

Panasonic Liquid Crystal Display Co.,Ltd.

For Messrs. PROMATE ELECTRONIC CO., LTD.




CUSTOMER'S ACCEPTANCE SPECIFICATIONS

VVX21F144H00

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Accepted by Date:	Panasonic Liquid Crystal Display Co., Ltd.
	Approved by 
	Reviewed by 
	Proposed by 

RECORD OF REVISION

Date	The upper section : Previous revision The lower section : New revision		Summary
	Sheet No.	Page	

DESCRIPTION

The following specifications are applied to the following IPS-TFT LCD module.

Product Name : VVX21F144H00

Product Factory : Panasonic Liquid Crystal Display Co.,Ltd.

General Specifications

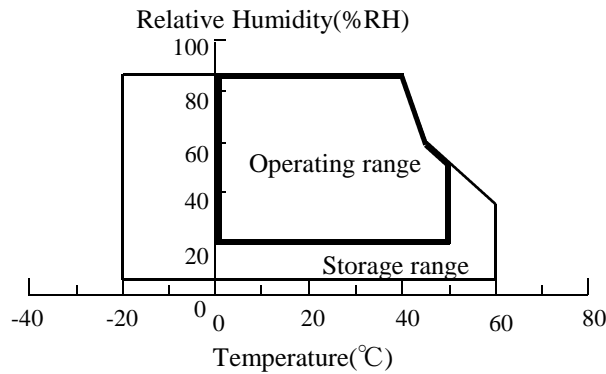
Effective display area	: (H) 432 × (V) 324	(mm)
Number of pixels	: (H) 1,600 × (V) 1,200	(pixels)
Pixel pitch	: (H) 0.270 × (V) 0.270	(mm)
Color pixel arrangement	: R+G+B vertical stripe	
Display mode	: Transmissive mode Normally black mode	
Top polarizer type	: Anti-Glare Hardness "3H"	
Number of colors	: 16,777,216	(colors)
Viewing angle range	: Super wide version (Horizontal & Vertical : 178°, CR ≥ 10)	
Input signal	: LVDS (LVDS : Low voltage differential signaling)	
Backlight	: 100 pcs of LED (LED : Light-emitting diode)	
External dimensions	: Typ. (H) 456 × (V) 349.5 × (T)22	(mm)
Weight	: Typ. 2,800	(g)
Particular mention	: Rohs Compliance	

1. ABSOLUTE MAXIMUM RATINGS

1.1 Environmental Absolute Maximum Ratings

ITEM	Operating		Storage		UNIT	NOTE
	Min.	Max.	Min.	Max.		
Temperature	0	50	-20	60	°C	1),6)
Humidity	2)		2)		%RH	1)
Vibration	-	4.9(0.5 G)	-	14.7(1.5 G)	m/s ²	3),4)
Shock	-	29.4(3 G)	-	294(30 G)	m/s ²	4),5)
Corrosive Gas	Not Acceptable		Not Acceptable		-	
Illumination at LCD Surface	-	50,000	-	50,000	1x	

- Note 1) Temperature and Humidity should be applied to the glass surface of a TFT LCD module, not to the system installed with a module.
- 2) $T_a \leq 40\text{ }^\circ\text{C}$ ······Relative humidity should be less than 85 %RH max. Dew is prohibited.
 $T_a > 40\text{ }^\circ\text{C}$ ······Relative humidity should be lower than the moisture of the 85 %RH at 40 °C.



- 3) Frequency of the vibration is between 15 Hz and 100 Hz. (Remove the resonance point) 1 hour and sine wave.
- 4) Direction : ±X, ±Y, ±Z (One time each direction)
- 5) Pulse width of the shock is 10 ms.
- 6) The temperature of LCD front surface would be 65 °C in operating, it may affect the optical characteristics however it does not damage the function of the module.

1. 2 Electrical Absolute Maximum Ratings

(1)TFT-LCD module

GND=0V

ITEM	SYMBOL	Min.	Max.	UNIT	NOTE
Power supply voltage	VDD	-0.3	6.5	V	
Input Voltage for logic	V1	-0.3	4.0	V	1)
Electrostatic Durability	V _{ESD0}	±100		V	2),3)
	V _{ESD1}	±4		kV	4),5)

- Note
- 1) It is applied to pixel data signal, clock signal and other control signals.
 - 2) Constant discharge: 200pF-0Ω(GRD=0V), Environment: 15-35°C/30-60%RH, Contact Discharge.
 - 3) It is applied to I/F connector pins. Non-operating.
 - 4) Constant discharge: 150pF-330Ω, Environment: 15-35°C/30-60%RH, Aerial Discharge.
 - 5) It is applied to the surface of a metallic bezel and a LCD panel. Operating.

(2) Backlight unit

ITEM	SYMBOL	Max.	UNIT	NOTE
Temperature Junction of LED	T _j	120	°C	1)
Forward Current	I _f	90	mA/string	2)

- Note
- 1) The specification shall be applied to each LED.
 - 2) The specification shall be applied at connector pins for LED at start-up.

2. INITIAL OPTICAL CHARACTERISTICS

The following optical characteristics are measured under stable conditions. It takes about 30 minutes to reach stable conditions. The measuring point is the center of display area unless otherwise noted.

The optical characteristics should be measured in a dark room or equivalent state.

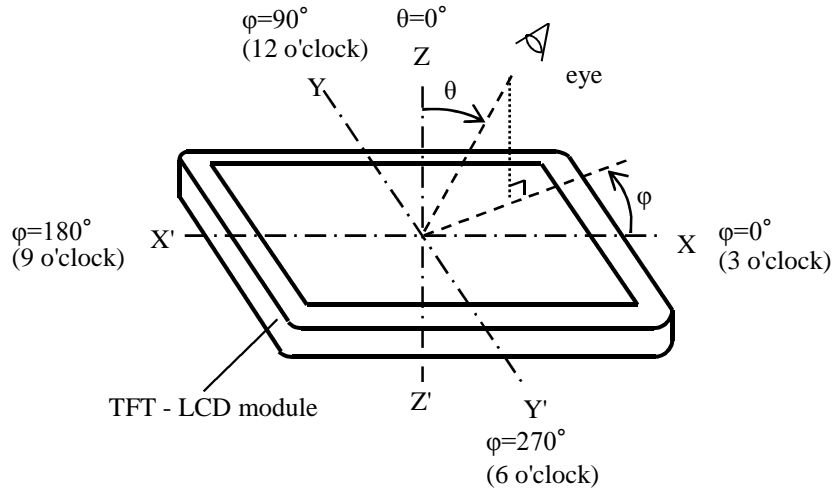
Measuring equipment : CS-1000A, or equivalent

Ambient Temperature =25 °C, f V=60 Hz ,

Ifc = 60mA/string

ITEM		SYMBOL	CONDITION	Min.	Typ.	Max.	UNIT	NOTE
Contrast ratio		CR	$\theta = 0^\circ$ 1)	1000	1400	-	-	2)
Response time	Rise	ton		-	11	20	ms	3)
	Fall	toff		-	9	20	ms	3)
Brightness of white		Bwh		640	800	-	cd/m ²	
Brightness uniformity		Buni		-	-	25	%	4)
Color chromaticity (CIE)	Red	x	$\theta = 50^\circ$ $\varphi = 0^\circ, 90^\circ, 180^\circ, 270^\circ$ 1)	0.626	0.656	0.686	-	【Gray scale =255】
		y		0.299	0.329	0.359		
	Green	x		0.272	0.302	0.332		
		y		0.594	0.624	0.654		
	Blue	x		0.117	0.147	0.177		
		y		0.043	0.073	0.103		
	White	x		0.268	0.298	0.328		
		y		0.307	0.337	0.367		
Variation of color position (CIE)	Red	Δx	$\theta = 50^\circ$ $\varphi = 0^\circ, 90^\circ, 180^\circ, 270^\circ$ 1)	-	-	0.04	-	5) 【Gray scale =255】
		Δy		-	-	0.04		
	Green	Δx		-	-	0.04		
		Δy		-	-	0.04		
	Blue	Δx		-	-	0.04		
		Δy		-	-	0.04		
	White	Δx		-	-	0.04		
		Δy		-	-	0.04		
Contrast ratio at 89 °		CR89	$\varphi=0^\circ, 90^\circ, 180^\circ, 270^\circ$ 6)	10	-	-	-	Estimated value
Image sticking		-	Mosaic pattern	Invisible			-	7)
Gray Scale Level		-	$\theta = 0^\circ$ 1)	-			-	8)

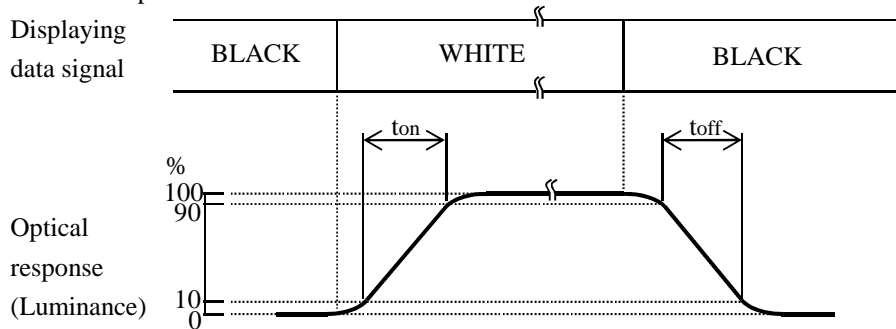
Note 1) Definition of viewing angle



2) Definition of contrast ratio (CR)

$$CR = \frac{\text{Luminance at displaying WHITE}}{\text{Luminance at displaying BLACK}}$$

3) Definition of response time

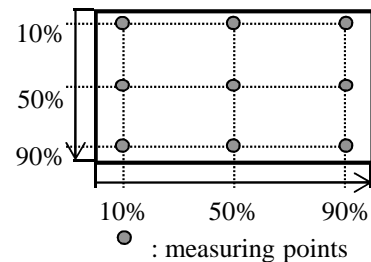


4) Definition of brightness uniformity

Display pattern is white (255 level) . The brightness uniformity is defined as the following equation. Brightness at each point is measured, and average, maximum and minimum brightness is calculated.

$$B_{uni} = \frac{B_{max} - B_{min}}{B_{max}} \times 100$$

where, B_{max} = Maximum brightness
 B_{min} = Minimum brightness



5) Variation of color position on CIE

Variation of color position on CIE is defined as difference between colors at $\theta = 0^\circ$ and at $\theta = 50^\circ$ & $\phi = 0^\circ, 90^\circ, 180^\circ, 270^\circ$.

