SAMSUNG ELECTRONICS

Approval

TO : OQO

DATE : July. 20. 2004

SAMSUNG TFT-LCD

MODEL NO. : LTP500WV-B04

Customer Approval

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Any Modification of Spec is not allowed without SEC's permission.

Approved by : ***H.J. KIM***

AMLCD DIVISION

Samsung Electronics Co . , LTD.

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Approval

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Revision History

Approval

Data	Rev. No.	Page	Summary
Nov. 24. 2003	000		Rev.000 was issued.
Jan. 10. 2004	001	27	TFT Pol. size changed. 68.97 → 67.97 (㎜)
Jul. 20. 2004	002	4,29	LTS500W1-PB4 → LTP500WV-B04 → LCD P/N was changed.
		13	Drawing was replaced with high quality one.
		27	1. Drawing was replaced with high quality one. 2. FPC dimension was changed → Dimensions of Ears were changed. - 2.5x2.5 ㎟ → 2.0x1.0 ㎟ (Bonding issue) → Rectangular hole was removed by customer issue. 3. Lower polarizer thickness was changed → 430 um → 390 um.

General Description

*** Description**

LTP500WV-B04 is a Transflective type color active matrix TFT(Thin Film Transistor) LCD(Liquid Crystal Display) that uses LTPS(Low Temperature Poly Silicon) TFT as a switching devices. This model is composed of a TFT-LCD panel, driver ICs and FPC. The resolution of a 5.0" contains 800 x 480 pixels and can display up to 260k colors.

*** Features**

- Transflective type and Landscape type.
- MTN(Mixed Twisted Nematic) mode.
- Integrated Gate Driver.
- Line inversion mode.
- Low Power consumption.

*** Applications**

- Display terminals for PDA application products.
- Smart phone / Game machine / Camcorder / Hand held PC.

*** General Information**

Items	Specification	Unit	Note
Display area	109.2(H) x 65.52(V)	mm	-
Driver element	Poly-Si TFT active matrix	-	-
Display colors	262,144	colors	-
Number of pixels	800(H) x 480(V)	pixel	-
Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.1365(H) x 0.1365(V)	mm	-
Display mode	Normally White	-	-
Viewing Direction	9:00	o'clock	-

*** Mechanical Information**

Item		Min.	Typ.	Max.	Unit	Note
Model size	Horizontal(H)	116.85	117.0	117.15	mm	
	Vertical(V)	75.75	75.90	76.05	mm	(1)
	Depth(D)	1.65	1.68	1.71	mm	
Weight		-	30.7	32.2	g	

Note (1) FPC is not included.

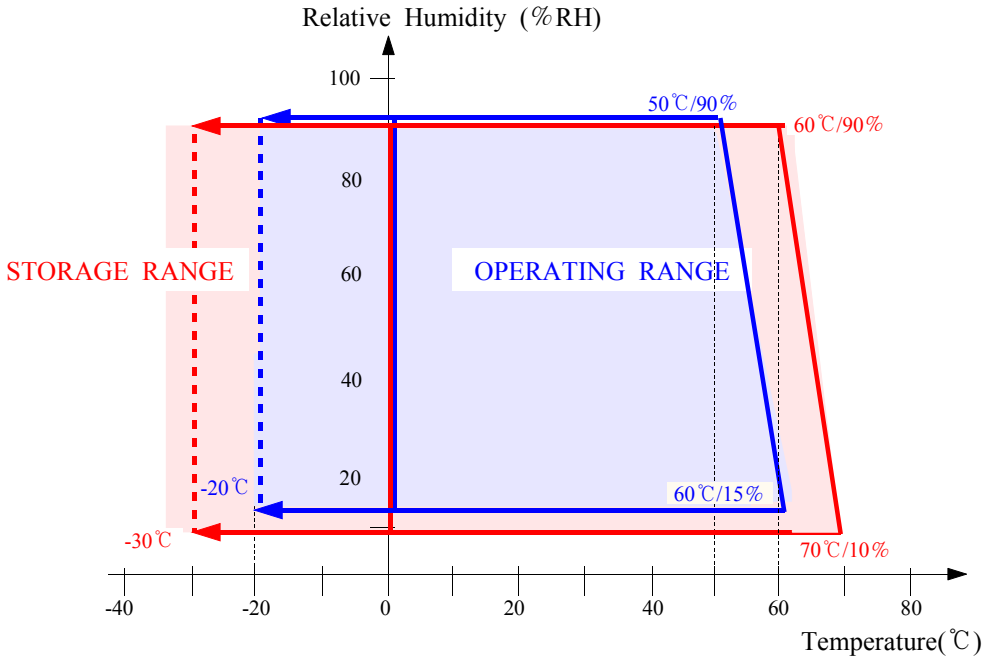
1. Absolute Maximum Ratings

1.1 Absolute Ratings of Environment

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	TSTG	-30	70	℃	(1)
Operating temperature (Ambient temperature)	TOPR	-20	60	℃	(1),(2)

Note (1) 90%RH maximum humidity, 60℃ maximum wet-bulb temperature

(2) When operated at a temperature lower than 0℃, the LCD worked slowly and the screen slowed appearing dim images due to the characteristics of LC (Liquid Crystal).



Temperature & Humidity Graph at Absolute Environment

1.2 Electrical Absolute Ratings

(1) TFT-LCD Module

(Ta = 25 ± 2°C, V_{SS}=GND=0V)

Characteristics	Symbol	Min.	Max.	Unit	Note
Digital Supply Voltage	DV_{DD}	-0.3	6.5	V	-
Analog Supply Voltage	AV_{DD}	-0.3	6.5	V	-
Gate On Voltage	V_{ON}	-0.3	20	V	-
Gate Off Voltage	V_{OFF}	V_{ON}-30	0.3	V	-
Signal Input voltage	V_I	-0.3	DV_{DD}+0.3	V	-
Common Voltage	V_{COM}	-1.5	5.5	V	AC

2. Optical Characteristics

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (2).
Measuring equipment: LCD-7200, BM-5A, BM-7, PR-650, EZ-Contrast

(Ta = 25 ± 2°C, I_B = 15mA)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Reflectance		Rf	B/L Off	5	6.3	-	%	(3) LCD-7200
Contrast ratio (Center point)		C/R1	B/L Off	10	17	-	-	(4) LCD-7200
		C/R2	B/L On	50	80	-	-	(4) BM-5A
Transmittance (Center point)		T	B/LOn	-	3.8	-	%	(5) BM-5A
Response time	Rising:Tr	Tr+Tf	-	-	30	50	msec	(6) LCD-7200 BM-7
	Falling:Tf							
Color chromaticity (CIE 1931)	White B/L Off	Wx1	B/L Off	0.290	0.320	0.350		(7) LCD-7200
		Wy1		0.340	0.370	0.400		
	White	Wx2	B/L On	0.205	0.305	0.405		(7) PR-650
		Wy2		0.220	0.320	0.420		
	Red	Rx		0.345	0.445	0.545		
		Ry		0.210	0.310	0.410		
	Green	Gx		0.220	0.320	0.420		
		Gy		0.325	0.425	0.525		
	Blue	Bx		0.075	0.175	0.275		
		By		0.105	0.205	0.305		
Viewing angle	Hor.	θL + θR	CR≥2 B/L Off	50	70	-	Degrees	(8) LCD-7200
	Ver.	ϕH + ϕL		80	100	-		
	Hor.	θL	CR≥10 B/L On	15	20	-		(8) EZ-Contrast
		θR		15	20	-		
	Ver.	ϕH		20	30	-		
		ϕL		35	50	-		

