SPECIFICATION FOR LCD MODULE

Model No. _TM128128CKFWG_

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

TIANMA MICROELECTRONICS CO., LTD

Ver. 1.0

REVISION RECORD

Date	Ver.	Ref. Page	Revision No.	Revision Items

1. General Specifications:

1.1 Display type: COLOR STN

1.2 Display color*[1]:

Display color: 65K COLOR

Background*[2]: Black (Red, Green, Blue dots are off state)

1.3 Polarizer mode: Transmissive/Negative

1.4 Viewing Angle: 6:00

1.5 Driving Method: 1/128 Duty 1/5 Bias

1.6 Backlight Type: LED (3 LAMPS)

Backlight Color: WHITE

1.7 Controller: S6B33B0

1.8 Data Transfer: 16 Bit Parallel

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

Storage Temperature: -30----+80℃

1.10 Power Supply Voltage: VDD=3.0V

1.11 LCD Operating Voltage: VLCD=10.6V

1.12 Outline Dimensions: Refer to outline drawing on next page

1.13 Dot Matrix: 128 X 3 (RGB) X 128 Dots

1.14 Dot Size: 0.192(R+G+B)×0.210(mm^2)

1.15 Dot Pitch: 0.204×0.220 (mm^2)

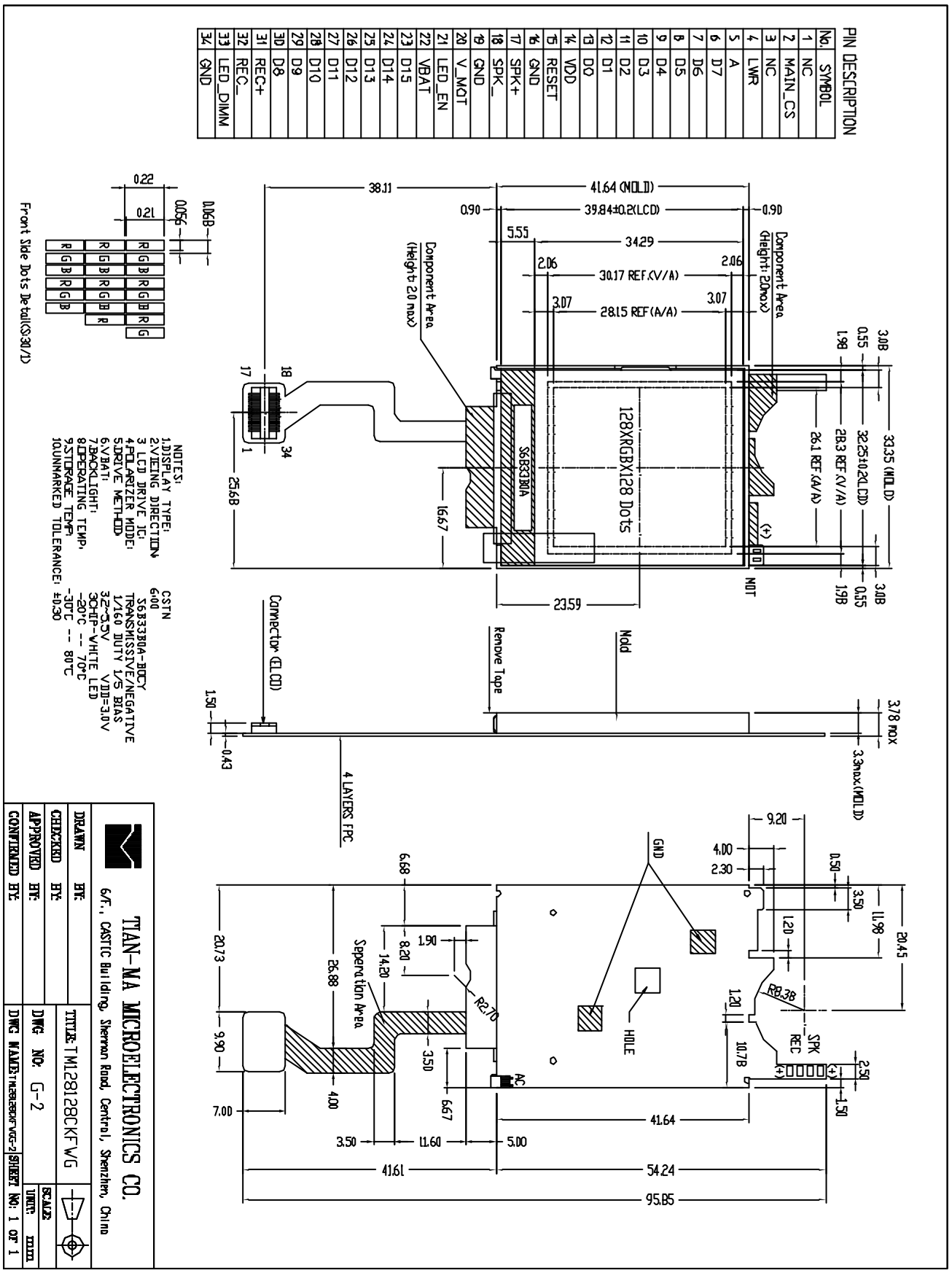
1.16 Weight: TBD*[3]

