LTPS LCD Specification

Model Name: TD028THED1

Customer Signature
Date

This technical specification is subjected to change without notice

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Record of Revision

Rev	Issued Date	Description
1.0	May.18.2007	New version

1. FEATURES

The 2.8" LCD module is the active matrix color TFT LCD module. LTPS (Low Temperature Poly Silicon) TFT technology is applied with vertical and horizontal drivers built on the panel.

Both of horizontal and vertical scan are reversible and controlled by the serial interface commands.

The product is designed for the requirement of the green product, and the specification complies with TPO's "Green Product Chemical Substance Specification Standard Hand Book".

2. GENERAL SPECIFICATIONS

Item	Description	Unit
Display Size (Diagonal)	2.8	Inch
Aspect ratio	3:4	-
Display Type	Transmissive	-
Active Area (HxV)	43.2 x 57.6	mm
Number of Dots (HxV)	240 x RGB x320	Dot
Dot Pitch (HxV)	0.06 x 0.18	mm
Color Arrangement	RGB Stripe	-
Color Numbers	262K	-
Outline Dimension (HxVxT)	52.9 x 71.7 x 1.8*(Approx.)	mm
Surface treatment	Hard Coat	
Weight	15.02	G

*Exclude FPC and protrusions.

## 3. INPUT/OUTPUT TERMINALS

3.1TFT LCD Panel

Recommend connector:

Compatible with **Molex 54393-3918**

No	Symbol	I/O	Description	Comment
1	LED+	P	B/L Positive Voltage	Note 3-1
2	LED-	P	B/L Negative Voltage	Note 3-1
3	VDD1	P	Logic Power Input	
4	VDD2	P	Analog Power Input	
5	VSS	P	GND	
6	NC		No Connection	
7	NC		No Connection	
8	NC		No Connection	
9	NC		No Connection	
10	CS	I	Chip Selection	
11	SDA	I/O	SPI Data	
12	VSS	P	GND	
13	SCL	I	SPI Clock	
14	SD	I	Auto Power On/Off Sequence Enable Input	
15	RESETB	I	Reset	
16	B0/ID1	I	Blue Data (LSB) / LCM ID Pin 1 (Pull-down 10K to VSS by Resistor)	
17	B1	I	Blue Data	
18	B2	I	Blue Data	
19	B3	I	Blue Data	
20	B4	I	Blue Data	
21	B5	I	Blue Data (MSB)	
22	G0/ID2	I	Green Data (LSB) / LCM ID Pin 2 (Pull-down 10K to VSS by Resistor)	
23	G1	I	Green Data	
24	G2	I	Green Data	
25	G3	I	Green Data	
26	G4	I	Green Data	
27	G5	I	Green Data (MSB)	
28	R0/ID0	I	Red Data (LSB) / LCM ID Pin 0 (Pull-down 10K to VSS by Resistor)	

29	R1	I	Red Data	
30	R2	I	Red Data	
31	R3	I	Red Data	
32	R4	I	Red Data	
33	R5	I	Red Data (MSB)	
34	VSS	P	GND	
35	DCLK	I	Clock for Driver	
36	VSS	P	GND	
37	VSYNC	I	Vertical Synchronous Input	
38	HSYNC	I	Horizontal Synchronous Input	
39	DE	I	Data Enable	

Note 3-1: The figure below shows the connection of backlight LED.
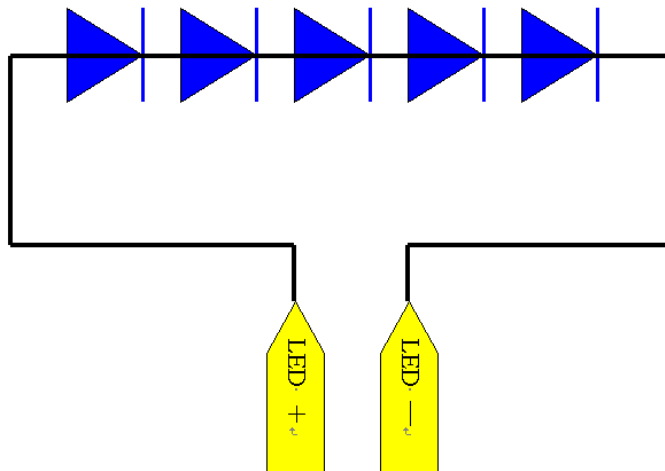
4. ABSOLUTE MAXIMUM RATINGS

Ta = 25℃

Item	Symbol	MIN	MAX	Unit	Remark
Logic Supply Voltage	VDD1	-0.3	3.6	V	
Analog Supply Voltage	VDD2	-0.3	3.6		
DC/DC Output Voltage	AVDD	-0.3	6.0		
Input Signal Voltage	DE, VSYNC, HSYNC, DCLK, RESETB, R[0:7], G[0:7], B[0:7],	0	VDD1	V	
Back Light Forward Current	I_{LED}	--	20	mA	
Operating Temperature	T_{OPR}	-20	60	℃	
Storage Temperature	T_{STG}	-30	70	℃	