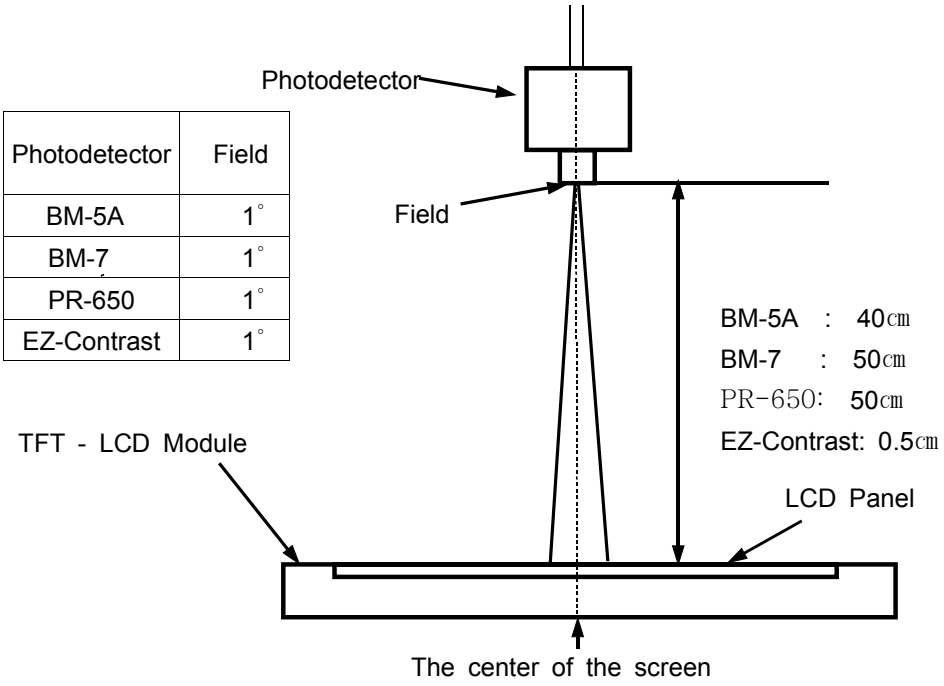
Note (1) If product is exposed to high temperatures for extended time, there is a possibility of the polarizer film damage which could degrade the optical characteristics.

Note (2) Test Equipment Setup

After stabilizing and leaving the panel alone at a given temperature for 30min, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30min after lighting light source. This should be measured in the center of screen.

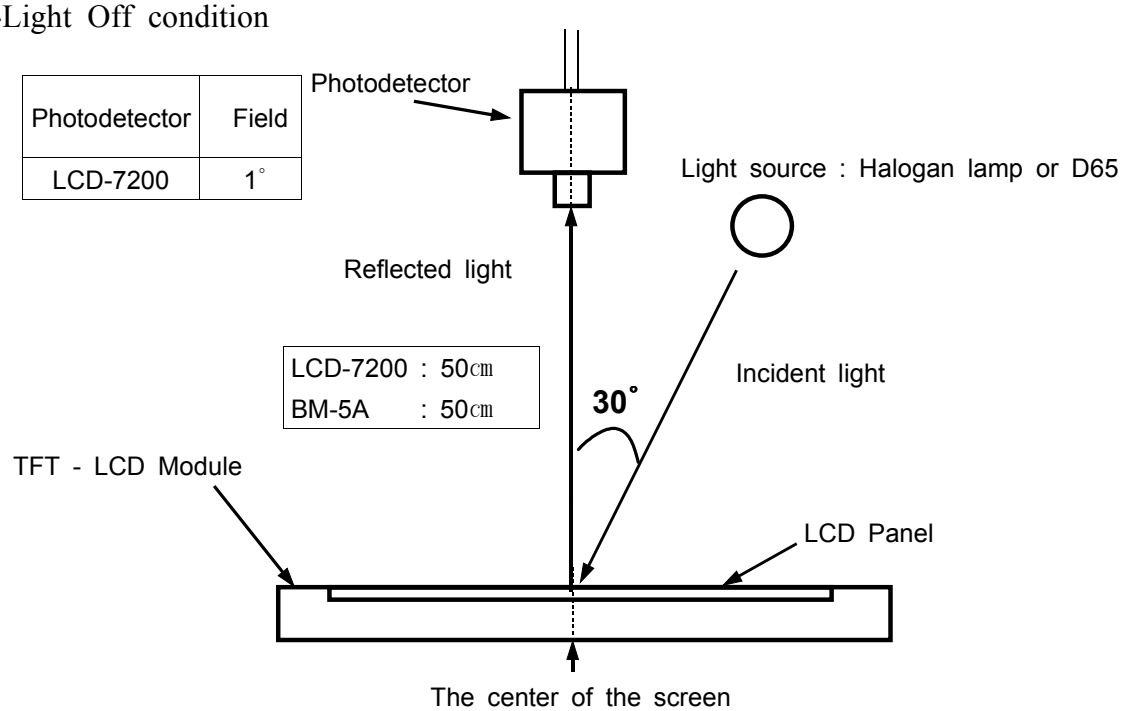
- Environment condition : Ta = 25 ± 2 °C
- Back-Light On condition

Photodetector	Field
BM-5A	1°
BM-7	1°
PR-650	1°
EZ-Contrast	1°



- Back-Light Off condition

Photodetector	Field
LCD-7200	1°



Note (3) Definition of Reflectance : The reflectance is relative quantity to the standard white $BaSO_4$ or MgO plate that the reflectance of the standard white plate is the 100%.

$$\text{Reflectance} = \frac{\dfrac{\text{Intensity of the reflected light on LCD}}{\text{Intensity of the incident light on BaSO4 plate}}}{\dfrac{\text{Intensity of the reflected light on BaSO4 plate}}{\text{Intensity of the incident light on BaSO4 plate}}} \text{ X } 100\%$$

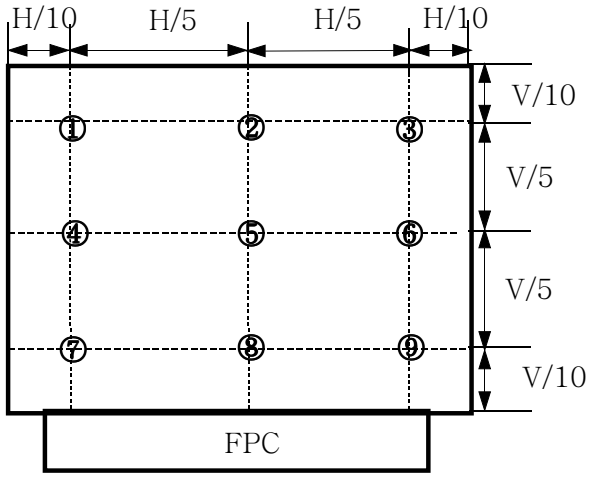
Note (4) Definition of Contrast Ratio (C/R) : Ratio of gray max (Gmax) & gray min (Gmin) at the center point of the panel.

$$C/R = \frac{Gmax}{Gmin}$$

* Gmax : Luminance with all pixels white
* Gmin : Luminance with all pixels black

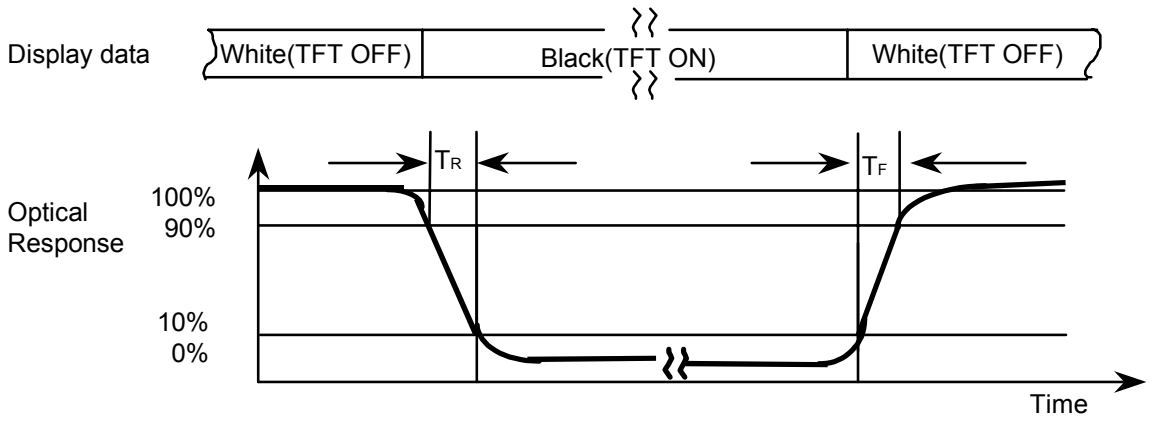
Note (5) Definition of Transmittance

$$\text{Transmittance}(\%) = \frac{\text{Luminance of Panel}}{\text{Luminance of Backlight unit}} \text{ X } 100\%$$



