SPECIFICATION
FOR
LCD MODULE

MODULE NO: AFK240320A1-2.4lNTM
REVISION NO: V02

Customer's Approval:

	SIGNATURE	DATE
PREPARED BY (RD ENGINEER)		
CHECKED BY		
APPROVED BY		

Records of Revision

DATE	REF.PAGE PARAGRAPH DRAWING No.	REVISED No.	SUMMARY	REMARK
2015-9-9		01	First Issue	
2016-7-6		02	Add the CIE data	

Contents

1. Introduction

1.1 Scope of application

This specification applies to the positive type TFT transmissive dot matrix LCD module.

LCD resolution: Dots 240xRGBx320.

As to basic specification of the driver IC, refer to the IC (ILI9341V) specification and data sheet.

1.2 Structure:

Module Structure: TFT Panel+Polarizer+IC+FPC+BL;

Full 262K/65K Color 2.4 inch TFT Panel;

One bare chip with gold bump (COG) TECH;

Support 80 MCU 8/9/16/18-bit bus interface I;

White LED back light;

1.3 TFT features:

Transmissive Type LCD, normally black;

240 dot-source and 320 dot-gate outputs;

All viewing direction;
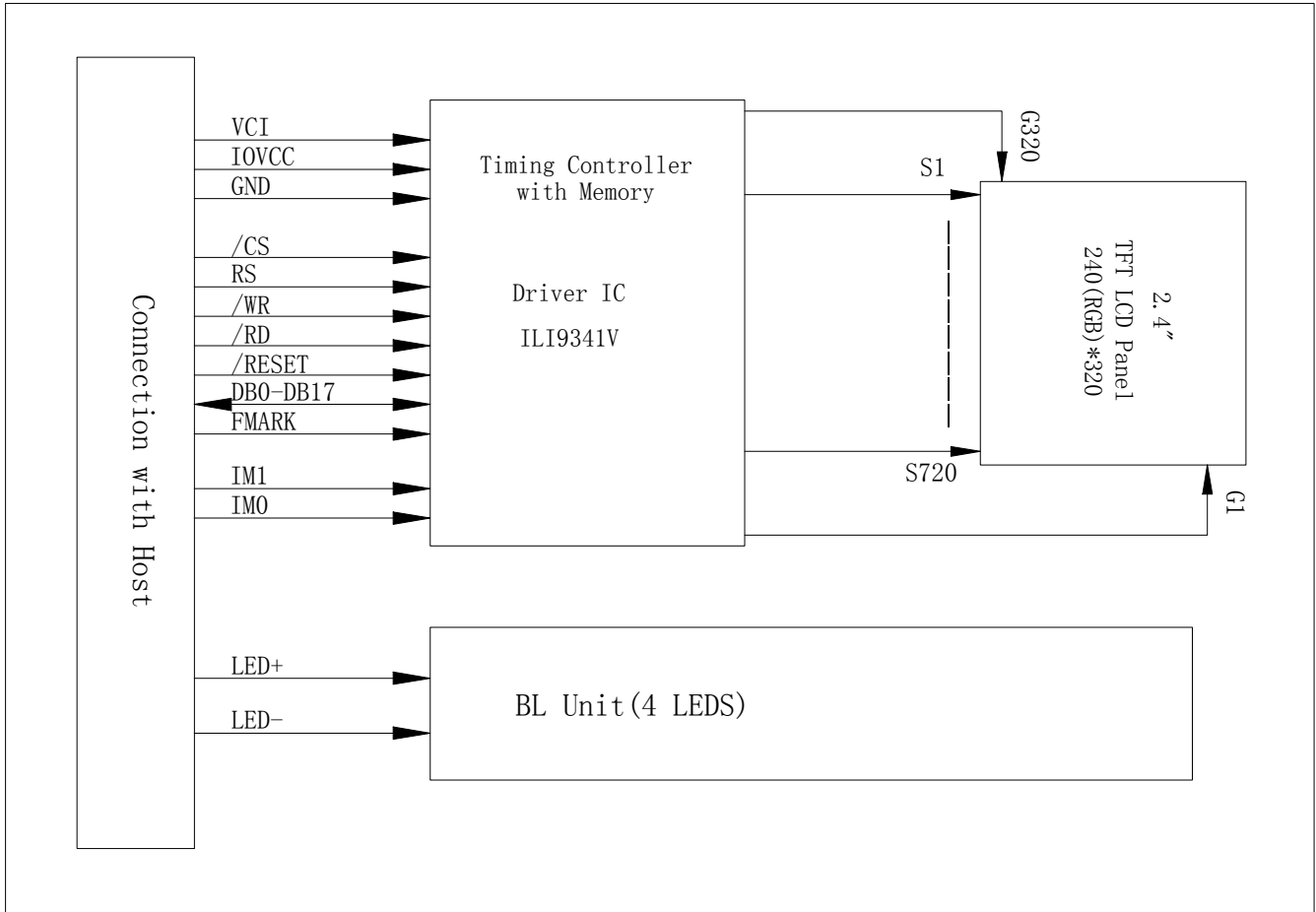
1.4 Applications:

Mobile phone

PSP

PDA

GPS

Etc···

2. General specification

ITEM	Standard value	UNIT
Display Mode	Transmissive,Normally black	---
Driver Mothod	TFT Active matrix	
Number of Dots	240(RGB)*320	Dots
Pixel Arrangement	RGB Vertical Stripe	
Active Area	36.72*48.96	mm
Viewing Direction	All	
Driver IC	ILI9341V	
Module Size(W*H*T)	42.72*60.4*2.2	mm
Approx. Weight	TBD	g
Back Light	4-Dies White LED series	
System interface	I80 MCU 8/9/16/18-bit	

3. Mechanical Drawing

Pin Description

Pin	Name
1	GND
2	IM0
3	IM1
4	FMARK
5	NC
6	DB17
7	DB16
8	DB15
9	DB14
10	DB13
11	DB12
12	DB11
13	DB10
14	DB9
15	DB8
16	IOVCC
17	DB7
18	DB6
19	DB5
20	DB4
21	DB3
22	DB2
23	DB1
24	DB0
25	/CS
26	RS
27	/WR
28	/RD
29	/RESET
30	VCI
31	GND
32	LED+
33	GND
34	LED-
35	GND

Display Type	TFT
Viewing Angle	TRANSMISSIVE
	ALL
LCD Driver IC	ILI9341V
Operating Voltage	VCC=2.8V
Operation Temperature	-20°C TO 70°C
Storage Temperature	-30°C TO 80°C
Interface	MCU interface
Backlight	4-LED White(20mA@12.8V)
Surface luminance	300cd/m^2(min.)
White X/Y	--

MODULE SPEC.

