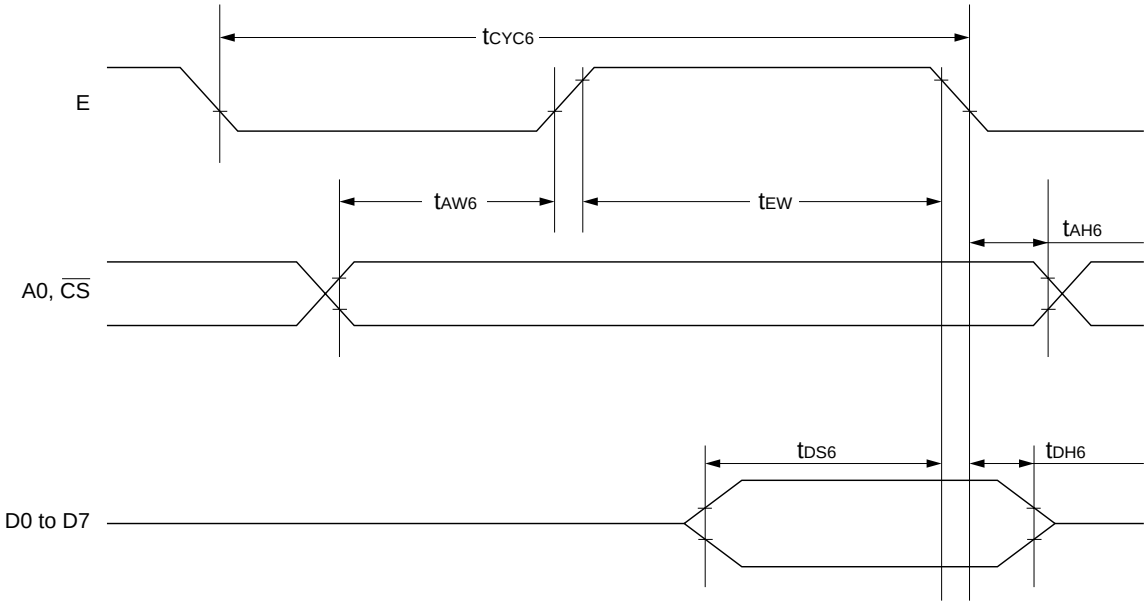


[V_{SS} = –3.6 V to –2.4 V, Ta = –30 to 85°C unless otherwise specified]

Item	Signal	Symbol	Measuring condition	Min.	Max.	Unit
Address hold time	A0, $\overline{CS}$	t_{AH8}		30		ns
Address setup time		t_{AW8}		60		ns
System cycle time	$\overline{WR}$	t_{CYC8}	V_{SS} = –3.0	500		ns
			–2.7	550		
			–2.4	650		
Control pulse width ($\overline{WR}$)		t_{CC}	V_{SS} = –3.0	100		ns
			–2.7	120		
			–2.4	150		
Data setup time	D0 ~ D7	t_{DS8}		100		ns
Data hold time		t_{DH8}		50		ns

*1: For the rise and fall of an input signal, set a value not exceeding 25 ns.
*2: Every timing is specified on the basis of 20% and 80% of V_{SS}.
*3: For A0 and $\overline{CS}$, the same time is not required. Input signals so that A0 and $\overline{CS}$ may satisfy t_{AW8} and t_{AH8} respectively.

(2) System Bus Write Characteristic II (68 series MPU)



[VSS = –3.6 V to –2.4 V, Ta = –30 to 85°C unless otherwise specified]

Item	Signal	Symbol	Measuring condition	Min.	Max.	Unit
System cycle time	A0, $\overline{CS}$	t CYC6	VSS = –3.0	500		ns
			–2.7	550		
			–2.4	650		
Address setup time		t AW6		60		
Address hold time		t AH6		30		ns
Data setup time	D0 ~ D7	t DS6		100		ns
Data hold time		t DH6		50		ns
Enable pulse width	E	t EW	VSS = –3.0	100		ns
			–2.7	120		
			–2.4	150		

*1: tCYC6 denotes the cycle of the E signal in the $\overline{CS}$ active state. tCYC6 must be reserved after $\overline{CS}$ becomes active.
*2: For the rise and fall of an input signal, set a value not exceeding 25 ns.
*3: Every timing is specified on the basis of 20% and 80% of VSS.
*4: For A0 and $\overline{CS}$, the same timing is not required. Input signals so that A0 and $\overline{CS}$ may satisfy tAW6 and tAH6 respectively.

