SANYO

ENGINEERING SPECIFICATIONS

TFT COLOR LCD MODULE

TM150XG-26L10D

-38cm (15.0 inch) diagonal
-XGA resolution (1024 × RGB × 768 dots)
-Wide View Angle
-LVDS Interface
-Ear mount
-With CFL backlight unit
-Nonglare surface type

(TENTATIVE)

Ver.2 May. 12, 2003

SANYO Electric Co., Ltd.
Display Company
LCD Business Unit
LD Development Department

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REVISION HISTORY

DATE	REVISION NO.	PAGE	DESCRIPTIONS
Apr.28, 03	Ver.1	-	Initial Release.
May.12, 03	Ver.2	2	Correct **MECHANICAL CHARACTERISTICS** (LCD module size: 13.55(t) -> 12.5(t)
		4	Correct **BACKLIGHT CHARACTERISTICS** (Lamp current MAX data: 8mA -> 6mA)

MECHANICAL CHARACTERISTICS

Ta=25 °C

ITEM	SPECIFICATION	UNIT
LCD module size	331.6(W) ×254.75(H) ×12.5(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	307.2(W) × 231.1(H)	mm
Weight	1250 TYP.	g

ELECTRICAL ABSOLUTE MAXIMUM RATINGS

Ta=25 °C

ITEM	SYMBOL	MIN	MAX	UNIT	NOTE
Power supply voltage	V_{DD}-V_{SS}	-0.3	4.0	V	
Input voltage	V_I	V_{SS}-0.3	V_{DD}+0.3	V	
CFL lamp current	I_L	-	6.5	mA	

ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

Ta=25 °C

ITEM	SYMBOL	CONDITIONS	MIN	MAX	UNIT	NOTE
Ambient temperature	T_{ST}	Storage	-20	60	°C	Note 1
	T_{OP}	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

V_{DD}=3.3V ,f_V=60Hz ,f_H=48kHz ,f_{CLK}=65MHz ,Ta=25°C

ITEM	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE
Power supply voltage	V_{DD}-V_{SS}		3.0	3.3	3.6	V	
LVDS input Threshold voltage	V_{IH}	High level	-	-	+100	mV	V_{CM}=1.2V
	V_{IL}	Low level	-100	-	-		
LVDS input common Mode voltage			1.0	1.2	1.4	V	
LVDS input termination resister	R_T			100		Ω	Internal
Power Supply current	I_{DD}	Note 1	-	420	800	mA	

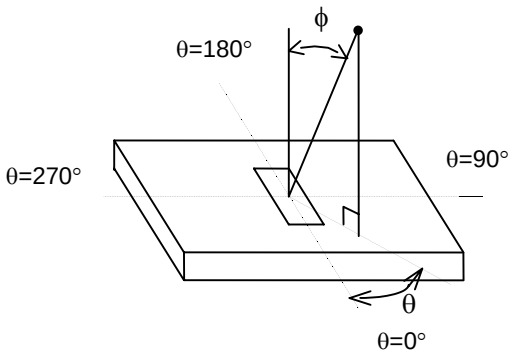
[Note 1] Under the following display image :
Typ. value : Display pattern is 256 gray scale bar.

[Note 2] V_{CM} : Common Mode Voltage of LVDS input.

