



**SPECIFICATION
FOR
LCM Module
KD022QVTBD009-01**

2009

MODULE:	KD022QVTBD009-01
CUSTOMER:	

REV	DESCRIPTION	DATE
1.0	FIRST ISSUE	2017.12.02

STARTEK	INITIAL	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

CUSTOMER	INITIAL	DATE
APPROVED BY		

ISO 9001:2008

常备库存 Stock For Sale	长期供货 Long Time supply	支持小量 NO MOQ	品种齐全 In Full Range
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Revision History

Date	Rev. No.	Page	Summary
2017.12.02	V1.0	ALL	FIRST ISSUE

ISO/TS16949: 2009

ISO9001: 2008

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*** Description**

This is a color active matrix TFT (Thin Film Transistor) LCD (liquid crystal display) that uses amorphous silicon TFT as a switching device. This model is composed of a Transmissive type TFT-LCD Panel, driver circuit, back-light unit. The resolution of a 2.2" TFT-LCD contains 240x320 pixels, and can display up to 65K colors.

*** Features**

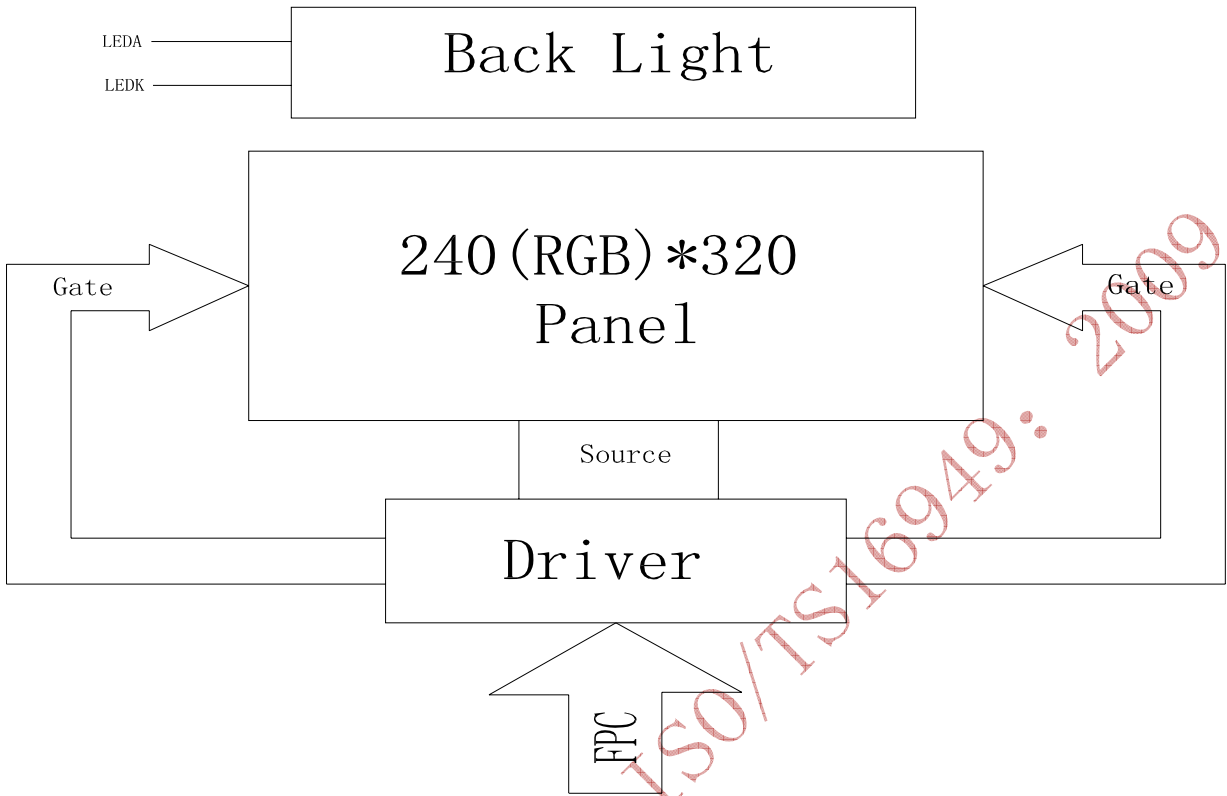
- Low Input Voltage: 3.3V(TYP)
- Display Colors of TFT LCD: 65K colors
- Interface: 8/16Bit MCU Interface

General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	33.84(H)*45.12(V) (2.2inch)	mm	-
Driver element	TFT active matrix	-	-
Display colors	65K	colors	-
Number of pixels	240(RGB)*320	dots	-
Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.141(H)*0.141(V)	mm	-
Viewing angle	6:00	o'clock	-
Controller IC	ST7789V	-	-
Display mode	Transmissive/Normally white	-	-
Operating temperature	-20~+70	°C	-
Storage temperature	-30~+80	°C	-

