

**TORISAN**

## **ENGINEERING SPECIFICATIONS**

TFT COLOR LCD MODULE

### **TM150XG-22L03A**

- 38cm (15.0 inch) diagonal
- XGA resolution (1024 × R·G·B × 768 dots)
- Wide View Angle
- Digital RGB (RGB × 8 bits × Dual Port)
- Power Supply Voltage : 5V
- Ear mount
- With CFL backlight unit
- Nonglare surface type

**(TENTATIVE)**

Ver. 3      Feb. 23, 2001

Tottori SANYO Electric Co., Ltd.  
LCD Division

3-201, Minami-yoshikata, Tottori, 680-8634 Japan  
TEL: 81-857-21-2941 , 1958  
FAX: 81-857-21-2265

  
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
Nov. 21, 00	Ver. 1	-	Initial release.
Feb. 01, 01	Ver. 2	6	Change connector maker (CN1).
		7	Change connector maker (CN2).
		8	Change INTERFACE TIMING PARAMETERS.
		14	Attach Alminum tapes for EMI improvement.
Feb. 23, 01	Ver. 3	3	Brightness TYP 230 → 250
		3	Contrast ratio TYP 250 → 350
		4	Measurement condition ⑤IL=5.5 → 6.0
		4	Lamp voltage NOTE IL=5.5 → 6.0
		4	Lamp voltage TYP 630 → 610

## MECHANICAL CHARACTERISTICS

Ta=25°C

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°C

ITEM	SYMBOL	MIN	MAX	UNIT	NOTE
Power supply voltage	V <sub>DD</sub> -V <sub>SS</sub>	0	6.0	V	
Input logic voltage	V <sub>I</sub>	V <sub>SS</sub>	3.6	V	
CFL lamp current	I <sub>L</sub>	-	6.5	mA	

## ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

Ta=25°C

ITEM	SYMBOL	CONDITIONS	MIN	MAX	UNIT	NOTE
Ambient temperature	T <sub>ST</sub>	Storage	-20	60	°C	Note 1
	T <sub>OP</sub>	Operation	0	50		
Humidity	-	Ta ≤ 40°C		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°C: Absolute humidity shall be less than that of 85% RH/40°C.

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

## ELECTRICAL CHARACTERISTICS

V<sub>DD</sub>=5.0V, f<sub>v</sub>=60Hz, f<sub>CLK</sub>=32.5MHz, Ta=25°C

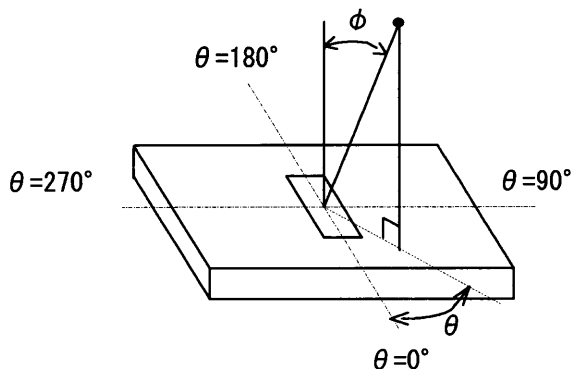
ITEM	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE
Power supply voltage	V <sub>DD</sub> -V <sub>SS</sub>		4.5	5.0	5.5	V	
Input logic voltage	V <sub>IH</sub>	High level	2.0	-	3.6	V	
	V <sub>IL</sub>	Low level	V <sub>SS</sub>	-	0.8		
Power Supply current	I <sub>DD</sub>	Note 1	-	(270)	(650)	mA	

[Note 1] Under the following display image :  
Typ. value : Display pattern is 256 gray scale bar.

