Tentative

Ver. 0.01

LTPS LCD Specification

Model Name: TC015THEBB

Customer Signature
Date

This technical specification is subjected to change without notice

Table of Contents

Record of Revision

Rev	Issued Date	Description
0.00	Sep 23, 2004	New Create
0.01	Dec 10,2004	Modify: 1. Page 6:VPCD change to PCD 2. Page 7:V block(H) change to V black(H) 3. Page 8:S&H Gamma Contract Bright change to S&H Gamma Contrast Brightness

1. FEATURES

The 1.5”(3.86 cm) LCD module is an active matrix color TFT LCD module with Digital and Analog Interface. LTPS (Low Temperature Poly Silicon) TFT technology is used. Vertical and horizontal drivers are built on the panel. NTSC and PAL format are compatible. Horizontal scan can be from left to right or from right to left, and Vertical scan can be from up to down or from down to up.

2. GENERAL SPECIFICATIONS

Item	Description	Unit
Display Size (Diagonal)	1.5 (3.86)	Inch (cm)
Display Type	Transmissive	
Active Area (HxV)	31.22 x 22.815	mm
Number of Dots (HxV)	557 x 234	dot
Dot Pitch (HxV)	0.056 x 0.0975	mm
Color Arrangement	RGB Delta	
Color Numbers	16Million / Full Color	
Outline Dimension (HxVxT)	37.1 x 32.7 x 2.85*	mm
Weight	7.0	g

* Exclude FPC and protrusions.

3. INPUT/OUTPUT TERMINALS

3.1 TFT LCD Panel

Pin	Symbol	I/O	Description	Remark
1	NC	-	No Connection	
2	V_{FS}	I	GND For LED Backlight	
3	V_F	I	LED Input Voltage	
4	NC	-	No Connection	
5	NC	-	No Connection	
6	NC	-	No Connection	
7	VCOM	I	Common Electrode Voltage	
8	CKV1	I	Vertical Clock 1	
9	CKV2	I	Vertical Clock 2	
10	STV	I	Vertical Start Signal	
11	XSTV	I	Inverted Signal Of STV	
12	VVDD	I	Power Supply For Vertical Driver	
13	ENB	I	Enable Signal	
14	XENB	I	Inverted Signal Of ENB	
15	CSV	I	UP/DOWN Reverse Control Signal	Note 3-1
16	VBB	O	Vertical Driver Output Power Voltage	Note 3-2
	NC	-	No Connection	
17	PCG	I	Precharge Data Signal	
18	XPCG	I	Inverted Signal Of PCG	
19	PCD	I	Precharge Data Signal For Pixel	
20	B	I	Video Signal (B)	
21	R	I	Video Signal (R)	
22	G	I	Video Signal (G)	
23	CSH	I	RIGHT/LEFT Reverse Control Signal	Note 3-3
24	VVEE	I	Vertical Driver Negative Power Supply Voltage	Note 3-4
	VSS	I	GND	
25	VSS	I	GND	
26	STH	I	Horizontal Start Signal	
27	XSTH	I	Inverted Signal Of STH	
28	HVDD	I	Power Supply For Horizontal Driver	
29	CKH1	I	Horizontal Clock 1	
30	CKH2	I	Horizontal Clock 2	

Note 3-1: H: Normal scan L: Reverse scan

Note 3-2 VBB is used for digital interface; NC is used for analog interface.

Note 3-3: H: Normal scan L: Reverse scan

Note 3-4 VVEE is used for digital interface; VSS is used for analog interface.

4. ABSOLUTE MAXIMUM RATINGS

VSS=0V

Item	Symbol	Min	MAX	Unit	Remark
Power Supply for Horizontal Driver	HVDD	-1.0	+14	V	
Power Supply for Vertical Driver	VVDD	-1.0	+14	V	
Vertical Driver Negative Power Supply Voltage	VVEE	-6.0	-1.0	V	
Common Electrode Voltage	VCOM	-1.0	+14	V	
Horizontal Driver / Precharge Data Input Voltage	STH, XSTH, CKH1, CKH2, CSH, PCG, XPCG	-1.0	+14	V	
Vertical Driver / Precharge Data Input Voltage	STV, XSTV, CKV1, CKV2, CSV, ENB, XENB	-1.0	+14	V	
Video / Precharge Data Input Voltage	VG, VR, VB, PCD	-1.0	+13	V	
Back Light Forward Current	I_F	-	25	mA	Note 4-1
Operating Temperature	Topr	-10	+60	℃	
Storage Temperature	Tstg	-30	+80	℃	

Note 4-1: Ta=25℃

5. ELECTRICAL CHARACTERISTICS

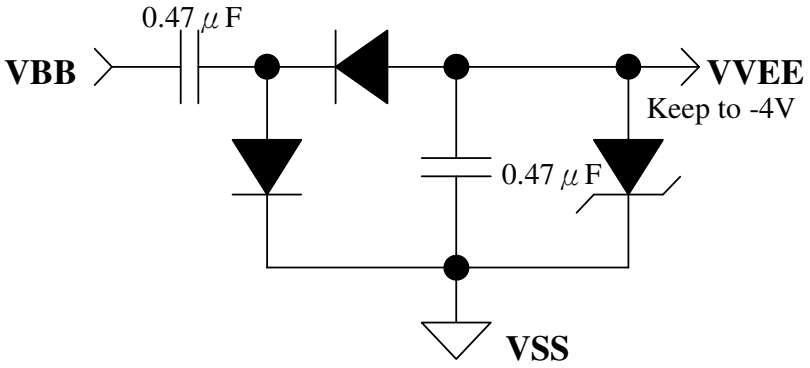
5.1 Driving TFT LCD Panel with Digital Interface

