



**SPECIFICATION
FOR
LCD Module
KD022QVTBD007**

MODULE:	KD022QVTBD007
CUSTOMER:	

REV	DESCRIPTION	DATE
1.0	FIRST ISSUE	2015.12.04

STARTEK	INITIAL	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

CUSTOMER	INITIAL	DATE
APPROVED BY		

Part. No	KD022QVTBD007	REV	V1.0	Page 1 of 26
常备库存 Standing Stock	长期供货 Long Availability	支持小量 NO MOQ	品种齐全 In Full Range	

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General Description

* 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: 8BIT/16BIT MCU

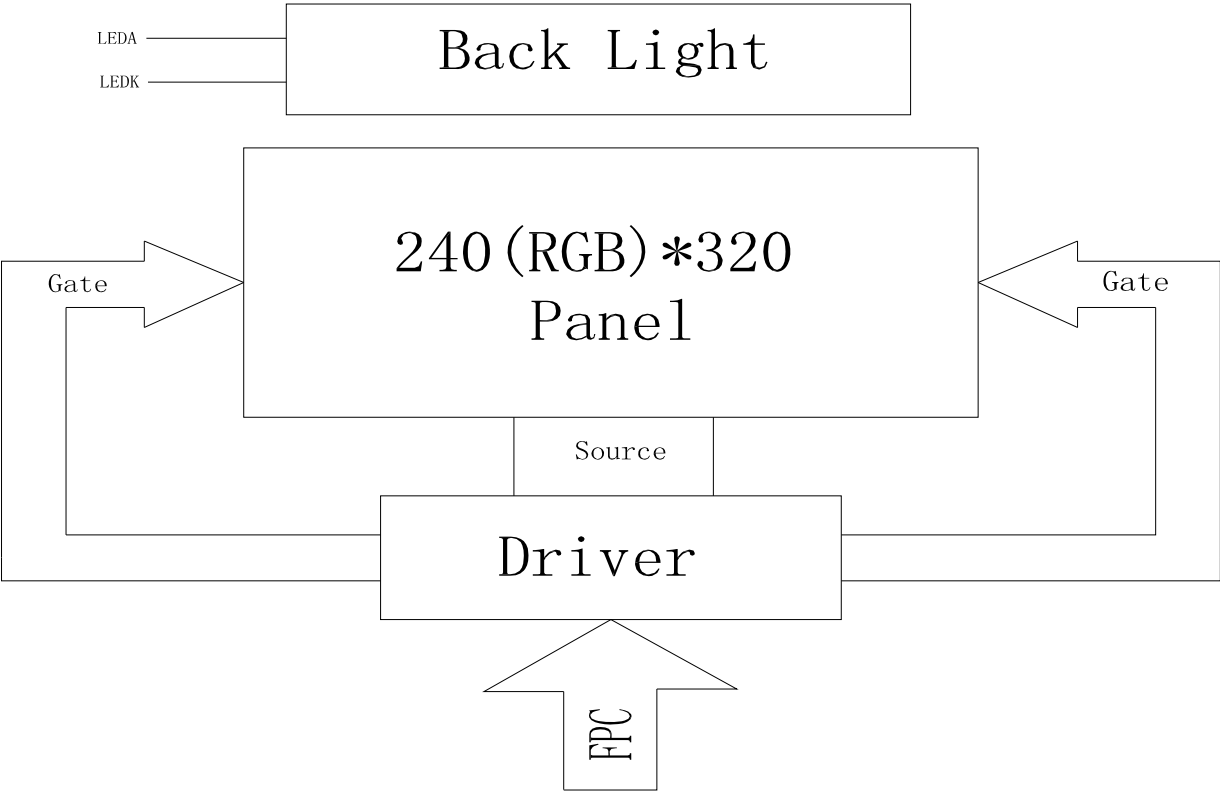
General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	33.84(H)*45.12(V) (2.2inch)	mm	-
Driver element	TFT active matrix	-	-
Display colors	65K	colors	-
Number of pixels	240(RGB)*320	dots	-
Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.141(H)*0.141(V)	mm	-
Viewing 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)		41.70		mm	-
	Vertical(V)		56.16		mm	-
	Depth(D)		2.60		mm	-
Weight			TBD		g	-



1. Block Diagram



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3. Input terminal Pin Assignment