ORIENT DISPLAY

TITLE	DRAWING NO.
	AFK240320A1-2.4INTM
	UNIT	mm	SCALE	FIT
	3rd Angle		SHEET 1 OF 1

	DRAWN	ME.CHECKED	EE.CHECKED	APPROVED	CUSTOMER'S APPROVAL

V02	Change the outline of FPC	2015.9.7A
V01	Add the thickness of FPC	2015.8.17A
V00	First Issue	2015.8.13A
VER.	AMENDMENT	DATE
SYMBOL		

1. Unspecified tolerance is ±0.2mm
2. With "O" are for reference dimension
3. Inter-face connector: FPC
4. RDHS REQUEST

240*(RGB)*320
Viewing Direction
ALL

CIRCUIT DIAGRAM
(20mA@12.8V)

4. BLOCK DIAGRAM

5. Interface Pin Function

Pin No.	Symbol	Description
1	GND	Power ground
2	IM0	Select the MCU interface mode
3	IM1	
4	FMARK	Tearing effect output pin to synchronize MPU to frame writing, activated by S/W command. When this pin is not activated, this pin is low. If not used, open this pin.
5	NC	No connection
6	DB17	Data bus.
7	DB16	
8	DB15	
9	DB14	
10	DB13	
11	DB12	
12	DB11	
13	DB10	
14	DB9	
15	DB8	
16	IOVCC	Power supply for interface logic circuits (1.8V/2.8V).
17	DB7	Data bus.
18	DB6	
19	DB5	
20	DB4	
21	DB3	
22	DB2	
23	DB1	
24	DB0	
25	/CS	Chip selection pin Low enable; High disable.
26	RS	This pin is used to select "Data or Command" in the parallel interface. When RS= 1, data is selected. When RS= 0, command is selected.
27	WR	Serves as a write signal and writes data at the rising edge.
28	RD	Serves as a read signal and MCU read data at the rising edge.
29	/RESET	This signal will reset the device and must be applied to properly initialize the chip. Signal is active low.

30	VCI	Power voltage(2.8V)
31	GND	Power ground
32	LED+	Anode of LED backlight
33	GND	Power ground
34	LED-	Cathode of LED backlight
35	GND	Power ground

Note: Select the MCU interface mode

IM1	IMO	MCU-Interface Mode	DB Pin in use
0	0	80 MCU 8-bit bus interface I	DB[7:0]
0	1	80 MCU 16-bit bus interface I	DB[15:0]
1	0	80 MCU 9-bit bus interface I	DB[8:0]
1	1	80 MCU 18-bit bus interface I	DB[17:0]

6. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Supply voltage for logic	IOVCC	−0.3	4.6	V
Supply voltage for Analog	VCI	−0.3	4.6	V
Input voltage	VIN	−0.3	VCI+0.3	V
Supply current (One LED)	I_{LED}		30	mA
Operating temperature	T_{OP}	−20	+70	°℃
Storage temperature	T_{ST}	−30	+80	°℃

7. ELECTRICAL CHARACTERISTICS

For IC

Item	Symbol	Min	Typ	Max	Unit	Applicable terminal
Supply voltage for logic	IOVCC	1.65	2.8	3.3	V	
Supply voltage for Analog	VCI	2.5	2.8	3.3	V	
Input voltage	VIL	VSS	–	0.3VCI	V	
	VIH	0.7VCI	–	VCI	V	
Input leakage current	I_{LKG}	−0.1		+0.1	μA	

For backlight

Item	Symbol	Min	Typ	Max	Unit	Condition
Supply Current	I		20		mA	
Forward Voltage	V_{LED}	12.0	12.8	13.6	V	I=20mA
Power Consumption	P		256		mW	
Life Time			50000		Hours	Note

Note: Brightness to be decreased to 50% of the initial value at ambient temperature TA=25℃

8. OPTICAL CHARACTERISTICS

ITEM		SYMBOL	CONDITIONS	SPECIFICATIONS			UNIT	NOTE
				MIN.	TYP.	MAX		
Brightness		B	Viewing normal angle	300	––	–	Cd/m^2	
Contrast Ratio		CR			800	––	––	
Response Time		Tr+Tf		––	35	45	ms	
CIE Color coordinate	Red	X$_R$		––				
		Y$_R$						
	Green	X$_G$		––				
		Y$_G$						
	Blue	X$_B$		––				
		Y$_B$						
	White	X$_W$		0.260	0.280	0.300		
		Y$_W$		0.289	0.309	0.329		
Viewing Angle	Hor.	θ_{X+}	Center CR$\geq$=10		80	––	Deg.	
		θ_{X-}			80	––		
	Ver.	θ_{Y+}			80	––		
		θ_{Y-}			80			
Uniformity		Un		80			%	