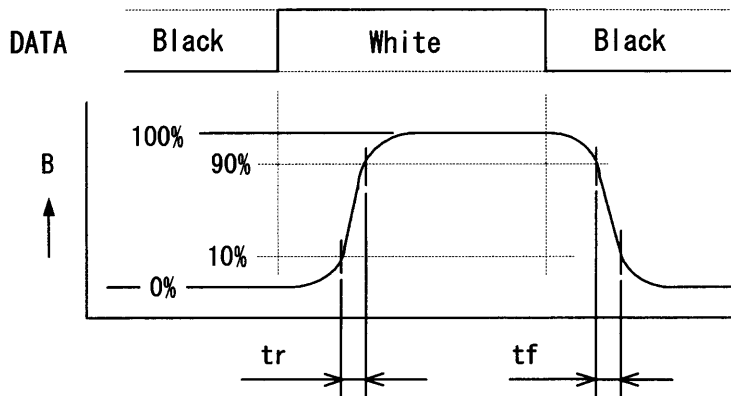
# ■ OPTICAL CHARACTERISTICS

Ta=25°C, VDD=5.0V, fv=60Hz

ITEM	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE		
Brightness	B		180	250	-	cd/m <sup>2</sup>	Note 5, 8		
Brightness uniformity			-	-	1.30	-	Note 5, 6, 8		
Contrast ratio	K	$\phi=0^\circ$	200	350	-	-	Note 2, 4, 8		
Viewing angle range	$\phi$	K>10	$\theta=0^\circ$	40	55	-	deg.	Note 1, 2, 4, 8	
			$\theta=90^\circ$	50	60	-			
			$\theta=180^\circ$	35	50	-			
			$\theta=270^\circ$	50	60	-			
Response time	Rise	tr	$\phi=0^\circ$		-	30	50	ms.	Note 3, 4, 8
	Fall	tf	-	10	40				
Color of CIE Coordinate	Red	x	$\phi=0^\circ$	(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 ]  $\phi$  and  $\theta$



[ Note 3 ] Response time

[ Note 2 ] Contrast ratio "K"

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

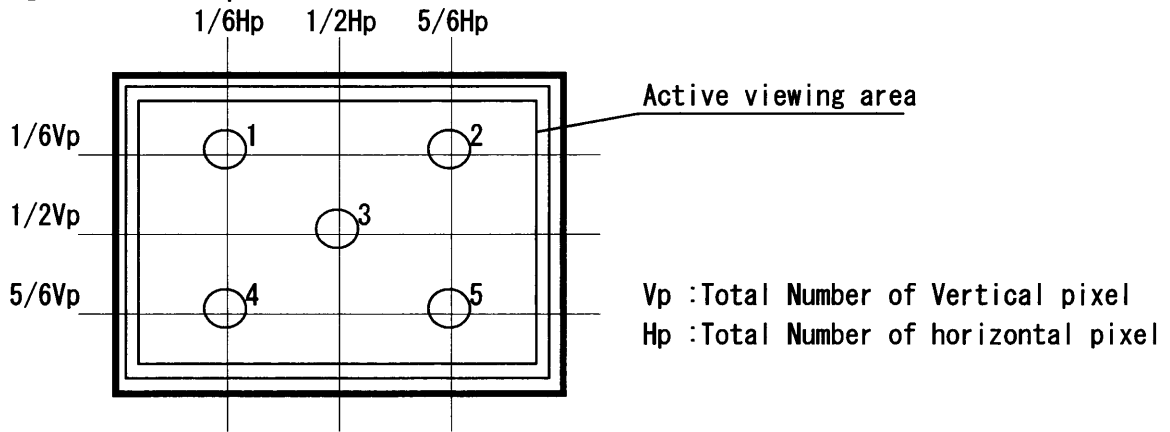
[ Note 4 ] This shall be measured at center point ③ of Note 7.

[ 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°C
- ③ LCD : All pixels are WHITE, VDD=5.0V, fv=60Hz
- ④ Measure after 30 minutes of CFL warm up.
- ⑤ IL=6.0 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.

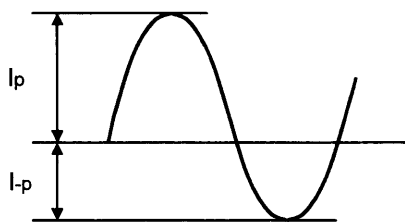
Ta=25°C

ITEM	SYM.	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE
Lamp voltage	VL		-	610	-	Vrms	at IL=6.0 mArms
Lamp current	IL		4	-	6	mArms	(Recommended value)
Operating frequency	fL		40	60	65	kHz	(Recommended value)
Start up voltage	VS		-	-	1500	Vrms	at Ta= 0°C
Operating life	tOL		50000	-	-	Hours	at IL=6.0 mArms

