

NEC

TFT COLOR LCD MODULE

Type: NL10276BC30-04D
38cm (15 Type), XGA
LVDS interface (1 port)

SPECIFICATIONS

(Third Edition)

PRELIMINARY

This document is preliminary. All information in this document is subject to change without prior notice.

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- | | |
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1. DESCRIPTION

NL10276BC30-04D is a TFT (thin film transistor) active matrix color liquid crystal display (LCD) comprising amorphous silicon TFT attached to each signal electrode, a driving circuit and a backlight. NL10276BC30-04D has a built-in backlight with an inverter.

The 38 cm (15 Type) diagonal display area contains 1024×768 pixels and can display 262,144 colors simultaneously.

2. FEATURES

- Wide viewing angle (with Retardation Film)
- High luminance (300cd/m^2 at IL= 6mArms / lamp)
- Low reflection
- LVDS interface (THC63LVDF64A, THine Electronics, Inc.)
- Incorporated edge type backlight (four lamps)
- Lamp holder replaceable (Part No.150LHS12)
- Recommendation inverter: Part No.150PW011
- Approved by UL1950 3rd Edition and CSA-C22.2 No.950-95

3. APPLICATIONS

- PC monitor

4. STRUCTURE AND FUNCTIONS

A color TFT (thin film transistor) LCD module is comprised of a TFT liquid crystal panel structure, LSIs for driving the TFT array, and a backlight assembly. Sandwiching liquid crystal material in the narrow gap between a TFT array glass substrate and a color filter glass substrate creates the TFT panel structure. After the driver LSIs are connected to the panel, the backlight assembly is attached to the backside of the panel.

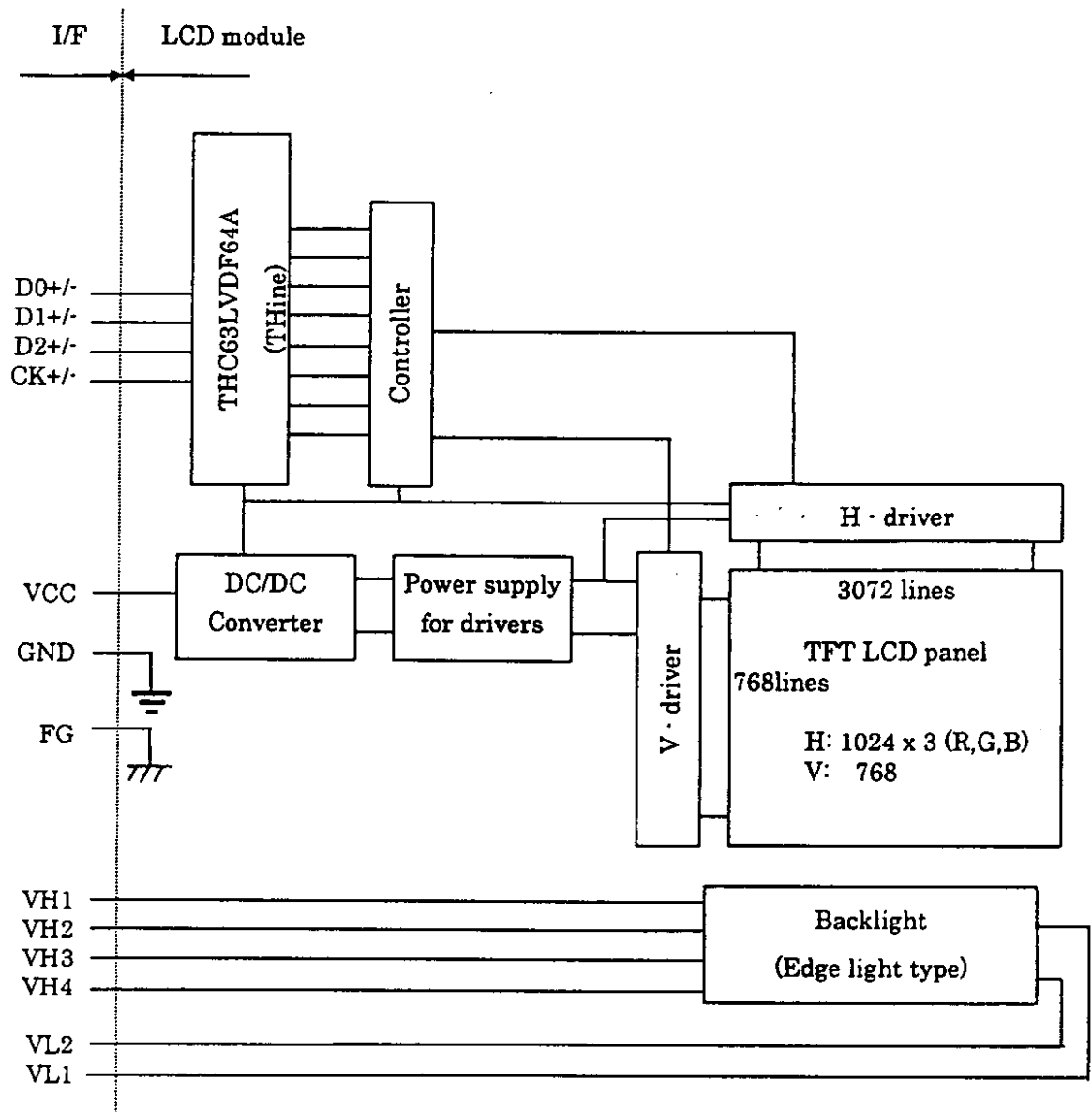
RGB (red, green, blue) data signals from a source system is modulated into a form suitable for active matrix addressing by the onboard signal processor and sent to the driver LSIs which in turn addresses the individual TFT cells.

Acting as an Electro-optical switch, each TFT cell regulates light transmission from the backlight assembly when activated by the data source. By regulating the amount of light passing through the array of red, green, and blue dots, color images are created with clarity.

5. OUTLINE OF CHARACTERISTICS (at room temperature)

Display area	304.128 (H) × 228.096 (V) mm
Drive system	a-Si TFT active matrix
Display colors	262,144 colors
Number of pixels	1024 × 768
Pixel arrangement	RGB vertical stripe
Pixel pitch	0.279 (H) × 0.279 (V) mm
Module size	350.0 (Typ., H) × 265.0 (Typ., V) × 21.5 (Max., D) mm
Weight	1560 g (Typ.)
Contrast ratio	200:1 (Typ.)
Viewing angle (more than the contrast ratio of 10:1)	<ul style="list-style-type: none"> • Horizontal: 65 ° (Typ., left side, right side) • Vertical: 45 ° (Typ., up side), 60 ° (Typ., down side)
Designed viewing direction	<ul style="list-style-type: none"> • Optimum grayscale ($\gamma = 2.2$) : perpendicular • Wider viewing angle with contrast ratio : down side (5° to 10°)
Polarizer pencil-hardness	3 H (Min., at JIS K5400)
Color gamut	40 % (Typ., at center, To NTSC)
Response time	15 ms (Typ.), "white" to "black"
Luminance	300 cd/m ² (Typ., at IL= 6mA / lamp)
Signal system	RGB 6-bit signals, Synchronous signals(Hsync, Vsync), Dot clock (CLK) LVDS interface (THC63LVDF64A, Thine Electronics, Inc.)
Supply voltage	5 V (Logic, LCD driving)
Backlight	Edge light type: Four cold cathode fluorescent lamps in a holder [Replaceable parts] • Lamp holder: Part No.150LHS12
Power consumption	17 W (Typ., Checker flag pattern, at IL= 6mA / lamp)

6. BLOCK DIAGRAM



Note 1: GND is not connected to FG (Frame Ground) in this LCD module.