Note 1 : Definition of Viewing Angle θ_X and θ_Y:
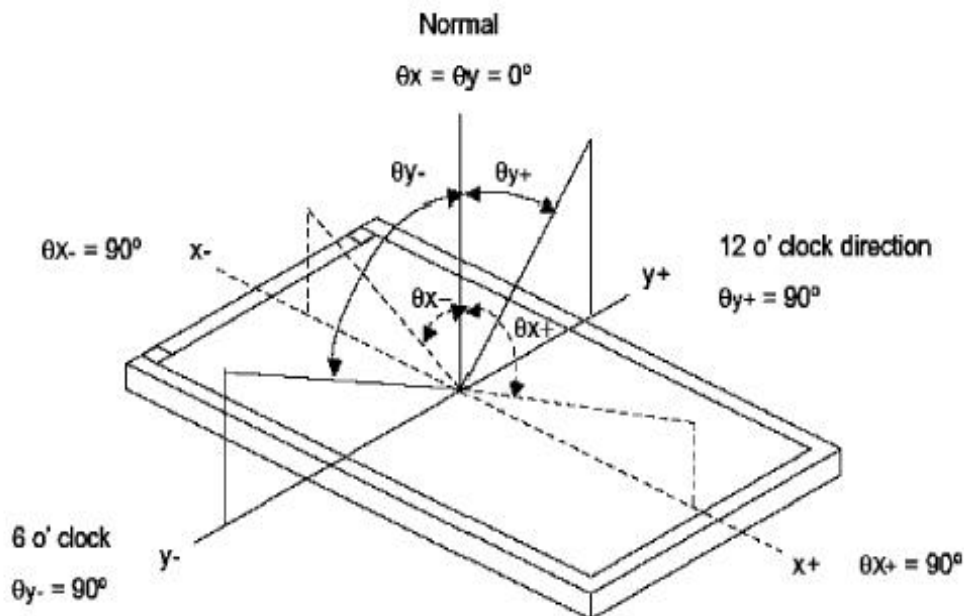
Note 2: Definition of contrast ratio CR:

$$CR = \frac{\text{Brightness of non-selected dots (white)}}{\text{Brightness of selected dots (black)}}$$

Note 3: Definition of response time (T_R, T_F)
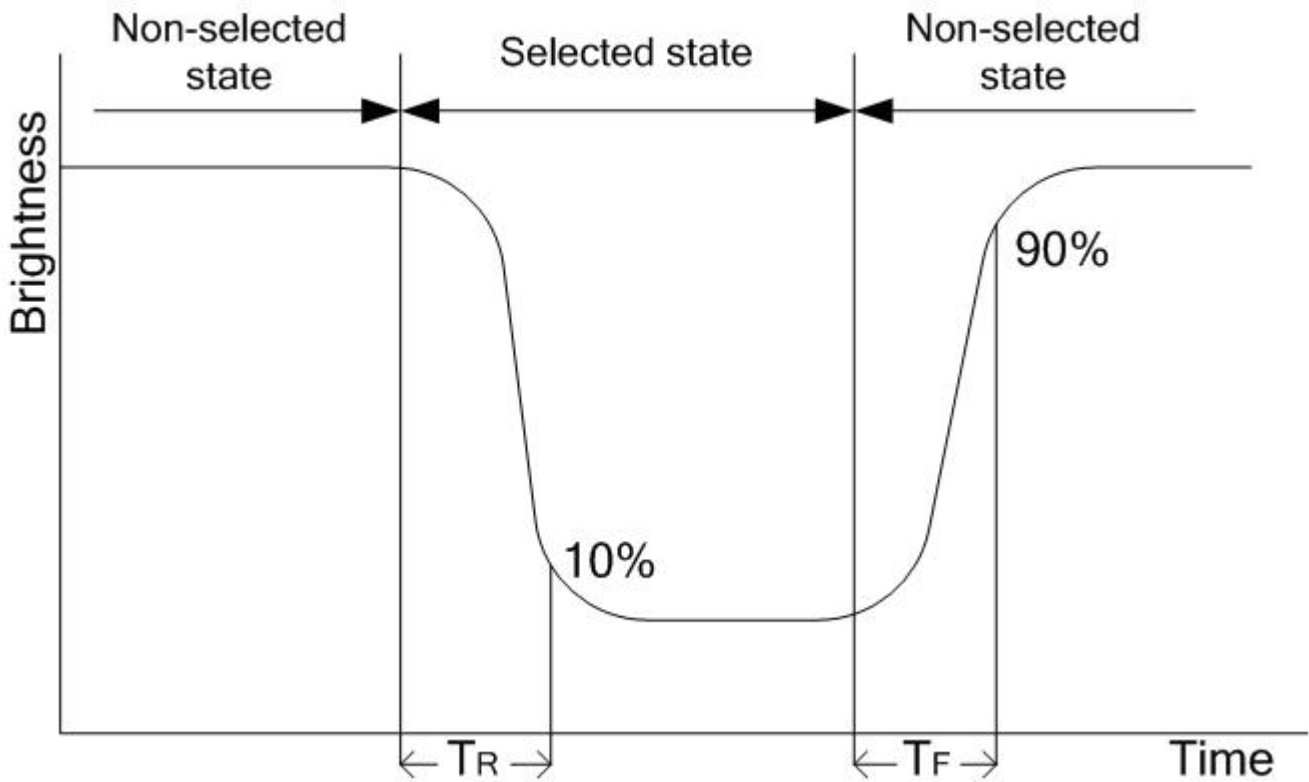
: The brightness test equipment setup
20mA   Field=2° (As measuring "black" image, field=2° is the best testing condition)

BM-7

Field = 2°

50 cm

TFT-LCD Panel

The center of the screen

Note 4:

H/6

H/3

H/3   Active area

H/6   H

L/6   L/3   L/3   L/6

L

Active area   Unit: mm
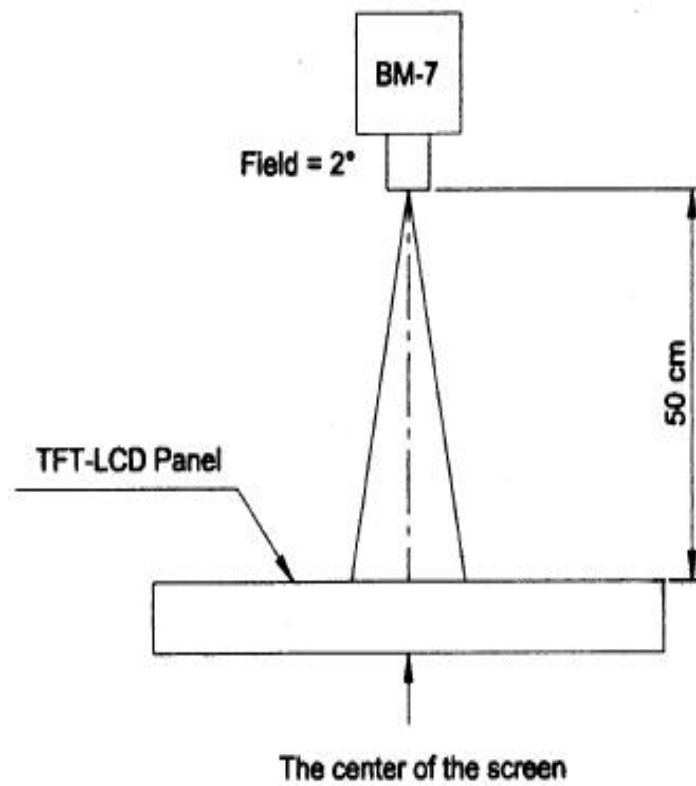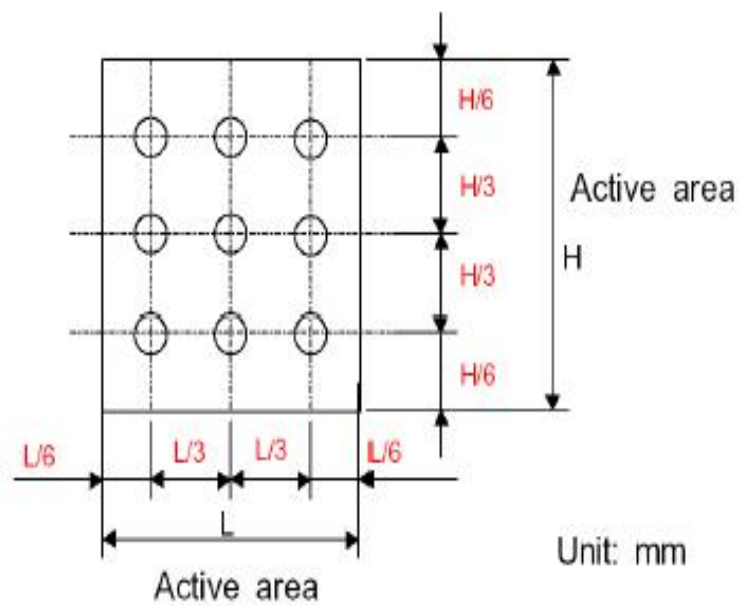
9. Timing characteristics

9.1 80 series MCU Parallel Interface Characteristics:18/16/9/8-bit Bus
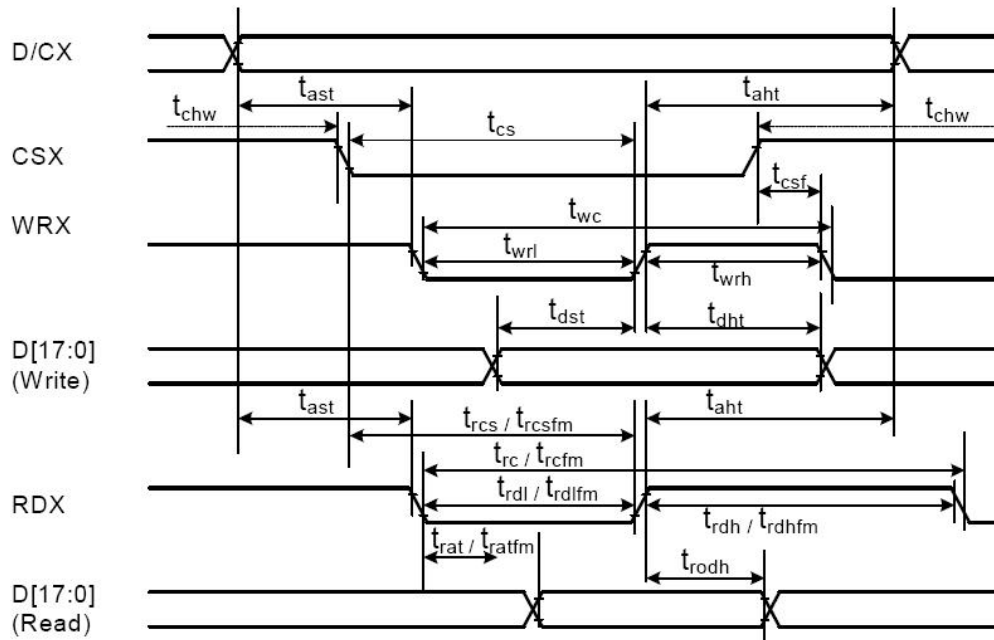
Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	0	-	ns	
CSX	tchw	CSX "H" pulse width	0	-	ns	
	tcs	Chip Select setup time (Write)	15	-	ns	
	trcs	Chip Select setup time (Read ID)	45	-	ns	
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	
	tcsf	Chip Select Wait time (Write/Read)	10	-	ns	
WRX	twc	Write cycle	66	-	ns	
	twrh	Write Control pulse H duration	15	-	ns	
	twrl	Write Control pulse L duration	15	-	ns	
RDX (FM)	trcfm	Read Cycle (FM)	450	-	ns	
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX (ID)	trc	Read cycle (ID)	160	-	ns	
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
D[17:0], D[15:0], D[8:0], D[7:0]	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: Ta=-30 to 70℃，IOVCC=1.65V to 3.3V，VCI=2.5V to 3.3V，VSS=0V
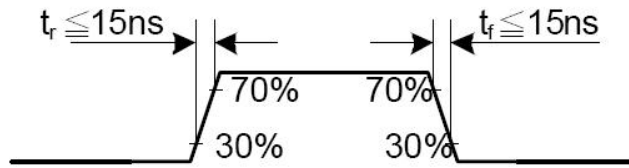
CS timings:
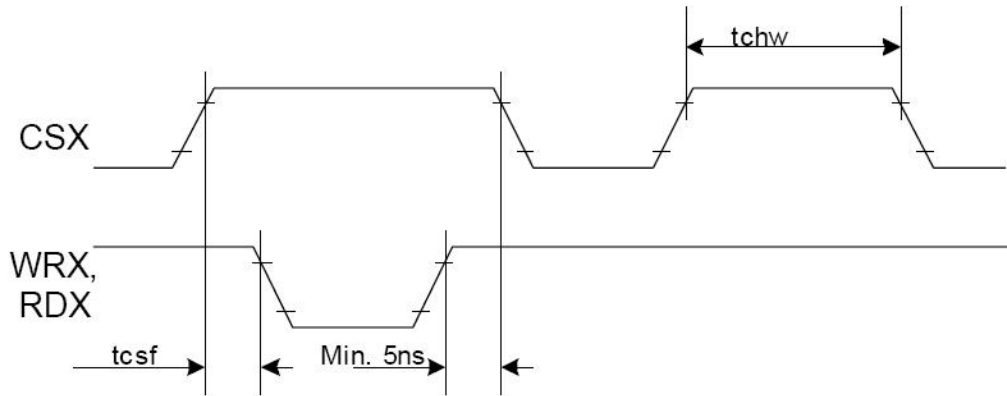
Note: Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.

