Ver.: 1.1

TFT LCD Specification

Model Name: TD024TTEA3

Customer Signature
Data

This technical specification is subjected to change without notice

Table of Contents

Record of Revision

Rev	Issued Date	Description
1.0	August. 24, 2006	New Create
1.1	September 4, 2006	To add Driving of Touch Panel

1. FEATURES

The 2.4”(6.1 cm) LCD module is an transmissive active matrix color TFT LCD module. LTPS (Low Temperature Poly Silicon) TFT technology is used. Vertical and horizontal drivers are built on the panel.

2. GENERAL SPECIFICATIONS

Item	Description	Unit
Display Size (Diagonal)	2.4 (6.1)	Inch(cm)
Display Type	Transmissive	
Active Area (HxV)	36.72 x 48.96	mm
Number of Dots (HxV)	240 x RGB x 320	dot
Dot Pitch (HxV)	0.051 x 0.153	mm
Color Arrangement	RGB Stripe	
Color Numbers	262144 (bit: R=6, G=6, B=6)	
Outline Dimension (HxVxT)	43.97 X 59.89 X 4.27	mm
Weight	20(Approx.)	g

* Exclude COF and protrusions.

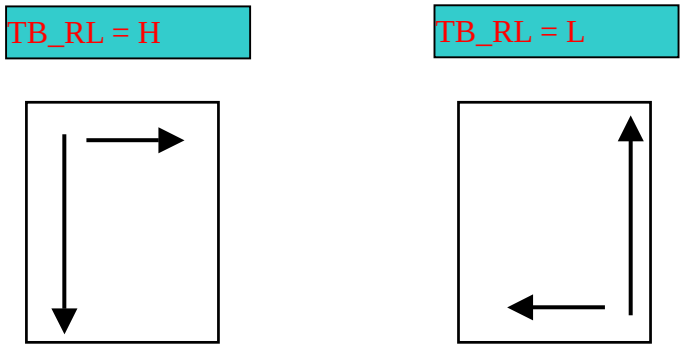
3. Input / Output Terminals

Pin	Symbol	I/O	Description	Remark
1	LED-	-	LED Power Supply (-)	
2	NC	I	Dummy	
3	LED+	-	LED Power Supply (+)	
4	VDD2	-	Power supply for DC/DC (+2.8V)	Min:2.5V Max:3.0V
5	GND	-	Ground	
6	DE	-	Data enable	
7	VSYNC	I	Vertical Synchronization	
8	HSYNC	I	Horizontal Synchronization	
9	GND	I	Ground	
10	PCLK	I	Clock signal	
11	GND	I	Ground	
12	SHDN(SD)	I	Auto power on/off sequence enable input	
13	TB_RL	I	Source&Data shift direction select	Note 1
14	CM	I	Display mode selection input. CM=L: Full display mode (65k/262k color), CM=H: Partial display mode (8 color)	
15	VDD1	I	Power supply for Logic (+2.8V)	Min:1.6V Max:3.0V
16	R5	I	Video Data Red 5(MSB)	
17	R4	I	Video Data Red 4	
18	R3	I	Video Data Red 3	
19	R2	I	Video Data Red 2	
20	R1	I	Video Data Red 1	
21	R0	I	Video Data Red 0 (LSB)	
22	G5	I	Video data green 5 (MSB)	
23	G4	I	Video data green 4	
24	G3	I	Video data green 3	
25	G2	I	Video data green 2	
26	G1	I	Video data green 1	
27	G0	I	Video data green 0(LSB)	
28	B0	I	Video data blue 0 (LSB)	
29	B1	P	Video data blue 1	
30	B2	I	Video data blue 2	
31	B3	P	Video data blue 3	
32	B4	I	Video data blue 4	

33	B5	-	Video data blue 5(MSB)	
34	GND	-	Ground	
35	TPX1	I	Touch Panel Right Side Pin	
36	TPX2	I	Touch Panel Left Side Pin	
37	TPY1	P	Touch Panel Upper Side Pin	
38	TPY2	P	Touch Panel Lower Side Pin	
39	GND	-	Ground	

**FFC/FPC wire connector: FF12-xxA-R1xB (DDK: 39Pin Pitch=0.3mm)

Note1:



4. ABSOLUTE MAXIMUM RATINGS

Item	Symbol	MIN	MAX	Unit	Remark
Supply Voltage	VDD1	-0.3	+3.6	V	
	VDD2	-0.3	+3.6	V	
Operating Temperature	Topr	-20	+60	℃	
Storage Temperature	Tstg	-30	+70	℃	

5. ELECTRICAL CHARACTERISTICS

Allowable Operation condition (Ta=-20 ~ +60℃ , VSS=0)

Parameter		Symbol	Conditions	Ratings			Unit
				MIN	TYP	MAX	
Supply Voltage (Logic)		VDD1		1.6	2.8	3.0	V
Supply Voltage (DC/DC)		VDD2		2.5	2.8	3.0	V
Logic high-level input		Vih		0.7VDD1	—	VDD1	V
Logic low-level input		Vil		0	—	0.3VDD1	V
Input Signal Voltage	DE signal	DE		1.6	2.8	3.0	V
	H_{SYNC} V_{SYNC} signals	HS VS		1.6	2.8	3.0	V
	Data Signals	R,G, B		1.6	2.8	3.0	V
	Clock signal	CLK		1.6	2.8	3.0	V
	Misc. signals	Serial I/F		1.6	2.8	3.0	V
Power consumption	Normal mode (Full screen@60Hz, 262k Color Mode)	Pwr	Tizu Map	—	15.4	18.8	mW
	Power Save Mode (64lines@30Hz, 8 Color Mode)			—	3.92	5.88	mW

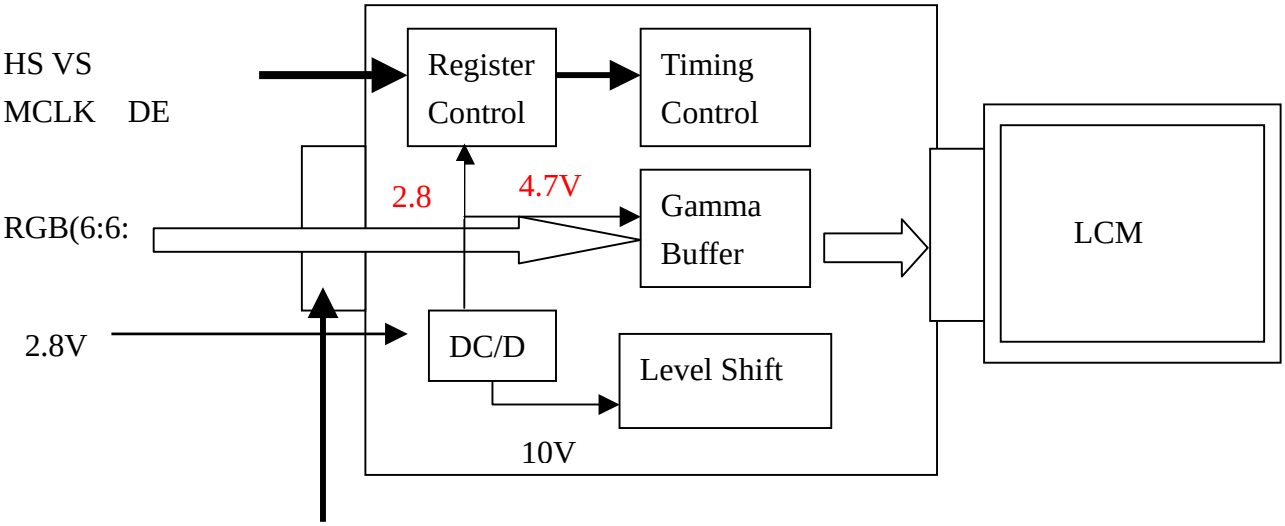
Normal mode

Power save mode

DC Characteristics (Ta=-40 ~ +85℃ , VDD2=2.5V~3.0V, VDD1=1.6~3.0V,, VSS=0)

Parameter	Symbol	Conditions	Ratings			Unit
			MIN	TYP	MAX	
Input pin capacitance	Cin		--	--	10	pF

5.1 Driving TFT LCD panel block diagram



39 pin
0.3 pitch

5.2 Driving Backlight

Ta=25℃

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	I_F	--	15	TBD	mA	
Forward Current Voltage	V_F	--	14.4	--	V	Note 5-2
Backlight Power Consumption	W_{BL}	--	216	--	mW	

Note 5-2: LEDx4

5.3 Driving Touch Panel (Analog Resistance Type)

Ta=25℃

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Resistor between terminals (XR-XL)	Rx	200	-	1300	Ω	
Resistor between terminals (YU-YL)	Ry	200	-	1300	Ω	
Operation Voltage	VTouch	-	5	-	V	DC
Line Linearity (X direction)	-	-1.5	-	+1.5	%	Note

Line Linearity (Y direction)	-	-1.5	-	+1.5	%	
Chattering	-	-	10	-	ms	
Surface Hardness	-	3	-	-	H	JIS K 5600
Minimum tension for detecting	-	-	-	80	g	
Insulation Resistance	Ri	20	-	-	MΩ	At DC 25V

Note: The minimum test force is 80 g.