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

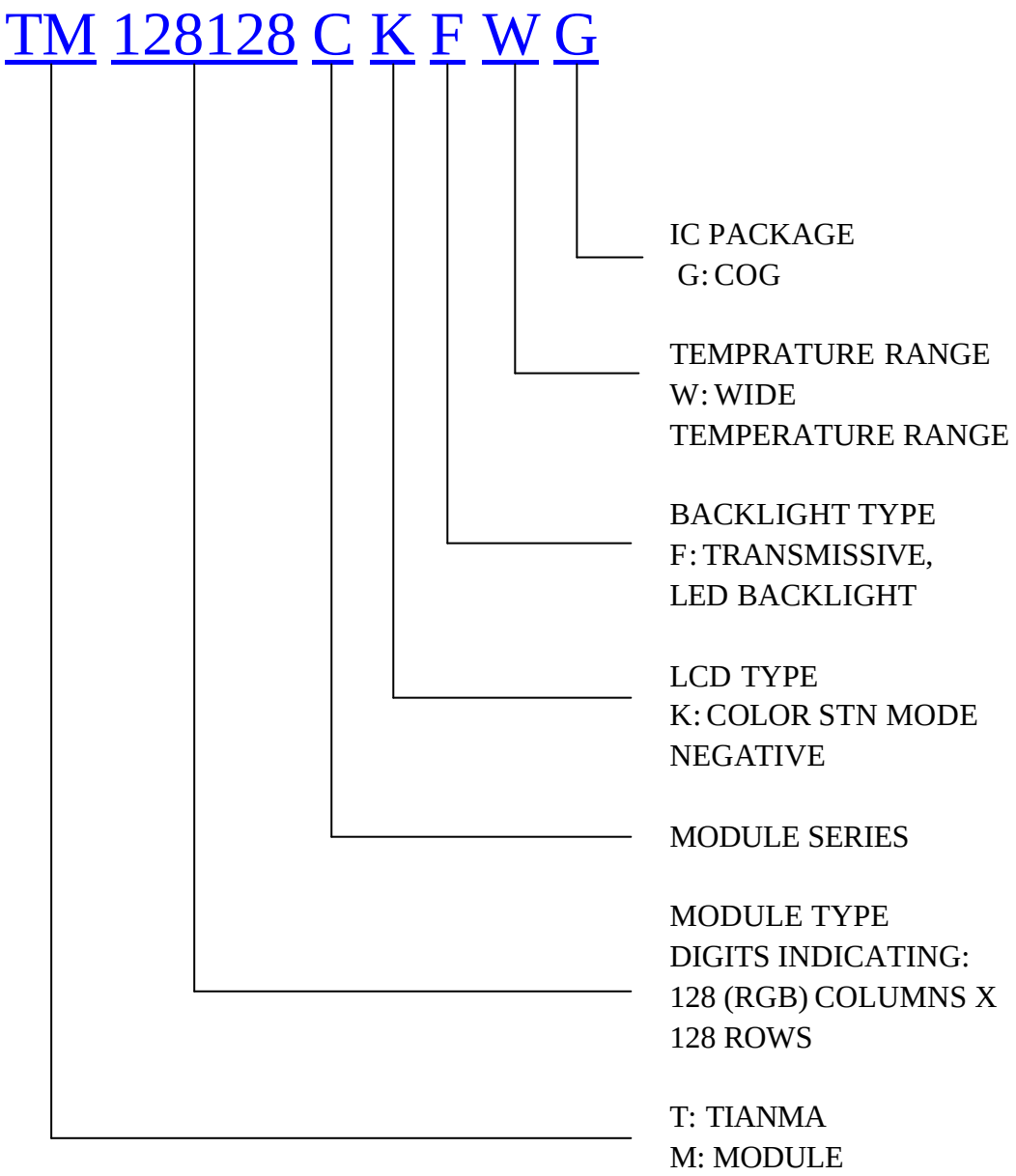
*[2] Color tone will be changed by backlight.

