優潔光科技股份有限公司
UJ Light Technologies Corporation

SPECIFICATIONS FOR LCD MODULE

RoHS COMPLIANT

MODEL NO.
BO9864B2-FPHNH$
VER.01

FOR MESSRS:

_____

ON DATE OF:

_____

APPROVED BY:

_____

History of Version

Version	Contents	Date	Note
01	NEW VERSION	2023/6/20	SPEC.

History of Version

C O N T E N T S

1. Numbering System

B	O	9864	B2	-	F	P	H	N	H	--	$	--
0	1	2	3		4	5	6	7	8	9	10	11

0	UJ Light	B				
1	Module Type	C	Character type	P	TAB /TCP type
		F	COF type	R	Color STN
		G	Graphic type	L	OLED
		O	COG type	Z	Customize
2	Format	2004	20 character type,4lines		
		12232	122 × 32 dots		
3	Version No.	B2			
			-		
4	LCD Color	B	STN / Blue, OLED/Blue	H	HTN
		C	Color	T	TN
		F	FSTN	Y	STN/Yellow-green
		G	STN/Grey	D	OLED/Blue+Yellow
		A	OLED/Blue+Yellow+Green	E	OLED/Yellow
		L	OLED/Green	R	OLED/RED
		W	OLED/White	J	ASTN
		K	DFSTN	V	VA LCD
5	LCD Type	R	Positive/reflective	M	Positive/ transmissive
		P	Positive/transflective	N	Negative/ transmissive
		T	Negative/ transflective		
6	Backlight type/color	L	(LED)Array/yellow-green	G	(LED)Edge/yellow-green
		M	(LED)Array/amber	H	(LED)Edge/white
		R	(LED)Array/red	D	(LED)Edge/blue
		U	(LED)Array/blue	E	(EL)white
		W	(LED)Array/white	B	(EL)blue
		C	(CCFL) white	F	(LED)Array/RGB
		Y	(LED)Array/yellow	N	No backlight
		O	(LED)Array/orange	K	(LED)Edge/green
		A	(LED)Edge/amber	Q	(LED)Edge/red
		J	(LED)Array/green	I	(LED)Edge/RGB
		Z	(LED) array red/green	P	(LED)Edge/orange

		S	(LED)edge/RGW	T	(LED)edge red/green
		V	EL blue/green`	X	(LED) Edge white / red
7	CGRAM Font	J	English/Japanese Font	C	English/Cyrillic Font
		G	Chinese(simple)	H	English/Hebrew Font
		E	English/European Font (ST7066U0B-BB)	S	English/European Font (ST7066U-0E-BB)
		F	Chinese(traditional)	M	Japanese-Kanji
		Z	Z=Chinese(simple)+Chinese (traditional)+Japanese+Korean	K	Korean (only for BG16032A BG24064C)
		A	English/Arabic Font	D	Chinese (simple/traditional) English/Japanese
		B	English/Japanese/European	N	None
8	View Angle /Operation Temperature	B	Bottom/Normal Temperature06:00	W	Top/Wide Temperature 12:00
		H	Bottom/Wide Temperature 06:00	E	Top/Ultra Temperature 12:00
		C	9H/Normal Temperature 09:00	U	Bottom/Ultra wide Temperature 06:00
		T	Top/Normal Temperature 12:00	F	9H/Ultra wide Temperature 09:00
		G	3H/Wide Temperature 3:00	D	9H/Wide Temperature 09:00
		I	3H/ Ultra Wide Temperature 3:00		
9	Special Code	N	Negative voltage for LCD	T	Negative voltage and Temperature compensation for LCD
		P	Touch panel	3/5	3/5 voltage logic power supply
10	RoHS	$			
11					

2. Handling Precaution

2.1 Precaution in use of LCD Module

2.1.1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure and/or sharp tools on the surface of display area.

2.1.2. The polarizer placed on the display surface is easily scratched and damaged. Extreme care should be taken when handling it. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isopropyl alcohol, ethyl alcohol, do not use water, ketone or aromatics to clear display surface, and never scrub it hard.

2.1.3. Keep LCD panels away from direct sunlight. The storage environment should be dust-free, clean, dry, temperature is $25°C±10°C$ and the humidity is below 55% RH.

2.1.4. Do not input any signal before power is turned on.

2.1.5. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.

2.1.6. It's important to control soldering temperature and time. RoHS compliant materials might need higher temperature and time, but try to keep temperature under $350°C$ and time in 3-5 sec.

2.1.7. EL is manufactured from the organic film, and is easily affected by temperature, humidity and other environmental impact. Long time storage might cause low quality of the case. Therefore, please start production in 3 months after reception of the LCM. If in any case, long time storage over 3 months is necessary, please keep EL in vacuum package or at least in humidity < 35% RH, and temperature $25°C±10°C$.
Note: 2.1.7. is applied to EL backlight only.

2.2 Static Electricity Precautions:

2.2.1. The LCD module contains a C-MOS LSI. People who operate the LCM should wear ESD protection equipment to prevent ESD hurt on products.

2.2.2. Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.

2.2.3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.

2.2.4. The modules should be kept in anti-static bags or trays for storage.

2.2.5. Only properly grounded soldering irons should be used.

2.2.6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.

2.2.7. The normal static prevention measures should be observed for work clothes and working benches.

2.2.8. Since dry air(almost low RH) is inductive to static, a humidity of 50-60% RH is recommended in assembly line.

2.3 Operation Precautions:

2.3.1. DC voltage applied on LCM causes electrochemical reactions, which will deteriorate the display over time. The applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.