5. ELECTRICAL CHARACTERISTICS

5.1. Driving TFT LCD Panel

GND=0V, Ta=25℃

Item		Symbol	MIN	TYP	MAX	Unit	Remark
Logic Supply Voltage		VDD1	1.6	2.8	3.6	V	
Analog Supply Voltage		VDD2	2.4	2.8	3.6	V	
DC/DC Output Voltage		AVDD	5.5	5.7	6.4	V	
VS		Source Driver Voltage	5.2	5.4	6.1	V	
VR		Panel Control Signal Voltage	4.9	5.0	5.1	V	
Input Signal Voltage	Low Level	V_{IL}	VSS	-	0.2x VDD1	V	Input Signal Voltage
	High Level	V_{IH}	0.8x VDD1	-	VDD1+0.3	V	
PWM Output Voltage		V_{PWM}	NA	NA	NA	V	
Feedback Voltage		V_{FB}	NA	NA	NA	V	
Panel Power Consumption		W_P	-	8.8	9.9	mA	

5.2 Driving Backlight   Ta=25℃

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	I_F	--	20	--	mA	
Forward Current Voltage	V_F	--	3.3	--	V	
Backlight Power Consumption	W_{BL}	--	330	--	mW	
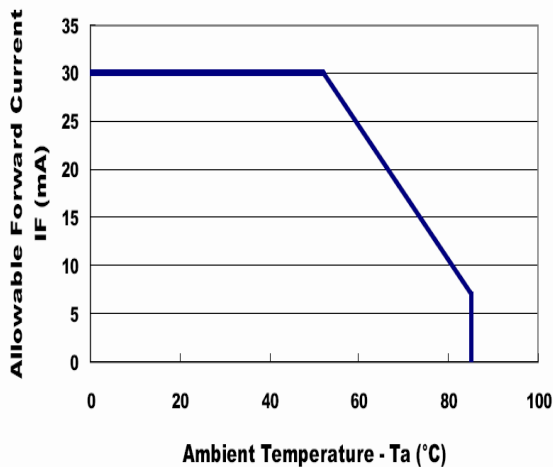
6. TIMING CHART

<Input timing > VSYNC+HSYNC+DE mode

--Horizontal--(VIH=0.8VDD1, VIL=0.2VDD1)
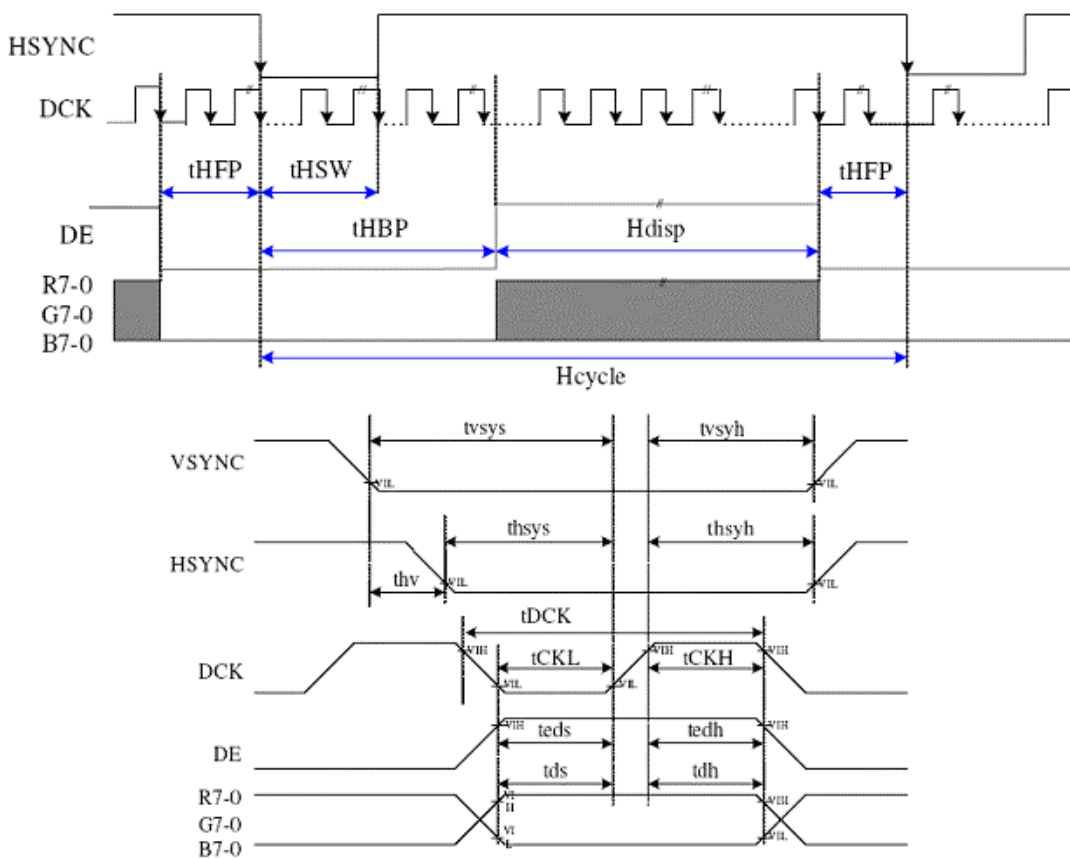
Parameter	Symbol	MIN	TYP	MAX	Unit
HSYNC Pulse Low Width	tHSW	--	10	--	DCK
Horizontal Front Porch	tHFP	--	10	--	DCK
Horizontal Back Porch	tHBP	--	30	--	DCK
VSYNC Set-up Time	tvsys	20	--	--	ns
VSYNC Hold Time	tvsyh	20	--	--	ns
HSYNC Set-up Time	thsys	20	--	--	ns
HSYNC Hold Time	thsyh	20	--	--	ns
Phase Difference of Sync Signal Falling Edge	thv	-18	--	20	DCK
DCK Frequency	fDCK	4.56	5.48	7.30	MHz
DCK Period	tDCK	219	183	140	ns
DCK High Period	tCKL	60	--	--	ns
DCK Low Period	tCKH	60	--	--	ns
Data Set-up Time	tds	20	--	--	ns
Data Hold Time	tdh	20	--	--	ns