*[3] TBD: To Be Determined.

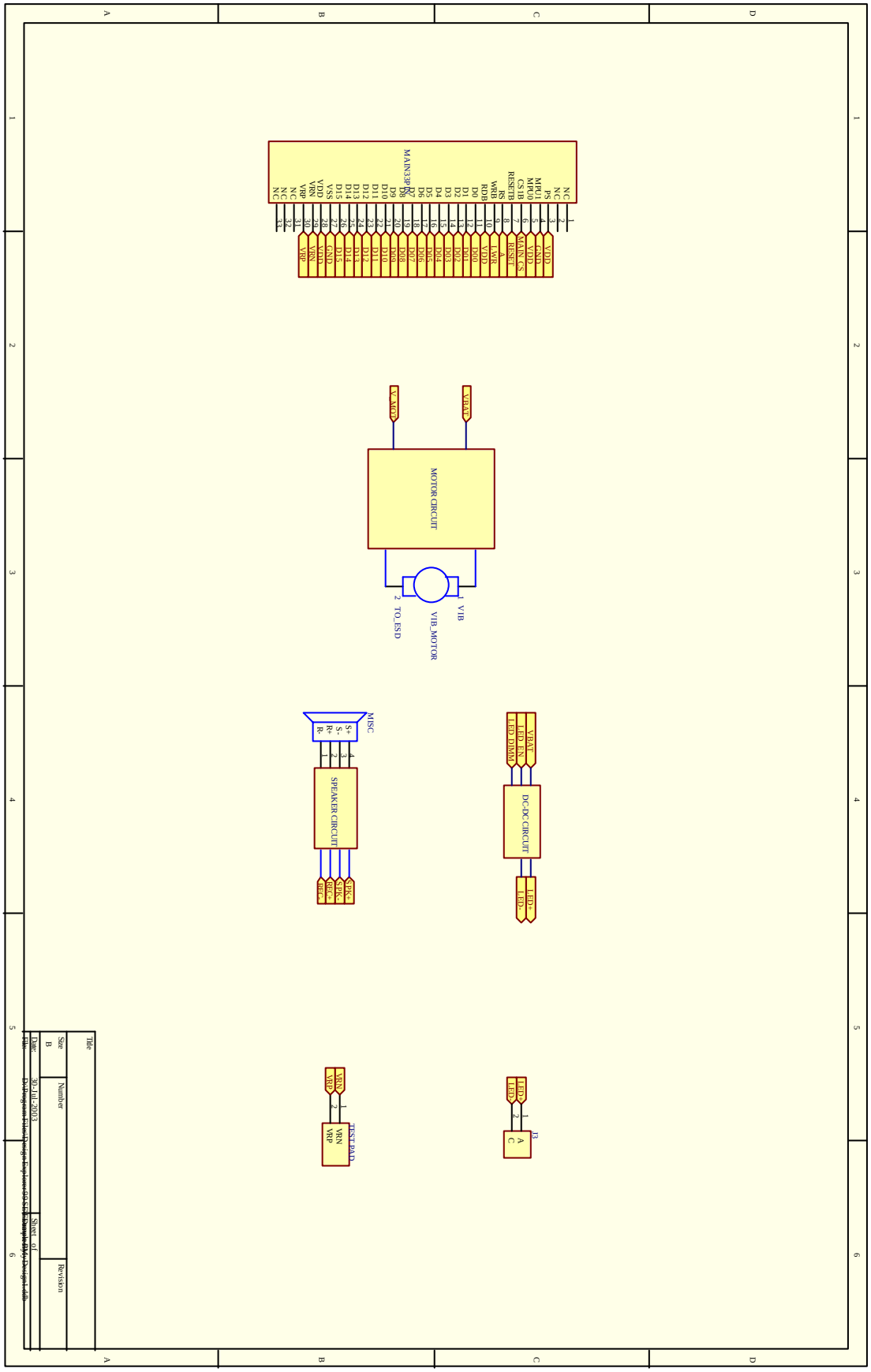
2. Outline Drawing



3. LCD Module Part Numbering System



4. Circuit Block Diagram



5. Absolute Maximum Ratings

Ta=25℃

Item	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	$V_{DD}-V_{SS}$	-0.3	+4.0	V	
LCD Driving Voltage	V_{LCD}	TBD	22		
Operating Temperature Range	T_{OP}	-20	+70	℃	No Condensation
Storage Temperature Range	T_{ST}	-30	+80		