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

$$\text{Unbalance rate} = |I_p - I_{-p}| / I_L \times 100 (\%)$$

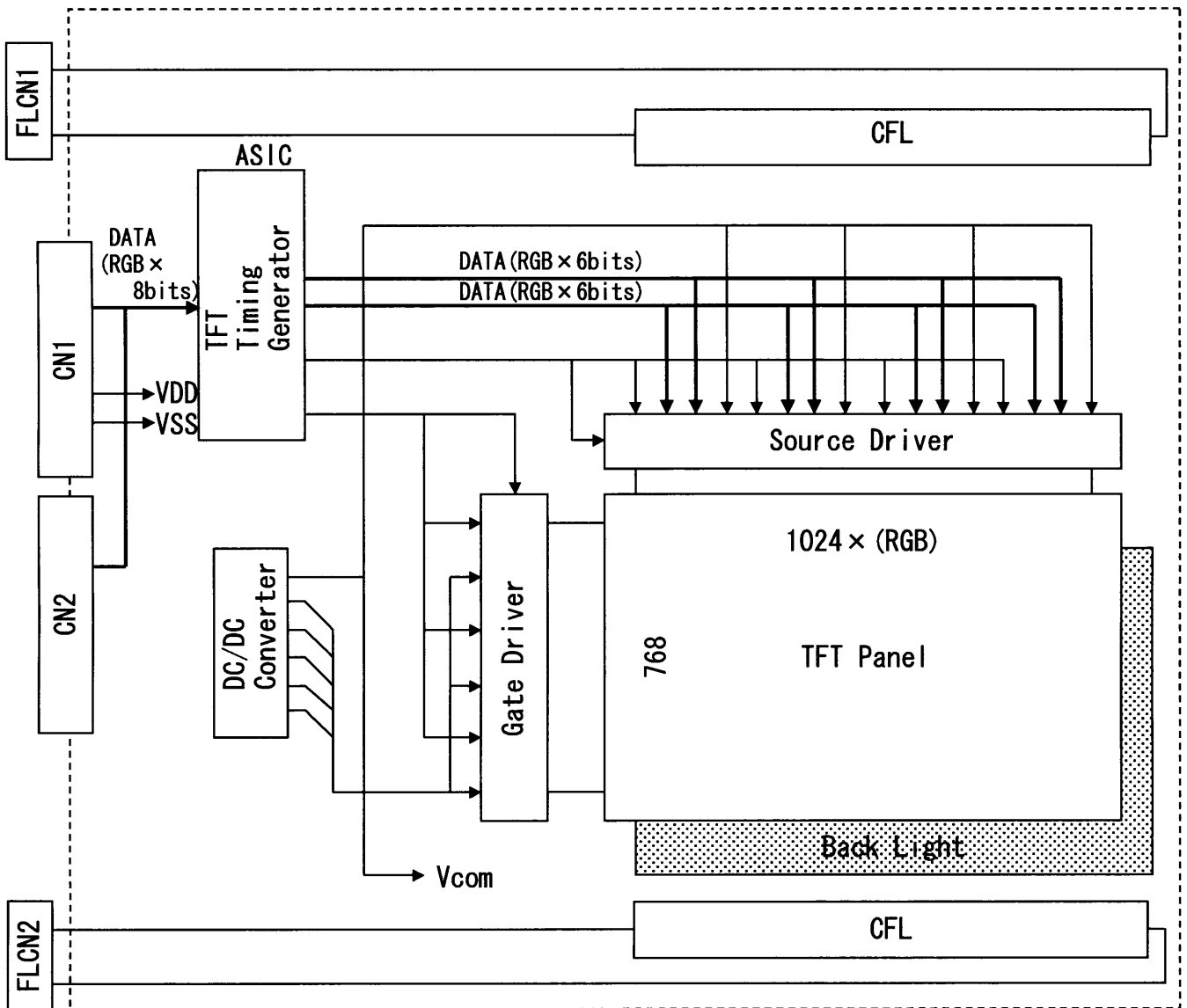
$$\text{Wave-height rate} = I_p \text{ (or } I_{-p}) / I_L$$

Ip : High peak value

I-p : Low peak value

IL : Effective value

■ **BLOCK DIAGRAM**



[ Note 1 ] ASIC converts incoming RGB x 8 bits data into outgoing RGB x 6 bits data with frame rate modulation and dithering, which enables LCD to perform 'pseudo-8 bits color'.