NO.	SYMBOL	DISCRIPTION	I/O
1	GND	Ground.	P
2	VCC	Supply Voltage(3.3V).	P
3	LEDA1	Anode pin of backlight.	P
4	LEDA2	Anode pin of backlight.	P
5	LEDA3	Anode pin of backlight.	P
6	LEDK	Cathode pin of backlight.	P
7-14	DB17-DB10	- 8-bit parallel bi-directional data bus for MCU interface mode. - Fix to GND level when not in use.	I/O
15-22	DB8-DB1	- 8-bit parallel bi-directional data bus for MCU interface mode. - Fix to GND level when not in use.	I/O
23	RD	Read enable clock input pin	I
24	WR	Write enable clock input pin	I
25	RS	Data / Command Selection pin	I
26	CS	Chip select signal. Low: chip can be accessed; High: chip cannot be accessed.	I
27	RESET	Reset pin. Setting either pin low initializes the LSI. Must be reset after power is supplied.	I
28	IM0	Interface Select, IM0=0, DB1-DB8, DB10-DB17; M0=1, DB10-DB17.	I
29	YU	Touch panel Top Film Terminal	A/D
30	XL	Touch panel LIFT Glass Terminal	A/D
31	YD	Touch panel Bottom Film Terminal	A/D
32	XR	Touch panel Right Glass Terminal	A/D

4. LCD Optical Characteristics

4.1 Optical specification

Item		Symbol	Condition	Min.	Typ.	Max.	Unit.	Note
Transmittance (with Polarizer)		T(%)	--	5.5	6.0	--	%	Note1
Contrast Ratio		CR	θ=0	250	350		%	Note1 Note3
Response time		T _{ON}	25°C	--	20	30	Ms	Note1
		T _{OFF}						Note4
NTSC		S(%)		--	48	--	%	Note5
Color Filter Chromaticity	White	W _X	C-light	0.253	0.303	0.353		Note5 Note1
		W _Y		0.309	0.359	0.409		
	Red	R _X		0.581	0.631	0.681		
		R _Y		0.265	0.315	0.365		
	Green	G _X		0.261	0.311	0.361		
		G _Y		0.478	0.528	0.578		
	Blue	B _X		0.081	0.131	0.181		
		B _Y		0.119	0.169	0.219		
Viewing angle	Hor.	θ _L	CR>10	40	45	--	Degree	Note 2
		θ _R		40	45	--		
	Ver.	θ _T		45	50	--		
		θ _B		15	20	--		
Option View Direction		6 O'clock						

4.2 Measuring Condition

■ Measuring surrounding: dark room

■ Ambient temperature: 25±2°C

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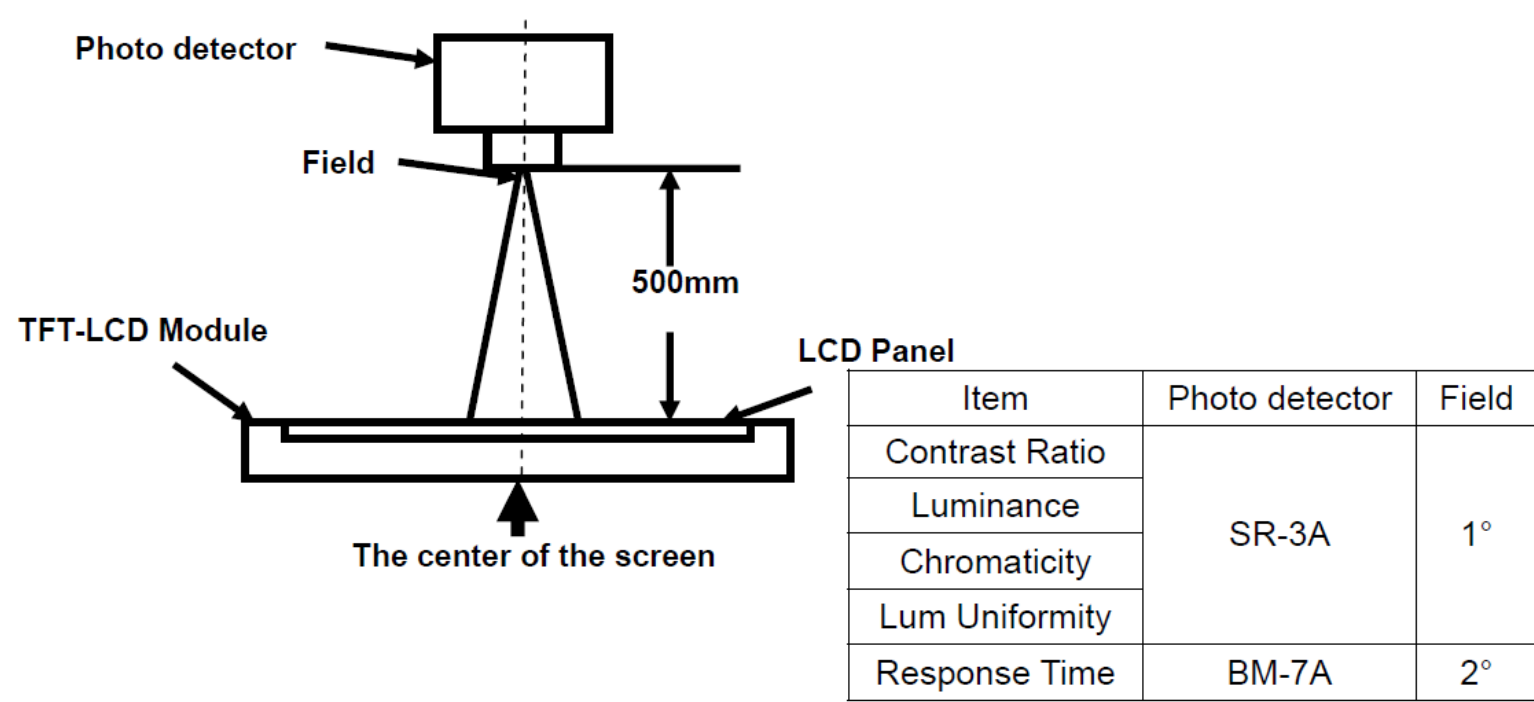
- 15min. warm-up time.

