

TORISAN

ENGINEERING SPECIFICATIONS

TFT COLOR LCD MODULE

TM150XG-22L03A

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

(TENTATIVE)

Ver.4

Apr. 23, 2001

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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 Aluminum tapes for EMI improvement.
Feb.23,01	Ver.3	3	Brightness TYP 230 → 250
		3	Contrast ratio TYP 250 → 350
		4	Measurement condition (5) IL=5.5 → 6.0
		4	Lamp voltage NOTE IL=5.5 → 6.0
		4	Lamp voltage TYP 630 → 610
Apr.23,01	Ver.4	6	CN1 (Description change)
		7	CN2 (Description change)
		9	Change RELATIONSHIP BETWEEN INPUT DATA AND DISPLAY POSITION
		17	Change Drawing

MECHANICAL CHARACTERISTICS

Ta=25°C

ITEM	SPECIFICATION	UNIT
LCD module size	341.0(W) × 262.0(H) × 13.8(T)	mm
Resolution	1024 × RGB(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	VDD-VSS	0	6.0	V	
Input logic voltage	Vi	Vss	3.6	V	
CFL lamp current	IL	-	6.5	mA	

ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

Ta=25°C

ITEM	SYMBOL	CONDITIONS	MIN	MAX	UNIT	NOTE
Ambient temperature	TST	Storage	-20	60	°C	Note 1
	TOP	Operation	0	50		
Humidity	-	Ta=40°C max.	-	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

VDD=5.0V ,fv=60Hz ,fCLK=32.5MHz ,Ta=25°C

ITEM	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE
Power supply voltage	VDD-VSS		4.5	5.0	5.5	V	
input logic voltage	VIH	High level	2.0	-	3.6	V	
	VIL	Low level	Vss	-	0.8		
Power Supply current	IDD	Note 1	-	(270)	(650)	mA	

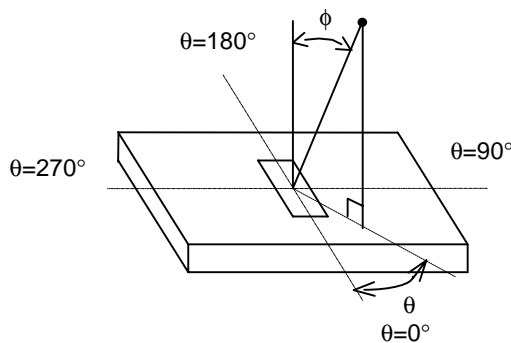
[Note 1] Under the following display image :

Typ. value : Display pattern is 256 gray scale bar.

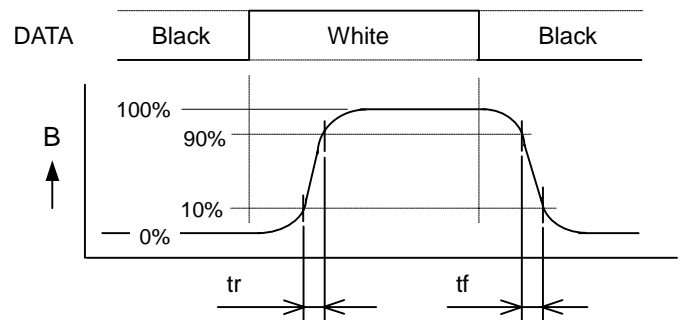
OPTICAL CHARACTERISTICS

Ta=25°C, VDD=5.0V, fv=60Hz

ITEM	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE	
Brightness	B	$\phi = 0^\circ$	180	250	-	cd/m ²	Note 5,8	
Brightness uniformity		$\phi = 0^\circ$	-	-	1.30	-	Note 5,6,8	
Contrast ratio	CR	$\phi = 0^\circ$	200	350	-	-	Note 2,4,8	
Viewing angle range	ϕ	CR>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] ϕ and θ



[Note 3] Response time

[Note 2] Contrast ratio "CR"