VSS=0V, Ta=25℃

Item		Symbol	MIN	TYP	MAX	Unit	Remark
Power Supply for Horizontal Driver		HVDD	8.2	8.5	8.8	V	
Power Supply for Vertical Driver		VVDD	8.2	8.5	8.8	V	
Vertical Driver Negative Power Supply Voltage		VVEE	-	-4.0	-	V	Note 5-1
Horizontal Driver Input Voltage	Low	VHIL	-0.3	0.0	0.3	V	
	High	VHIH	2.5	3.0	4.0	V	
Vertical Driver Input Voltage	Low	VVIL	-0.3	0.0	0.3	V	
	High	VVIH	2.5	3.0	4.0	V	
CSH, CSV	Low	VSIL	-0.3	0.0	0.3	V	
	High	VSIH	8.2	8.5	8.8	V	
Video Signal Center Voltage		VVC	2.4	2.6	2.8	V	Note 5-2
Video Signal Voltage	Black (H)	V black (H)	4.0	4.2	4.6		
	Black (L)	V black (L)	0.8	1.0	1.2		
	White-Black	V sig w-b	-	-	3.00	V	
Common Electrode Signal Center Voltage		VCOM c	(VVC-0.2) -0.2	(VVC-0.2)	(VVC-0.2) + 0.2	V	Note 5-3
Common Electrode Signal Center Range		VCOM p-p	-	3.8	-	V	
Panel Power Consumption		W_P	-	21	-	mW	

Note 5-1 Negative Power Supply Generator

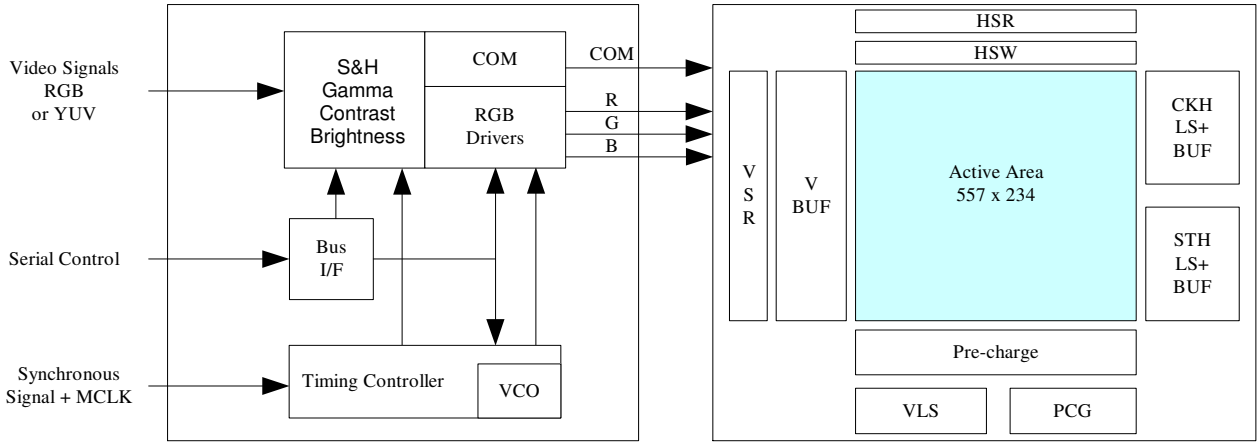
To stabilize VBB output voltage, VBB should be tied VSS through a zener diode with smoothing capacitor as the following diagram.



Note 5-2: Video signal and precharge data signal shall be input symmetrically around VVC.

Note 5-3: Set common electrode voltage to the optimum voltage.

