TORiSAN

ENGINEERING SPECIFICATIONS

TFT COLOR LCD MODULE

TM150XG-22L01A

- 38cm (15.0 inch) diagonal
- XGA resolution (1024×R·G·B×768 dots)
- Wide View Angle
- Digital RGB (RGB×6 bits×Dual Port)
- Power Supply Voltage : 5V
- Ear mount
- With CFL backlight unit
- Nonglare surface type

(TENTATIVE)

Ver. 5 Nov. 02, 2000

Tottori SANYO Electric Co., Ltd.
LCD Division

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Department Manager S. IWASAKI

Engineering Manager N. OMOTE

■*NOTICES*

1 .The contents stated in this document and the product may be subject to change without prior notice.

When you kindly study to use this product, please ask us or our distributor for the latest information.

2 .This product is developed and produced for usage onto normal electronic products (office automation equipments, communication peripherals, electric appliance products, game machines, etc.) and is not suitable for applications which need extremely high reliability and extreme safety (aero- or space-use machines, control equipments for nuclear power, life keeping equipments, etc.).

3 .This document shall not grant or guarantee any right to adapt intellectual property or any other patents of third party.

4 .Please use this product correctly according to operating conditions and precautions for use stated in this document.

Please install safety proof in your designing to avoid human accident, fire accident and social damage which may be resulted from malfunction of this product.

5 .This product is not designed to withstand against radiant rays.

6 .It is strictly prohibited to copy or publish a part or whole of this document without our prior written approval.

■ *REVISION HISTORY*

DATE	REVISION NO.	PAGE	DESCRIPTIONS
May.27,99	Ver. 1	-	Initial release
Jul.16,99	Ver. 2	2	Power Supply current 500 → 650
		3	Brightness uniformity 1.3 MAX → (1.3) MAX
Dec.02,99	Ver. 3	2	Power Supply current (250) → 260
		3	OPTICAL CHARACTERISTICS
		4	Lamp voltage (620) → 630
		8	INTERFACE TIMING PARAMETERS
Sep.09,00	Ver. 4	3	OPTICAL CHARACTERISTICS
		4	BACKLIGHT CHARACTERISTICS
		11	Changed the indication of "t"into "t1,2,3,4,5,6,7".
Nov.02.00	Ver. 5	3	OPTICAL CHARACTERISTICS

■ *MECHANICAL CHARACTERISTICS*

Ta=25℃

ITEM	SPECIFICATION	UNIT
Module size	341.0(W) × 262.0(H) × 13.8(T)	mm
Resolution	1024 × R·G·B(W) × 768(H)	pixel
Sub-pixel pitch	0.099(W) × 0.297(H)	mm
Pixel pitch	0.297(W) × 0.297(H)	mm
Active viewing area	304.1(W) × 228.1(H)	mm
Bezel opening area	307.3(W) × 231.3(H)	mm
Weight	1350 Typ.	g

■ *ELECTRICAL ABSOLUTE MAXIMUM RATINGS*

Ta=25℃

ITEM	SYMBOL	MIN	MAX	UNIT	NOTE
Power supply voltage	V_{DD}-V_{SS}	0	6.0	V	
Input logic voltage	V_I	VSS	3.6	V	
CFL lamp current	I_L	-	6.5	mA	

■ *ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS*

Ta=25℃

ITEM	SYMBOL	CONDITIONS	MIN	MAX	UNIT	NOTE
Ambient temperature	T_{ST}	Storage	-20	60	℃	Note 1
	T_{OP}	Operation	0	50		
Humidity	-	Ta≦40℃		85	%RH	No condensation Note 2
Vibration	-	Storage	-	1.5	G	Note 3
Shock	-	Storage	-	50	G	XYZ 11ms/direction

[Note 1] Care should be taken so that the LCD module may not be subjected to the temperature beyond this specification.

[Note 2] Ta>40℃:Absolute humidity shall be less than that of 85% RH/40℃.

[Note 3] 10-200Hz, 30min/cycle, X/Y/Z each one cycle and except for resonant frequency.

■ *ELECTRICAL CHARACTERISTICS*

V_{DD}=5.0V , f_V=60Hz , f_{CLK}=32.5MHz , Ta=25℃

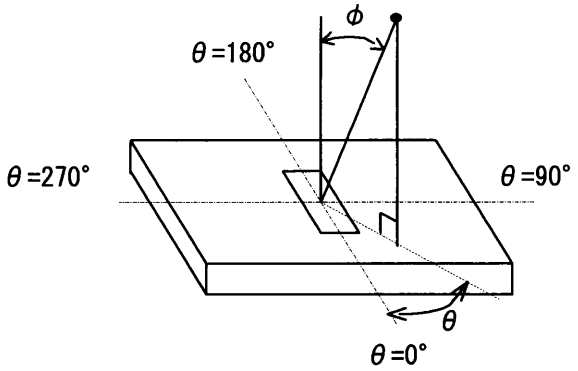
ITEM	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE
Power supply voltage	V_{DD}-V_{SS}		4.5	5.0	5.5	V	
Input logic voltage	V_{IH}	High level	2.0	-	3.6	V	
	V_{IL}	Low level	VSS	-	0.8		
Power Supply current	I_{DD}	Note 1	-	260	650	mA	

[Note 1] Under the following display image :
Typ. value : Display pattern is 64 gray scale bar.