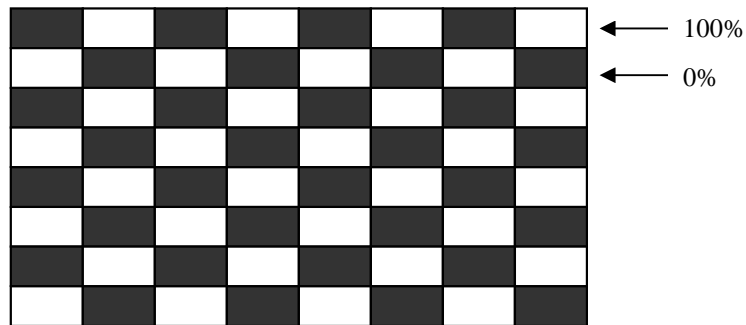
6) Contrast ratio at 89°

Evaluation conditions are on horizontal & vertical axis

7) Image sticking

Condition : Operating mosaic pattern for 2 hours and gray scale (21.5 %) for 1 hour.

Mosaic pattern



8) Gray Scale Level (Typ.)

Gray Level	Relative Brightness (Typ.)
0	0.1%
16	0.3%
32	1.0%
48	2.4%
64	4.6%
80	7.7%
96	11.6%
112	16.1%
128	21.5%
144	28.4%
160	36.0%
176	44.5%
192	53.7%
208	63.9%
224	74.9%
240	88.1%
255	100.0%

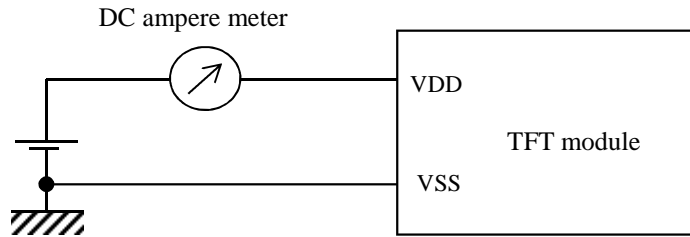
3. ELECTRICAL CHARACTERISTICS

3.1 TFT-LCD module

 $T_a = 25\text{ }^\circ\text{C}$, GND = 0 V

ITEM	SYMBOL	Min.	Typ.	Max.	UNIT	NOTE
Power supply voltage	VDD	4.5	5.0	5.5	V	
Power supply current	IDD	-	0.75	1.15	A	1),2)
Ripple voltage of power supply	VDDR	-	-	500	mV	

Note 1) $f_V=60.0\text{Hz}$, $DCLK=65.125\text{MHz}$, $VDD=5.0\text{V}$, and display pattern is white.



- 2) Current fuse is built in a module. Current capacity of power supply for VDD should be larger than 4[A], so that the fuse can be opened at the trouble of electrical circuit of module.

3.2 Backlight unit

 $T_a = 25\text{ }^\circ\text{C}$, $V_{SS} = 0\text{ V}$

ITEM	SYMBOL	Min.	Typ.	Max.	UNIT	NOTE	
Forward Current (One LED Assembly)	Anode	Ifa	-	300	315	mA/array	
	Cathode	Ifc	-	60	63	mA/string	
Forward Voltage	String	Vf	55.2	59.3	63.3	V	Ifc=60mA/string
	Variation	Vf(unit)	-	-	3	V	One BL unit
Power Consumption	Pbl	-	35.6	38.0	W	Ifc=60mA/string	
LED Life time	-	30,000	-	-	h	2)	

One Backlight Unit : 2 LED Array.

One LED Array : 5 LED String.

One LED String : 10 LED package.

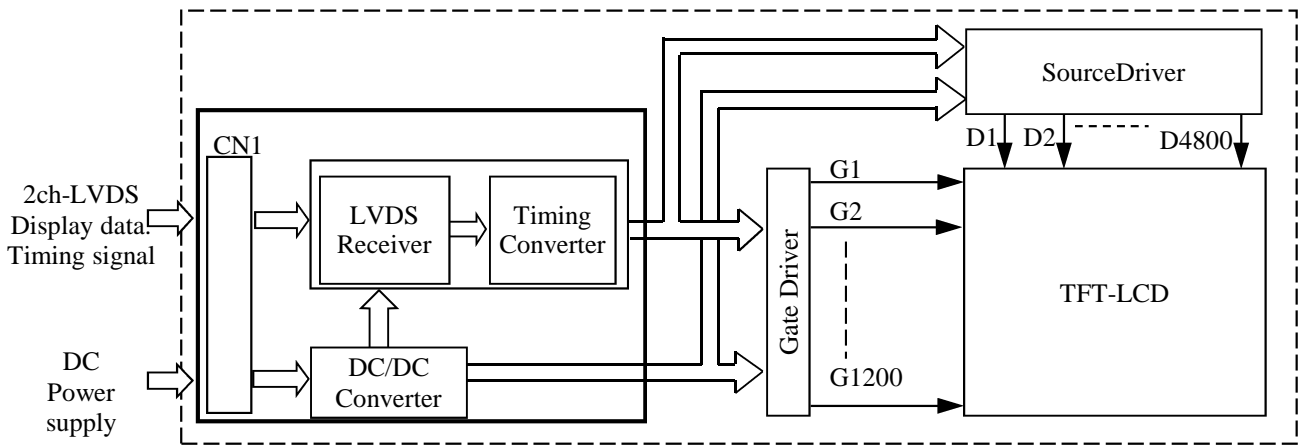
Note 1) This characteristics should be applied putting on the LED about 60 minutes later with ambient temperature. ($T_a = 25\text{ }^\circ\text{C} \pm 2\text{ }^\circ\text{C}$)

- 2) The life time is estimated value and not guaranteed value.

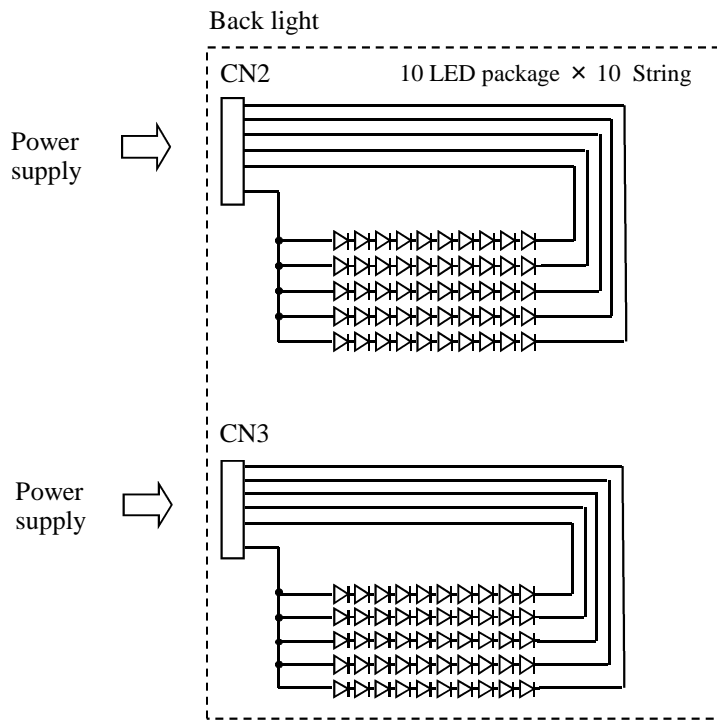
Life time of a LED is defined as follows. The life is determined as the time at which brightness of the LED is 50 % compared to that of initial value at that typical forward current on condition of continuous operating at $25 \pm 2\text{ }^\circ\text{C}$.