7. GENERAL SPECIFICATIONS

Items	Specifications	Unit
Module size	350.0±0.6 (H) × 265.0±0.6 (V) × 21.5(Max., D)	mm
Display area	304.128 (H) × 228.096 (V)	mm
Number of pixels	1024×3 (H) × 768 (V)	pixel
Dot pitch	0.099 (H) × 0.297 (V)	mm
Pixel pitch	0.297 (H) × 0.297 (V)	mm
Pixel arrangement	RGB (Red, Green, Blue) vertical stripe	—
Display colors	262,144	color
Weight	1610 (Max.)	g

8. ABSOLUTE MAXIMUM RATINGS

Parameters	Symbols	Ratings	Unit	Remarks
Supply voltage	VCC	-0.3 to +6.0	V	Ta = 25°C
Logic input voltage	VI	-0.3 to VCC+0.3	V	Ta = 25°C
Lamp voltage	VL	2000	Vrms	Ta = 25°C
Storage temperature	Tst	-20 to +60	°C	—
Operating temperature	Top	0 to +50	°C	Module surface Note 1
Relative humidity Note 2		≤ 95	%	Ta ≤ 40°C
		≤ 85	%	40°C < Ta ≤ 50°C
Absolute humidity Note 2		Absolute humidity shall not exceed Ta = 50°C, RH = 85%		g/m ³ Ta > 50°C

Note 1: Measure at the panel surface (Including self heat)

Note 2: No condensation

9. ELECTRICAL CHARACTERISTICS

(1) Logic/ LCD driving

(Ta = 25°C)

Parameters	Symbols	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	VCC	4.75	5.0	5.25	V	—
Ripple voltage	VRP	—	—	+100	mV	For VCC
Differential input (H) Threshold voltage	VTH	—	—	+100	mV	VCM=1.2V Note 1
Differential input (L) Threshold voltage	VTL	-100	—	—	mV	
Differential Input voltage	VI	0	—	2.4	V	—
Terminating resistor	RT	—	100	—	Ω	—
Supply current	ICC	—	300 Note 2	600 Note 3	mA	VCC= 5.0V

Note 1: Common mode voltage in LVDS driver

Note 2: Checker flag pattern (in EIAJ ED-2522)

Note 3: Theoretical maximum current pattern

(2) Backlight

(Ta = 25°C)

Parameters	Symbols	Min.	Typ.	Max.	Unit	Remarks
Lamp current	IL	3.0	6.0	6.5	mA _{rms}	per lamp
Lamp voltage	VL	—	680	—	V _{rms}	—
Lamp turn on voltage	VS	1100	—	—	V _{rms}	Ta = 25°C
Note 1		1650	—	—	V _{rms}	Ta = 0°C
Oscillator frequency	Ft	53	—	67	kHz	Note 2

Note 1: When VS is less than Min. value, lamps might be not turned on.

Note 2: Recommended value of "Ft"

• Ft is within the specification.

and

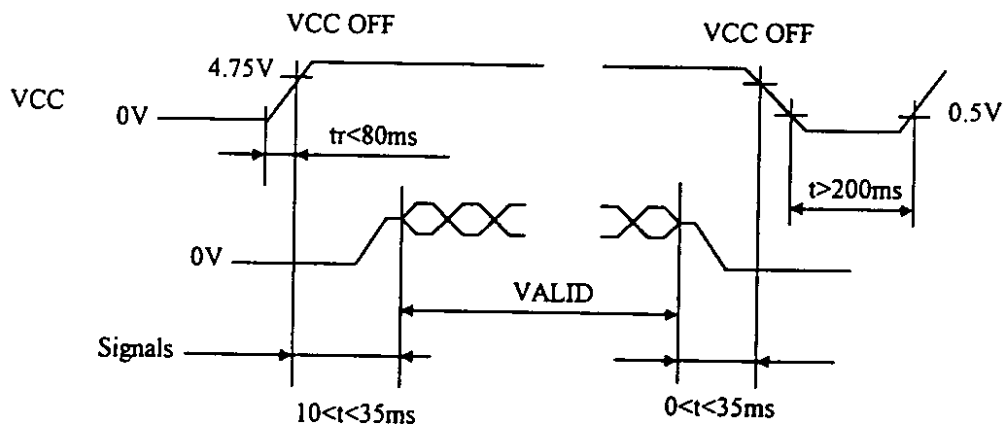
• $Ft = 1/4th \times (2n-1)$

th : Hsync period

n : a natural number (1,2,3...)

If Ft is out of the recommended value, interference between Ft frequency and Hsync frequency may cause beat on the display.

10. SUPPLY VOLTAGE SEQUENCE



Note 1: Logic signals (synchronous signals and control signals) must be "0" voltage (V), when VCC is not input. If input voltage to signal lines is higher than 0.3 V, the internal circuit will be damaged.

Note 2: The supply voltage for input signals should be the same as VCC.

Note 3: Turn on the backlight within the LCD operation period. When the backlight turns on before LCD operation or the LCD operation turns off before the backlight turns off, the display may momentarily become white.

Note 4: When the power is off, please keep whole signals low level or high impedance.

Note 5: This LCD module uses fuse as follows.

Fuse

	Type name	Producer	Rating
VCC	ICP-S1.2	Rohm	50V/1.2A

Before the power is designed, the fuses should be considered. The power capacity should be used more than 1.5 times of fuse rating.

In case of small power capacity, the module should be evaluate enough.

11. INTERFACE PIN CONNECTIONS

(1) Interface connector for signal and power

CN1

Part No. : FI-SE20P-HF

Adaptable socket : FI-SE20M

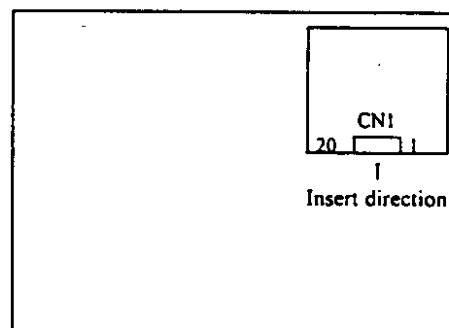
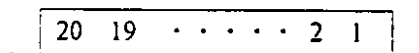
Supplier : Japan Aviation Electronics Industry Limited (JAE)

Pin No.	Symbols	Signal type	Function
1	GND	Ground	Note 1
2	GND		
3	NC	Non-connection	—
4	NC		
5	GND	Ground	Note 1
6	CK+	Pixel clock	CLK for pixel data f=65MHz (Typ.) (LVDS level)
7	CK-		
8	GND	Ground	Note 1
9	D2+	Pixel data	LVDS differential data input
10	D2-		
11	GND	Ground	Note 1
12	D1+	Pixel data	LVDS differential data input
13	D1-		
14	GND	Ground	Note 1
15	D0+	Pixel data	LVDS differential data input
16	D0-		
17	GND	Ground	Note 1
18	GND		
19	VCC	+5.0V power supply	Supply +5.0V \pm 5%
20	VCC		

Note 1: GND is signal ground for logic and LCD driving. GND is not connected to FG(frame ground) in this module.

Note 2: Connect all pins (except 3, 4) to avoid noise issue.
Use 100 Ω twist pair wires for the cable.