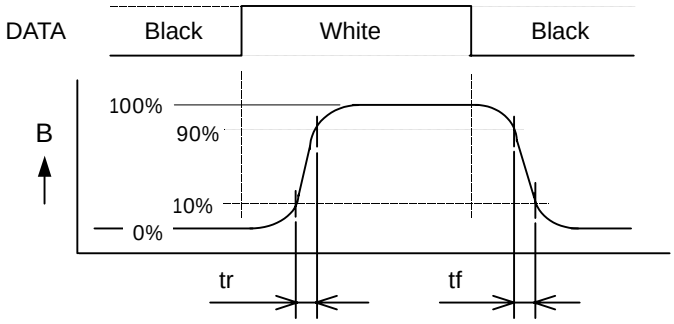
OPTICAL CHARACTERISTICS

V_{DD}=3.3V ,f_V=60Hz ,f_H=48kHz ,f_{CLK}=65MHz ,Ta=25°C

ITEM		SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT	NOTE
Brightness		B	ϕ = 0º		350	450	-	cd/m^2	Note 5,8
Brightness uniformity			ϕ = 0º		-	-	1.30	-	Note 5,6,8
Contrast ratio		CR	ϕ = 0º		300	500	-	-	Note 2,4,8
Viewing angle range		ϕ	CR>10	θ = 0º	50	65	-	deg.	Note 1,2, 4,8
				θ = 90º	55	65	-		
				θ =180º	40	55	-		
				θ =270º	55	65	-		
Response time	Rise	tr	ϕ = 0º		-	20	-	ms.	Note 3,4,8
	Fall	tf			-	5	-		
Color of CIE Coordinate	Red	x	ϕ = 0º		0.573	0.623	0.673	-	Note 4,8
		y			0.295	0.345	0.395		
	Green	x			0.236	0.286	0.336		
		y			0.555	0.605	0.655		
	Blue	x			0.092	0.142	0.192		
		y			0.037	0.087	0.137		
	White	x			0.247	0.297	0.347		
		y			0.280	0.330	0.380		



[Note 1] ϕ and θ



[Note 3] Response time

[Note 2] Contrast ratio "CR"

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

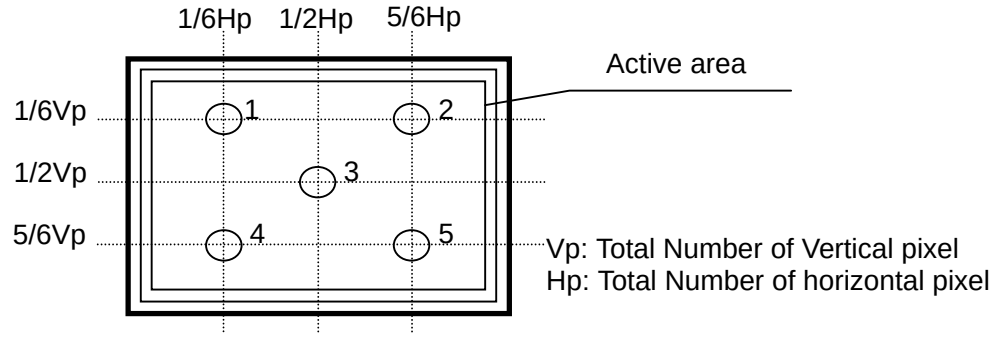
[Note 4] This shall be measured at center point No.3 of Note 7.

[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=3.3V, fV=60Hz
(4) Measure after 30 minutes of CFL warm up.
(5) IL=6.0 mArms with the CFL inverter CFP-102 (TORiSAN)

BACKLIGHT CHARACTERISTICS

This module is used the backlight with 4 CFL.
Please follow the characteristics of 1 CFL as below.

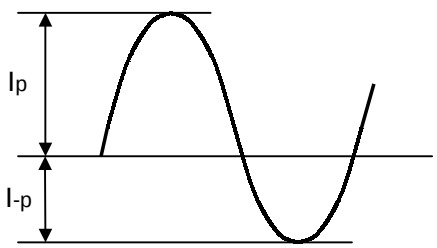
Ta=25°C

ITEM	SYM.	CONDITIOS	MIN	TYP	MAX	UNIT	NOTE
Lamp voltage	V_L		-	570	-	Vrms	at IL=6.0mArms
Lamp current	I_L		3	-	6	mArms	(Recommended value)
Operating frequency	f_L		-	55	-	kHz	(Recommended value)
Start up voltage	V_S		-	-	1500	Vrms	at Ta=0ºC
Operating life	t_{OL}		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. And please make sure that frequency, phase of Drive voltage and current of four lamps, match each other.

[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.