6.4 Instruction Code

Command	Code										Function
	A0	WR	D7	D6	D5	D4	D3	D2	D1	D0	
(1) Cursor Home	0	0	0	0	0	1	*	*	*	*	Moves the cursor to the home position.
(2) Static Display Control	0	0	0	0	1	0	*	*	SD1	SD0	Sets the display mode of static display symbol SD1, SD0 = 0, 0 (display OFF), 0, 1 (1 - 2 Hz blink), 1, 0 (3 4 Hz blink), 1, 1 (all display ON)
(3) Display ON/OFF Control	0	0	0	0	1	1	C	B	DC	D	Sets cursor ON/OFF (C), cursor blink ON//OFF (B), double cursor ON/OFF (DC) and display ON/OFF (D). C = 1 (cursor ON) 0 (cursor OFF), B = 1 (blink ON) 0 (blink OFF) DC = 1 (double cursor ON) 0 (double cursor OFF), D = 1 (display ON) D = 0 (display OFF)
(4) Power Save	0	0	0	1	0	0	*	*	0	PS	Sets power save ON/OFF (PS) and oscillating circuit ON/OFF (0). PS = 1 (power save ON) 0 (power save OFF), 0 = 1 (oscillating circuit ON) 0 (oscillating circuit OFF)
(5) Power Control	0	0	0	1	0	1	0	VC	VF	P	Sets voltage regulating circuit ON/OFF and boosting circuit ON/OFF (P). VC = 1 (voltage regulating circuit ON) 0 (voltage regulating circuit OFF) VF = 1 (voltage follower ON) 0 (voltage follower OFF), P = 1 (boosting circuit ON) 0 (boosting circuit OFF)
(6) System Set	0	0	0	1	1	0	N2	N1	*	CG	Sets the use or non-use of CG RAM and display lines (N2, N1). CG = 1 (use of CG RAM) 0 (non-use of CG RAM), N2, N1 = 0, 0 (2 lines) 0, 1 (3 lines) 1, 0 (4 lines)
(7) Electronic Volume Register	0	0	0	1	1	1	MSB			LSB	Sets the electronic volume register value.
(8) RAM Address Set	0	0	1	ADDRESS							Sets the DD RAM, CG RAM or symbol register address.
(9) RAM Write	1	0	DATA								Writes data into the DD RAM, CG RAM or symbol register address.


Lower 4 Bit of Code
0 1 2 3 4 5 6 7 8 9 A B C D E F
Higher 4 Bit of Cord
0 1 2 3 4 5 6 7 8 9 A B C D E F

