

SPECIFICATION FOR LCD MODULE

Model No. TM9664FKFWG

Prepared by:	Date:
Checked by :	Date:
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Approved by:	Date:

TIANMA MICROELECTRONICS CO., LTD

REVISION RECORD

Date	Ver.	Ref. Page	Revision No.	Revision Items

1. General Specifications:

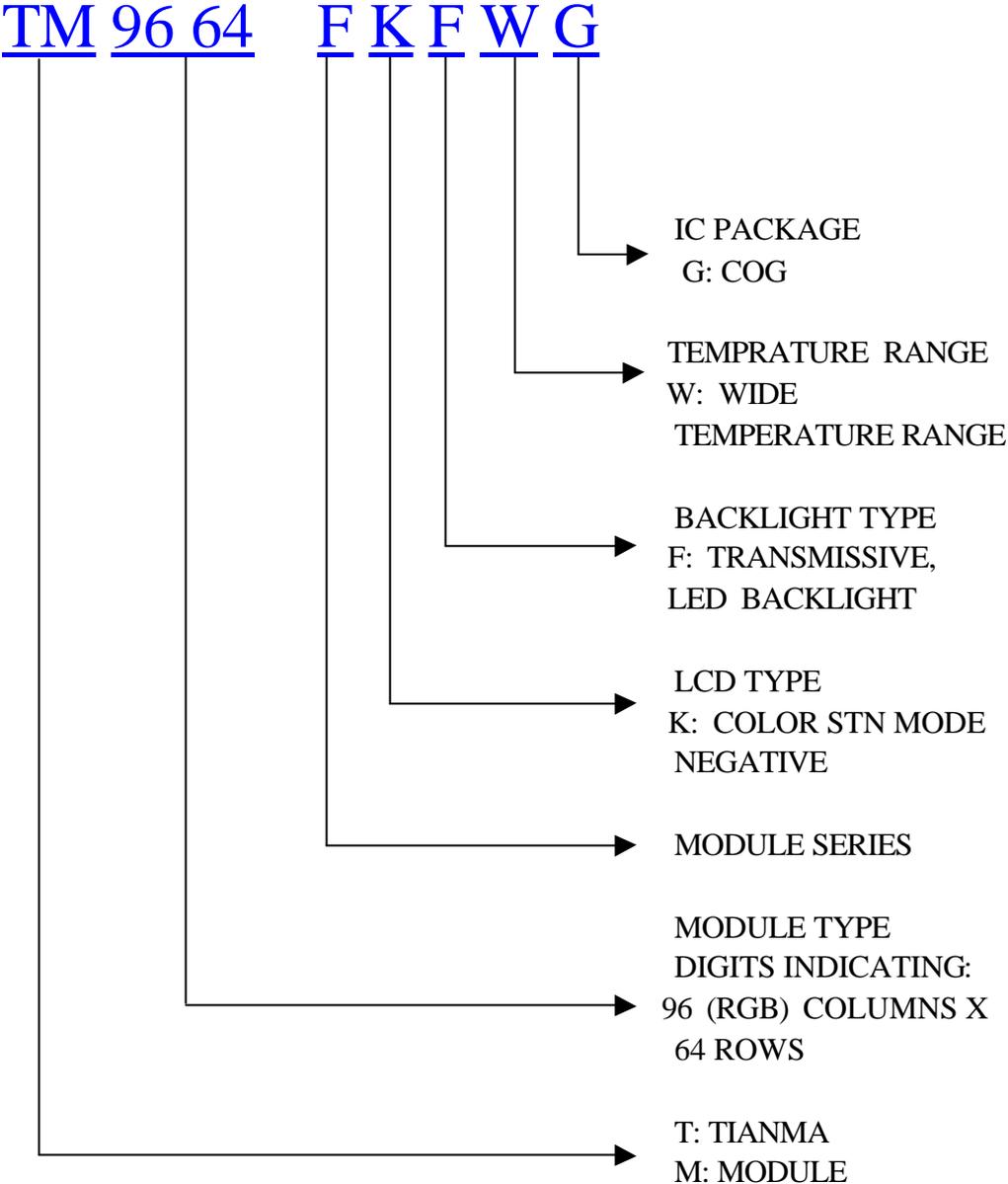
- 1.1 Display type: CSTN
- 1.2 Display color*¹:
 - Display color: 221K(max) COLOR
 - Background*²: Black (Red, Green, Blue dots are off state)
- 1.3 Polarizer mode: Transmissive/Negative
- 1.4 Viewing Angle: 6:00
- 1.5 Driving Method: 1/64 Duty
- 1.6 Backlight Type: LED (2 LAMPS)
 - Backlight Color: WHITE
- 1.7 Controller: UC1682XGAD-U0
- 1.8 Data Transfer: 8 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=8.8V
- 1.12 Outline Dimensions: Refer to outline drawing on next page
- 1.13 Dot Matrix: 96 X 3 (RGB) X 64 Dots
- 1.14 Dot Size: 0.20(R+G+B) × 0.20(mm²)
- 1.15 Dot Pitch: 0.21 × 0.21 (mm²)
- 1.16 Weight: TBD*³