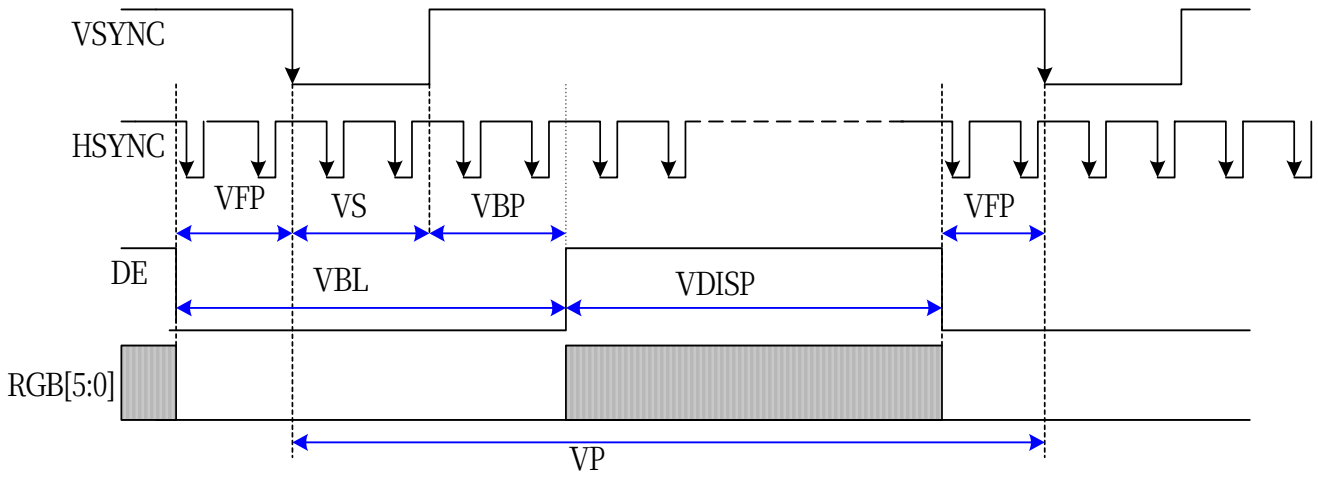
6. TIMING CHART

Display timing

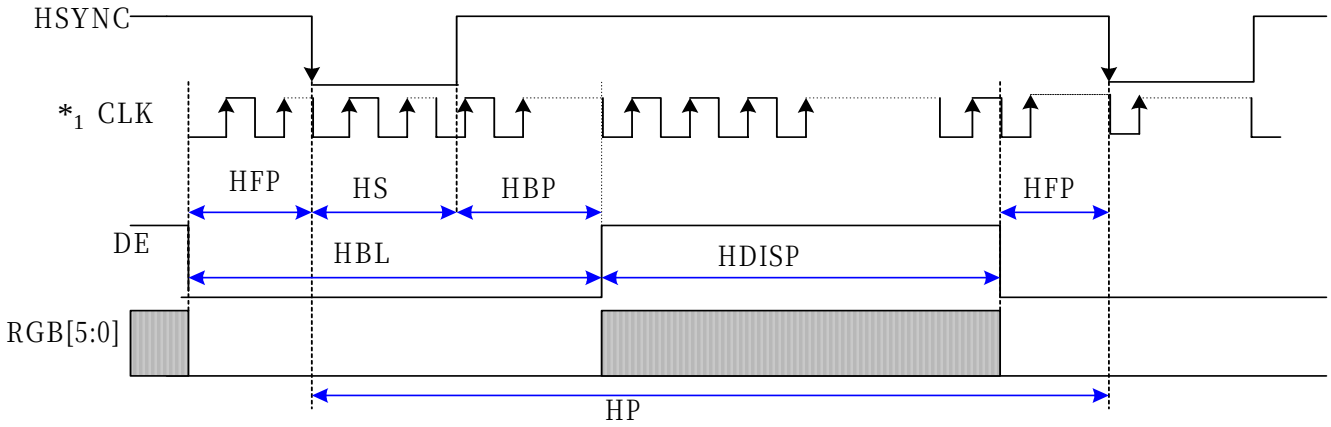
Display Mode	Parameter	Symbol	Conditions	Ratings			Unit
				MIN	TYP	MAX	
Normal	Vertical cycle	VP		323	326	340	Line
	Vertical data start	VDS	VS+VBP	4	6	—	Line
	Vertical front porch	VFP		1	2	—	Line
	Vertical blanking period	VBL	VS+VBP+VFP	5	8	—	Line
	Vertical active area	VDISP		—	320	—	Line
	Horizontal cycle	HP		260	280	300	dot
	Horizontal front porch	HFP		10	10	—	dot
	Horizontal Sync Pulse width	HS		2	10	—	dot
	Horizontal Back porch	HBP		10	30	63	dot
	Horizontal Data start	HDS	HS+HBP	12	40	—	dot
	Horizontal active area	HDISP		—	240	—	dot
	Clock frequency	fclk		5.02	5.48	5.93	MHz
		tclk		199	183	169	ns

