Ver.: 1.2

TFT LCD Specification

Model Name: TD019THEC1

Part No.: TD019THEC1

Customer Signature
Date

This technical specification is subjected to change without notice.

1. FEATURES

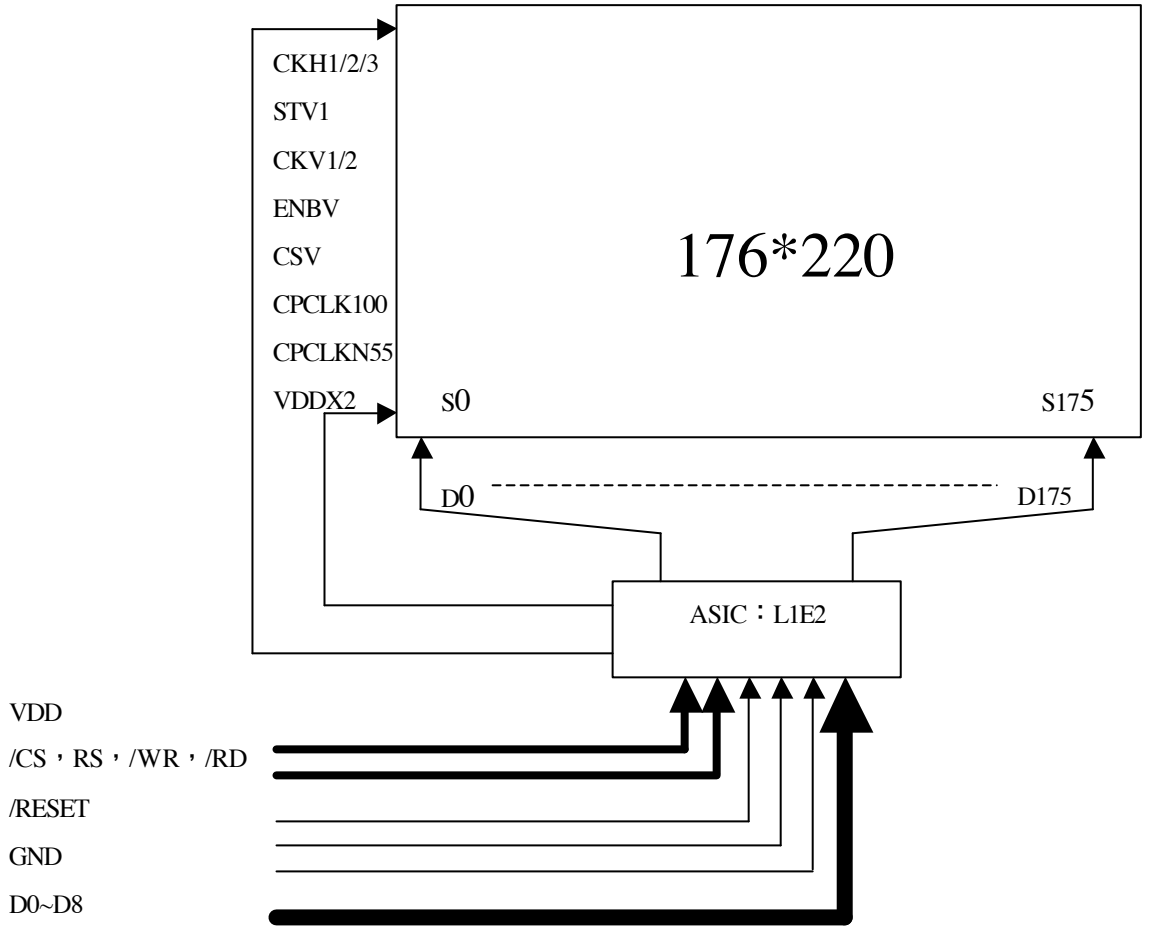
The 1.88" (4.7752 cm) LCD module is an active matrix color TFT LCD module. LTPS (Low Temperature Poly Silicon) TFT technology is used. Vertical and horizontal drivers are built on the panel.

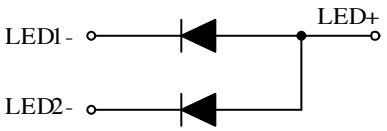
2. GENERAL SPECIFICATIONS

	Item	Description	Unit
1	Display Method	LTPS Active Matrix TFT	
2	Display Type	Transmissive	
3	Display Size (Diagonal)	1.88"	Inch
4	Resolution	176 x RGB x 220	
5	Pixel Pitch (HxV)	0.0565 x 0.1695	mm
6	Display Color	262K	
7	Glass Thickness(mm) Vendor	0.3 mm (NHT)	mm
8	Active Area (HxV)	29.83 x 37.29	mm
9	Viewing Area (HxV)	31.96 x 38.62	mm
10	Module Dimension (HxVxT) *	36.3 x 50 x 2.05 (2D, 3D)	mm
11	Weight	8.3 +/- 0.5	g
12	Interface	9 bits CPU I/F	
13	Pin No	31	
14	Surface treatment	3H Hard coating	
15	Driver IC vendor	NTK NT39160	
16	Connector vendor	JST BM02B-ACHKS-GAN-TF (Receiver connector)	
17	FPC vendor	旗勝	
18	Backlight LED Type vendor	凱鼎 2 pcs	
19	Operating Temperature Range	-20 ~ 70℃	
20	Storage Temperature Range	-30 ~ 80℃	
21	Operating Life	30000	Hr

* Exclude FPCa and protrusions.

3. Block Diagram of Display





4. PIN Connection

Interfaces: CPU mode 8080 (Parallel)		
Connector TYPE: NA		
Pin No	**Pin Name**	**Pin Description**
1	VSS	Ground
2	D0	Data 0
3	D1	Data 1
4	D2	Data 2
5	D3	Data 3
6	D4	Data 4
7	D5	Data 5
8	D6	Data 6
9	D7	Data 7
10	D8	Data 8
11	/CS	Chip Select
12	RS	Data/ Command (DC = 0: command; DC = 1: data)
13	/WR	Write Enable
14	/RD	Read control signal
15	TE	Tear effect signal output
16	VSS	Ground
17	LED+	LED Supply Voltage (LED1 & LED2 Anode)
18	LED2-	LED2 Cathode
19	LED1-	LED1 Cathode
20	I_LED_G	Green LED control pin
21	I_LED_O	Amber LED control pin
22	I_LED_B	Blue LED control pin
23	/RESET	Reset
24	VSS	Ground
25	VBAT	RGB LED power
26	VDD	DC/DC Supply Voltage (2.5V~3.6V)
27	VSS	Ground
28	VSS	Ground
29	EARN	Receiver pin
30	EARP	Receiver pin
31	VSS	Ground

5. Absolute Maximum Ratings

VSS=0V

Parameter	Symbol	Rating	Unit
Power supply	VDD	-0.3 to VDDA+0.3	V

6. Typical Operation Conditions

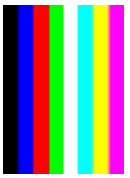
VSS=0V, Ta=25℃

Parameter	Symbol	Condition	Specification			Unit
			Min	Typ	Max	
Power Supply Voltage	VDD	Operating Voltage	2.5	3.0	3.6	V
Logic High level input voltage	VIH		0.8VDDI		VDDI	V
Logic Low level input voltage	VIL		VSS		0.2VDDI	V
Logic High level output voltage	VOH	IOUT= -1mA	0.8VDDI		VDDI	V
Logic Low level output voltage	VOL	IOUT=1mA	VSS		0.2VDDI	V
Logic High level input current	IIH	Except D[7..0]			10	A
	IIHD	D[7..0]			10	uA
Logic Low level input current	IIL	Except D[7..0]	-10			uA
	IILD	D[7..0]	-10			uA

7. Power Consumption

Normal mode:

Full Screen 176x220 262K colors at 70Hz frame frequency
Input Voltage (VDD=2.8 V, VDDI=1.8/2.8 V)
Display Pattern: Color Bar
Operating Temp.: 25℃



Partial mode:

Partial Screen 176x32 8 colors at 70Hz frame frequency
Input Voltage (VDD=2.8 V, VDDI=1.8/2.8 V)
Display Pattern: Partial 8 Color Bar
Operating Temp.: 25℃

Standby mode:

Display Off ; Oscillator off; internal regulator

Item	Characteristics	Symbol	Min	Typical	Max	Unit
1	Power consumption in Normal Mode	P_{Normal}	--	5.35	6.89	mW
2	VDD Current consumption in Normal Mode	$I_{VDD-Normal}$	--	1.91	2.46	mA
3	Power consumption in Partial Mode	$P_{Partial}$	--	1.29	1.6	mW
4	VDD Current consumption in Normal Mode	$I_{VDD-Partial}$	--	0.46	0.55	mA
5	Power consumption in Standby Mode	P_{STBY}	--	--	90	uW
6	VDD Current consumption in Standby Mode	$I_{VDD-STDBY}$	--	--	30	uA