6. Electrical Specifications and Instruction Code

6.1 Electrical characteristics Vss=0V, Ta=25℃

Item		Symbol	Min.	Typ.	Max.	Unit
Supply Voltage (Logic)		V_{DD}-Vss	+1.8	+3.0	+3.3	V
Supply Voltage (LCD Drive)		V_{LCD}	-	10.6	-	V
Input Signal Voltage	High	V_{IH} (V_{DD}=3.0)	0.8V_{DD}	-	V_{DD}	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)	-	-	2.5	mA
Operating current		I_{op}	-	-	60	mA
Oscillator frequency range		f_{osc}	84.48	-	288	KHz
Supply Voltage (LED)		V_{LED}	-	9.9	-	V
Supply current (LED)		I_{LED}		15.0	20.0	mA

6.2 Interface Signals

6.2.1 CN1

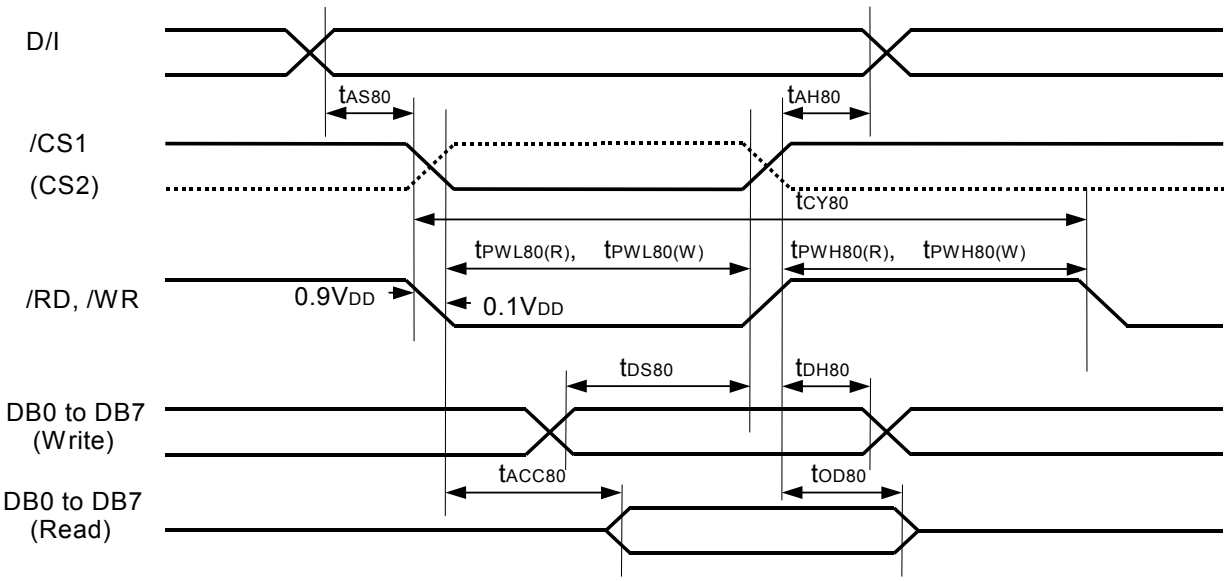
Pin No.	Symbol	Level	Description
1	NC		
2	MAIN_CS	H/L	Chip select: Low active
3	NC		
4	LWR	H/L	Signal to select data write operation(80-system)
5	A	H/L	Index register / Data command select
6	D07	H/L	Data bus bit 7
7	D06	H/L	Data bus bit 6
8	D05	H/L	Data bus bit 5
9	D04	H/L	Data bus bit 4
10	D03	H/L	Data bus bit 3
11	D02	H/L	Data bus bit 2
12	D01	H/L	Data bus bit 1
13	D00	H/L	Data bus bit 0
14	VDD	3.0V	Logic circuit power supply
15	RESET	H/L	Reset pin: Low active
16	GND	0V	Ground
17	SPK+	H/L	Speaker input pin(+)
18	SPK_	H/L	Speaker input pin(-)
19	GND	0V	Ground
20	V_MOT	H/L	Motor drive pin(L:active)
21	LED_EN	H/L	LED enable pin
22	Vbat	Vbat	Battery power supply
23	D15	H/L	Data bus bit 15
24	D14	H/L	Data bus bit 14
25	D13	H/L	Data bus bit 13
26	D12	H/L	Data bus bit 12
27	D11	H/L	Data bus bit 11