5.1.1 Driving TFT LCD Panel Block Diagram



5.2 Driving TFT LCD Panel with Analog Interface

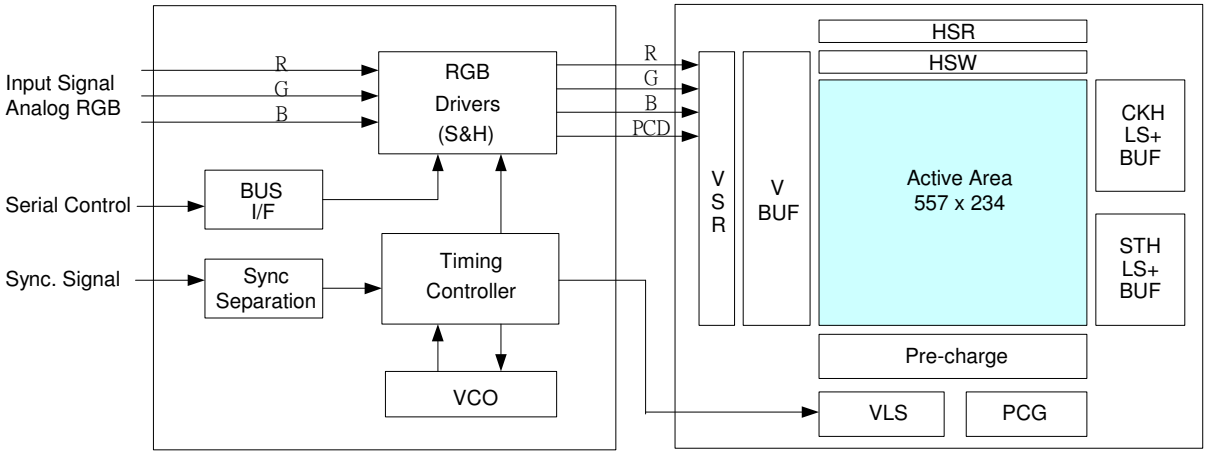
VSS=0V, Ta=25℃

Item		Symbol	MIN	TYP	MAX	Unit	Remark
Power Supply for Vertical Driver		VVDD	11.7	12	12.3	V	
Power Supply for Horizontal Driver		HVDD	11.7	12	12.3	V	
Horizontal Driver Input Voltage	Low	VHIL	-0.3	0.0	0.3	V	
	High	VHIH	2.5	3.0	4.0	V	
Vertical Driver Input Voltage	Low	VVIL	-0.3	0.0	0.3	V	
	High	VVIH	2.5	3.0	4.0	V	
CSH, CSV	Low	VSIL	-0.3	0.0	0.3	V	
	High	VSIH	11.7	12	12.3	V	
Video Signal Center Voltage		VVC	5.0	5.2	5.4	V	Note 5-4
Video Input Voltage Range		VG, VR, VB	VCC-3.5	--	VVC+3.5	V	
Common Electrode Voltage		VCOM	--	VVC-0.2	--	V	Note 5-5
Panel Power Consumption		W_P	--	43	--	mW	

Note 5-4: Video signal and precharge data signal shall be input symmetrically around VVC.

Note 5-5: Set common electrode voltage to the optimum voltage.

5.2.1 Driving TFT LCD Panel Block Diagram



5.3 Driving Backlight

Ta=25℃

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	I_F	--	20	25	mA	Note 5-6
Forward Current Voltage	V_F	--	3.6	--	V	
Backlight Power Consumption	W_{BL}	--	72	--	mW	

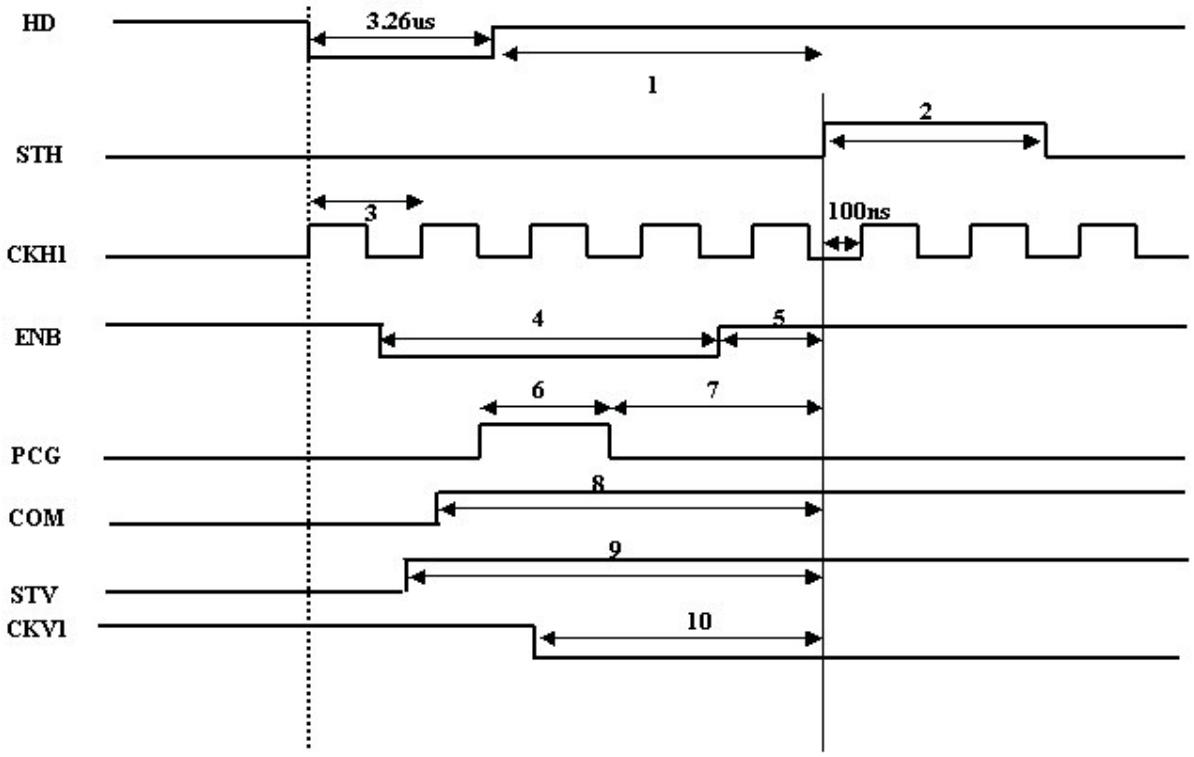
Note 5-6: Backlight driving circuit is recommended as the fix current circuit.