4. BLOCK DIAGRAM

4.1 TFT-LCD module



4.2 Backlight unit



5. INTERFACE PIN ASSIGNMENT

5.1 TFT-LCD module

< CN1:JAE FI-X30SSLA-HF >

PIN No.	SYMBOL	DESCRIPTION	NOTE
1	RxA0-	LVDS	1)
2	RxA0+	Odd Pixel Data	
3	RxA1-	LVDS	1)
4	RxA1+	Odd Pixel Data	
5	RxA2-	LVDS	1)
6	RxA2+	Odd Pixel Data	
7	GND	Ground(0V)	2)
8	RxAC-	LVDS	1)
9	RxAC+	Odd Pixel Clock	
10	RxA3-	LVDS	1)
11	RxA3+	Odd Pixel Data	
12	RxB0-	LVDS	1)
13	RxB0+	Even Pixel Data	
14	GND	Ground(0V)	2)
15	RxB1-	LVDS	1)
16	RxB1+	Even Pixel Data	
17	GND	Ground(0V)	2)
18	RxB2-	LVDS	1)
19	RxB2+	Even Pixel Data	
20	RxBC-	LVDS	1)
21	RxBC+	Even Pixel Clock	
22	RxB3-	LVDS	1)
23	RxB3+	Even Pixel Data	
24	GND	Ground(0V)	2)
25	NC	No Connection	
26	NC	No Connection	
27	NC	No Connection	
28	VDD	Power Supply	3)
29	VDD		
30	VDD		

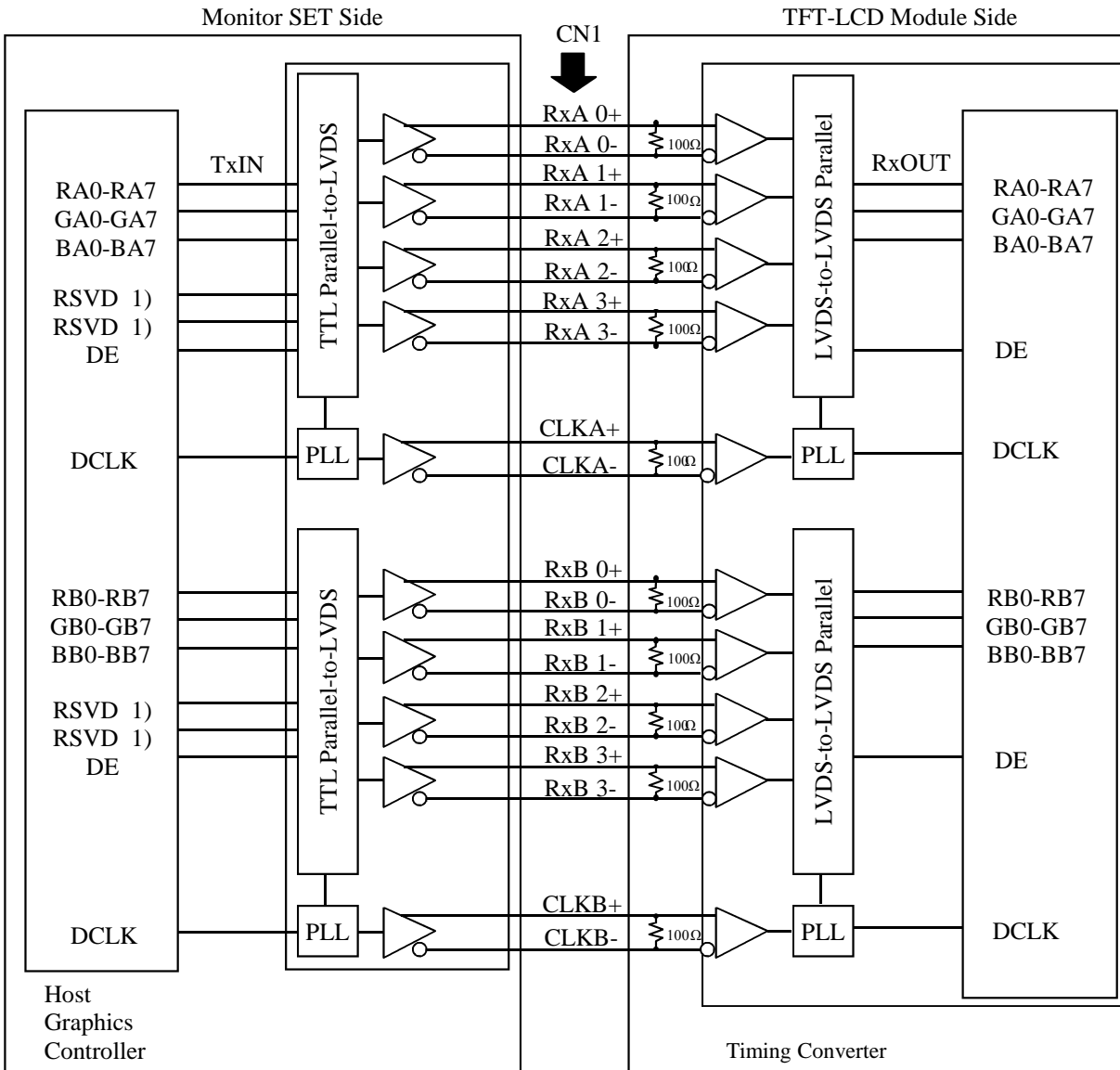
- Notes 1) RxAn+/-, RxBn+/-, (n=0~5), CLKA+/- and CLKB+/- should be wired by side-by-side FPC patterns, respectively.
 2) All GND pins shall be grounded. Metal bezel is internally connected to GND.
 3) All VDD pins shall be connected to +5.0V(Typ.).

5.2 Back light unit

<CN2,3:(JST PHR-10)>

PIN No.	DESCRIPTION	NOTE
1	Cathode	-
2	NC	-
3	Cathode	-
4	Cathode	-
5	NC	-
6	NC	-
7	Cathode	-
8	Cathode	-
9	NC	-
10	Anode	-

5.3 Block diagram of interface



RA0~RA7, RB0~RB7 : Pixel R Data (7; MSB, 0; LSB)
 GA0~GA7, GB0~GB7 : Pixel G Data (7; MSB, 0; LSB)
 BA0~BA7, BB0~BB7 : Pixel B Data (7; MSB, 0; LSB)
 DE : Data Enable

- Note 1) The system must have the transmitter to drive the module.
 2) LVDS cable impedance shall be 50 ohms per signal line or about 100 ohms per twist-pair line when it is used differentially.

5. 4 LVDS interface

	SIGNAL	TRANSMITTER THC63LVDM83A		INTERFACE CONNECTOR		RECEIVER		TFT CONTROL
		PIN	INPUT	Monitor Set	TFT-LCD	PIN	OUTPUT	INPUT
24bit	RA0/RB0	51	Tx IN0	TA OUT0+	RxA/B 0+	27	Rx OUT0	RA0/RB0
	RA1/RB1	52	Tx IN1			29	Rx OUT1	RA1/RB1
	RA2/RB2	54	Tx IN2			30	Rx OUT2	RA2/RB2
	RA3/RB3	55	Tx IN3			32	Rx OUT3	RA3/RB3
	RA4/RB4	56	Tx IN4			33	Rx OUT4	RA4/RB4
	RA5/RB5	3	Tx IN6			35	Rx OUT6	RA5/RB5
	GA0/GB0	4	Tx IN7			37	Rx OUT7	GA0/GB0
	GA1/GB1	6	Tx IN8	TA OUT1+	RxA/B 1+	38	Rx OUT8	GA1/GB1
	GA2/GB2	7	Tx IN9			39	Rx OUT9	GA2/GB2
	GA3/GB3	11	Tx IN12			43	Rx OUT12	GA3/GB3
	GA4/GB4	12	Tx IN13			45	Rx OUT13	GA4/GB4
	GA5/GB5	14	Tx IN14			46	Rx OUT14	GA5/GB5
	BA0/BB0	15	Tx IN15			47	Rx OUT15	BA0/BB0
	BA1/BB1	19	Tx IN18			51	Rx OUT18	BA1/BB1
	BA2/BB2	20	Tx IN19	TA OUT2+	RxA/B 2+	53	Rx OUT19	BA2/BB2
	BA3/BB3	22	Tx IN20			54	Rx OUT20	BA3/BB3
	BA4/BB4	23	Tx IN21			55	Rx OUT21	BA4/BB4
	BA5/BB5	24	Tx IN22			1	Rx OUT22	BA5/BB5
	HSYNC or RSVD 1)	27	Tx IN24			3	Rx OUT24	HSYNC or RSVD 1)
	VSVD or RSVD 1)	28	Tx IN25			5	Rx OUT25	VSVD or RSVD 1)
	DE/DE	30	Tx IN26			6	Rx OUT26	DE/DE
	RA6/RB6	50	Tx IN27	TA OUT3+	RxA/B 3+	7	Rx OUT27	RA6/RB6
	RA7/RB7	2	Tx IN5			34	Rx OUT5	RA7/RB7
	GA6/GB6	8	Tx IN10			41	Rx OUT10	GA6/GB6
GA7/GB7	10	Tx IN11	42			Rx OUT11	GA7/GB7	
BA6/BB6	16	Tx IN16	49			Rx OUT16	BA6/BB6	
BA7/BB7	18	Tx IN17	50			Rx OUT17	BA7/BB7	
RSVD 1)	25	Tx IN23	2			Rx OUT23	RSVD 1)	
	DCLK	31	TxCLK IN	TxCLK OUT+	RxCLKA/B IN+	26	RxCLK OUT	DCLK
				TxCLK OUT-	RxCLKA/B IN-			

RA0~RA7, RB0~RB7 : Pixel R Data (7; MSB, 0; LSB)

GA0~GA7, GB0~GB7 : Pixel G Data (7; MSB, 0; LSB)

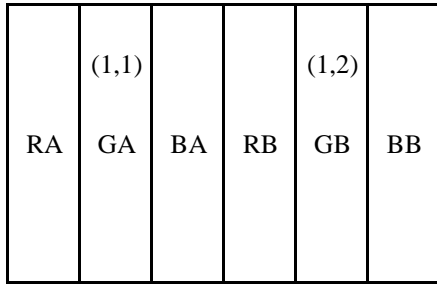
BA0~BA7, BB0~BB7 : Pixel B Data (7; MSB, 0; LSB)

DE : Data Enable

Note 1) RSVD(reserved) pins on the transmitter shall be tied to"H"or"L".