8. Backlight driving condition

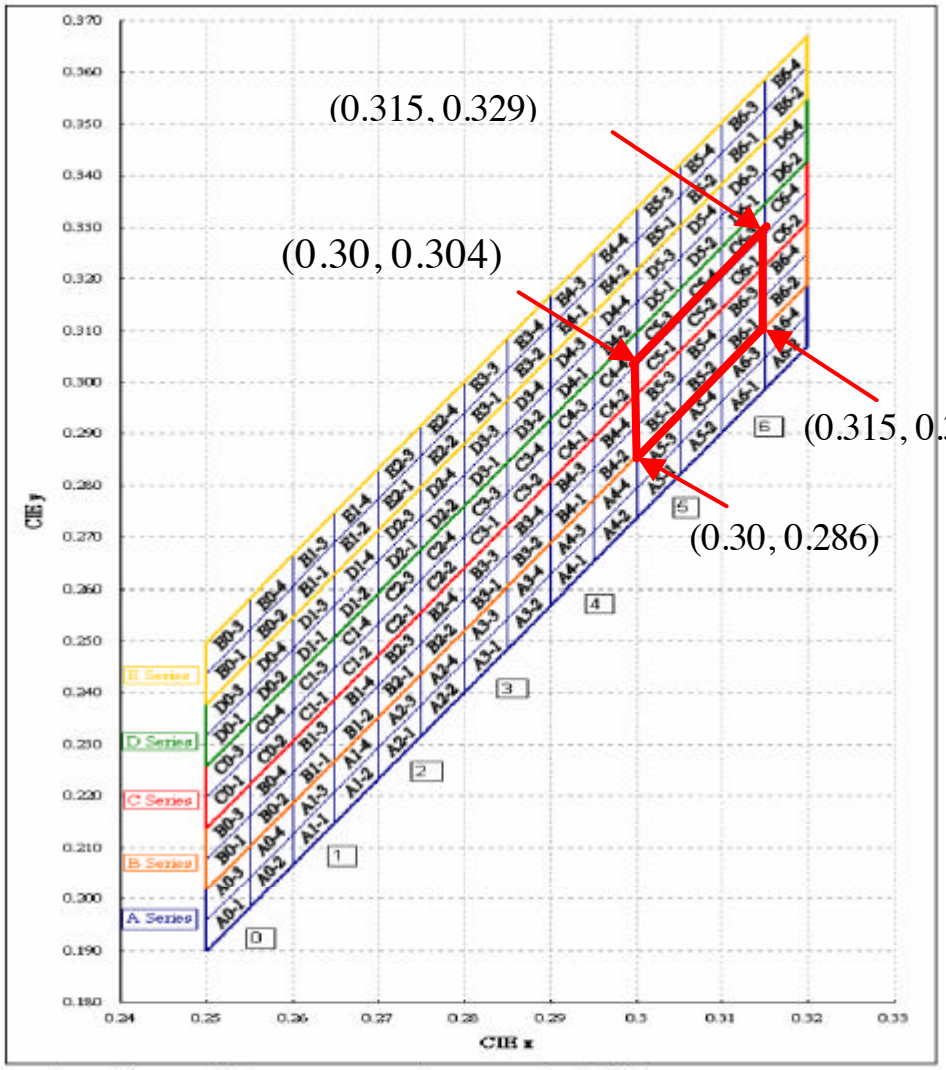
Ta=25℃

Parameter	Symbol	Min	Typical	Max	Unit	Remark
LED Voltage	V_L	3.0	3.2	3.3	V	
LED Current (V_L=3.3V)	I_L		20		mA	Tolerance with+/-5%
Power Consumption	W_L	--	128	--	mW	2 LEDs

8.1 LED SPEC (For LCM Module use only)

LED Part Name	SPEC
Light House-LT-15056C1 WD-CA1-0A	**Luminous:** Rank V2 (1520-1600 mcd) at 20 mA/ Ta= 25℃. Rank V3(1600~1690 mcd) at 20 mA/ Ta= 25℃. **Color Ranks:** C5-1, C5-2, C6-1, B5-3, B5-4, B6-3, B5-1, B5-2, B6-1 rank at 20 mA/ Ta= 25℃ **Volt Rank(Vf) :** 3.0V~3.1V、3.1V~3.2V、3.2V~3.3V、3.3V~3.4V、3.4V~3.5V、3.5V~3.6V at 20 mA/ Ta= 25℃,
AOT-0603GS31A-Z0-N-3 LED_GREEN	Wavelength :520~530 Brightness:60~110mcd
AOT-0603BL31A-N0-N-3 SMT Blue Color LED_Blue	Wavelength :465~475 Brightness:9~23mcd
AOT-0603AM31A-N0-N-3 SMD LED:Amber color	Wavelength :600~610 Brightness:24~60mcd

Chromaticity Diagram

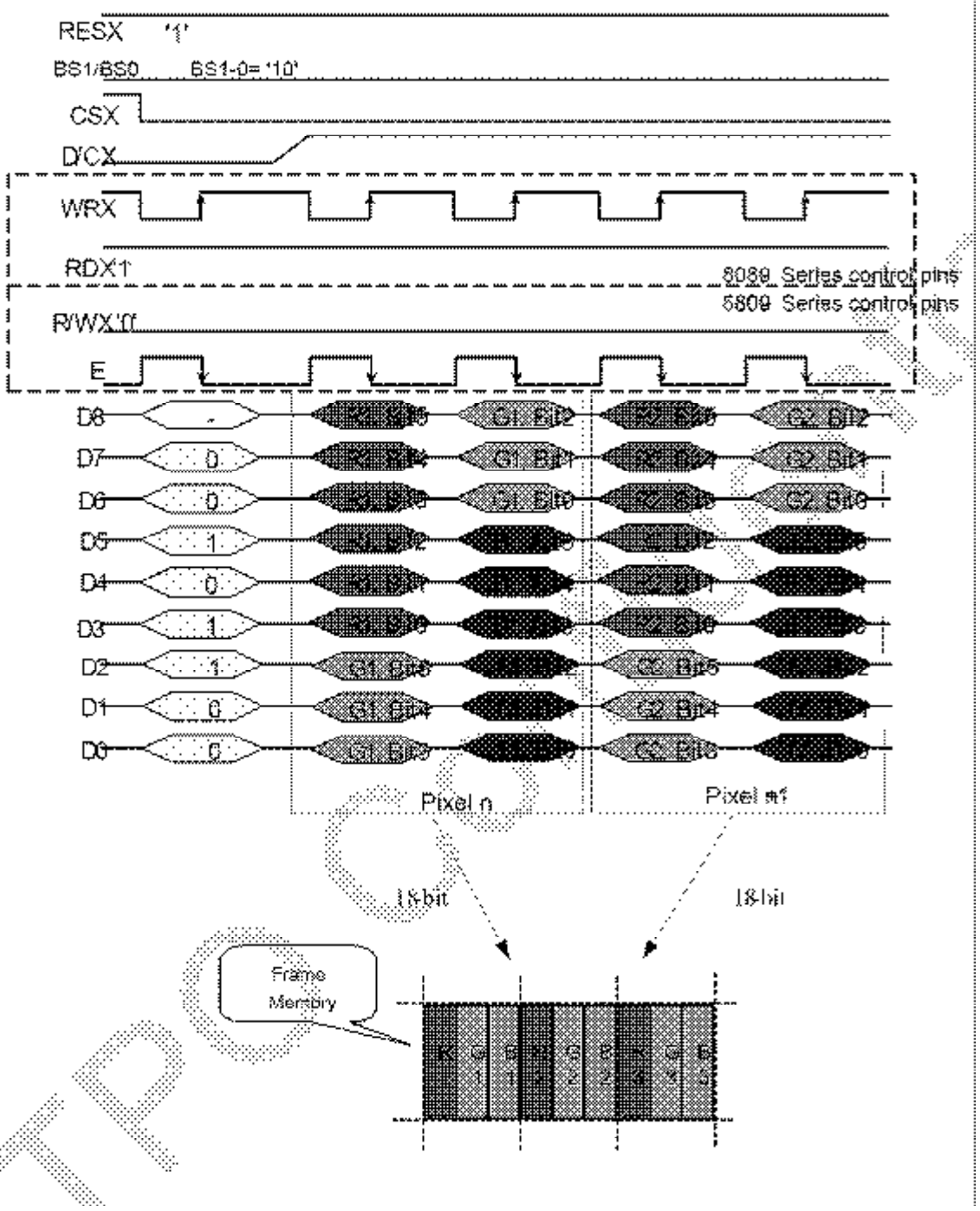


Color Coordinates Measurement allowance is ± 0.01.