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

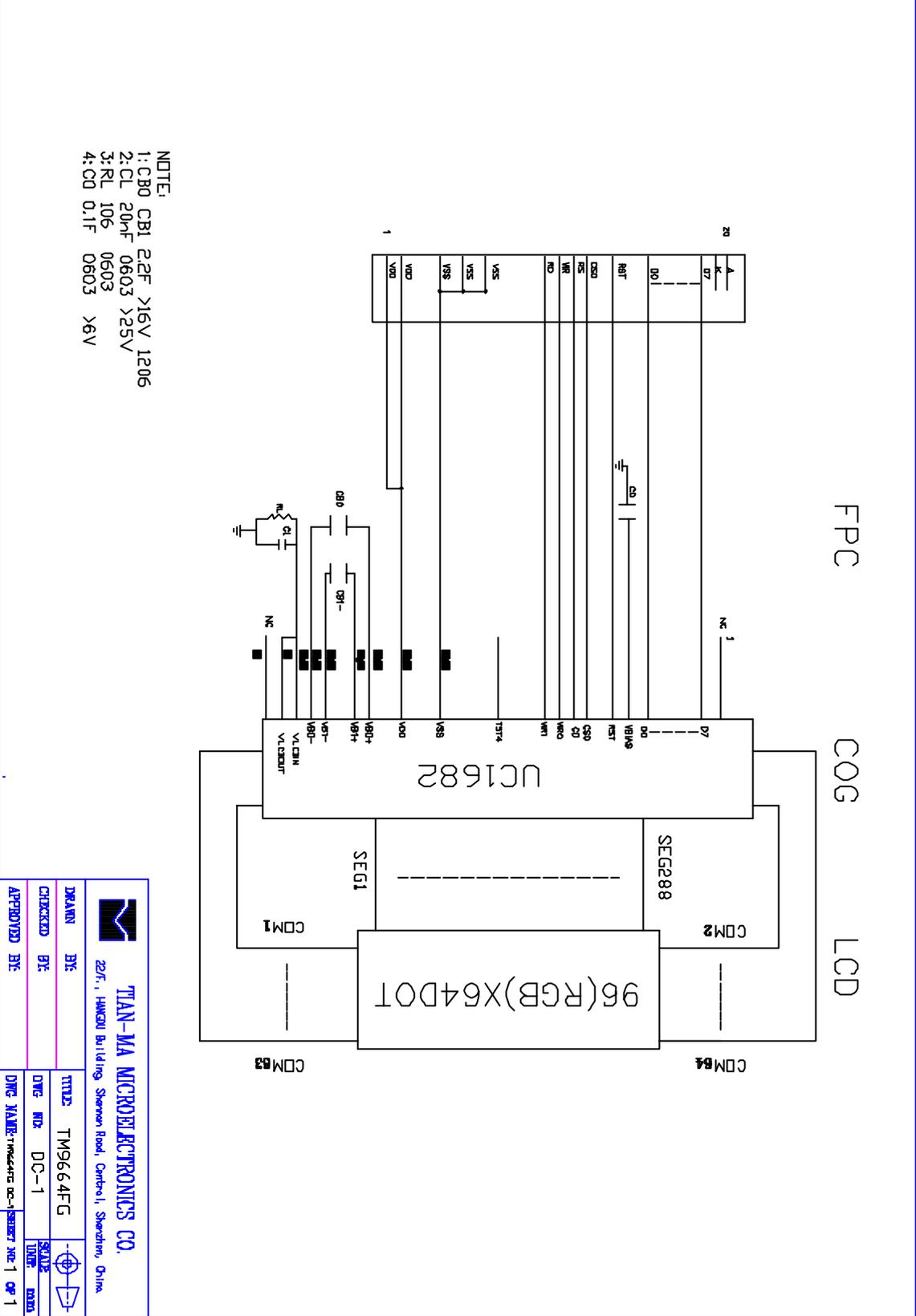
*² Color tone will be changed by backlight.