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

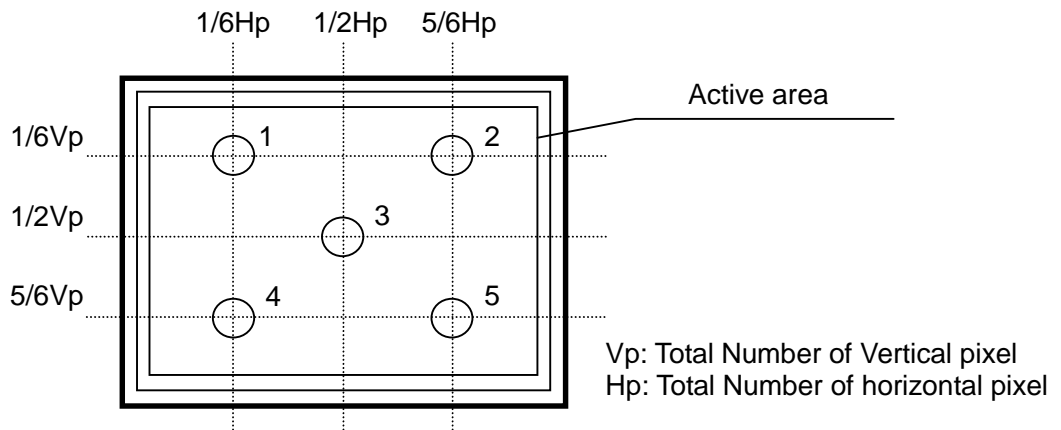
[Note 4] This shall be measured at center point No.3 of Note 7.

[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 backlight with 2 CFL.
Please follow the characteristics of 1 CFL as below.

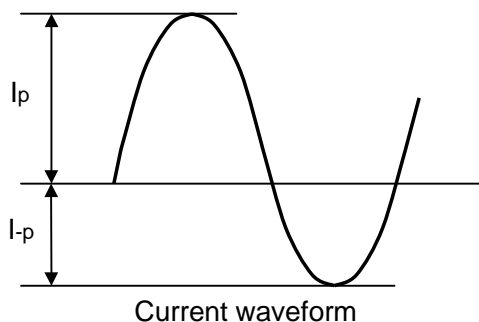
Ta=25°C

ITEM	SYM.	CONDITIOS	MIN	TYP	MAX	UNIT	NOTE
Lamp voltage	VL		-	610	-	Vrms	at IL=6.0mArms
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 $\sqrt{2} \pm 10\%$. And this driving waveform shall be confirmed in your system.