## ■ INTERFACE PIN CONNECTIONS

LCM : CN1

PIN NO.	SYMBOL	FUNCTION
1	GND	Ground
2	DCLK	Dot Clock
3	GND	Ground
4	DE	Data enable
5	GND	Ground
6	NC	No Connection
7	GND	Ground
8	NC	No Connection
9	GND	Ground
10	NC	No Connection
11	GND	Ground
12	BO7	Blue odd data (MSB)
13	BO6	Blue odd data
14	BO5	Blue odd data
15	BO4	Blue odd data
16	GND	Ground
17	BO3	Blue odd data
18	BO2	Blue odd data
19	BO1	Blue odd data
20	BO0	Blue odd data (LSB)
21	GND	Ground
22	GO7	Green odd data (MSB)
23	GO6	Green odd data
24	GO5	Green odd data
25	GO4	Green odd data
26	GND	Ground
27	GO3	Green odd data
28	GO2	Green odd data
29	GO1	Green odd data
30	GO0	Green odd data (LSB)
31	GND	Ground
32	RO7	Red odd data (MSB)
33	RO6	Red odd data
34	RO5	Red odd data
35	RO4	Red odd data
36	GND	Ground
37	RO3	Red odd data
38	RO2	Red odd data
39	RO1	Red odd data
40	RO0	Red odd data (LSB)
41	VCC	
42	VCC	
43	NC	No Connection
44	NC	No Connection
45	NC	No Connection

CN1 (Data Signal and Power Supply):  
FH12-45S-0.5SH(49) (HIROSE)

## ■ INTERFACE PIN CONNECTIONS

LCM : CN2

PIN NO.	SYMBOL	FUNCTION
1	GND	Ground
2	BE7	Blue even data (MSB)
3	BE6	Blue even data
4	BE5	Blue even data
5	BE4	Blue even data
6	GND	Ground
7	BE3	Blue even data
8	BE2	Blue even data
9	BE1	Blue even data
10	BE0	Blue even data (LSB)
11	GND	Ground
12	GE7	Green even data (MSB)
13	GE6	Green even data
14	GE5	Green even data
15	GE4	Green even data
16	GND	Ground
17	GE3	Green even data
18	GE2	Green even data
19	GE1	Green even data
20	GE0	Green even data (LSB)
21	GND	Ground
22	RE7	Red even data (MSB)
23	RE6	Red even data
24	RE5	Red even data
25	RE4	Red even data
26	GND	Ground
27	RE3	Red even data
28	RE2	Red even data
29	RE1	Red even data
30	RE0	Red even data (LSB)

CN2 (Data Signal):

FH12-30S-0.5SH(49) (HIROSE)