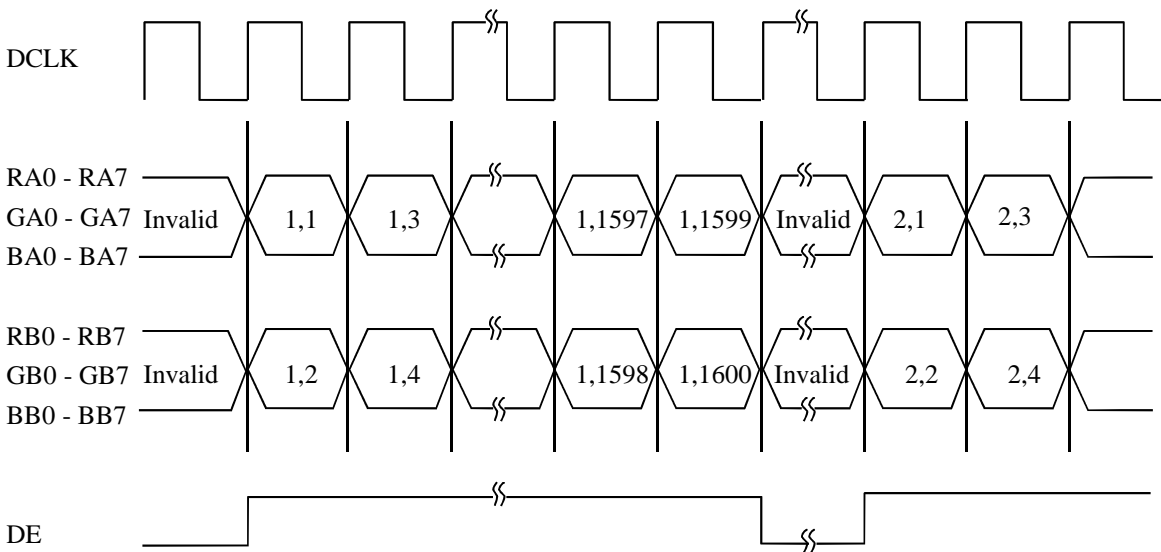
5. 5 Correspondence between input data and display image

Display data of adjacent one pixel is latched during one cycle of DCLK.



ODD pixel : RA0 - RA7 : R data
 GA0 - GA7 : G data
 BA0 - BA7 : B data
 EVEN pixel RB0 - RB7 : R data
 GB0 - GB7 : G data
 BB0 - BB7 : B data

1, 1	1, 2	1, 3	-----	1, 1600
2, 1	2, 2	2, 3	-----	2, 1600
3, 1	3, 2	3, 3	-----	3, 1600
⋮	⋮	⋮		⋮
1200, 1	1200, 2	1200, 3		1200, 1600



5. 6 Relationship between display colors and input signals

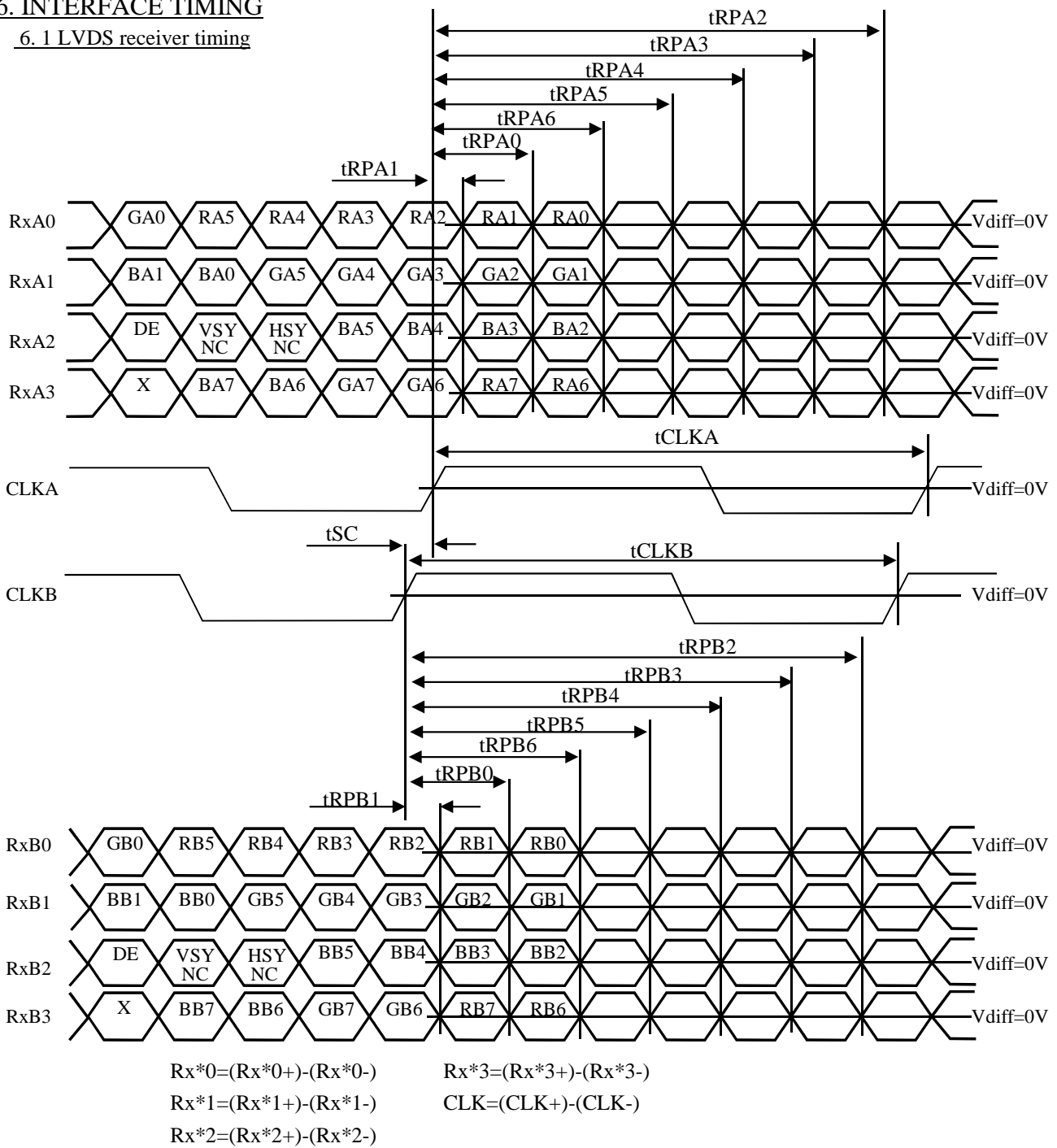
Input Color		Red Data								Green Data								Blue Data							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
		MSB				LSB				MSB				LSB				MSB				LSB			
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	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	1	1	1	1	1	1
Red	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	Red(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
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	Green(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	
Blue	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue (254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

Note 1) Definition of gray scale :
 Color(n) · · · · Number in parenthesis indicates gray scale level.
 Larger n corresponds to brighter level.

2) Data : 1 : High, 0 : Low

6. INTERFACE TIMING

6.1 LVDS receiver timing

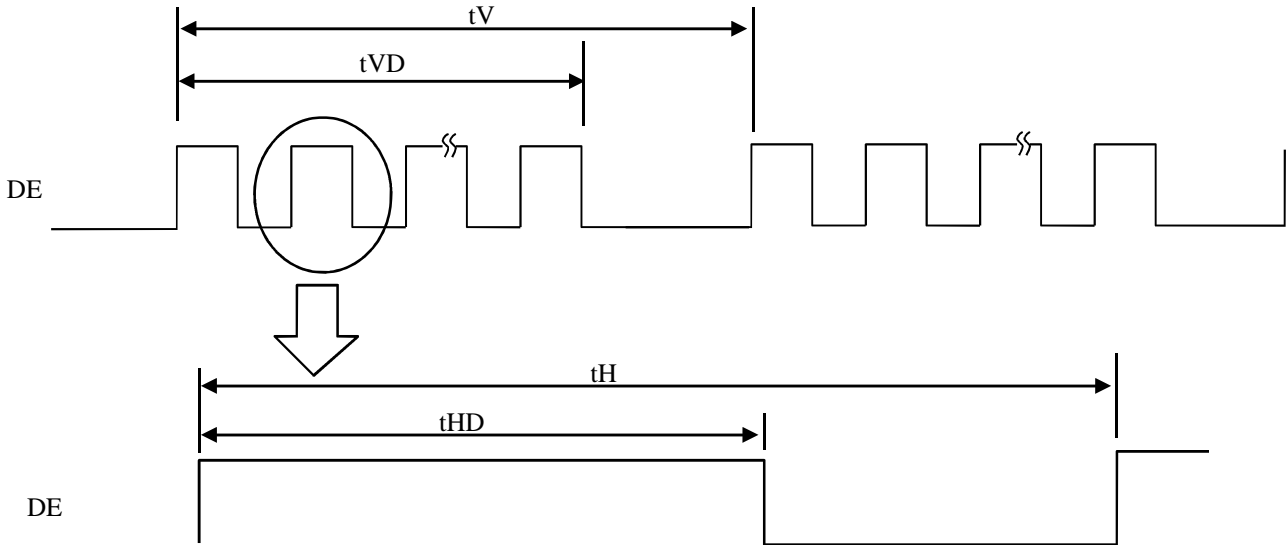


	ITEM	SYMBOL	Min.	Typ.	Max.	UNIT	NOTE
CLK	Frequency	DCLK	62.0	65.125	67.5	MHz	
	CLK Skew	tSC	- 4.0	0	+ 4.0	ns	
Rx*0 Rx*1 Rx*2 Rx*3	0 data position	tRP0	1/7tCLK - 0.4	1/7tCLK	1/7tCLK + 0.4	ns	
	1st data position	tRP1	- 0.4	0	+ 0.4		
	2nd data position	tRP2	6/7tCLK - 0.4	6/7tCLK	6/7tCLK + 0.4		
	3rd data position	tRP3	5/7tCLK - 0.4	5/7tCLK	5/7tCLK + 0.4		
	4th data position	tRP4	4/7tCLK - 0.4	4/7tCLK	4/7tCLK + 0.4		
	5th data position	tRP5	3/7tCLK - 0.4	3/7tCLK	3/7tCLK + 0.4		
	6th data position	tRP6	2/7tCLK - 0.4	2/7tCLK	2/7tCLK + 0.4		