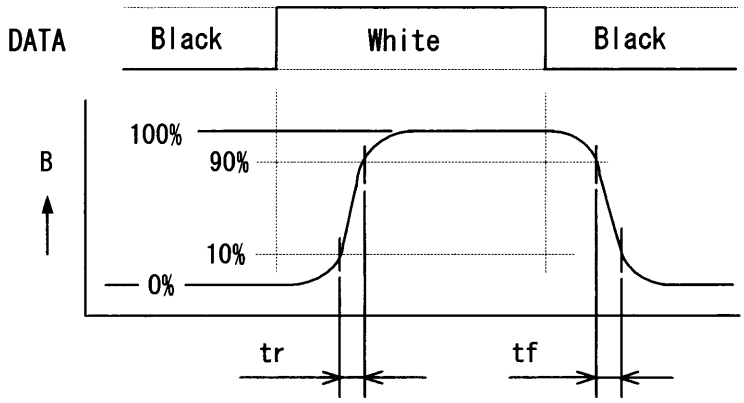
■ *OPTICAL CHARACTERISTICS*

Ta=25℃, V_{DD}=5.0V, fv=60Hz

ITEM		SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT	NOTE
Brightness		B			180	230	-	cd/㎡	Note 5, 8
Brightness uniformity					-	-	1.30	-	Note 5, 6, 8
Contrast ratio		K	ϕ=0°		200	250	-	-	Note 2, 4, 8
Viewing angle range		ϕ	K>10	θ= 0°	40	55	-	deg.	Note 1, 2, 4, 8
				θ= 90°	50	60	-		
				θ=180°	35	50	-		
				θ=270°	50	60	-		
Response time	Rise	tr	ϕ=0°		-	30	50	ms.	Note 3, 4, 8
	Fall	tf			-	10	40		
Color of CIE Coordinate	Red	x	ϕ=0°		0.59	0.64	0.69	-	Note 4, 8
		y			0.30	0.35	0.40		
	Green	x			0.24	0.29	0.34		
		y			0.55	0.60	0.65		
	Blue	x			0.09	0.14	0.19		
		y			0.04	0.09	0.14		
	White	x			0.27	0.32	0.37		
		y			0.28	0.33	0.38		



[Note 1] ϕ and θ



[Note 3] Response time

[Note 2] Contrast ratio "K"

$$K = \frac{\text{Brightness at White}}{\text{Brightness at Black}}$$

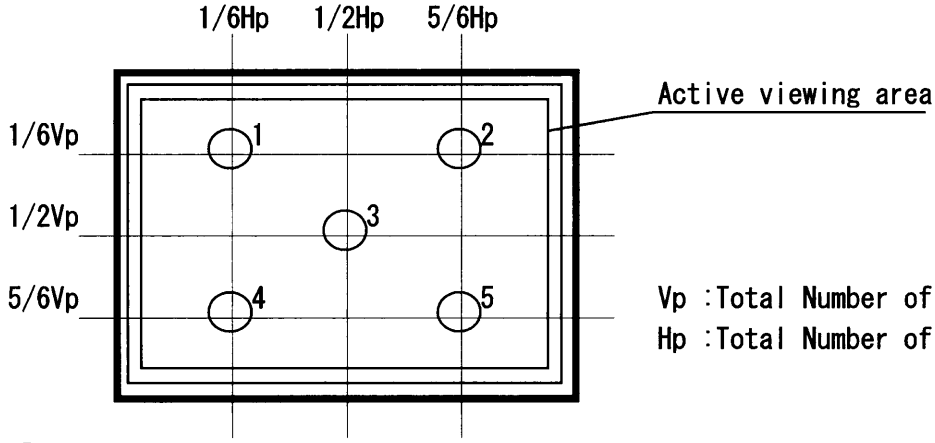
[Note 4] This shall be measured at center point ③ of Note 7.

[Note 5] The brightness shall be the average of the following 5 points of Note 7.

[Note 6] The brightness uniformity shall be calculated by using following formula.

$$\text{Brightness uniformity} = \frac{\text{Maximum Brightness of 5 points}}{\text{Minimum Brightness of 5 points}}$$

[Note 7] Measurement points



[Note 8] Measurement condition

① Measurement equipment : BM-5A(TOPCON Corp.), Field=2°
② Ambient temperature Ta : 25 ±2℃
③ LCD : All pixels are WHITE, V_{DD}=5.0V, fv=60Hz
④ Measure after 30 minutes of CFL warm up.
⑤ I_L=5.5 mArms with the CFL inverter CXA-P1212-VJL(TDK).

■ *BACKLIGHT CHARACTERISTICS*

This module is used the back light with 2 CFL.
Please follow the characteristics of 1 CFL as below.