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

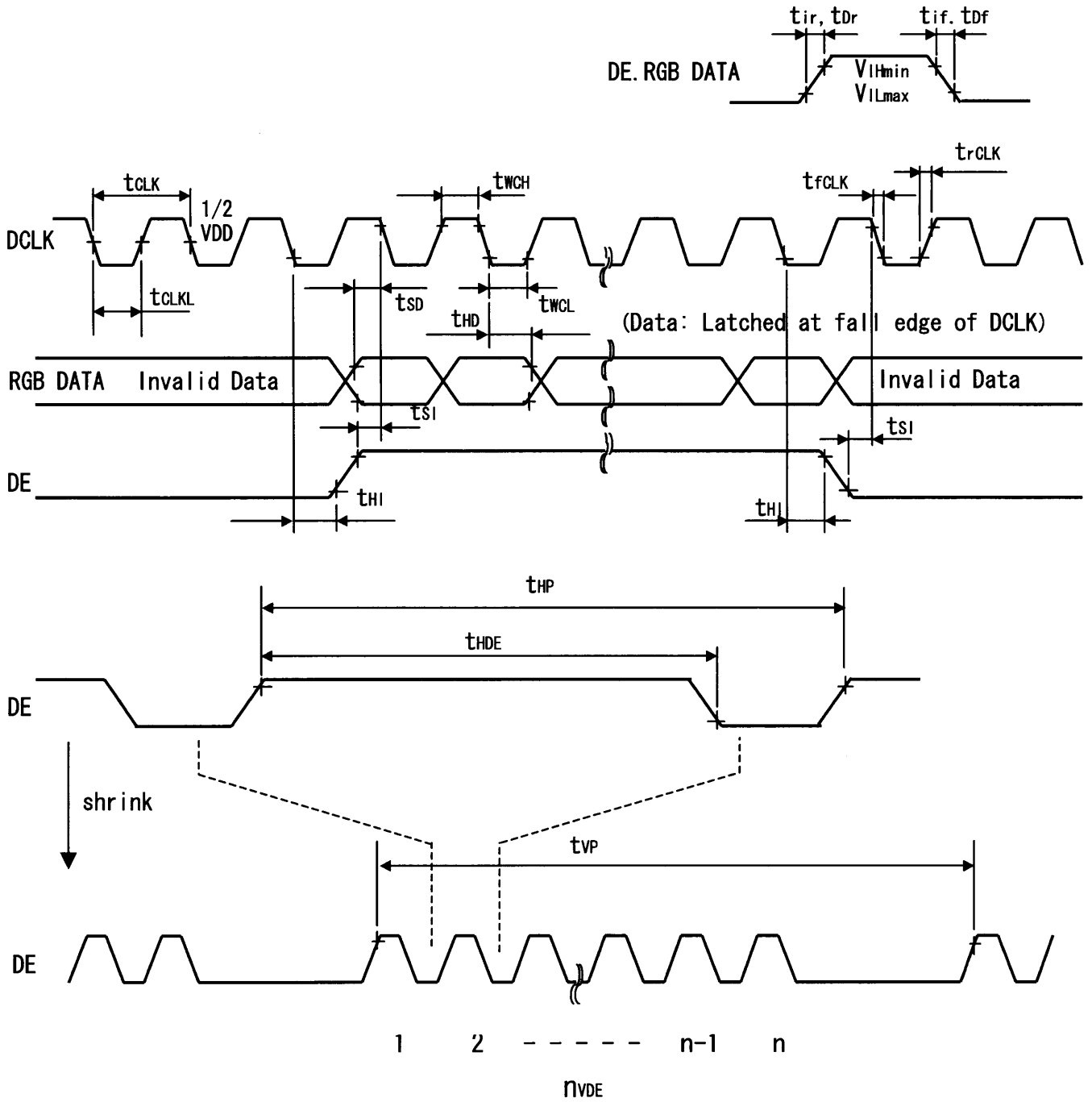
	PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
DCLK	Period	t <sub>CLK</sub>	30.0	32.5	39.5	MHz	
	Width-Low	t <sub>WCL</sub>	5.0	—	—	ns	
	Width-High	t <sub>WCH</sub>	5.0	—	—	ns	
	Rise Time	t <sub>rCLK</sub>	—	—	(5.0)	ns	
	Fall Time	t <sub>fCLK</sub>	—	—	(5.0)	ns	
	Duty	D	(0.40)	0.50	(0.60)	—	D=t <sub>CLKL</sub> /t <sub>CLK</sub>
DE	Setup Time	t <sub>SI</sub>	(5.0)	—	—	ns	For DCLK
	Hold Time	t <sub>HI</sub>	(5.0)	—	—	ns	
	Rise/Fall Time	t <sub>ir</sub> , t <sub>if</sub>	—	—	(5.0)	ns	
	Horiz. Period	t <sub>HP</sub>	525	(672)	900	t <sub>CLK</sub>	
	Horiz. DE	t <sub>HDE</sub>	512	(512)	512	t <sub>CLK</sub>	
	Vert. Period	t <sub>VP</sub>	(780)	806	—	t <sub>HP</sub>	60Hz typical
	Vert. DE	n <sub>VDE</sub>	768	(768)	768	n	
DATA	Setup Time	t <sub>SD</sub>	(5.0)	—	—	ns	For DCLK
	Hold Time	t <sub>HD</sub>	(5.0)	—	—	ns	
	Rise/Fall Time	t <sub>Dr</sub> , t <sub>Df</sub>	—	—	(5.0)	ns	