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 optical measurement system.

The optical characteristics should be measured in dark room. After 5 minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Note 2: Definition of viewing angle range and measurement system.

viewing angle is measured at the center point of the LCD by CONOSCOPE(ergo-80)。

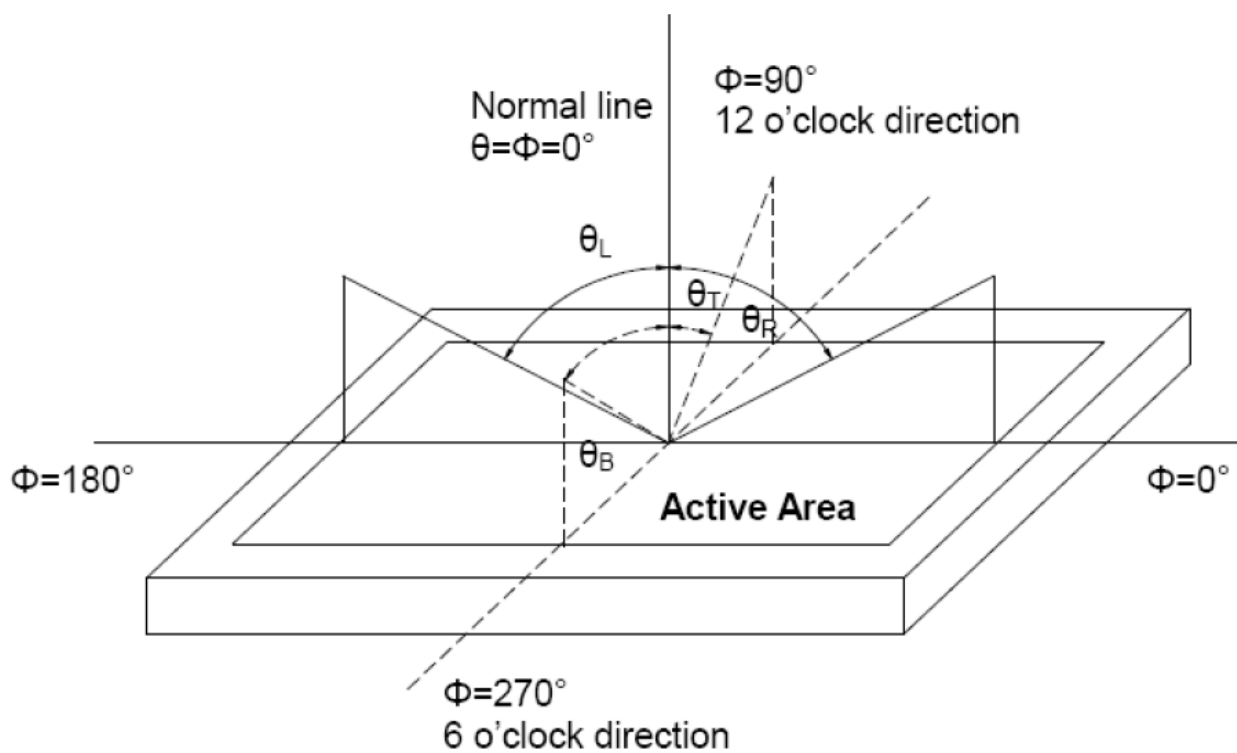


Fig. 1 Definition of viewing angle

Note 3: Definition of contrast ratio

Contrast ratio (CR) =

Luminance measured when LCD is on the "White" state

Luminance measured when LCD is on the "Black" state

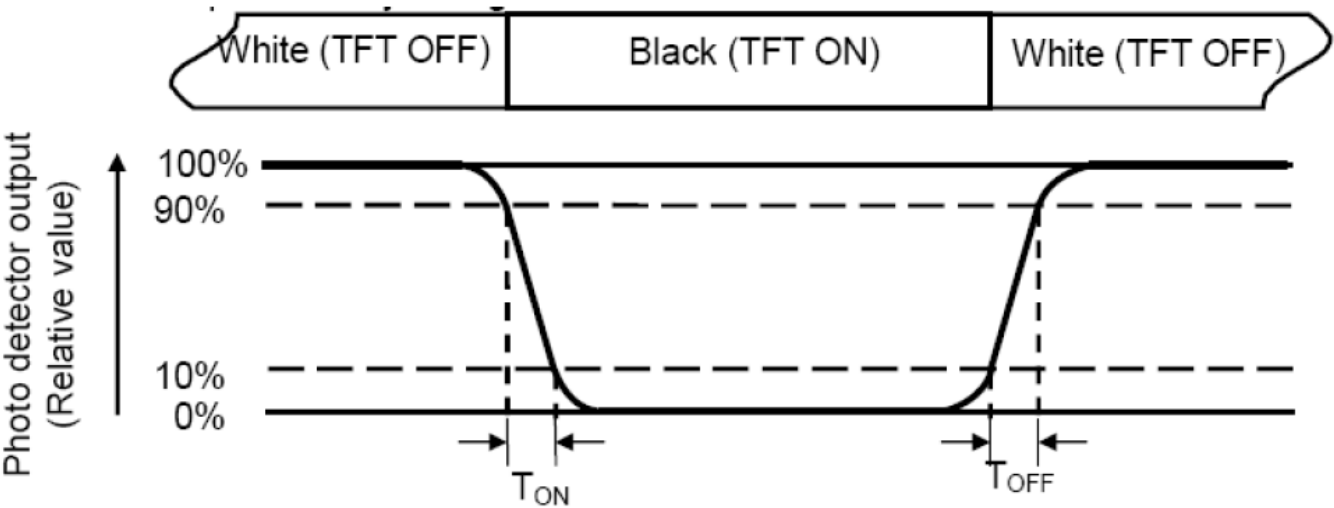
“White state “:The state is that the LCD should driven by Vwhite.

“Black state”: The state is that the LCD should driven by Vblack.

V_{White}: To be determined V_{Black}: To be determined.

Note 4: Definition of response time

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time (T_{ON}) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T_{OFF}) is the time between photo detector output intensity changed from 10% to 90%.



Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

5. Electrical Characteristics

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

Characteristics	Symbol	Min.	Max.	Unit
Digital Supply Voltage	VDD	-0.3	4.8	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

5.2 DC Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Digital Supply Voltage	VDD	2.4	3.3	4.8	V	
Digital interface supply Voltage	VDDIO	1.65	3.3	4.8	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	

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	320	--	--	cd/m ²	If=60mA

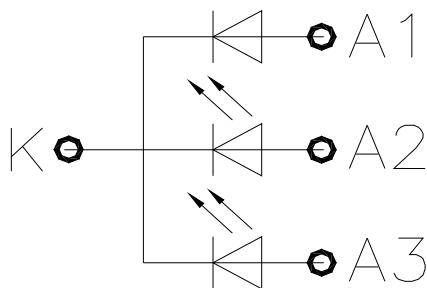


LED life time	Hr	50000	--	--	Hour	Note1,2
Uniformity	AVg	80	--	--	%	

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%.

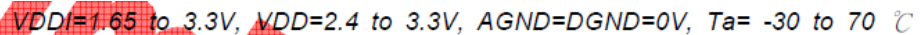
Note (2) The “LED life time” is defined as the module brightness decrease to 50% original brightness at $T_a=25^{\circ}\text{C}$ and $I_L=60\text{mA}$. The LED lifetime could be decreased if operating I_L is larger than 60mA. The constant current driving method is suggested.