6 TIMING CHART

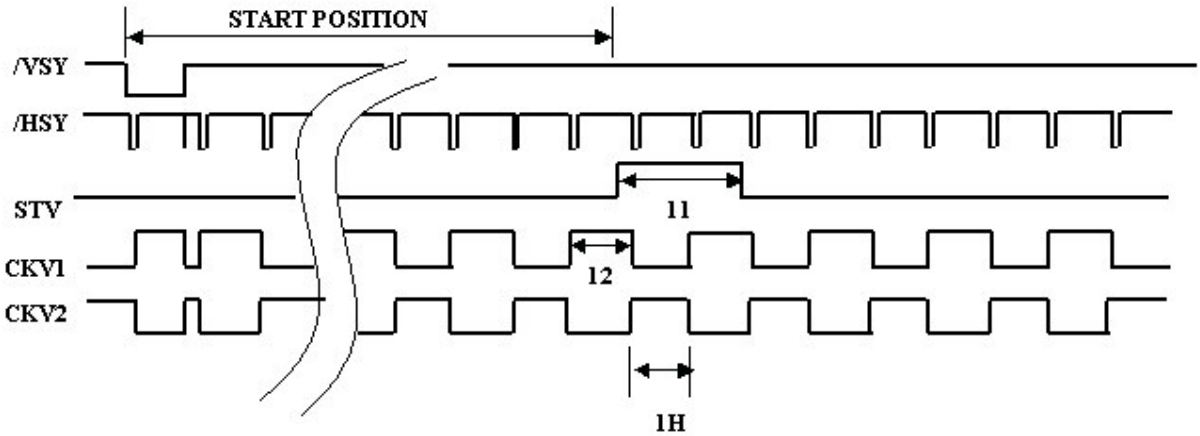
6.1 Timing Chart with Digital Interface

1	2	3	4	5	6	7	8	9	10	11	12
9.94us	1.18us	540ns	7.26us	1.06us	3.98us	1.62us	5.24us	8.04us	3.34us	127.1us	63.56us