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

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

$$f_v \text{ (Vertical Frequency)} = 1/t_{VP}$$

■ 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				
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	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	L	L	L	L	L	L
	RED (255)	H	H	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	GREEN (255)	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H	L	L	L	L	L	L	L	L
	BLUE (255)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H
	CYAN	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
	MAGENTA	H	H	H	H	H	H	H	H	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H
	YELLOW	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L	L	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	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	L	L	L	L	L	L
	RED (1) *	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	RED (2) *	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	RED (3) *	L	L	L	L	L	L	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	RED (4)	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	⋮																								
	RED (251) *	H	H	H	H	H	L	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	RED (252)	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	RED (253)	H	H	H	H	H	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	RED (254)	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
RED (255)	H	H	H	H	H	H	H	H	L	L	L	L	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	L	L	L	L	L	L
	GREEN (1) *	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L
	GREEN (2) *	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L
	GREEN (3) *	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	L	L	L	L	L	L	L	L
	GREEN (4)	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L
	⋮																								
	GREEN (251) *	L	L	L	L	L	L	L	L	H	H	H	H	H	L	H	H	L	L	L	L	L	L	L	L
	GREEN (252)	L	L	L	L	L	L	L	L	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L
GREEN (253)	L	L	L	L	L	L	L	L	H	H	H	H	H	L	H	L	L	L	L	L	L	L	L	L	
GREEN (254)	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H	L	L	L	L	L	L	L	L	
GREEN (255)	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H	L	L	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	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	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	L	L	L	L	L	L	L	H
	BLUE (3) *	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H
	BLUE (4)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L
	⋮																								
	BLUE (251) *	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	L	H	H
	BLUE (252)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	L	L	L
BLUE (253)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	L	H	H	
BLUE (254)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	L	H	L	
BLUE (255)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	L	H	H	

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

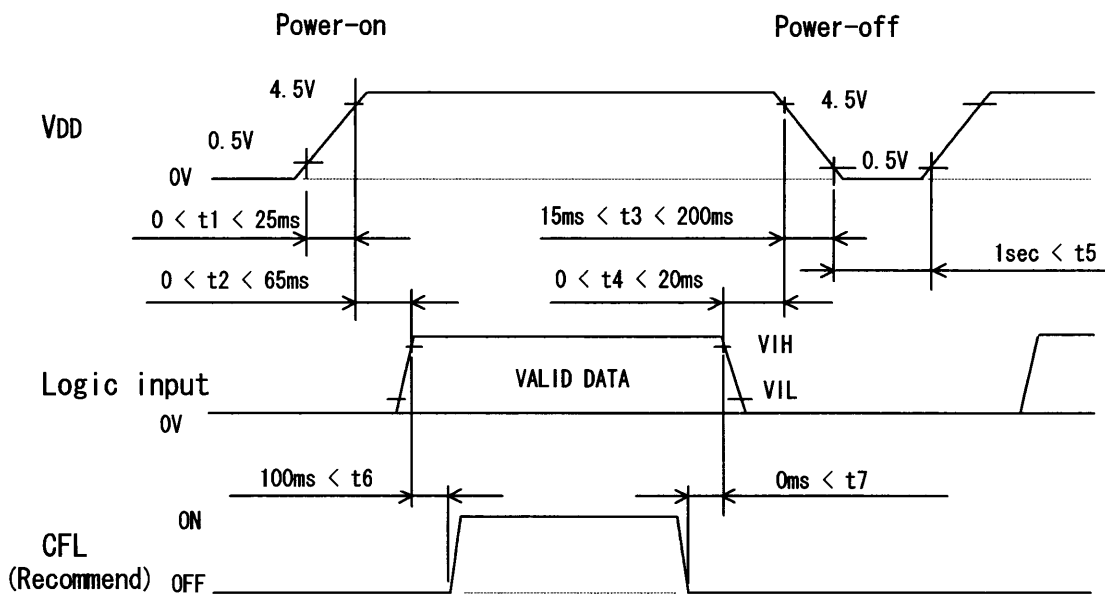
[Note 2] '\*' Mark shows using the frame rate modulation and dithering.