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

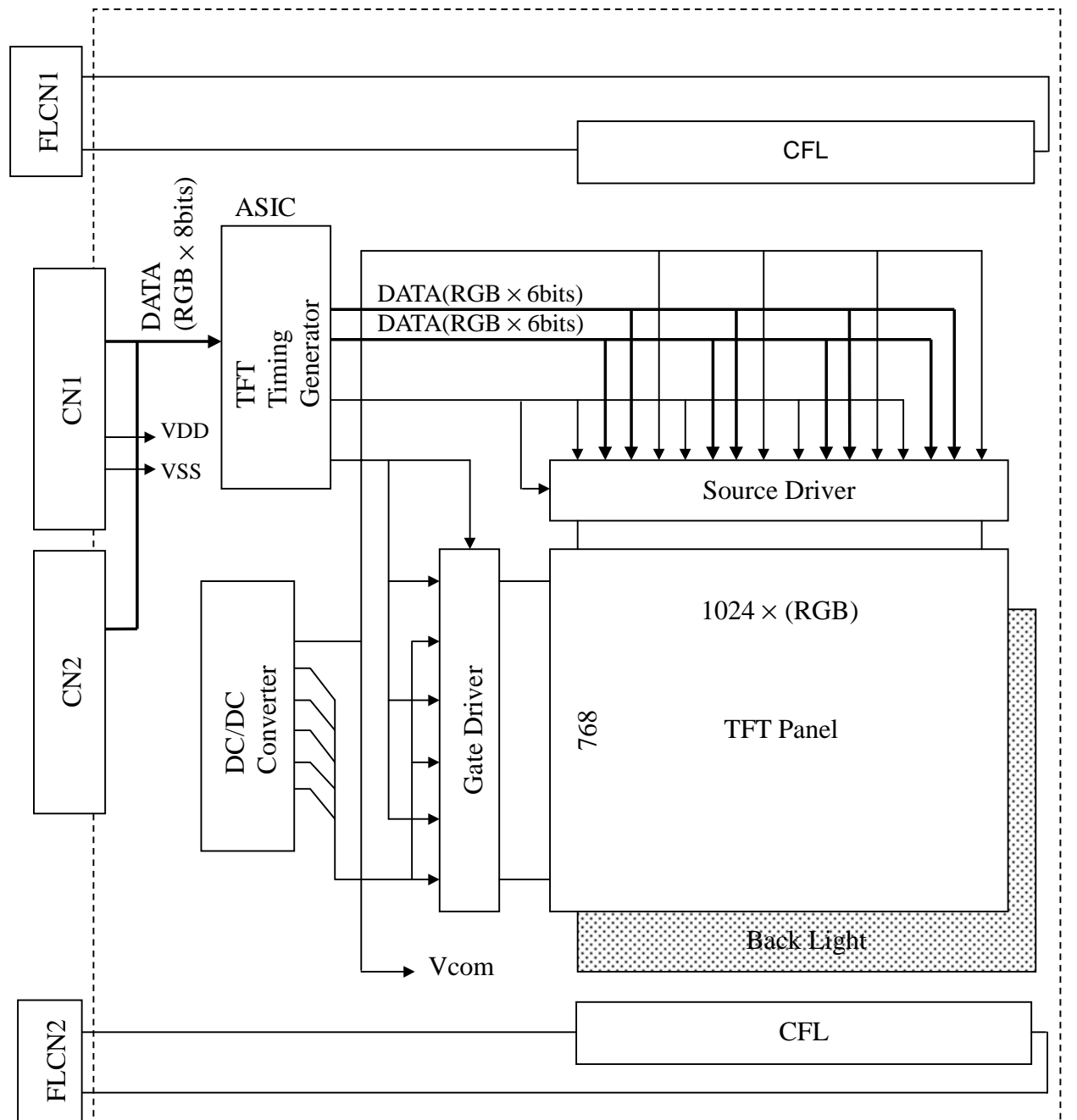
$$\text{Wave-height rate} = I_p \text{ (or } I_{-p}) / I_L$$

I_p : High peak value

I_{-p} : Low peak value

I_L : Effective value

BLOCK DIAGRAM



[Note 1] ASIC converts incoming RGB × 8 bits data into outgoing RGB × 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)

INTERNAL SIGNAL TIMING PARAMETERS (DE_MODE)