*** Mechanical Information**

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)		39.6		mm	-
	Vertical(V)		56.0		mm	-
	Depth(D)		2.55		mm	-
Weight			9		g	-

1. Block Diagram

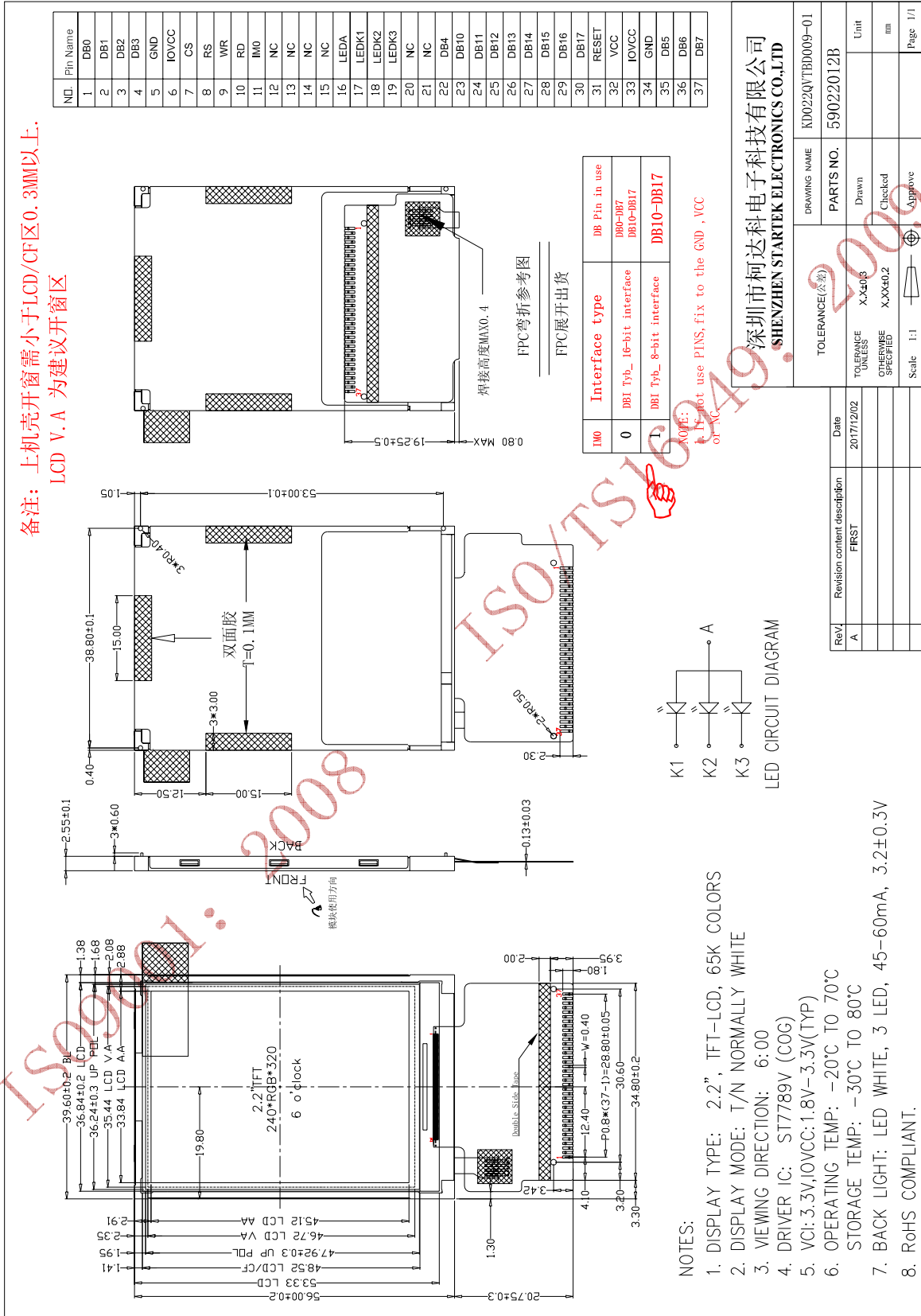


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2. Outline dimension



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3. Input terminal Pin Assignment

1	DB0	H/L	DATA BUS. If not used pins must be fixed to GND level.
2	DB1	H/L	
3	DB2	H/L	
4	DB3	H/L	
5	GND	L	GND
6	IOVCC	H	POWER SUPPLY
7	/CS	H/L	Chip select input pin
8	RS	H/L	A register select signal
9	/WR	H/L	Write enable clock input pin
10	/RD	H/L	Read enable clock input pin
11	IM0	H/L	Interface select.
12	NC		NO CONNECT
13	NC		NO CONNECT
14	NC		NO CONNECT
15	NC		NO CONNECT
16	LED-A	H	Backlight+
17	LED-K1	L	Backlight-
18	LED-K2	L	Backlight-
19	LED-K3	L	Backlight-
20	LED-K4	L	Backlight-
21	NC	H/L	NC
22	DB4	H/L	DATA BUS If not used pins must be fixed to GND level.
23	DB10	H/L	
24	DB11	H/L	
25	DB12	H/L	
26	DB13	H/L	
27	DB14	H/L	
28	DB15	H/L	
29	DB16	H/L	
30	DB17	H/L	
31	/RESET	H/L	HARDWARE RESET PIN
32	VCI	H	POWER SUPPLY
33	IOVCC	H	POWER SUPPLY
34	GND	L	GND
35	DB5	H/L	DATA BUS DB5 If not used pins must be fixed to GND level.
36	DB6	H/L	
37	DB7	H/L	