Current waveform

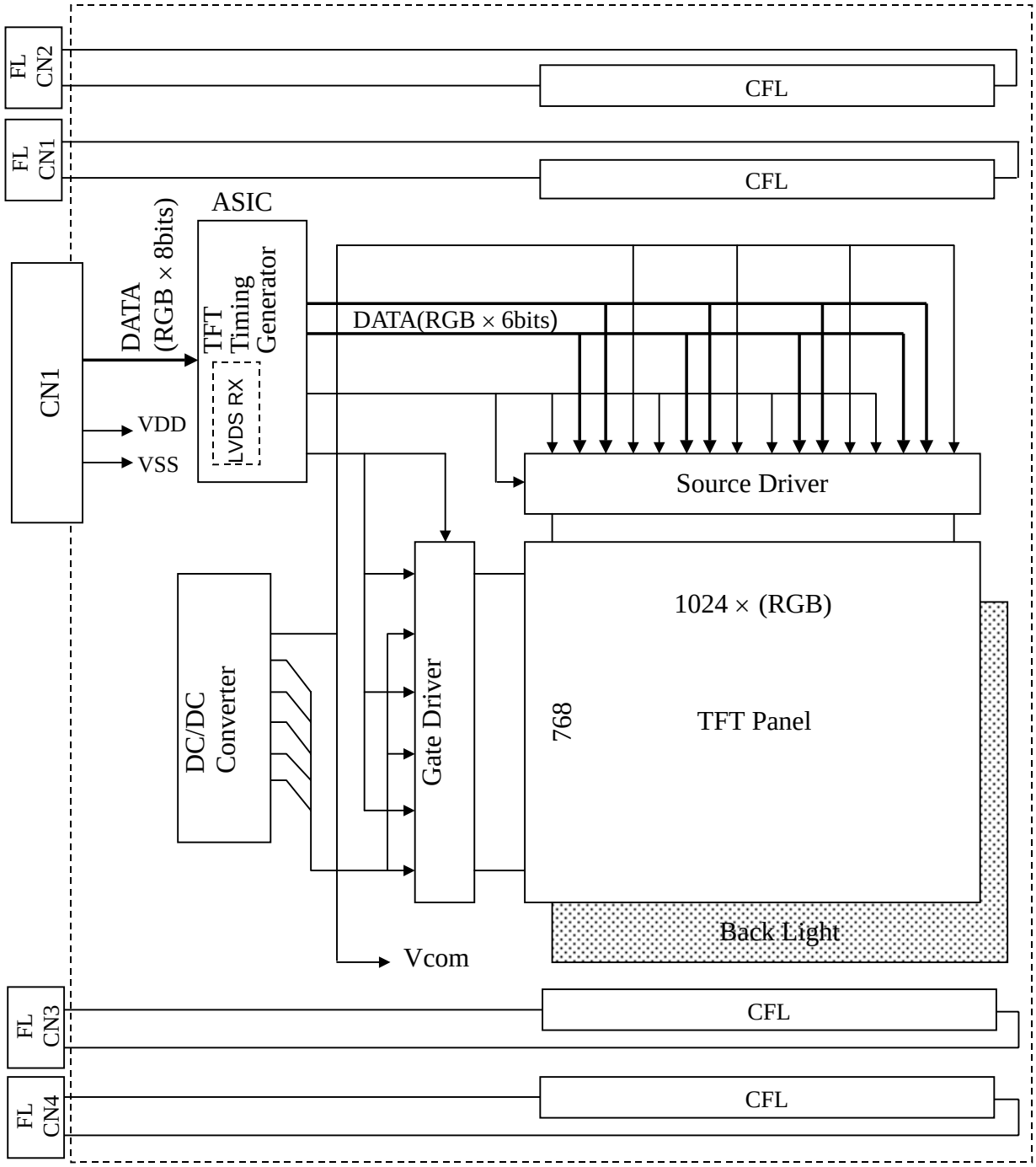
Unbalance rate = | Ip - I-p | / IL × 100 (%)

Wave-height rate = Ip (or I-p) / IL

Ip : High peak value
I-p : Low peak value
IL : Effective value

[Note 4] The inverter of ground reference type should be used. The inverter of ground floating type should not be used.

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	V_{DD}	Power Supply (3.3V normal)
2	V_{DD}	Power Supply (3.3V normal)
3	V_{SS}	Ground
4	V_{SS}	Ground
5	Rin0-	Receiver Signal (-)
6	Rin0+	Receiver Signal (+)
7	V_{SS}	Ground
8	Rin1-	Receiver Signal (-)
9	Rin1+	Receiver Signal (+)
10	V_{SS}	Ground
11	Rin2-	Receiver Signal (-)
12	Rin2+	Receiver Signal (+)
13	V_{SS}	Ground
14	RCLK-	Clock Signal (-)
15	RCLK+	Clock Signal (+)
16	V_{SS}	Ground
17	Rin3-	Receiver Signal (-)
18	Rin3+	Receiver Signal (+)
19	V_{SS}	Ground
20	NC	Reserved