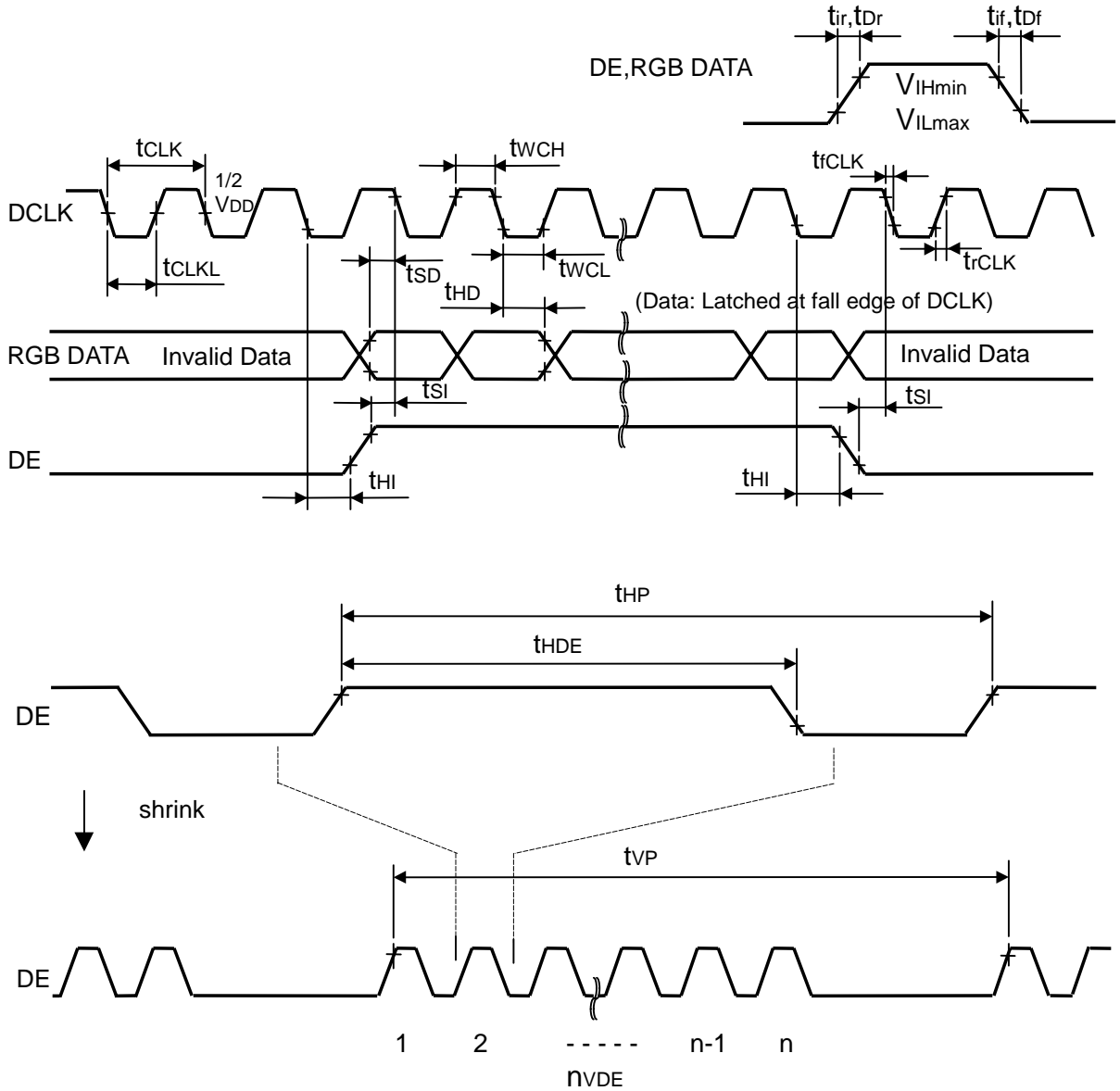
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE	
DCLK	Frequency	fCLK	30.0	32.5	39.5	MHz	tCLK=1/fCLK
	Width-Low	twCL	5.0	-	-	ns	
	Width-High	twCH	5.0	-	-	ns	
	Rise Time	trCLK	-	-	(5.0)	ns	
	Fall Time	tfCLK	-	-	(5.0)	ns	
	Duty	D	(0.40)	0.50	(0.60)	-	D=tCLKL/tCLK
DE	Setup Time	tSI	(5.0)	-	-	ns	for DCLK
	Hold Time	tHI	(5.0)	-	-	ns	
	Rise/Fall Time	tir,tif	-	-	(5.0)	ns	
	Horiz. Period	tHP	525	(672)	900	tCLK	
	Horiz. DE	tHDE	512	(512)	512	tCLK	
	Vert. Period	tVP	(780)	806	-	tHP	fV=60Hz Typ.
	Vert. DE	nVDE	768	(768)	768	n	
DATA	Setup Time	tSD	(5.0)	-	-	ns	for DCLK
	Hold Time	tHD	(5.0)	-	-	ns	
	Rise/Fall Time	tDr,tDf	-	-	(5.0)	ns	

[Note 1] Definition of Vertical Frequency fV and Horizontal Frequency fH:

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

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

INTERNAL SIGNAL TIMING DIAGRAM (DE_MODE)



RELATIONSHIP BETWEEN INPUT DATA AND DISPLAY POSITION

1:1(Odd)	1:1(Even)	1:2(Odd)	...	1:512(Odd)	1:512(Even)
2:1(Odd)	2:1(Even)				2:512(Even)
3:1(Odd)					
⋮					⋮
⋮					⋮
⋮					⋮
767:1(Odd)					767:512(Even)
768:1(Odd)	768:1(Even)	...		768:512(Odd)	768:512(Even)