The spot locations for luminance measurement

Note (6) Definition of Response time : Sum of Tr ,Tf

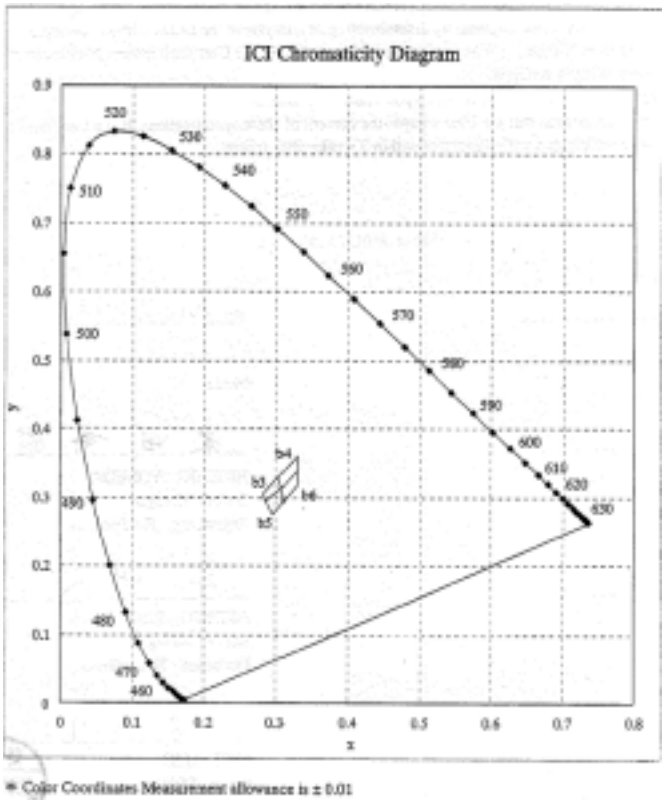


Note (7) Definition of Color Chromaticity (CIE 1931)

Color coordinate of white & red, green, blue at center point.

- Back-Light On condition Light source

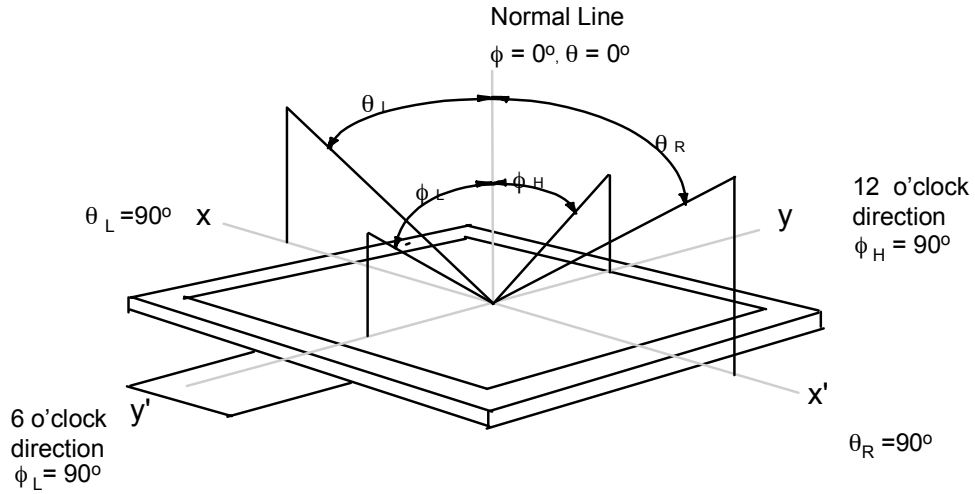
* Nichia Withe LED (NSCW215T) b3~b6 rank 8EA



* Color Coordinates Measurement allowance is ± 0.01

	Rank b3			
x	0.287	0.283	0.304	0.307
y	0.295	0.305	0.330	0.315
	Rank b4			
x	0.307	0.304	0.330	0.330
y	0.315	0.330	0.360	0.339
	Rank b5			
x	0.296	0.287	0.307	0.311
y	0.276	0.295	0.315	0.294
	Rank b6			
x	0.311	0.307	0.330	0.330
y	0.294	0.315	0.339	0.318

Note (8) Definition of Viewing Angle



3. Electrical Characteristics

3.1 TFT-LCD Module

(Ta = 25 ± 2°C)

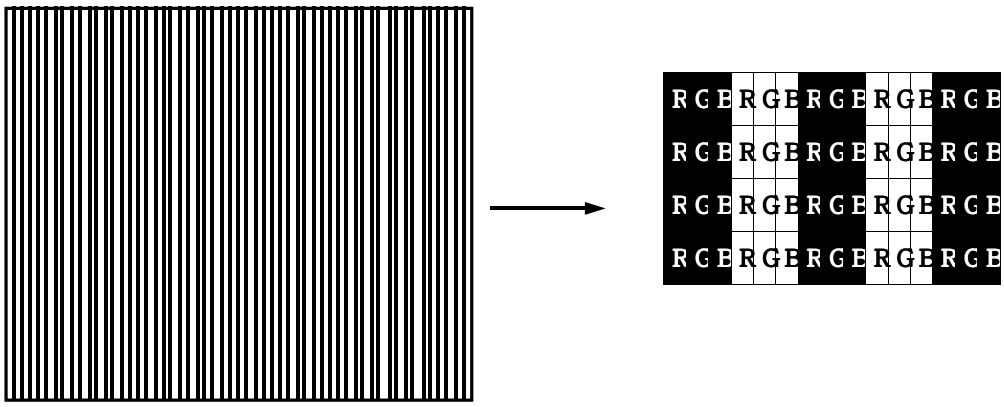
Characteristics		Symbol	MIN.	TYP.	MAX.	Unit	Note
Digital supply voltage		DV_{DD}	3.0	3.3	3.6	V	
Analog supply voltage		AV_{DD}	4.75	4.85	4.95	V	
Gate On voltage		V_{ON}	10.5	11.5	12.5	V	(1)
Gate Off voltage		V_{OFF}	-8	-7	-6	V	
Common voltage		$V_{COMH(Vpp)}$	4.1	4.2	4.3	V	
Digital supply current		I_{DVDD}	-	7	-	mA	
Analog supply current		I_{AVDD}	-	10	-	mA	
Gate supply current		$I_{VON/VOFF}$	-	0.4	-	mA	
Input voltage	Source driver (High)	V_{IHS}	$0.7DV_{DD}$	-	DV_{DD}	V	
	Source driver (Low)	V_{ILS}	GND	-	$0.3DV_{DD}$	V	
Power Dissipation	White	P_W	-	75	-	mW	(2),(3), (4)
	Black	P_B	-	150	-		
	Vertical	P_V	-	105	-		

Note (1) $V_{ON} + |V_{OFF}| \leq 18.5$

(2) Condition : TFT-LCD module only with typ. electrical characteristics

(3) Power dissipation check pattern

[800 x 480 Vertical Line]



Note (4) Reference Circuit

See the next page.