*³ TBD: To Be Determined.

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	+3.3	V	
LCD Driving Voltage	V _{LCD}		+8.8		
Operating Temperature Range	T _{OP}	-20	+70		Condensation
Storage Temperature Range	T _{ST}	-30	+80		

6. Electrical Specifications and Instruction Code

6.1 Electrical characteristics

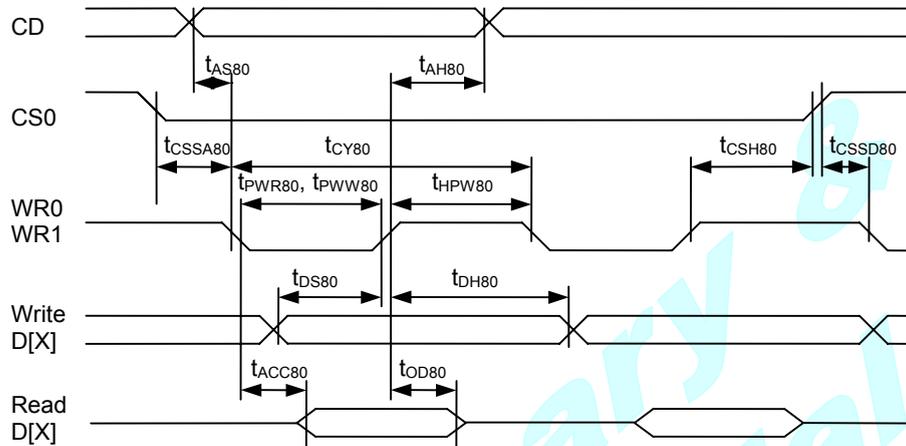
V_{SS}=0V, Ta=25

Item	Symbol	Min.	Typ.	Max.	Unit	
Supply Voltage (Logic)	V _{DD} -V _{SS}	+2.8	+3.0	+3.20	V	
Supply Voltage (LCD Drive)	V _{LCD}	-	8.8	-	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)	-	-	0.8	mA	
Supply Voltage (LED)	V _{LED}	-	6.8	-	V	
Supply current (LED)	I _{LED}		15.0	20.0	mA	

6.2 Interface Signals

Pin No.	Symbol	Level	Description
1	VDD	3.0V	SUPPLY POWER
2	VDD	3.0V	SUPPLY POWER
3	VSS	0V	GOUND
4	VSS	0V	GOUND
5	VSS	0V	GOUND
6	RD	H/L	READ SINGAL
7	WR	H/L	WRITE SINGAL
8	RS	H/L	SELECT CONTROL /DISPLAY
9	CS0	H/L	CHIP SELECT
10	RST	H/L	RESET
11	D7	H/L	Data bus bit 7
12	D6	H/L	Data bus bit 6
13	D5	H/L	Data bus bit 5
14	D4	H/L	Data bus bit 4
15	D3	H/L	Data bus bit 3
16	D2	H/L	Data bus bit 2
17	D1	H/L	Data bus bit 1
18	D0	H/L	Data bus bit 0
19	K	0V	LED CATHODE
20	A	6.8V	LED ANODE