Pin No.	Symbol	Level	Description
28	D10	H/L	Data bus bit 10
29	D09	H/L	Data bus bit 9
30	D08	H/L	Data bus bit 8
31	REC+	H/L	Receiver input pin(+)
32	REC_	H/L	Receiver input pin(-)
33	LED_DIMM	H/L	LED luminosity control(H:bright)
34	GND	0V	Ground

6.2.2 CN2

Pin No.	Symbol	Level	Description
1, 2	CATHODE	0V	LED CATHODE
3, 4	ANODE	9.9V	LED ANODE

6.3 Interface Timing Chart



** $t_{PWL80(W)}$ and $t_{PWL80(R)}$ is specified in the overlapped period when CS1B is low (CS2 is high) and /WR(/RD) is low.

Parallel Interface (8080-series MPU) Timing Diagram

6.4 Instruction code

Instruction Table

Instruction Name	D/I	WRB	RDB	DB15 ~ DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Hex.	Parameter
Non Operation	0	0	1	*	0	0	0	0	0	0	0	0	00	
Oscillation Mode Set	0	0	1	*	0	0	0	0	0	0	1	0	02	1Byte
Driver Output Mode Set	0	0	1	*	0	0	0	1	0	0	0	0	10	1Byte
DC-DC Select	0	0	1	*	0	0	1	0	0	0	0	0	20	1Byte
Bias Set	0	0	1	*	0	0	1	0	0	0	1	0	22	1Byte
DCDC Clock Division Set	0	0	1	*	0	0	1	0	0	1	0	0	24	1Byte
DCDC and AMP ON/OFF set	0	0	1	*	0	0	1	0	0	1	1	0	26	1Byte
Temperature Compensation Set	0	0	1	*	0	0	1	0	1	0	0	0	28	1Byte
Contrast Control(1)	0	0	1	*	0	0	1	0	1	0	1	0	2A	1Byte
Contrast Control(2)	0	0	1	*	0	0	1	0	1	0	1	1	2B	1Byte
Standby Mode OFF	0	0	1	*	0	0	1	0	1	1	0	0	2C	-
Standby Mode ON	0	0	1	*	0	0	1	0	1	1	0	1	2D	-
DDRAM Burst Mode OFF	0	0	1	*	0	0	1	0	1	1	1	0	2E	-
DDRAM Burst Mode ON	0	0	1	*	0	0	1	0	1	1	1	1	2F	-
Addressing Mode Set	0	0	1	*	0	0	1	1	0	0	0	0	30	1Byte
ROW Vector Mode Set	0	0	1	*	0	0	1	1	0	0	1	0	32	1Byte
N-line Inversion Set	0	0	1	*	0	0	1	1	0	1	0	0	34	1Byte
Entry Mode Set	0	0	1	*	0	1	0	0	0	0	0	0	40	1Byte
X-address Area Set	0	0	1	*	0	1	0	0	0	0	1	0	42	2Byte
Y-address Area Set	0	0	1	*	0	1	0	0	0	0	1	1	43	2Byte
RAM Skip Area Set	0	0	1	*	0	1	0	0	0	1	0	1	45	1Byte
Display OFF	0	0	1	*	0	1	0	1	0	0	0	0	50	-
Display ON	0	0	1	*	0	1	0	1	0	0	0	1	51	-
Specified Display Pattern Set	0	0	1	*	0	1	0	1	0	0	1	1	53	1Byte
Partial Display Mode Set	0	0	1	*	0	1	0	1	0	1	0	1	55	1Byte
Partial Display Start Line Set	0	0	1	*	0	1	0	1	0	1	1	0	56	1Byte
Partial Display End Line Set	0	0	1	*	0	1	0	1	0	1	1	1	57	1Byte
Area Scroll Mode Set	0	0	1	*	0	1	0	1	1	0	0	1	59	4Byte
Scroll Start Line Set	0	0	1	*	0	1	0	1	1	0	1	0	5A	1Byte
Set Display Data Length	X	X	X	*	1	1	1	1	1	1	0	0	FC	1Byte
Display Data Write	1	0	1	Display Data Write									-	-
Display Data Read	1	1	0	Display Data Read									-	-
Status Read	0	1	0	0	Status Data Read								-	-
Test Mode1	0	0	1	*	1	1	1	1	1	1	1	1	FF	-
Test Mode2	0	0	1	*	1	1	1	1	1	1	1	0	FE	-
Test Mode3	0	0	1	*	1	1	1	1	1	1	0	1	FD	-
Test Mode4	0	0	1	*	1	1	1	1	1	0	1	1	FB	-
Test Mode5	0	0	1	*	1	1	1	1	1	0	1	0	FA	-
Test Mode6	0	0	1	*	1	1	1	1	1	0	0	1	F9	-