CN1: Figure from socket view



(2) Connector for backlight unit

CN21

Part No. : BHR-03VS-1

Adaptable socket : SM02(8.0)B-BHS-TB

Supplier : J.S.T. TRADING COMPANY, LTD.

Pin No.	Symbols	Function
1	VL1	Up side lamp, Low voltage terminal (The cable color is gray)
2	NC	Non-connection
3	VH1	Up side lamp, High voltage terminal (The cable color is white)

CN22

Part No. : BHR-02VS-1

Adaptable socket : SM02(4.0)B-BHS-TB

Supplier : J.S.T. TRADING COMPANY, LTD.

Pin No.	Symbols	Function
1	NC	Non-connection
2	VH2	Up side lamp, High voltage terminal (The cable color is white)

CN23

Part No. : BHR-03VS-1

Adaptable socket : SM02(8.0)B-BHS-TB

Supplier : J.S.T. TRADING COMPANY, LTD.

Pin No.	Symbols	Function
1	VL2	Down side lamp, Low voltage terminal (The cable color is gray)
2	NC	Non-connection
3	VH3	Down side lamp, High voltage terminal (The cable color is white)

CN24

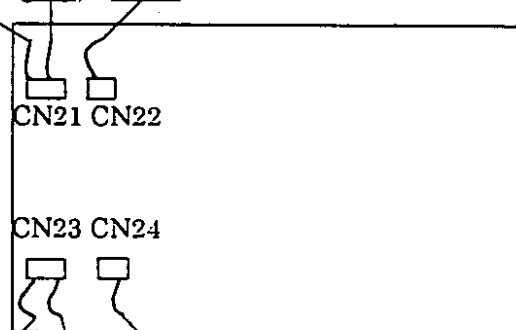
Part No. : BHR-02VS-1

Adaptable socket : SM02(4.0)B-BHS-TB

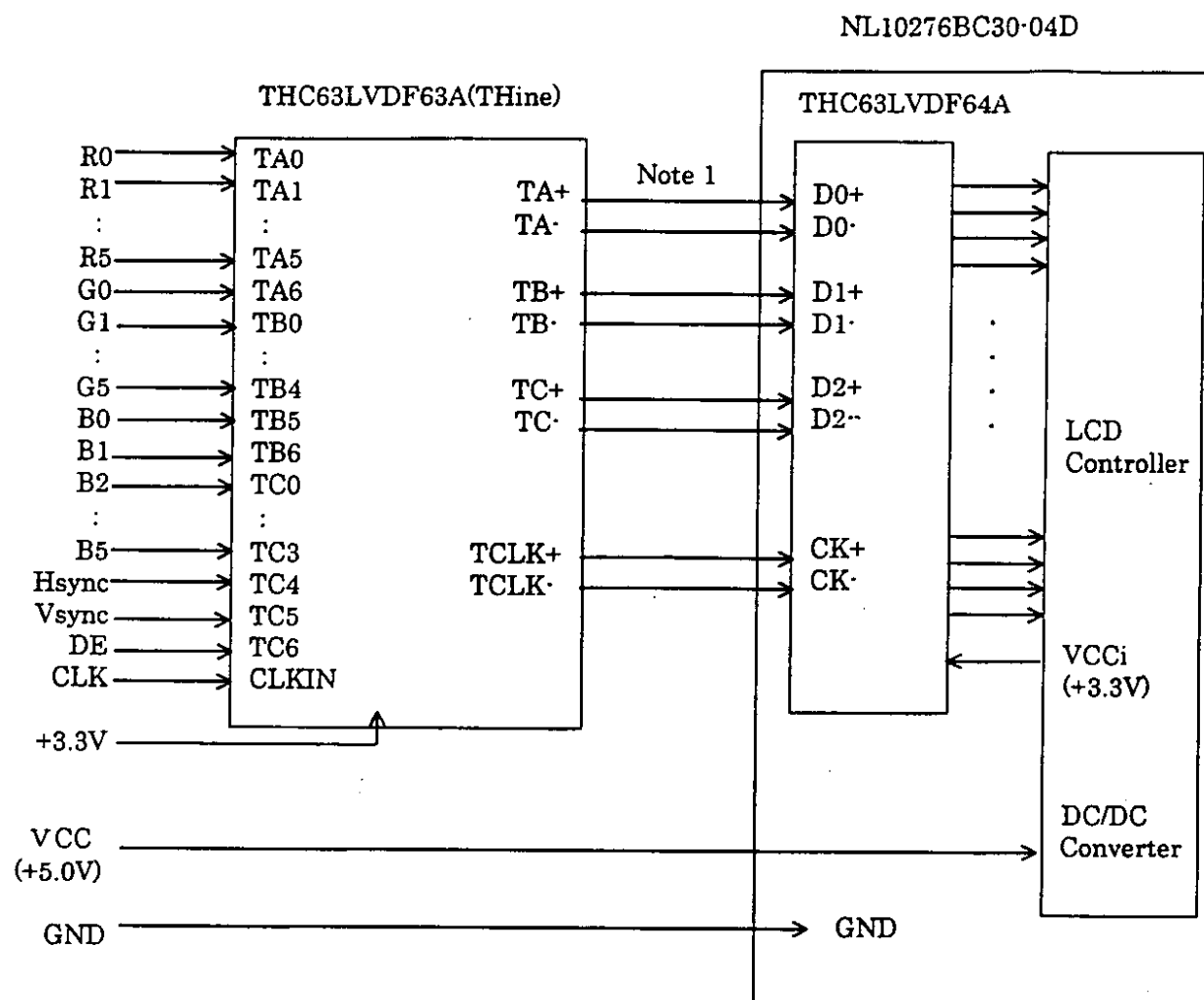
Supplier : J.S.T. TRADING COMPANY, LTD.

Pin No.	Symbols	Function
1	NC	Non-connection
2	VH4	Down side lamp, High voltage terminal (The cable color is white)

Note: VH and VL must be connected correctly. If you make a mistake to connect, you will get hurt and the module will break.

Color of the cable: white, gray, whiteColor of the cable: gray, white, white

12. METHOD OF CONNECTION FOR THC63LVDF63A



Note 1: 100 Ω twist pair

Note 2: These signals should be kept in the specified range of 14.INPUT SIGNAL TIMINGS.

13. DISPLAY COLORS vs. INPUT DATA SIGNALS

Display colors		Data signal(0: Low level, 1: High level)																	
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	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
Red grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	dark	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑					⋮													
	↓					⋮													
	bright	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Green grayscale		1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	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	0	0	0	0	1	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Blue grayscale	↑					⋮													
	↓					⋮													
	bright	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
		0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: Colors are developed in combination with 6-bit signals (64 steps in grayscale) of each primary red, green, and blue color. This process can result in up to 262,144 ($64 \times 64 \times 64$) colors.