--Vertical--(VIH=0.8VDD1, VIL=0.2VDD1)
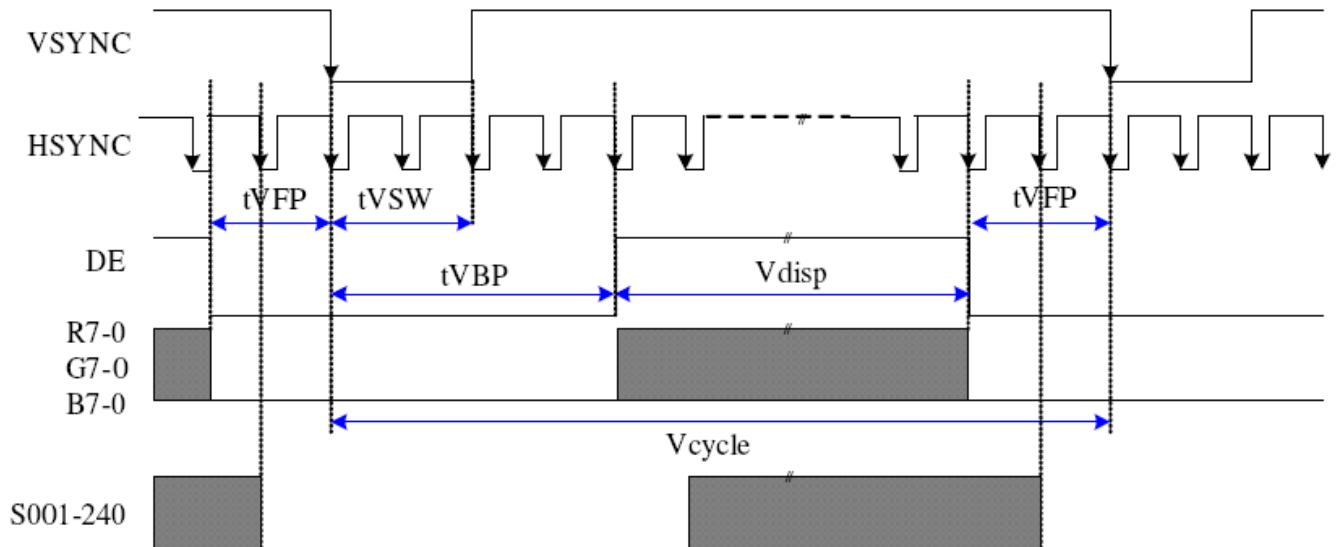
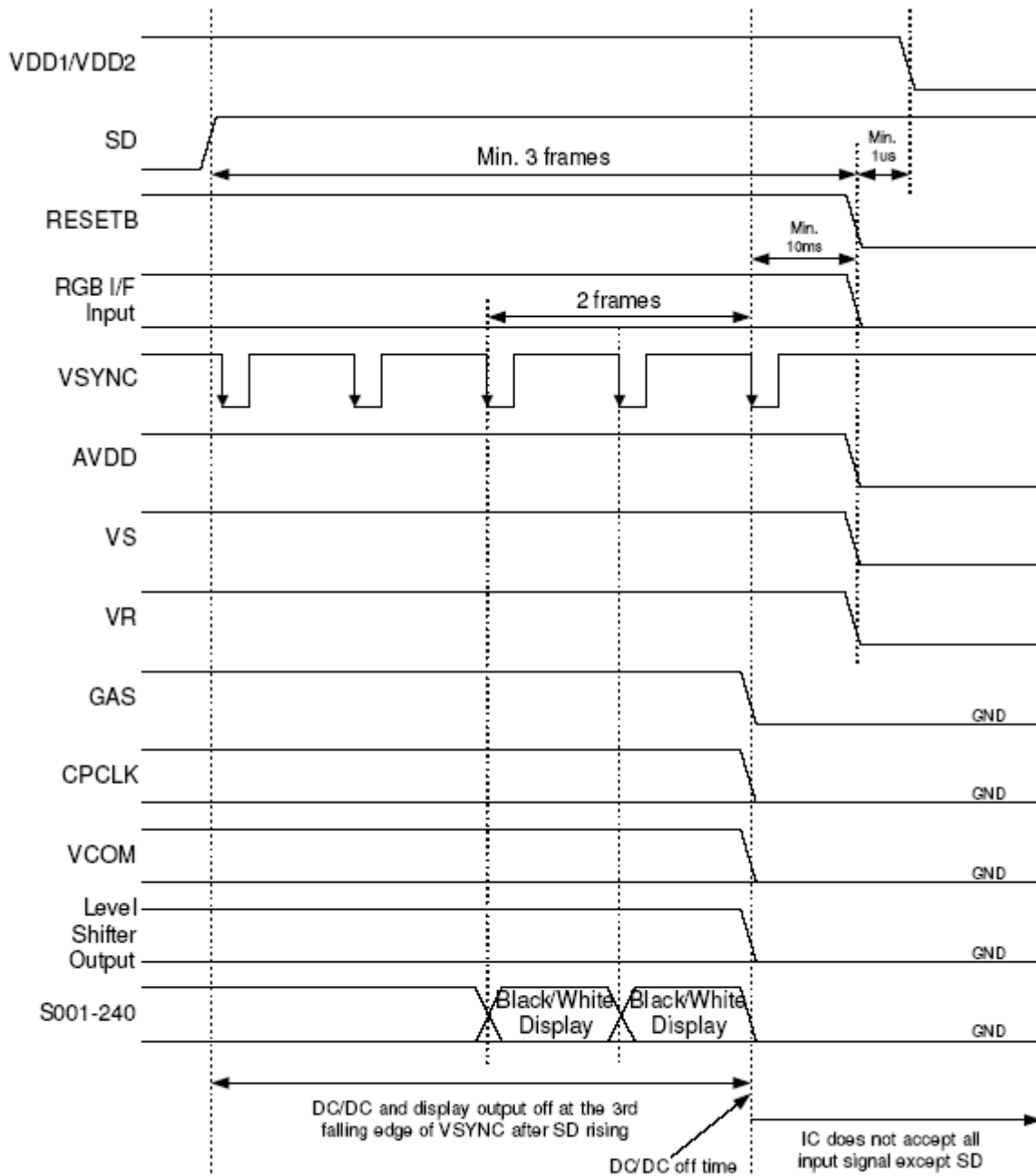| Parameter	Symbol	MIN	TYP	MAX	Unit
VSYNC Pulse Low Width	tVSW	--	2	--	HSYNC
Vorizontal Front Porch	tVFP	--	2	--	HSYNC
Vorizontal Back Porch	tVBP	--	4	15	HSYNC