2.3.2. LCD driving voltage should be kept within specified range; excess voltage will shorten display life, while less voltage may not turn on LCM.

2.3.3. LCM response time will be extremely delayed in low operating temperature(such as -20 $°C$) than in room operating temperature. Therefore, higher LCD driving voltage is required in low operating temperature; On the other hand, in high operating temperature (such as +70$°C$) LCD shows dark background color, therefore lower LCD driving voltage is required. Be sure to use the specified LCD driving voltage in different operating temperature.

2.4 Safety:

2.4.1 If the LCD panel breaks, be careful not to get the liquid crystal to touch your skin. If the liquid crystal touches your skin or clothes, please wash it off immediately by using soap and water.

2.5 WARRANTY POLICY

UJ Light Will provide one-year warranty for the products only if under specification operating conditions.

If there are functional defects found during the period of warranty, the defective products would be replaced on a one-to-one basis.

UJ Light would not be responsible for any direct/indirect liabilities consequential to any parties.

2.6 MTBF

2.6.1 .By specific test condition, MTBF based on 30℃ normal operation temperature is 50,000hours.

2.6.2 Test Condition:

2.6.2.1 Supply Voltage for LCM: Typical Vdd

2.6.2.2 CC (Constant Current) mode and typical current is applied for LED.

2.6.2.3 Run-Patterns: by UJ Light's test program that has defined patterns and cyclic period.

2.6.2.4 Humidity: 60%RH

2.6.3 Test Criteria:

Attenuation of average brightness: $\leqq$ 50%

Increasing of current consumption for LCM/Backlight: $\leqq$ 20%

Display function at room temperature: Normal

Appearance: Normal

3. General Specification

(1) Mechanical Dimension

Item	Standard Value	Unit
Number of dots	98 × 64	dots
Module Size　(W x H x T)	36.2 x 64.1 x 4.0 - LED B/L	mm
View area	31.0(W) × 22.5(H)	mm
Dot size	0.26W) × 0.31(H)	mm
Dot pitch	0.28(W) × 0.33(H)	mm

(2) Controller IC: ST7578i Controller

4. Absolute Maximum Ratings

4.1 Electrical Absolute Maximum Ratings　　　　　　　　　　　(VSS=0V, Ta=25℃)

Item	Symbol	Min	Typ	Max	Unit
Digital Power supply voltage	VDD1	-0.3	—	3.6	V
Analog Power supply voltage	VDD2	-0.3	—	VDD+0.3	V
Supply Voltage For LCD	V0-XV0	-0.3	—	15	V

4.2 Environmental Absolute Maximum Ratings

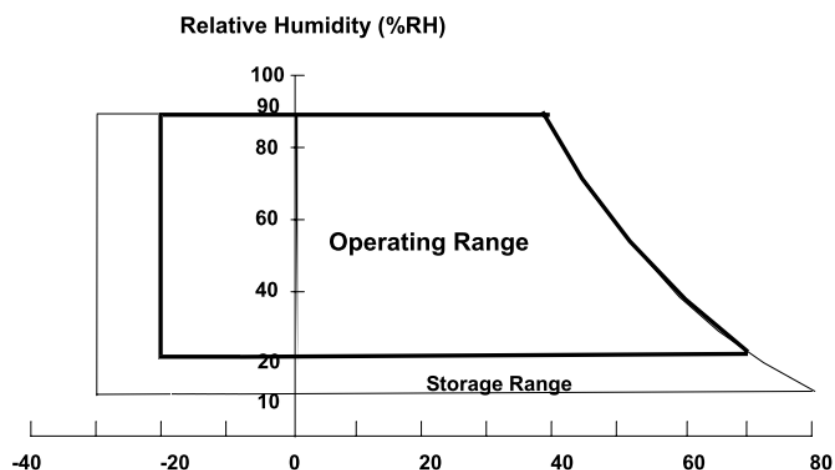| Item	Symbol	Min	Max	Unit	Note
Operating Temperature	TOP	-20	70	℃	(1)
Storage Temperature	TST	-30	80	℃	(1)

Note (1)

　(a) 90 %RH Max. (Ta <= 40 ºC).

　(b) Wet-bulb temperature should be 39 ºC Max. (Ta > 40 ºC).

　(c) No condensation.

5. Electrical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Logic Circuit Supply Voltage	V_{DD}-V_{SS}	--	2.8	3.0	3.3	V
LCD Driving Voltage	V_{LCD}	25 °C	9.9	10.2	10.5	V
Input Voltage	VIH	--	0.7 V_{DD}	--	V_{DD}	V
	VIL	--	Vss	--	0.3 V_{DD}	V
Logic Supply Current	IDD	V_{DD} = 3.0V	--	2.0	--	mA
LCM Surface Luminance Ta=25℃	L	ILED=40 mA Display all OFF	67	100	—	cd/m^2