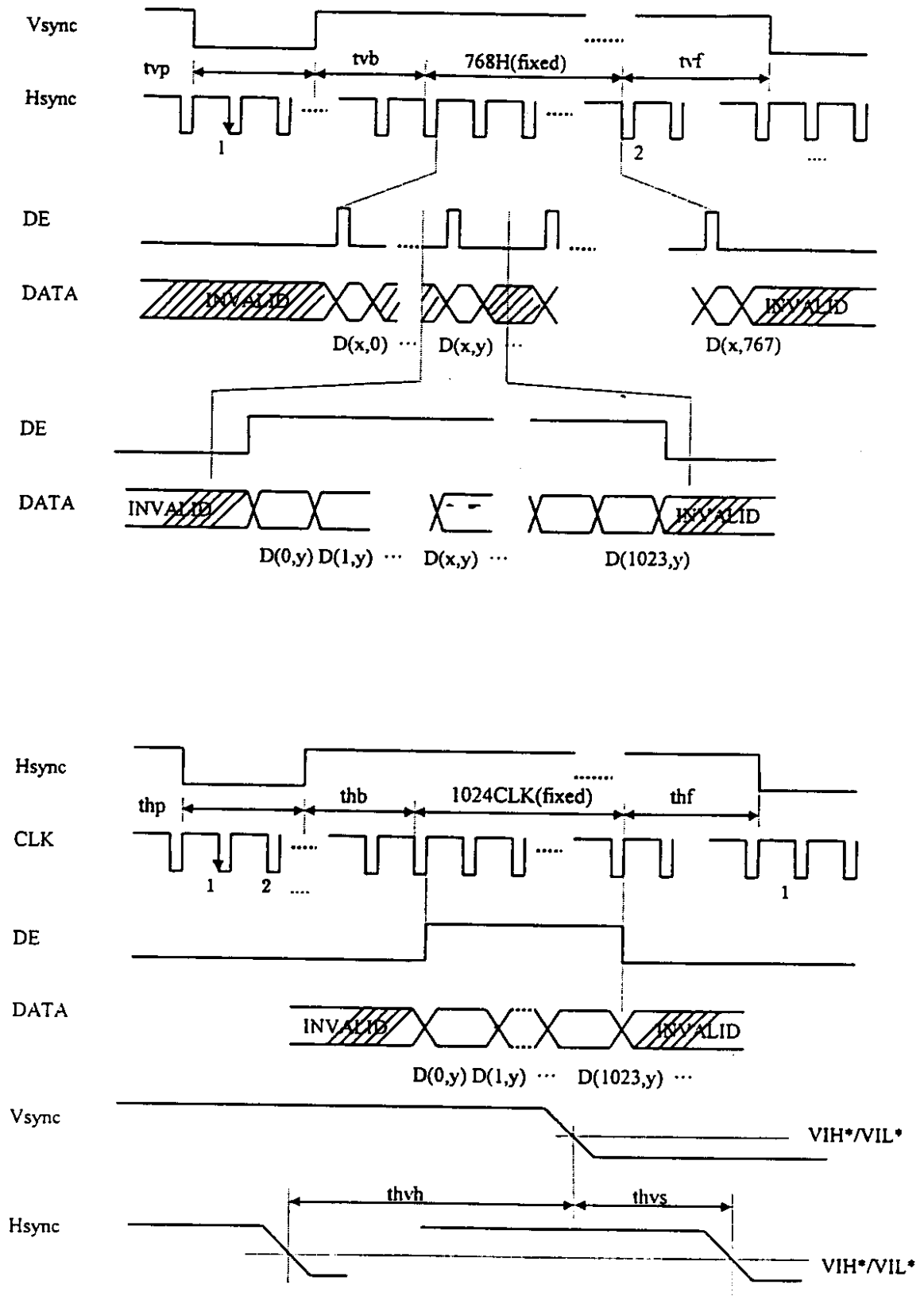
14. INPUT SIGNAL TIMINGS

(1) Input signal specification for LCD controller

	Parameters	Symbols	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency	1/tc	60.0	65.0	68.0	MHz	—
	Rise, fall	trf	—	15.385	—	ns	
	Duty	tch/ tc	Note			ns	—
						—	—
Hsync	Period	th	16.0	20.676	22.7	μ s	48.363kHz(Typ.)
			1110	1344	—	CLK	
	Display period	thd	—	1024	—	CLK	—
	Front-porch	thf	0	—	—	CLK	—
	Pulse width	thp *	12	—	—	CLK	—
	Back-porch	thb *	2	—	—	CLK	—
	* thp + thb		86	—	—	CLK	—
	Hsync-CLK timing	ths	Note			ns	—
	CLK-Hsync timing	thh				ns	—
	DE-CLK timing	tes				ns	—
	CLK-DE timing	teh				ns	—
	Rise, fall	thrf, terf	—	—	10	ns	—
Vsync	Period	tv	13.3	16.666	18.5	ms	60.004Hz(Typ.)
			—	806	—	H	
	Display period	tvd	—	768	—	H	—
	Front-porch	tvf	1	—	—	H	—
	Pulse width	tvp *	1	3	36	H	—
	Back-porch	tvb *	1	—	36	H	—
	* tvp + tvb		3	—	38	H	—
	Vsync-Hsync timing	tvhs	Note			ns	—
	Hsync-Vsync timing	tvhs				ns	—
	Rise, fall	tvrf				ns	—
DATA (R0-R5) (G0-G5) (B0-B5)	DATA-CLK(Set up)	tds	Note			ns	—
	CLK-DATA(Hold)	tdh				ns	—
	Rise, fall	tdrf				ns	—

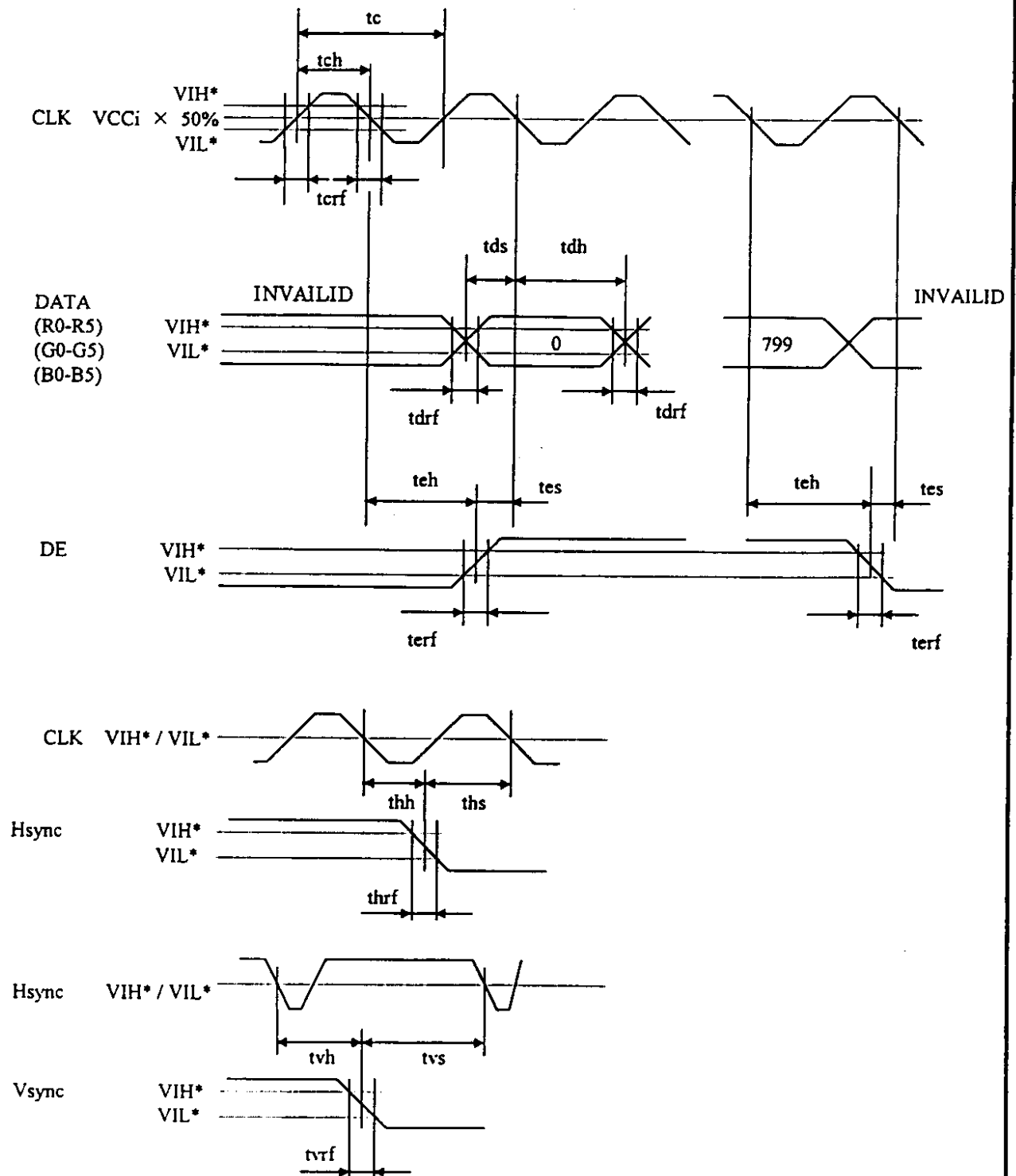
- Note : These values are in the timing regulation of THC63LVDF64A (THine).
: The product equivalent to THC63LVDF63A(THine) is recommended to the input of LVDS transmitter.
: The Timing regulation prescribes in the input of the LVDS transmitter.