Input timing chart

＜Vertical Timing chart＞

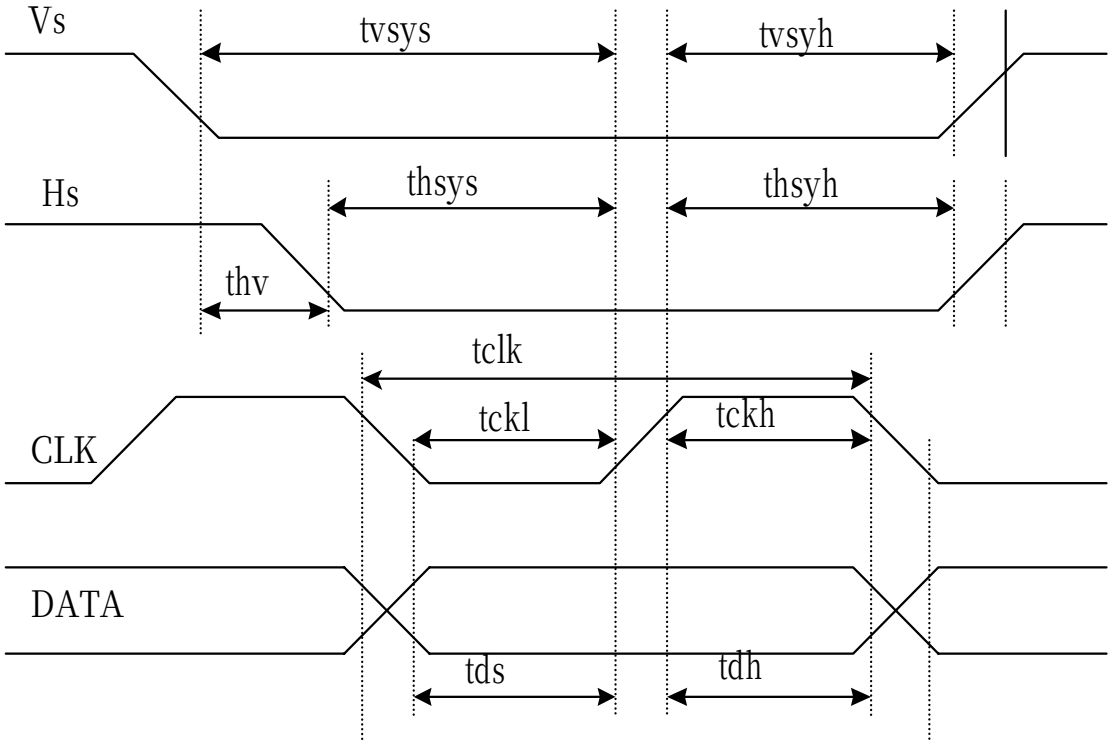


＜Horizontal Timing chart＞



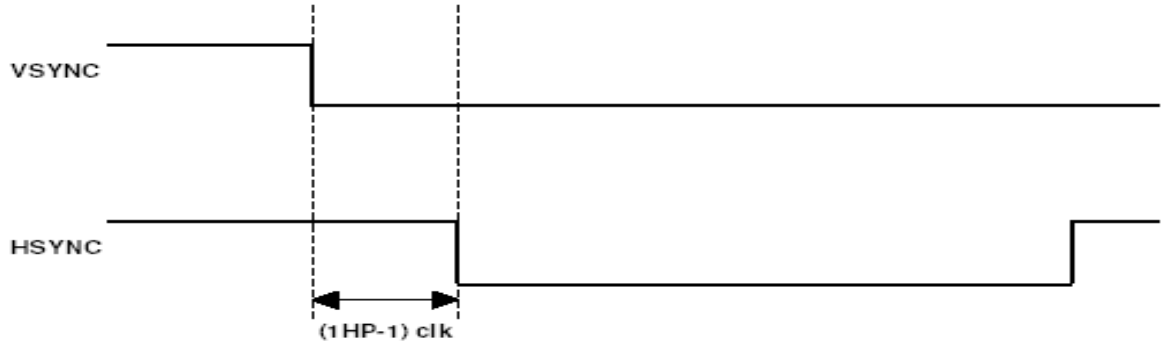
*1 The frequency of CLK should be continued whether in display or blank region to ensure IC operating normally.

Setup/ Hold Timing chart

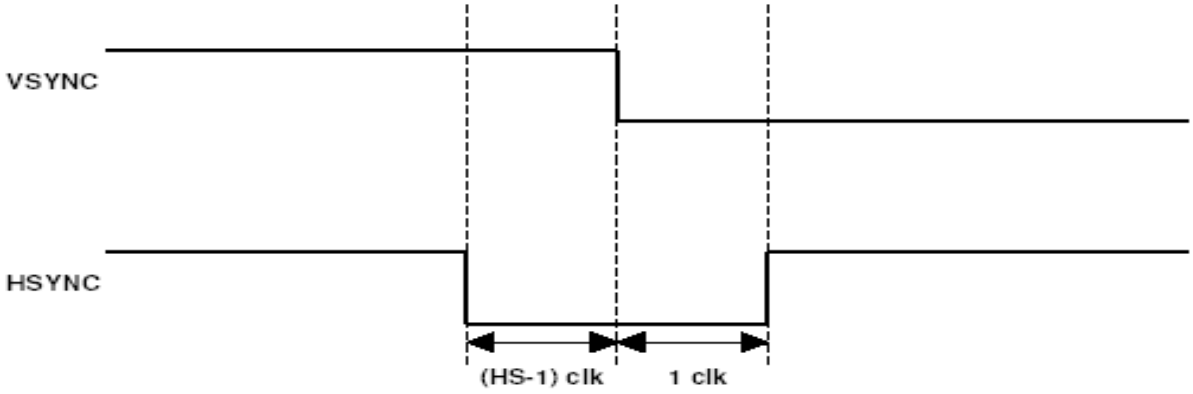


Phase difference of Sync.

Maximum Timing chart：



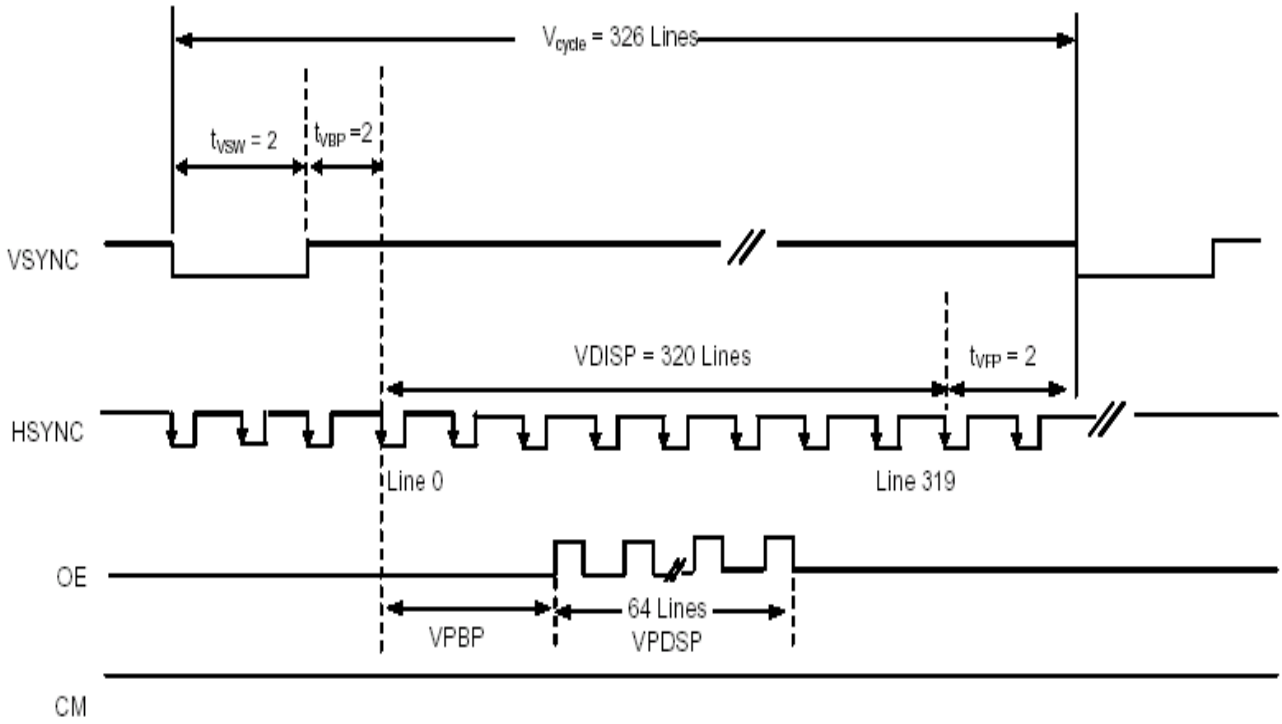
Minimum Timing chart:



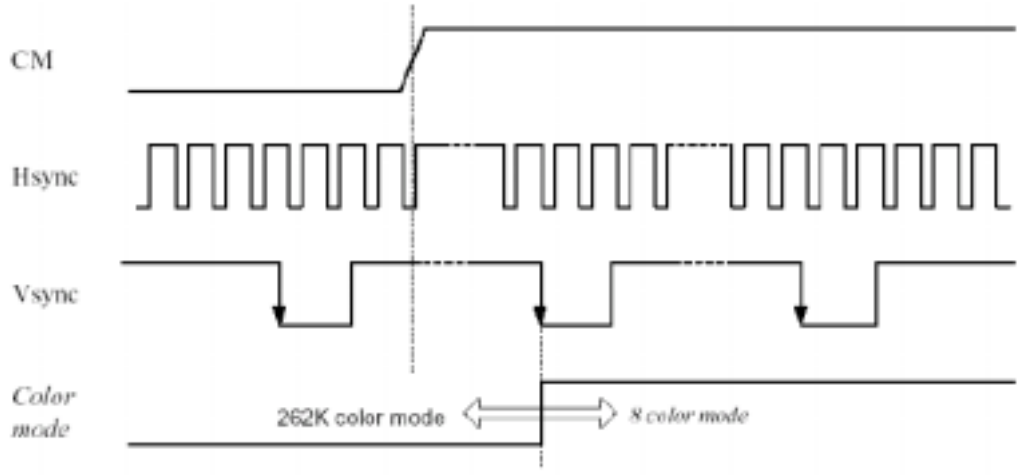
AC Characteristics:

Parameter	Symbol	Conditions	Ratings			Unit
			MIN	TYP	MAX	
Vertical Sync. Setup time	tvsys		20	—	—	ns
Vertical Sync. Hold time	tvsyh		20	—	—	ns
Horizontal Sync. Setup time	thsys		20	—	—	ns
Horizontal Sync. Hold time	thsyh		20	—	—	ns
Phase difference of Sync. Signal Falling edge	thv		-(HS-1)	—	1HP-1	clk
Clock “L” Period	tckl		30	50	70	%
Clock “H” Period	tckh		30	50	70	%
Data setup time	tds		20	—	—	ns
Data Hold time	tdh		20	—	—	ns
Digital logic input	Trise/Tfall				15	ns

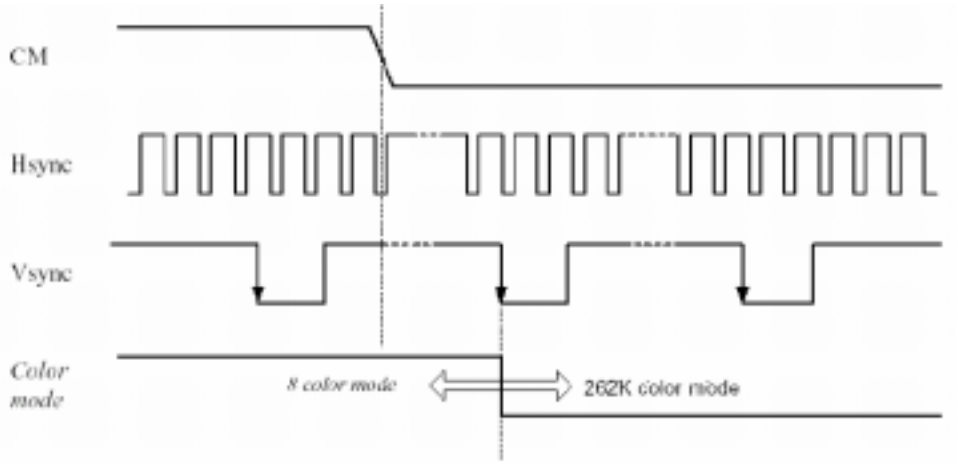
Power Save Mode



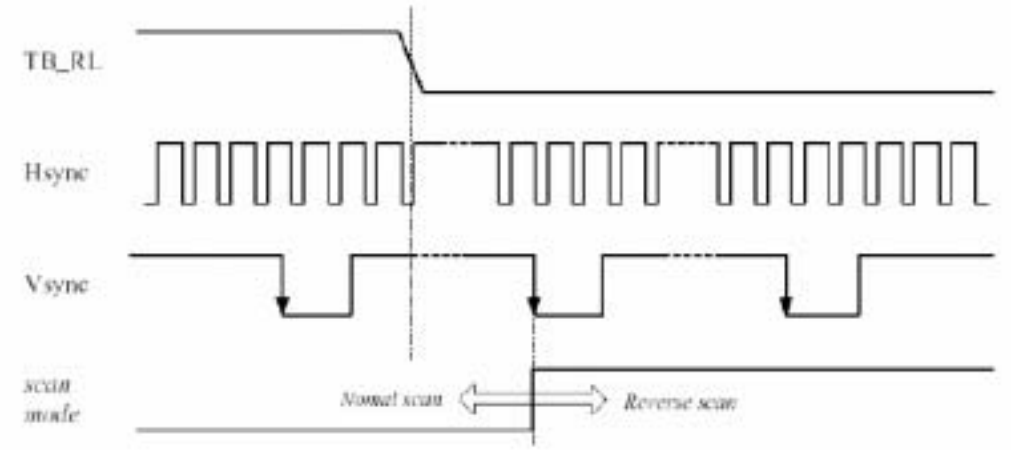
262K colors Mode → 8 colors Mode



8 colors Mode → 262K colors Mode

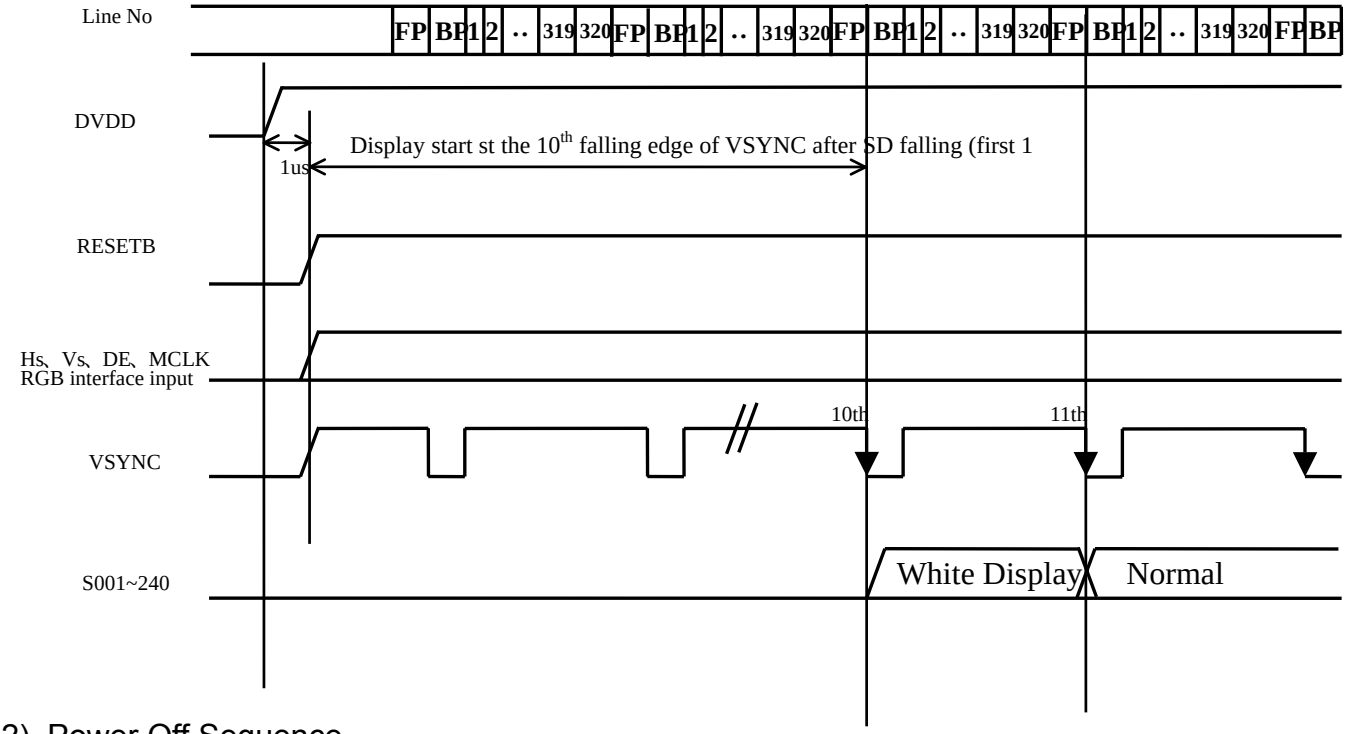


Display Scan Direction

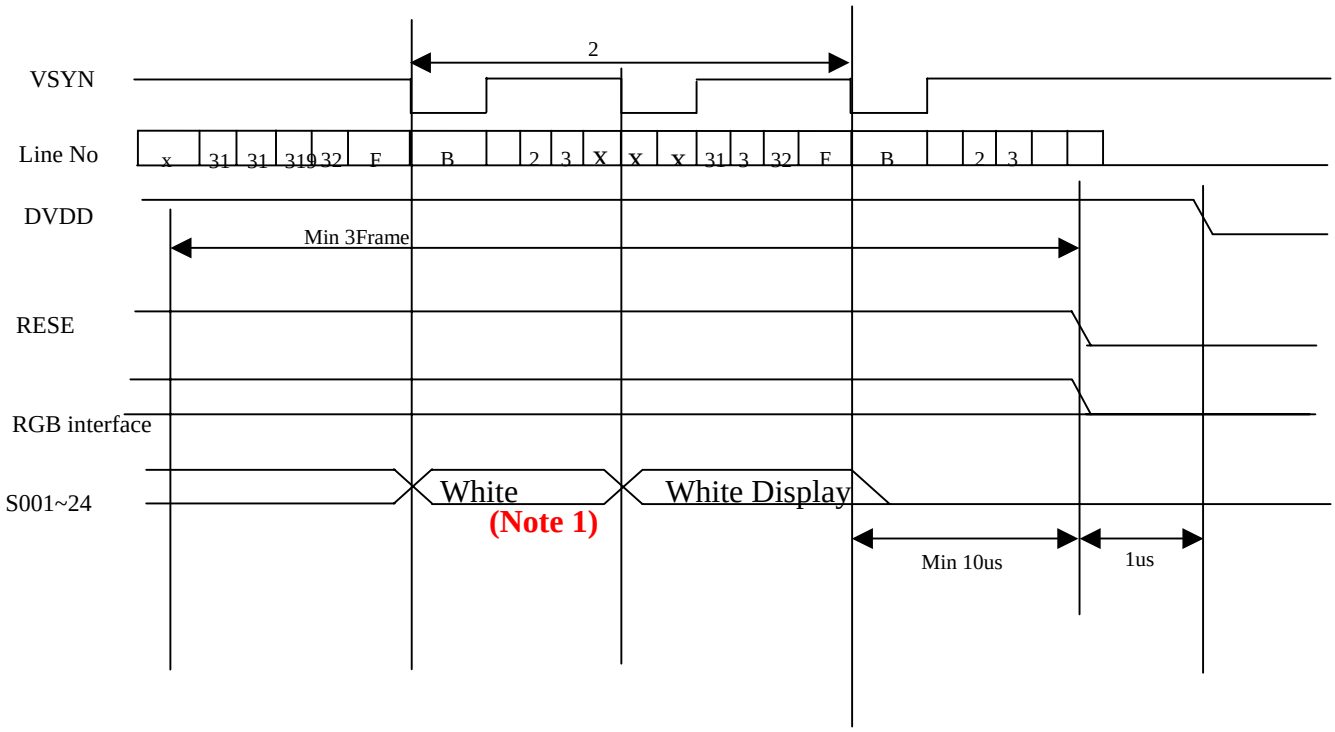


Power On/Off Sequence

1).Power On Sequence



2). Power Off Sequence



(Note 1) To avoid image retention , please input white image for two frame before power off.

7. OPTICAL CHARACTERISTICS

7.1. Optical Specification (T = 25 deg C)

Ta=25℃

Item		Symbol	Condition	MIN	TYP	MAX	Unit	Remarks
Viewing Angles		Θ11	CR ≥ 10	50	55	--	Degree	Note 7-1
		Θ12		50	55	--		