CN1 : DF14H-20P-1.25H (HIROSE)
Suitable mating connector: DF14-20S-1.25 (HIROSE)

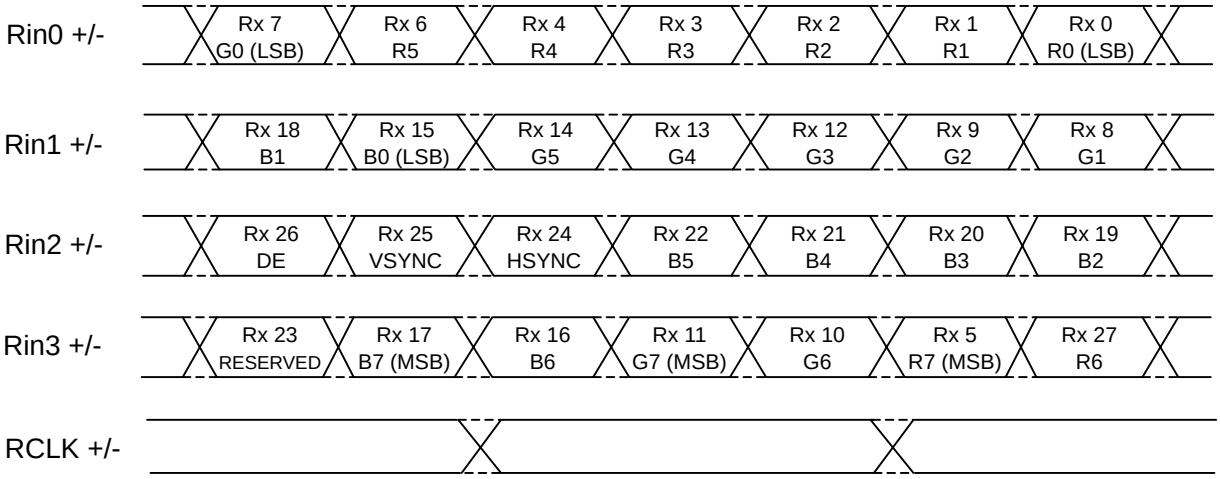
[Note 1] Internal termination resistors of LVDS input lines are 100 ohms.

Back Light : FLCN1,2,3,4

PIN NO.	SYMBOL	FUNCTION
1	H.V	High voltage for CFL
2	LGND	Low voltage for CFL

FLCN1,2,3,4 : BHSR-02VS-1 (JST)
Suitable mating connector: SM02B-BHSS-1-TB (JST) or equivalent.

INTERFACE (LVDS) DATA ASSIGNMENT



INTERFACE SIGNALS

SYMBOL	FUNCTION	
DCLK	Data Clock	
HSYNC	Horizontal Sync - This signal initiates a new line(negative).	
VSYNC	Vertical Sync - This signal initiates a new frame(negative).	
DE	Data Enable	(positive)
R0	Red Data	(LSB)
R1	Red Data	
R2	Red Data	
R3	Red Data	
R4	Red Data	
R5	Red Data	
R6	Red Data	
R7	Red Data	(MSB)
G0	Green Data	(LSB)
G1	Green Data	
G2	Green Data	
G3	Green Data	
G4	Green Data	
G5	Green Data	
G6	Green Data	
G7	Green Data	(MSB)
B0	Blue Data	(LSB)
B1	Blue Data	
B2	Blue Data	
B3	Blue Data	
B4	Blue Data	
B5	Blue Data	
B6	Blue Data	
B7	Blue Data	(MSB)

[Note 1] The valid synchronous signals are DCLK and DE, HSYNC and VSYNC are invalid.

[Note 2] INTERFACE SIGNALS are loaded from LVDS-transmitter to TFT Timing generator with LVDS sequence. (See BLOCK DIAGRAM.)