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4. LCD Optical Characteristics

4.1 Optical specification

Item	Symbol	Condition	Min.	Typ.	Max.	Unit.	Note
Contrast Ratio	CR	$\Theta=0$	240	350			
Response time	Rising	T_R	Normal viewing angle	20	30	msec	
	Falling	T_F		20	30		
Color gamut	S(%)		--	48	--	%	
Color Filter Chromacity	White	W_X	0.237	0.277	0.317		
		W_Y	0.259	0.299	0.339		
	Red	R_X	0.539	0.559	0.579		
		R_Y	0.294	0.314	0.334		
	Green	G_X	0.298	0.318	0.338		
		G_Y	0.576	0.596	0.616		
	Blue	B_X	0.130	0.150	0.170		
		B_Y	0.063	0.083	0.103		
Viewing angle	Hor.	Θ_L	CR>10	45	50	--	
		Θ_R		45	50	--	
	Ver.	Θ_U		45	50	--	
		Θ_D		15	20	--	
Option View Direction			6:00				

4.2 Measuring Condition

- Measuring surrounding: dark room
- Ambient temperature: $25\pm 2^\circ\text{C}$
- 15min. warm-up time.

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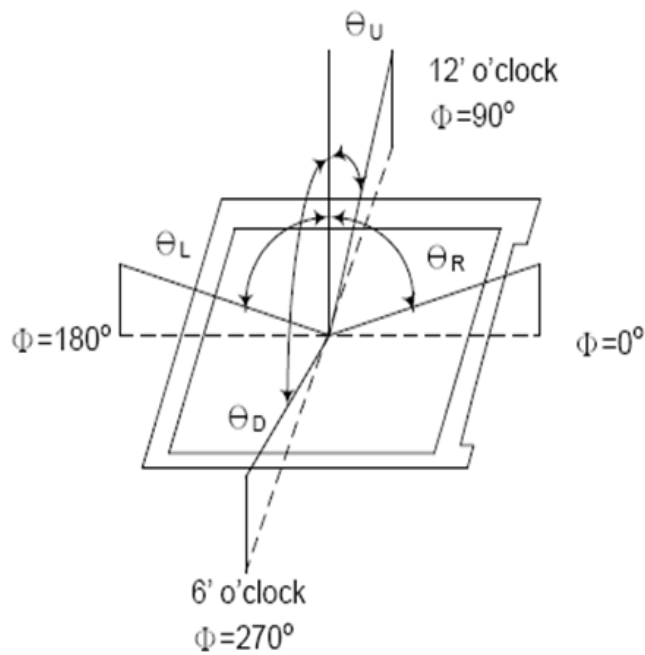
支持小量
NO MOQ

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4.3 Measuring Equipment

- FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

Note (1) Definition of Viewing Angle:



Note (2) Definition of Contrast Ratio (CR) :
measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

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5. Electrical Characteristics

5.1 Absolute Maximum Rating (Ta=25 VSS=0V)

Characteristics	Symbol	Min.	Max.	Unit
Digital Supply Voltage	VDD	-0.3	4.6	V
Digital interface supply Voltage	VDDIO	-0.3	4.6	V
Operating temperature	T _{OP}	-20	+70	°C
Storage temperature	T _{ST}	-30	+80	°C

NOTE: If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.

5.2 DC Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Digital Supply Voltage	VDD	2.4	2.8	3.3	V	
Digital interface supply Voltage	VDDIO	1.65	1.8	3.3	V	
Normal mode Current consumption	IDD	--	7	--	mA	
Level input voltage	V _{IH}	0.7V _{DDIO}		VDDIO	V	
	V _{IL}	GND		0.3V _{DDIO}	V	
Level output voltage	V _{OH}	0.8V _{DDIO}		VDDIO	V	
	V _{OL}	GND		0.2V _{DDIO}	V	

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5.3 LED Backlight Characteristics

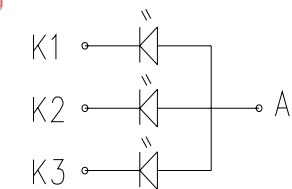
The back-light system is edge-lighting type with 3 chips White LED

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I_F	45	60	--	mA	
Forward Voltage	V_F	--	3.2	--	V	
LCM Luminance	L_V	200	250	--	cd/m ²	Note3
LED life time	Hr	50000	--	--	Hour	Note1,2
Uniformity	AVg	80	--	--	%	Note3

Note (1) LED life time (Hr) can be defined as the time in which it continues to operate under the condition:

$T_a=25\pm3\text{ }^\circ\text{C}$, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note (2) The "LED life time" is defined as the module brightness decrease to 50% original brightness at $T_a=25\text{ }^\circ\text{C}$ and $I_L=60\text{mA}$. The LED lifetime could be decreased if operating I_L is larger than 60mA. The constant current driving method is suggested.