※Optimum LCD driving voltage value, referring to above mentioned range, is changed due to

different batch of LCD glass.
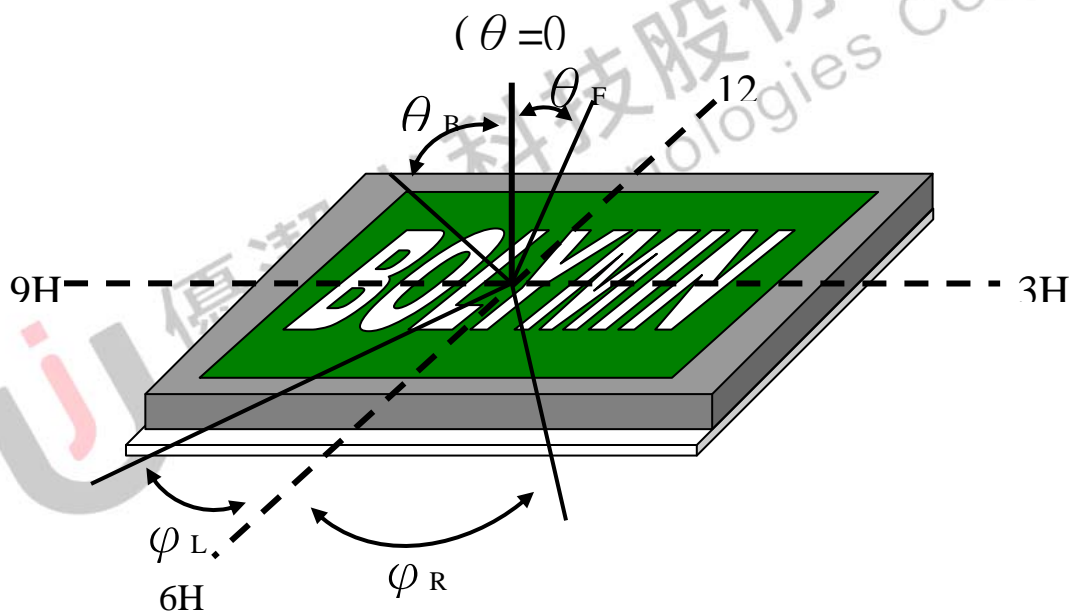