BLU CIRCUIT DIAGRAM



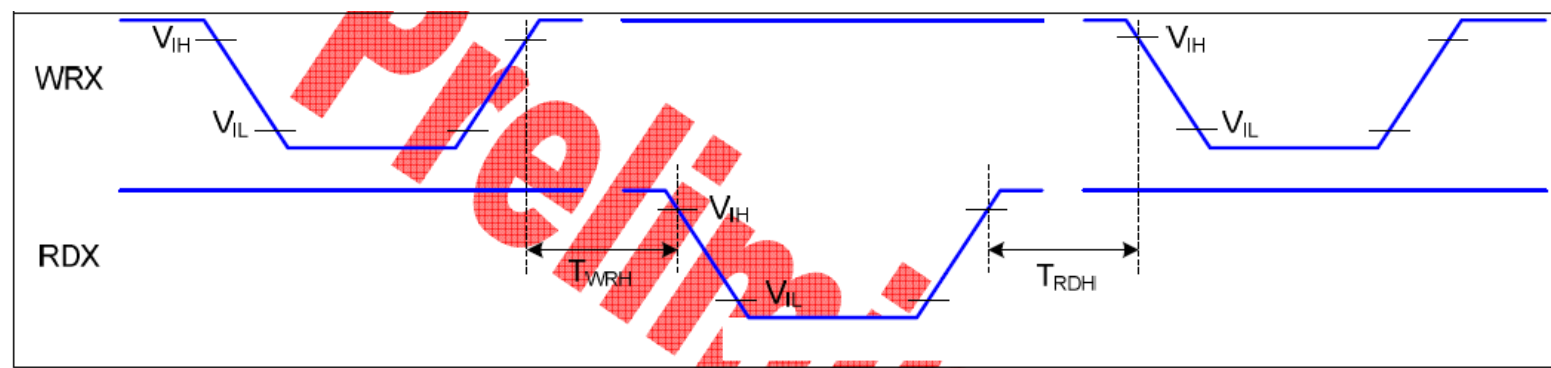
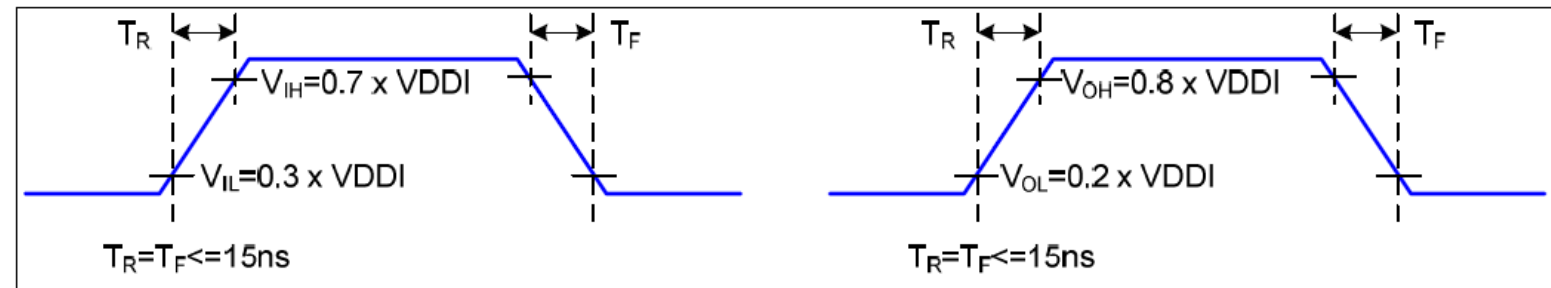
6.1. Display Parallel 8/16-bit Interface Timing Characteristics (8080 system)



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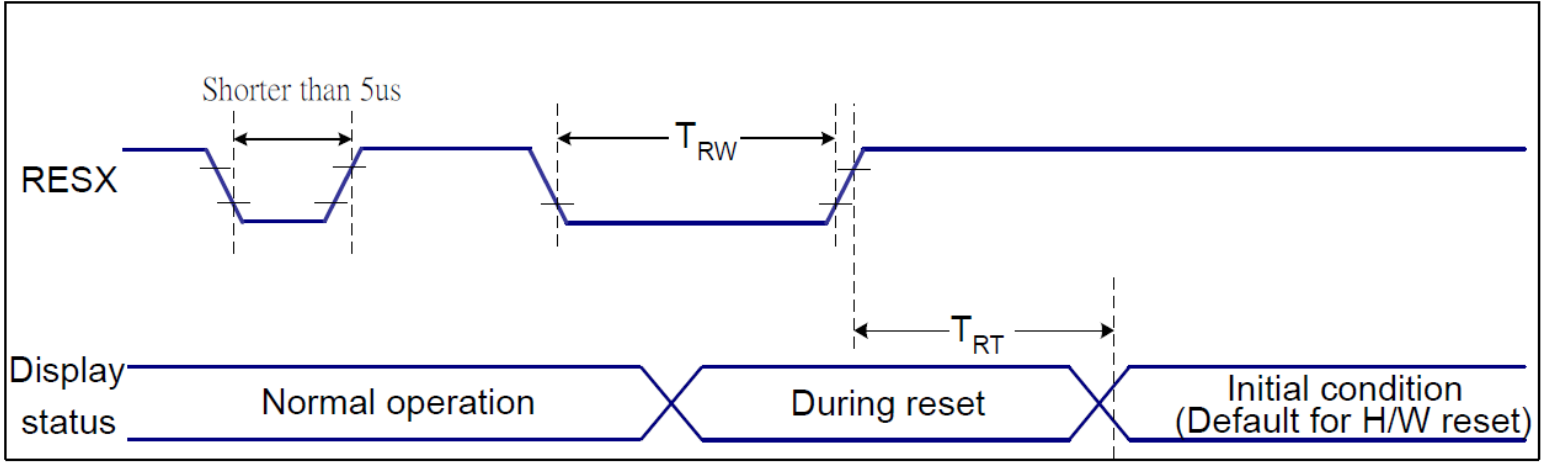
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In Full Range