*: Don't care

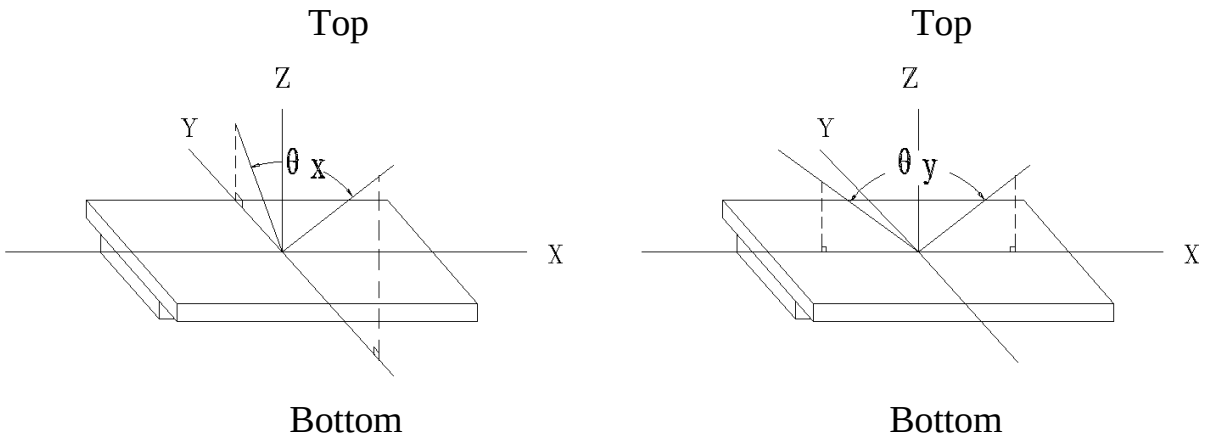
7. Optical Characteristics

7.1 Optical Characteristics V_{LCD}=10.6V Ta=25℃

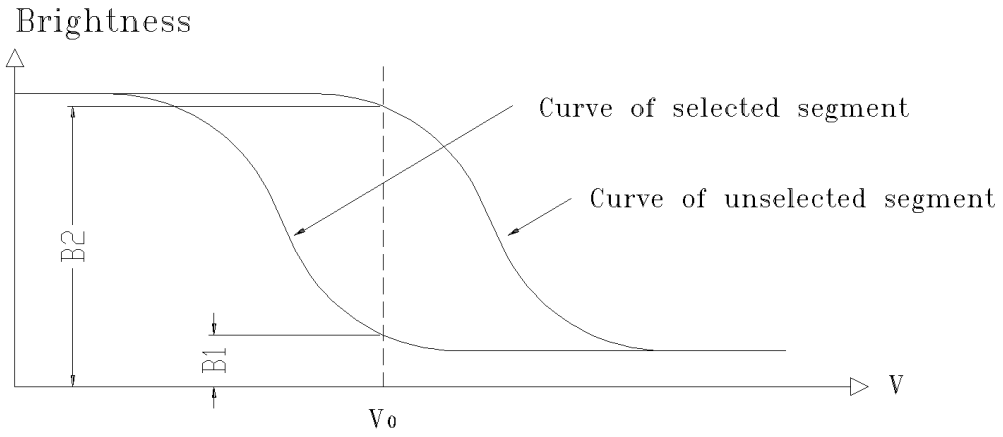
Item		Symbol	Condition		Min.	Typ.	Max.	Unit
Viewing Angle		θ_x	C_r=2	θ_y=0 °	-40 -- +35			Deg
		θ_y		θ_x=0 °	-30 -- +30			
Contrast Ratio		C_r	θ_x=0 ° θ_y=0 °		30	-	-	
Response Time	Turn on	T_{on}	θ_x=0 ° θ_y=0 °		-	-	200	ms
	Turn off	T_{off}			-	-	100	
Color Of CIE Coord-Inate	Red	x	θ_x=0 ° θ_y=0 °		-	0.43	-	cd/m^2
		y			-	0.35	-	
	Green	x	θ_x=0 ° θ_y=0 °		-	0.32	-	cd/m^2
		y			-	0.46	-	
	Blue	x	θ_x=0 ° θ_y=0 °		-	0.22	-	cd/m^2
		y			-	0.26	-	