Write to read or read to write timings:
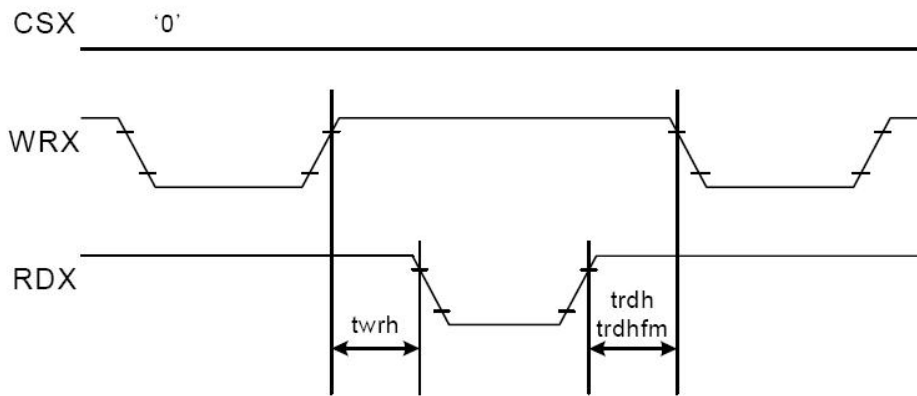
Note: Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.

9.2 Reset Timing
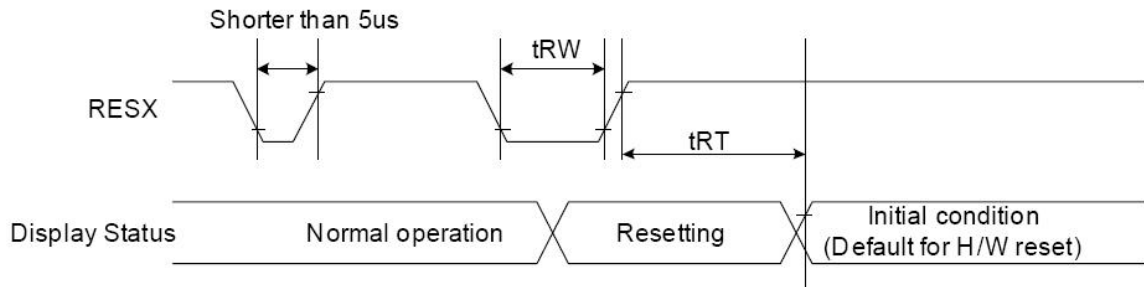
Signal	Symbol	Parameter	Min	Max	Unit
RESX	tRW	Reset pulse duration	10		uS
	tRT	Reset cancel		5 (note 1,5)	mS
				120 (note 1,6,7)	mS

Note 1: The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NV memory 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.

Note 2: 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 10us	Reset
Between 5us and 10us	Reset starts

Note 3: 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.

Note 4: Spike Rejection also applies during a valid reset pulse as shown below:
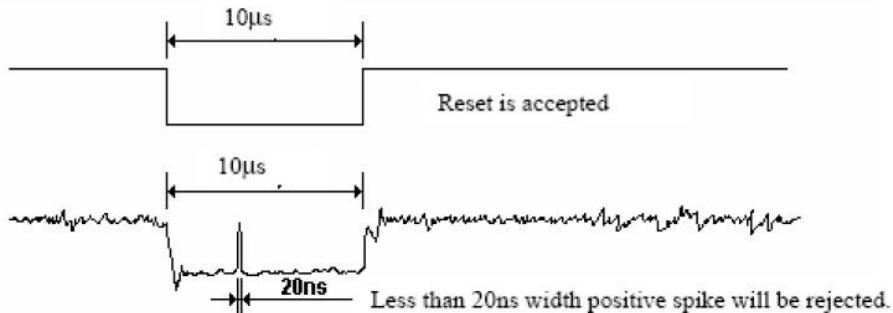
Note 5: When Reset applied during Sleep In Mode.
Note 6: When Reset applied during Sleep Out Mode.
Note 7: It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