--Power On Sequence--
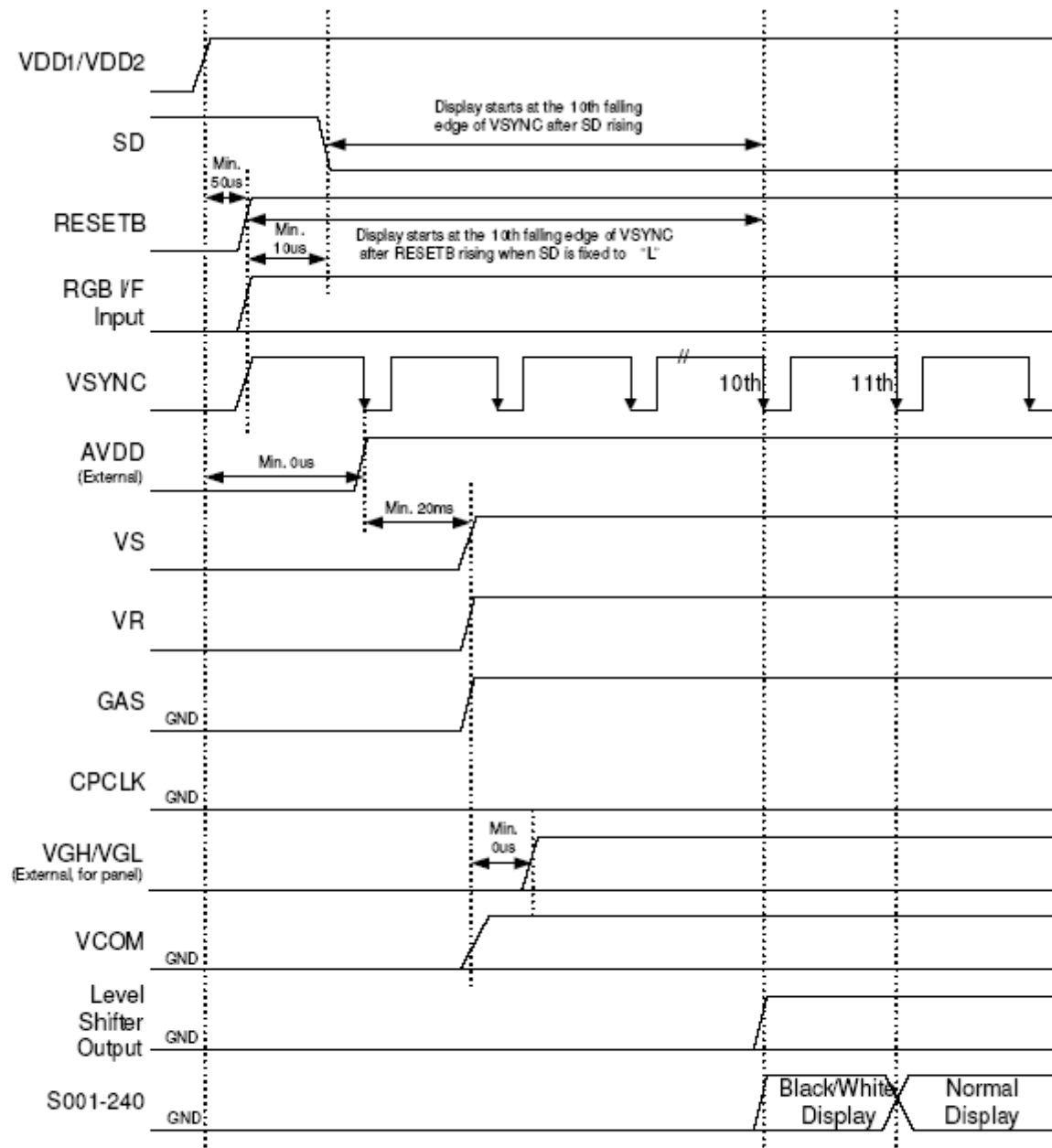
Note1: RGB I/F Input – VSYNC/HSYNC/DCK/DE/CM/R7-0/G7-0/B7-0
Note2: Level Shifter Output – STV/CKV1/CKV2/ENBV/CSV/CKH1/CKH2/CKH3/VC1/VC2/VCOM
Note3: VGH/VGL are external voltages for panel