6.3 Interface Timing Chart



Parallel Bus Timing Characteristics (for 8080 MCU)

($V_{DD}=2.5V$ to $3.3V$, $T_a = -30$ to $+85^{\circ}C$)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{AS80} t_{AH80}	CD	Address setup time Address hold time		0 10	—	ns
t_{CY80}		System cycle time 8 bits bus (read) (write) 4 bits bus (read) (write)		140 128 128 128	—	ns
t_{PWR80}	WR1	Pulse width 8 bits (read) 4 bits		65 35	—	ns
t_{PWW80}	WR0	Pulse width 8 bits (write) 4 bits		35 35	—	ns
t_{HPW80}	WR0, WR1	High pulse width 8 bits bus (read) (write) 4 bits bus (read) (write)		65 35 35 35	—	ns
t_{DS80} t_{DH80}	D0~D7	Data setup time Data hold time		30 10	—	ns
t_{ACC80} t_{OD80}		Read access time Output disable time	$C_L = 100pF$	— 10	50 50	ns
t_{SSA80} t_{CSSD80} t_{CSH80}	CS1/CS0	Chip select setup time		10 10 20		ns

6.4 Instruction code

The following is a list of host commands supported by UC1680

C/D: 0: Control, 1: Data
W/R: 0: Write Cycle, 1: Read Cycle
Useful Data bits
- Don't Care

	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default
1	Write Data Byte	1	0	#	#	#	#	#	#	#	#	Write 1 byte	N/A
2	Read Data Byte	1	1	#	#	#	#	#	#	#	#	Read 1 byte	N/A
3	Get Status	0	1	-	MX	MY	WA	DE	WS	OD	OS	Get Status	N/A
4	Set Column Address LSB	0	0	0	0	0	0	#	#	#	#	Set CA[3:0]	0
	Set Column Address MSB	0	0	0	0	0	1	-	#	#	#	Set CA[6:4]	0
5	Set Temp. Compensation	0	0	0	0	1	0	0	1	#	#	Set TC[1:0]	0
6	Set Panel Loading	0	0	0	0	1	0	1	0	#	#	Set PC[1:0]	01b
7	Set Pump Control	0	0	0	0	1	0	1	1	#	#	Set PC[3:2]	11b
8	Set Adv. Program Control (double byte command)	0	0	0	0	1	1	0	0	0	R	Set APC[R][7:0], R = 0, or 1	N/A
		0	0	#	#	#	#	#	#	#	#		
9	Set Scroll Line LSB	0	0	0	1	0	0	#	#	#	#	Set SL[3:0]	0
	Set Scroll Line MSB	0	0	0	1	0	1	#	#	#	#	Set SL[7:4]	0
10	Set Row Address LSB	0	0	0	1	1	0	#	#	#	#	Set RA[3:0]	0
	Set Row Address MSB	0	0	0	1	1	1	#	#	#	#	Set RA[7:4]	0
11	Set V _{BIAS} Potentiometer (double-byte command)	0	0	1	0	0	0	0	0	0	1	Set PM[7:0]	83H
		0	0	#	#	#	#	#	#	#	#		
12	Set Partial Display Control	0	0	1	0	0	0	0	1	#	#	Set LC[9:8]	0: Disable
13	Set RAM Address Control	0	0	1	0	0	0	1	#	#	#	Set AC[2:0]	001b
14	Set Fixed Lines	0	0	1	0	0	1	#	#	#	#	Set FL[3:0]	0
15	Set Line Rate	0	0	1	0	1	0	0	0	#	#	Set LC[4:3]	10b
16	Set All-Pixel-ON	0	0	1	0	1	0	0	1	0	#	Set DC[1]	0
17	Set Inverse Display	0	0	1	0	1	0	0	1	1	#	Set DC[0]	0
18	Set Display Enable	0	0	1	0	1	0	1	1	#	#	Set DC[3:2]	10b
19	Set Color Mask	0	0	1	0	1	1	0	#	#	#	Set MSK[2:0]	0
20	Set LCD Mapping Control	0	0	1	1	0	0	0	#	#	#	Set LC[2:0]	0
21	Set Color Pattern	0	0	1	1	0	1	0	0	0	#	Set LC[5]	0 (BGR)
22	Set Color Mode	0	0	1	1	0	1	0	1	#	#	Set LC[7:6]	10b (65K)
23	System Reset	0	0	1	1	1	0	0	0	1	0	System Reset	N/A
24	NOP	0	0	1	1	1	0	0	0	1	1	No operation	N/A
25	Set Test Control (double byte command)	0	0	1	1	1	0	0	1	TT		For testing only. Do not use.	N/A
		0	0	#	#	#	#	#	#	#	#		
26	Set LCD Bias Ratio	0	0	1	1	1	0	1	0	#	#	Set BR[1:0]	11b (12)
27	Reset Cursor Update Mode	0	0	1	1	1	0	1	1	1	0	AC[3]=0, CA=CR	AC[3]=0
28	Set Cursor Update Mode	0	0	1	1	1	0	1	1	1	1	AC[3]=1, CR=CA	AC[3]=1
29	Set COM End	0	0	1	1	1	1	0	0	0	1	Set CEN[7:0]	159
		0	0	#	#	#	#	#	#	#	#		
30	Set Partial Display Start	0	0	1	1	1	1	0	0	1	0	Set DST[7:0]	0
		0	0	#	#	#	#	#	#	#	#		
31	Set Partial Display End	0	0	1	1	1	1	0	0	1	1	Set DEN[7:0]	159
		0	0	#	#	#	#	#	#	#	#		