RDX (ID)	T_{RC}	Read cycle (ID)	160		ns	When read ID data
	T_{RDH}	Control pulse "H" duration (ID)	90		ns	
	T_{RDL}	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	T_{RCFM}	Read cycle (FM)	450		ns	When read from frame memory
	T_{RDHFM}	Control pulse "H" duration (FM)	90		ns	
	T_{RDLFM}	Control pulse "L" duration (FM)	355		ns	
D[17:0]	T_{DST}	Data setup time	10		ns	For CL=30pF



Note: The rising time and falling time (T_r , T_f) of input signal and fall time are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of V_{DDI} for Input signals.

6.2 Reset Timing Characteristics



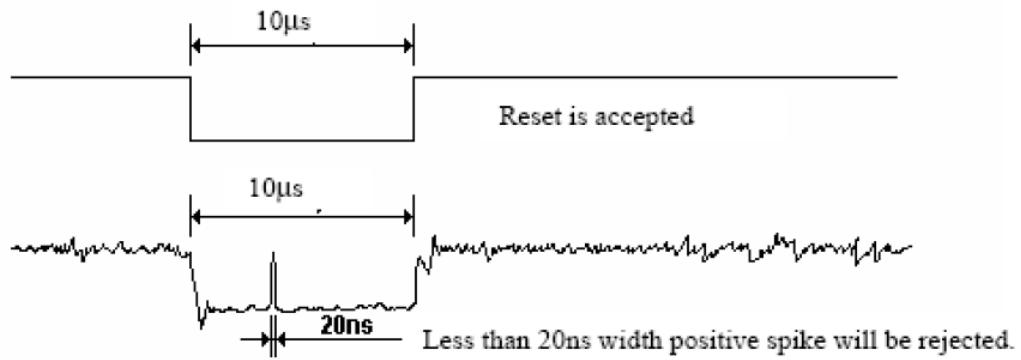
VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 ~ 70 °C

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 (tRT) 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	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:



- 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.

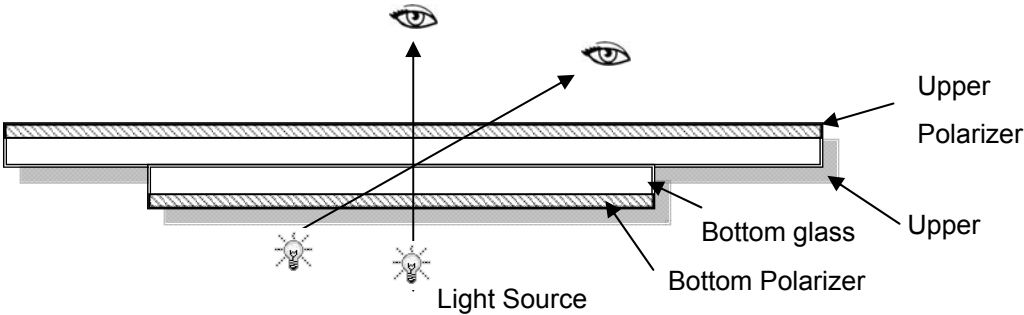
7. LCD Module Out-Going Quality Level

7.1 VISUAL & FUNCTION INSPECTION STANDARD

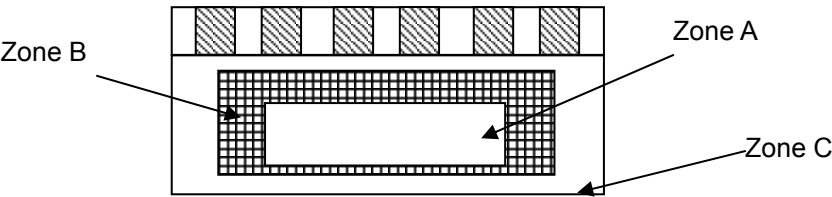
7.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

- Temperature : 25±5℃
- Humidity : 65%±10%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 .)