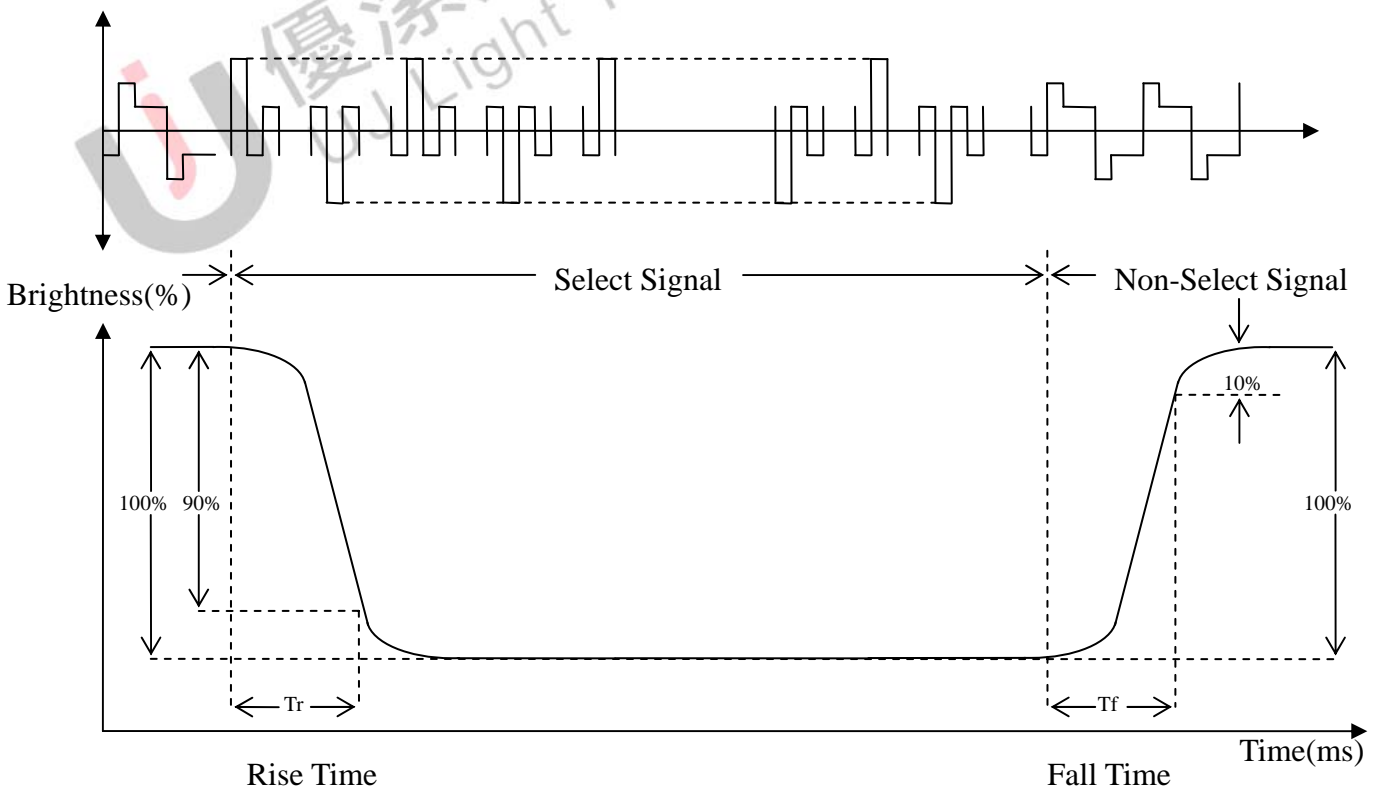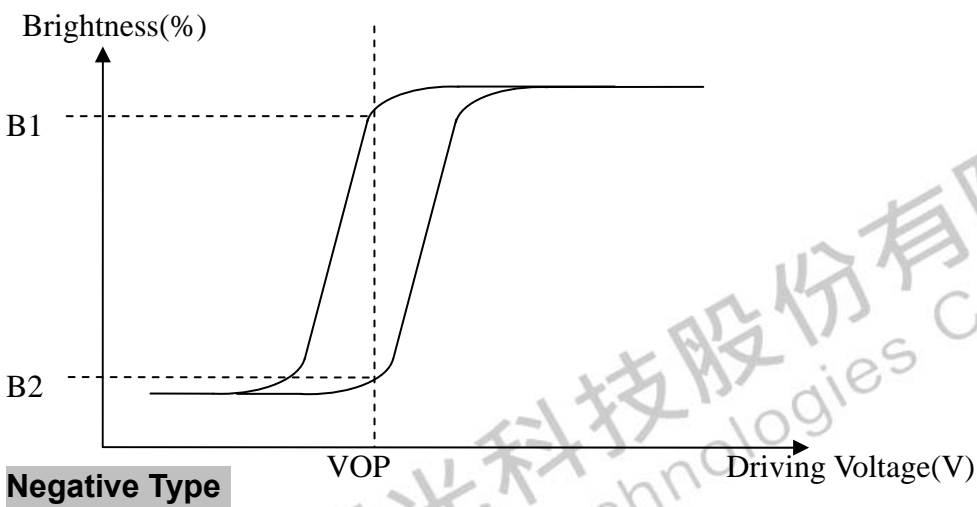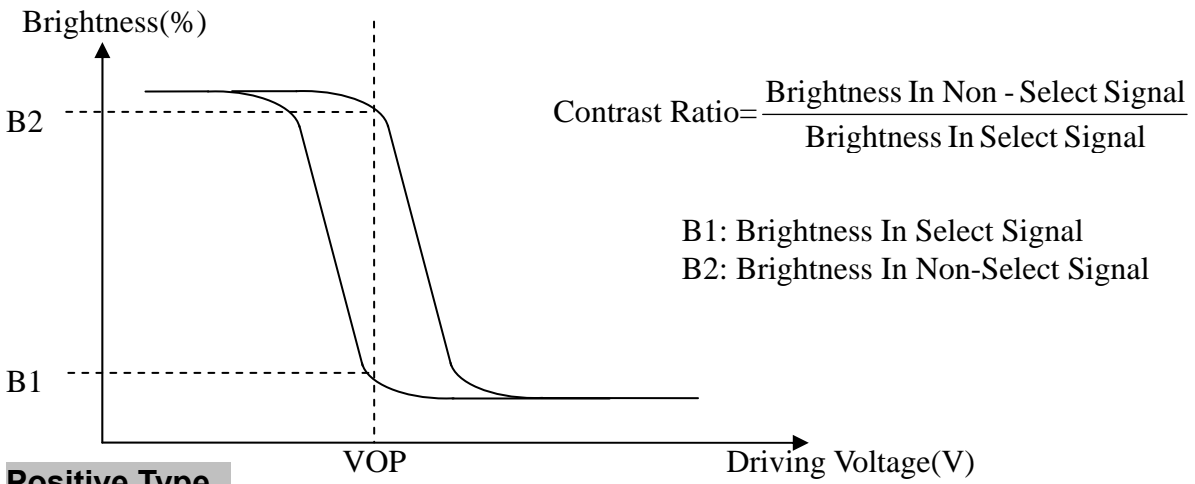# 6.Optical Characteristics