	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default
32	Set Window Program Starting Column Address	0 0	0 0	1 -	1 #	1 #	1 #	0 #	1 #	0 #	0 #	Set WPC0[6:0]	0
33	Set Window Programming Starting Row Address	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	0 #	1 #	Set WPP0[7:0]	0
34	Set Window Programming Ending Column Address	0 0	0 0	1 -	1 #	1 #	1 #	0 #	1 #	1 #	0 #	Set WPC1[6:0]	127
35	Set Window Programming Ending Row Address	0 0	0 0	1 #	1 #	1 #	1 #	0 #	1 #	1 #	1 #	Set WPP1[7:0]	159
36	Enable window program	0	0	1	1	1	1	1	0	0	#	Set AC[4]	0: Disable
37	Set OTP Operation control	0 0	0 0	1 -	0 -	1 #	1 #	1 #	0 #	0 #	0 #	Set OTP0[5:0]	0
38	Set OTP Write Mask	0 0	0 0	1 #	0 #	1 #	1 #	1 #	0 #	0 #	1 #	Set OTP1[7:0]	0
39	Set V _{OTP1} Potentiometer	0 0	0 0	1 #	0 #	1 #	1 #	1 #	0 #	1 #	0 #	Set OTP2[7:0]	93
40	Set V _{OTP2} Potentiometer	0 0	0 0	1 #	0 #	1 #	1 #	1 #	0 #	1 #	1 #	Set OTP3[7:0]	42
41	Set OTP Write Timer	0 0	0 0	1 #	0 #	1 #	1 #	1 #	1 #	0 #	0 #	Set OTP4[7:0]	128
42	Set OTP Read Timer	0 0	0 0	1 #	0 #	1 #	1 #	1 #	1 #	0 #	1 #	Set OTP5[7:0]	128

* Other than commands listed above, all other bit patterns may result in undefined behavior.