V_p:H_p R G B

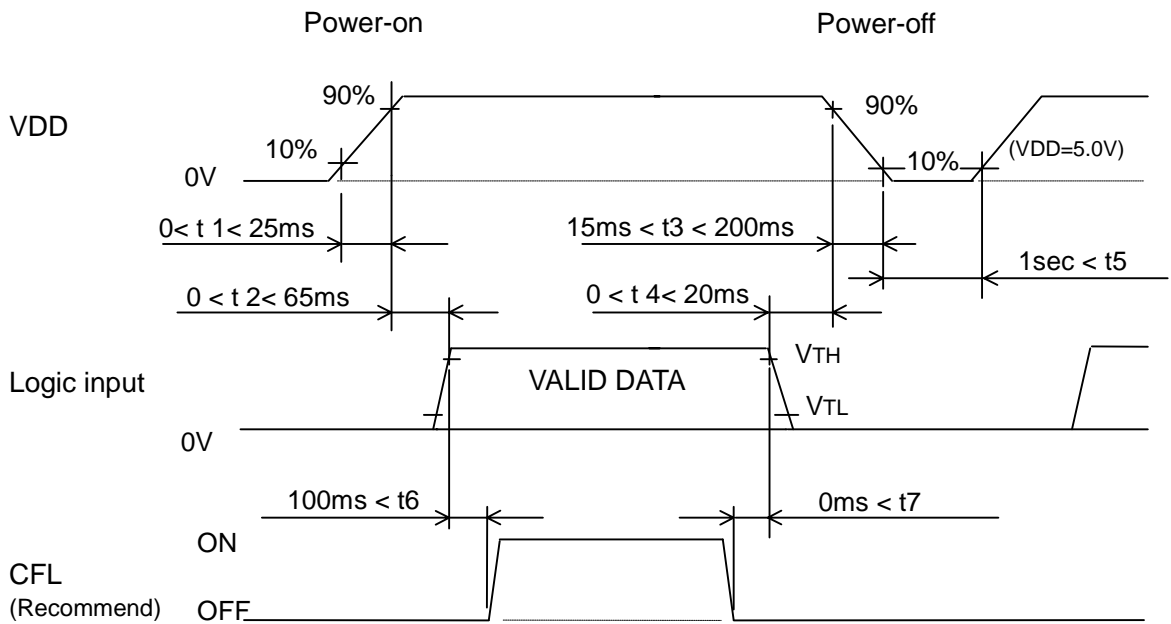
RELATIONSHIP BETWEEN INPUT DATA AND DISPLAY COLOR

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	
	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	
	GREEN(255)	L	L	L	L	L	L	L	L	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	H	H	H	H	H	H	H	H	
	CYAN	H	H	L	L	L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	
	MAGENTA	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	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	
RED	BLACK	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		
	RED(2) *	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L		
	RED(3) *	L	L	L	L	L	L	H	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		
	:																								
	RED(251) *	H	H	H	H	H	L	H	H	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		
	RED(253)	H	H	H	H	H	L	H	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		
	RED(255)	H	H	H	H	H	H	H	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	
GREEN(1) *		L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L		
GREEN(2) *		L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L		
GREEN(3) *		L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	L	L	L	L	L	L	L		
GREEN(4)		L	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L		
:																									
GREEN(251) *		L	L	L	L	L	L	L	H	H	H	H	H	L	H	H	L	L	L	L	L	L	L		
GREEN(252)		L	L	L	L	L	L	L	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L		
GREEN(253)		L	L	L	L	L	L	L	H	H	H	H	H	H	L	H	L	L	L	L	L	L	L		
GREEN(254)		L	L	L	L	L	L	L	H	H	H	H	H	H	H	L	L	L	L	L	L	L	L		
GREEN(255)		L	L	L	L	L	L	L	H	H	H	H	H	H	H	H	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	
	BLUE(1) *	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	H		
	BLUE(3) *	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	H	L		
	:																								
	BLUE(251) *	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	L	H		
	BLUE(252)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	L		
	BLUE(253)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	L		
	BLUE(254)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	L		
BLUE(255)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H			

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

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

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 (INSTRUCTIONS FOR SAFE AND PROPER USE)