6.2 SSC

	Unit	Min.	Typ	Max.	Note
Modulation frequency	kHz	0	-	200	
Modulation rate	%	-2	-	+2	
Modulation profile	-	Triangle wave			

6.3 Synchronization signal timing

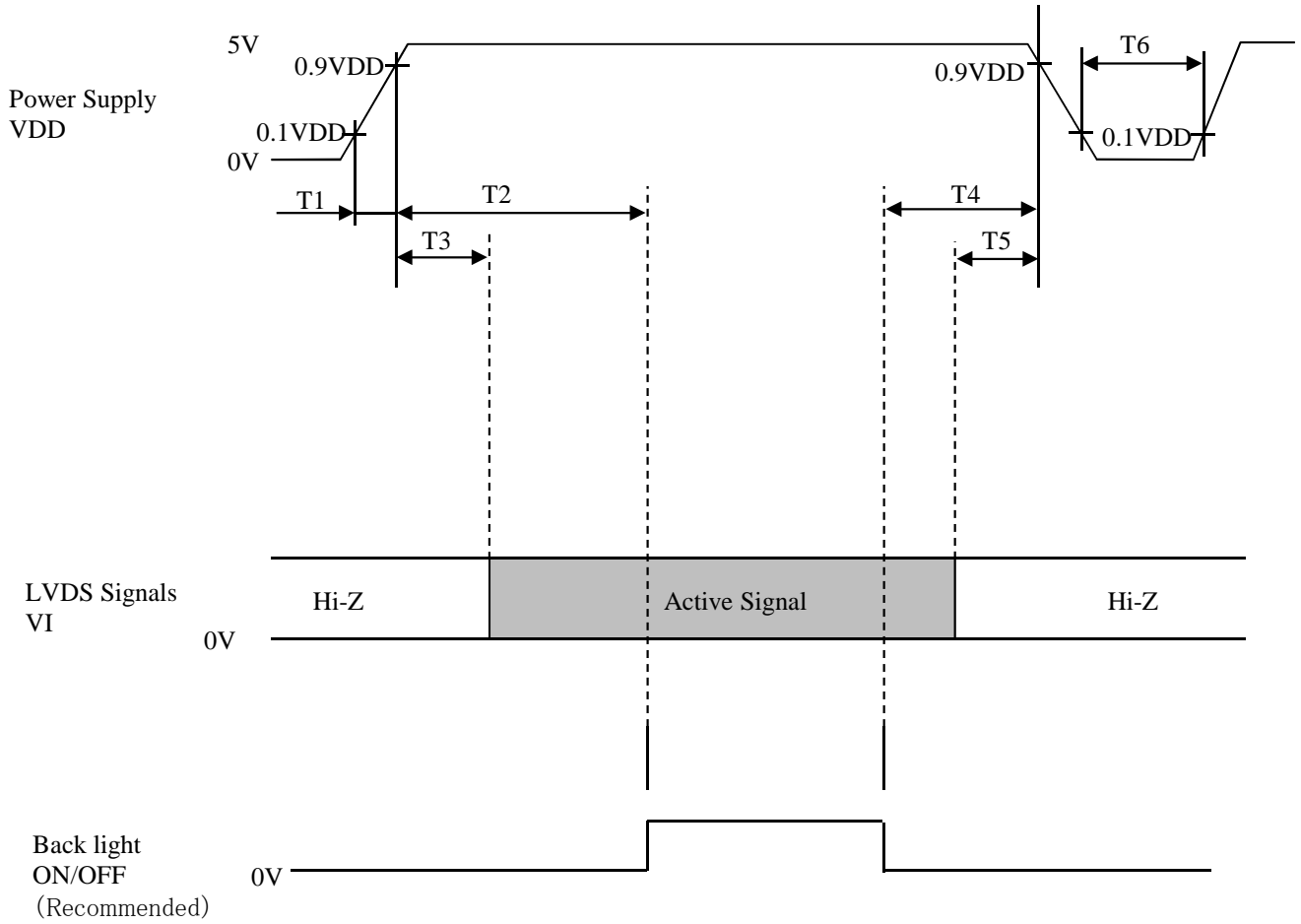


Note 1) The timing of DCLK to other signals conforms to the specifications of LVDS transmitter.

ITEM		SYMBOL	Min.	Typ.	Max.	UNIT	NOTE
DE	Vertical Frequency	fV	58	60	63	Hz	
	Vertical Period	tV	1229	1233	-	tH	
	Vertical Valid	tVD	1200			tH	
	V-Blanking	-	29	33	-	tH	
	Horizontal Frequency	fH	71.5	74	78	kHz	
	Horizontal Period	tH	850	880	940	tCLK	
	Horizontal Valid	tHD	800			tCLK	
H-Blanking	-	50	80	140	tCLK		

2pxl/clock

6.4 Timing between interface signals power supply



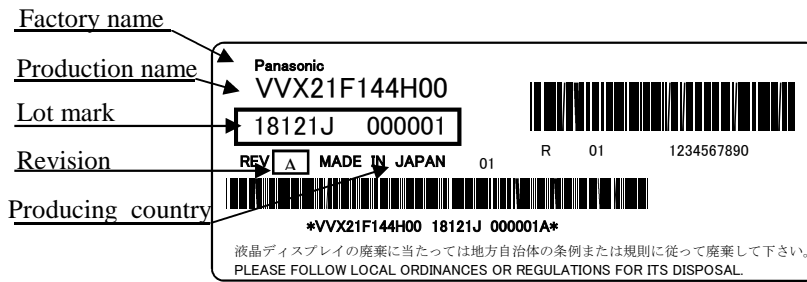
$$\begin{array}{ll}
 0 \leq T1 \leq 10 & 0 \leq T4 \\
 (500) \leq T2 & 0 \leq T5 \\
 (10) \leq T3 & (1000) \leq T6
 \end{array}$$

Unit : ms

7. LABEL FORMAT

7.1 Label

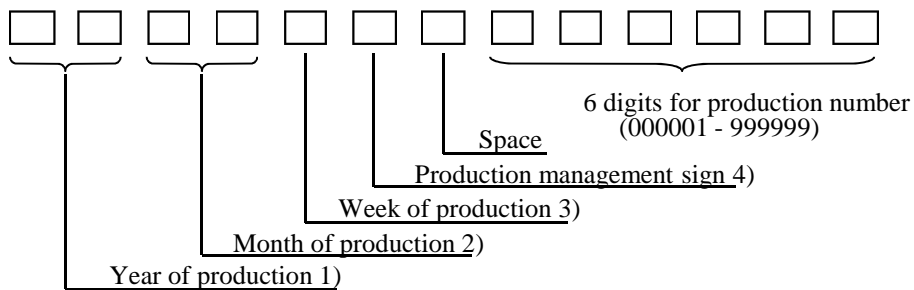
The label is on the metallic bezel as shown in 12. External Dimensional.
 The style of character will be changed without notice.



7.2 Revision (REV.) control

REV. is the column for manufacturing convenience. A-Z except I and O may be written on this column.

7.3 Lot mark



Notes 1)

Mark	Year
18	2018
19	2019
20	2020

2)

Mark	Month	Mark	Month
01	1	07	7
02	2	08	8
03	3	09	9
04	4	10	10
05	5	11	11
06	6	12	12

3)

Week mark	Day
1	1~7
2	8~14
3	15~21
4	22~28
5	29~31

4) J : Made by Panasonic Liquid Crystal Display Co., Ltd.

7.4 Record of revision described on the label

Rev.A=Initial

8. COSMETIC SPECIFICATIONS

8.1 Condition for cosmetic inspection

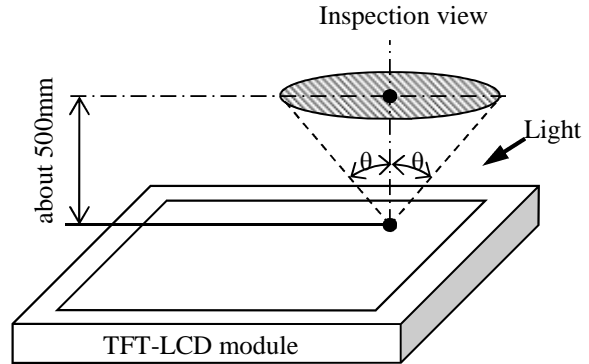
(1) Viewing zone

a) The figure shows the correspondence between eyes (of inspector) and TFT-LCD module.