10. Standard Specification for Reliability :

10-1. Standard Specifications for Reliability of LCD Module

No	Item	Description
01	High temperature operation	The sample should be allowed to stand at 70℃ for 240 hours under driving condition and then returning it to normal temperature condition, and allowing it stand for 2 hours.
02	Low temperature operation	The sample should be allowed to stand at -20℃ for 240 hours under driving condition and then returning it to normal temperature condition, and allowing it stand for 2 hours.
03	High temperature storage	The sample should be allowed to stand at 80℃ for 240 hours under no-load condition, and then returning it to normal temperature condition, and allowing it stand for 2 hours.
04	Low temperature storage	The sample should be allowed to stand at -30℃ for 240 hours under no-load condition, then returning it to normal temperature condition, and allowing it stand for 2 hours.
05	Moisture storage	The sample should be allowed to stand at 60℃,90%RH MAX for 240 hours under no-load condition, then taking it out and drying it at normal temperature for 2 hours.
06	Thermal shock storage	The sample should be allowed to stand the following 10 cycles : -30℃ for 30 minutes → normal temperature for 5 minutes → +80℃ for 30 minutes → normal temperature for 5 minutes, as one cycle.
07	Packing vibration	Frequency range : 10Hz ~ 55Hz Amplitude of vibration : 1.5mm Sweep time: 12 min X,Y,Z 2 hours for each direction.
08	Packing drop test	According to ISTA 1A 2001.
09	Electrical Static Discharge	Air: ±4KV 150pF/330Ω 5 times
		Contact: ±2KV 150pF/330Ω 5 time

*Sample size for each test item is 3~5pcs

10 - 2. Testing Conditions and Inspection Criteria

For the final test the testing sample must be stored at room temperature for 24 hours, after the tests listed in Table 12.2, Standard specifications for Reliability have been executed in order to ensure stability.

No	Item	Test Model	In section Criteria
01	Current Consumption	Refer To Specification	The current consumption should conform to the product specification.
02	Contrast	Refer To Specification	After the tests have been executed, the contrast must be larger than half of its initial value prior to the tests.
03	Appearance	Visual inspection	Defect free.

10- 3. MTBF

MTBF	Functions, performance, appearance, etc. shall be free from remarkable deterioration within10,000 hours under ordinary operating and storage conditions room temperature (25±5℃), normal humidity (50±10% RH), and in area not exposed to direct sun light.

11. Specification of Quality Assurance:

11-1. Purpose

This standard for Quality Assurance should affirm the quality of LCD module products to supply to purchaser by Orient Display.

11-2. Standard for Quality Test

a. Inspection:

Before delivering, the supplier should take the following tests, and affirm the quality of product.

b. Electro-Optical Characteristics:

According to the individual specification to test the product.

c. Test of Appearance Characteristics:

According to the individual specification to test the product.

d. Test of Reliability Characteristics:

According to the definition of reliability on the specification for testing products.

e. Delivery Test:

Before delivering, the supplier should take the delivery test.

(i) Test method: According to MIL-STD105E.General Inspection Level II take a single time.

(ii) The defects classify of AQL as following:

Major defect: AQL = 0.65

Minor defect: AQL = 2.5

Total defects: AQL = 2.5

11-3. Non- conforming Analysis & Deal With Manners

a. Non- conforming Analysis:

(i) Purchaser should supply the detail data of non- conforming sample and the non- conforming.

(ii) After accepting the detail data from purchaser, the analysis of non- conforming should be finished in two weeks.

(iii) If supplier can not finish analysis on time, must announce purchaser before 3 days.

b. Disposition of non- conforming:

(i) If find any product defect of supplier during assembly time, supplier must change the good product for every defect after recognition.

(ii) Both supplier and customer should analyze the reason and discuss the disposition of non-conforming when the reason of nonconforming is not sure.

11-4. Agreement items

Both sides should discuss together when the following problems happen.

a. There is any problem of standard of quality assurance, and both sides should think that must be modified.

b. There is any argument item which does not record in the standard of quality assurance.

c. Any other special problem.

11-5. Standard of The Product Appearance Test
     a. Manner of appearance test:
      (i) The test must be under 20W × 2 or 40W fluorescent light, and the distance of view must be at 30±5cm.
      (ii) When test the model of transmissive product must add the reflective plate.
    (iii)The test direction is base on around 10° of vertical line.
    (iiii)Temperature: 25±5℃   Humidity: 60±10%RH
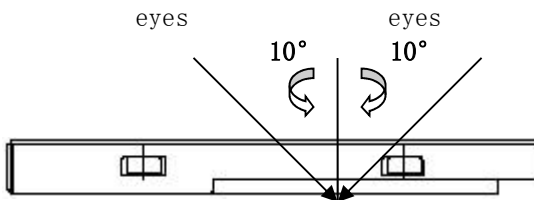
  (iv) Definition of area:
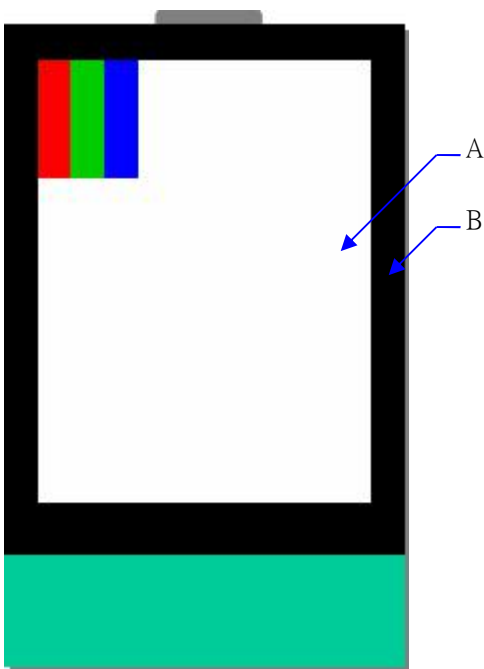
A. Area: Viewing area.
B. Area: Out of viewing area.
      (Outside viewing area)
b. Basic principle:
 (i) It will accord to the AQL when the standard can not be described.
(ii) The sample of the lowest acceptable quality level must be discussed by both supplier and customer when any dispute happened.
(iii) Must add new item on time when it is necessary.
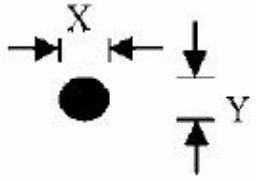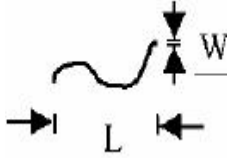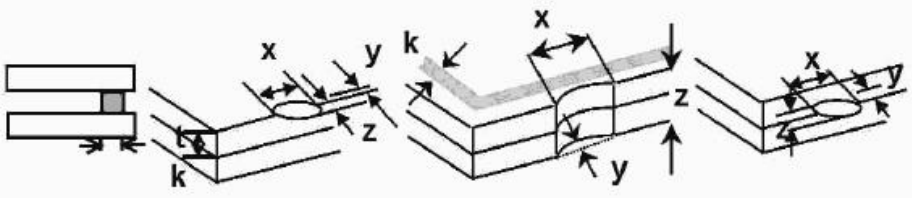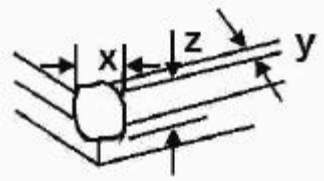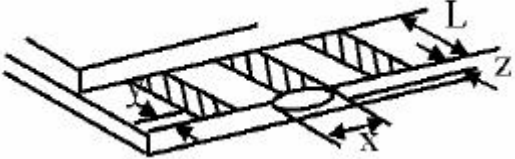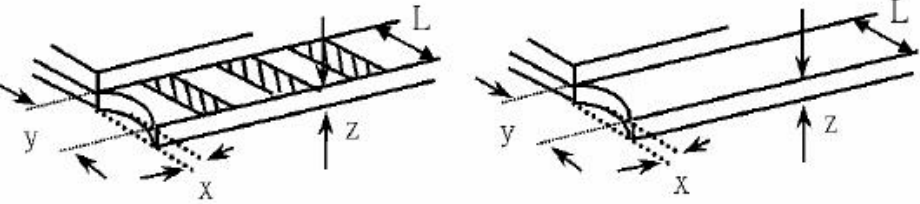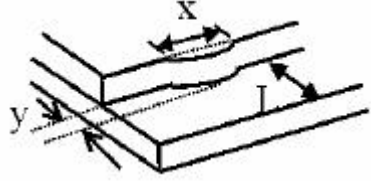
c. Standard of inspection: (Unit: mm)