--Power Off Sequence--

Note1 : RGB I/F Input – VSYNC/HSYNC/DCK/DE/CM/R7-0/G7-0/B7-0
Note2 : Level Shifter Output – STV/CKV1/CKV2/ENBV/CSV/CKH1/CKH2/CKH3/VC1/VC2/VCOM

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7. OPTICAL CHARACTERISTICS

7.1 Optical Specification

(1) Backlight on /w touch panel

Ta=25℃

Item		Symbol	Condition	MIN	TYP	MAX	Unit	Remarks
Viewing Angles		$\Theta 11(R)$	CR ≥ 10	30	40	-	Degree	Note 7-1
		$\Theta 12(L)$		30	40	-		
		$\Theta 21(U)$		45	55	-		
		$\Theta 22(D)$		10	15	-		
Contrast Ratio		CR	$\Theta = 0°$	240	300	-		Note 7-2
Response Time	Rising	Tr		-	5	10	ms	Note 7-3
	Falling	Tf		-	11	20		
Luminance (I_F=20mA)		L		260	320	390	cd/m^2	Note 7-4
Uniformity		-		70	80	-	%	Note 7-6
Chromaticity	NTSC%	-		40	50	-		
	White	x_W		0.26	0.31	0.36		Note 7-5
		y_W		0.28	0.33	0.338		