6.1.1 Horizontal



6.1.2 Vertical

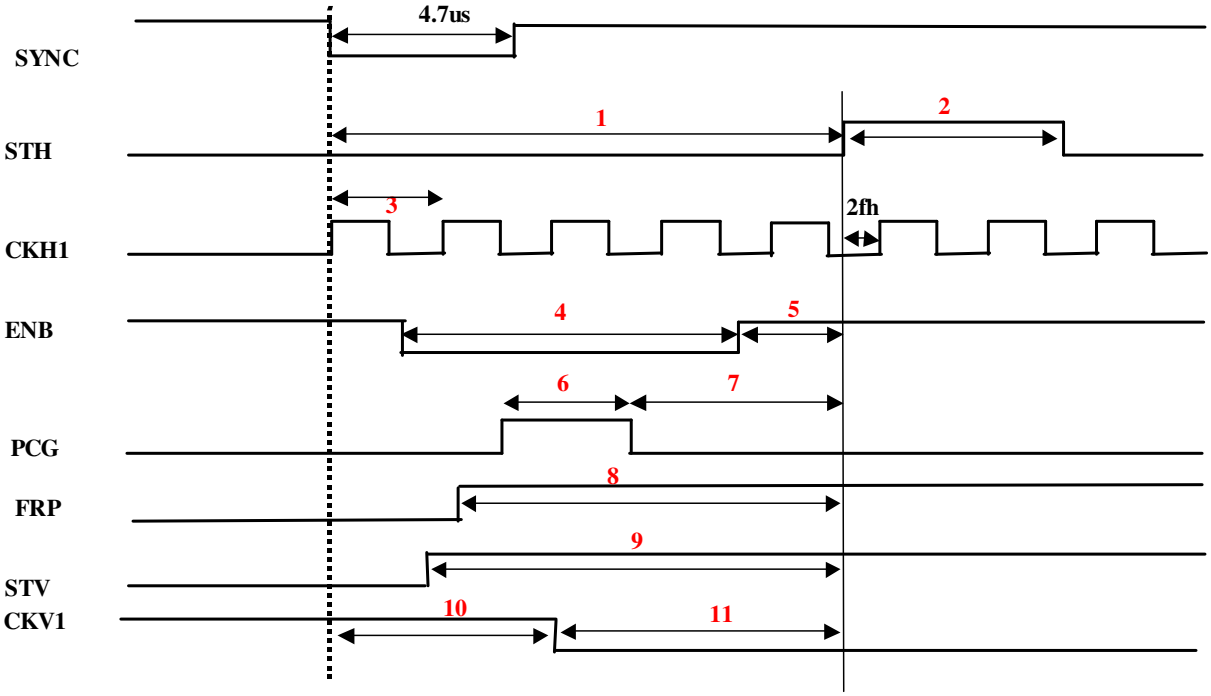


6.2 Timing chart with Analog Interface

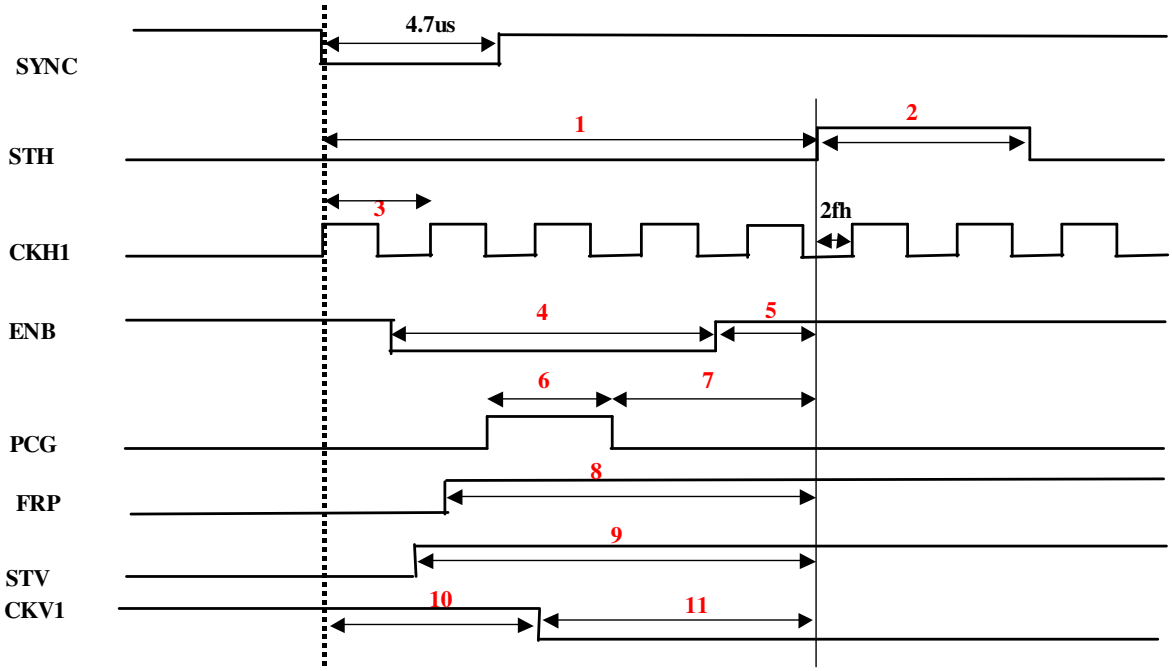
6.2.1 Horizontal

	NTSC Cycle(fh)	PAL Cycle(fh)	1(fh)	2(fh)	3(fh)	4(fh)	5(fh)	6(fh)	7(fh)	8(fh)	9(fh)	10(fh)	11(fh)
Odd Line	622 (t=102.2ns)	636 (t=100.6ns)	82.5	12	6	69	9.5	25	19.5	31.5	76.5	50	32.5
Even Line	622 (t=102.2nS)	636 (t=100.6nS)	81	12	6	69	8	25	18	30	75	50	32.5

(1) Odd Line

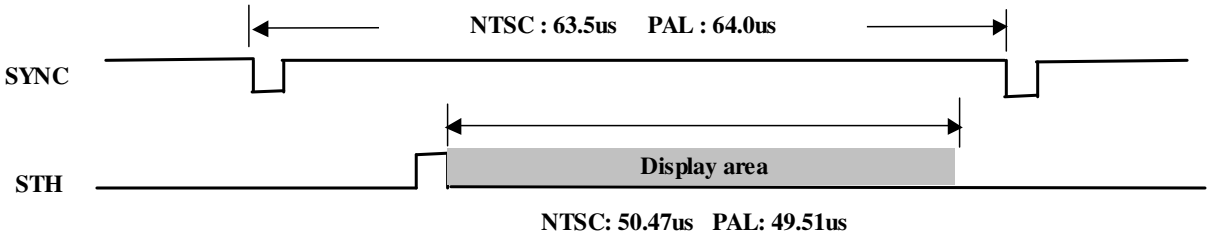


(2) Even Line



6.2.2 Vertical

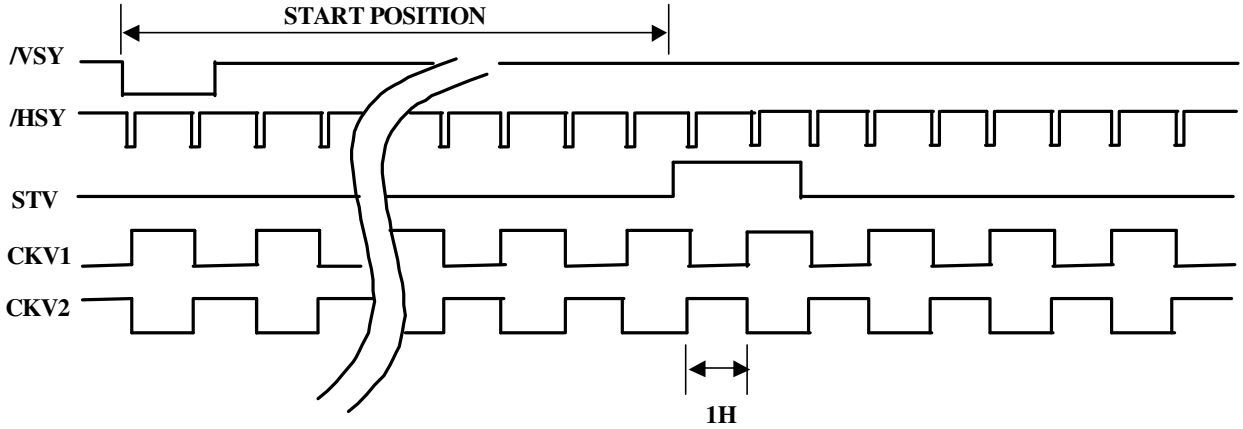
(1) Display Area



NTSC: 50.47us PAL: 49.51us

(2) Start Position

	Odd Field	Even Field
NTSC	16	15
PAL	23	22



7 OPTICAL CHARACTERISTICS

7.1 Optical Specification

Ta=25℃

Item		Symbol	Condition	MIN	TYP	MAX	Unit	Remarks
Viewing Angles		Θ11	CR ≥ 10	30	40	--	Degree	Note 7-1
		Θ12		30	40	--		
		Θ21		11	16	--		
		Θ22		45	55	--		
Contrast Ratio		CR	Θ=0°	120	200	--		Note 7-2
Response Time	Rising	Tr		--	15	25	ms	Note 7-3
	Falling	Tf		--	25	45		
Luminance (I_F=20mA)		L	Θ=0°	190	240	--	cd//m^2	Note 7-4
Chromaticity	White	x_W	Θ=0°	0.26	0.31	0.36		Note 7-5
		y_W	Θ=0°	0.29	0.34	0.39		