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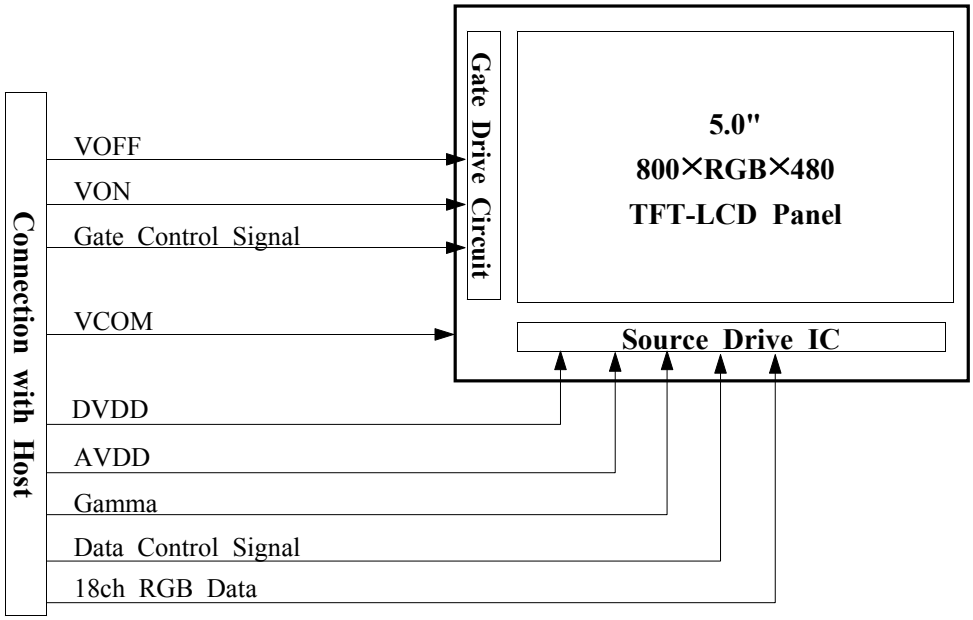
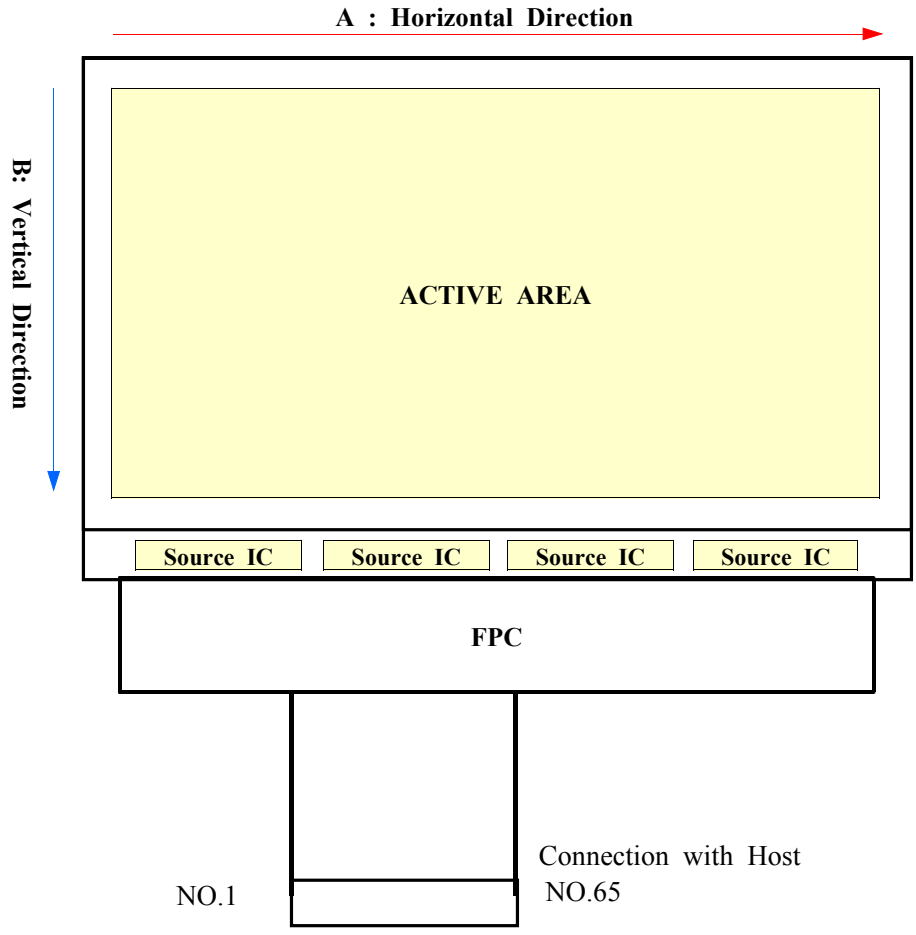
4. Block Diagram

4.1 TFT-LCD Module



The scanning direction for the horizontal period and the vertical period are A and B respectively as shown below. The scanning directions are from a front view.



5. Input Terminal Pin Assignment

5.1 TFT-LCD Module (Connector : 65Pin FPC type → KYOCERA 00-6267-065-000-851)

Pin No	Symbol	Description	Remark
1	VSS	Ground	-
2	VOFF	Power Supply (Gate OFF)	-
3	VOFF	Power Supply (Gate OFF)	-
4	VCOM1	Common Voltage	-
5	STV	Vertical Start Pulse	-
6	CPV	Vertical Shift Clock	-
7	DVDD	Power Supply (+3.3V)	-
8	TG1	TG1 Open Pulse	-
9	TG2	TG2 Open Pulse	-
10	VON	Power Supply (Gate ON)	-
11	VON	Power Supply (Gate ON)	-
12	VSS	Ground	-
13	NC	No Connection	-
14	NC	No Connection	-
15	VCOM2	Common Voltage	-
16	DVDD	Power Supply (+3.3V)	-
17	VSS	Ground	-
18	AVDD	Power Supply (+4.85V)	-
19	STH	Horizontal Start Pulse	-
20	RG5	Red & Green Pixel Data	-
21	RG4	Red & Green Pixel Data	-
22	RG3	Red & Green Pixel Data	-
23	RG2	Red & Green Pixel Data	-
24	RG1	Red & Green Pixel Data	-
25	RG0	Red & Green Pixel Data	-
26	VSS	Ground	-
27	BR5	Blue & Red Pixel Data	-
28	BR4	Blue & Red Pixel Data	-
29	BR3	Blue & Red Pixel Data	-
30	BR2	Blue & Red Pixel Data	-
31	BR1	Blue & Red Pixel Data	-
32	BR0	Blue & Red Pixel Data	-
33	HCLK	Horizontal Sampling Clock	-
34	INV	Digital Data Inversion	-

Pin No	Symbol	Description	Remark
35	AVDD	Power Supply (+4.85V)	-
36	VREF0	Gray Scale Voltage	-
37	VREF1	Gray Scale Voltage	-
38	VREF2	Gray Scale Voltage	-
39	VREF3	Gray Scale Voltage	-
40	VREF4	Gray Scale Voltage	-
41	VREF5	Gray Scale Voltage	-
42	VREF6	Gray Scale Voltage	-
43	VREF7	Gray Scale Voltage	-
44	VREF8	Gray Scale Voltage	-
45	VREF9	Gray Scale Voltage	-
46	VREF10	Gray Scale Voltage	-
47	VSS	Ground	-
48	TP	Source Driver Data Load Pulse	-
49	GB5	Green & Blue Pixel Data	-
50	GB4	Green & Blue Pixel Data	-
51	GB3	Green & Blue Pixel Data	-
52	GB2	Green & Blue Pixel Data	-
53	GB1	Green & Blue Pixel Data	-
54	GB0	Green & Blue Pixel Data	-
55	AVDD	Power Supply (+4.85V)	-
56	VSS	Ground	-
57	DVDD	Power Supply (+3.3V)	-
58	VCOM3	Common Voltage	-
59	VCOM4	Common Voltage	-
60	VSS	Ground	-
61	NC	No Connection	-
62	NC	No Connection	-
63	NC	No Connection	-
64	NC	No Connection	-
65	NC	No Connection	-

5.2 Input Signal, Basic Display Colors and Gray Scale of Each Colors

COLOR	DISPLAY	DATA SIGNAL																		GRAY SCALE LEVEL
		RED						GREEN						BLUE						
		R0	R1	R2	R3	R4	R5	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	B4	B5	
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	-
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0
	DARK	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1
	↑	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R60
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	↓	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R61
	LIGHT	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R62
	RED	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R63
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0
	DARK	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	G1
	↑	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	G2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~G60
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	↓	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0	G61
	LIGHT	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	G62
	GREEN	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	G63
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0
	DARK	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	B1
	↑	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	B2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B60
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	↓	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	B61
	LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	B62
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	B63

Note) Definition of Gray :

Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

Input Signal : 0 = Low level voltage, 1 = High level voltage

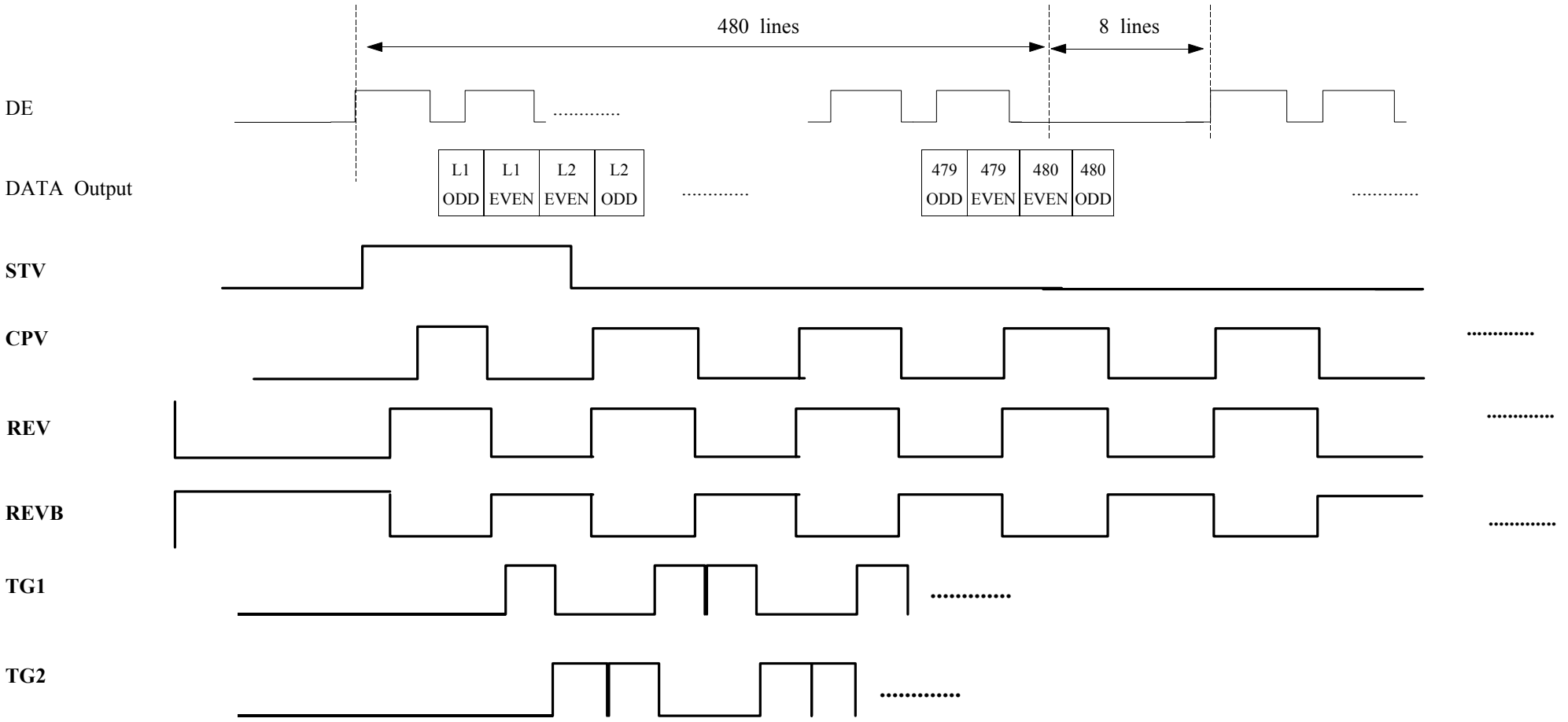
※R5,G5,B5:MSB R0,G0,B0:LSB

6. Interface Timing

6.1 Timing Parameters of TFT-LCD Module Input Signals

ITEM	Symbol	MIN.	TYP.	MAX.	Unit
HCLK frequency	$1/t_{HCLK}$	-	26.7	-	MHz
HCLK pulse low width	t_{WL1}	$0.5t_{HCLK}$	-	-	-
HCLK pulse high width	t_{WH1}	$0.5t_{HCLK}$	-	-	-
STH setup time	t_{ST1}	15	-	-	ns
STH hold time	t_{HD1}	15	-	-	ns
TP setup time	t_{ST2}	15	-	-	ns
TP hold time	t_{HD2}	15	-	-	ns
INV setup time	t_{ST3}	15	-	-	ns
INV hold time	t_{HD3}	15	-	-	ns

6.2 Timing Diagrams of Interface Signal (TFT-LCD Module)



< Vertical Timing Diagram >

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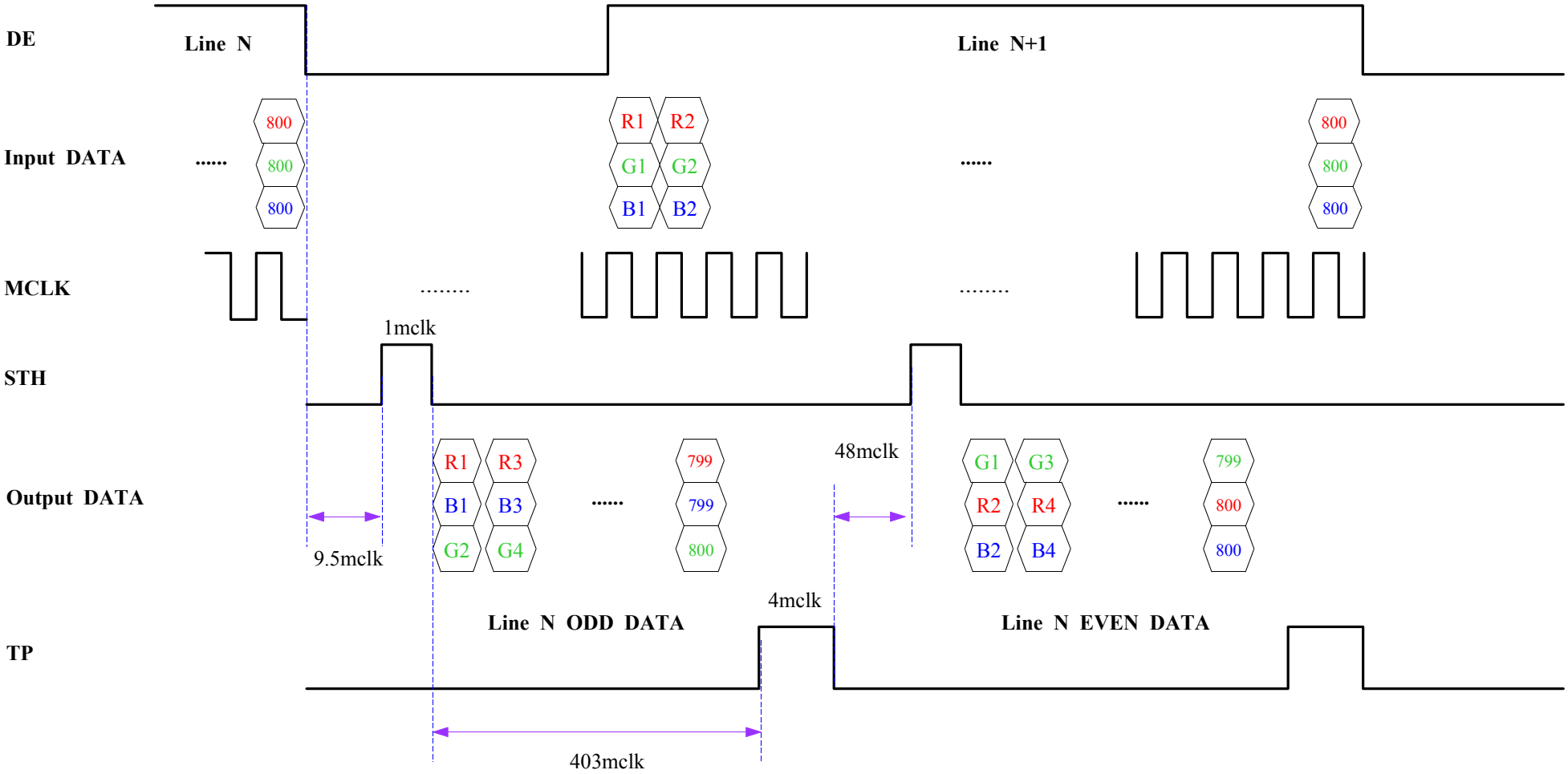
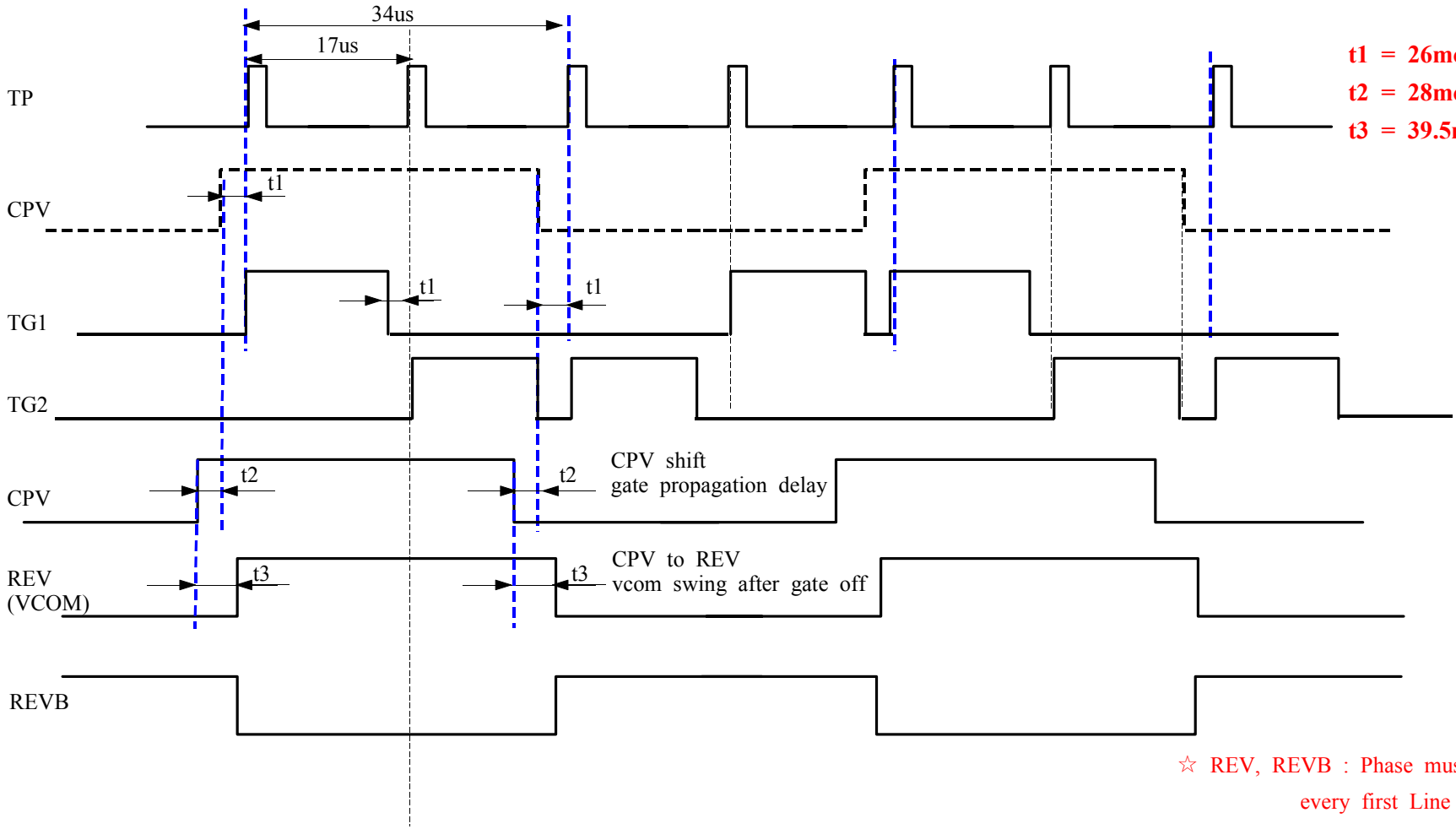