$\theta \leq 45^\circ$: when non-operating inspection
when operating MURA inspection

$\theta \leq 5^\circ$: when operating inspection

b) Inspection should be executed only from front side and only A-zone.
Cosmetic of B-zone and C-zone are ignore.
(refer to 8.2 Definition of zone)



(2) Environmental

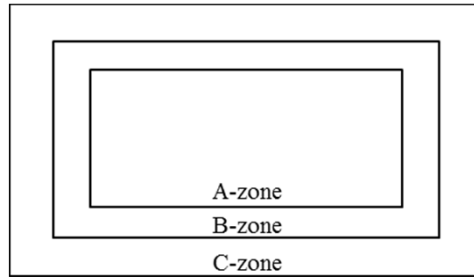
a) Temperature : 25 °C

b) Ambient light : about 100 lx and non-directive when operating inspection.
: about 1000 lx and non-directive when non-operating inspection.

c) Backlight : when non-operating inspection, backlight should be off .

8.2 Definition of zone

- A-zone : Display area (pixel area)
- B-zone : Area between A-zone and C-zone
- C-zone : Metallic bezel area



8.3 Cosmetic specifications

When displaying conditions are not stable (ex. at turn on or off), the following specifications are not applied.

	No.	ITEM		Max. acceptable number		Unit	Note	
				Bright defect	Low bright defect			
Operating inspection	1	Sparkle mode	1-dot	0	12	pcs	1),3)	
			2-dots	0	-	Units	1),4)	
			3-dots	0	-			
		Black mode	1-dot	7		pcs	2),3)	
			2-dots	1		Units	2),4),9)	
			3-dots	0				
			Density	3		pcs/φ20mm	2),5)	
	Total		7		pcs	2)		
	2	Uneven Brightness	Kumi mura		The brightness of Kumi mura is under 300% of the brightness of Center within Black Screen.		-	-
			Others		Mura is basically judged OK if invisible with 5%ND Filter. Limit sample is set up if needed after deliberations.			

	No.	ITEM	Max. acceptable number		Unit	Note	
			Bright defect	Low bright defect			
Operating inspection	3	Stain inclusion Line shape (W : width (mm)) (L : length (mm))	$W \leq 0.01$	$L < 0.3$	Ignore	pcs	6),10)
			$W \leq 0.1$	$L \leq 5.0$	3		
				$L > 5.0$	0		
		$W > 0.1$	-	0			
	4	Stain inclusion Dot shape (D : ave. dia (mm))	$D \leq 0.22$		Ignore	pcs	6),10)
			$D \leq 0.5$		3		
			$D > 0.5$		0		
	5	Scratch on polarizer Line shape (W : width (mm)) (L : length (mm))	$W \leq 0.01$	$L \leq 0.3$	Ignore	pcs	7)
			$W \leq 0.07$	$L \leq 5.0$	3		
				$L > 5.0$	0		
	6	Scratch on polarizer Dot shape (D : ave. dia (mm))	$D \leq 0.2$		Ignore	pcs	7)
			$D \leq 0.5$		3		
$D > 0.5$			0				
Non operating inspection	7	Bubbles, peeling in polarizer (D : ave. dia (mm))	$D \leq 0.2$		Ignore	pcs	7)
			$D \leq 0.5$		10		
			$D > 0.5$		0		
	8	Wrinkles on polarizer		Serious one is not allowed.	-	-	

Note

- 1) Sparkle mode :
 - bright defect $G \geq 96$ (check as compared with 96/255 tone dot using black screen.)
 - $R \geq 96$ (check as compared with 96/255 tone dot using black screen.)
 - $B \geq 96$ (check as compared with 96/255 tone dot using black screen.)
 - low bright defect $96 > G \geq 25$ (check as compared with 96/255 and 25/255 tone dot using black screen.)
 - $96 > R \geq 25$ (check as compared with 96/255 and 25/255 tone dot using black screen.)
 - $96 > B \geq 49$ (check as compared with 96/255 and 49/255 tone dot using black screen.)
- 2) Black mode : brightness of dot is less than 70% at white. (visible to eye)
- 3) 1 dot : defect dot is isolated, not attached to other defect dot.
- 4) N dots : N defect dots are consecutive. (N means the number of defects dots)
- 5) Density : number of defect dots inside $\phi 20$ mm
- 6) Those stains which can be wiped out easily are acceptable.
- 7) Polarizer area inside of B-zone is not applied.
- 8) No major (serious) defects when viewed in gray scale mode.
- 9) Regarding 2-dots defect of black mode, when the pixel of the black dot is seen as the low bright dot in the other pattern (each RGB plain color,etc.) except white raster and black raster, this low bright dot shall be ignored.
- 10) Limit sample is set up if needed after deliberations.

9. PRECAUTION

Please pay attention to the followings when a TFT module with a backlight unit is used, handled and mounted.

9.1 Precaution to handling and mounting

- (1) Applying strong force to a part of the module may cause partial deformation of frame or mold, and cause damage to the display.
- (2) The module should gently and firmly be held by both hands. Never hold by just one hand in order to avoid any internal damage. Never drop or hit the module.
- (3) The module should be installed with mounting holes of a module.
- (4) Uneven force such as twisted stress should not be applied to a module when a module is mounted on the cover case. The twisted stress causes Kumi mura and the deformation of internal optical sheets and/or other parts which causes uneven brightness.

The cover case must have sufficient strength so that external force can not be transmitted directly to a module.

- (5) It is recommended to leave a space between a module and a holding board of a module so that partial force is not applied to a module.

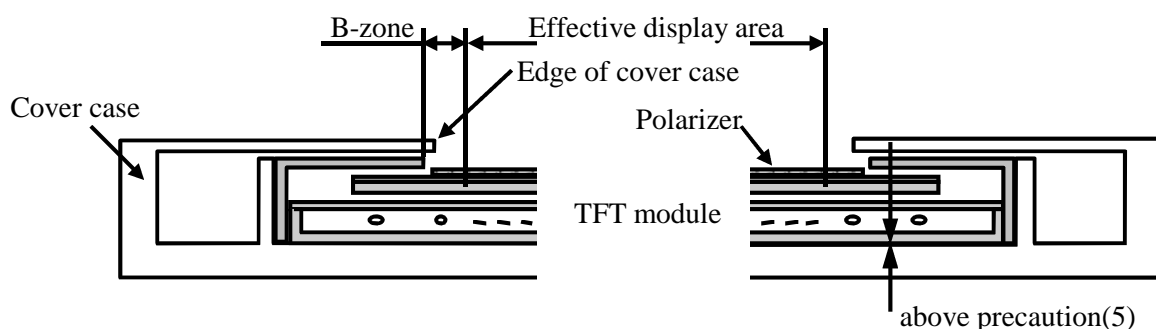


Fig.1 Cross sectional view of a monitor set

- (6) The edge of a cover case should be located inside more than 1mm from the edge of a module front frame. The edge of a module front frame is not rustproofed, please process a cover case so as not to see the edge of a module front frame if necessary.
- (7) A transparent protective plate should be added on the display area of a module in order to protect a polarizer and TFT cell. The transparent protective plate should have sufficient strength so that the plate can not touch a module by external force.
- (8) Materials included acetic acid and choline should not be used for a cover case as well as other parts and boards near a module. Acetic acid attacks a polarizer. Choline attacks electric circuits due to electro-chemical reaction.
- (9) The polarizer on a TFT cell should carefully be handled due to its softness, and should not be touched, pushed or rubbed with glass, tweezers or anything harder than 3H pencil lead. The surface of a polarizer should not be touched and rubbed with bare hand, greasy clothes or dusty clothes.
- (10) The surface of a polarizer should be gently wiped with absorbent cotton, chamois or other soft materials slightly contained petroleum benzene when the surface becomes dirty. Normal-hexane or Isopropyl alcohol as cleaning chemicals is recommended in order to clean adhesives which fix front/rear polarizers on a TFT cell. Other cleaning chemicals such as acetone, toluen and alcohol should not be used to clean adhesives because they cause chemical damage to a polarizer.
- (11) Saliva or water drops should be immediately wiped off. Otherwise, the portion of a polarizer may be deformed and its color may be faded.
- (12) The module should not be opened or modified. It may cause not to operate properly.
- (13) Metallic bezel of a module should not be handled with bare hand or dirty gloves. Otherwise, color of a metallic frame may become dirty during its storage. It is recommended to use clean soft gloves and clean finger stalls when a module is handled at incoming inspection process and production (assembly) process.
- (14) LED cables should not be pulled and held.

- (15) Module and monitor set should be transported under standing conditions (portrait/vertical or landscape/lateral), should not be transported under flat/horizontal condition.
Otherwise, the vibration of LCD cell generates air flow which can suck dust particles in module.
- (16) The structure of module is not airtight. The air blow to the panel surface may cause the ingress of dust particles into module which resulted in display defects and/or malfunctions. Please do suction or wiping for removal of dust particles on the panel surface.
- (17) This product is designed on the premise of using it upright. In case of using this product at other angles, please evaluate under actual set-in condition.