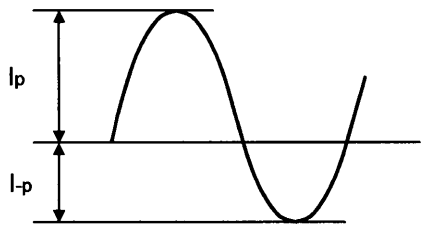
Ta=25℃

ITEM	SYM.	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE
Lamp voltage	V_L		-	630	-	Vrms	at I_L=5.5 mArms
Lamp current	I_L		4	-	6	mArms	(Recommended value)
Operating frequency	f_L		40	60	65	kHz	(Recommended value)
Start up voltage	V_S		-	-	1500	Vrms	at Ta= 0℃
Operating life	t_{OL}		50000	-	-	Hours	at I_L=6.0 mArms

[Note 1] Backlight driving conditions (operating frequency f_L especially) may interfere with horizontal frequency f_H, causing the beat or flicker on the display. Therefore the operating frequency f_L shall be adjusted in relation to horizontal frequency f_H to avoid interference.

[Note 2] The inverter open voltage should be larger than start up voltage, otherwise backlight may blinking for a moment after turns on or not be turned on. And this voltage should be applied to lamp for more than 1 second to start up, otherwise backlight may not be turned on.

[Note 3] If driving current waveform is asymmetrical, mercury deviation inside of CFL will incline to one side and consequently abnormal lighting may occur. To prevent such unfavorable lighting, driving current waveform is asked to have unbalance rate of less than 10% and wave-height rate of less than $\sqrt{2}$ +/- 10%. And this driving waveform shall be confirmed in your system.

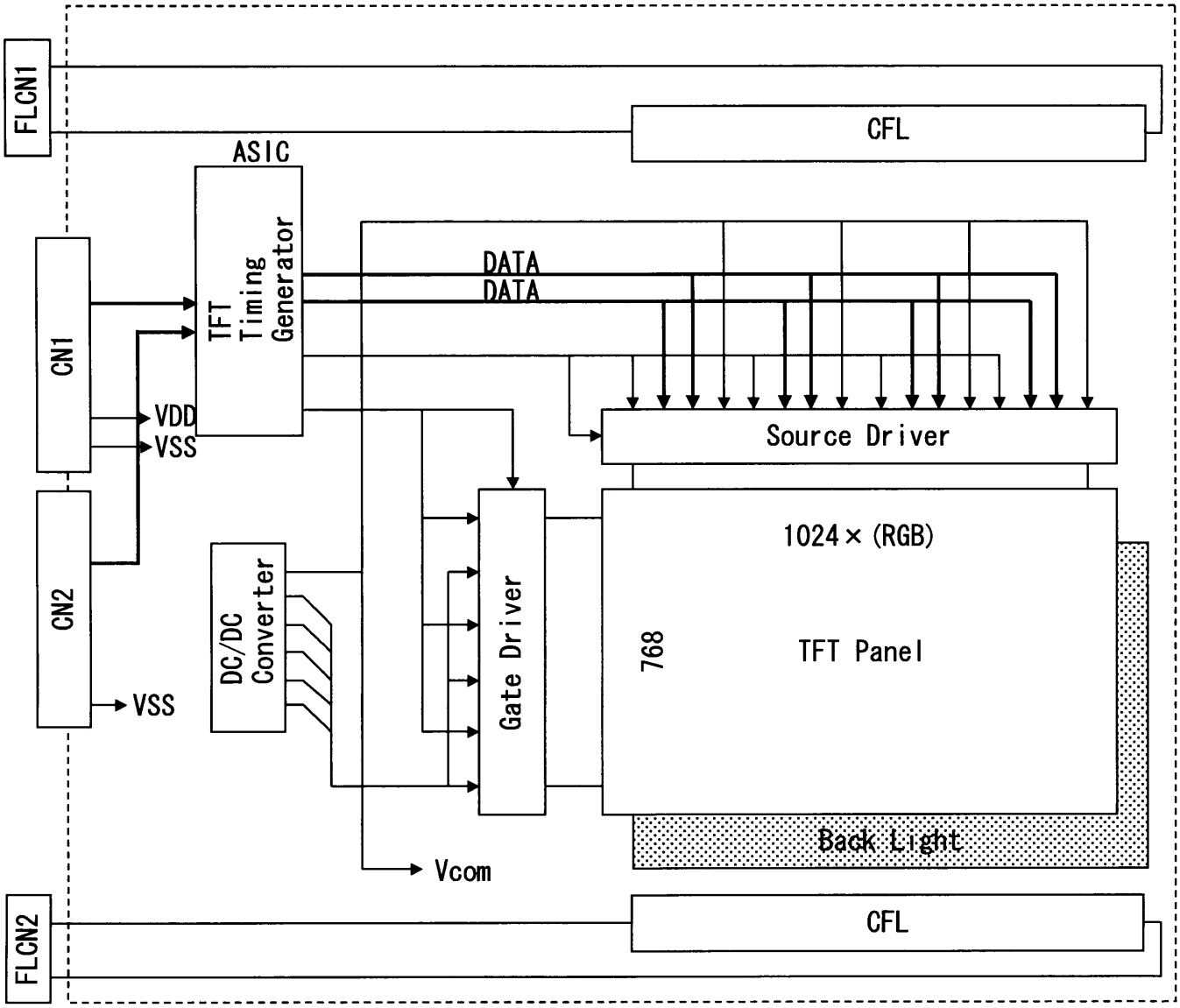


Current waveform

Unbalance rate = | I_p - I_{-p} | / I_L x 100 (%)
Wave-height rate = I_p (or I_{-p}) / I_L