7.2 Definition of Optical Characteristics

7.2.1 Definition of Viewing Angle



7.2.2 Definition of Contrast Ratio

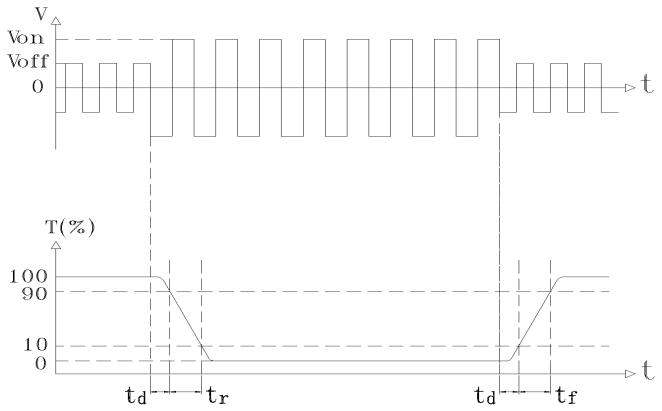


$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

1) Ambient Temperature: 25℃ ; 2) Frame frequency: 70.0Hz

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:10.6V 2) Frame frequency: 70.0Hz

7.3 Brightness Characteristic

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Brightness	Bp	Ta=25℃±3℃ 30-80%RH	65	-	-	cd/m^2
Uniformity	△Bp		-	-	60	%

Note:

1. The data is measured after LEDs are turned on for 5 minutes.
2. Testing conditions LED: V_{LED} = 9.9 V (DC)
   LCD: All dots are on (White color)
3. Brightness in the center of the LCD panel.
4. Definition of Uniformity (△Bp)
   △Bp = Bp (Min.) / Bp (Max.) X 100 (%)
   Bp (Max.) = Maximum brightness in 9 measurement spots
   Bp (Min.) = Minimum brightness in 9 measurement spots

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℃±2℃ 240H Restore 4H at 25℃
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	-30℃±2℃ 240H Restore 4H at 25℃
3	High Temperature /Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time	70℃±2℃ 90%RH 240H Restore 4H at 25℃
4	Temperature Cycle	Endurance test applying the low and high temperature cycle -30℃←→25℃←→80℃←→25℃ 30min 5min 30min 5min ←——————————→ 1 cycle	-30℃/80℃ 10 cycles Restore 4H at 25℃
5	Vibration Test (package state)	Endurance test applying the vibration during transportation	10Hz~150Hz, 100m/s^2, 120min
6	Shock Test (package state)	Endurance test applying the shock during transportation	Half- sine wave, 300m/s^2, 18ms
7	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	v	v	v	v	v	v	v	v	v	Out of the basic Specification
Electrical specification	v	v	v	v	v					Out of the electrical specification
Mechanical Specification							v	v		Out of the mechanical specification
Optical Characteristic	v	v	v	v	v	v			v	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℃

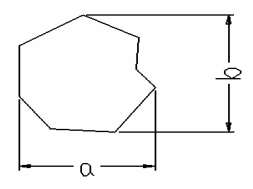
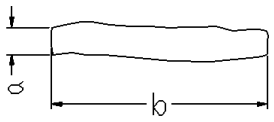
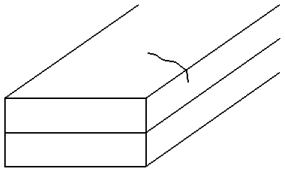
Relatively humidity: ≤80%

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.