		Θ21		50	55	--		
		Θ22		40	45	--		
Contrast Ratio		CR	Θ=0°	250	300	--	--	Note 7-2
Luminance (I_F=15 mA)		L		250	300	--	cd/m^2	Note 7-3
Uniformity		--		70	80	--	%	Note 7-5
Color Chromaticity	White	x		0.274	0.324	0.374	--	Note 7-4
		y		0.294	0.344	0.394		
	Red	x		0.538	0.588	0.638	--	Note 7-4
		y		0.305	0.355	0.405		
	Green	x		0.264	0.314	0.364	--	Note 7-4
		y		0.542	0.592	0.652		
	Blue	x		0.088	0.138	0.188	--	Note 7-4
		y		0.031	0.081	0.131		
	NTSC	(x,y)		50	55	--	--	Note 7-4

Note: Above data was generated by using Tpo design of Polarizer, FPC, and Backlight. Values might be varied if using different materials for Module assembly.

7.2 Basic measure condition

(1) Driving voltage

VDD= 12.0V, VEE=-6.5V

(2) Ambient temperature: Ta=25℃

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

(4) Testing Facility

Environmental illumination: ≤ 1 Lux

a. System A

Set up:

i. Device: Autronic-Melchers DMS-series

ii. Detector: Spectrometer (or photometer)

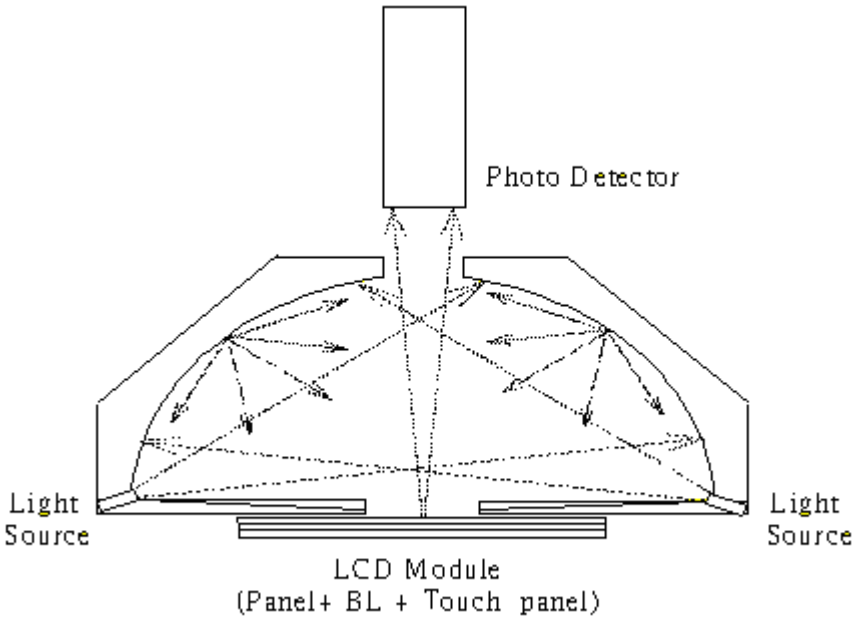
III. Light source: DMS hemisphere without secular reflection (temperature stage), standard distance 3mm