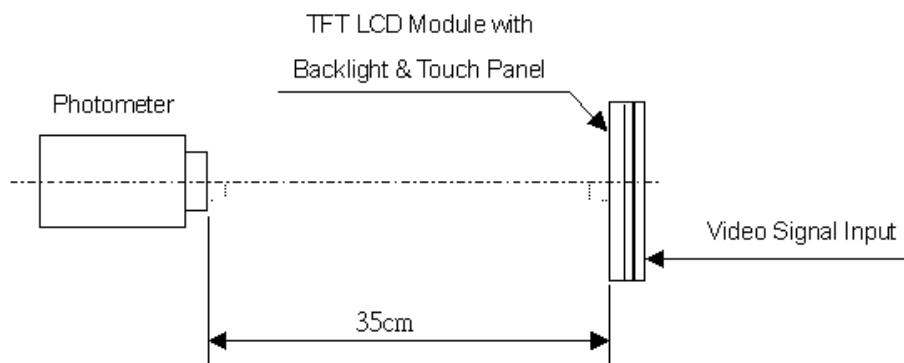### 7.2 Basic Measure Conditions

(1) Driving voltage

Vcc= 5 V

(2) Ambient Temperature: Ta=25℃

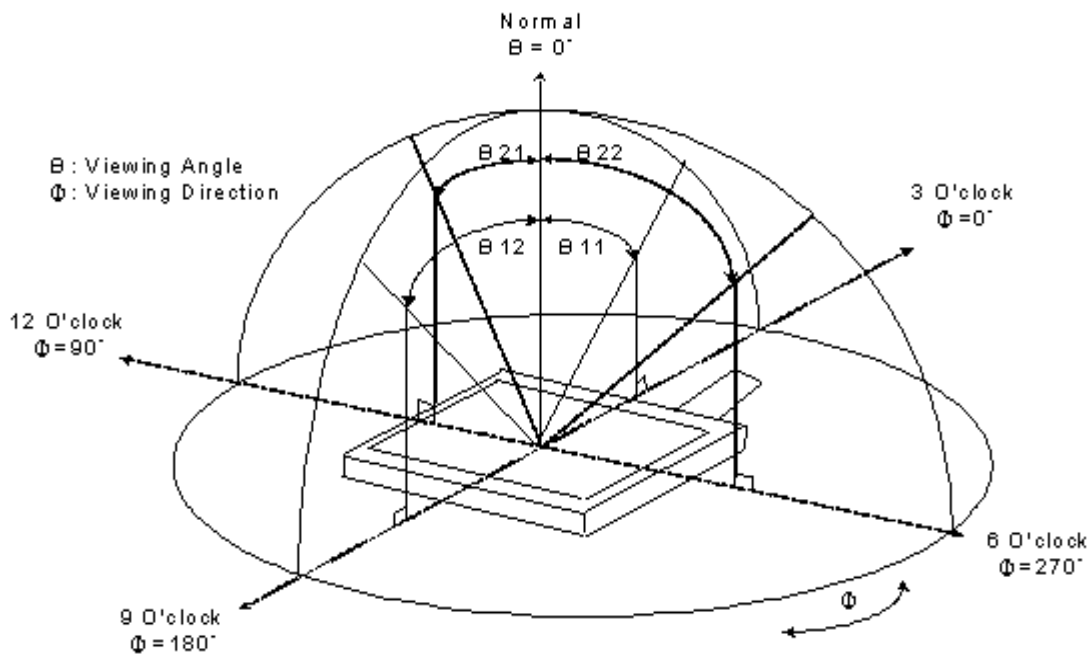(3) Testing Point: Measure in the display center point and the test angle Θ=0°

(4) LED Current: I_F=20mA.

(5) Testing Facility

Environmental illumination: ≤ 1 Lux
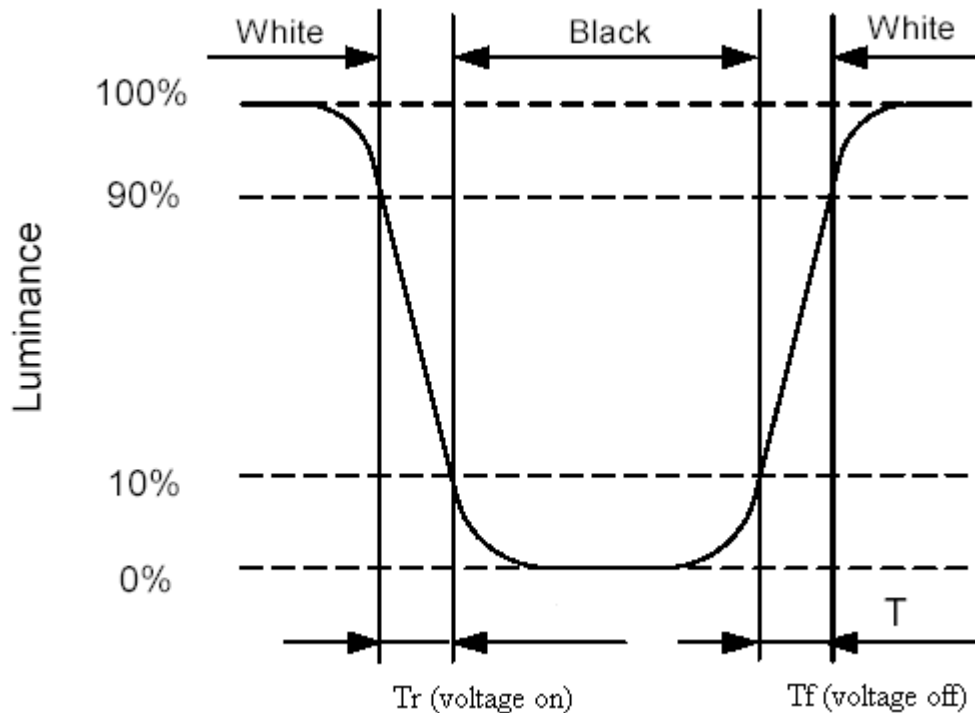
Note 7-1: Viewing angle diagrams:

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: 9 points average of Display (Measured by DMS)

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

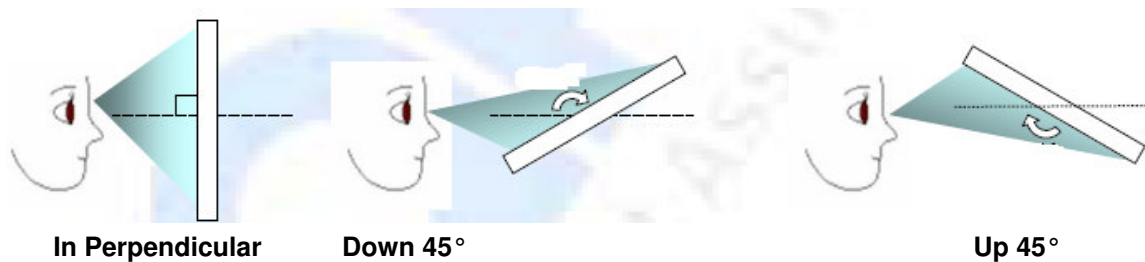Note 7-6 : Hot Spot (Curtain Mura) Examination

    -Test Condition

    Dark room with ambient illuminance under 5 lux.