11-6. Inspection specification
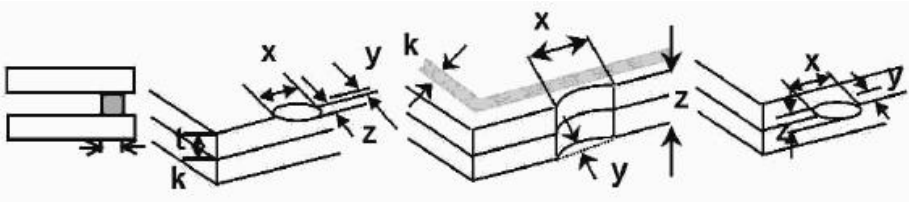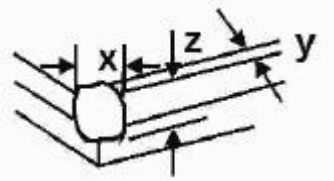
NO	Item	Criterion	AQL
01	Electrical Testing	1.1 Missing vertical, horizontal segment, segment contrast defect. 1.2 Missing character, dot or icon. 1.3 Display malfunction. 1.4 No function or no display. 1.5 Current consumption exceeds product specifications. 1.6 LCD viewing angle defect. 1.7 Mixed product types. 1.8 Flicker	0.65
02	Black or White spots or Bright spots or Color spots on LCD (Display only)	2.1 White and black or color spots on display $\leqq$ 0.25mm, no more than Five spots. 2.2 Densely spaced: No more than three spots within 3mm.	2.5
03	LCD and Touch Panel black spots, white spots, contamination (non - display)	3.1 Round type: As following drawing Φ = (X+Y) / 2 | Size(mm)	Acceptable Q'ty
---	---
$\Phi \leqq 0.10$	Accept no dense
$0.10 < \Phi \leqq 0.20$	2
$0.20 < \Phi \leqq 0.25$	2
$0.25 < \Phi \leqq 0.30$	1
$0.30 < \Phi$	0	 * Densely spaced: No more than two spots within 3mm.	2.5
		3.2 Line type: (As following drawing) | Length(mm)	Width(mm)	Acceptable Q'ty
---	---	---
---	$W \leqq 0.02$	Accept no dense
$L \leqq 3.0$	$0.02 < W \leqq 0.05$	2
$L \leqq 2.5$	$0.03 < W \leqq 0.08$	
---	$0.08 < W$	Rejection | * Densely spaced: No more than two lines within 3mm.	2.5
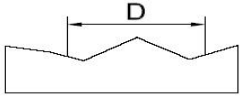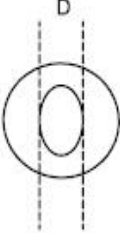
NO	Item	Criterion	AQL
04	Polarizer bubbles	If bubbles are visible, judge using black spot specifications, not easy to find, must check in specify direction <table><tr><td>Size Φ(mm)</td><td>Acceptable Q'ty</td></tr><tr><td>Φ≦0.20</td><td>Accept no dense</td></tr><tr><td>0.20< Φ≦0.50</td><td>3</td></tr><tr><td>0.50< Φ≦1.00</td><td>2</td></tr><tr><td>1.00< Φ</td><td>0</td></tr><tr><td>Total Q'ty</td><td>3</td></tr></table>	2.5
05	Scratches	Follow NO.3 -2 Line Type.	
06	Chipped glass	(see below)	2.5

Criterion for 06 Chipped glass:

Symbols:
x: Chip length   y: Chip width   z: Chip thickness
k: Seal width   t: Glass thickness a: LCD side length
L: Electrode pad length
6.1 General glass chip:
6.1.1 Chip on panel surface and crack between panels:

z: Chip thickness	y: Chip width	x: Chip length
$Z \leqq 1/2t$	Not over viewing area	$x \leqq 1/8a$
$1/2t < z \leqq 2t$	Not exceed 1/3k	$x \leqq 1/8a$

⊙ Unit: mm
⊙ If there are 2 or more chips, x is the total length of each chip

6.1.2 Corner crack:

z: Chip thickness	y: Chip width	x: Chip length
$Z \leqq 1/2t$	Not over viewing area	$x \leqq 1/8a$
$1/2t < z \leqq 2t$	Not exceed 1/3k	$x \leqq 1/8a$