IV. Labsphere standard diffuse reflective white sample (SRS-99-020)

V. Detector angle: perpendicular (Φ= viewing direction, θ=0°); the hemisphere slit position is at Φ=90

VI. Detector position: screen center (x=0, y=0)

VII. Spectrometer evaluation light source: D65

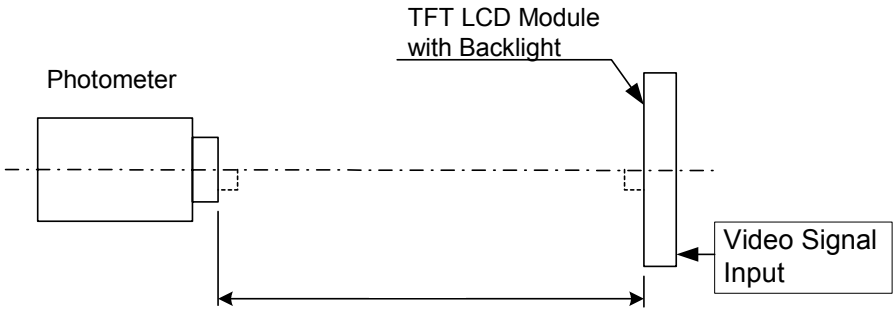


b. System B

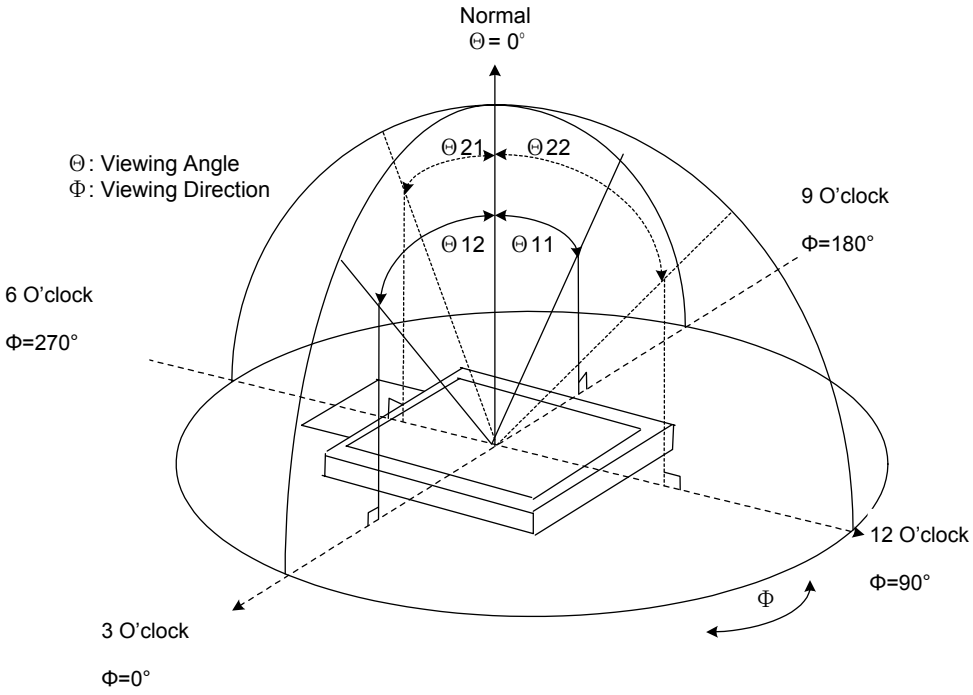
Set up:

i. Device: Autronic-Melchers DMS-series

ii. Detector: Spectrometer (or photometer)



Note 7-1: Viewing angle diagrams:

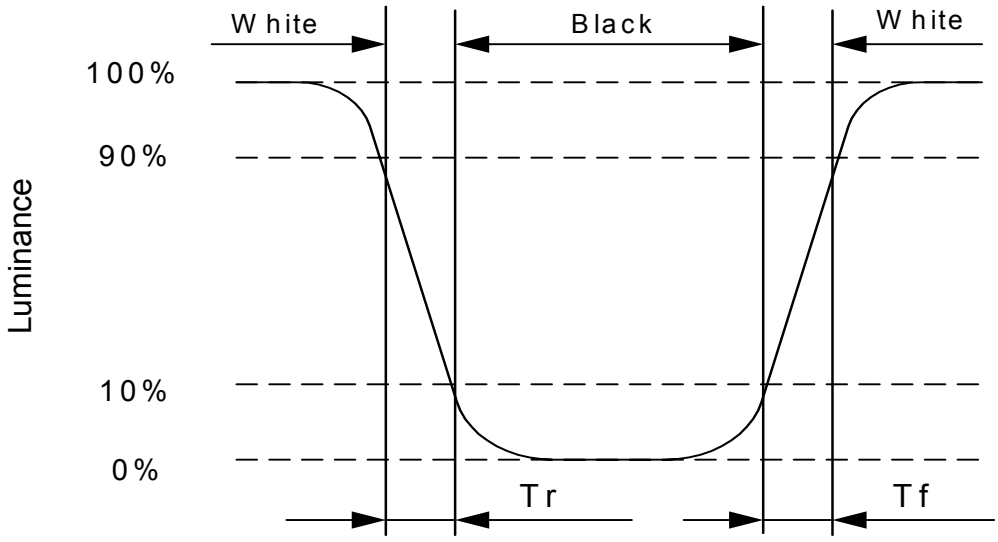


Note 7-2: Contrast ratio in back light on (Measure System C)

Contrast ratio is measured in optimum common electrode voltage.

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

Note 7-3:Definition of response time: (Measure System C)

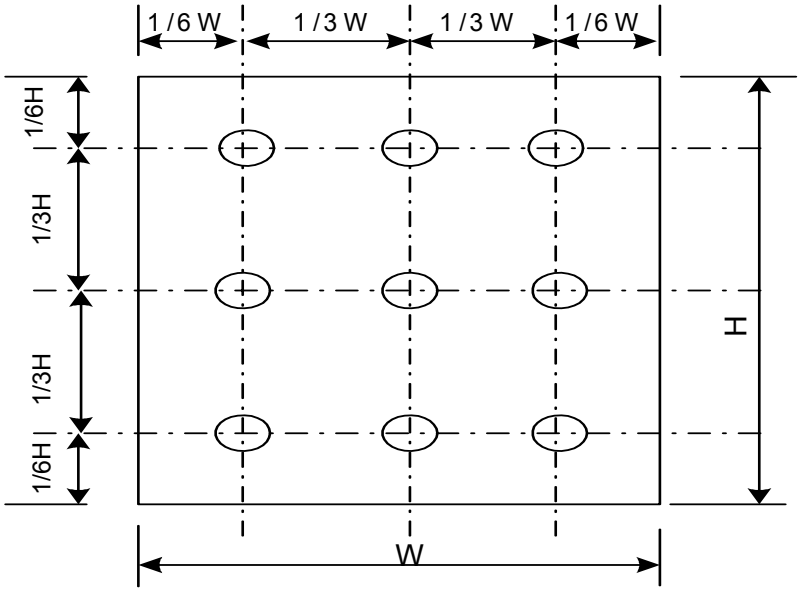


Note 7-4: Chromaticity: The same test condition as Note 7-3.

Note 7-5: Definition of uniformity: Light on backlight 5 minutes before test.

$$\text{Luminous intensity ratio} = \frac{\text{Minimum Luminance of 9 test points}}{\text{Maximum Luminance of 9 test points}}$$

The definition of 9 test points:



8. RELIABILITY

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 = -20℃, 240hrs
4	High Temperature Storage (Non-operation)	Ta = +70℃, 240hrs
5	Low Temperature Storage (Non-operation)	Ta = -30℃, 240hrs
6	High Temperature & High Humidity Storage (Non-operation)	Ta = +60℃, 90％RH、240hrs
7	Thermal Shock (Non-operation)	-20℃←→ 70℃, 30 cycles 30min 30min
8	Shock (Non-operation)	Acceleration: 100G; Period: 6ms Directions: ±X, ±Y, ±Z; Cycles: Three times
9	Sine Vibration Test (Non Operation)	Frequency Range: 10~55~10Hz Acceleration: 0.5G Sweep Mode: Log Sweep Sweep Speed: 1Oct/min Test Time: 2 hrs for each direction of X, Y, Z
10	Pin Activation Test (Touch Panel)	Hit 1,000,000 times with a silicon rubber of R0.8, HS 60. Hitting Force: 250g Hitting Speed: 3 time/sec
11	Writing Friction Resistance Test (Touch Panel)	Pen: 0.8R Polyacetal stylus Load: 250g Speed: 3 Strokes/sec Stroke: 35m 100000 times
12	Terminal ESD Test (Non Operation)	MM (Machine Model) C=200pF, R=0Ω Discharge:>+/-200V, 1times/termimal

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. Connector the wrist conduction ring to the earth and the conducting shoes to the earth is 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 Touch Panel

(1) The front touch panel is vulnerable to heavy weight, so any input must be done by special stylus or by finger. Do not put any heavy stuff on it.

(2) When any dust or stain is observed on a film surface, clean it using a glass lens cleaner for something similar.

9.4 Design Notes on Touch Panel

(1) Explanation of each boundary of touch panel

Boundary of Double-sided adhesive: Electrically detectable within this zone. When holding the touch panel by housing, it needs to be held at outside of this zone. Film is supported by double-sided adhesive tape.

(2) Viewing area

Cosmetic inspection to be done for this area. This area is set as inside of boundary of double-sided adhesive with tolerance.

(3) Boundary of transparent insulation

a. Purpose is to ˋHelpˊ to secure insulation.