    Observation Direction: With up and down 45° vertical or in perpendicular view angle. (Refer to the figure below)

    Observation Area: Entire Screen (especially on the side of Back Light Source.)

    Back Light Luminance: Tune to be maximum.

In Perpendicular   **Down 45°**   **Up 45°**

Test Pattern: Full screen white pattern

8. REILIABILITY

No	Test Item	Condition
1	High Temperature Operation	T= 70℃, 240hrs
2	High Temperature & High Humidity Operation	T= 40℃, 95% RH, 240hrs
3	Low Temperature Operation	T=-20℃, 240hrs
4	High Temperature Storage	T=+80℃, 240hrs
5	Low Temperature Storage	T=-30℃, 240hrs
6	Thermal Shock (non-operation)	-20℃(30min)←→70℃(30min) , 50 cycles
7	ESD Test (MM – Non - OP)	C=200pF, R= 0 Ω Discharge::> ±200V; 1 times / Terminal
8	Vibration (non-operation)	Frequency: 10~55~10Hz Acceleration :0.5G Sweep Mode : Log Sweep Sweep speed: 1 Oct/min. Test Time: 2 hrs for each direction of X, Y, Z
9	Shock (non-operation)	Acceleration: 100G; Period: 6ms Directions: ±X, ±Y, ±Z; Cycles: Twice