< Horizontal Timing Diagram >



< Horizontal & Vertical Timing Diagram >

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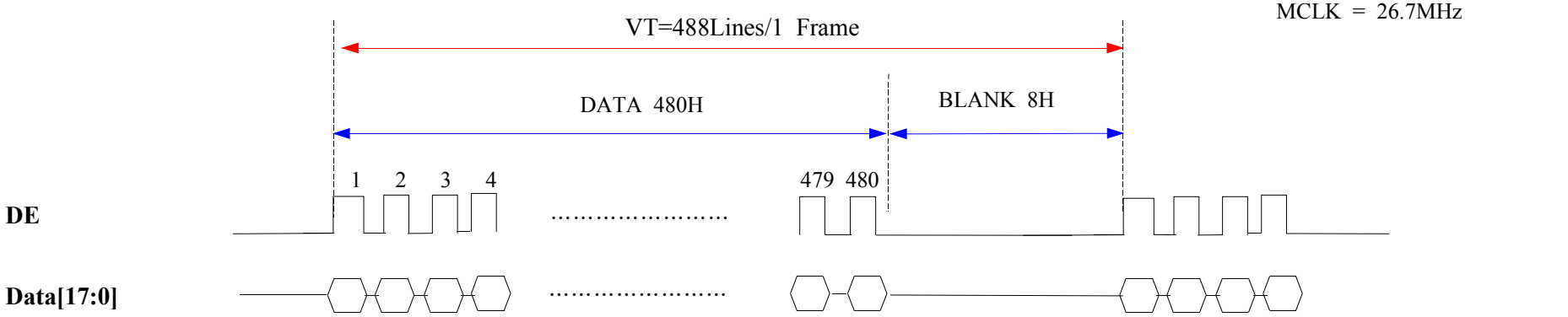
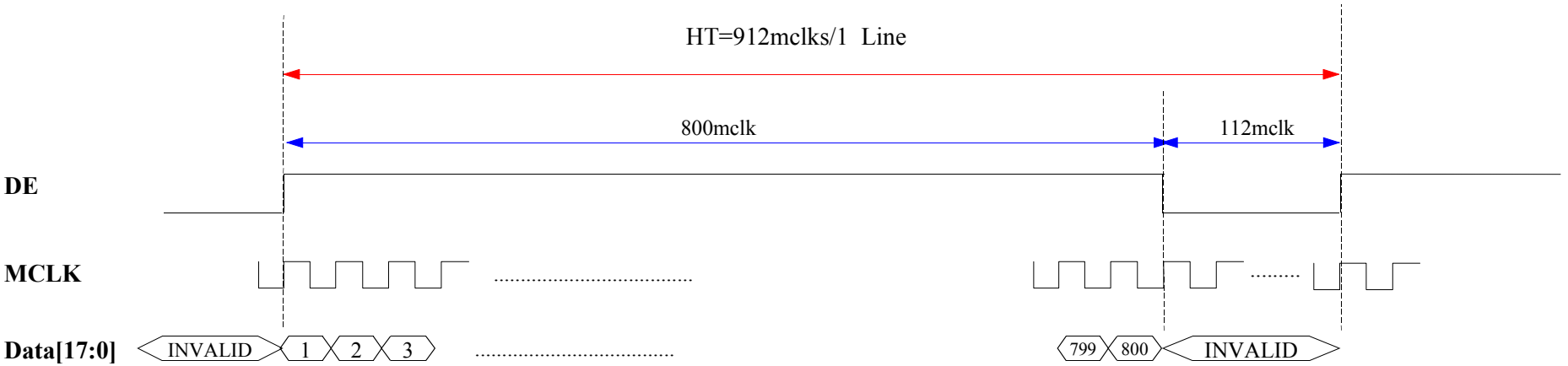
6.3 Timing Diagrams of Interface Signal (Timing Controller)