a. FSTN   (Ta=25℃)

Item	Symbol	Min.	Typ.	Max.	Unit
View Angle (CR>=2)	θF	-	36	-	deg
	θB	-	38	-	deg
	φL	-	40	-	deg
	φR	-	45	-	deg
Contrast Ratio	CR	-	5	-	-
Response Time 25℃	T rise	-	200	400	ms
	T fall	-	250	400	ms

Positive Type

Brightness(%)

B2

B1

VOP

Driving Voltage(V)

$$\text{Contrast Ratio} = \frac{\text{Brightness In Non - Select Signal}}{\text{Brightness In Select Signal}}$$

B1: Brightness In Select Signal
B2: Brightness In Non-Select Signal

Negative Type

Brightness(%)

B1

B2

VOP

Driving Voltage(V)

Brightness(%)

Select Signal

Non-Select Signal

100% 90%

10%

100%

Tr

Tf

Rise Time

Fall Time

Time(ms)

7.Interface Pin Function

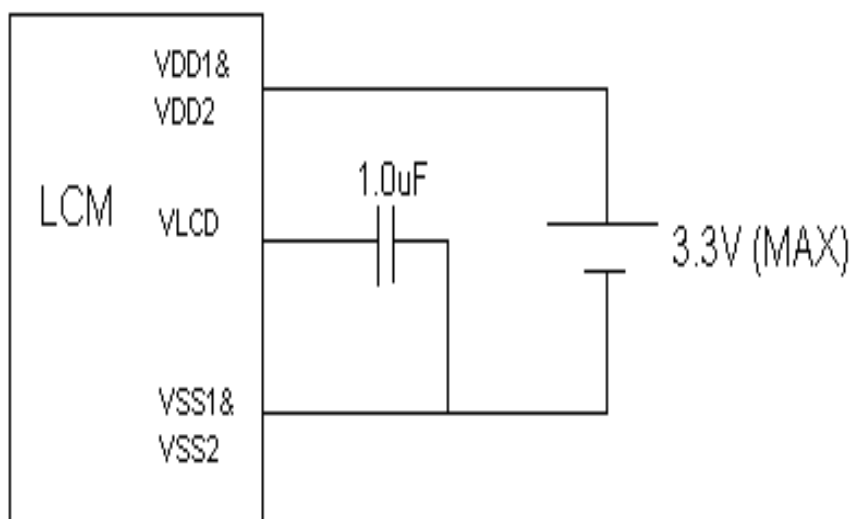| NO.	Symbol	Function
1	NC	
2	VSS	Power Supply (0V, GND)
3	VSS	Power Supply (0V, GND)
4	SCLK	Serial clock signal input (SCLK)
5	SDA	Serial input data(SDA_IN)
6	/RES	This signal is used to rest the device. This signal is active Low.
7	VDD	Positive power supply
8	VDD	Positive power supply
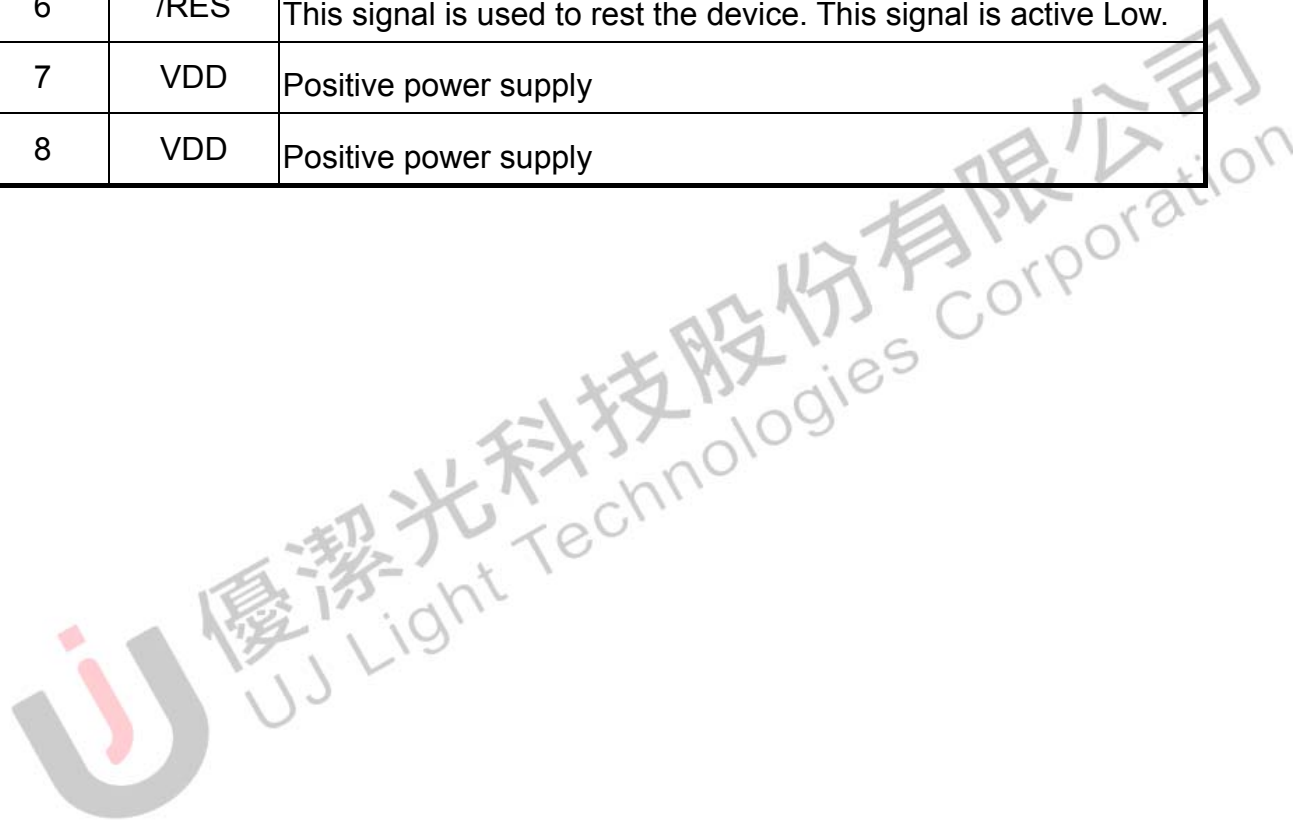
8. Block Diagram And Power Supply for LCD Module

Block Diagram

```
C63
  |
C33        LCD
           98*64              C32
                               |
         S0 ---------- S97    C0

        SEG0 -------- SEG97

COM33                        COM0

COM63    IC:ST7578i          COM32
```