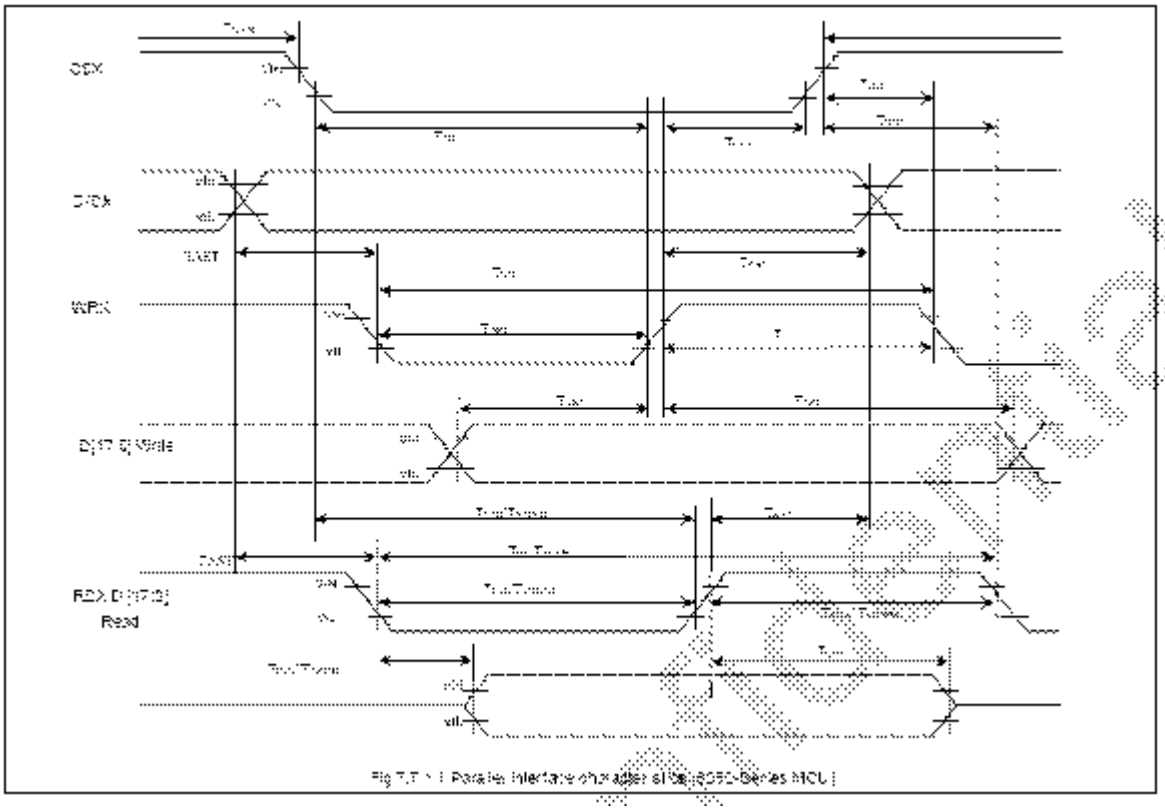
9. AC Timing Characteristics

Write 9-bit data for RGB 6-6-6-bits input (262k-color)

There are 2 pixels (6 sub-pixels) per 4-transfer, 18-bits/pixel. 3Ah="06h"

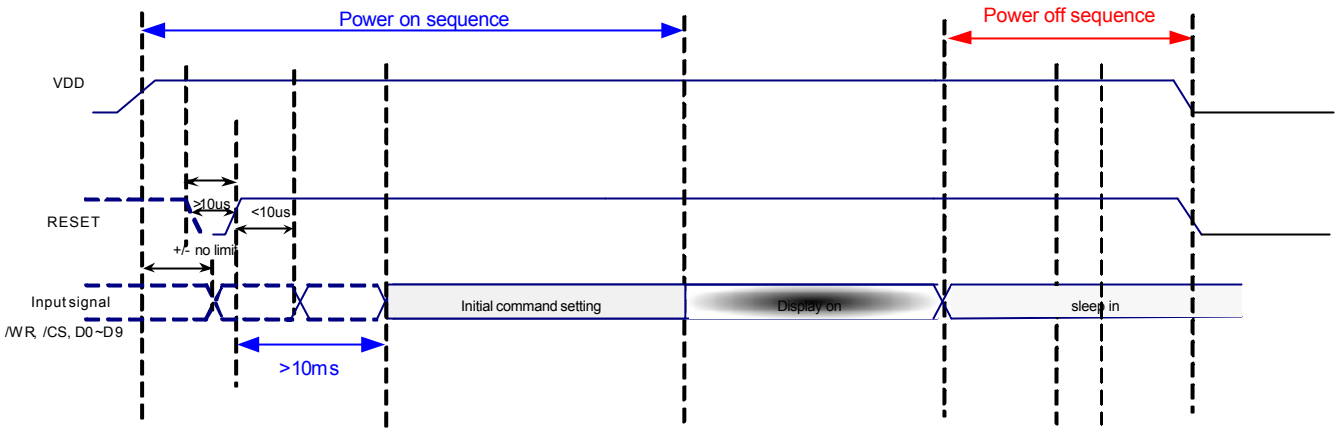


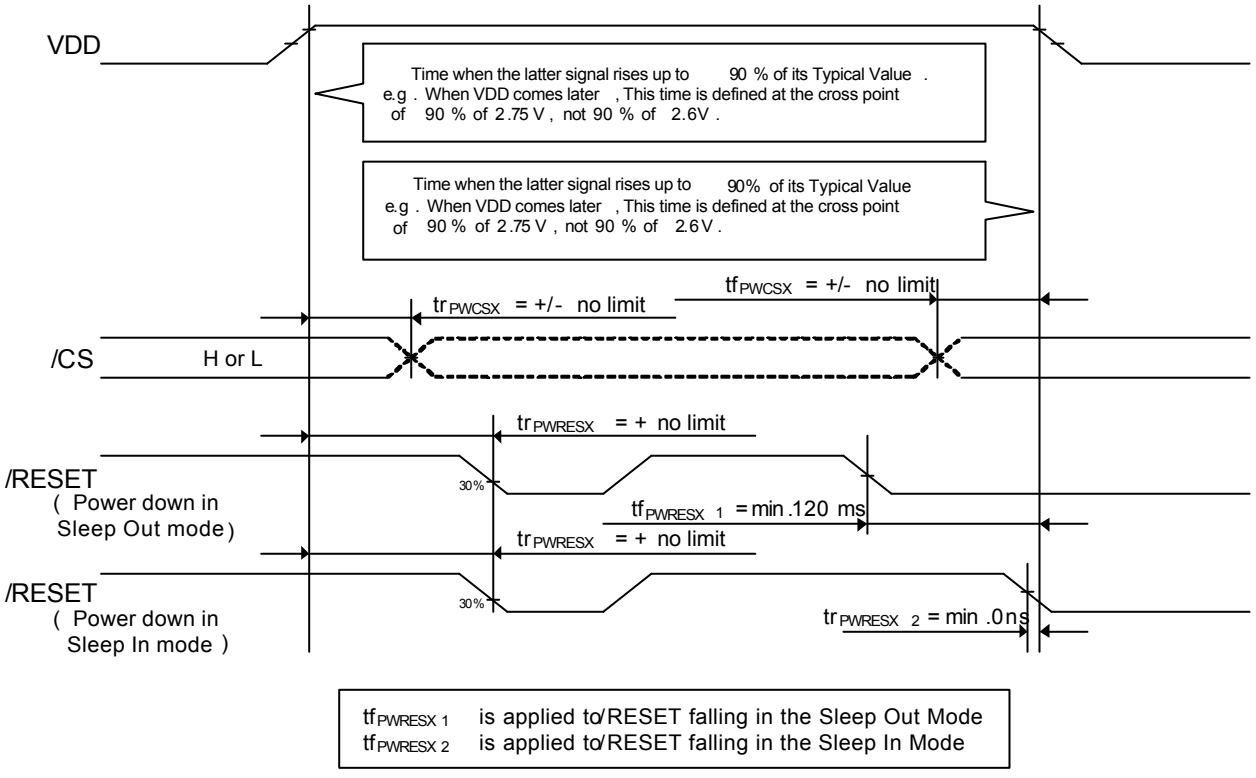
CPU Interface 8080 Mode



Signal	Symbol	Parameter	MIN	MAX	Unit	Description
D/CX	tAST	Address setup time	10		ns	-
	tAHT	Address hold time (Write/Read)	10		ns	
CSX	tCHW	Chip select "H"pulse width	0		ns	
	tCS	Chip select setup time (Write)	35		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	
	tCSH	Chip select hold time	10		ns	
WRX	tWC	Write cycle	80		ns	
	tWRH	Control pulse "H" duration	35		ns	
	tWRL	Control pulse "L" duration	35		ns	
RDX (ID)	tRC	Read cycle (ID)	160		ns	When read ID data
	tRDH	Control pulse "H" duration (ID)	90		ns	
	tRDL	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	tRCFM	Read cycle (FM)	450		ns	When read from frame memory
	tRDHFM	Control pulse "H" duration (FM)	90		ns	
	tRDLFM	Control pulse "L" duration (FM)	355		ns	
D[17:0]	tDST	Data setup time	10		ns	For maximum CL=30pF For minimum CL=8pF
	tDHT	Data hold time	10		ns	
	tRAT	Read access time (ID)		40	ns	
	tRATFM	Read access time (FM)		340	ns	
	tODH	Output disable time	20	80	ns	