< 800(H) × 480(V) , DE mode Only >

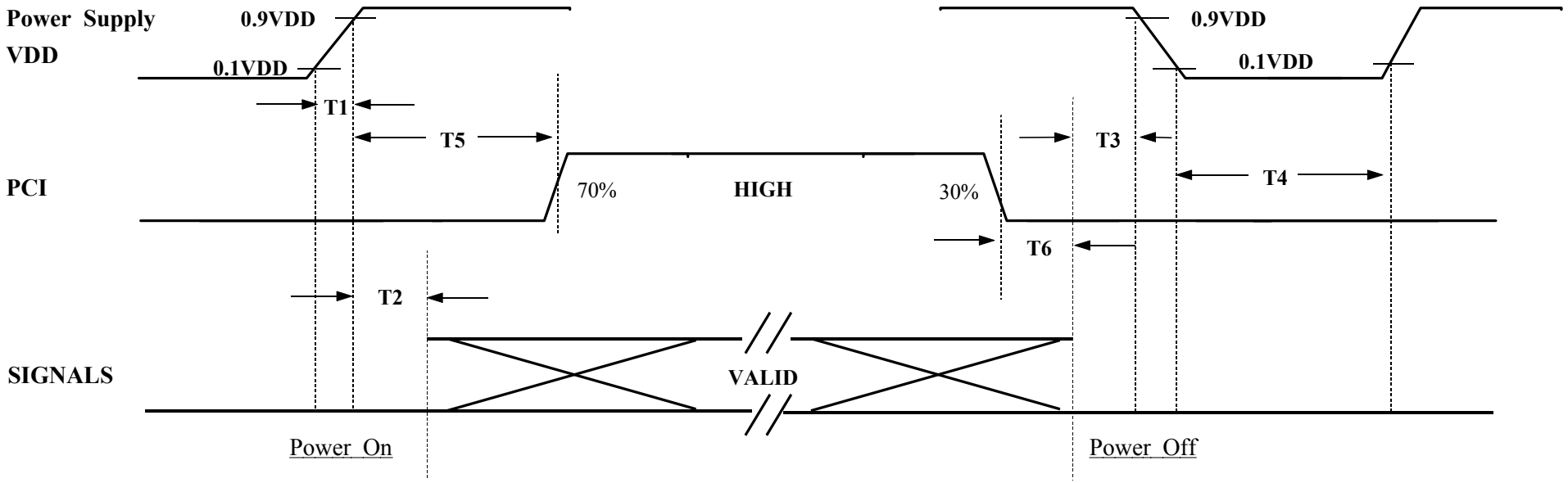
Frame Rate = 60 Hz
MCLK = 26.7MHz





6.4 Power On/Off Sequence

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence shall be as shown below.



0 < T1 ≤ 10ms	* T1 : VDD rising from 10% to 90%.
0 < T2 ≤ 50ms	T2 : The time from VDD to valid data at power ON.
T3 = 0	T3 : The time from Valid data off to VDD off at power Off
1000ms ≤ T4	T4 : VDD off time for Windows restart.
110 < T5 ≤ 140ms	T5 : The time from VDD to PCI signal HIGH at power ON.
20 < T6 ≤ 50ms	T6 : The time from PCI signal LOW to VDD off at power Off.

Note) (1) The supply voltage of the external system for the module input should be the same as the definition of VDD.

(2) In case of VDD = off level, please keep the level of input signals on the low or keep a high impedance.

(3) T4 should be measured after the module has been fully discharged between power off and on period.

(4) Interface signal shall not be kept at high impedance when the power is on.

(5) PCI : Power Control In

H - Normal Data Output

L - White Data Output

7. Reliability Test Result

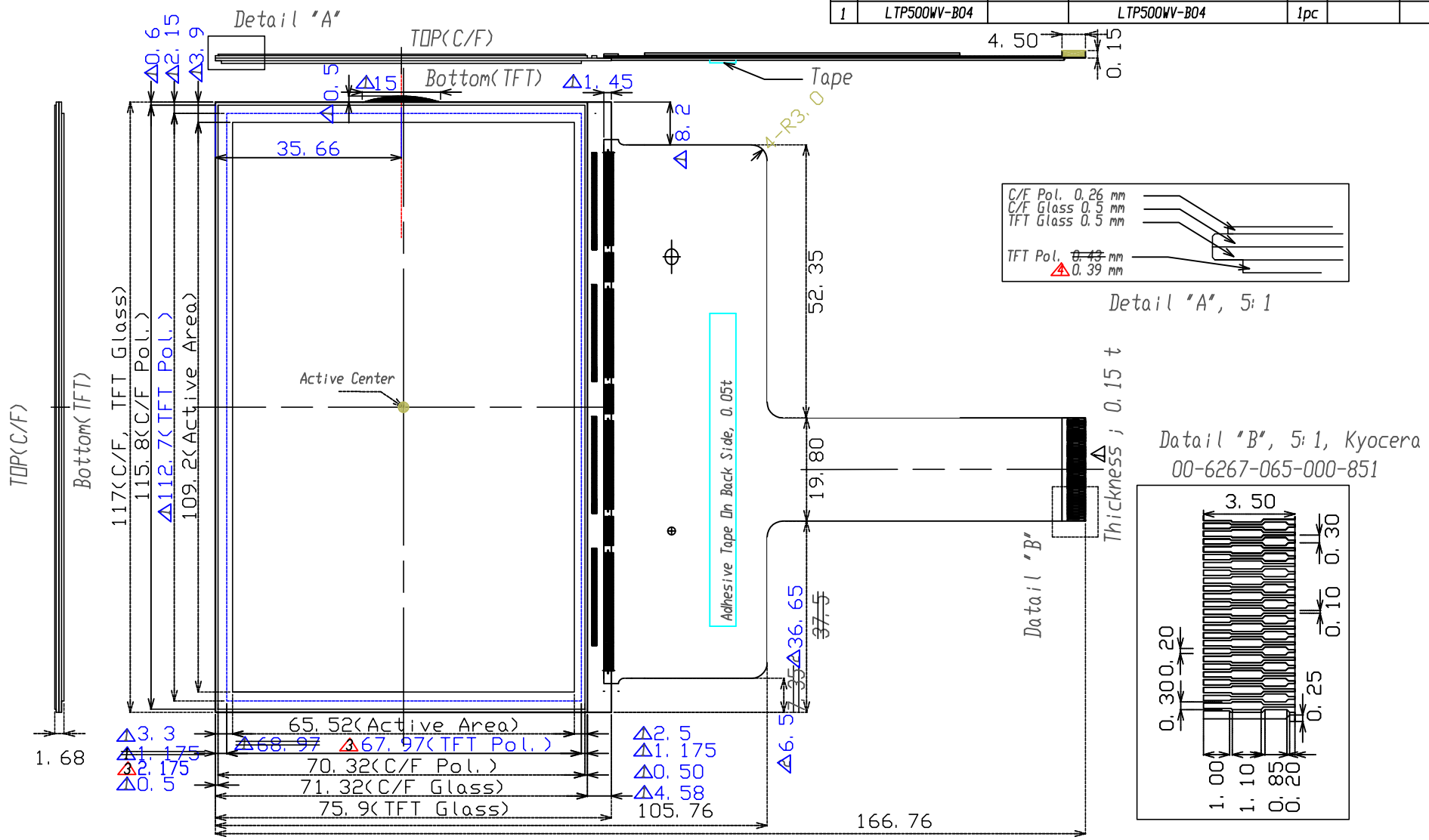
Item		TEST CONDITION	Test Result
High Temperature Operating Life Test		60℃, 240Hrs	No Failure
Low Temperature Operating Life Test		-20℃, 240Hrs	No Failure
Temperature Cycle On/Off Test		-30℃↔70℃ On/Off, 12Cycles	No Failure
High Temperature Storage Test		70℃, 240Hrs	No Failure
Low Temperature Storage Test		-30℃, 240Hrs	No Failure
Wet Humidity Temperature Storage Test		60℃/90%RH, 240Hrs	No Failure
Thermal Humidity Bias Test		50℃/90%RH, 240Hrs	No Failure
Thermal Shock Test (Non-Operating)		-25℃↔70℃, 100Cycles	No Failure
Low Pressure Test (Non-Operating)		115mb/RT, 72Hrs	No Failure
Electro-Static Discharge Test (Non-Operating)	Contact	±4kV, 150pF/330Ω, 20Times	No Failure
	Air	±8kV, 150pF/330Ω, 20Times	No Failure
BOX Vibration Test		RANDOM 0.74Grms MIL-STD 810E, 1HR/Y-axis	No Failure
BOX Drop Test		1Corner, 3Edges, 6Faces, 76㎝	No Failure

8. Outline Dimensions

8.1 Module Outline Dimensions

- Refer to the Next Page.