7.2 Basic Measure Conditions

(1) Driving voltage

Driving voltage with Digital Interface

HVDD= 8.5V, VVDD=8.5V

VVC=2.6V, VCOM = Optimum common electrode voltage

Driving voltage with Analog Interface

HVDD= 12.0V, VVDD=12.0V

VVC=5.2V, VCOM = Optimum common electrode voltage

(2) Ambient Temperature: Ta=25℃

(3) Testing Point: Measure in the display center point and the test angle Θ=0°

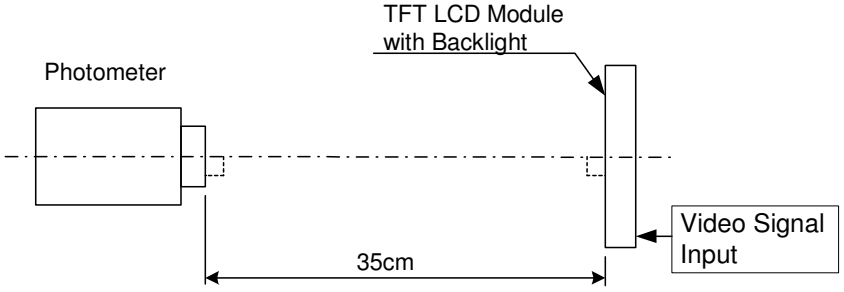
(4) R, G, B signal input voltage VG, VR, VB

VG, VR, VB=VVC ± VAC (VAC: Signal Amplitude)

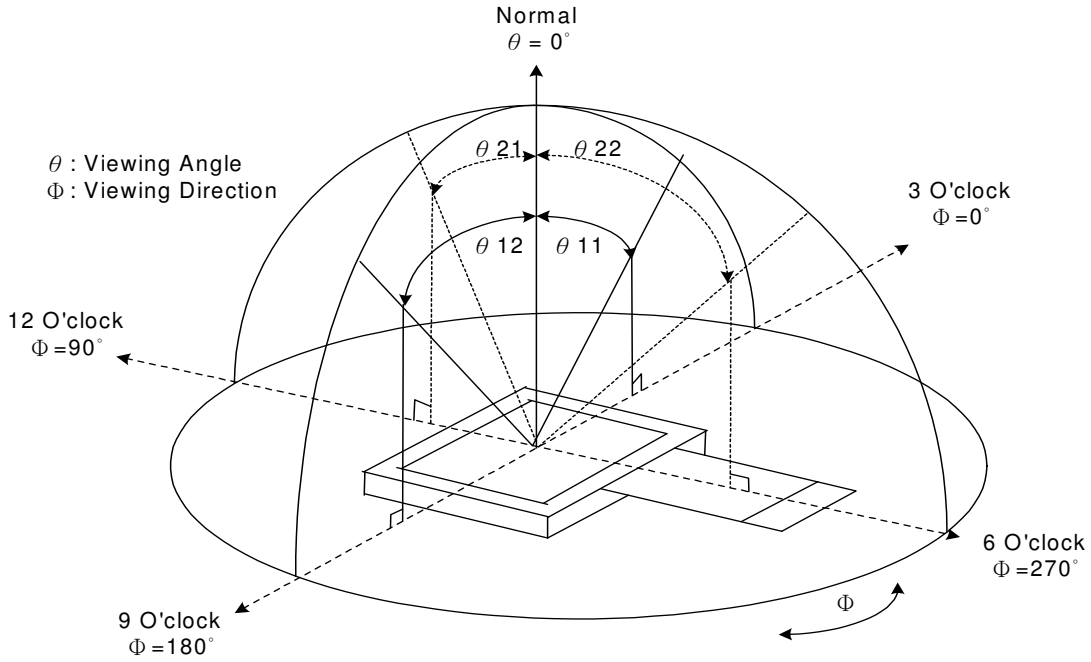
(5) LED Current: I_F=20mA.

(6) Testing Facility

Environmental illumination: ≤ 1 Lux



Note 7-1: Viewing angle diagrams:

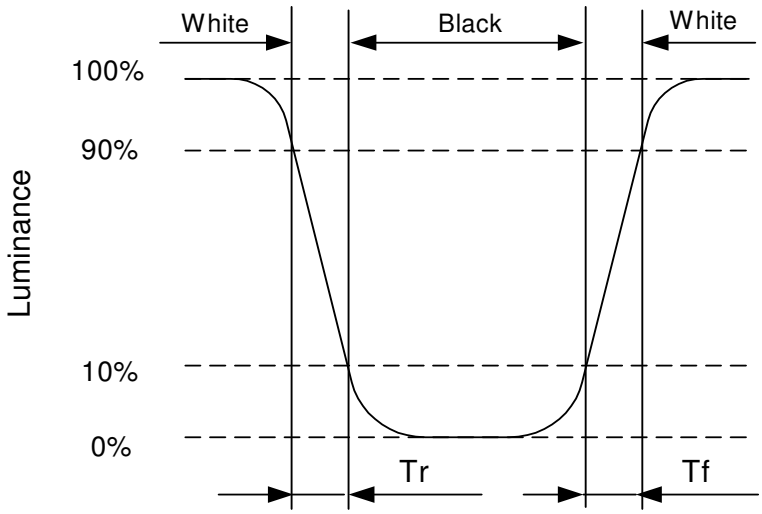


Note 7-2: Contrast Ratio:

Contrast ratio is measured in optimum common electrode voltage.