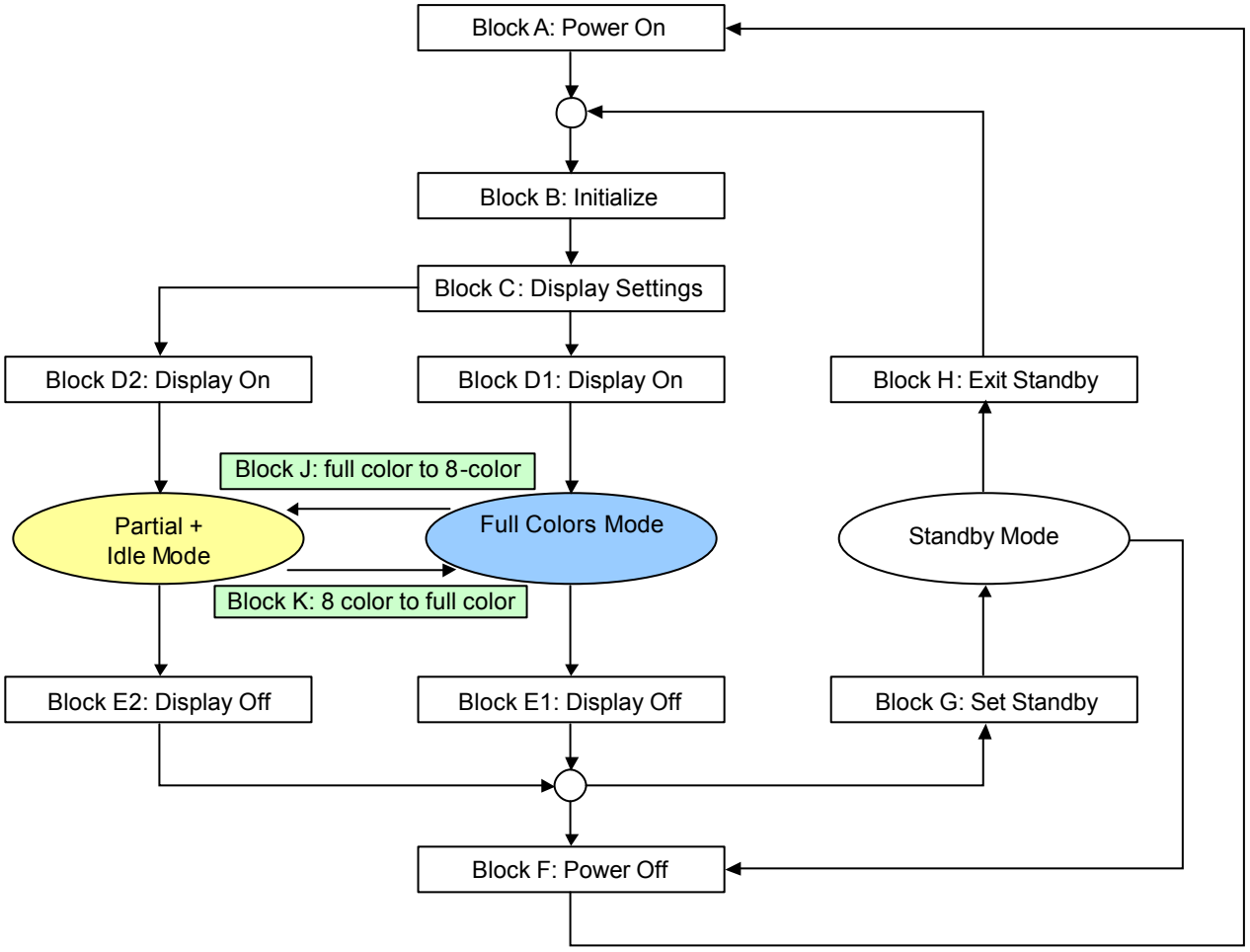
10. Display Power on/down Sequence





tf PWRESX 1 is applied to/RESET falling in the Sleep Out Mode
tf PWRESX 2 is applied to/RESET falling in the Sleep In Mode

Note : Unless otherwise specified , timings herein show cross point at 50 % of signal/power level



L1E2-01 Software Flow

Power on Sequence:

Block A: Power On

Step	Register	Setting	Operation
1	HW reset		
2	Delay 120ms		
3	11h	-	Sleep out
4	CEh	0x0F 0x01	Close the VDC voltage for Panel control power
5	Delay 120ms		
6	Initialize		

Block B: Initialize setting

Step	Register	Parameter Setting		Operation
3	AAh			GAMMA Separate off
4	0xC0	1st	0x04	GAMMA reference voltage setting
5	0xE6	1st	0x01	GAMMA setting enable
6	0xE2	1st	0x1B	GAMMA 2.4 Positive setting
		2nd	0x17	
		3rd	0x0A	
		4th	0x0B	
		5th	0x07	
		6th	0x09	
		7th	0x09	
		8th	0x0D	
		9th	0x09	
		10th	0x06	
		11th	0x00	
		12th	0x00	
		13th	0x03	
		14th	0x02	
		15th	0x0C	
		16th	0x2B	
		17th	0x38	
7	0xE3	1st	0x18	GAMMA 2.4 Negative setting
		2nd	0x13	
		3rd	0x14	
		4th	0x18	
		5th	0x15	
		6th	0x16	
		7th	0x12	
		8th	0x0D	
		9th	0x05	
		10th	0x1A	
		11th	0x23	
		12th	0x1F	
		13th	0x2B	
		14th	0x28	

		15th	0x20	
		16th	0x43	
		17th	0x0C	
8	35h	0X00 or 0X01		TE mode 1,2 select (optional)

Block C: Display Settings (176X220)

Step	Register	Setting	Operation
1	13h	-	Normal display on
2	2Ah	MV=0(0x00~0XAF) MV=1(0x00~0XDB)	Column address set (Parameter range: 0<XS[15:0]< XE[15:0]<175) , MV=" 0" (Parameter range: 0<XS[15:0]< XE[15:0]<219) , MV=" 1"
4	2Bh	MV=0(0x00~0XDB) MV=1 (0x00~0XAF)	Row address set (Parameter range: 0<YS[15:0]< YE[15:0]<219) , MV=" 0" (Parameter range: 0<YS[15:0]< YE[15:0]<175) , MV=" 1"
5	30h	0x00~0XDB	Partial area (PSL,PEL)
6	33h	TFA: 0x00~0XDC VSA: 0x00~0XDC BFA: 0x00~0XDC	Scroll area (TFA+VSA+BFA=220)
7	37h	0x00~0XDB	Vertical scroll start address of RAM
8	3Ah	0x55	Interface pixel format (base application)

Block D1: Display On

Step	Register	Setting	Operation
1	29h	-	Display on
2	Full Color Mode Display On		

Block D2: Set Idle and partial mode

Step	Register	Setting	Operation
1	39h	-	Idle mode on
2	12h	-	Partial mode on
3	29h	-	Display on
4	8 Color Mode Display On (Idle Mode)		

Block E1,E2: Display Off

Step	Register	Setting	Operation
1	28h	-	Display off
	Display off mode		

Block G: Set Standby

Step	Register	Setting	Operation
1	10h	-	Sleep in
	Standby mode		

Block H: Exit Standby

Step	Register	Setting	Operation
1	11h	-	Sleep out
2	Delay 120ms		
	Normal mode		

Block J: Full color to 8-color mode

Step	Register	Setting	Operation
1	12h	-	Partial mode on
2	39h	-	Idle mode on
	Partial + 8 Color Mode (Idle Mode)		

Block K: 8-colors to Full color mode

Step	Register	Setting	Operation
1	38h	-	Idle mode off
2	13h	-	Normal display on
	Full Color Mode		

Power down Sequence:

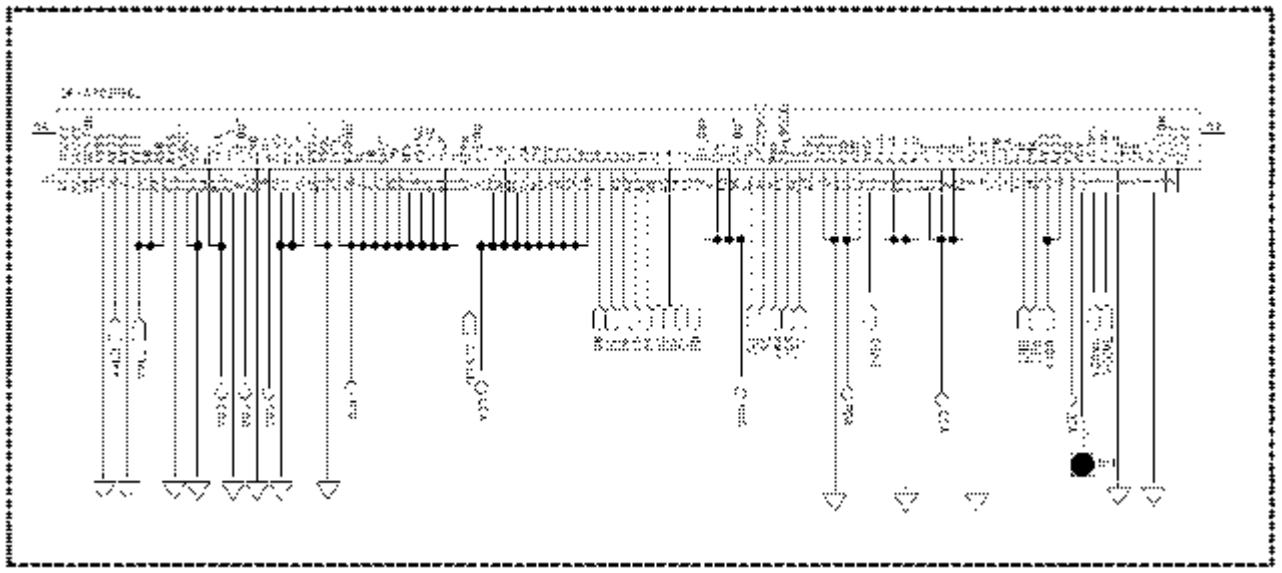
Block F: Power Off

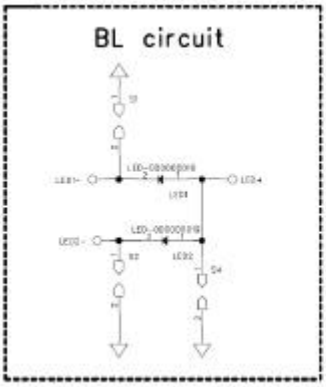
Step	Register	Setting	Operation
1	10h	-	Sleep in
2	Delay (120msec)		
3	RES = L		
4	VDD OFF		
5	VDDI OFF		

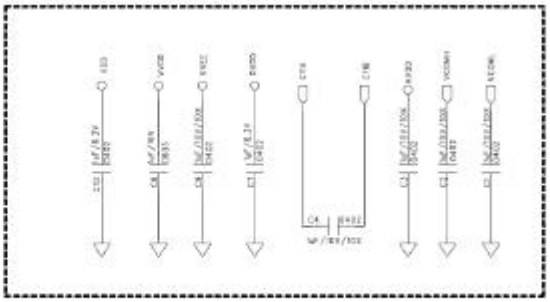
11. FPC

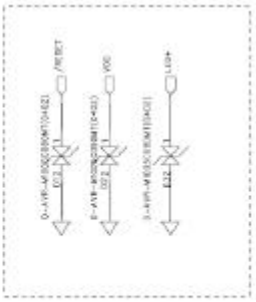
a. BOM

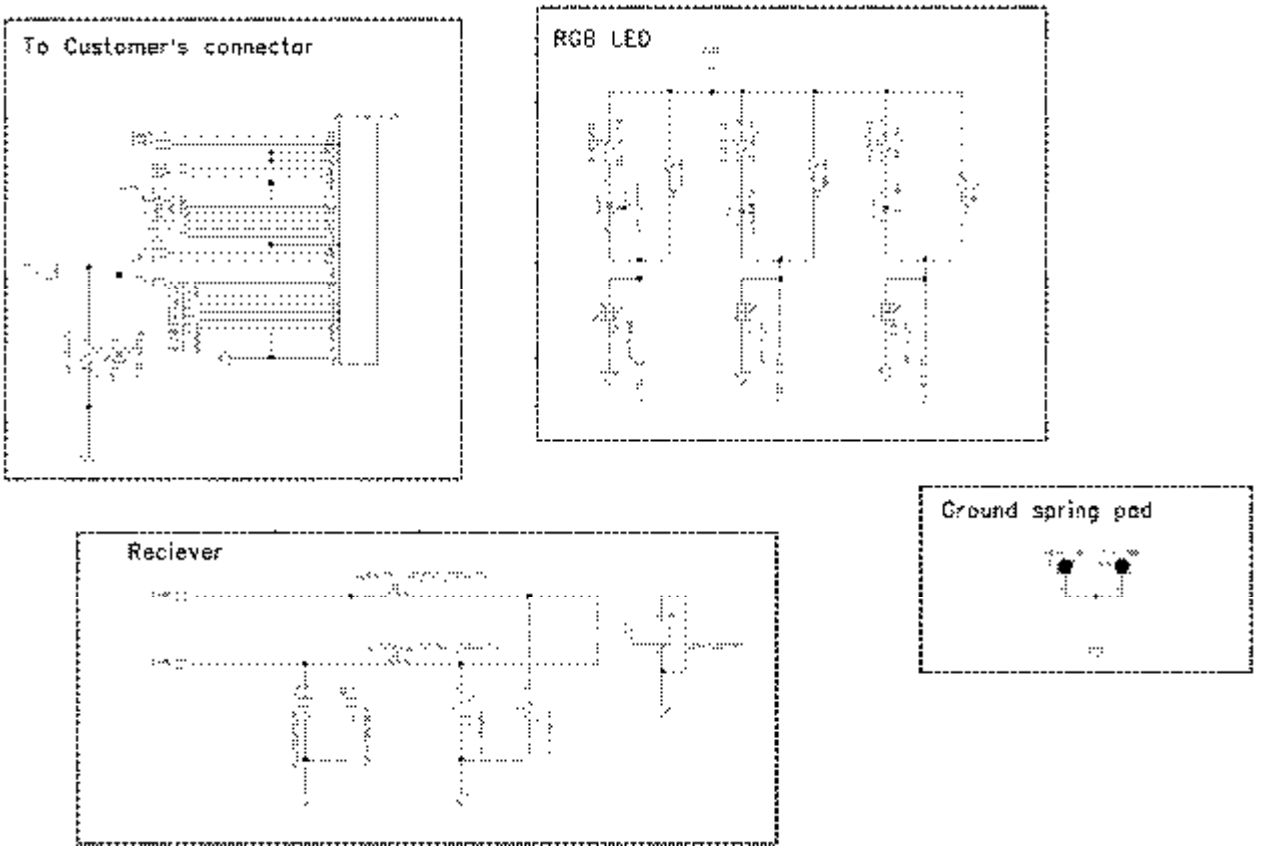
b. Schematics



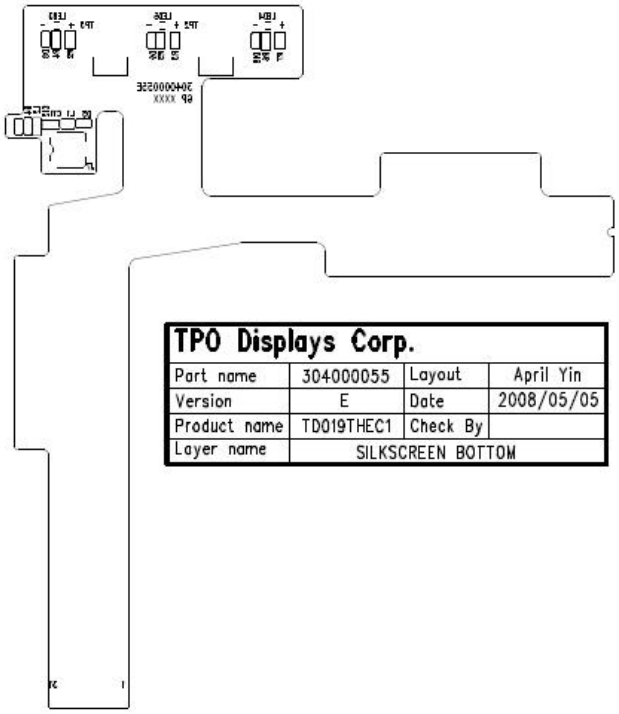


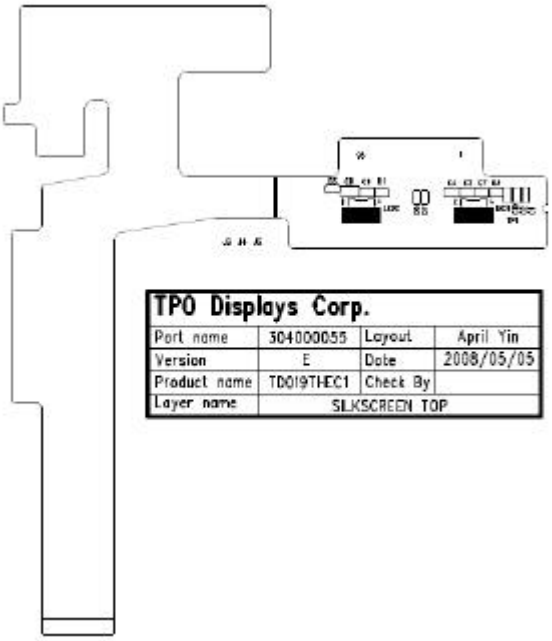






c. Components Location





12. ESD test

Test Item			SPEC	Note
Module	Power On	HBM R=1.5k ohm ,C=100pF	+/- 5.0kV	VDD, VDDI ,Reset
ASIC		HBM (R=1.5k ohm ,C=100pF)	≧+/-2.5kV	Refer to ESD report of ASIC Vendor
		MM (R=0k ohm ,C=200pF)	≧+/-200V	
		Latch Up	≧200mA	