NO	PART NAME	CODE NO	SPECIFICATION	Q'TY	SPEC NO	REMARK
1	LTP500WV-B04		LTP500WV-B04	1pc		



REV	DATE	DESCRIPTION OF REVISION
03	'04,07,18	3 Outline (FPC 2 Ear, Center Hole) Changed △1 1 Demension Point Changed
02	'04,01,07	△2 2 Demension Point Changed by Customer Issue
01	'03,10,21	Tolerance Level Changed From Level 3 to Level 2 △16 16 Dimension Point Appended △2 2 Demension Point Changed

GENERAL TOLERANCE			
STEP	LEVEL 1	LEVEL 2	LEVEL 3
0 < X ≤ 4	±0.05	±0.1	±0.2
4 < X ≤ 16	±0.08	±0.15	±0.3
16 < X ≤ 64	±0.12	±0.25	±0.5
64 < X ≤ 256	±0.25	±0.4	±0.8

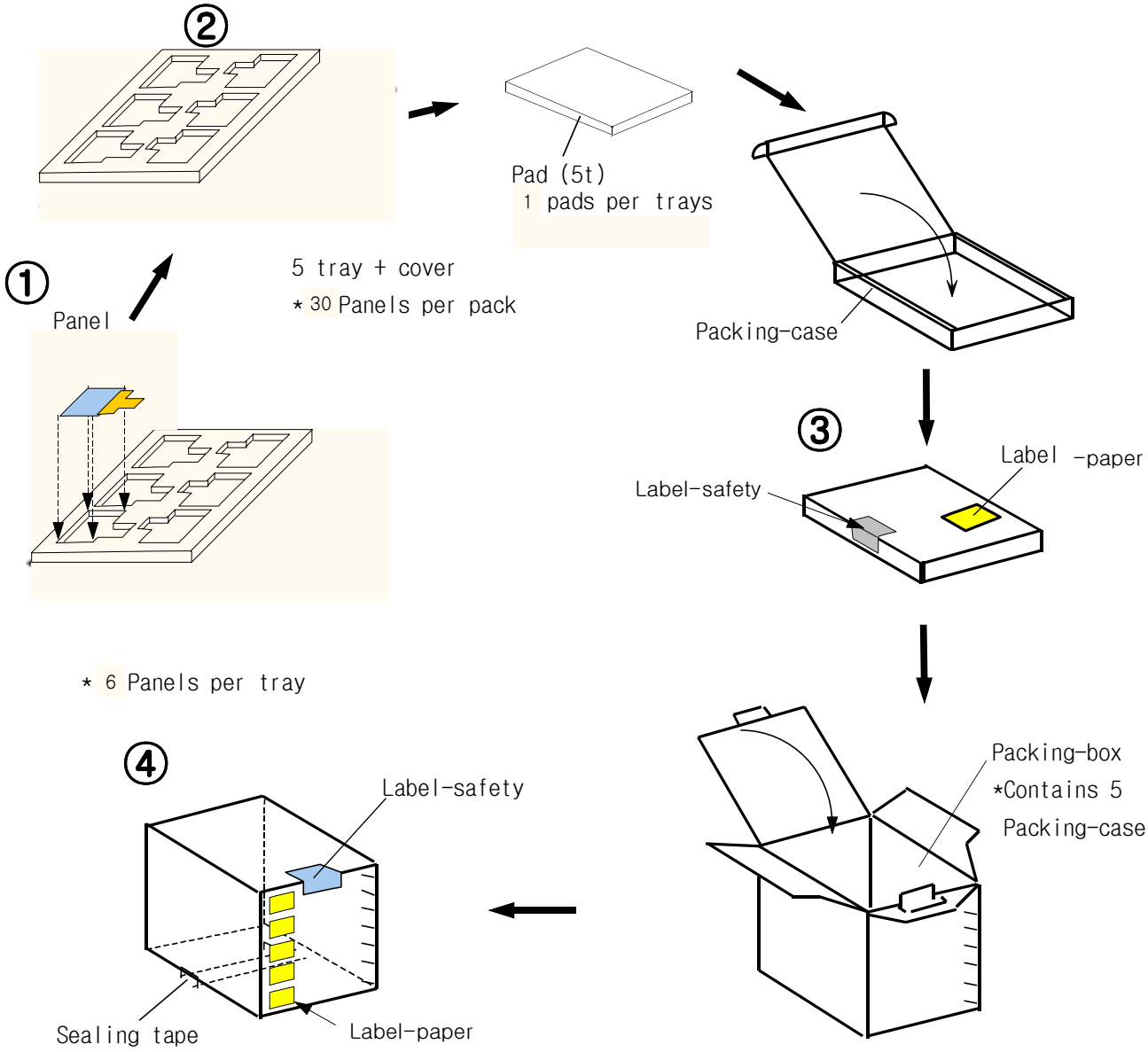
UNIT	mm	DRA'N BY	DES'D BY	CHK'D BY	APP'D BY
SCALE	1/1	S.C.Song		U.S.Kim	
TOLERANCE LEVEL	2	'04,07,18		'04,07,18	

SAMSUNG ELECTRONICS

SPEC. NO: TBD

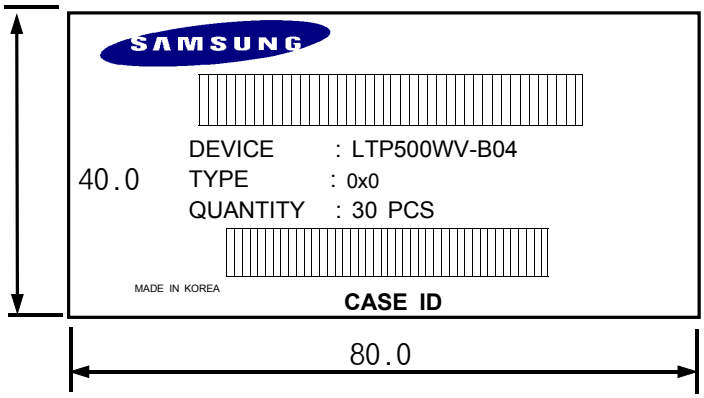
CUSTOMER DEMAND	-
SPEC RATIONALIZATION	-
REASON	-
MODEL NAME	LTP500WV-B04
PART/SHEET NAME	Outline Dimension
SHEET	1/1
CODE NO.	
VER.	3.0

9. PACKING


②
Pad (5t)
1 pads per trays
5 tray + cover
* 30 Panels per pack
①
Panel
Packing-case
③
Label -paper
Label-safety
* 6 Panels per tray
Packing-box
*Contains 5
Packing-case
④
Label-safety
Sealing tape
Label-paper

10. MARKING & OTHERS

(1) Packing case attach



TYPE : 0 x 0

- Part Revision (R, 0, 1, 2, 3, ...)
  - R: R&D Sample, - 0: MP Revision 0
- Module Manufacturing Site
  - 0: SEC Module Line
  - A: HYESUNG LMD CO., LTD.
  - B: IDS CO., LTD.
- Customer Code

CASE ID : NA 0 00 00001

- Serial No.(00001-99999)
- Week
- Year
- Device

11. General Precautions

11.1 Handling

(a) When the module is assembled, it should be attached to the system firmly. Be careful not to twist and bend the module.

(b) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module.

(c) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.

(d) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.

(e) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.

(f) The desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane. Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.

(g) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.

(h) Protect the module from static, it may cause damage to the CMOS Gate Array IC.

(i) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

(j) Do not disassemble the module.

(k) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.

(l) Pins of I/F connector shall not be touched directly with bare hands.

11.2 Storage

(a) Do not leave the panel in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35°C and relative humidity of less than 70%.

(b) Do not store the TFT-LCD module in direct sunlight.

(c) The module shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

11.3 Operation

(a) Do not connect, disconnect the module in the "Power On" condition.

(b) Power supply should always be turned on/off by the item 6.4 "Power on/off sequence"

11.4 Others

(a) The liquid-crystal is deteriorated by ultraviolet rays. Do not leave it in direct sunlight and strong ultraviolet rays for many hours.

(b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.

(c) Do not exceed the absolute maximum rating value. (the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on)
Otherwise the panel may be damaged.

(d) If the panel displays the same pattern continuously for a long period of time, it can be the situation when the image "Sticks" to the screen.

(e) This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.