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

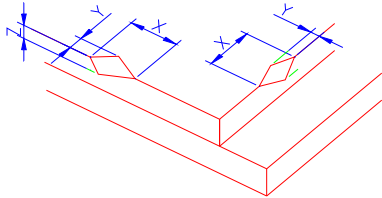
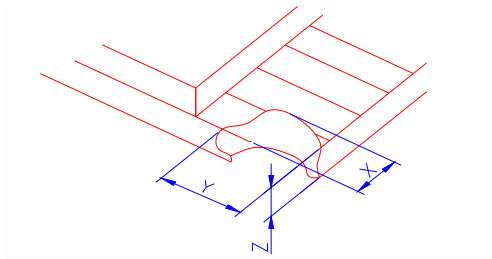
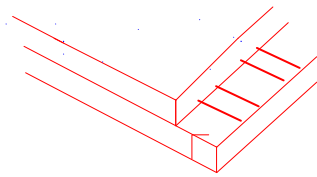
AQL:

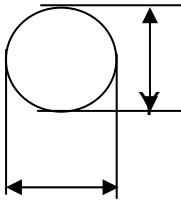
Major defect	Minor defect
0.65	1.5

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	Soldering appearance	Good soldering , Peeling off is not allowed.	
6	LCD/Polarizer/TP	Black/White spot/line, scratch, crack, etc.	

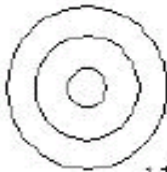
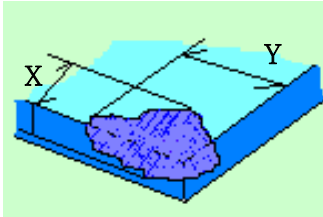
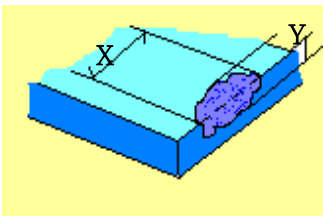
7.1.4 Criteria (Visual)

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><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>≤3.0mm</td><td><Inner border line of the seal</td><td>≤T</td></tr></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><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>≤3.0mm</td><td>≤L</td><td>≤T</td></tr></table>	X	Y	Z	≤3.0mm	≤L	≤T	
X	Y	Z						
≤3.0mm	≤L	≤T						
(3) LCD crack	 Crack Not allowed							

Number	Items	Criteria (mm)																											
2.0	Spot defect  X Φ=(X+Y)/2	① light dot (LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain)																											
		<table><tr><th rowspan="2">Zone Size (mm)</th><th colspan="3">Accep able Qty</th></tr><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>Φ≤0.10</td><td colspan="2">Ignore</td><td rowspan="4">Ignor</td></tr><tr><td>0.10<Φ≤0.20</td><td colspan="2">3(distance ≥ 10mm)</td></tr><tr><td>0.20<Φ≤0.25</td><td colspan="2">2</td></tr><tr><td>Φ > 0.25</td><td colspan="2">0</td></tr></table>	Zone Size (mm)	Accep able Qty			A	B	C	Φ≤0.10	Ignore		Ignor	0.10<Φ≤0.20	3(distance ≥ 10mm)		0.20<Φ≤0.25	2		Φ > 0.25	0								
		Zone Size (mm)		Accep able Qty																									
			A	B	C																								
		Φ≤0.10	Ignore		Ignor																								
		0.10<Φ≤0.20	3(distance ≥ 10mm)																										
		0.20<Φ≤0.25	2																										
		Φ > 0.25	0																										
		②Dim spot (LCD/TP/Polarizer dim dot, light leakage、dark spot)																											
		<table><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><tr><td>Φ≤0.1</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr><tr><td>0.10<Φ≤0.20</td><td colspan="2">3(distance ≥ 10mm)</td></tr><tr><td>0.20<Φ≤0.30</td><td colspan="2">2</td></tr><tr><td>Φ > 0.30</td><td colspan="2">0</td></tr></table>	Zone Size (mm)	Acceptable Qty			A	B	C	Φ≤0.1	Ignore		Ignore	0.10<Φ≤0.20	3(distance ≥ 10mm)		0.20<Φ≤0.30	2		Φ > 0.30	0								
		Zone Size (mm)		Acceptable Qty																									
			A	B	C																								
		Φ≤0.1	Ignore		Ignore																								
		0.10<Φ≤0.20	3(distance ≥ 10mm)																										
		0.20<Φ≤0.30	2																										
	Φ > 0.30	0																											
	③ Polarizer accidented spot																												
	<table><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><tr><td>Φ≤0.2</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr><tr><td>0.3<Φ≤0.5</td><td colspan="2">2(distance ≥ 10mm)</td></tr><tr><td>Φ>0.5</td><td colspan="2">0</td></tr></table>	Zone Size (mm)	Acceptable Qty			A	B	C	Φ≤0.2	Ignore		Ignore	0.3<Φ≤0.5	2(distance ≥ 10mm)		Φ>0.5	0												
	Zone Size (mm)		Acceptable Qty																										
		A	B	C																									
	Φ≤0.2	Ignore		Ignore																									
0.3<Φ≤0.5	2(distance ≥ 10mm)																												
Φ>0.5	0																												
Line defect (LCD/TP /Polarizer black/white line, scratch, stain)	<table><tr><th rowspan="2">Width(mm)</th><th rowspan="2">Length(mm)</th><th colspan="3">Acceptable Qty</th></tr><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>Φ≤0.03</td><td>Igno e</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr><tr><td>0.03<W≤0.05</td><td>L≤3.0</td><td colspan="2">N≤2</td></tr><tr><td>0.05<W≤0.08</td><td>L≤2.0</td><td colspan="2">N≤2</td></tr><tr><td>0.08<W</td><td colspan="4">Define as spot defect</td></tr></table>				Width(mm)	Length(mm)	Acceptable Qty			A	B	C	Φ≤0.03	Igno e	Ignore		Ignore	0.03<W≤0.05	L≤3.0	N≤2		0.05<W≤0.08	L≤2.0	N≤2		0.08<W	Define as spot defect		
	Width(mm)	Length(mm)	Acceptable Qty																										
			A	B	C																								
	Φ≤0.03	Igno e	Ignore		Ignore																								
	0.03<W≤0.05	L≤3.0	N≤2																										
	0.05<W≤0.08	L≤2.0	N≤2																										
0.08<W	Define as spot defect																												