LED CIRCUIT DIAGRAM

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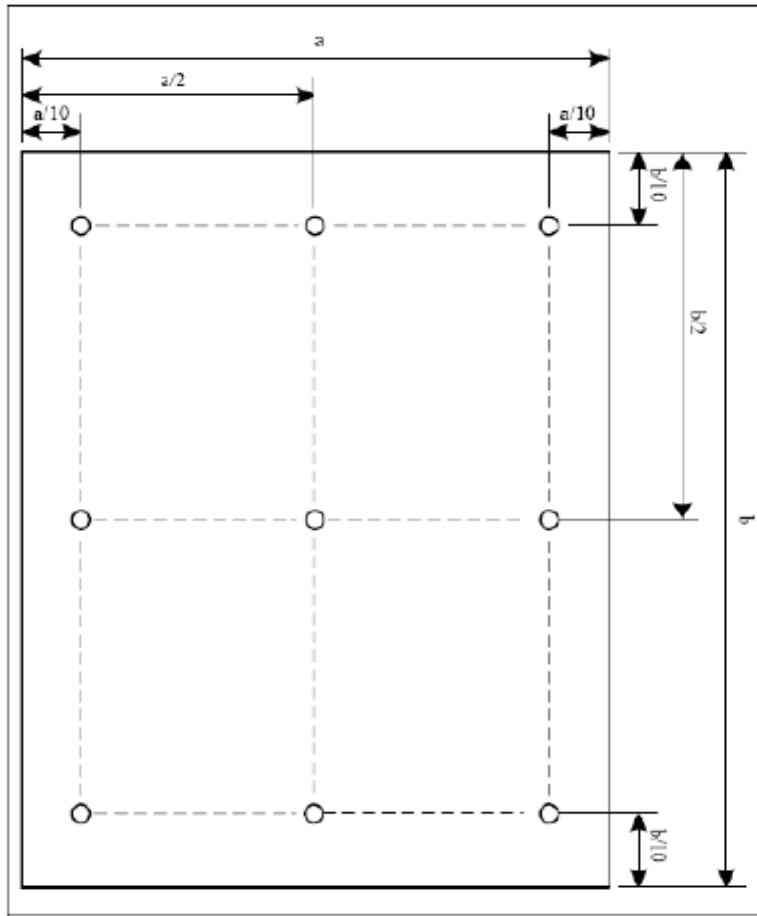
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NOTE 3: Luminance Uniformity of these 9 points is defined as below:



$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$

$$\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$$

ISO9001

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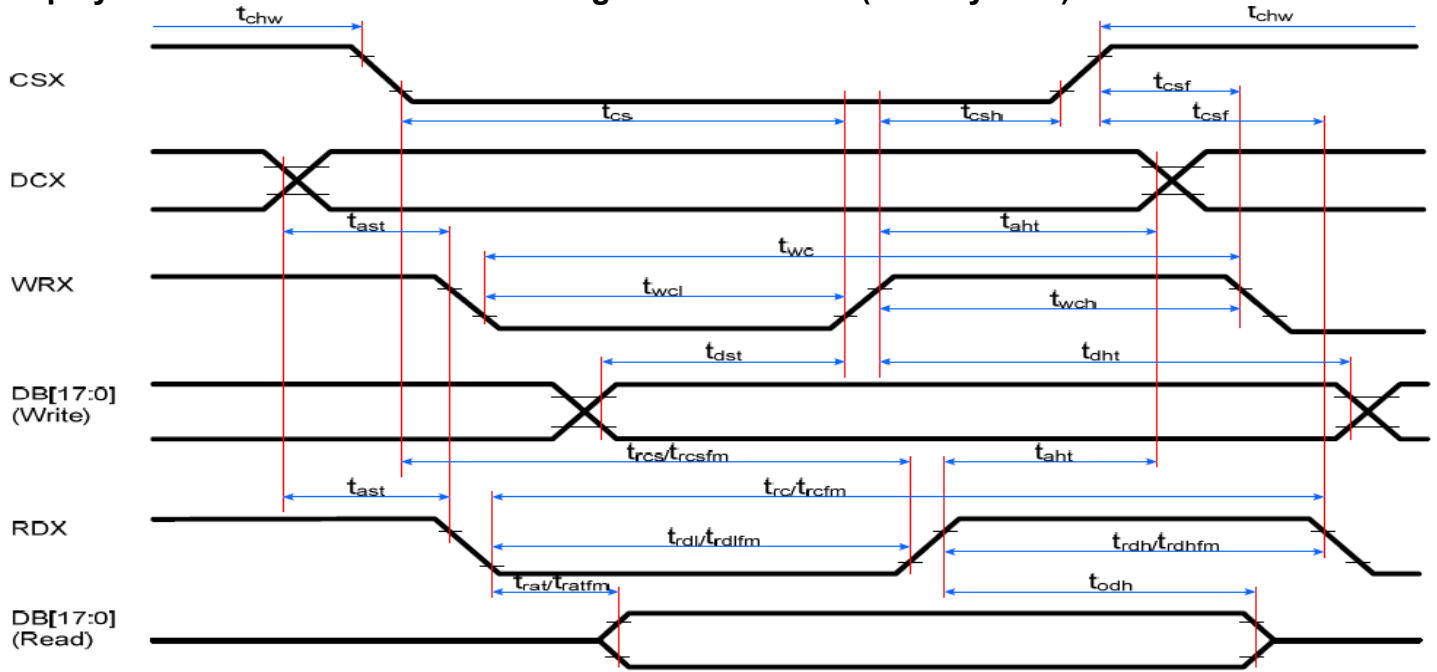
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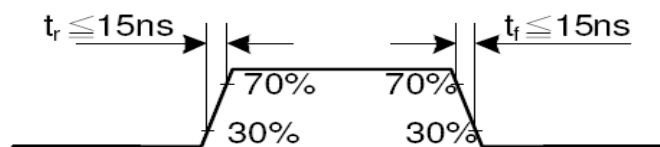
6. AC Characteristic