(2) Definition of input signal timing



* V_{IH} , V_{IL} : Refer to LVDS transmitter specifications.

(3) Input signal timing chart



* V_{IH} , V_{IL} : Refer to LVDS transmitter specifications.

(4) Display position of input data

D(0,0)	D(0,1)	D(0,2)	. . .	. . .	D(0,1023)
D(1,0)	D(1,1)	D(1,2)	. . .	. . .	D(1,1023)
D(2,0)	D(2,1)	D(2,2)	. . .	. . .	D(2,1023)
.
.
.
.
D(767,0)	D(767,1)	D(767,2)	. . .	. . .	D(767,1023)

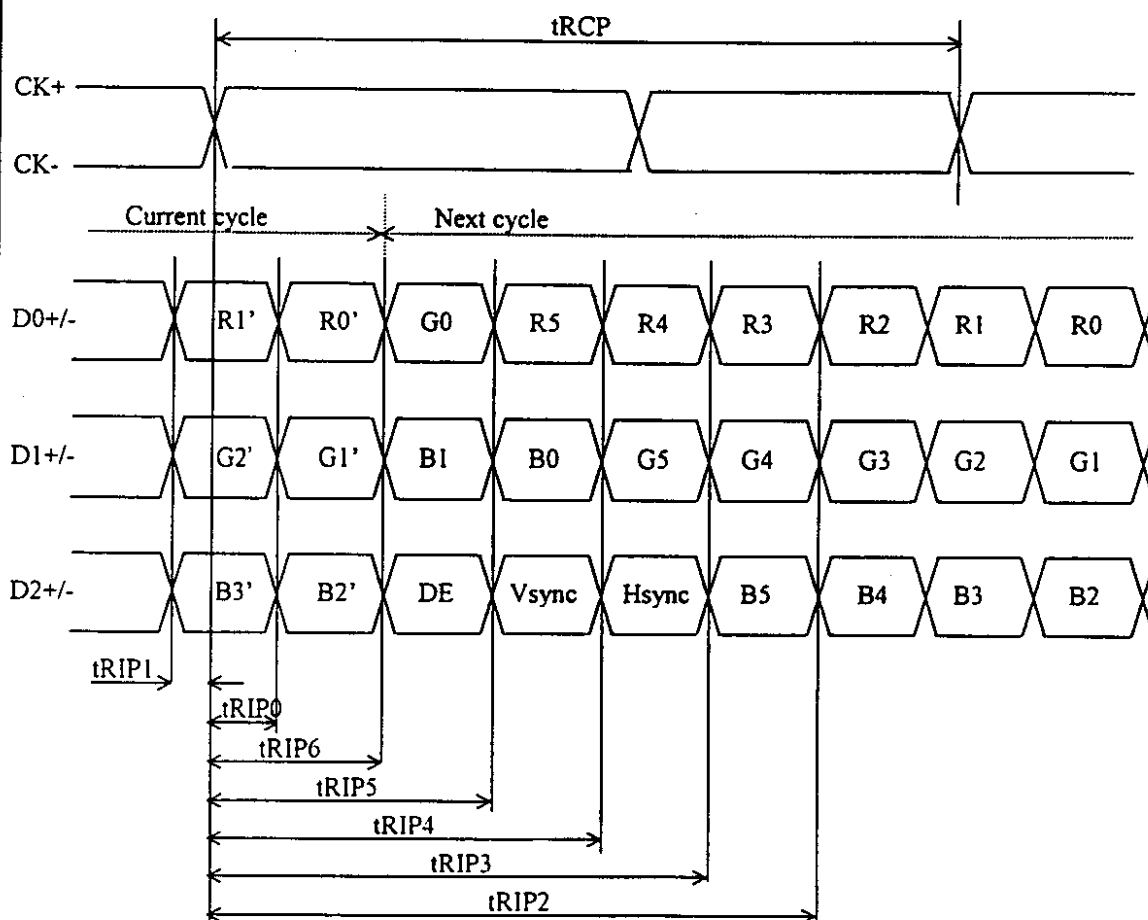
15. FOR LVDS RECEIVER

(1) Input signal specifications

Parameters	Symbols	Min.	Typ.	Max.	Unit	Remarks
CLK Frequency	tRCP	14.71	T	16.66	ns	—
Bit0 position	tRIP1	-0.5	0	0.5	ns	T=15.38nS
Bit1 position	tRIP0	T/7-0.5	T/7	T/7+0.5	ns	T=15.38nS
Bit2 position	tRIP6	2T/7-0.5	2T/7	2T/7+0.5	ns	T=15.38nS
Bit3 position	tRIP5	3T/7-0.5	3T/7	3T/7+0.5	ns	T=15.38nS
Bit4 position	tRIP4	4T/7-0.5	4T/7	4T/7+0.5	ns	T=15.38nS
Bit5 position	tRIP3	5T/7-0.5	5T/7	5T/7+0.5	ns	T=15.38nS
Bit6 position	tRIP2	6T/7-0.5	6T/7	6T/7+0.5	ns	T=15.38nS

Note: See the specifications of LVDS manufactures for detailed design.