1. Instructions for safety

- (1) Please do not disassemble or modify LCD module to avoid the possibility of electric shock, damage of electronic components, scratch at display surface and invasion of foreign particles. In addition, such activity may result in fire accident due to burning of electronic component.
LCD module disassembled or modified by customer is out of warranty.
- (2) Please be careful in handling of LCD module with broken glass.
When the display glass breaks, please pay attention not to injure your fingers. The display surface has the plastic film attached, which prevents dispersion of glass pieces, however touching broken edge will injure your fingers. Also CFL (Cold Cathode Fluorescent Lamp) is made of glass, therefore please pay attention in the same way.
- (3) Please do not touch the fluid flown out of broken display glass.
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.
- (4) Please make secure connection of CFL connector.
Please make sure that CFL connector from LCD module is connected with output connector on inverter circuit securely. Poor connection may cause smoke or fire accident due to high voltage in circuit. If connection may not be secure, please switch off the power supply for LCD module and CFL and then make secure connection.
Please do not make connection with another connector than recommended mating connector.
- (5) CFL contains mercury inside. Please follow regulations or rules established by local autonomy at its disposal.
- (6) Please be careful to electric shock.
Before handling LCD module, please switch off the power supply.
Since high voltage is applied to CFL terminal, cable, connector and inverter circuit in operation mode, touching them will cause electric shock.

2. Instructions for designing

- (1) Mounting of LCD
Please fix LCD module at all mounting flanges shown in this specification for installation onto system. The used screws should have proper dimensions.
Furthermore, designing of mounting parts should be adequate so that LCD module is not warped or twisted, to achieve good display quality.
- (2) Polarity of power supply for CFL
Please give careful consideration in designing so that each polar of cable should be connected correctly at assembling (i.e. high voltage side is connected to high voltage side and low voltage side is connected to low voltage side). Since longer CFL cable may cause insatiable start-up of CFL and reduction of brightness, please make cable short as much as possible.

- (3) Designing of power supply circuit for CFL
Please design the circuit so that high voltage output can be kept for more than 1 second. The shorter time may not start up CFL. The driving inverter circuit is recommended to be the type which CFL current can be controlled.
The type which voltage is controlled is not recommended, because it may cause big current under high temperature and insatiable start-up of CFL under low temperature.
- (4) Heat radiation
CFL generates heat at lighting and causes temperature rise inside system. Therefore, designing to radiate heat like radiation slits at cabinet is recommended to meet the specified operating temperature range for LCD module.
- (5) Noise on power line
Spike noise contained in power line causes abnormal operation of driving circuit and abnormal display. To avoid it, spike noise should be suppressed below $VDD \pm 200mVp-p$. (In any case, absolute maximum rating should be kept.)
- (6) Power sequence
Before LCD module is switched on, please make sure that power supply and input signals of system, testing equipment, etc. meet the recommended power sequence.
- (7) Absolute maximum rating
Absolute maximum rating specified in this specification has to be kept in any case. It shows the maximum that cannot be exceeded.
Exceeding it may cause burning or non-recoverable break of electronic components in circuit. Please make system design so that absolute maximum rating is not exceeded even if ambient temperature, input signal and components are varied.
- (8) Protection for power supply
Please study to adapt protection for power supply against trouble of LCD module, depending on usage condition of system. Fuse installed on LCD module should be never modified. Any modification to make the function of fuse ineffective may cause burning or break of printed wiring board or other components at circuit trouble.
- (9) Protection against electric shock
High voltage is applied to CFL connector, inverter circuit and CFL at lighting. Please make design not to expose or be accessible to such high voltage parts to avoid electric shock.
- (10) Protection cover and cut-off filter for ultraviolet rays
When LCD module is used under severe condition like outdoor, it is recommended to use transparent protection cover over display surface to avoid scratches and invasion of dust and water. In addition, when LCD module is exposed to direct sun light for long time, use of cut-off filter for ultraviolet rays is also recommended. Please be careful not to get condensation.