6.1 Display Parallel 8/16-bit Interface Timing Characteristics (8080 system)

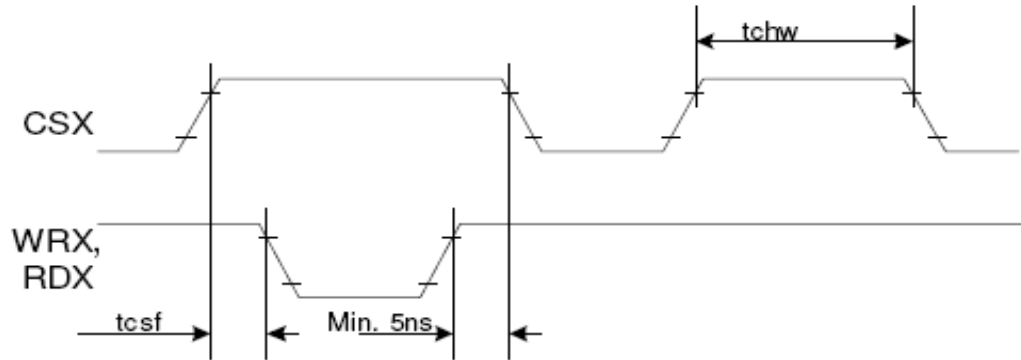


Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	10	-	ns	
CSX	tchw	CSX "H" pulse width	0	-	ns	
	tcs	Chip Select setup time (Write)	15	-	ns	
	trcs	Chip Select setup time (Read ID)	45	-	ns	
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	
WRX	tcsf	Chip Select Wait time (Write/Read)	10	-	ns	
	twc	Write cycle	66	-	ns	
	twrh	Write Control pulse H duration	15	-	ns	
RDX (FM)	twrl	Write Control pulse L duration	15	-	ns	
	trcfm	Read Cycle (FM)	450	-	ns	
RDX (ID)	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
	trc	Read cycle (ID)	160	-	ns	
D[17:0], D[15:0], D[8:0], D[7:0]	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
tratfm	Read access time	-	340	ns		
trod	Read output disable time	20	80	ns		

Note: $T_a = -30$ to 70 °C, $IOVCC=1.65V$ to $2.8V$, $VCI=2.6V$ to $3.3V$, $GND=0V$

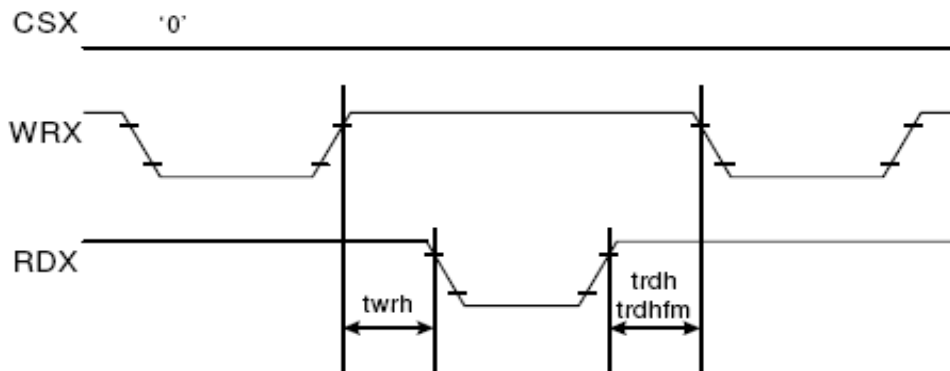


CSX timings :



Note: Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.