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

Note 7-3: Definition of response time:



Note 7-4: Luminance:

Test Point: Display Center

Note 7-5: Chromaticity: The same test condition as Note 7-4.

8 REILIABILITY

No	Test Item	Condition
1	High Temperature Operation	Ta=+60℃, 240hrs
2	High Temperature & High Humidity Operation	Ta=+40℃, 95% RH, 240hrs
3	Low Temperature Operation	Ta=-10℃, 240hrs
4	High Temperature Storage (non-operation)	Ta=+80℃, 240hrs
5	Low Temperature Storage (non-operation)	Ta=-30℃, 240hrs
6	Thermal Shock (non-operation)	-30℃←→80℃, 50 cycles 30 min 30 min
7	Resistance to Static Electricity Discharge (non-operation)	C=200pF, R=0Ω; Discharge: ±150V 3 times / Terminal
8	Surface Discharge (non-operation)	C=150pF, R=330Ω; Discharge: Air: ±15kV; Contact: ±8kV 5 times / Point; 5 Points / Panel
9	Vibration (non-operation)	Frequency: 10~55Hz; Amplitude: 1.5mm Sweep Time: 11min Test Time: 2 hrs for each direction of X, Y, Z
10	Shock (non-operation)	Acceleration: 100G; Period: 6ms Directions: ±X, ±Y, ±Z; Cycles: Twice

Ta: Ambient Temperature

9 HANDLING CAUTIONS

9.1 ESD (Electrical Static Discharge) Strategy

ESD will cause serious damage of the panel, ESD strategy is very important in handling. Following items are the recommended ESD strategy

(1) In handling LCD panel, please wear non-charged material gloves. Connect the wrist conduction ring to the earth and the conducting shoes to the earth are necessary.

(2) The machine and working table for the panel should have ESD protection strategy.

(3) In handling the panel, using ionized air to decrease the charge in the environment is necessary.

(4) In the process of assembly the module, shield case should connect to the ground.

9.2 Environment

(1) Working environment of the panel should be in the clean room.

(2) The front polarizer is easy damaged. Handle it carefully and do not scratch it by sharp material.

(3) Panel has polarizer protective film in the surface. Please remove the protection film of polarizer slowly with ionized air to prevent the electrostatic discharge.

9.3 Others

(1) Turn off the power supply before connecting and disconnecting signal input cable.

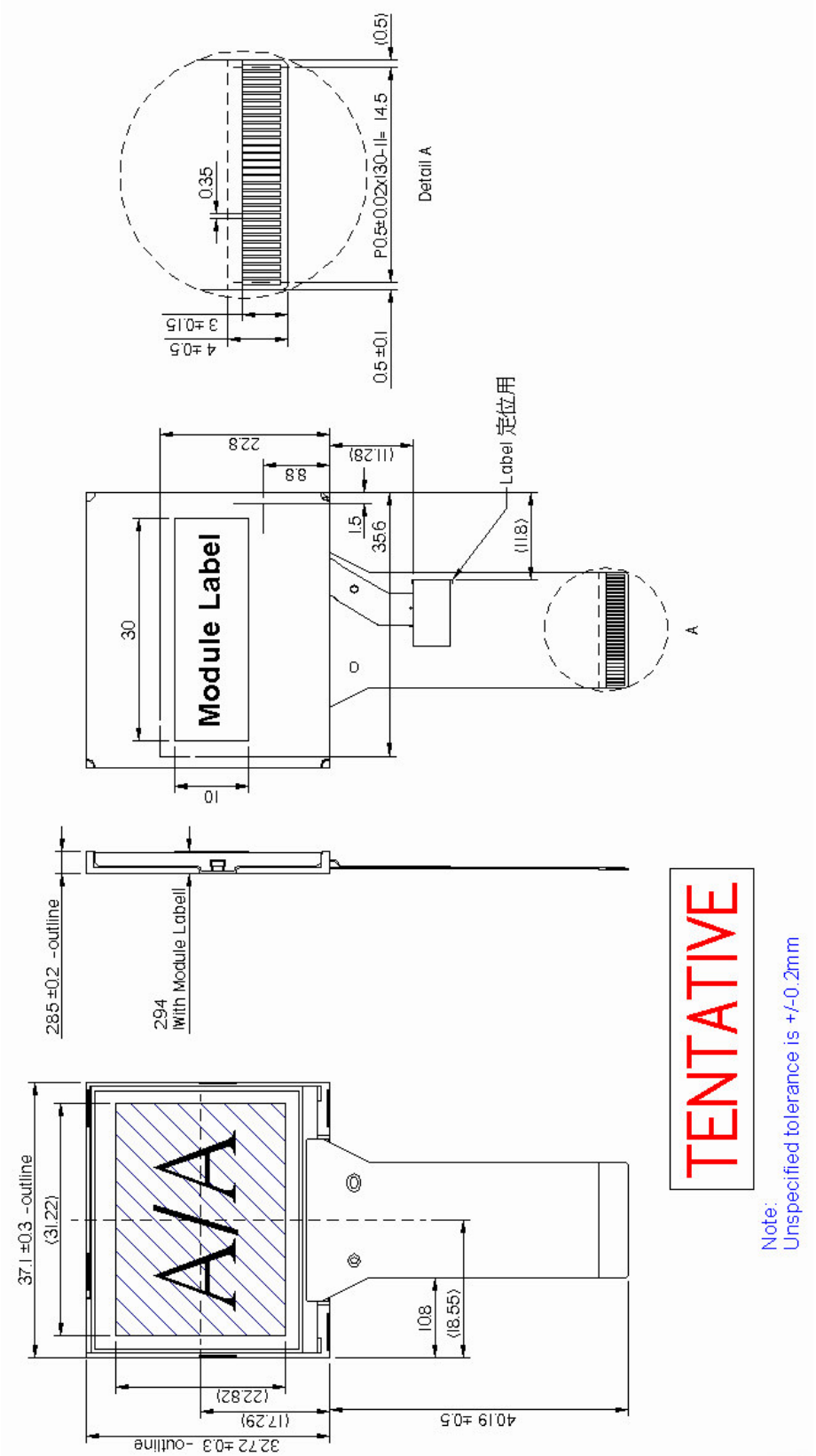
(2) The connection area of FPC and panel is very weak, do not handle panel only by FPC or bend FPC.