Power Supply for LCD Module

```
        VDD1&
        VDD2

LCM     VLCD      1.0uF        3.3V (MAX)

        VSS1&
        VSS2
```
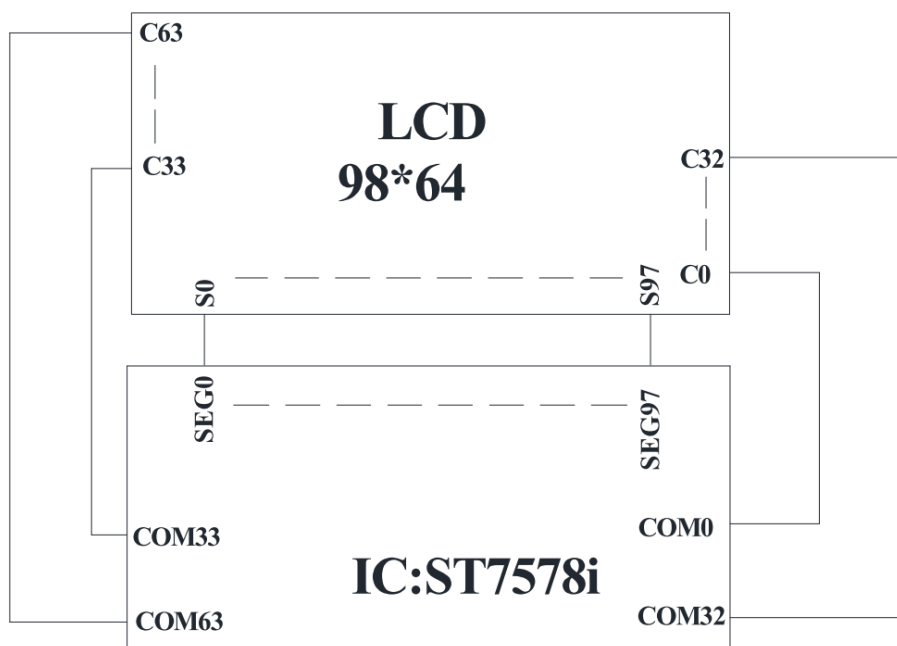
9. Backlight information

9.1 Specification

(1)LED edge/white

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Current	ILED	—	40	—	mA	V=3.1V
Supply Voltage	Vf	2.8	3.1	3.4	V	ILED =40mA
Reverse Voltage	VR	—	—	5	V	
CIE	X	0.25		0.31		ILED =40mA
	Y	0.26	—	0.32		
Color	white					

9.2 Backlight driving methods

a.LED B/L drive from A、K
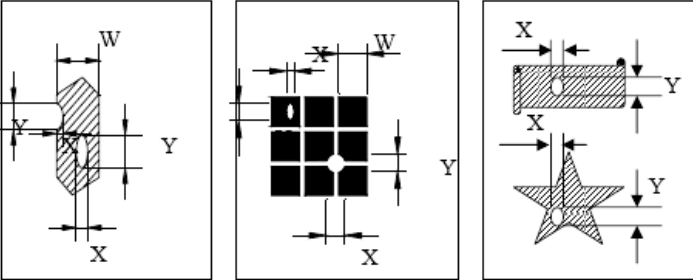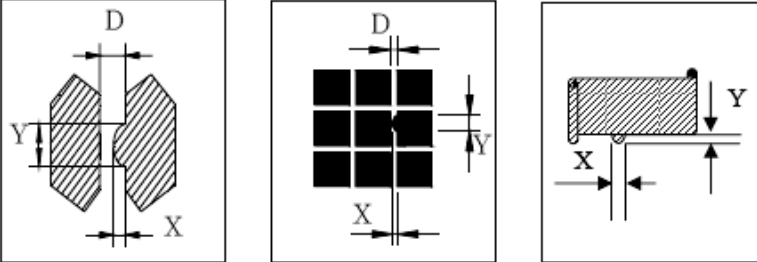
a.1 edge/ (white)

LCM
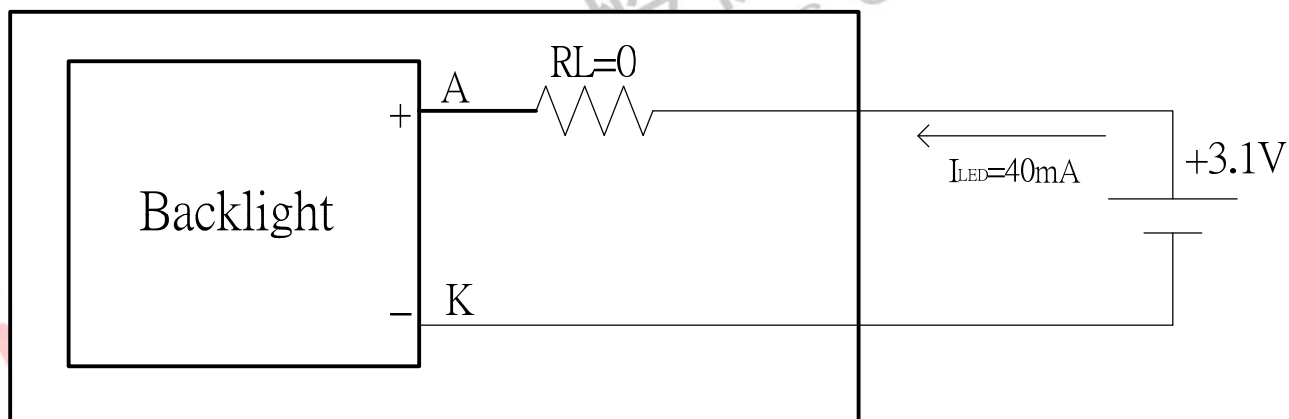
10. Quality Assurance

10.1 **Inspection conditions**

1. The LCD shall be inspected under 20~40W white fluorescent light.

2. Checking Direction shall be in the 40 degree from perpendicular line of specimen surface.
3. Checker shall see over 30 cm.
4. Inspect about 5 seconds for each side.