Write to read or read to write timings:



Note: Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.

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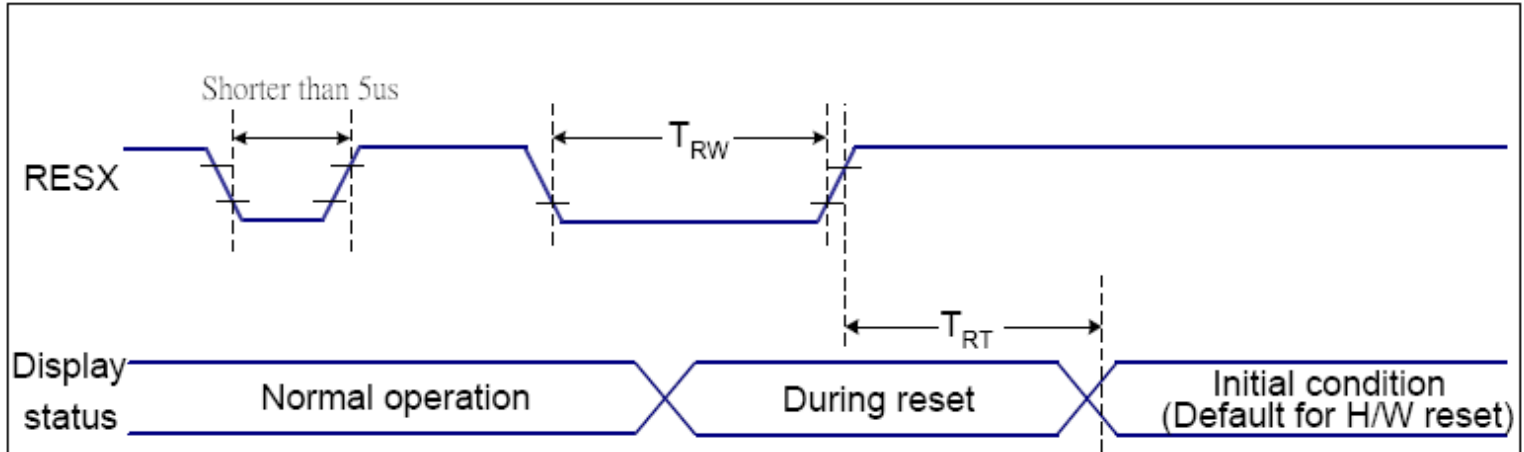
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6.2 Reset Timing Characteristics



VDD1=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, $T_a = -30 \sim 70 \text{ }^\circ\text{C}$

Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
-			120 (Note 1, 6, 7)	ms	

Notes:

- The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (t_{RT}) within 5 ms after a rising edge of RESX.
- Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset starts

- During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode.) and then return to Default condition for Hardware Reset.

- Spike Rejection also applies during a valid reset pulse as shown below:

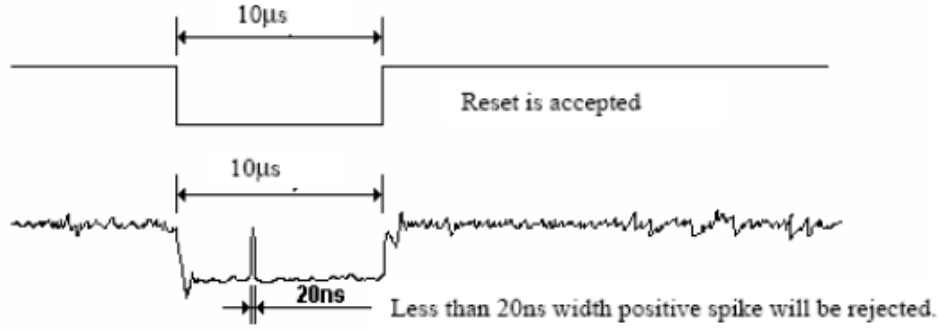
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5. When Reset applied during Sleep In Mode.
6. When Reset applied during Sleep Out Mode.
7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

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7. LCD Module Out-Going Quality Level