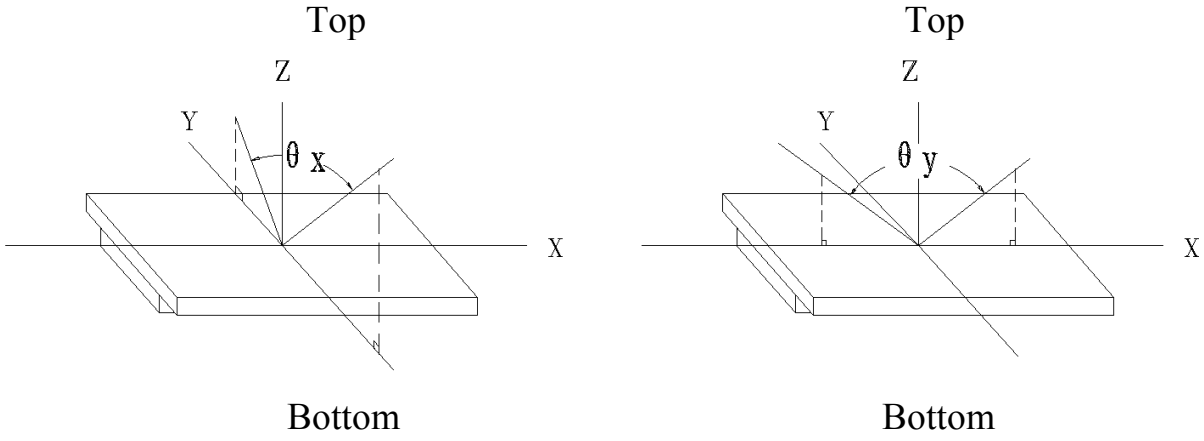
7 Optical Characteristics

7.1 Optical Characteristics Ta=25℃

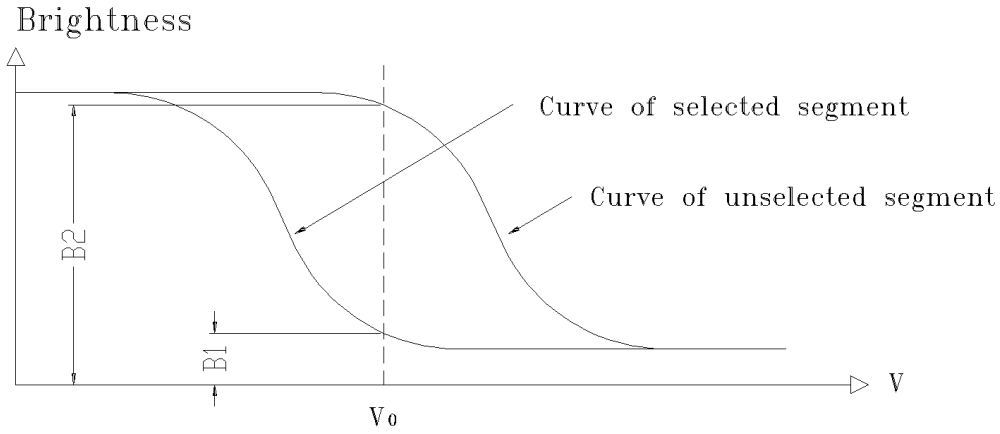
Item		Symbol	Condition		Min.	Typ.	Max.	Unit
Viewing Angle		θ_x	$C_r \geq 2$	$\theta_y=0°$	-35 -- 20			Deg
		θ_y		$\theta_x=0°$	-30 -- 30			
Contrast Ratio		C_r	$\theta_x=0°$ $\theta_y=0°$		4	-	-	
Response Time	Turn on	T_{on}	$\theta_x=0°$ $\theta_y=0°$		-	-	250	ms
	Turn off	T_{off}			-	-	250	

7.2 Definition of Optical Characteristics

7.2.1 Definition of Viewing Angle



7.2.2 Definition of Contrast Ratio

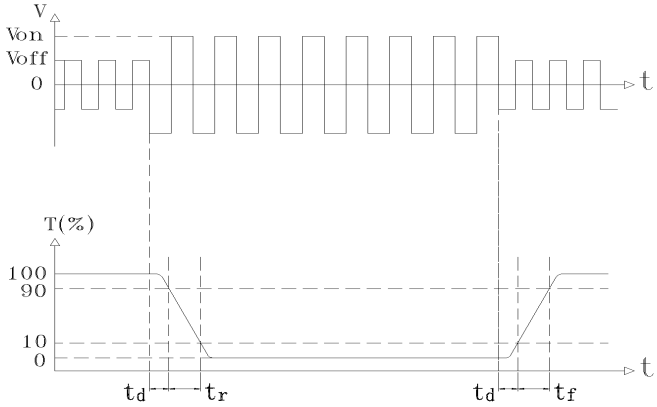


$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

1) Frame frequency: 100.0Hz

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: 6.5V 2) Frame frequency: 100.0Hz

8 Reliability

8.1 Environmental 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	85℃ 240H
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	-30℃ 240H
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	-20℃ 240H
5	High Temperature /Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time	60℃ 95%RH 240H 80℃ 95%RH 48H (Non condensation)
6	Temperature Cycle	Endurance test applying the low and high temperature cycle -30℃←→25℃←→90℃←→25℃ 30min 5min 30min 5min ←——————————→ 1 cycle	-30℃/90℃ 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

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_{amb}=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 annex A			II	Major 0.4 Minor 0.65
Display Defects	Under normal illumi-nation and eyesight condition, display on inspection.	See annex B			II	Major 0.4 Minor 0.65
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℃

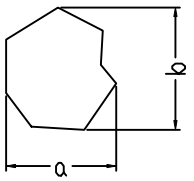
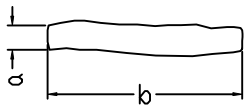
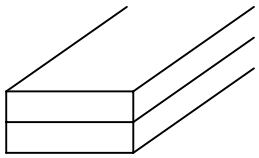
Relatively humidity: ≤80%

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.