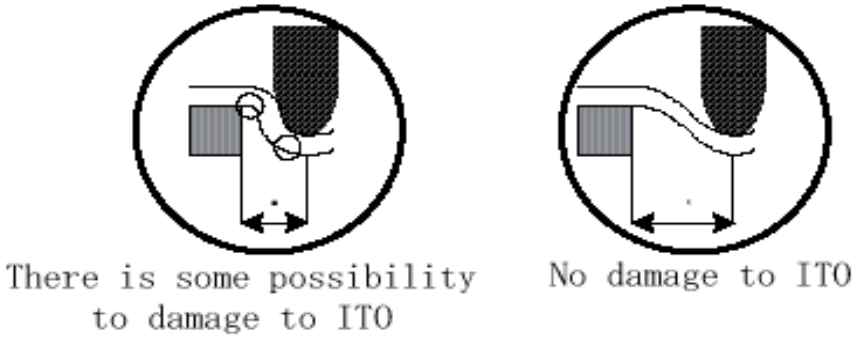
b. Electrical insulation on this area is not guaranteed.

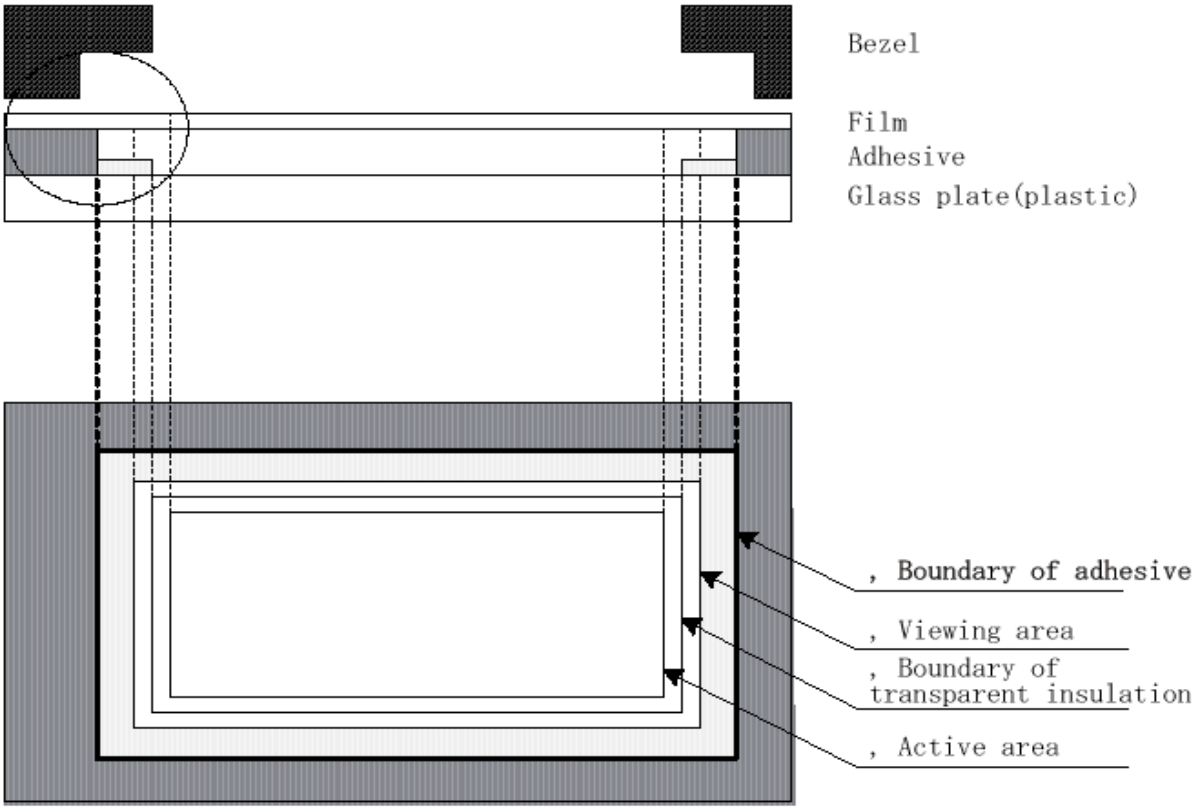
c. We do recommend not to hold this area by something like housing or gasket.

(4) Active area

a. This area is where the performance is guaranteed.

b. This area set as 2.3mm inside from the boundary area of double-sided adhesive tape since its neighboring area is less durable to writing friction.



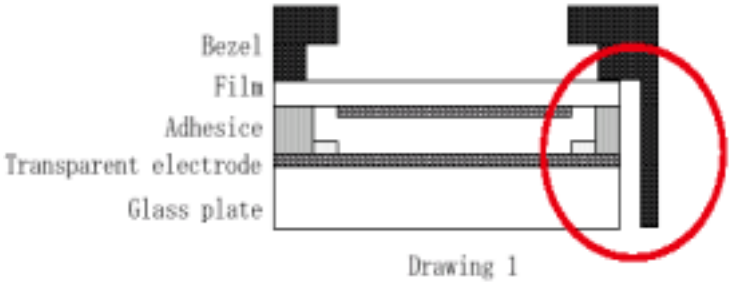


(5) Housing and Touch Panel

a. Please have clearance between the side of touch panel and any conductive material such as metal

b. frame (Drawing.1). Transparent electrode exists on glass of touch panel from end to end.

c. It is recommended to fix a touch panel on the LCD module chassis rather than the touch panel housing. Clinging at conductive material and side of touch panel might cause the malfunction.



Drawing 1

Drawing 2

9.5 Others

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

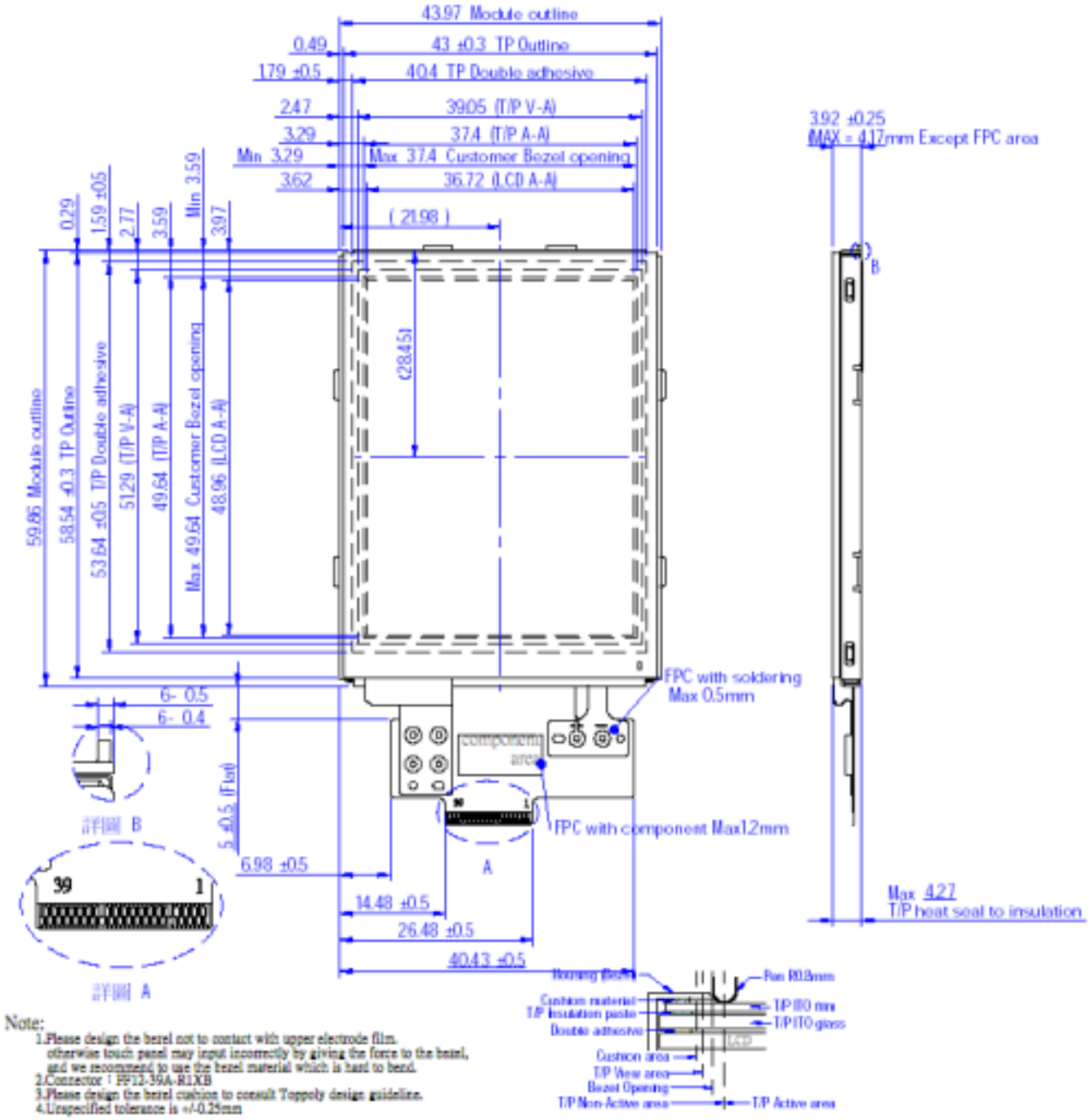
(2) The connection area of FPC and panel is very weak, do not handle panel only by FPC or bend FPC.