13. OPTICAL CHARACTERISTICS

13.1 Optical Specification (Back Light On, LED current = 20mA)

Ta=25℃

Test Item				SPEC		
				Min	Typ	Max
1	CR			200	350	---
2	CR	High T(60deg)		220	380	---
		Low T(-20deg)		140	250	---
3	Viewing Angle (Iso-CR plot)	Theta=45, phi = 0		15	25	---
		Theta=45, phi = 90		5	10	---
		Theta=45, phi = 180		0.5	2	---
		Theta=45, phi = 270		5	10	---
4	Viewing Direction	CR>10, phi = 0		40	50	---
		CR>10, phi = 90		35	45	---
		CR>10, phi = 180		10	20	---
		CR>10, phi = 270		35	45	---
5	Brightness			220	260	---
6	Brightness uniformity (%)			80	---	---
7	Flicker (dB)			---	---	-30
8	Cross talk (%)			---	---	6
9	Gamma-12GS (plot)			---	2.2	---
10	Color Chromaticity (defined by DMS-900 spectrum meter)	White	x	0.266	0.316	0.366
			y	0.289	0.339	0.389
		Red	x	0.582	0.632	0.682
			y	0.296	0.346	0.396
		Green	x	0.253	0.303	0.353
			y	0.546	0.596	0.646
		Blue	x	0.086	0.136	0.186
			y	0.045	0.095	0.145
11	NTSC			55	65	---
12	Response Time (ms)			---	35	45
13	Response Time (ms)	High T(60deg)		---	20	---
		Low T(-20deg)		---	400	---
14	MSA (Gauge R&R)	Luminance		---	30%	---

		CR	---	---	---
		Uniformity	---	---	---
		Flicker	---	---	---
15	Cpk (Luminance, CR , Uniformity, Flicker)		>1.33		
16	Polarizing Angle (absorption axis)		UP = 135 deg/Down =45 deg		
17	BEF Angle		45 deg.		

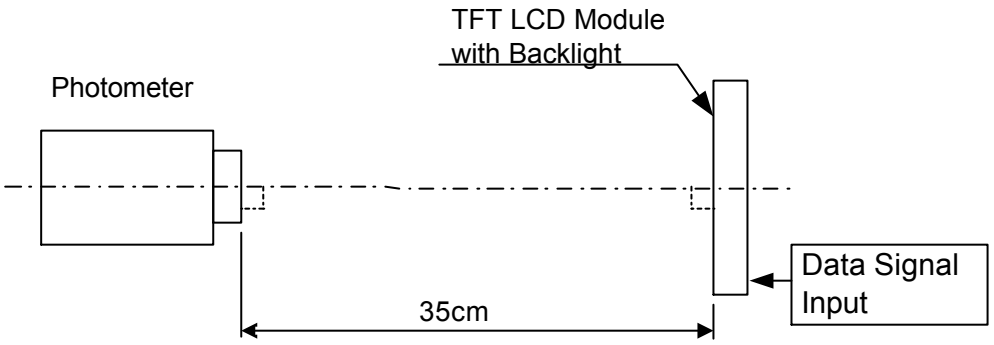
13.2 Basic Measure Condition

(1) Ambient Temperature: Ta=25℃

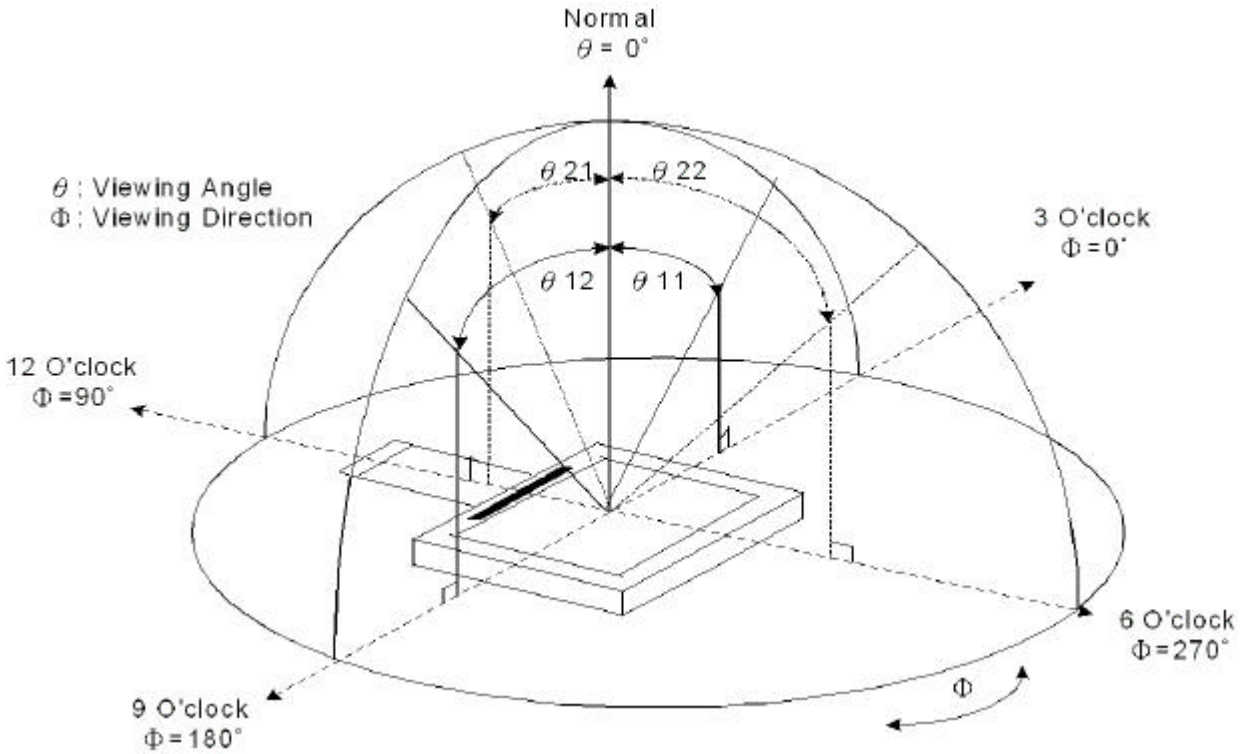
(2) Testing Point: Measure in the display center point and the test angle T=0°

(3) Measuring System

a. Measure System A



13.2.1: Viewing angle diagram:

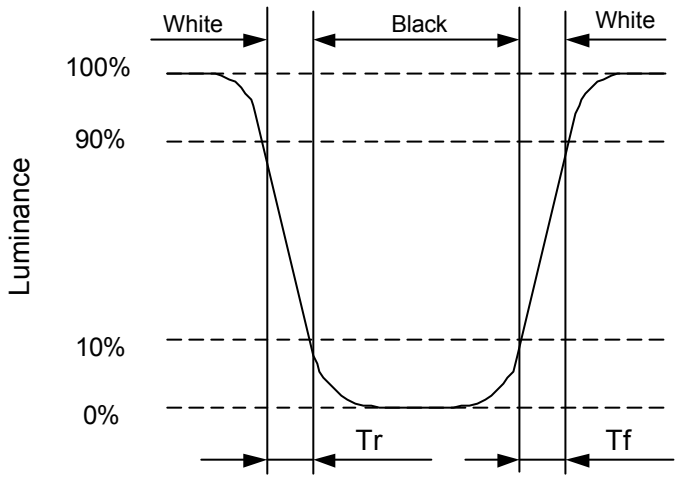


13.2.2: Contrast Ratio as Backlight On: (Measure System A)

Contrast ratio is measured in optimum common electrode voltage. The signal amplitude

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

13.2.3: Definition of response time: (Measure System A)



13.2.4: Luminance: (Measure System A)

Test Point: Display Center

LED Current I_F = 20 mA

13.2.5: Chromaticity: The same test condition as 13.2.4

13.2.6: Contrast Ratio as Backlight Off (Measure System A)

Contrast ratio is measured in optimum common electrode voltage. The signal amplitude

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

13.2.7: White chromaticity as back light off (Measure System A)