7.1 VISUAL & FUNCTION INSPECTION STANDARD

7.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

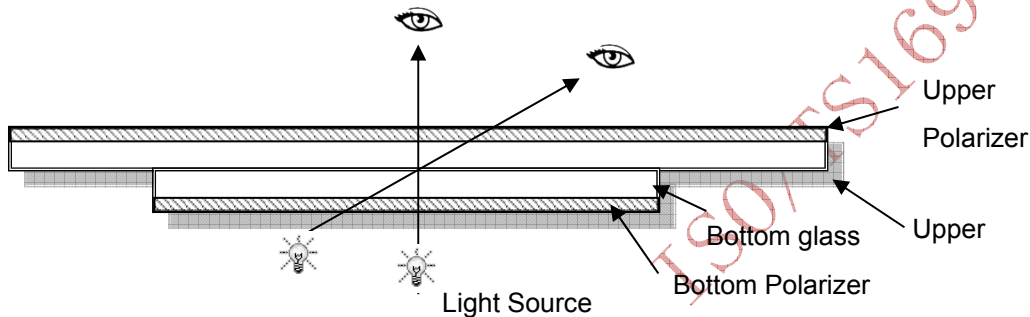
Temperature : $25\pm 5^{\circ}\text{C}$

Humidity : $65\%\pm 10\%\text{RH}$

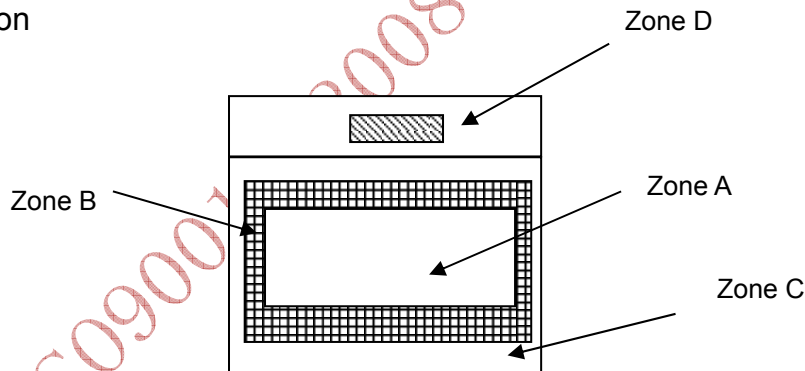
Viewing Angle : Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance:30-50cm



7.1.2 Definition



Zone A : Effective Viewing Area(Character or Digit can be seen)

Zone B : Viewing Area except Zone A

Zone C : Outside (Zone A+Zone B) which can not be seen after assembly by customer .)

Zone D : IC Bonding Area

Note:

As a general rule ,visual defects in Zone C can be ignored when it doesn't effect product function or appearance after assembly by customer

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7.1.3 Sampling Plan

According to GB/T 2828-2003 ; , normal inspection, Class II

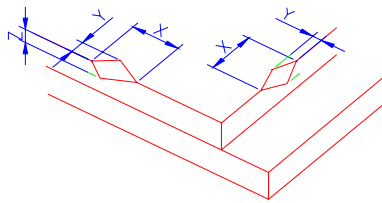
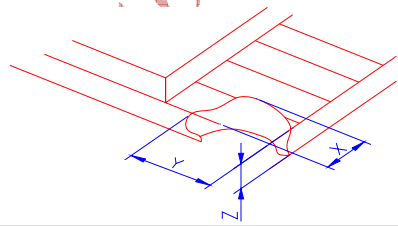
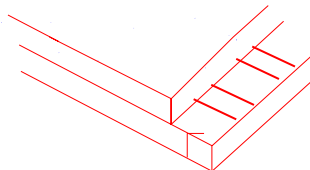
AQL:

Major defect	Minor defect
0.65	1.5

LCD: Liquid Crystal Display , TP: Touch Panel , LCM: Liquid Crystal Module

No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. 4) TP no function	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed	
4	Color tone	Color unevenness, refer to limited sample	Minor
5	Spot Line defect	Light dot, Dim spot, Polarizer Bubble ; Polarizer accidented spot.	
6	Soldering appearance	Good soldering , Peeling off is not allowed.	
7	LCD/Polarizer/TP	Black/White spot/line, scratch, crack, etc.	

7.1.4 Criteria (Visual)

Number	Items	Criteria(mm)						
1.0 LCD Crack/Broken NOTE: X: Length Y: Width Z: Height L: Length of ITO, T: Height of LCD	(1) The edge of LCD broken	 <table border="1" data-bbox="758 667 1455 817"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td><Inner border line of the seal</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3.0mm	<Inner border line of the seal	≤T
X	Y	Z						
≤3.0mm	<Inner border line of the seal	≤T						
	(2)LCD corner broken	 <table border="1" data-bbox="833 1124 1375 1227"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td>≤L</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3.0mm	≤L	≤T
X	Y	Z						
≤3.0mm	≤L	≤T						
	(3) LCD crack	 <p>Crack Not allowed</p>						



