

NEC

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TFT COLOR LCD MODULE

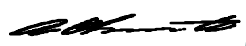

Type: NL10276BC30-04F
38cm (15 Type), XGA

SPECIFICATIONS

(Second Edition)

PRELIMINARY

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

NEC Corporation NEC Electron Devices Display Device Operations Unit Color LCD Division 1st Engineering Department		
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1. DESCRIPTION

NL10276BC30-04F 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. NL10276BC30-04F has a built-in backlight.

The 38cm(15 Type) diagonal display area contains 1024×768 pixels and can display 262144 colors simultaneously.

2. FEATURES

- LVDS interface (THC63LVDF64A, THine Electronics, Inc.)
- Wide viewing angle (with retardation film)
- High luminous and Low reflection
- Incorporated edge type backlight (Two lamps) and Backlight tube replaceable
- Replaceable lamp Holder (Part No.: 150LHS11)
- Inverter-less
- Approved by UL1950 Third Edition (E170632) and CSA-C22.2 No.950-95 (E170632)

3. APPLICATIONS

- Engineering work station, Desk-top type of PCs
- Display terminals for control systems
- Monitors for process controller

4. STRUCTURE AND FUNCTIONS

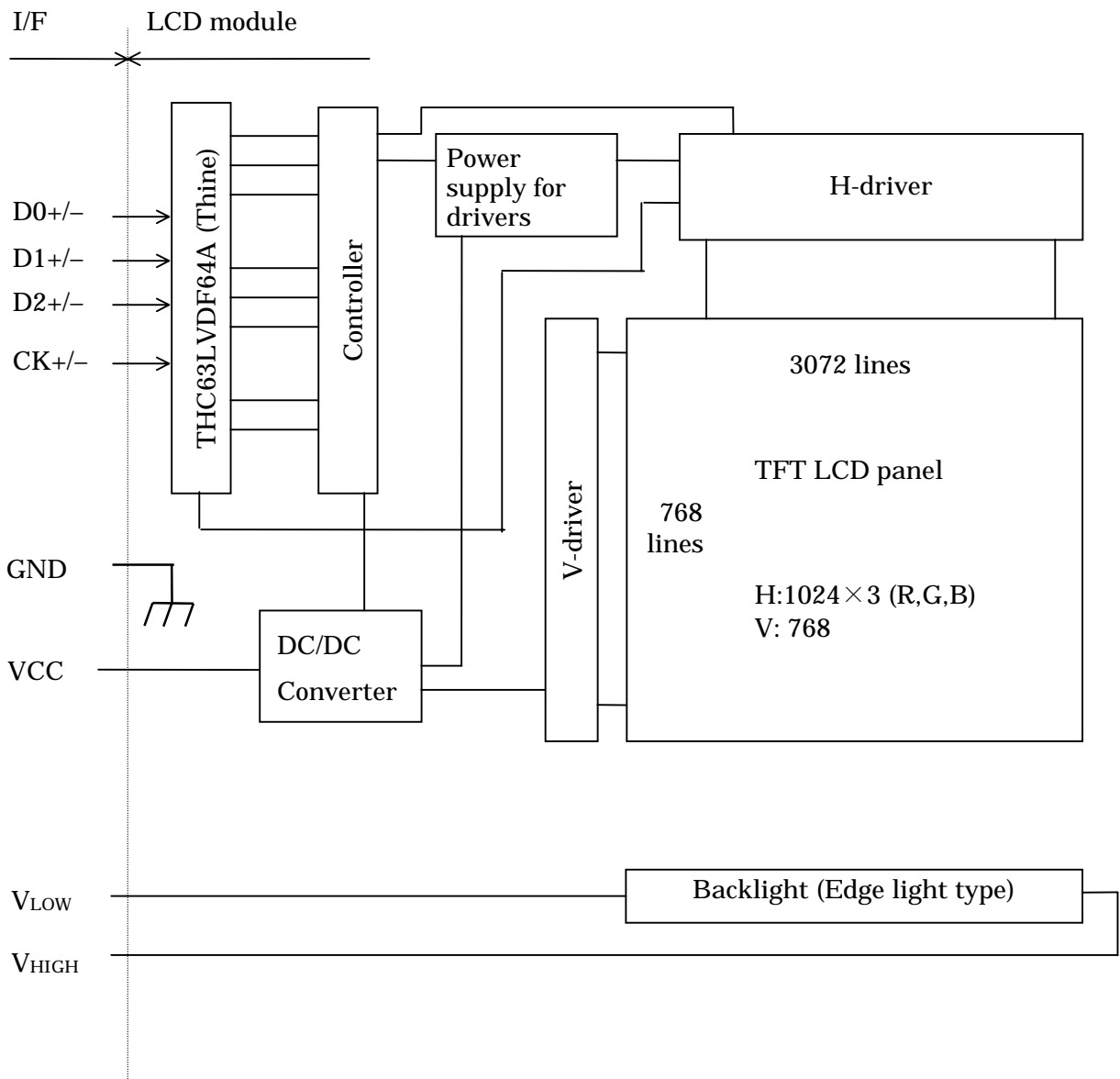
A color TFT (thin film transistor) LCD module is comprised of a TFT liquid crystal panel structure, LSIs for driving the TFT array, and a backlight assembly. Sandwiching liquid crystal material in the narrow gap between a TFT array glass substrate and a color filter glass substrate creates the TFT panel structure. And 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 are 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. CHARACTERISTICS (at room temperature)