(2) Input signal timing chart



16. OPTICAL CHARACTERISTICS

(Ta = 25 °C, Note 1)

Parameters	Symbols	Conditions	Min.	Typ.	Max.	Unit	Remarks
Contrast ratio	CR	Note 4	80	150	—	—	Note 2
Luminance	Lumax	Note 4	220	300	—	cd/m ²	Note 3
Luminance uniformity	—	Max. / Min.	—	—	1.30	—	Note 7

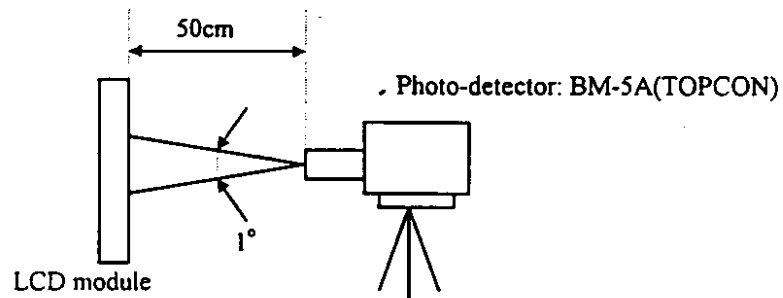
Reference data

(Ta = 25 °C, Note 1)

Parameters		Symbols	Conditions	Min.	Typ.	Max.	Unit	Remarks
Contrast ratio		CR	Best contrast angle $\theta x = \pm 0^\circ$, $\theta y = -5^\circ$ to -10°	—	400	—	—	Note 3
Color gamut		C	To NTSC	35	40	—	%	Note 4
Chromaticity Coordinates		W	White (x, y)	—	(0.30, 0.31)	—	—	—
		R	Red (x, y)	—	(0.58, 0.33)	—	—	
		G	Green (x, y)	—	(0.33, 0.52)	—	—	
		B	Blue (x, y)	—	(0.15, 0.11)	—	—	
Viewing Angle Range (CR>10)	Horizontal	$\theta x+$	CR>10, $\theta y = \pm 0^\circ$	50	65	—	deg.	Note 5
		$\theta x-$		50	65	—	deg.	
	Vertical	$\theta y+$	CR>10, $\theta x = \pm 0^\circ$	35	45	—	deg.	
		$\theta y-$		30	60	—	deg.	
Viewing Angle Range (CR>5)	Horizontal	$\theta x+$	CR>5, $\theta y = \pm 0^\circ$	—	80	—	deg.	
		$\theta x-$		—	80	—	deg.	
	Vertical	$\theta y+$	CR>5, $\theta x = \pm 0^\circ$	—	55	—	deg.	
		$\theta y-$		—	80	—	deg.	
Response time		Ton	“White” to “Black”	—	15	40	ms	Note 6
		Toff	“Black” to “White”	—	40	80	ms	

note 1: VDD = 5V, IL= 6mAms, with recommended inverter Part No.150PW011

note 2: The luminance is measured after 20 minutes from the module works, with all pixels in "white".
Typical value is measured after luminance saturation.
The luminance is measured in dark room.

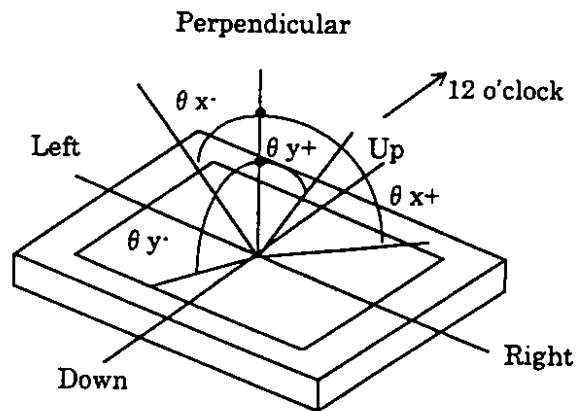


note 3: The contrast ratio is calculated by using the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance with all pixels in "white"}}{\text{Luminance with all pixels in "black"}}$$

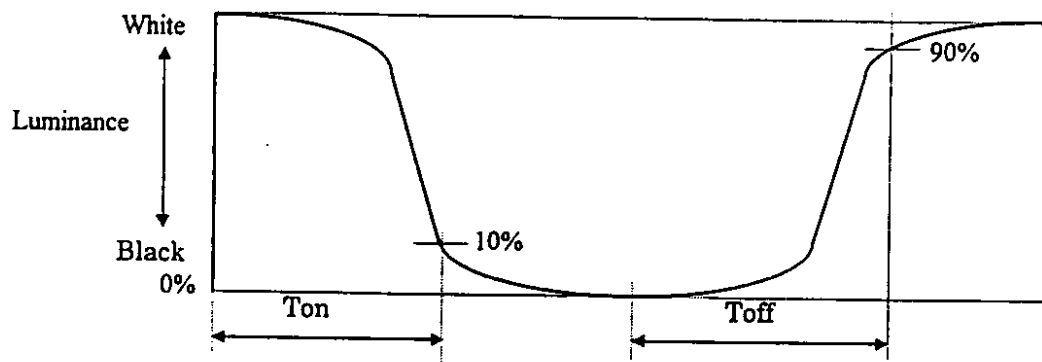
note 4: Viewing angle is $\theta_x = \pm 0^\circ$, $\theta_y = \pm 0^\circ$, At center.

note 5: Definitions of viewing angle are as follows



note 6: Definitions of response time is as follows.

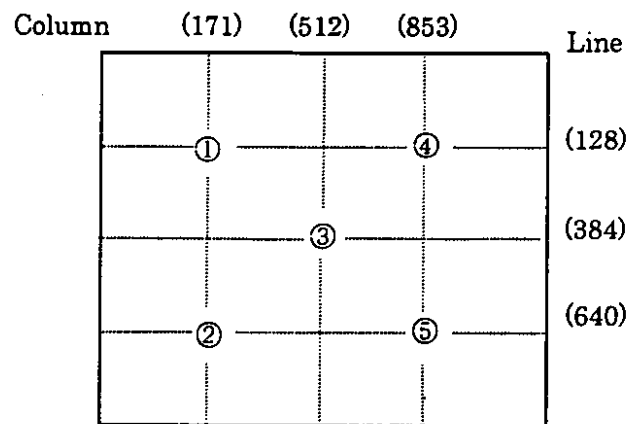
Photo-detector output signal is measured when the luminance changes "white" to "black" or "black" to "white". Response time is the time between 10% and 100% of the photo-detector output amplitude.



note 7: Luminance uniformity is calculated by using the following formula.

$$\text{Luminance uniformity} = \frac{\text{Maximum luminance}}{\text{Minimum luminance}}$$

The luminance is measured at near the five points shown below.



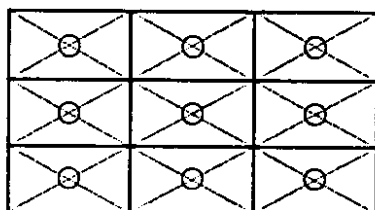
17. RELIABILITY TEST

Test items	Test condition	Judgment
High temperature / humidity operation	$50 \pm 2^{\circ}\text{C}$, RH= 85% 240 hours, Display data is black.	Note 1
Heat cycle (operation)	① $0^{\circ}\text{C} \pm 3^{\circ}\text{C} \cdots 1$ hour $55^{\circ}\text{C} \pm 3^{\circ}\text{C} \cdots 1$ hour ② 50 cycles , 4 hours / cycle ③ Display data is black.	Note 1
Thermal shock (non-operation)	① $-20^{\circ}\text{C} \pm 3^{\circ}\text{C} \cdots 30$ minutes $60^{\circ}\text{C} \pm 3^{\circ}\text{C} \cdots 30$ minutes ② 100 cycles ③ Temperature transition time is within 5 minutes.	Note 1
Vibration (non-operation)	① 5-100Hz, 19.6m/s^2 (2G) 1 minute / cycle, X,Y,Z direction ② 50 times each direction	Note 1 Note 2
Mechanical shock (non-operation)	① 294 m/s^2 (30G), 11ms X,Y,Z direction ② 3 times each direction	Note 1 Note 2
ESD (operation)	150pF, 150 Ω , $\pm 10\text{KV}$ 9 places on a panel Note 3 10 times each place at one-second intervals	Note 1
Dust (operation)	15 kinds of dust (JIS-Z 8901) Hourly 15 seconds stir, 8 times repeat	Note 1

Note 1: Display function is checked by the same condition as LCD module out-going inspection.