3. Instructions for use and handling

- (1) Protection against Static electricity
C-MOS LSI and semiconductors are easily damaged by static discharge. LCD module should be handled on conductive mat by person grounded with wrist strap etc. to avoid getting static electricity. Please be careful not to generate static electricity during operation.

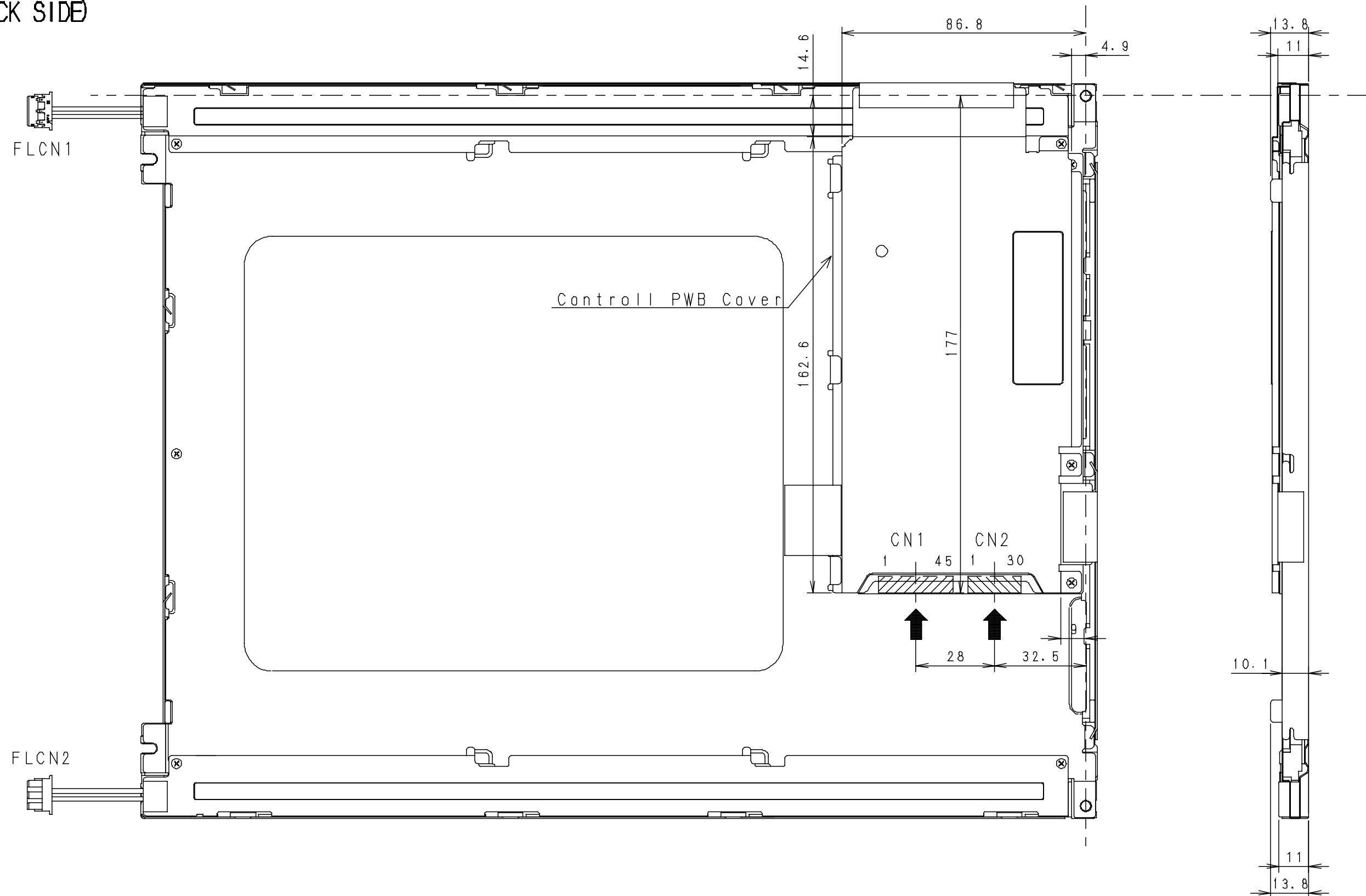
- (2) Protection against dust and stain
LCD module should be handled in circumstance as clean as possible.
It is recommended to wear fingerstalls or ductless and soft gloves before handling to avoid getting dust or stain on display surface.
- (3) Protection film for display surface
It is recommended to remove protection film at nearly final process of assembling to avoid getting scratch or dust. To remove film, please pick up its edge with dull-head tweezers or cellophane tape at first and then remove film gradually taking more than 3 seconds. If film is removed quickly, static electricity may be generated and may damage semiconductors or electronic components.
- (4) Contamination of display surface
When display surface of LCD module is contaminated, please wipe the surface softly with cotton swab or clean cloth. If it is not enough, please take it away with cellophane tape or wipe the surface with cotton swab or clean cloth containing benzene. In this case, please be careful so that benzene does not get in inside of LCD module, because it may be damaged.
- (5) Water drop on LCD surface
Please do not leave LCD module with water drop. When the display surface gets water drop, please wipe it off with cotton swab or soft cloth immediately, otherwise display surface will be deteriorated.
If water gets in inside of LCD module, circuit may be damaged.
- (6) Please make sure that LCD module is not warped or twisted at installation into system. Even temporary warp or twist may be the cause for failure.
- (7) Mechanical stress
Please be careful not to apply strong mechanical stress like drop or shock to LCD module. Such stress may cause break of display glass and CFL or may be the cause for failure.
- (8) Pressure to display surface
Please be careful not to apply strong pressure to display surface. Such pressure may cause scratches at surface or may be the cause of failure.
- (9) Protection against scratch
Please be careful not to hit, press or rub the display surface with hard material like tools. In addition, please do not put heavy or hard material on display surface, and do not stack LCD modules. Polarizer at front surface can be easily scratched.
- (10) Plugging in of connector
Please be careful not to apply strong stress to connector part of LCD module at plugging in or out, because strong stress may damage the inside connection. At plugging in connector, place LCD module on the flat surface and hold the backside of connector on LCD module. Please make sure that connector is plugged in correctly. Insecure connection may be the cause for failure during operation.
In addition, please be careful not to put the connecting cable between cabinet of system and LCD module at installing LCD module into system.
- (11) Handling of CFL cable and FPC (Flexible Printed Circuit)
Please be careful not to pull or scratch CFL cable, because CFL or soldered part of cable may be damaged consequently.
Also FPC should not be pulled or scratched.
- (12) Switching off before plugging in connector
Please make sure that power is switched off before plugging in connector.
If power is on at plugging in or out, circuit of LCD module may be damaged.
When LCD is switched on for test or inspection, please make sure that power supply and input signals of driving system meet the specified power sequence.