Display area	304.128(H)×228.096(V)mm	
Drive system	a-Si TFT active matrix	
Display colors	262144 colors	
Number of pixels	1024×768	
Pixel arrangement	RGB vertical stripe	
Pixel pitch	0.297(H)×0.297(V)mm	
Module size	350.0 (H)×265.0 (V)×18.0 typ. (D) mm	△ ₂
Weight	TBD g (typ.)	
Contrast ratio	450:1 (typ. down side 5 °)	
Viewing angle (more than the contrast ratio of 10:1)	<ul style="list-style-type: none"> • Horizontal: 60 ° (typ. , left side, right side) • Vertical: 40 ° (typ. , up side), 50 ° (typ. , down side) 	
Designed viewing direction	<ul style="list-style-type: none"> • Wider viewing angle with contrast ratio: down side (6 o'clock) • Wider viewing angle without image reversal: up side (12 o'clock) • Optimum grayscale ($\gamma = 2.2$): perpendicular 	
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	200 cd/m ² (typ., at IL=6.5mA)	△ ₂
Signal system	RGB 6-bit signals, Synchronous signals(Hsync, Vsync), Dot clock (CLK), and DE LVDS interface (THC63LVDF64A, Thine Electronics, Inc.)	△ ₂
Supply voltage	5V (Logic, LCD driving)	△ ₂
Backlight	Edge light type: Two cold cathode fluorescent lamps in two holders, Inverter-less 【Replaceable parts】 <ul style="list-style-type: none"> • Lamp holder: type No.150LHS11 	△ ₂
Power consumption	10.1 W (typ., Checker flag pattern, at IL=6.5mA/lamp)	△ ₂

6. BLOCK DIAGRAM



Note 1: GND is signal ground for logic and LCD driving. GND is not connected to FG (Frame Ground) in the LCD module and these grounds should be connected to system ground in customer equipment.

7. GENERAL SPECIFICATIONS

Item	Specification	Unit
Module size	350.0±0.6 (H) × 265.0±0.6 (V) × 19.0 (max.)(D)	mm
Display area	304.128 (H) × 228.096 (V)	mm
Number of pixels	1024 (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 (RGB, 6bit)	color
Weight	TBD (max.)	g

8. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	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 (RH) 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% level.	g/m ³	Ta > 50°C

Note1: Measure at the panel surface (including self-heat)

Note2: No condensation

9. ELECTRICAL CHARACTERISTICS

(1) Logic, LCD driving

(Ta=25°C)

Parameter	Symbol	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	ViH	—	—	+100	mV	VCM=1.2V Note 1
Differential input (L) Threshold voltage	ViL	-100	—	—	mV	
Differential Input voltage	Vi	0.25	0.35	0.45	V	—
Common mode voltage	VCM	1.125	1.25	1.375	V	Rt=100Ω
Terminating resistor	Rt	—	100	—	Ω	—
Supply current	ICC	—	300 Note 2	600 Note 3	mA	VCC= 5.0V

Note1: Common mode voltage in LVDS driver

Note2: Checker flag pattern (in EIAJ ED-2522)

Note3: Theoretical maximum current pattern

(2) Backlight

(Ta = 25°C)

Parameters	Symbols	Min.	Typ.	Max.	Unit	Remarks
Lamp current	IL	3.0	6.5	7.0	mArms	at a lamp, IL=6.5mArms: 200cd/m ² , Note 1
Lamp voltage	VL	—	660	—	Vrms	—
Lamp turn on voltage	VS	1100	—	—	Vrms	Ta = 25°C, Note 1
		1650	—	—	Vrms	Ta = 0°C, Note 1
Oscillator frequency	Ft	52	56	60	kHz	Note 2

Note1: When IL and VS are less than Min. value, lamps might be not turned on.