7. Optical Characteristics

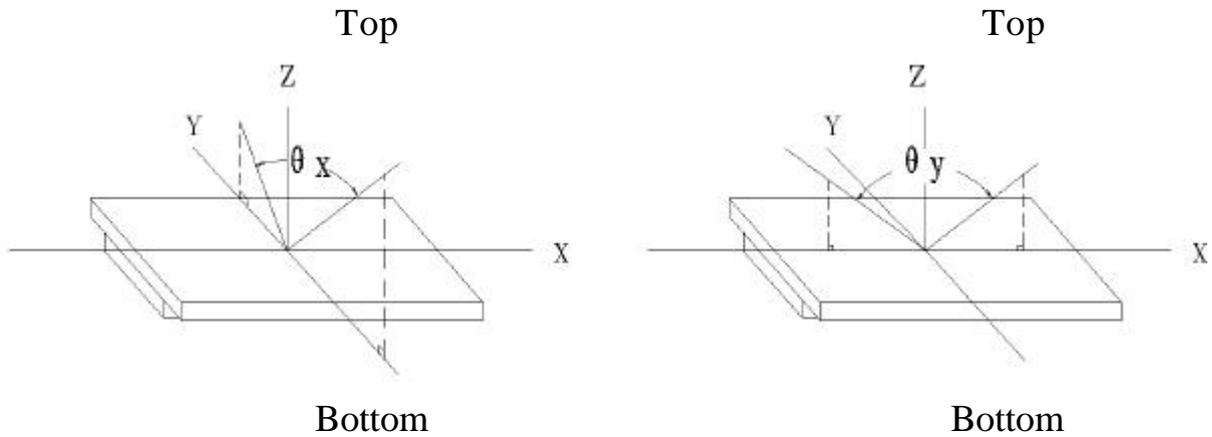
7.1 Optical Characteristics

$V_{LCD}=8.8V$ $T_a=25$

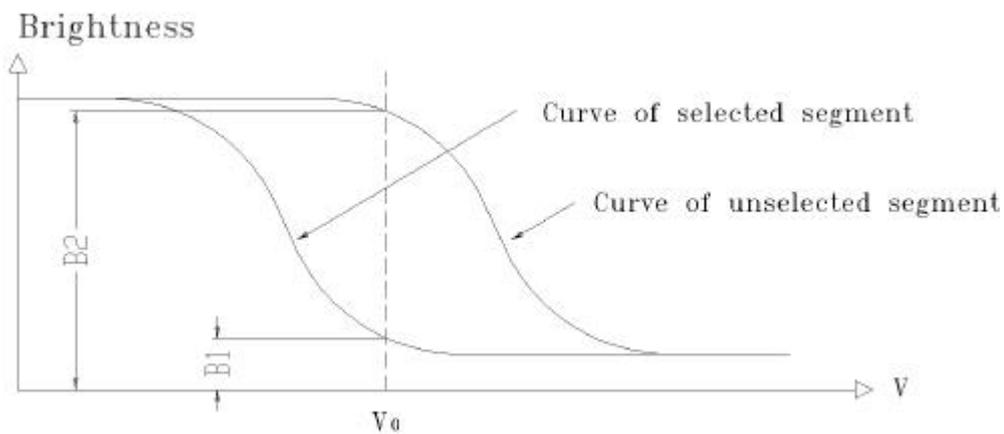
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	
Viewing Angle	x	$C_r=2$	$y=0^\circ$	-40	--	+40	Deg
	y		$x=0^\circ$	-40	--	+40	
Contrast Ratio	C_r	$x=0^\circ$ $y=0^\circ$	40	-	-		
Response Time	Turn on	T_{on}	$x=0^\circ$ $y=0^\circ$	-	150	200	ms
	Turn off	T_{off}		-	100	150	
Color Of CIE Coord-Inate	Red	x	$x=0^\circ$ $y=0^\circ$	-	0.54	-	
		y		-	0.36	-	
	Green	x	$x=0^\circ$ $y=0^\circ$	-	0.30	-	
		y		-	0.49	-	
	Blue	x	$x=0^\circ$ $y=0^\circ$	-	0.17	-	
		y		-	0.19	-	