I_p : High peak value
I_{-p} : Low peak value
I_L : Effective value

■ *BLOCK DIAGRAM*



■ *INTERFACE PIN CONNECTIONS*

LCM : CN1

PIN NO.	SYMBOL	FUNCTION
1	VSS	Ground
2	DCLK	Data Clock
3	NC	No Connection
4	NC	No Connection
5	VSS	Ground
6	RA0(ODD)	Red Data - ODD (LSB)
7	RA1	Red Data
8	RA2	Red Data
9	RA3	Red Data
10	RA4	Red Data
11	RA5	Red Data - ODD (MSB)
12	VSS	Ground
13	GA0(ODD)	Green Data - ODD (LSB)
14	GA1	Green Data
15	GA2	Green Data
16	GA3	Green Data
17	GA4	Green Data
18	GA5	Green Data - ODD (MSB)
19	VSS	Ground
20	BA0(ODD)	Blue Data - ODD (LSB)
21	BA1	Blue Data
22	BA2	Blue Data
23	BA3	Blue Data
24	BA4	Blue Data
25	BA5	Blue Data - ODD (MSB)
26	DE	Data Enable
27	VSS	Ground
28	VDD	Power Supply (5.0V normal)
29	VDD	Power Supply (5.0V normal)
30	VSS	Ground

CN1 : DF14A-30P-1.25H(Hirose)

Suitable mating connector : DF14S-30P-1.25C(Hirose) or Compatible

■ *INTERFACE PIN CONNECTIONS*

LCM : CN2

PIN NO.	SYMBOL	FUNCTION
1	VSS	Ground
2	RB0(EVEN)	Red Data - EVEN (LSB)
3	RB1	Red Data
4	RB2	Red Data
5	VSS	Ground
6	RB3	Red Data
7	RB4	Red Data
8	RB5	Red Data - EVEN (MSB)
9	VSS	Ground
10	GB0(EVEN)	Green Data - EVEN (LSB)
11	GB1	Green Data
12	GB2	Green Data
13	VSS	Ground
14	GB3	Green Data
15	GB4	Green Data
16	GB5	Green Data - EVEN (MSB)
17	VSS	Ground
18	BB0(EVEN)	Blue Data - EVEN (LSB)
19	BB1	Blue Data
20	BB2	Blue Data
21	VSS	Ground
22	BB3	Blue Data
23	BB4	Blue Data
24	BB5	Blue Data - EVEN (MSB)
25	VSS	Ground

CN2 : DF14A-25P-1.25H(Hirose)

Suitable mating connector : DF14S-25P-1.25C(Hirose) or Compatible

Back Light : FLCN1,2

PIN NO.	SYMBOL	FUNCTION
1	H.V	High voltage for CFL
2	NC	No Connection
3	LGND	Low voltage for CFL

FLCN1,2 : BHR-03VS-1(JST)

Suitable mating connector : SM02(8.0)B-BHS-1(JST)