INTERNAL SIGNAL TIMING PARAMETERS (DE_MODE)

PARAMETER		SYMBOL	MIN	TYP	MAX	UNIT	NOTE
DCLK	Frequency	f_{CLK}	-	65.0	79.0	MHz	$t_{CLK}=1/f_{CLK}$
	Duty	D	(0.40)	0.50	(0.60)	-	$D=t_{CLKL}/t_{CLK}$
DE	Setup Time	t_{SI}	(3.0)	-	-	ns	for DCLK
	Hold Time	t_{HI}	(3.0)	-	-	ns	
	Horiz. Period	t_{HP}	1050	1344	1800	t_{CLK}	
	Horiz. DE	t_{HDE}	1024	1024	1024	t_{CLK}	
	Horiz. Frequency	f_H	36.1	48.4	61.9	KHz	($f_H = 1/ t_{HP}$)
	Vert. Period	t_{VP}	780	806	860	t_{HP}	f_V=60Hz Typ.
	Vert. DE	n_{VDE}	768	768	768	n	
	Vert. Frequency	f_V	42	60	79	Hz	($f_V = 1/ t_{VP}$)
DATA	Setup Time	t_{SD}	(3.0)	-	-	ns	for DCLK
	Hold Time	t_{HD}	(3.0)	-	-	ns	

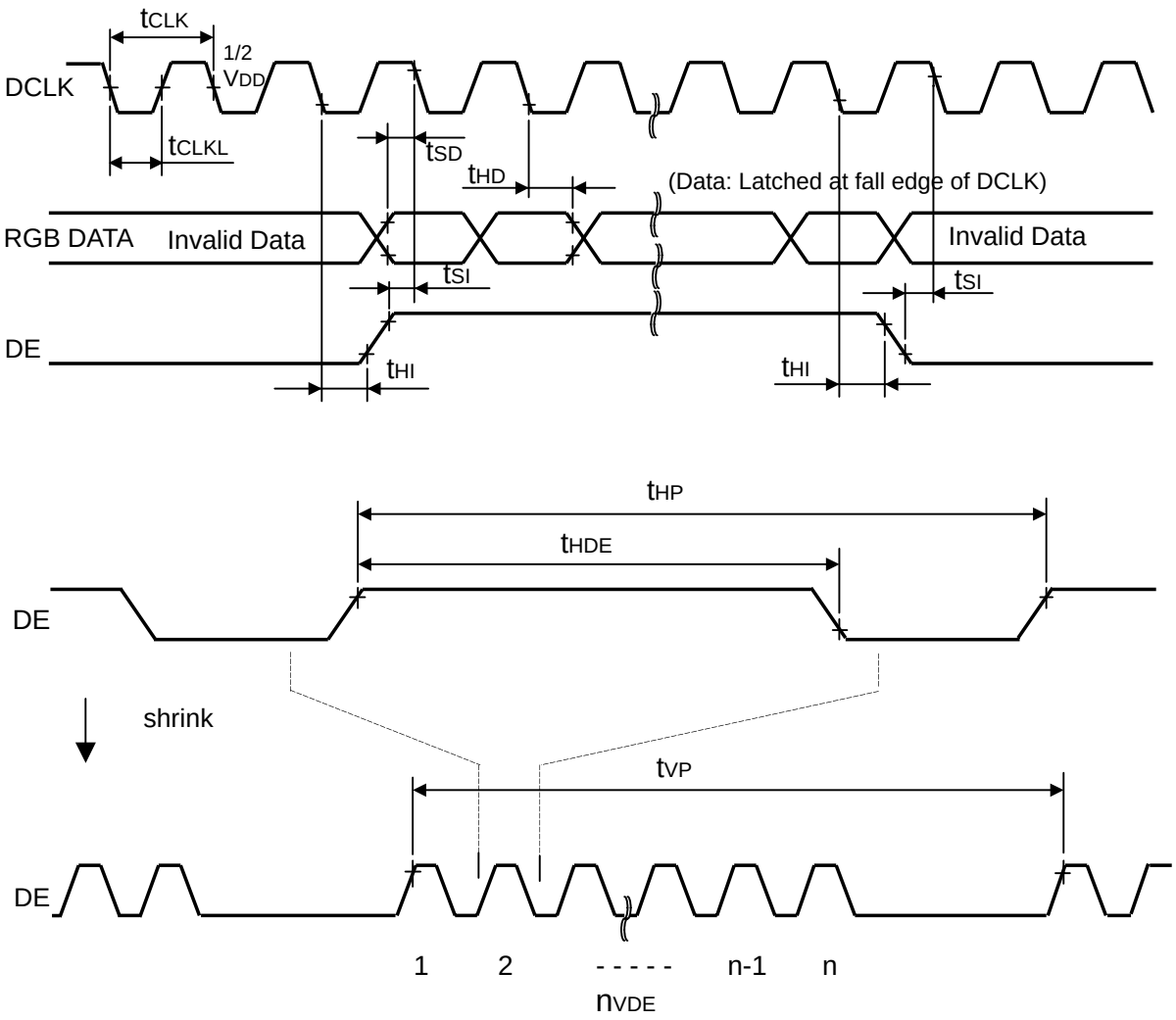
[Note 1] Definition of Vertical Frequency f_V and Horizontal Frequency f_H:

f_H (Horizontal Frequency) = $1/T_{hp}$
f_V (Vertical Frequency) = $1/T_{vp}$

[Note 2] These signal timing parameters are specified at the digital input of LVDS transmitter.

[Note 3] The values in this table only show the normal operating conditions of internal logic circuit, and it does not assure the conditions for appearance and display quality. The conditions for appearance and display quality are shown in the inspection standard separately.

INTERNAL SIGNAL TIMING DIAGRAM (DE_MODE)



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					
.					.
.		Vp·Hp	R G B		.
.					.
.					.
767·1					767·1024
768·1	768·2	. . . . .		768·1023	768·1024

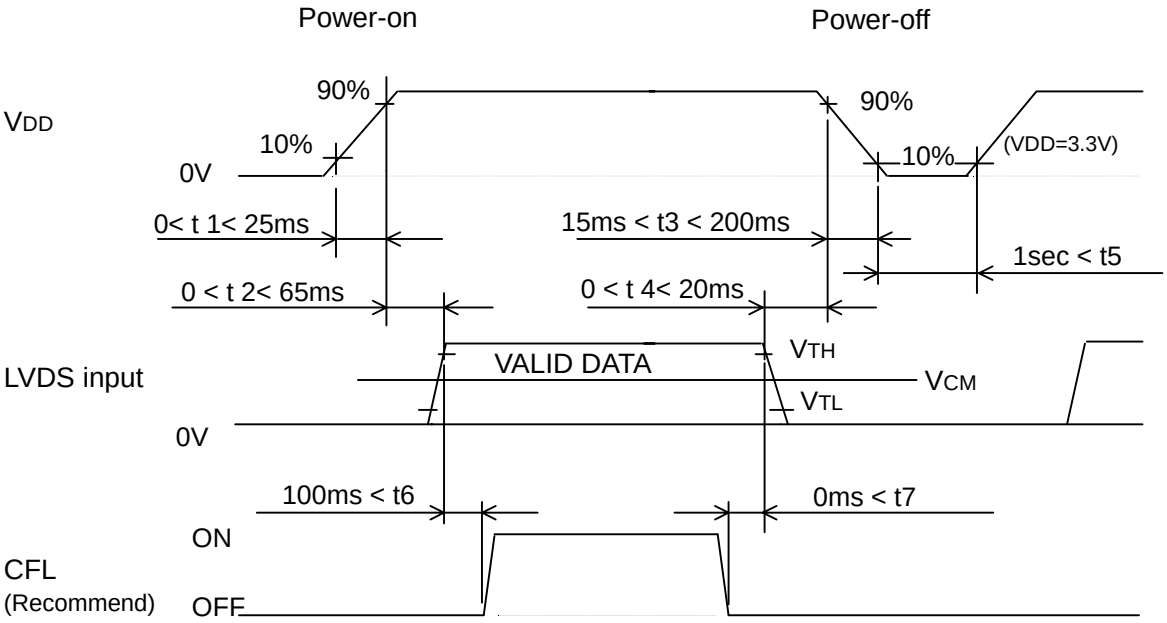
RELATIONSHIP BETWEEN INPUT DATA AND DISPLAY COLOR

INPUT DATA / DISPLAY COLOR		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	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	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	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	H	L	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	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		H	H	H	H	H	H	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		H	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		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	L	H	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	H	L	L	L	L	L	L	L	L	L	L
		L	L	L	L	L	L	L	L	H	H	H	H	H	H	L	H	L	L	L	L	L	L	L	L
		L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L
		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	H	L
	BLUE(3) *	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	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	H	L	L
		L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	L	H
		L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	L
		L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	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, LVDS 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 LVDS 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 LVDS 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) Power supply 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.