7.2 Definition of Optical Characteristics

7.2.1 Definition of Viewing Angle



7.2.2 Definition of Contrast Ratio

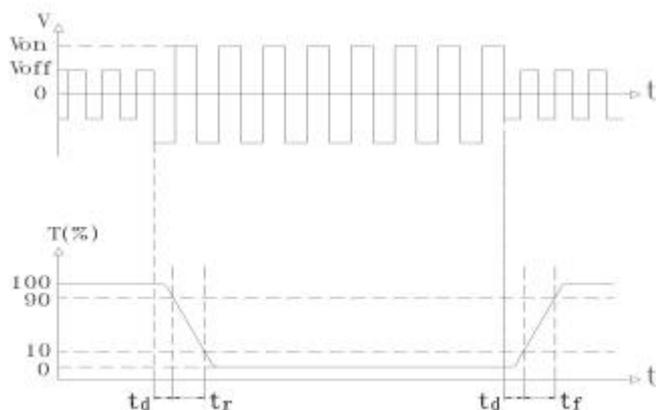


$$\text{Contrast Ratio} = B2/B1 = \frac{\text{unselected state brightness}}{\text{selected state brightness}}$$

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: 8.8V
- 2) Frame frequency: 70.0Hz

7.3 Brightness Characteristic

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Brightness	Bp	Ta=25 ±3	150	-	-	cd/m ²
Uniformity	Bp	30-80%RH	-	-	85	%

Note:

1. The data is measured after LEDs are turned on for 5 minutes.
2. Testing conditions LED: V_{LED} = 6.8 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 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	65 90%RH 240H
6	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
7	Vibration Test (package state)	Endurance test applying the vibration during transportation	10Hz~150Hz, 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	v	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

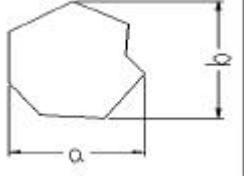
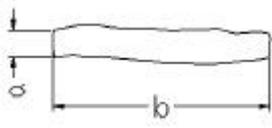
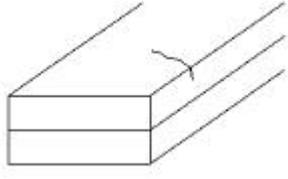
Relatively humidity: 80%

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.

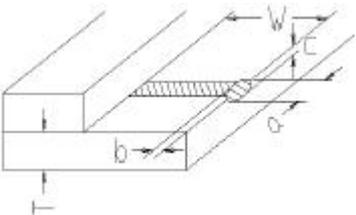
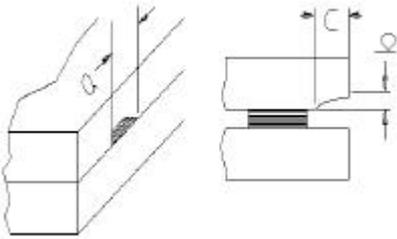
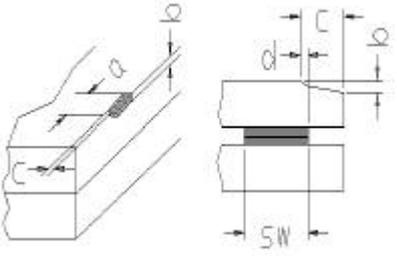
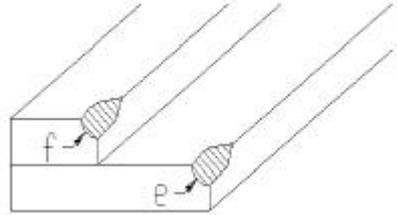
Appendix A

Inspection items and criteria for appearance defects

Items	Contents	Criteria		
Leakage		Not permitted		
Rainbow		According to the limit specimen		
Polarizer	Wrong polarizer attachment	Not permitted		
	Bubble between polarizer and glass	Not counted	Max. 3 defects allowed	
		$\phi < 0.3\text{mm}$	0.3mm ϕ 0.5mm	
Scratches of polarizer	According to the limit specimen			
Black spot (in viewing area)		Not counted	Max. 3 spots allowed	Max. 3 spots (lines) allowed
		$X < 0.2\text{mm}$	0.2mm X 0.5mm	
		$X = (a+b)/2$		
Black line (in viewing area)		Not counted	Max. 3 lines allowed	
		$a < 0.02\text{mm}$	0.02mm a 0.05mm b 2.0mm	
Progressive cracks		Not permitted		