9.2 Precaution to operation

- (1) The ambient temperature near the operated module should be satisfied with the absolute maximum ratings. Unless it meets the specifications, sufficient cooling system should be adopted to system.
- (2) The spike noise causes the mis-operation of a module. The level of spike noise should be as follows:
-200mV \leq over- and under- shoot of VDD \leq +200mV
VDD including over- and under- shoot should be satisfied with the absolute maximum ratings.
- (3) Optical response time, luminance and chromaticity depend on the temperature of a TFT module.
- (4) Sudden temperature change may cause dew on and/or in the a module. Dew makes damage to a polarizer and/or electrical contacting portion. Dew causes fading of displayed quality.
And rapid temperature and/or humidity change may cause uneven brightness in black display.
- (5) Fixed patterns displayed on a module for a long time may cause after-image. It will be recovered soon.
But, white fixed patterns for a long time may cause after-image which can not be recovered.
- (6) A module has high frequency circuits. Sufficient suppression to electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be effective to minimize the interference.
- (7) Noise may be heard when a backlight is operated. If necessary, sufficient suppression should be done by system manufacturers.
- (8) The module should not be connected or removed while a main system works.
- (9) Inserting or pulling I/F connectors causes any trouble when power supply and signal data are on-state.
I/F connectors should be inserted and pulled after power supply and signal data are turned off.
- (10) The temperature of LCD front surface would be 70 °C in operating, it may affect the function of liquid crystal.

9.3 Electrostatic discharge control

- (1) Since a module consists of a TFT cell and electronic circuits with CMOS-ICs, which are very weak to electrostatic discharge, persons who are handling a module should be grounded through adequate methods such as a list band.
I/F connector pins should not be touched directly with bare hands.
- (2) Protection film for a polarizer on a module should be slowly peeled off so that the electrostatic charge can be minimized.

9.4 Precaution to strong light exposure

- (1) A module should not be exposed under strong light. Otherwise, characteristics of a polarizer and color filter in a module may be degraded.

9.5 Precaution to storage

When modules for replacement are stored for a long time, following precautions should be taken care of:

- (1) Modules should be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during storage.
Modules should be stored at 0 to 35°C at normal humidity (60%RH or less).
- (2) The surface of polarizers should not come in contact with any other object. It is recommended that modules should be stored in the shipping box of Panasonic Liquid Crystal Display Co.,Ltd.

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9.6 Precaution to handling protection film

- (1) The protection film for polarizers should be peeled off slowly and carefully by persons who are electrically grounded with adequate methods such as a list band. Besides, ionized air should be blown over during peeling action. Dusts on a polarizer should be blown off by an ionized nitrogen gun and so on.
- (2) The protection film should be peeling off without rubbing it to the polarizer. Because, if the film is rubbed together with the polarizer, since the film is attached to the polarizer with a small amount of adhesive, the adhesive may remain on a polarizer.
- (3) The module with protection film should be stored on the conditions explained in 9.5 (1). However, in case that the storage time is too long, adhesive may remain on a polarizer even after a protection film is peeled off. Besides, in case that a module is stored at higher temperature and/or higher humidity, adhesive may remain on a polarizer. The remained adhesive may cause non-uniformity of display image.
- (4) The adhesive can be removed easily with Normal-Hexane or Isopropyl alcohol. The remained adhesive or its vestige on the polarizer should be wiped off with absorbent cotton or other soft materials such as chamois slightly contained Normal-Hexane or Isopropyl alcohol.

9.7 Precaution to fluid

- (1) Since a module consists of a TFT cell and electronic circuits, which are very weak to fluid, keep fluid from entering between the frame and the polarizing plate.

9.8 Safety

- (1) Since a TFT cell is made of glass, handling to the broken module should be taken care sufficiently in order not to be injured. Hands touched liquid crystal from a broken cell should be washed sufficiently.
- (2) The module should not be taken apart during operation so that backlight drives by voltage.

9.9 Environmental protection

Flexible printed circuits and printed circuits board used in a module contain small amount of lead. Please follow local ordinance or regulations for its disposal.

9.10 Use restrictions and limitations

- (1) This product is not authorized for use in life support devices or systems, military applications or other applications which pose a significant risk of personal injury.
- (2) In no event shall Panasonic Liquid Crystal Display Co.,Ltd. be liable for any incidental, indirect or consequential damages in connection with the installation or use of this product, even if informed of the possibility thereof in advance. These limitations apply to all causes of action in the aggregate, including without limitation breach of contract, breach of warranty, negligence, strict liability, misrepresentation and other torts.

9.11 Others

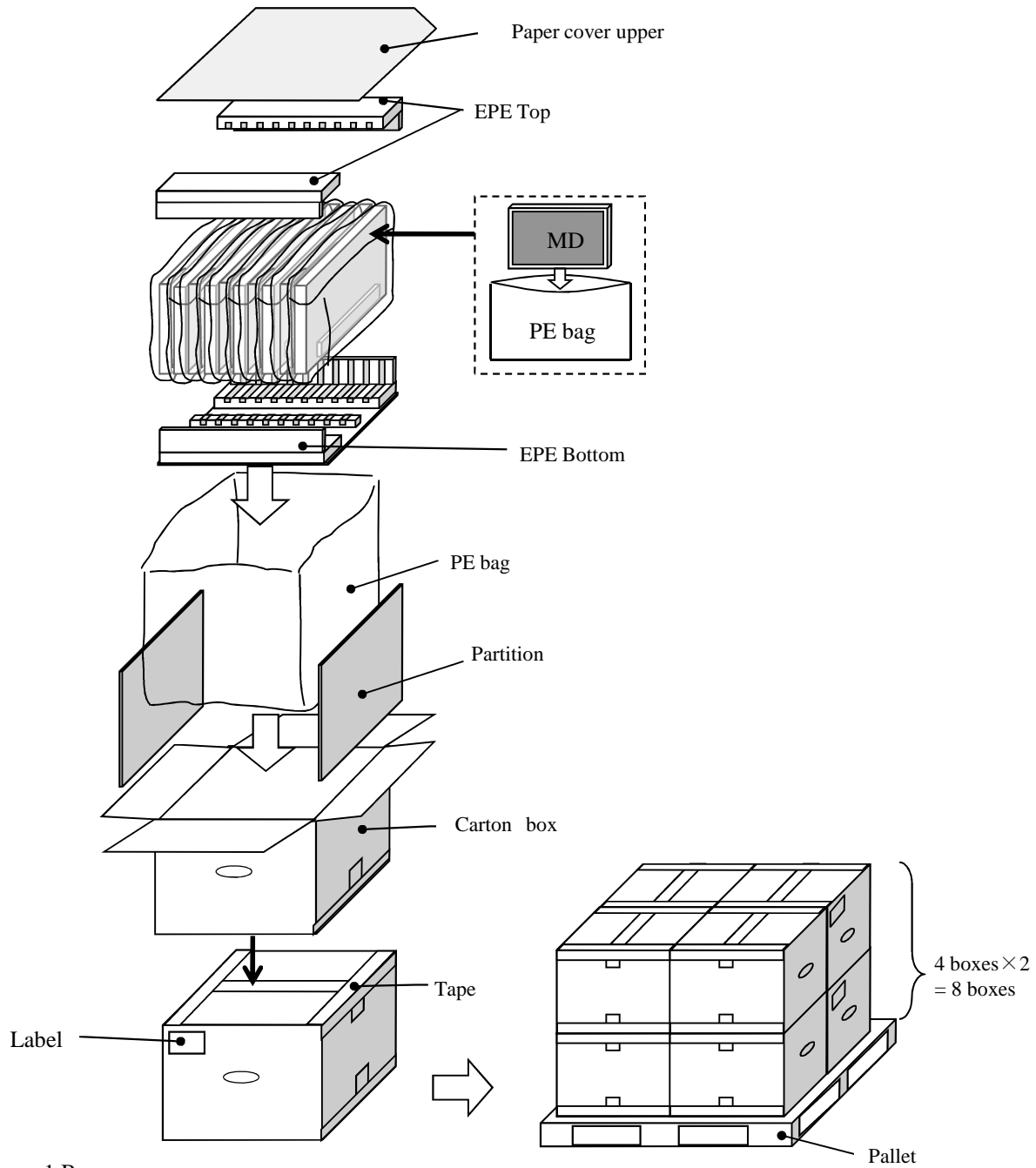
Electrical components which may not affect electrical performance are subjective to change without notice because of their availability.

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10. PACKING

10.1 Precaution to handling and mounting

Standard packing specification



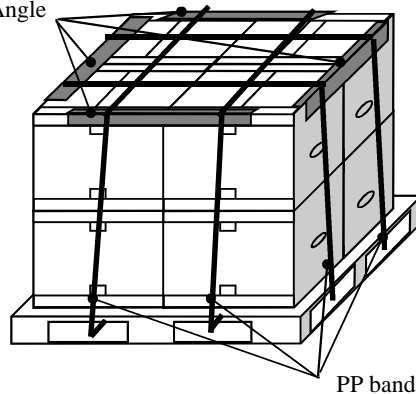
1 Box

Packing Size	550(L)×540(W)×470(H)mm
Gross Weight	33kg/Box
MD QTY	10pcs

1 Pallet Total

Packing Size	1200(L)×1100(W)×1065(H)mm or 1150(L)×1150(W)×1065(H)mm
Gross Weight	275kg/PL
MD QTY	10pcs×8boxes = 80pcs/PL

Corner Angle



PP band

11. Reliability test

No.	Item	condition	determination
1	Low Temperature / Operating	Ta=0°C	500h
2	High Temperature / Operating	Ta=45°C	500h
3	High Temperature High Humidity / Operating	45°C 80%RH	500h
4	Low Temperature / Strage	Ta=-30°C	500h
5	High Temperature / Strage	Ta=70°C	500h
6	High Temperature High Humidity / Strage	40°C 80%RH	500h
7	Heat shock	-25/70°C 30min./30min.	100cy.
8	Heat shock test for solder	-35/85°C 30min./30min.	200cy.