■ **RELATIONSHIP BETWEEN INPUT DATA AND DISPLAY POSITION**

1-1	1-2	1-3	⋮	1-1023	1-1024
2-1	2-2				2-1024
3-1					⋮
⋮					⋮
⋮					⋮
⋮					⋮
767-1					767-1024
768-1	768-2	⋮		768-1024	768-1024

Vp·Hp    R G B

## ■ POWER ON/OFF SEQUENCE REQUIREMENT



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

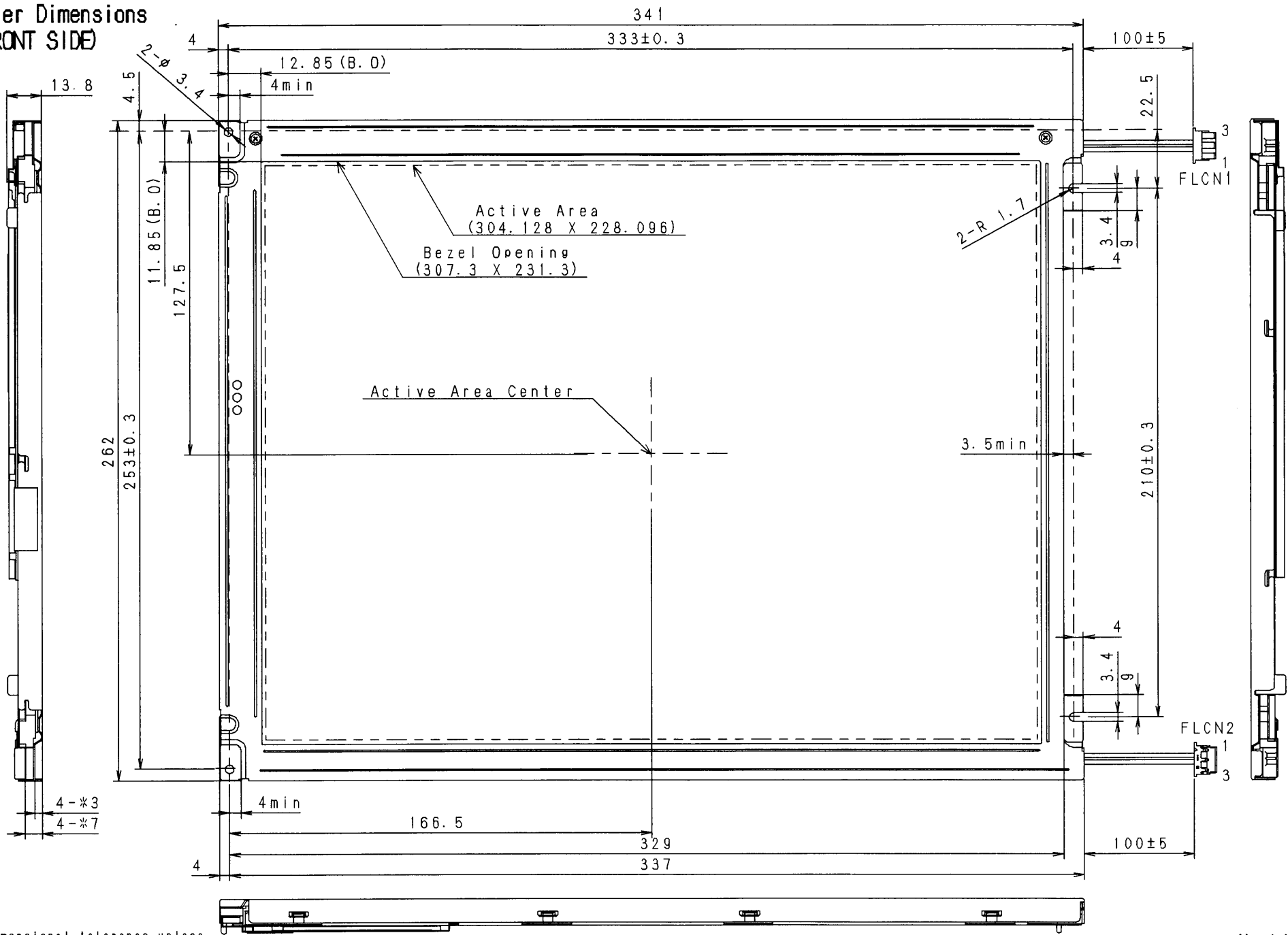
Power sequence for CFL(backlight) is not specified especially, however it is recommended to consider some timing difference between Logic input as shown above. If backlight lights on before LCD starts function, or if backlight is kept on after LCD stopped function, screen may look white for a moment 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.