If LCD display turned into reddish screen or remarkable brightness decreases by the end of CFL life, please make a consideration of design that the backlight is turned off immediately.

(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 +/- 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 benzine. In this case, please be careful so that benzine 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 Lamp 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.

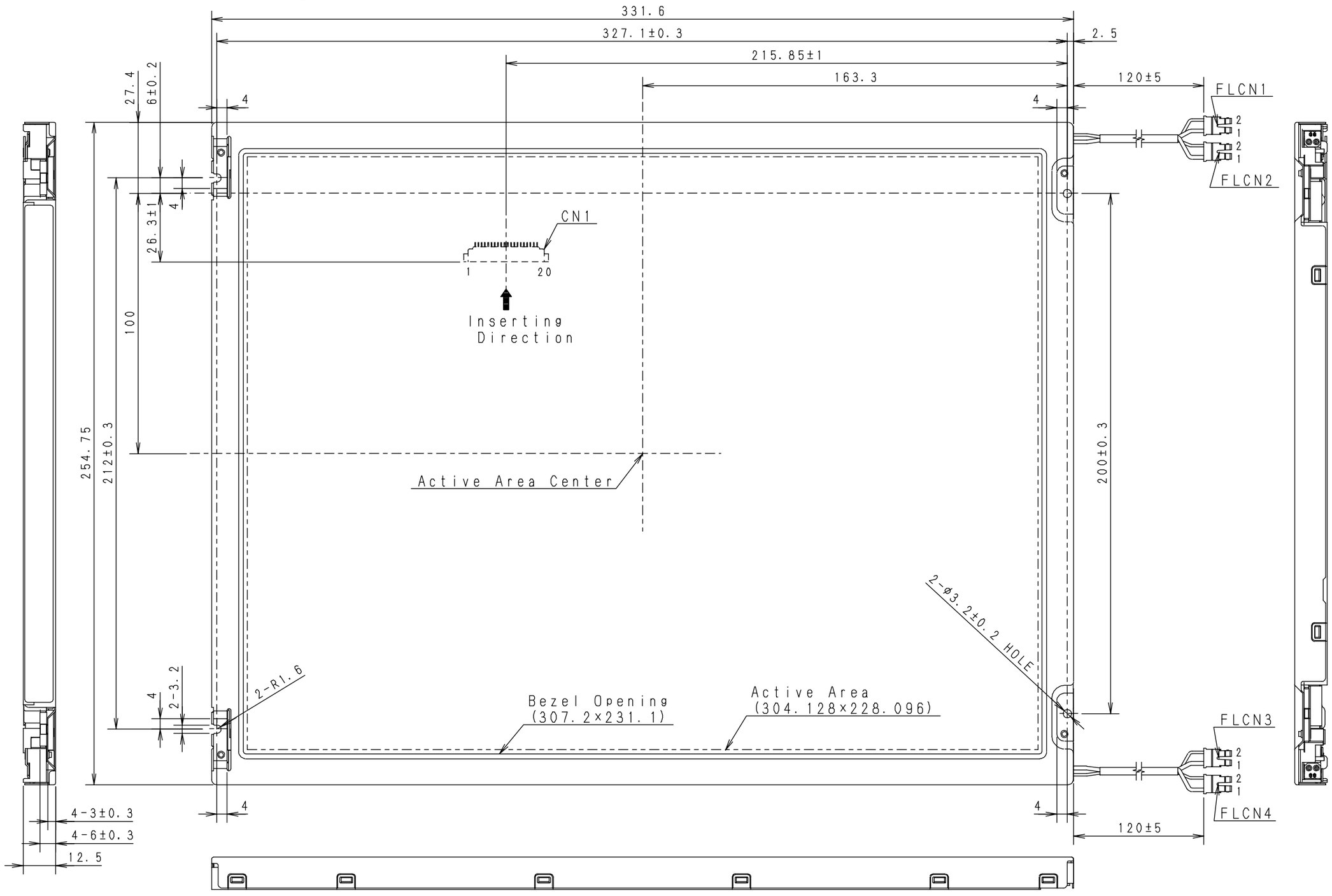
4. Instructions for storage and transportation

(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 (FRONT SIDE)