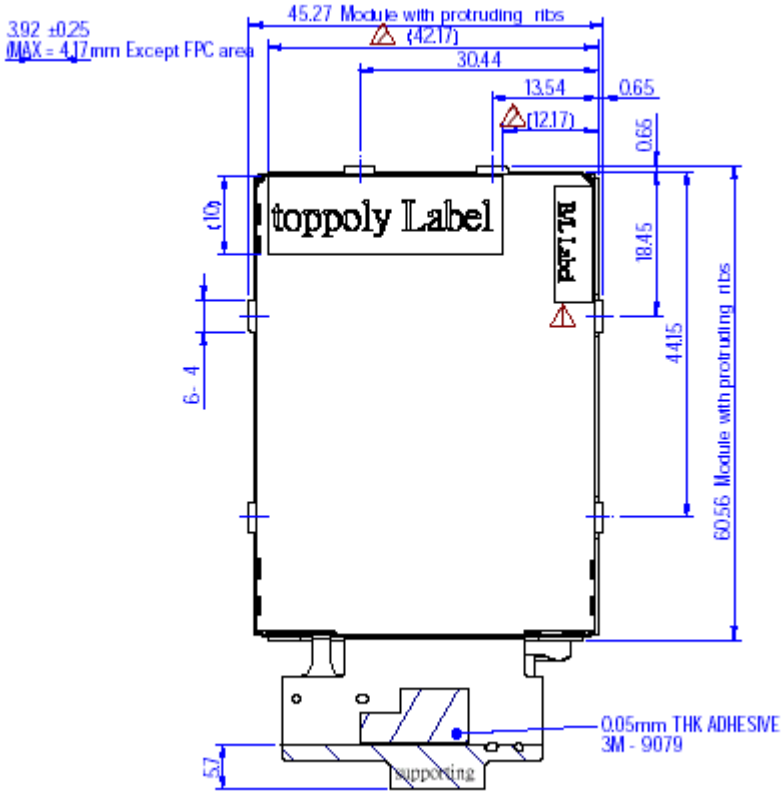
(3) Water drop on the surface or condensation as panel power on will corrode panel electrode.

(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.

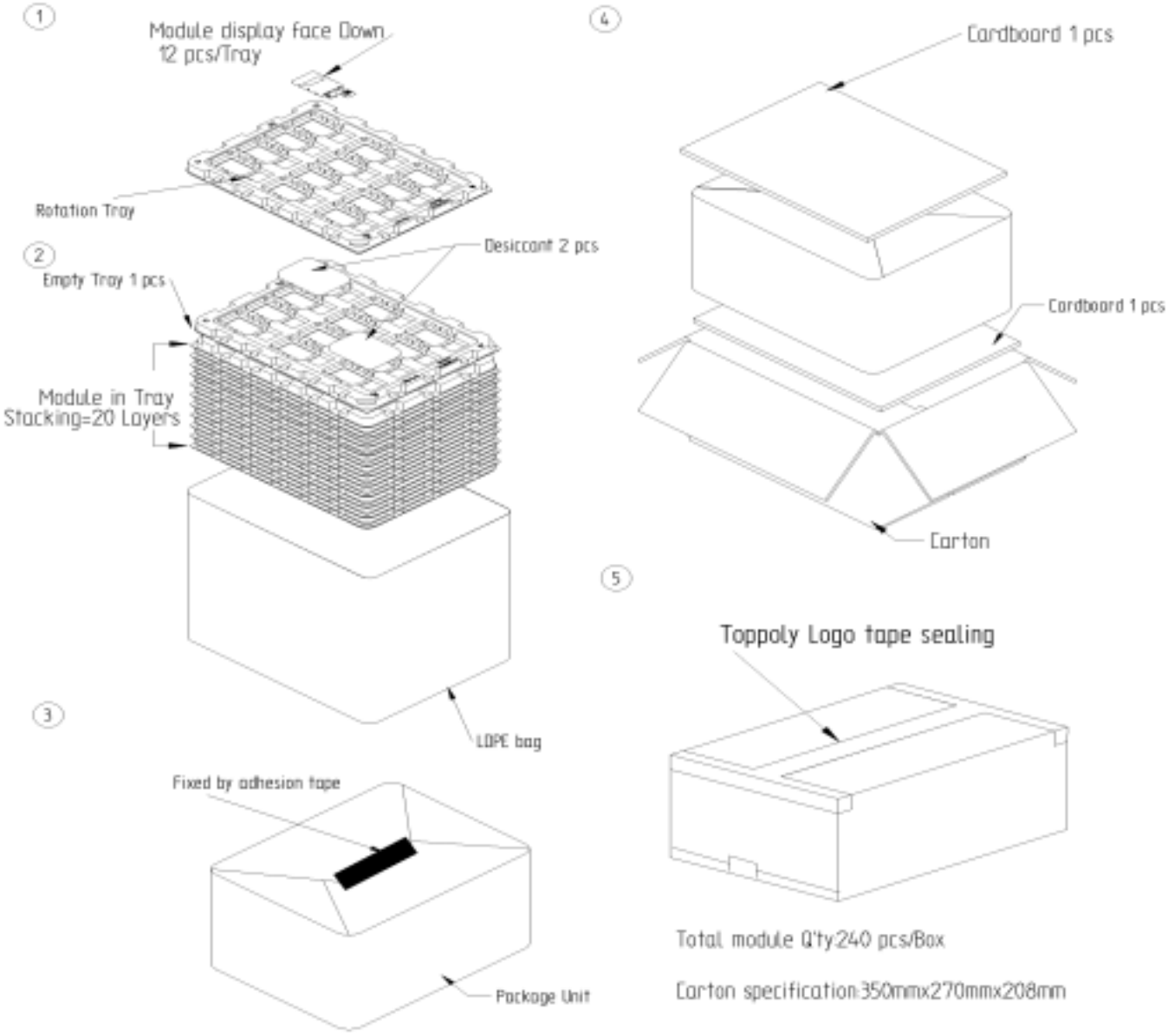
10.MECHANICAL DRAWING





Note: Remove backlight backside insulation tape

11. PACKING DRAWING



TD024TTEA3 Module delivery packing method

(1). Module packed into tray cavity (with Module display face down), and stacking tray of reverse 180 degree in order.

(2). Stacking the production on tray with 20 layers and with 1 empty tray above the stacking tray unit, and put 2 Desiccant on the empty tray.

(3). Stacking tray unit put into the LDPE bag and fix by adhesive tape.

(4). Put 1 pcs cardboard inside the carton bottom, then pack the package unit into the carton, finally put 1 pcs cardboard above the package unit

(5) Sealing the Carton with Toppoly Logo adhesive tape.