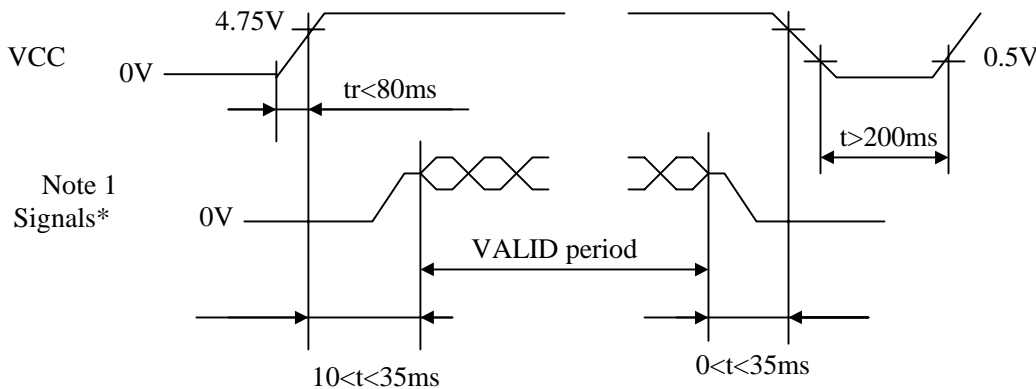
Note2: Recommended value of "Ft"

- Ft is within the specification.
and

$$Ft = 1 / 4th \times (2n-1) \quad \begin{matrix} th & : & \text{Hsync period} \\ n & : & \text{a natural number (1,2,3...)} \end{matrix}$$

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



* Signals: Hsync, Vsync, DE, CLK, R0 to R5, G0 to G5, B0 to B5

Note1: Terminations of the signal lines are resistance 100 Ω .

Remark1: 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.

Remark2: The supply voltage for input signals should be the same as VCC.

Remark3: 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.

Remark4: When the power is off, please keep whole signals low level or high impedance.

Remark5: This LCD module uses a fuse as follows.

Fuse

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

Before the power supplies of the system are designed, fuses should be considered. The power capacity should be used more than 2 times of fuses rating. In case of small power capacity less than 2 times of fuses rating, the module must be evaluated enough from safety point of view.

11. INTERFACE PIN CONNECTIONS

(1) Interface connector for signal and power

Part No. : FI-SE20P-HF
 Adaptable plug : FI-SE20M
 Supplier : Japan Aviation Electronics Industry Limited (JAE)

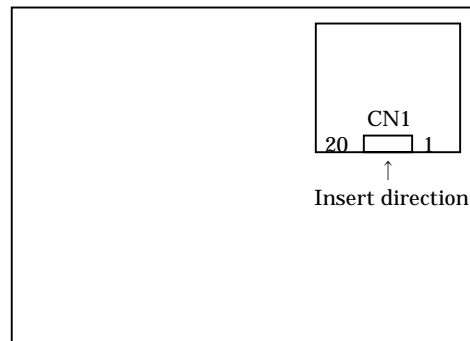
CN1 socket

Pin No.	Symbol	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 ± 5%
20	VCC		

Note 1: GND is signal ground for logic and LCD driving. GND should be connected to system ground. GND is not connected to FG (Frame Ground) in this LCD module.

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

CN1: Figure from socket view



(2) Connector for backlight unit

CN21 socket

Part No.: BHR-03VS-1

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

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

Pin No.	Symbols	Functions
1	V _{LOW1}	Up side lamp, Low voltage terminal (The cable color is gray)
2	N.C.	Non-connection
3	V _{HIGH1}	Up side lamp, High voltage terminal (The cable color is white)