2.0	<p>Spot defect</p> <p>$\Phi = (X+Y)/2$</p>	① light dot (LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain)																									
		<table border="1"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.10$</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.10 < \Phi \leq 0.20$</td> <td colspan="3">3(distance $\geq 10\text{mm}$)</td> </tr> <tr> <td>$0.20 < \Phi \leq 0.25$</td> <td colspan="3">2</td> </tr> <tr> <td>$\Phi > 0.3$</td> <td colspan="3">0</td> </tr> </tbody> </table>			Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.10$	Ignore			$0.10 < \Phi \leq 0.20$	3(distance $\geq 10\text{mm}$)			$0.20 < \Phi \leq 0.25$	2			$\Phi > 0.3$	0		
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$0.20 < \Phi \leq 0.25$	2																										
$\Phi > 0.3$	0																										
② Dim spot (LCD/TP/Polarizer dim dot, light leakage, dark spot)																											
<table border="1"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.1$</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.10 < \Phi \leq 0.20$</td> <td colspan="3">3(distance $\geq 10\text{mm}$)</td> </tr> <tr> <td>$0.20 < \Phi \leq 0.25$</td> <td colspan="3">2</td> </tr> <tr> <td>$\Phi > 0.3$</td> <td colspan="3">0</td> </tr> </tbody> </table>			Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.1$	Ignore			$0.10 < \Phi \leq 0.20$	3(distance $\geq 10\text{mm}$)			$0.20 < \Phi \leq 0.25$	2			$\Phi > 0.3$	0				
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3.0	Line defect (LCD/TP /Polarizer backlight black/white line, scratch, stain)	Width(mm)	Length(m)	Acceptable Qty		
				A	B	C
		$\Phi \leq 0.03$	Ignore	Ignore		
		$0.03 < W \leq 0.04$	$L \leq 3.0$	N \leq 2		
		$0.04 < W \leq 0.05$	$L \leq 2.0$	N \leq 1		
		$0.05 < W$	Define as spot defect			
4.0	Electronic Components SMT	Not allow missing parts, solderless connection, cold solder joint, mismatch, The positive and negative polarity opposite				
5.0	Display color & Brightness	1. Color : Measuring the color coordinates, The measurement standard according to the datasheet or samples. 2. Brightness : Measuring the brightness of White screen, The measurement standard according to the datasheet or Samples.				

Criteria (functional items)

Number	Items	Criteria (mm)
1	No display	Not allowed
2	Missing segment	Not allowed
3	Short	Not allowed
4	Backlight no lighting	Not allowed
5	TP no function	Not allowed

8. Reliability Test Result

Item	Condition	Inspection after test
High Temperature Operating	70°C, 96H	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1. Air bubble in the LCD; 2. Non-display; 3. Missing segments/line; 4. Glass crack; 5. Current IDD is twice higher than initial value.
Low Temperature Operating	-20°C, 96HR	
High Temperature Storage	80°C, 96HR	
Low Temperature Storage	-30°C, 96HR	
High Temperature & High Humidity Storage	+60°C, 90% RH, 96 hours.	
Thermal Shock (Non-operation)	-30°C, 30 min ↔ 80°C, 30 min. Change time: 5min 20CYC.	
ESD test	C=150pF, R=330, 5points/panel Air: ±8KV, 5times; Contact: ±6KV, 5 times; (Environment: 15°C~35°C, 30%~60%).	
Vibration (Non-operation)	Frequency range: 10~55Hz, Stroke: 1.5mm Sweep: 10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z. (6 hours for total) (Package condition).	
Box Drop Test	1 Corner 3 Edges 6 faces, 80cm (MEDIUM BOX)	

Remark:

- The test samples should be applied to only one test item.
- Sample size for each test item is 5~10pcs.
- For Damp Proof Test, Pure water (Resistance > 10MΩ) should be used.
- In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.
- Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

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常备库存
Stock For Sale

长期供货
Long Time supply

支持少量
NO MOQ

品种齐全
In Full Range

9. Cautions and Handling Precautions

9.1 Handling and Operating the Module

- (1) When the module is assembled, it should be attached to the system firmly.
Do not warp or twist the module during assembly work.
- (2) Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and back-light unit.
- (3) Note that polarizer is very fragile and could be easily damaged. Do not press or scratch the surface.
- (4) Do not allow drops of water or chemicals to remain on the display surface.
If you have the droplets for a long time, staining and discoloration may occur.
- (5) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (6) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane.
Do not use ketene type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs, or clothes, it must be washed away thoroughly with soap.
- (8) Protect the module from static; it may cause damage to the CMOS ICs.
- (9) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (10) Do not disassemble the module.
- (11) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (12) Pins of I/F connector shall not be touched directly with bare hands.
- (13) Do not connect, disconnect the module in the "Power ON" condition.
- (14) Power supply should always be turned on/off by the item 6.1 Power On Sequence & 6.2 Power Off Sequence

9.2 Storage and Transportation.

- (1) Do not leave the panel in high temperature, and high humidity for a long time.
It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%
- (2) Do not store the TFT-LCD module in direct sunlight.
- (3) The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.
- (4) It is recommended that the modules should be stored under a condition where no condensation is allowed. Formation of dewdrops may cause an abnormal operation or a failure of the module.
In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.
- (5) This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.

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	常备库存 Stock For Sale	长期供货 Long Time supply	支持少量 NO MOQ	品种齐全 In Full Range

10. Packing

---TBD-----

ISO9001: 2008
ISO/TS16949: 2009

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	常备库存 Stock For Sale	长期供货 Long Time supply	支持小量 NO MOQ	品种齐全 In Full Range