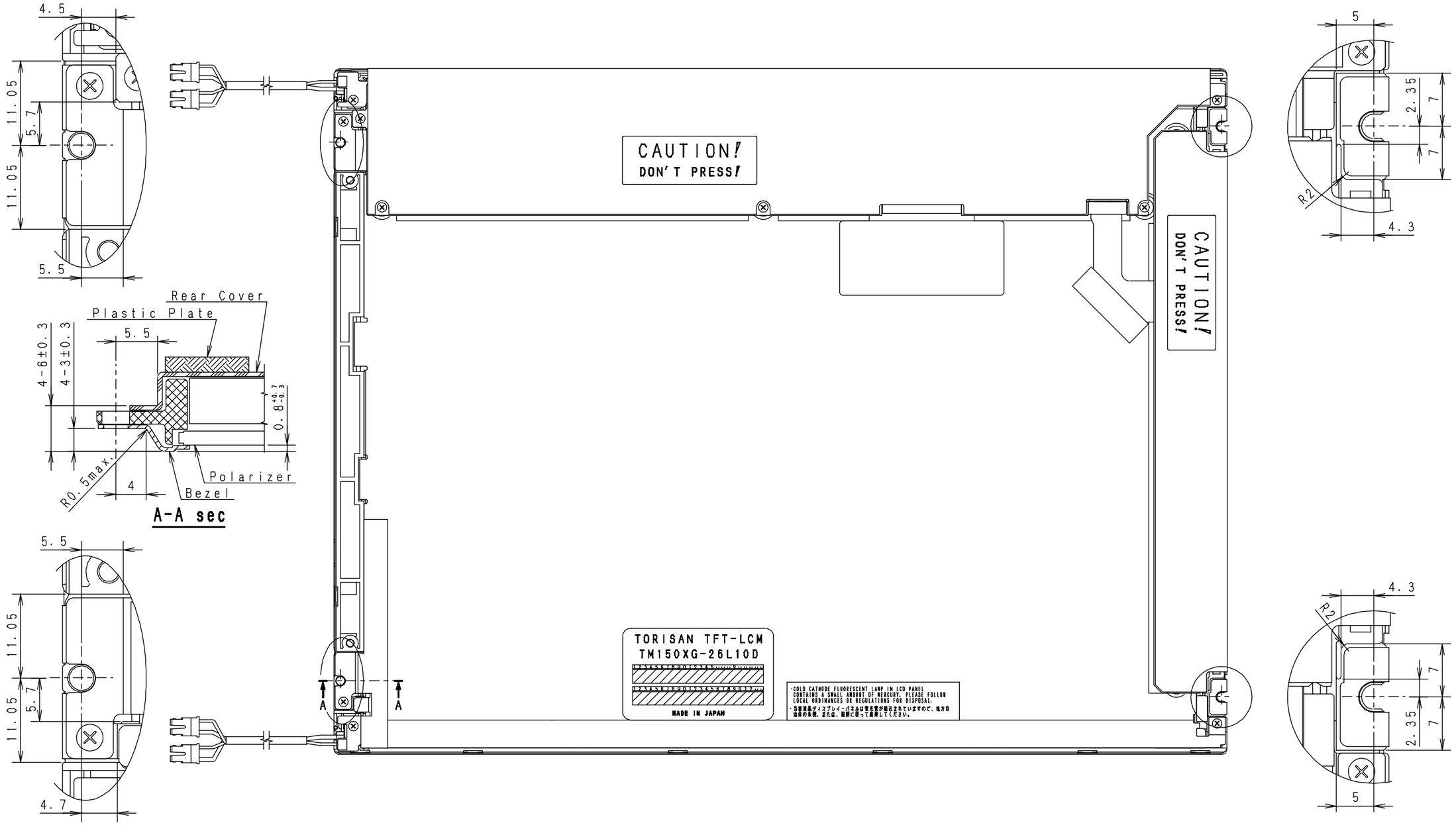


CN1 : DF14H-20P-1.25H (HIROSE)
FLCN1, 2, 3, 4 : BHSR-02VS-1 (JST)

Note1 : Unspecified dimension tolerances to be ±0.5mm.

Unit : mm

■ Outer Dimensions (BACK SIDE)



Note1：Unspecified dimension tolerances to be ±0.5mm.
Note2：This drawing is only preliminary data and can be changed without previous notices.

Unit：mm