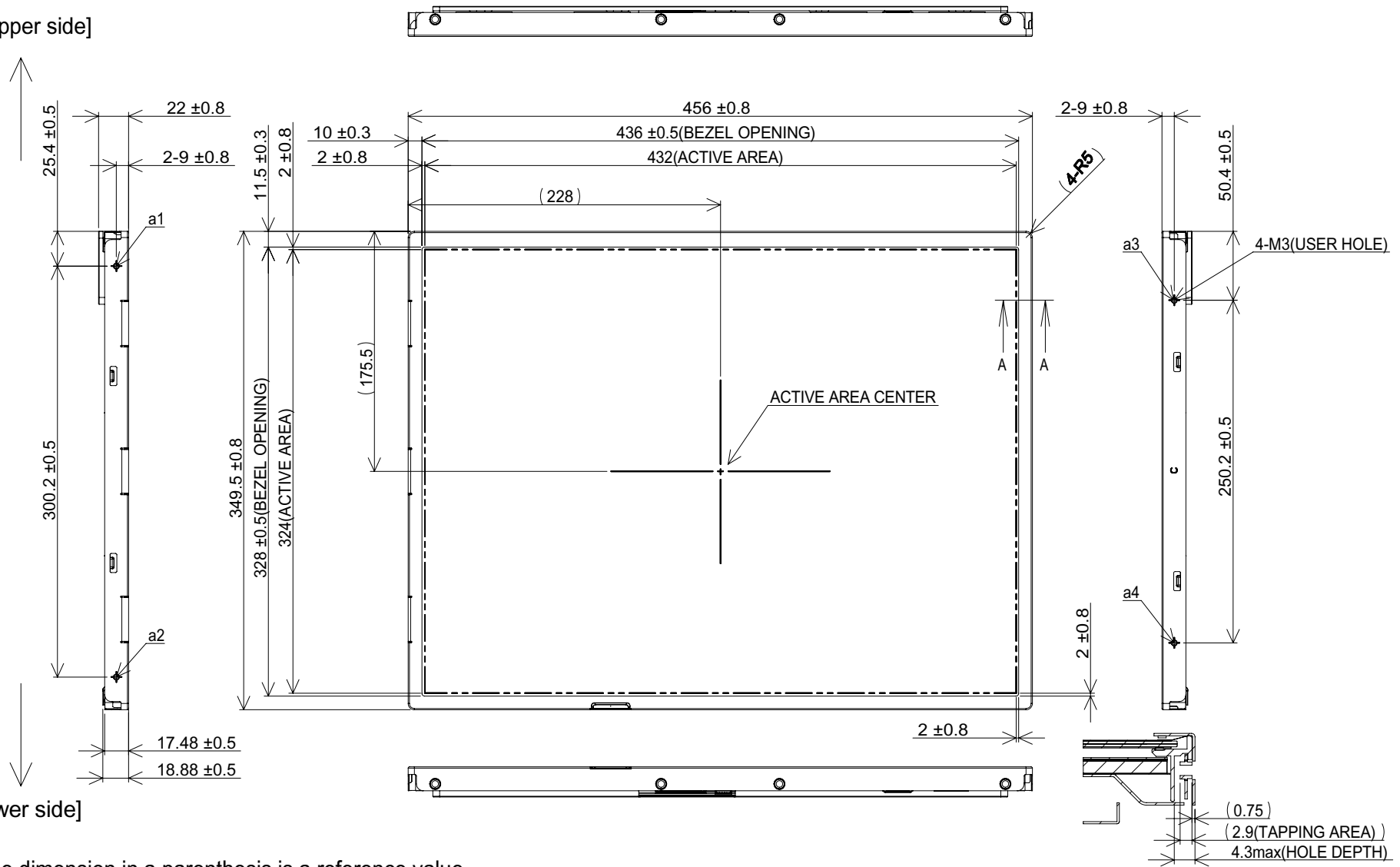
Result Evaluation

Display function should be kept.

12. Dimensional Outline

(1) Front view

[Upper side]



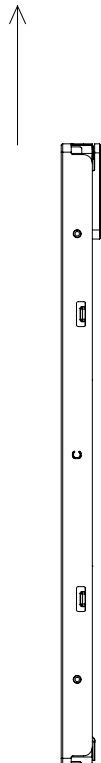
[Lower side]

Note.

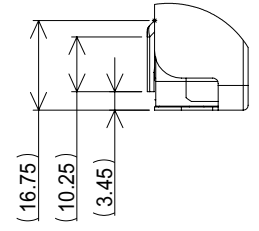
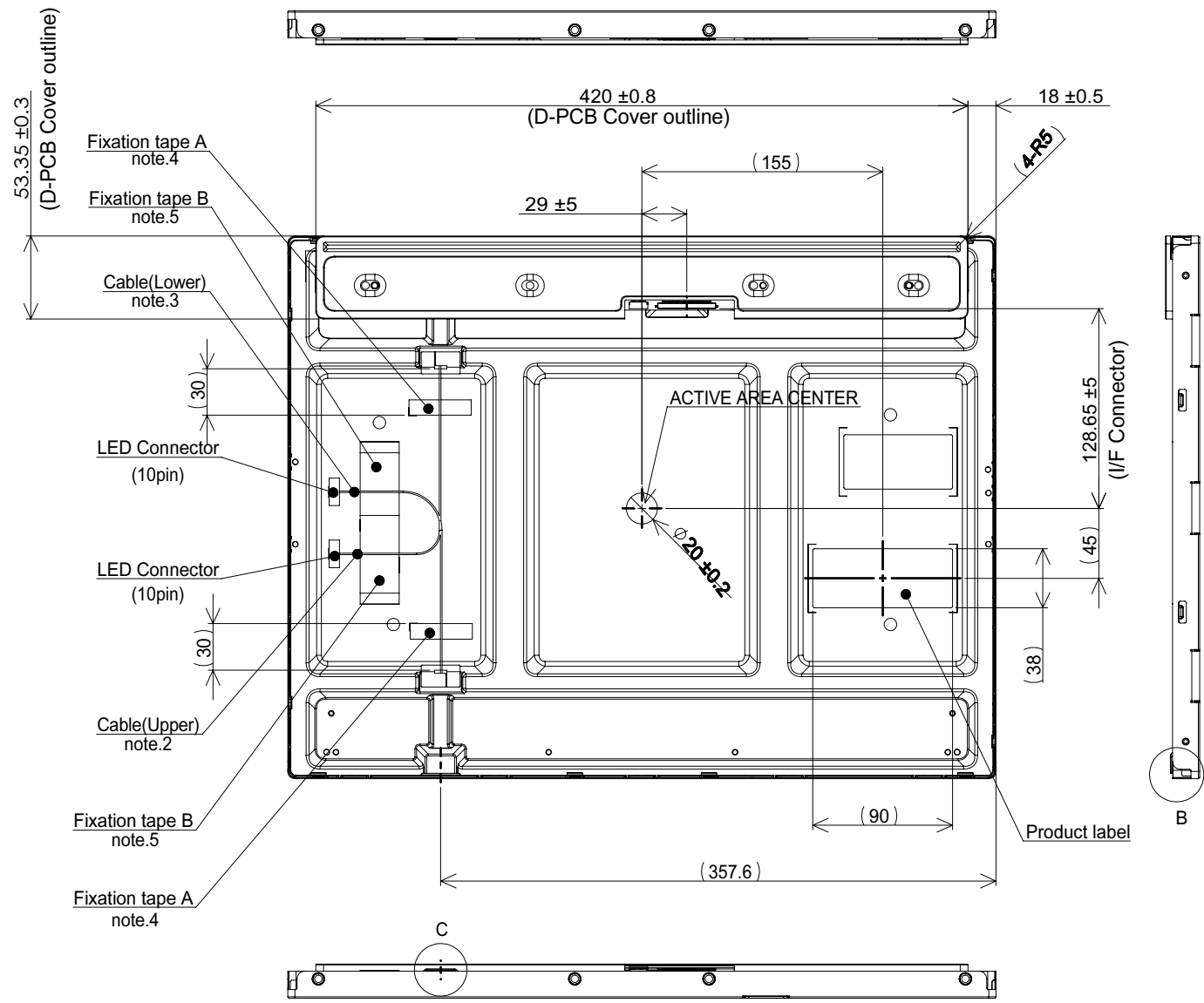
- 1) The dimension in a parenthesis is a reference value.
- 2) The measuring method depends on Panasonic Liquid Crystal Display Co., Ltd standard.
- 3) The recommended torque of M3 (USER HOLE) is $5.0 \pm 0.5 \text{ kgf} \cdot \text{cm}$ ($0.49 \pm 0.049 \text{ N} \cdot \text{m}$)
- 4) Warp quantity $\leq 1 \text{ mm}$.

(2) Back view

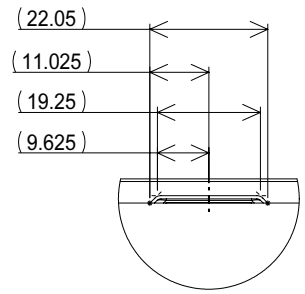
[Upper side]



[Lower side]



Detail B (1:1)



Detail C (1:1)

Note.

- 1) The dimension in parenthesis is a reference value.
- 2) The cable length of upper side is 180mm(typ.). (It excluding LED connector.)
- 3) The cable length of lower side is 195mm(typ.). (It excluding LED connector.)
- 4) Fixation tape A must not be peeling off.
- 5) Fixation tape B can be peel off.