- (13) Temperature dependence of LCD display
Response speed (optical response) of LCD display is dependent on temperature. Under low temperature, response speed is slower.
Also brightness and chromaticity change slightly depending on temperature.
- (14) Slow light-up of CFL under low temperature
Under low temperature, start-up of CFL gets difficult. (The time from switch-on to stable lighting becomes longer.)
As characteristic of CFL, operation under low temperature makes the life time shorter. To avoid this, it is recommended to operate under normal temperature.
- (15) Condensation
LCD module may get condensation on its display surface and inside in the circumstance where temperature changes much in short time.
Condensation can cause deterioration or failure. Therefore, please be careful not to get condensation.
- (16) Remaining of image
Displaying the same pattern for long time may cause remaining of image even after changing the pattern. This is not failure but will disappear with time.

4. Instructions for storage and transportation

- (1) Storage
Please store LCD module in the dark place of room temperature and low humidity in original packing condition, to avoid condensation that may cause failure.
Since sudden temperature change may cause condensation, please store in circumstance of stable temperature.
- (2) Stacking number
Since excessive weight causes deformation and damage of carton box, please stack only up to the number stated on carton box for storage and transportation.
- (3) Handling
Since LCD module consists of glass and precise electronic components, it will be damaged by excessive shock and drop. Therefore, please handle the carton box carefully to minimize shock at loading, reloading and transportation.

■ Outer Dimensions
(BACK SIDE)



<NOTE>
1. All dimensional tolerance unless otherwise specified ± 0.5

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

Unit: mm