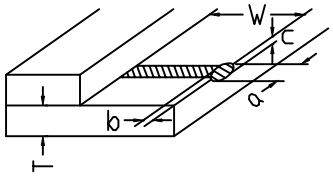
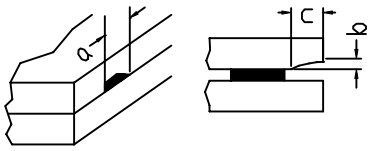
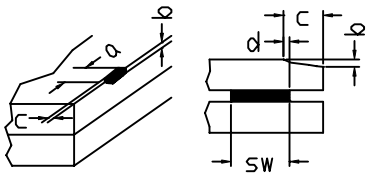
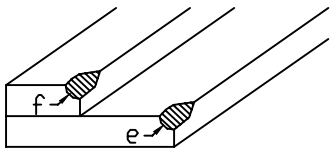
Annex A

Inspection items and criteria for appearance defects

<table>
<tr><th>Items</th><th>Contents</th><th colspan="3">Critera</th></tr>
<tr><td colspan="2">Protective
Glue</td><td colspan="3">No clear defects</td></tr>
<tr><td colspan="2">Cover
Tape</td><td colspan="3">Covering all of the chip and no clear crimple</td></tr>
<tr><td colspan="2">Leakage</td><td colspan="3">Not permitted</td></tr>
<tr><td colspan="2">Rainbow</td><td colspan="3">Accoding 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 defect allowed</td></tr>
<tr><td>ø<0.3mm</td><td colspan="2">0.3mm⩽ø⩽0.5mm</td></tr>
<tr><td>Scratches of polarizer</td><td colspan="3">Accoding 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<0.20mm</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>

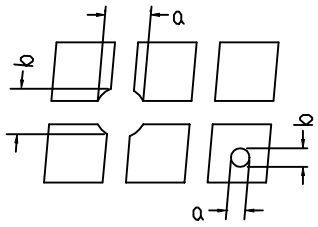
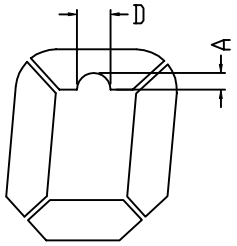
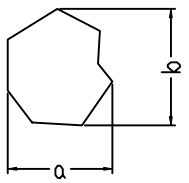
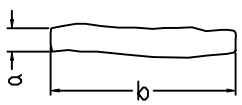
Annex A

Inspection items and criteria for appearance defects (continued)

<table>
<tr><th>Items</th><th>Contents</th><th colspan="4">Critera</th></tr>
<tr><td rowspan="4">Glass
Cracks</td><td>cracks on pads
 
</td><td>a
<3mm
<3mm</td><td>b
≤W/5
≤W/5</td><td>c
≤T/2
>T/2</td><td>Max. 2 cracks allowed</td><td rowspan="4">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="2">e<2.0mm²
f<2.0mm²</td><td>Max. 3 cracks allowed</td></tr>
</table>

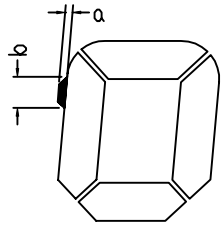
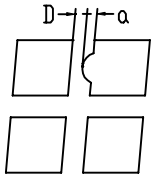
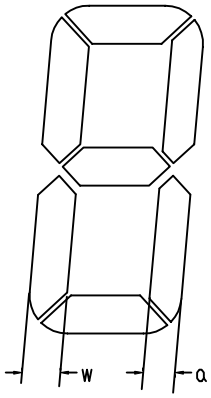
Annex B

Inspection items and criteria for display defects

<table>
<tr><th>Items</th><th>Contents</th><th colspan="3">Critera</th></tr>
<tr><td colspan="2">Open segment or open common</td><td colspan="3">Not permitted</td></tr>
<tr><td colspan="2">short</td><td colspan="3">Not permitted</td></tr>
<tr><td colspan="2">Wrong viewing angle</td><td colspan="3">Not permitted</td></tr>
<tr><td colspan="2">Contrast radio uneven</td><td colspan="3">According to the limit specimen</td></tr>
<tr><td colspan="2">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>

Annex B

Inspection items and criteria for display defects (continued)

<table>
<tr><th>Items</th><th>Contents</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⩽0.20mm</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⩽0.20mm
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>