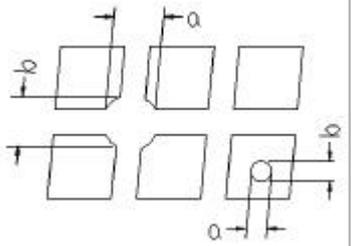
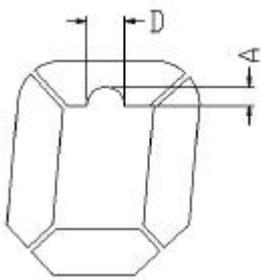
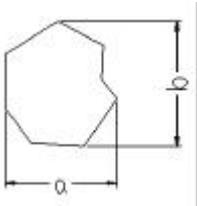
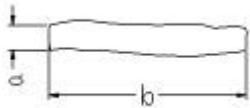
Appendix A

Inspection item and criteria for appearance defects (continued)

Items	Contents	Criteria							
Glass Cracks	<p>Cracks on pads</p> 	a	b	c	Max. 2 cracks allowed	Max. 5 cracks allowed			
		3mm	W/5	T/2					
		2mm	W/5	$T/2 < C < T$					
	<p>Cracks on contact side</p> 	a	b		Max. 2 cracks allowed				
		3mm	T/2						
		2mm	$T/2 < b < T$						
		C shall be not reach the seal area							
	<p>Cracks on non-contact side</p> 	a	b		Max. 2 cracks allowed				
		3mm	T/2						
		2mm	$T/2 < b < T$						
	C 0.5mm								
	d SW/3								
<p>Corner cracks</p> 	$e < 2.0\text{mm}^2$			Max. 3 cracks allowed					
	$f < 2.0\text{mm}^2$								

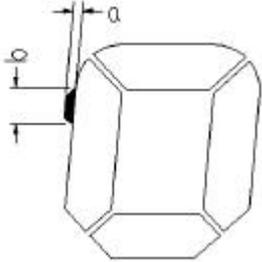
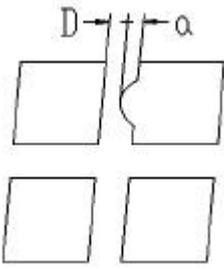
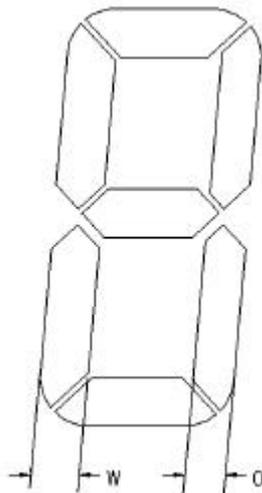
Appendix B

Inspection items and criteria for display defects

Items	Contents	Criteria		
Open segment or open common		Not permitted		
Short		Not permitted		
Wrong viewing angle		Not permitted		
Contrast ratio uneven		According to the limit specimen		
Crosstalk		According to the limit specimen		
Pin holes and cracks in segment (DOT)		Not counted	Max.3 dots allowed	Max.3 dots allowed
		$X < 0.1\text{mm}$	0.1mm X 0.2mm	
		$X = (a+b)/2$		
		Not counted	Max.2 dots allowed	
$A < 0.1\text{mm}$		0.1mm A 0.2mm $D < 0.25\text{mm}$		
Black spot (in viewing area)		Not counted	Max.3 spots allowed	Max.3 spots (lines) allowed
		$X < 0.1\text{mm}$	0.1mm X 0.2mm	
		$X = (a+b)/2$		
Black line (in viewing area)		Not counted	Max.3 lines allowed	
		$a < 0.02\text{mm}$	0.02mm a 0.05mm b 0.5mm	

Appendix B

Inspection items and criteria for display defects (continued)

Items	Content	Criteria			
Transformation of segment		Not counted	Max. 2 defects allowed	Max.3 defects allowed	
	$x < 0.1\text{mm}$		0.1mm x 0.2mm		
		$x = (a+b)/2$			
		Not counted	Max. 1 defects allowed		
		$a < 0.1\text{mm}$	$0.1\text{mm} \leq a \leq 0.2\text{mm}$ $D > 0$		
		Max.2 defects allowed $0.8W \leq a \leq 1.2W$ $a = \text{measured value of width}$ $W = \text{nominal value of width}$			