5. Defect that is located at outside of VA and doesn't affect function is ignored.

10.2 **Inspection Parameters**

NO.	Parameter	Criteria			
1	Black or White spots (Particle)	Dimension \ Zone	Acceptable Number	Class Of Defects	Acceptable Level
		D≦0.10	Disregard	Minor	2.5
		0.10＜D≦0.2	4		
		0.2＜D≦0.3	2		
		0.3＜D	0		

D=(Long + Short)/2
Total defects should not exceed 5/module
Defect that is located at outside of AA and doesn't affect function is ignored.

NO.	Parameter	Zone		Acceptable Number	Class Of Defects	Acceptable Level
		X(mm)	Y(mm)			
2	Scratch, Substances	－	0.05≧W	Disregard	Minor	2.5
		4.0≧L	0.05≧W	4		
		3.0≧L	0.1≧W	2		
		－	0.1＜W	0		

X: Length   Y: Width
Total defects should not exceed 5/module
Defect that is located at outside of AA and doesn't affect function is ignored.

		Zone Dimension	Acceptable Number	Class Of Defects	Acceptable Level	
3	Air Bubbles (between glass & polarizer)	D≦0.2	Disregard			
		0.2＜D≦0.5	3	Minor	2.5	
		0.5＜D	0			

Total defects shall not excess 3/module.
Defect that is located at outside of AA and doesn't affect function is ignored.
Bobble is sawn only under reflection light is disregarded.

4	Displaying Pattern	

1. Incomplete or broken line is not allowed.
2. Pinholes

Dimension Φ(mm)	Criteria	Class Of Defects	Acceptable Level
Φ＜0.1	Disregard		
0.1＜Φ≦0.2	2	Minor	2.5
0.2＜Φ≦0.25	1		
0.25＜Φ	0		

$\emptyset=(X+Y)/2$

3. Deformation

Dimension Φ(mm)	Criteria	Class Of Defects	Acceptable Level
Φ＜0.15	Disregard		
Φ≦0.25 and X≦1/2D	3	Minor	2.5
Φ＞0.25and X＞1/2D	0		

D：間距 $\emptyset=(X+Y)/2$

Other Inspection standard reference UJ Light standard.

11.Reliability

■Content of Reliability Test

Environmental Test				
No	Test Item	Content of Test	Test Condition	Applicable Standard
1	High Temperature storage	Endurance test applying the high storage temperature for a long time.	80℃ 96 hrs	――
2	Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-30℃ 96 hrs	――
3	High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70℃ 96 hrs	――
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20℃ 96 hrs	――
5	Humidity Test	Endurance test applying the high humidity storage for a long time.	40℃,90%RH 96hrs	――
6	Temperature cycle (Non-operation)	Endurance test applying the low and high temperature cycle. -30℃　　　　　　80℃ ←――――――――→ 30min　　　30min 1 cycle	-30℃/80℃ 10　cycles	――
7	Vibration test	Endurance test applying the vibration during transportation and using.	Total Fixed Amplitude:1.5mm Vibration Frequency :10~55Hz One cycle 60 seconds to 3 direction of X,Y,Z for each 15minutes	――

※Assess after placing at normal temperature and humidity for 4 hour。No abnormalities in functions and appearance。

12.Appendix (Drawing , ST7578i controller data)
12.1 Drawing

PIN NO.	SYMBOL
1	NC
2	VSS
3	VSS
4	SCLK
5	SDA
6	/RES
7	VDD
8	VDD

A Block

0.28
0.26
0.31
0.33

The non-specified tolerance of dimension is ±0.3 mm

PART_NAME		TITLE	NA
PART_NO.		MATERIAL	NA
VERSION		SURFACE	NA
		TOL. UNLESS NOTED.	NA
		UNIT	mm
		SCALE	1/1
		SHEET	1/1 OF

R1
25.0
2.0 min
4.0±0.5
1.65
2
2*0.55=1.1

LCD
ST7578i
C32 C0 SEG97 COM0 COM32
C63 C33 S0 SEG0 COM33 COM63

0.9
0.6
25.0
25.0
4.0±0.5
1.65
2
2*0.55=1.1

Conduct side
Contact side
0.3±0.05

3.3±0.5

0.8max
30.2
8.75
8.0max

8
1

36.2±0.5
34.0±0.3LCD
31.0±0.3(VA)
27.42(AA)
98*64 Dots
R5.0
17.5
28.0
P0.5x7=3.5
4.5±0.1

3
1
33.2
36.2

1.5
3.29
21.1(AA)
10.7
22.5Min(V.A)
10.0
26.0
8.0
6.7
34.0
29±0.5
35.1±0.5
64.1.0±0.6

1.5
2
4
1.5

APPROVAL / DATE
CHECK / DATE
DRAW / DATE

	DATE	LOCA	DRAW	DESCRIPTION	NO.	REV.

TOLERANCE UNLESS OTHERWISE SPEC.