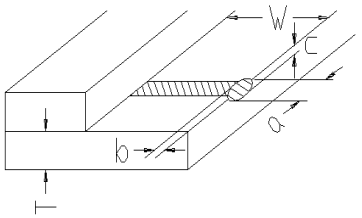
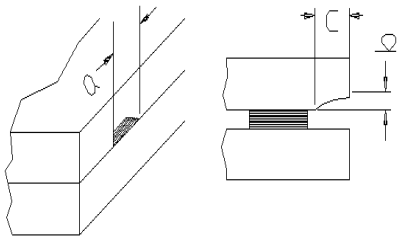
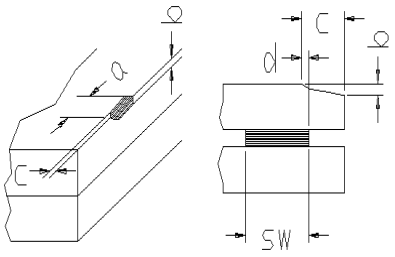
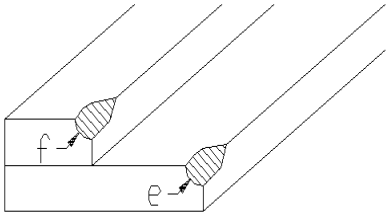
Appendix A

Inspection items and criteria for appearance defects

<table>
<tr><td>Items</td><td>Contents</td><td colspan="4">Criteria</td></tr>
<tr><td>Leakage</td><td></td><td colspan="4">Not permitted</td></tr>
<tr><td>Rainbow</td><td></td><td colspan="4">According to the limit specimen</td></tr>
<tr><td rowspan="3">Polarizer</td><td>Wrong polarizer attachment</td><td colspan="4">Not permitted</td></tr>
<tr><td rowspan="2">Bubble between polarizer and glass</td><td colspan="2">Not counted</td><td colspan="2">Max. 3 defects allowed</td></tr>
<tr><td colspan="2">ϕ<0.3mm</td><td colspan="2">0.3mm≤ϕ≤0.5mm</td></tr>
<tr><td>Scratches of polarizer</td><td colspan="4">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="4">Max. 3 spots (lines) allowed</td></tr>
<tr><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">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="4">Not permitted</td></tr>
</table>

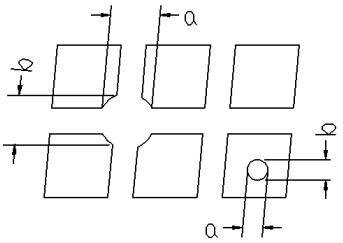
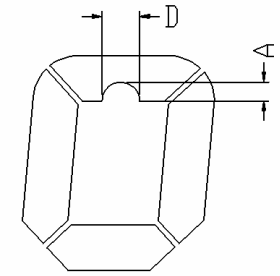
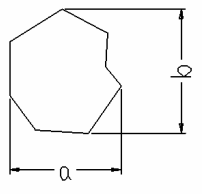
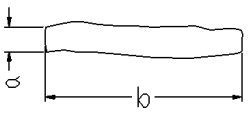
Appendix A

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="4">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="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="2">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>

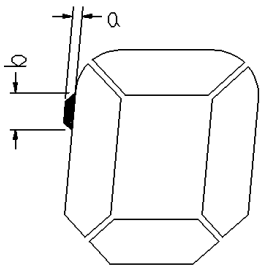
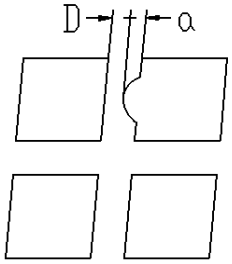
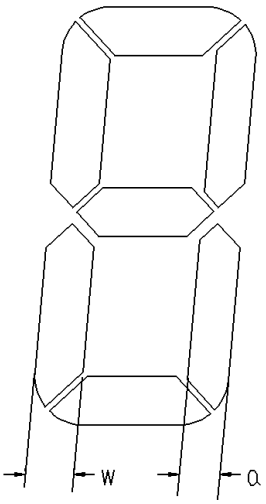
Appendix B

Inspection items and criteria for display defects

<table>
<tr><td colspan="2">Items</td><td>Contents</td><td colspan="3">Criteria</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">Criteria</th></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">0.1mm≦a≦0.2mm
D>0</td></tr>
<tr><td>a＜0.1mm</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>