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 recommend ESD strategy

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

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

(3) In handling the panel, ionize flowing 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 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
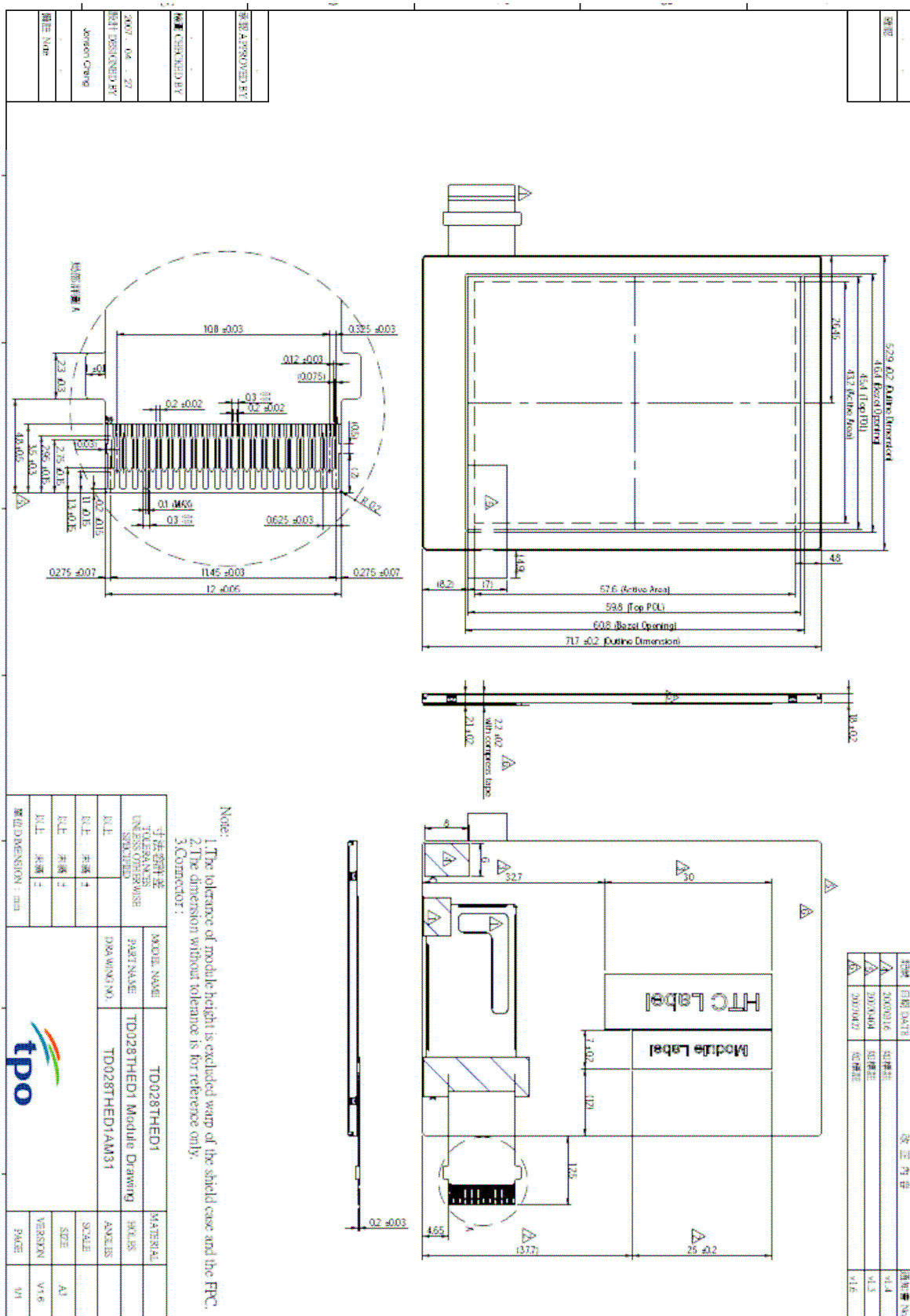
11 Packing Drawing
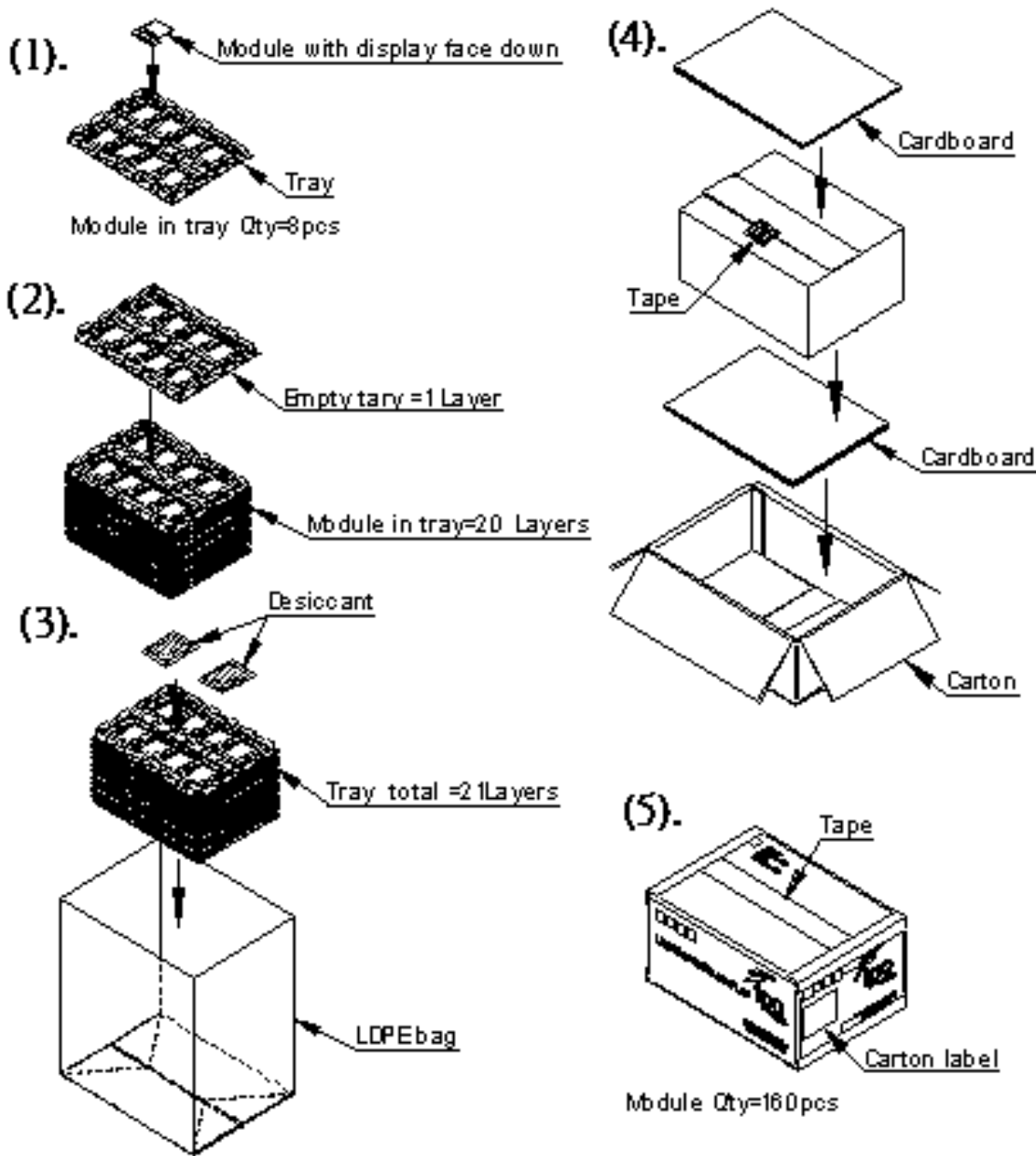
2.8" module (TD028THED1) delivery packing method

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

(2). Tray stacking with 15 layers and with 1 empty tray above the stacking tray unit.
   2pcs desiccant put above the empty tray

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

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

(5). Carton tapping with adhesive tape