	F	G	H	J	K	L
~ 8	'0.05	'0.1	'0.1	'0.2	'0.2	'0.4
8 ~ 25	'0.08	'0.15	'0.15	'0.3	'0.3	'0.6
25 ~ 80	'0.12	'0.2	'0.25	'0.4	'0.5	'0.8
80 ~250	'0.25	'0.3	'0.4	'0.6	'0.8	'1.2
250~	'0.5		'0.6	'0.8	'1.0	'1.5	'2.0

12.2 ST7578i controller data

12.2.1. Instruction table

H=0 or 1   (H-Flag Independent)

INSTRUCTION	A0	R/W (RWR)	D7	D6	D5	D4	D3	D2	D1	D0	DESCRIPTION
			COMMAND BYTE								
NOP	0	0	0	0	0	0	0	0	0	0	No operation
Reserved	0	0	0	0	0	0	0	0	0	1	Do not use
Function Set	0	0	0	0	1	MX	MY	PD	V	H	Power down; entry mode; Select instruction table
Read Status	0	1	PD	0	0	D	E	MX	MY	DO	Read status byte
Read Data	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data to RAM
Write Data	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data to RAM

H=0   (Basic Instruction)

INSTRUCTION	A0	R/W (RWR)	D7	D6	D5	D4	D3	D2	D1	D0	DESCRIPTION
Reserved	0	0	0	0	0	0	0	0	1	X	Do not use
Set V0 Range	0	0	0	0	0	0	0	1	0	PRS	V0 range L/H select
Display Control	0	0	0	0	0	0	1	D	0	E	Sets display configuration
Reserved	0	0	0	0	0	1	0	0	X	X	Do not use
Set Y Address of RAM	0	0	0	1	0	0	Y3	Y2	Y1	Y0	Sets Y address of RAM 0≤Y≤9
Set X Address of RAM	0	0	1	X6	X5	X4	X3	X2	X1	X0	Sets X address of RAM 0≤X≤101

H=1   (Extended Instruction)

INSTRUCTION	A0	R/W (RWR)	D7	D6	D5	D4	D3	D2	D1	D0	DESCRIPTION
Reserved	0	0	0	0	0	0	0	0	X	X	Do not use
Display Configuration	0	0	0	0	0	0	1	DO	X	X	Top/bottom row mode set data order
Bias System	0	0	0	0	0	1	0	BS2	BS1	BS0	Set bias system (BSx)
Reserved	0	0	0	1	X	X	X	X	X	X	Do not use
Set V0	0	0	1	V_{OP6}	V_{OP5}	V_{OP4}	V_{OP3}	V_{OP2}	V_{OP1}	V_{OP0}	Set V_{OP} parameter to register

12.2.2 Timing characteristics

Reset Timing
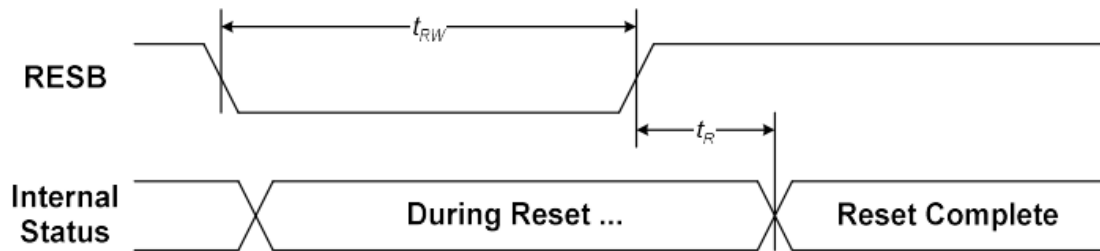
(VDD = 3.3V , Ta =-30~85°C)

Item	Symbol	Condition	Min.	Max.	Unit
Reset time	tR		—	1.5	us
Reset "L" pulse width	tRW		1.5	—	

Serial Interface (I2C interface)
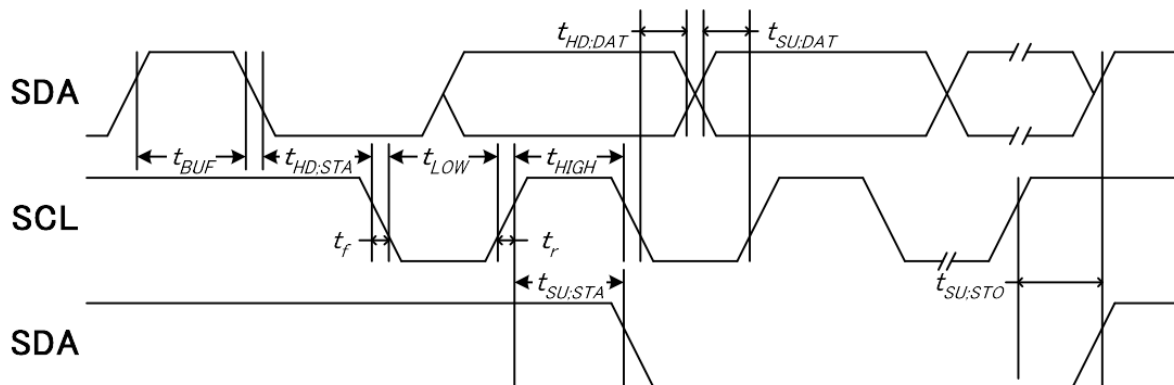
(Ta=25℃, VDD=3.0V)

Item	Signal	Symbol	Min.	Max.	Unit
SCL clock frequency	SCL	FSCLK	-	400	KHZ
SCL clock low period		TLOW	1.3	-	us
SCL clock high period		THIGH	0.6	-	
Data set-up time	SDA	TSU; DATA	100	-	ns
Data hold time		THD; DATA	0	0.9	us
SCL, SDA rise time	SI	TR	20+0.1Cb	300	ns
SCL, SDA fall time		TF	20+0.1Cb	300	
Capacitive load represented by each bus line		CB	-	400	pF
Setup time for a repeated START condition	SI	TSU; SUA	0.6	-	us
Start condition hold time		THD; STA	0.6	-	
Setup time for STOP condition		TSU; STO	0.6	-	
Tolerable spike width on bus		TSW	-	50	ns
BUS free time between a STOP and START condition	SCL	TBUF	1.3	-	us