■ *INTERFACE TIMING PARAMETERS*

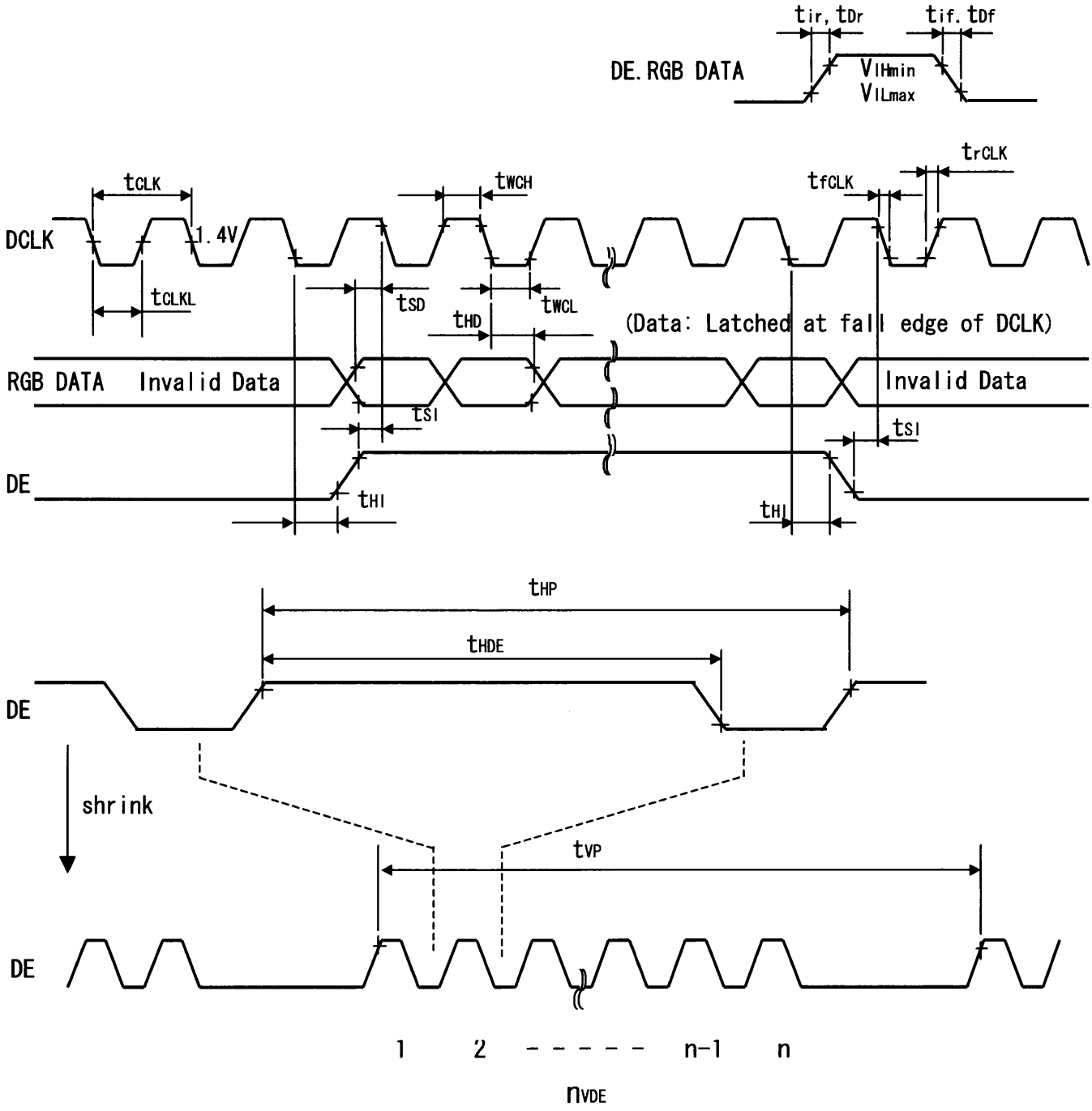
PARAMETER		SYMBOL	MIN	TYP	MAX	UNIT	NOTE
DCLK	Period	t_{CLK}	28.6	30.8	—	ns	32.5MHz typ.
	Width-Low	t_{WCL}	9.0	—	—	ns	
	Width-High	t_{WCH}	9.0	—	—	ns	
	Rise Time	t_{rCLK}	—	—	10	ns	
	Fall Time	t_{fCLK}	—	—	10	ns	
	Duty	D	(0.40)	0.50	(0.60)	—	$D=t_{CLKL}/t_{CLK}$
DE	Setup Time	t_{SI}	5.0	—	—	ns	For DCLK
	Hold Time	t_{HI}	5.0	—	—	ns	
	Rise/Fall Time	t_{ir}, t_{if}	—	—	10	ns	
	Horiz. Period	t_{HP}	630	672	704	t_{CLK}	
	Horiz. DE	t_{HDE}	512	512	512	t_{CLK}	
	Vert. Period	t_{VP}	780	806	860	t_{HP}	60Hz typical
	Vert. DE	n_{VDE}	768	768	768	n	
DATA	Setup Time	t_{SD}	5.0	—	—	ns	For DCLK
	Hold Time	t_{HD}	5.0	—	—	ns	
	Rise/Fall Time	t_{Dr}, t_{Df}	—	—	10	ns	

[Note 1] Definition of Vertical Frequency fv and Horizontal Frequency f_H:

f_H (Horizontal Frequency) = $1/t_{HP}$

fv (Vertical Frequency) = $1/t_{VP}$

■ *INTERFACE TIMING DIAGRAM (DE Mode)*



■ *RELATIONSHIP BETWEEN INPUT DATA AND DISPLAY COLOR*

DISPLAY COLOR \ INPUT DATA		R DATA						G DATA						B DATA					
		MSB					LSB	MSB					LSB	MSB					LSB
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
BASIC COLOR	BLACK	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	RED (63)	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L
	GREEN (63)	L	L	L	L	L	L	H	H	H	H	H	H	L	L	L	L	L	L
	BLUE (63)	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H
	CYAN	L	L	L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H
	MAGENTA	H	H	H	H	H	H	L	L	L	L	L	L	H	H	H	H	H	H
	YELLOW	H	H	H	H	H	H	H	H	H	H	H	H	L	L	L	L	L	L
	WHITE	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
RED	BLACK	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	RED (1)	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L
	RED (2)	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L
	:			:						:						:			
	:			:						:						:			
	RED (61)	H	H	H	H	L	H	L	L	L	L	L	L	L	L	L	L	L	L
	RED (62)	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L
	RED (63)	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L
GREEN	BLACK	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	GREEN (1)	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L
	GREEN (2)	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L
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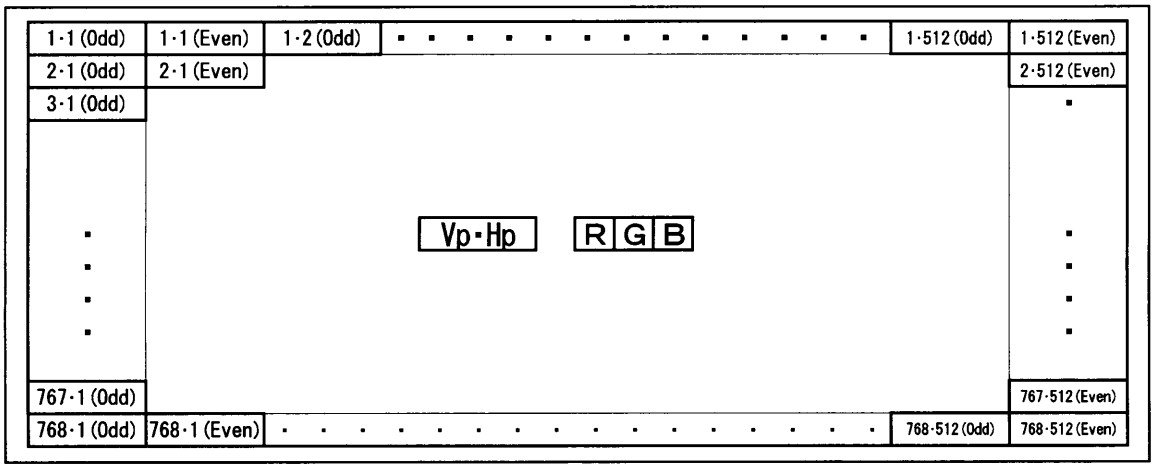
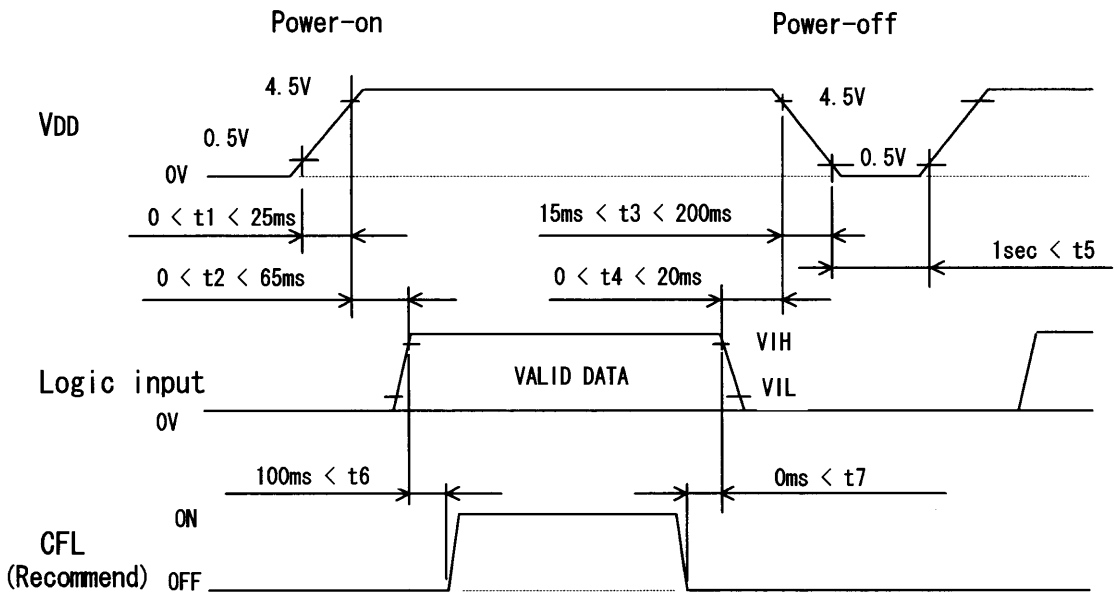
	:			:						:						:			
	GREEN (61)	L	L	L	L	L	L	H	H	H	H	L	H	L	L	L	L	L	L
	GREEN (62)	L	L	L	L	L	L	H	H	H	H	H	L	L	L	L	L	L	L
	GREEN (63)	L	L	L	L	L	L	H	H	H	H	H	H	L	L	L	L	L	L
BLUE	BLACK	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	BLUE (1)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H
	BLUE (2)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L
	:			:						:						:			
	:			:						:						:			
	BLUE (61)	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	L	H
	BLUE (62)	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	L
	BLUE (63)	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H

Note 1) Color (n) --- 'n' indicates gray scale step.