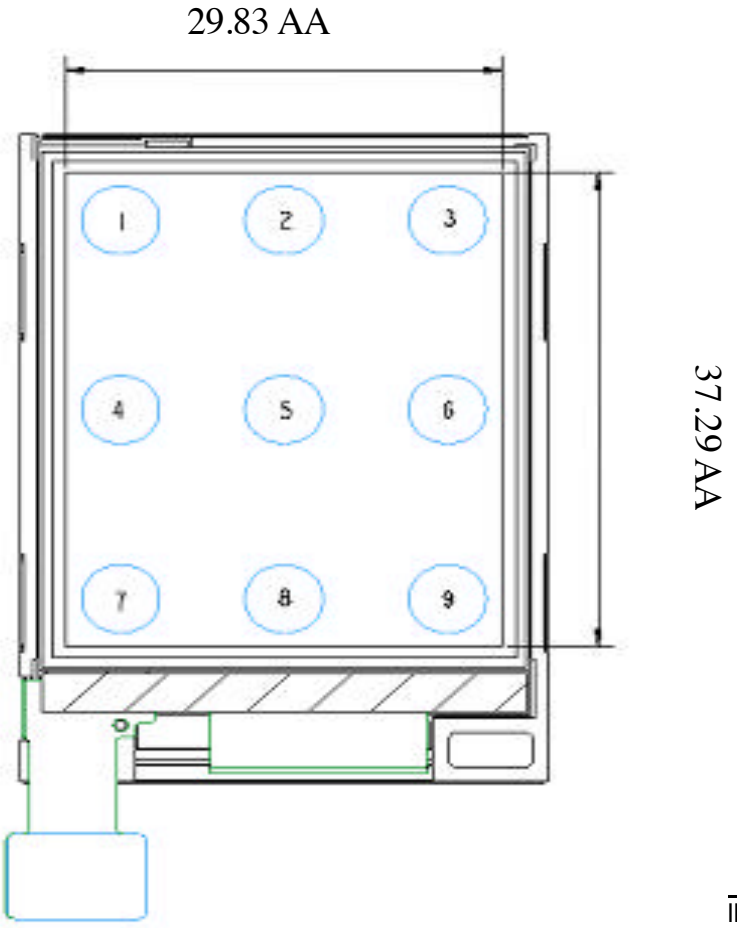
13.2.8: Reflectance (Measure System A)

$$\text{Reflection ratio(R)} = \frac{\text{Light detected level of refection by the LCD module}}{\text{Light detected level of refection by the standard white}}$$

13.2.9: Definition of uniformity: Light on backlight 5 minutes before test.

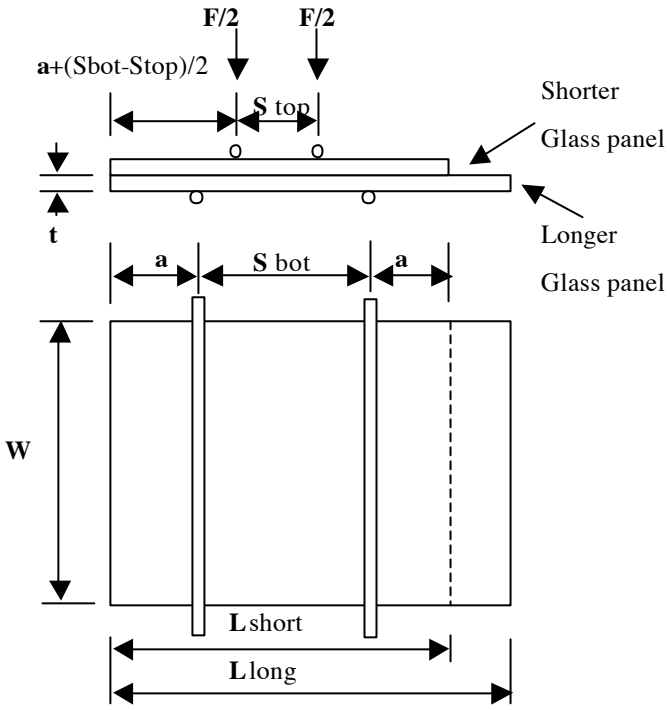
$$\text{Uniformity (Lu)} = \frac{\text{Minimum}}{\text{Maximum}}$$

The definition of 3 columns X 3 rows test points:

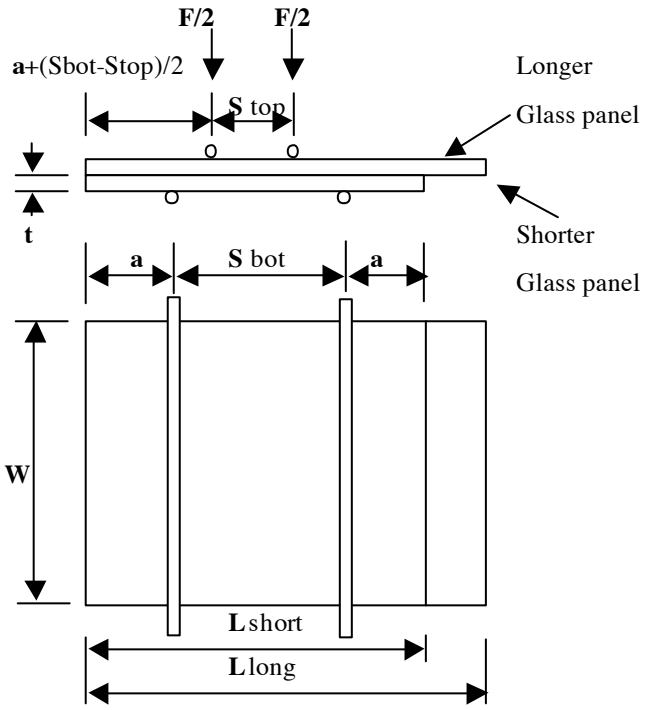


14. GLASS QUALITY REQUIREMENT

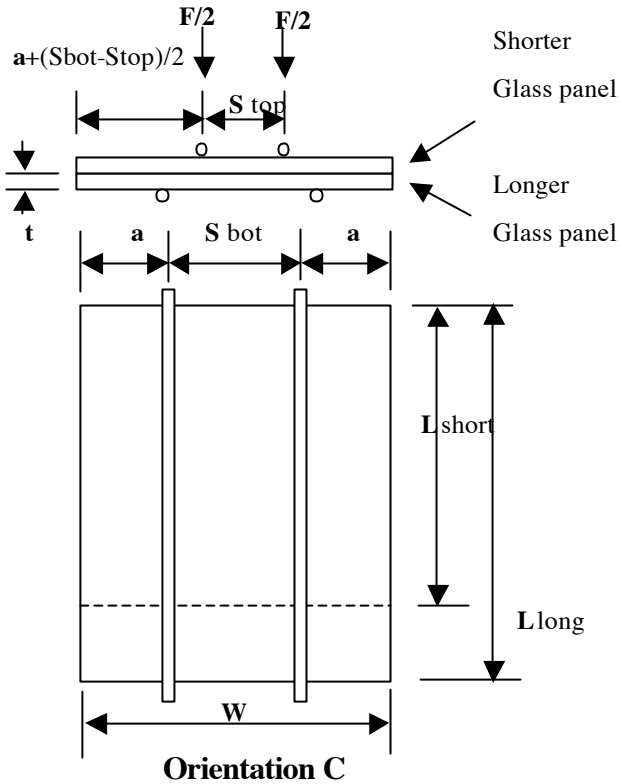
14.1 The LCD glass strength (failure load) will be defined at a single 90% survival rate value. The B10 strain shall be meet 0.15% on both orientation A & orientation B. LCD glass strength test setup as below attached drawing.



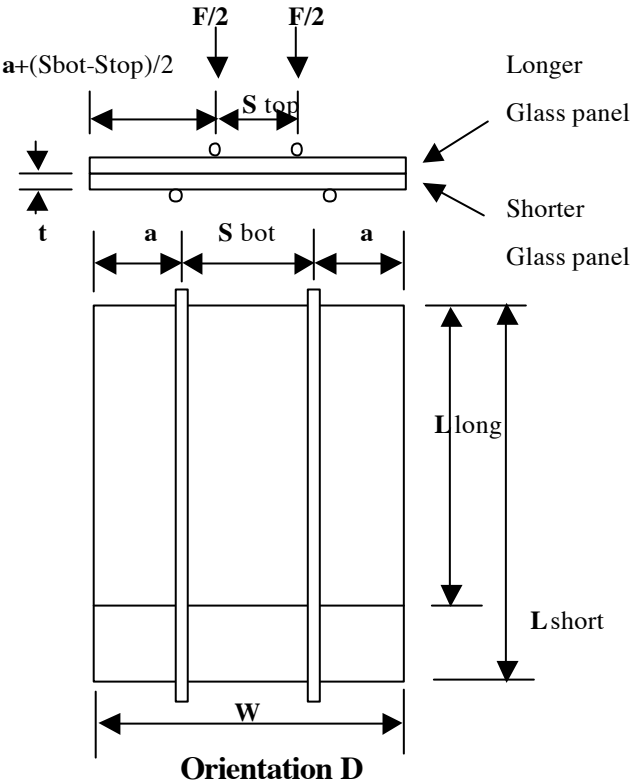
Orientation A



Orientation B



Orientation C



Orientation D

14.2 The Anisotropic Conductive Film (ACF) joint between glass and flex must have minimum of 1 lb/in peel strength.

15. RELIABILITY

No	Test Item	Condition
1	High Temperature Operation	Ta = +70℃, 240hrs
2	High Temperature & High Humidity Operation	Ta = +60℃, 90% RH, 88hrs
3	Low Temperature Operation	Ta = -30℃, 240hrs
4	High Temperature Storage (non-operation)	Ta = +85℃, 240hrs
5	Low Temperature Storage (non-operation)	Ta = -40℃, 240hrs
6	Heat Shock (non-operation)	-40℃ ← → 85℃, 27cycles (30min / 30min)
7	Electrostatic Discharge (Machine mode; non-operation)	±250V, C=200pF, R=0Ω; Once for each terminal
8	Electrostatic Discharge (Human body mode; non-operation)	±2.5KV, C=100pF, R=1.5KΩ; Once for each terminal
9	Electrostatic Discharge (Operation)	HBM ±5kV, (VCC, VCI, Reset) C=100pF, R=1.5KΩ;
10	Shock Test (Package state)	Height: 80cm 1 Corner, 3edges, 6 surfaces (Once for each direction)

Note: Ta: Ambient Temperature

16. HANDLING CAUTIONS

A. 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

i. 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.

ii. The machine and working table for the panel should have ESD protection strategy.