(3) Water drop on the surface or condensation as panel power on will corrode panel electrode.

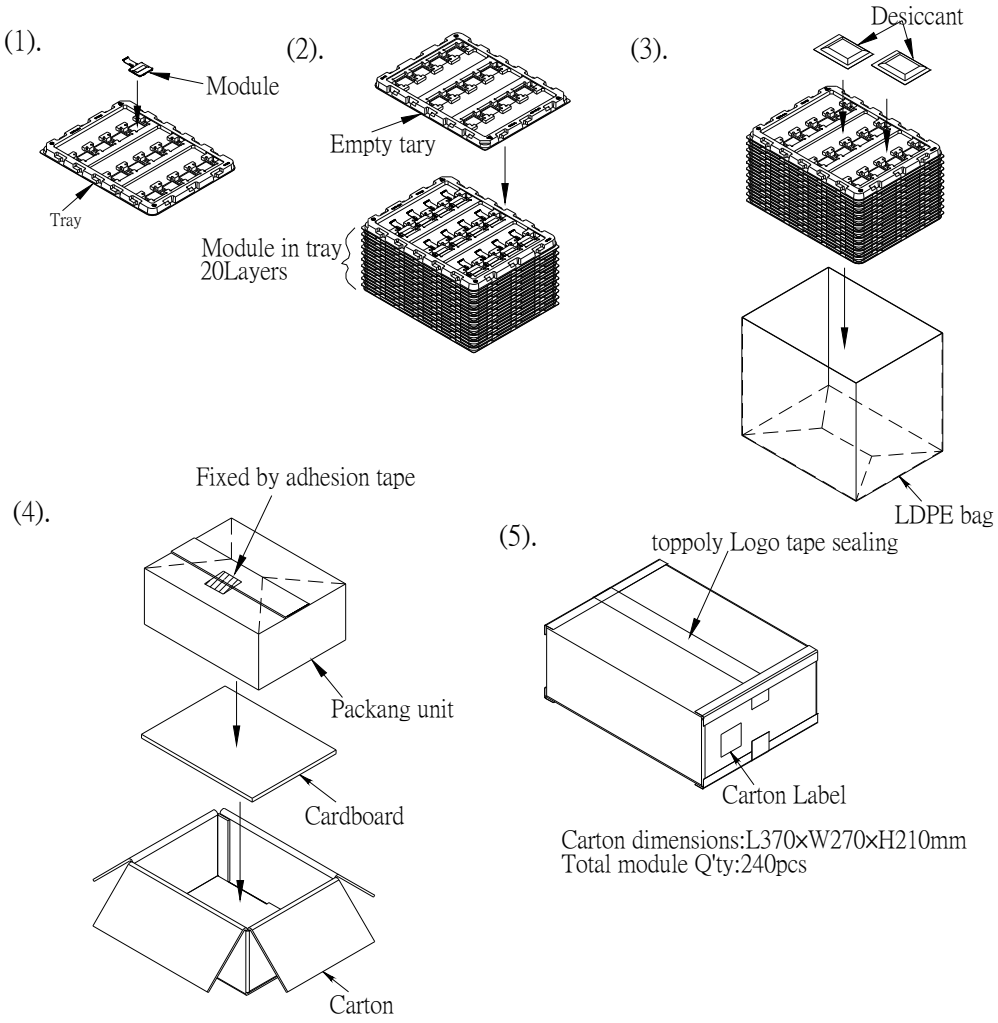
(4) As the packing bag open, watch out the environment of the panel storage. High temperature and high humidity environment is prohibited.

(5) When the TFT LCD module is broken, please watch out whether liquid crystal leaks out or not. If your hand touches liquid crystal, wash your hand cleanly by water and soap as soon as possible.

10 MECHANICAL DRAWING



11 PACKING DRAWING



1.5" （TC015THEBB）Module delivery packing method

(1) . Module packed into tray cavity (with Module display face down)

(2) . Tray stacking with 20 layers and with 1 empty tray above the stacking tray unit

(3) . 2pcs desiccant put above the empty tray. Stacking tray unit put into the LDPE bag and fixed by adhesive tape.

(4) . Put 1pc cardboard inside the carton bottom, then pack the package unit into the carton

(5) . Carton tapping with adhesive tape