3.0	Polarizer Bubble				
		Zone Size (mm)		Acceptable Qty	
				A	B
		$\Phi \leq 0.2$	Ignore		Ignore
		$0.2 < \Phi \leq 0.4$	3(distance ≥ 10 m)		
		$0.4 < \Phi \leq 0.6$	2		
		$0.6 < \Phi$	0		
4.0	SMT	According to IPC-A-610C class II standard . Function defect and missing part are major defect ,the others are minor defect.			

		TP bubble/ accidented spot								
			TP bubble/ accidented spot							
				TP bubble/ accidented spot						
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5.0	TP Related	Newton Ring	Newton Ring area>1/3 TP area NG			 1 规律性					
			Newton Ring area≤1/3 TP area OK				 2 非规律性				
		 似牛顿环									
TP corner broken X : length Y : width Z : height		<table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>X≤3.0mm</td><td>Y≤3.0mm</td><td>Z<LCD thicknes</td></tr></table> * Circuitry broken is not allowed.	X	Y	Z	X≤3.0mm	Y≤3.0mm	Z<LCD thicknes			
X	Y	Z									
X≤3.0mm	Y≤3.0mm	Z<LCD thicknes									
TP edge broken X : length Y : width Z : height		<table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>X≤6.0mm</td><td>Y≤2.0mm</td><td>Z<LCD thicknes</td></tr></table> * Circuitry broken is not allowed.	X	Y	Z	X≤6.0mm	Y≤2.0mm	Z<LCD thicknes			
X	Y	Z									
X≤6.0mm	Y≤2.0mm	Z<LCD thicknes									

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

8.1 Condition

Item	Condition	Sample Size	Test Result	Note
Low Temperature Operating Life test	-20℃, 96HR	3ea	pass	-
Thermal Humidity Operating Life test	70℃90%RH, 96HR	3ea	pass	-
Temperature Cycle ON/OFF test	-20℃ ↔ 70℃, ON/OFF, 20CYC	3ea	pass	(1)
High Temperature Storage test	80℃, 96HR	3ea	pass	-
Low Temperature Storage test	- 30℃, 96HR	3ea	pass	-
ESD test	150pF, 330Ω , ±6KV(Contact)/± 8KV(Air), 5 points/panel, 10 times/point	3ea	pass	
Thermal Shock Resistance	The sample should be allowed to stand the following 5 cycles of operation: TSTL for 30 minutes -> normal temperature for 5 minutes -> TSTH for 30 minutes -> normal temperature for 5 minutes, as one cycle, then taking it out and drying it at normal temperature, and allowing it stand for 24 hours	3ea	pass	
Box Drop Test	1 Corner 3 Edges 6 faces, 66cm(MEDIUM BOX)	1box	pass	-

Note (1) ON Time over 10 seconds, OFF Time under 10 seconds

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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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10 Packing

----TBD-----

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