■ *RELATIONSHIP BETWEEN INPUT DATA AND DISPLAY POSITION*



■ *POWER ON/OFF SEQUENCE REQUIREMENT*



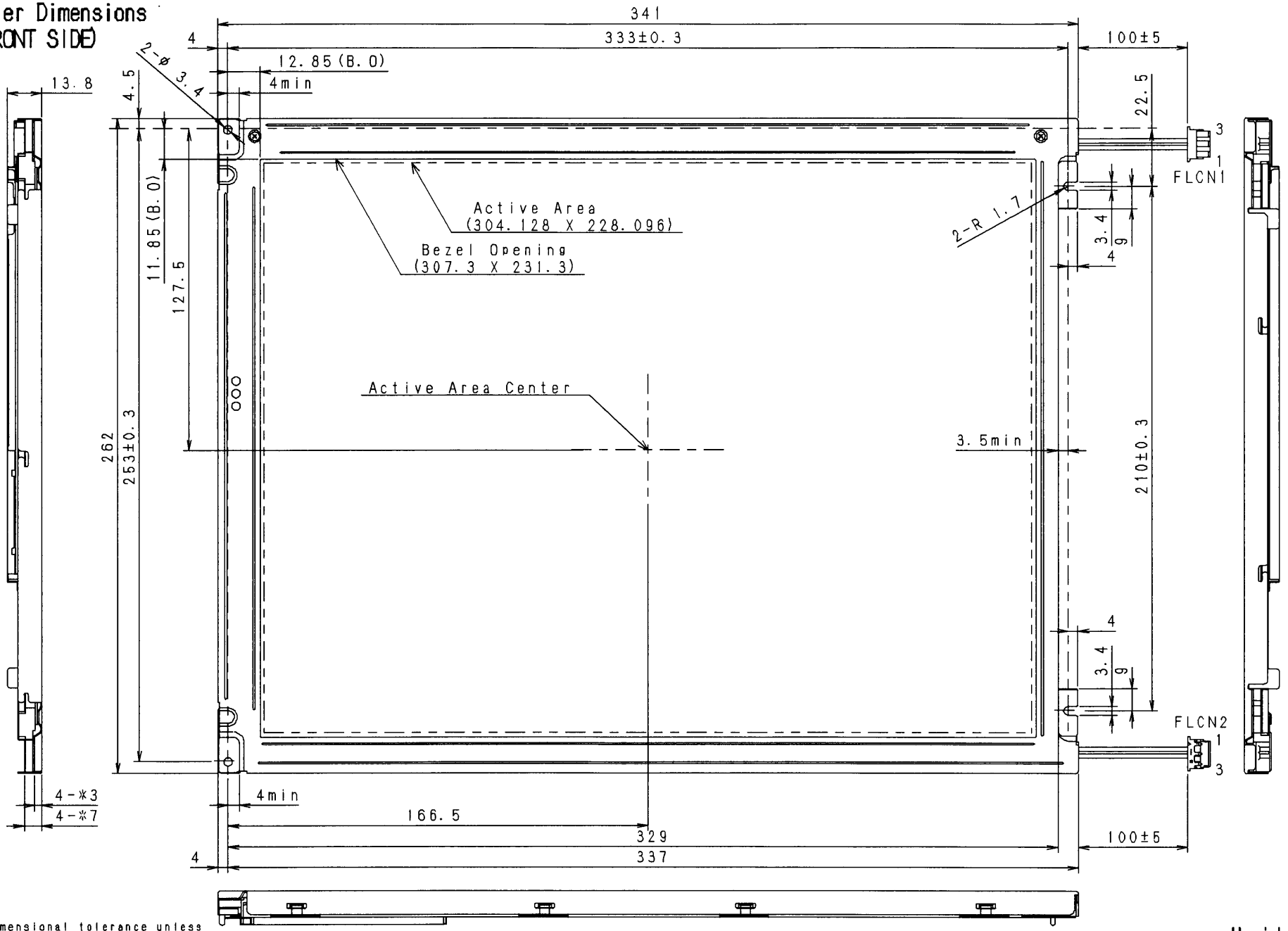
When the power is off, Logic input must be kept at either low level or high impedance.

Power sequence for CFL(backlight) is not specified especially, however it is recommended to consider some timing difference between Logic input as shown above. If backlight lights on before LCD starts function, or if backlight is kept on after LCD stopped function, screen may look white for a moment or abnormal image may be displayed.
This is caused by variation in output signal from timing generator at Logic input on or off. It does not cause damage to liquid crystal molecule and driving circuit.

■*PRECAUTIONS*

1. This data sheet explains the outline of LCD module. Before designing your system with this LCD module, please ask for specification to understand our more precautions and recommendations.
2. Please avoid disassembling or modification of this module.
3. Since this LCD module consists of glass, dropping, pinching strongly or punching may break or result in damage. When glass breaks, please be careful not to be injured by glass piece.
4. When glass breaks and fluid flows out, do not suck in, drink or touch the fluid. If the fluid should stick to hand or clothes, wipe off with soap or alcohol immediately and then wash it with water. If the fluid should get in eyes, wash eyes immediately with washing lotion for more than 15 minutes and then consult the doctor.
5. Since high voltage is applied to CFL during lighting, please make design to avoid electric shock or take care in handling. Since poor connection of CFL connector may cause burning due to leakage of high voltage, please make sure of proper connection.
6. CFL contains mercury inside. Please follow regulations or rules established by local autonomy at its disposal.
7. Please do not rub, press or touch the display surface with hard material or jigs, because the polarizer at surface can be easily scratched. When the display surface gets a drop of water or contamination, wipe it off lightly with soft cloth.
8. Since this LCD module contains semiconductors, please pay attention against static-electricity in handling.
9. Please switch OFF power supply before connecting or disconnecting interface connector.
10. For storage, please store under room temperature, low humidity and dark circumstance in original packing condition.