⊙ Unit: mm
⊙ If there are 2 or more chips, x is the total length of each chip

NO	Item	Criterion	AQL
07	Glass crack	Symbols: x: Chip length y: Chip width z: Chip thickness k: Seal width t: Glass thickness a: LCD side length L: Electrode pad length 7.2 Protrusion over terminal: 7.2.1 Chip on electrode pad:	2.5

Symbols:
x: Chip length   y: Chip width   z: Chip thickness
k: Seal width   t: Glass thickness a: LCD side length
L: Electrode pad length
7.2 Protrusion over terminal:
7.2.1 Chip on electrode pad:

y: Chip width	x: Chip length	z: Chip thickness
$y \leqq 0.5mm$	$x \leqq 1/8a$	$0 < z \leqq t$

7.2.2   Non-conductive portion:

y: Chip width	x: Chip length	z: Chip thickness
$y \leqq L$	$x \leqq 1/8a$	$0 < z \leqq t$

⊙ If there chipped area touches the ITO terminal, over 2/3 of the ITO must remain and be inspected according to electrode terminal specifications.
⊙ If the product will be heat sealed by the customer, the alignment mark must mot be damaged.
7.2.3 Substrate protuberance and internal crack

y: width	x: length
$y \leqq 1/3L$	$X \leqq a$

NO	Item	Criterion	AQL
08	Cracked glass	The LCD with extensive crack is not acceptable.	2.5
09	Backlight elements	9.1 Illumination source flickers when lit. 9.2 Spots or scratches that appear when lit must be judged. Using LCD spot, lines and contamination standards. 9.3 Backlight doesn't light or color is wrong.	2.5 2.5 0.65
10	Bezel	Bezel must comply with product specifications.	2.5
11	PCB、COB	11.1 COB seal may not have pinholes larger than 0.2mm or contamination. 11.2 COB seal surface may not have pinholes through to the IC. 11.3 The height of the COB should not exceed the height indicated in the assembly diagram. 11.4 There may not be more than 2mm of sealant outside the seal area on PCB. And there should be no more than three places. 11.5 Parts on PCB must be the same as on the production characteristic chart, There should be no wrong parts, missing parts or excess parts. 11.6 The jumper on the PCB should conform to the product characteristic chart.	2.5 2.5 2.5 2.5 0.65 0.65
12	FPC	12.1 FPC terminal damage ≦ 1/2 FPC terminal width and can not affect the function , we judge accept. 12.2 FPC alignment hole damage ≦ 1/2 alignment area and can not affect the function , we judge accept.	2.5 2.5
13	Soldering	13.1 No cold solder joints, missing solder connections, oxidation or icicle. 13.2 No short circuits in components on PCB or FPC.	2.5 0.65

NO	Item	Criterion	AQL
14	Touch Panel Chipped glass	Symbols: x: Chip length y: Chip width z: Chip thickness k: Seal width t: Touch Panel Total thickness a: LCD side length L: Electrode pad length 14.1 General glass chip: 14.1.1 Chip on panel surface and crack between panels: _table below_ ⊙ Unit: mm ⊙ If there are 2 or more chips, x is the total length of each chip 14.1.2 Corner crack: _table below_ ⊙ Unit: mm ⊙ If there are 2 or more chips, x is the total length of each chip	2.5

14.1.1 table:

z: Chip thickness	y: Chip width	x: Chip length
$Z \leqq t$	$\leqq 1/2$ k and not over viewing area	$x \leqq 1/8a$

14.1.2 table:

z: Chip thickness	y: Chip width	x: Chip length
$z \leqq t$	$\leqq 1/2$ k and not over viewing area	$x \leqq 1/8a$

NO	Item	Criterion	AQL
15	Touch Panel(Fish eye、dent and bubble on film)	<table><tr><td>SIZE(mm)</td><td>Acceptable Q'ty</td></tr><tr><td>Φ≦0.2</td><td>Accept no dense</td></tr><tr><td>0.2< D ≦0.4</td><td>5</td></tr><tr><td>0.4< D ≦0.5</td><td>2</td></tr><tr><td>0.5< D</td><td>0</td></tr></table>	2.5
16	Touch Panel Newton ring	Newton ring dimension ≦ 1/2 touch panel area and not affect font and line distortion(≦2.5%), it is acceptable.	2.5
17	Touch Panel Linearity	Less than 2.5% is acceptable.	2.5
18	LCD Ripple	Touch the touch panel , can not see the LCD ripple. Pen: R 1.0mm silicon rubber. Operation Force: 80g	2.5
19	General appearance	19.1 Pin type must match type in specification sheet. 19.2 LCD pin loose or missing pins. 19.3 Product packaging must the same as specified on packaging specification sheet. 19.4 Product dimension and structure must conform to product specification sheet.	0.65 0.65 0.65 0.65

12. Handling Precaution:

12-1 Handling of LCM

- Don't give external shock.
- Don't apply excessive force on the surface.
- Liquid in LCD is hazardous substance. Must not lick and swallow.
  when the liquid is attach to your hand, skin, cloth etc.
  Wash it out thoroughly and immediately.
- Don't operate it above the absolute maximum rating.
- Don't disassemble the LCM.
- The operators should be grounded whenever he/she comes into contact with
  the module. Never 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.
- The modules should be kept in antistatic bags or other containers resistant
  to static for storage.
- The 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.

12-2 Storage

- Store in an ambient temperature of 25±10℃, and in a relative humidity of 50±
  10%RH. Don't expose to sunlight or fluorescent light.
- Storage in a clean environment, free from dust, active gas, and solvent.
- Store in anti-static electricity container.
- Store without any physical load.

11-3 Soldering

- Use only soldering irons with proper grounding and no leakage.
- Iron: No higher than 280±10℃ and less than 3 sec during Hand soldering.
- Rewiring: no more than 2 times.

13 Packing method

------TBD