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

iv. In the process of assembly the module, shield case should connect to the ground.

B. Environment

v. Working environment of the panel should be in the clean room.

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

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

C. Others

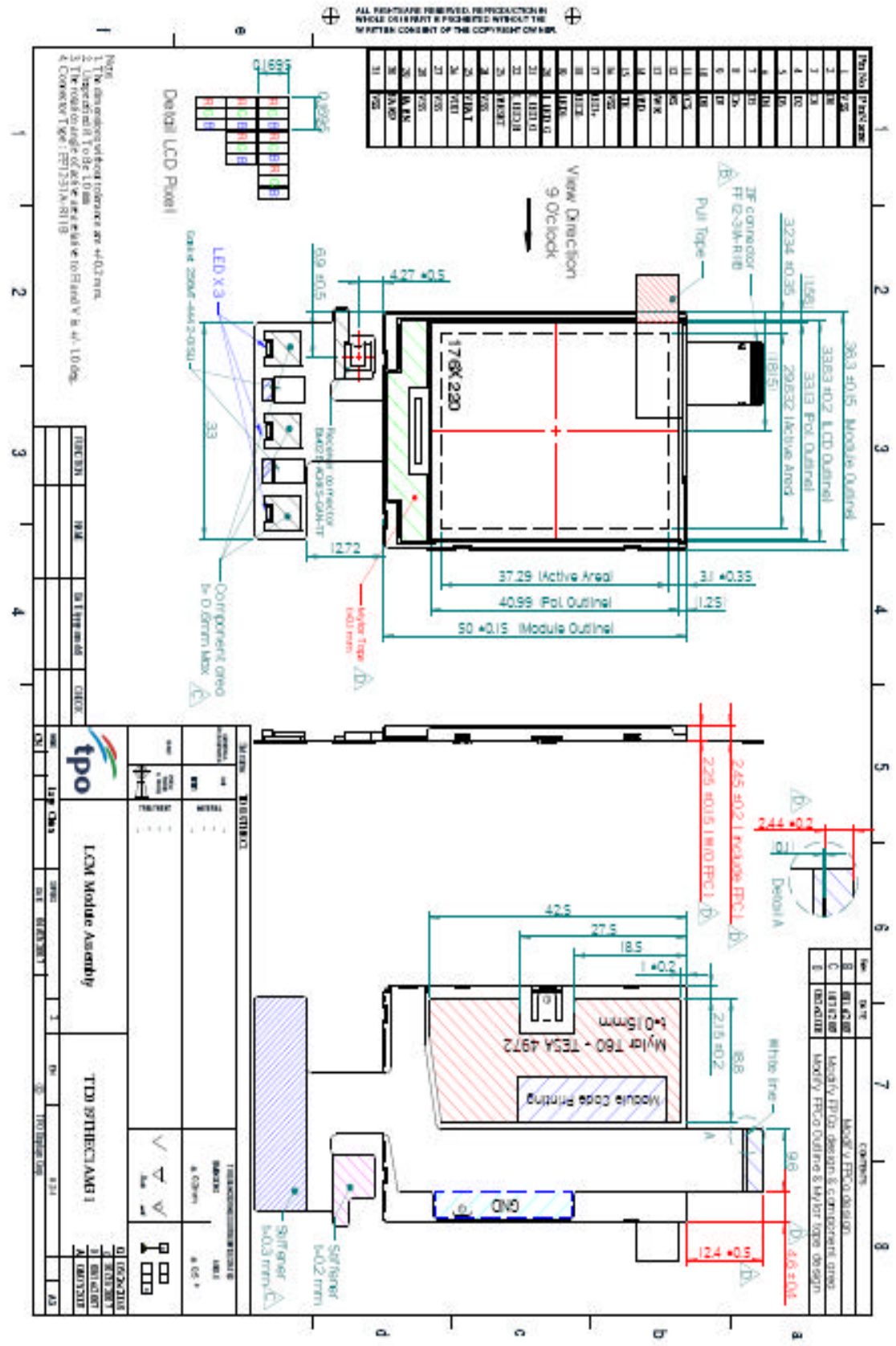
viii. Turn off the power supply before connecting and disconnecting signal input cable.

ix. Water drop on the surface or condensation as panel power on will corrode panel electrode.

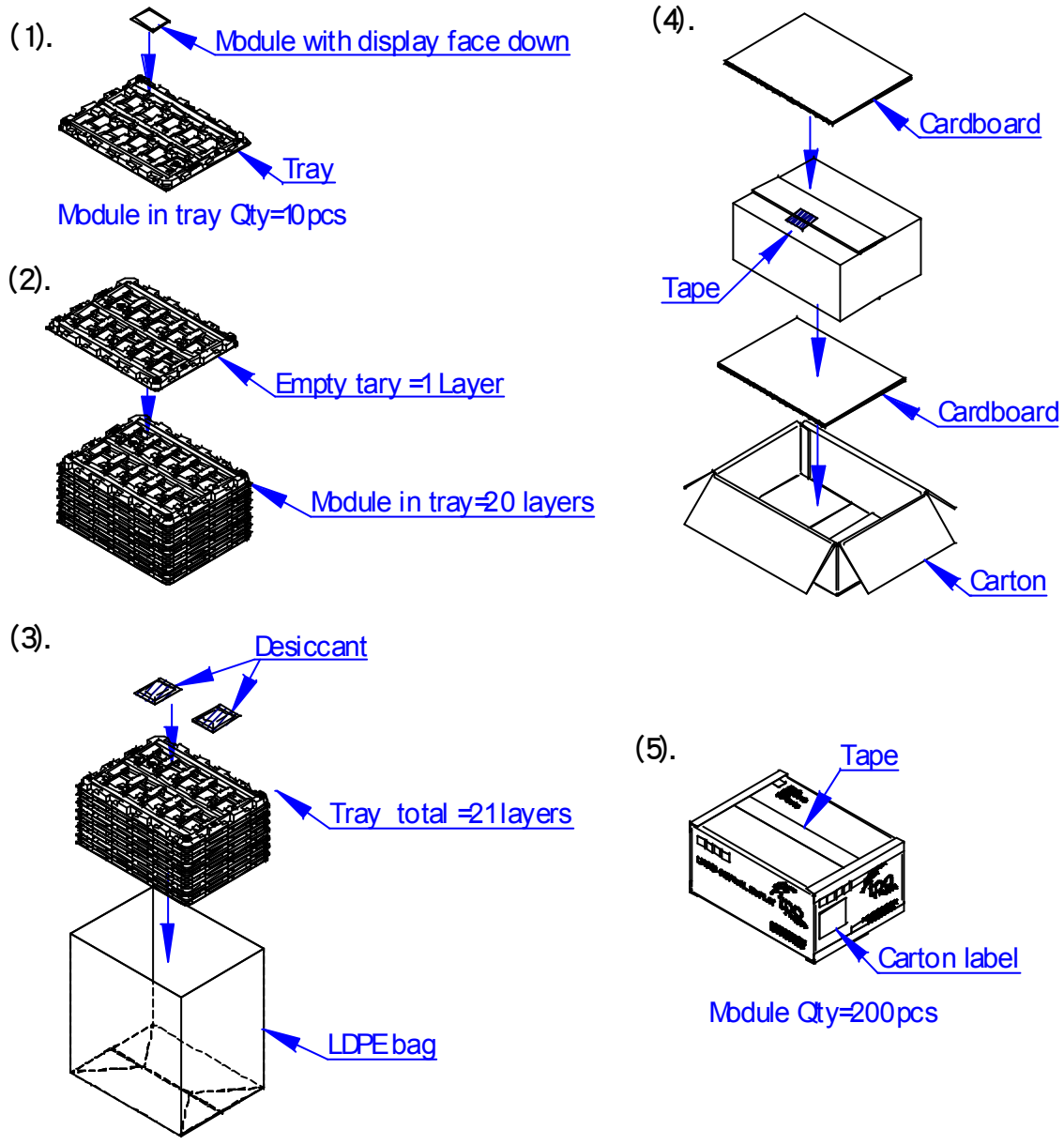
x. As the packing bag open, watch out the environment of the panel storage. High temperature and high humidity environment is prohibited.

xi. 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.

17. MECHANICAL DRAWING



18. PACKING DRAWING



1.9" module (TD019THEC1) 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.
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.