■ Outer Dimensions (FRONT SIDE)

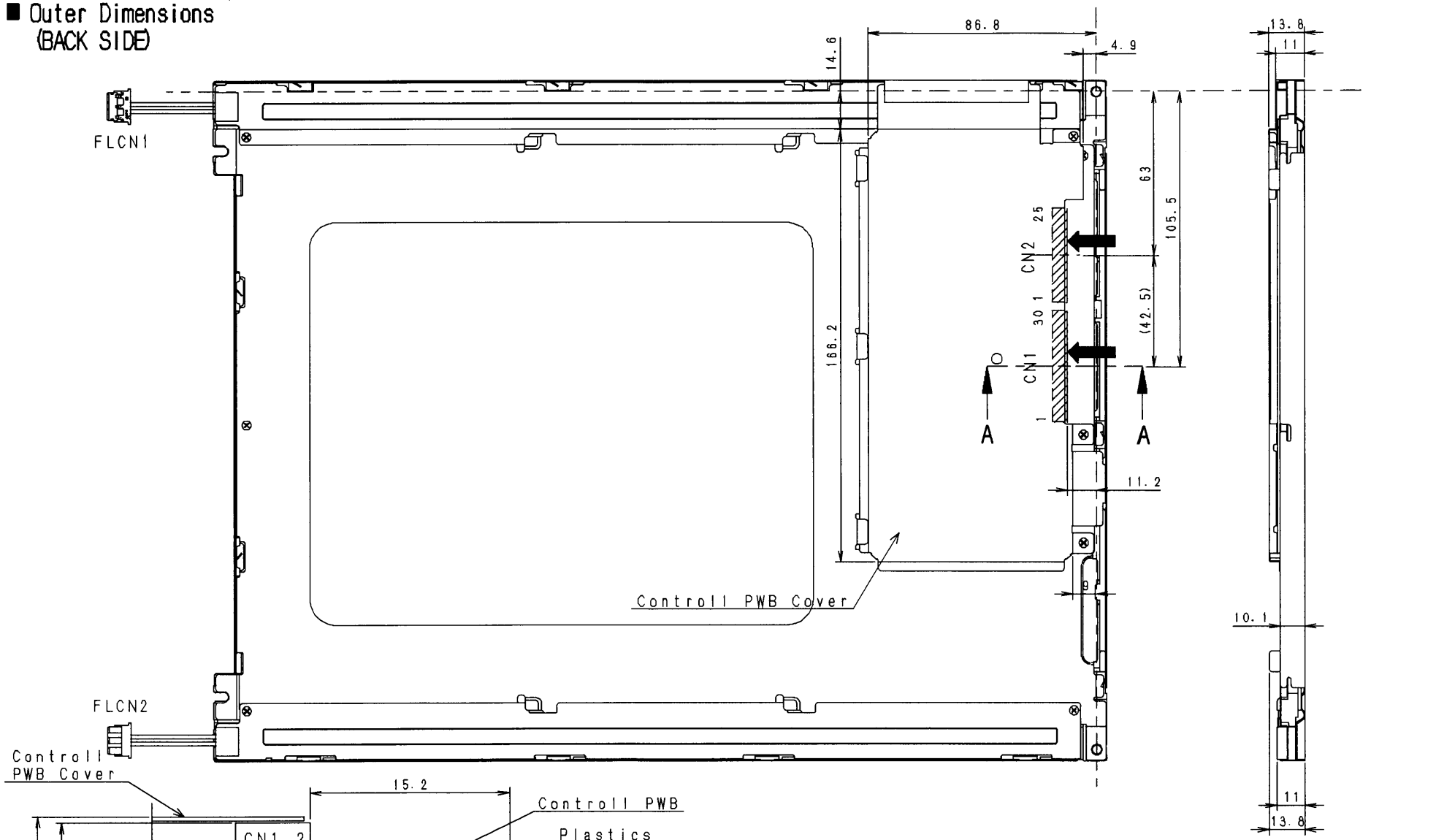


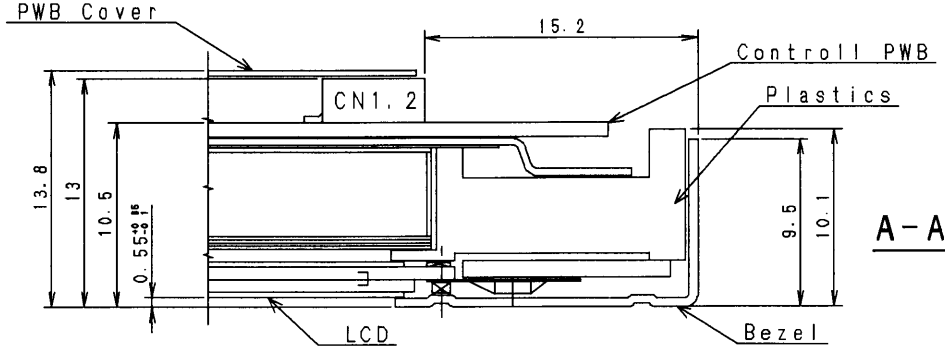
<NOTE>
1. All dimensional tolerance unless otherwise specified ±0.5
2. *:This value shows the thickness after mounting and fixing to customer's cabinet.

CN1:DF14A-30P-1.25H(HIROSE)
CN2:DF14A-25P-1.25H(HIROSE)
FLCN1,2:BHR-03VS-1(JST)

Unit:mm

■ Outer Dimensions (BACK SIDE)





A-A SEC

<NOTE>
1. All dimensional tolerance unless otherwise specified ±0.5
2. ✱: This value shows the thickness after mounting and fixing to customer's cabinet.

CN1 : DF14A-30P-1.25H (HIROSE)
CN2 : DF14A-25P-1.25H (HIROSE)
FLCN1, 2 : BHR-03VS-1 (JST)

Unit : mm