Note 2: Physical damage

Note 3: Discharge points are shown as follows.



18. EXPECTED LIFE-TIME OF THE LAMP

	Lamp
Condition	IL= 6mAmps, Luminance Maximum Room temp. ($25 \pm 2^{\circ}\text{C}$) , Continuous operation
MTTF	40,000H
Criteria	Half value luminance (compared with initial value.)

Note 1: The lifetime is expected value (reference).

Note 2: This module has four lamps even though a lamp goes off, the other lamp may go off.

19. GENERAL CAUTIONS

Next figures and sentences are very important, please understand these contents as follows.



CAUTION

This figure is a mark that you will get hurt and/or the module will have damages when you make a mistake to operate.



This figure is a mark that you will get an electric shock when you make a mistake to operate.



This figure is a mark that you will get hurt when you make a mistake to operate.



CAUTIONS




Do not touch an inverter — on which is stuck a caution label — while the LCD module is under the operation, because of dangerous high voltage.

(1) Caution when taking out the module

- ① Pick the pouch only, when taking out the module from a carrier box.

(2) Cautions for handling the module

- ① As the electrostatic discharges may break the LCD module, handle the LCD module with care against electrostatic discharges. Peel protection sheet out from the LCD panel surface as slowly as possible.
- ②  As the LCD panel and backlight element are made from fragile glass material, impulse and pressure to the LCD module should be avoided.
- ③ As the surface of polarizer is very soft and easily scratched, use a soft dry cloth without chemicals for cleaning.
- ④ Do not pull the interface connectors in or out while the LCD module is operating.
- ⑤ Put the module display side down on a flat horizontal plane.
- ⑥ Handle connectors and cables with care.
- ⑦ When the module is operating, do not lose CLK, Hsync, or Vsync signal. If any one or more of these signals is lost, the LCD panel would be damaged.
- ⑧ The torque for mounting screws should never exceed 0.39 N·m (4 kgf·cm).
- ⑨ Don't push or rub the surface of LCD module please.
If you do, the scratches or the marks like rubbing marks may be left on the surface of the module.

(3) Cautions for the atmosphere

- ① Dew drop atmosphere must be avoided.
- ② Do not store and/or operate the LCD module in a high temperature and/or high humidity atmosphere. Storage in an anti-static pouch and under the room temperature atmosphere is recommended.
- ③ This module uses cold cathode fluorescent lamps. Therefore, the life of lamps becomes short if the module is operated under the low temperature environment.
- ④ Do not operate the LCD module in high magnetic field.

(4) Cautions for the module characteristics

- ① Do not apply any fixed patterns data for a long time to the LCD module. It may cause image sticking. Please use screen savers if the display pattern is fixed for a long time.
- ② This module has the retardation film which may cause the variation of the color hue in the different viewing angles. The ununiformity may appear on the screen under the high temperature operation.
- ③ The light vertical stripe may be observed depending on the display pattern. This is not defects or malfunctions.
- ④ The noise from the inverter circuit may be observed in the luminance control mode. This is not defects or malfunctions.

(5) Cautions for assembling of an inverter

- ① In case that the inverter is assembled to a mold shashih, the tightening condition of screws is as follows.

Recommendation electric screwdriver	: CL driver (Supplier: HIOS Inc.)
Recommendation unloaded rotation speed	: less than 1000 rpm
Recommendation screws	: Cross Recessed Head Machine Screws with Small Washer (JIS B-1188)

Recommendation torque of the screwdriver	: $0.39 \pm 0.05 \text{ N} \cdot \text{m}$ ($4.0 \pm 0.5 \text{ kgf} \cdot \text{cm}$)
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The permission tightening number of the screw hole	: three times
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(The tightening of second and third times must tighten in accordance with the screw ditch.

Otherwise, the screw ditch is broken and the broken ditch can not repair.)

Caution for the screw tightening

: Tighten the screw perpendicularly. Do not tighten the screw obliquely. Please use the screwdriver suitable for the screw size.

- ② Please insert an insulation sheet between the inverter and the mold shashih when the inverter is assembled to the mold shashih. If you do not insert the insulation sheet, electric discharge may occur from the inverter to the module.

Before an insulation sheet is adopted, the material and the thickness of an insulation sheet should be considered.

(Design example:

Thickness of the inverter printed wiring board	: t1.0
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Thickness of the insulation sheet	: t0.4
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Material	: Polyethylene terephthalate (UL class : 94V-0)
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(6) Other cautions

- ① Do not disassemble and/or reassemble LCD module.
- ② Do not readjust variable resistors nor switches in the module.
- ③ When returning the module for repair or etc., please pack the module properly to avoid any damages. We recommend the original shipping packages.
- ④ In case that the scan converter is used to convert VGA signal to NTSC, it is recommended using the frame-memory type, not the line-memory.

Liquid Crystal Display has the following specific characteristics. These are not defects or malfunctions.

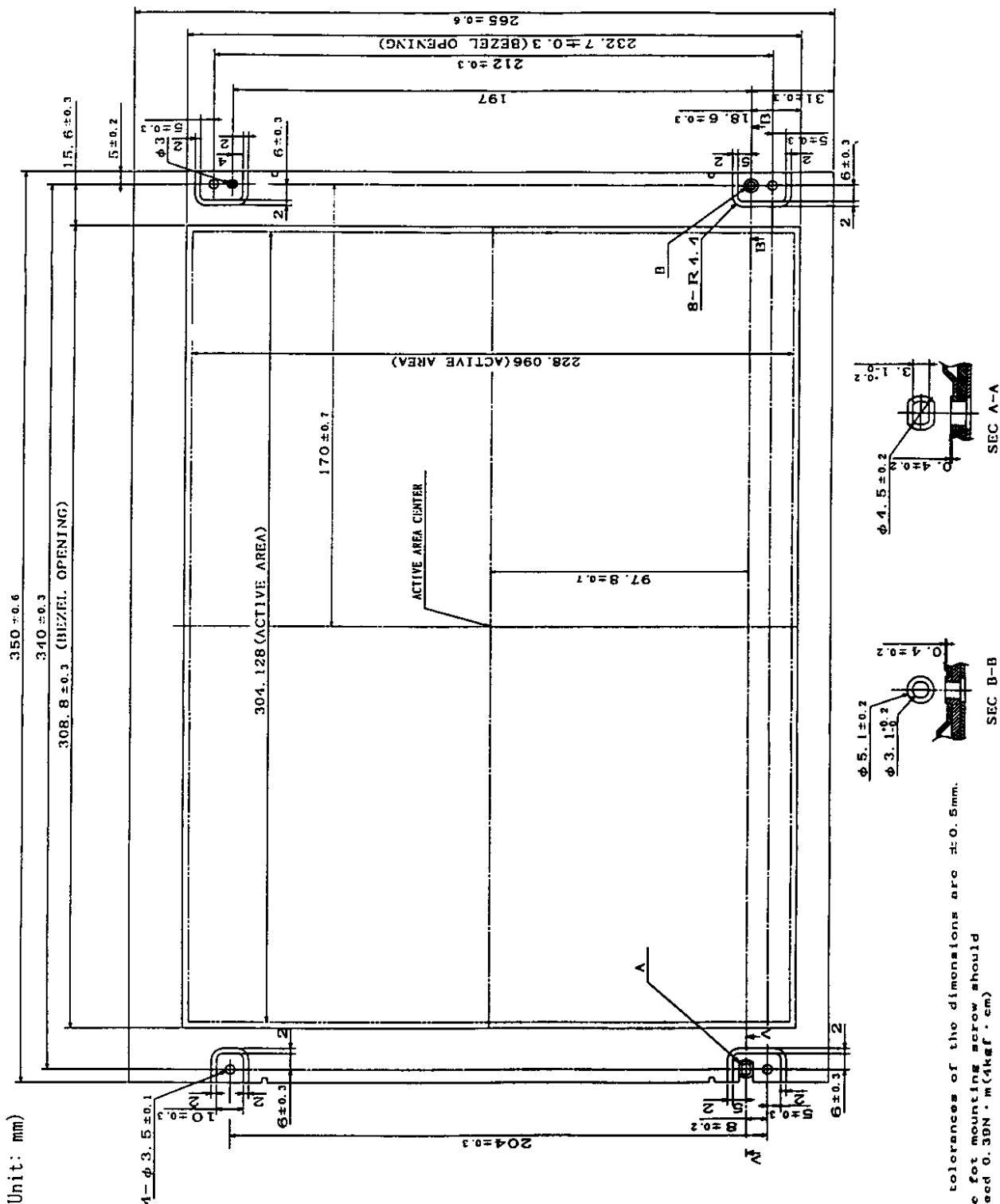
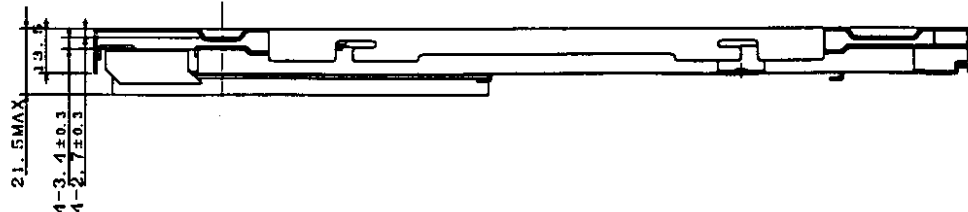
The optical characteristics of this module may be affected by the ambient temperature.