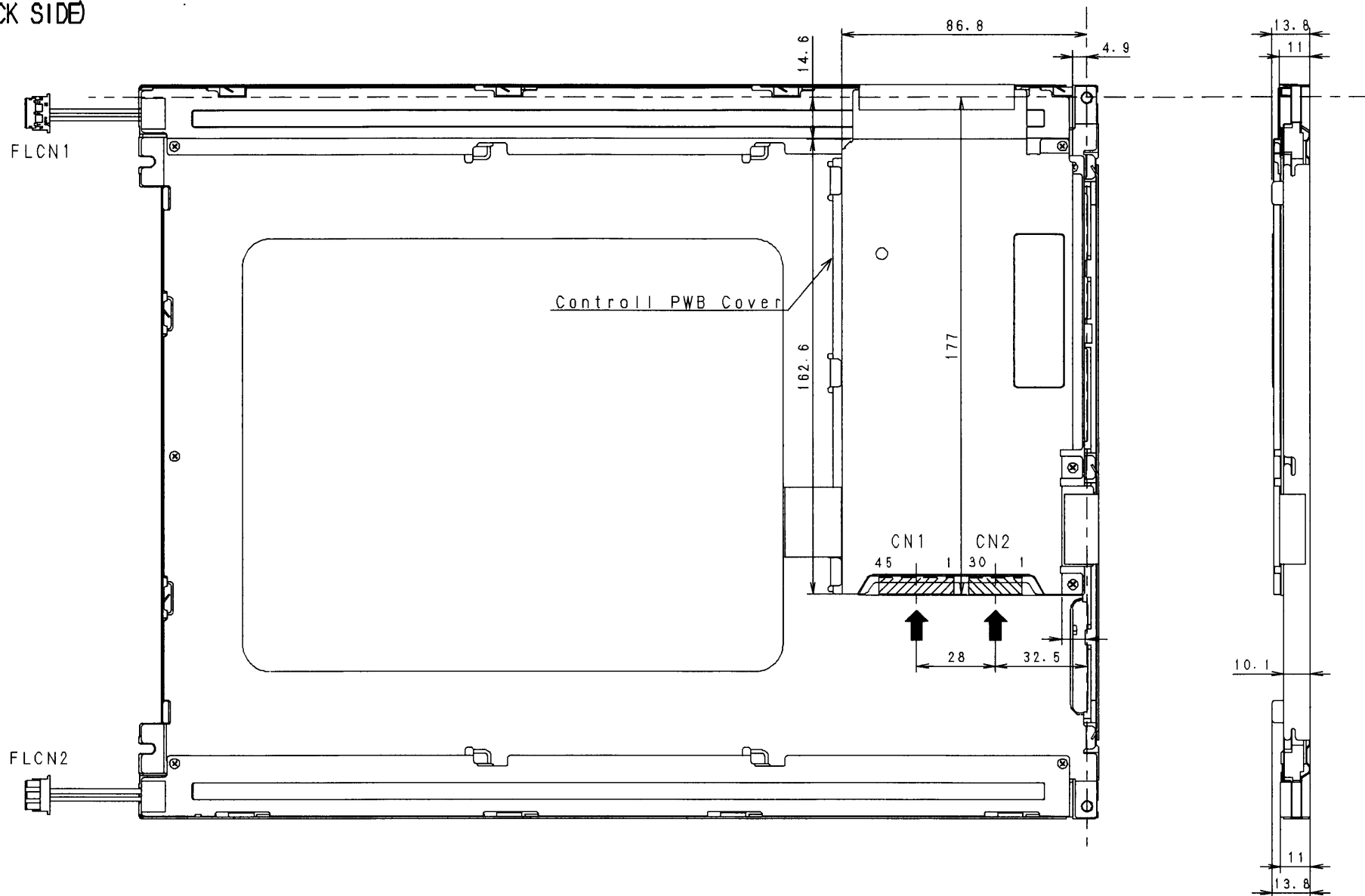
■ Outer Dimensions  
(FRONT SIDE)



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

Unit:mm

■ Outer Dimensions  
(BACK SIDE)



<NOTE>  
1. All dimensional tolerance unless otherwise specified  $\pm 0.5$

CN1: FH12-45S-0.5SH (49) (HIRDSE)  
CN2: FH12-30S-0.5SH (49) (HIRDSE)  
FLCN1, 2: BHR-03VS-1 (JST)

Unit: mm