This module has cold cathode tube for backlight. Optical characteristics, like luminance or uniformity, will be changed by the progress in time.

Uneven brightness and/or small spots may be observed depending on different display patterns.

20. OUTLINE DRAWINGS

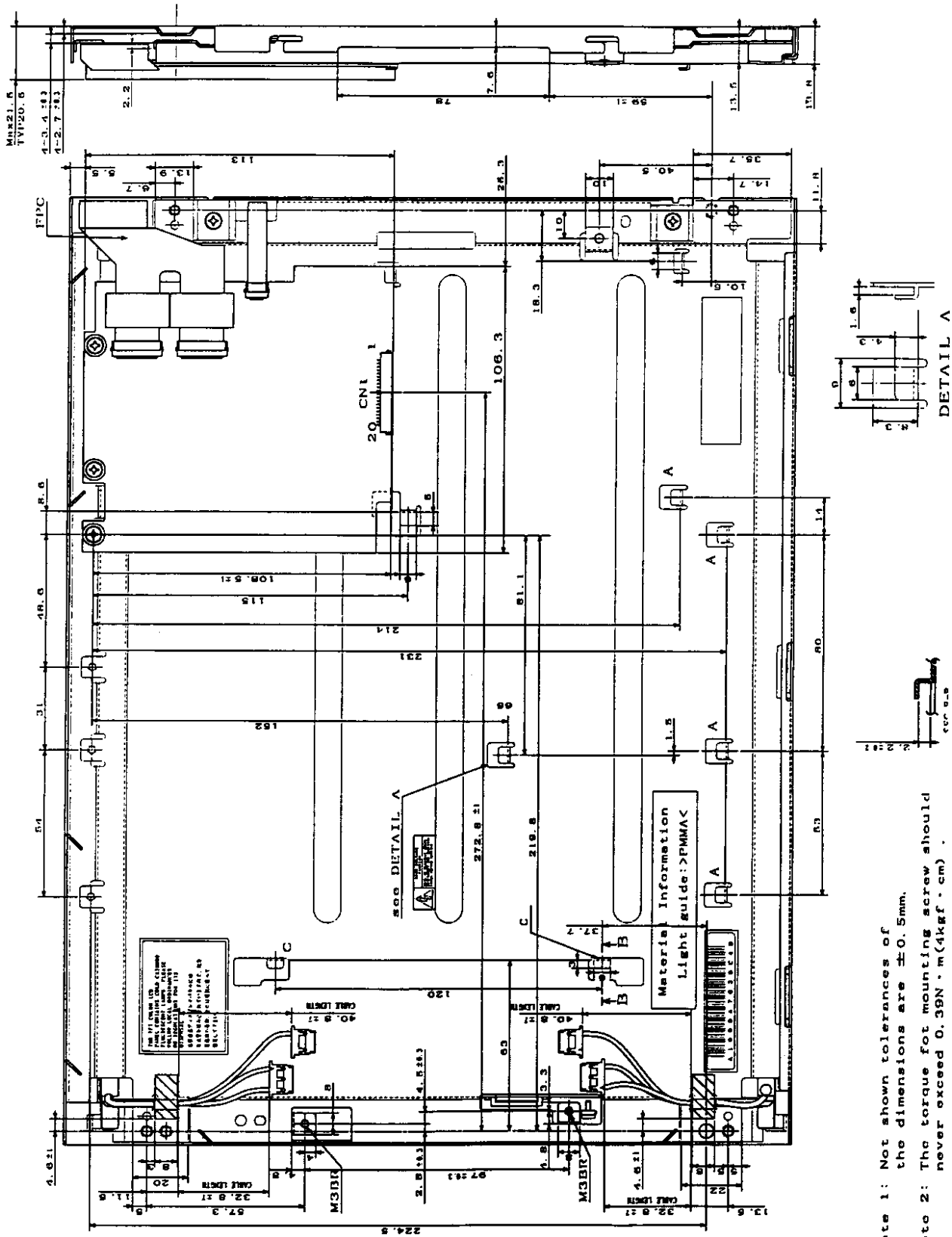
20.1 FRONT VIEW (Unit: mm)



Note 1: Not shown tolerances of the dimensions are $\pm 0.5\text{mm}$.

Note 2: The torque for mounting screw should never exceed $0.39\text{N} \cdot \text{m}$ (4kgf · cm)

20.2 REAR VIEW (Unit: mm)



Note 1: Not shown tolerances of the dimensions are $\pm 0.5\text{mm}$.

Note 2: The torque for mounting screw should never exceed $0.39\text{N} \cdot \text{m} (4\text{kgf} \cdot \text{cm})$.

Revision History					DOD-H-7478	26/26
Rev.	Prepared Date	Revision contents	Approved	Checked	Prepared	Issued Date
1	Oct. 06, 1999	DOD-H-7453 (Abstract)	H.Tachimoto	T.Kusanagi	R.Kawashima	—
2	Oct. 15, 1999	DOD-H-7462 (all specs)	H.Tachimoto	T.Kusanagi	R.Kawashima	—
3	Oct. 21, 1999	DOD-H-7478 P9 Note 1: To correct an error writing. GND is connected to FG. ↓ GND is not connected to FG.	<i>H. Tachimoto</i>	—	<i>R. Kawashima</i>	—