CN22 socket

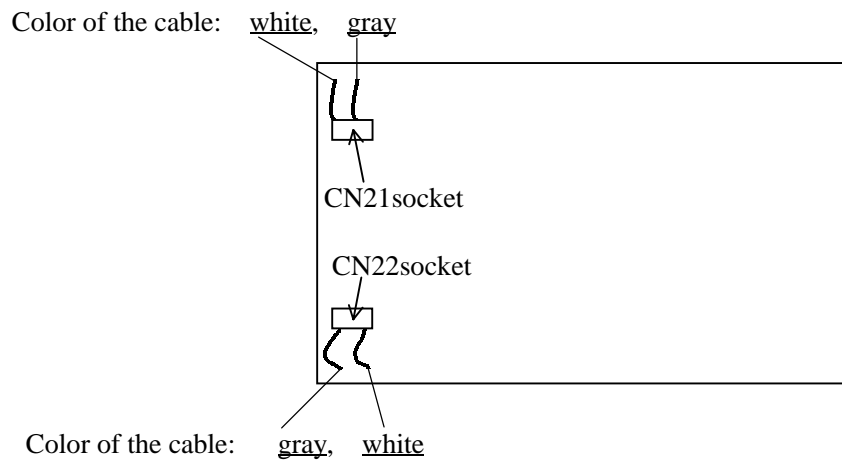
Part No.: BHR-03VS-1

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

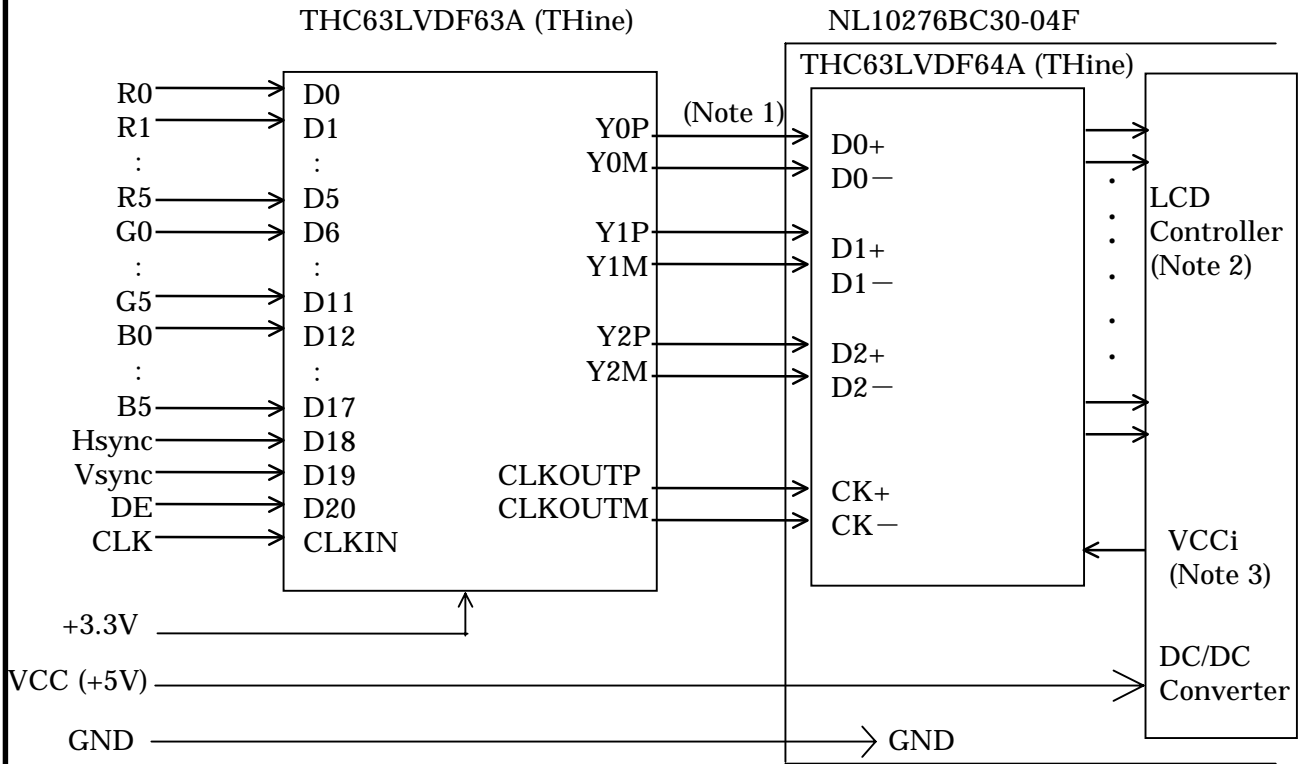
Supplier: J.S.T. TRADING COMPANY, LTD.

Pin No.	Symbols	Functions
1	V _{LOW2}	Down side lamp, Low voltage terminal (The cable color is gray)
2	N.C.	Non-connection
3	V _{HIGH3}	Down side lamp, High voltage terminal (The cable color is white)

Note: V_{HIGH} and V_{LOW} must be connected correctly. If you connect wrongly, you will get hurt and the module will be broken.



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**.

Note 3: VCCi=3.3V (LCD internal voltage)

Note 4: Shipping inspection is used THC63LVDF63A as LVDS transmitter.

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
	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	
Green 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	0	0	0	0	0	0	1	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	↑				:					:						:			
	↓				:					:						:			
	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	
Blue 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	0	0	0	0	0	0	0	0	0	0	0	0	1
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	↑				:					:						:			
	↓				:					:						:			
	bright	0	0	0	0	0	0	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	
Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	

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 × 64 × 64) colors.

14. INPUT SIGNAL TIMINGS

(1) Input signal specification for LCD controller

	Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency	1/tc	60.0	65.0	68.0	MHz	15.385ns(typ.)
	Duty	tch/tc	note 1			—	—
	Rise, fall	tcrf				ns	—
Hsync	Period	th	16.0	20.676	22.7	ms	48.363kHz(typ.)
			1110	1344	1780	CLK	
	Display period	thd	1024			CLK	—
	Front-porch	thf	0	—	—	CLK	—
	Pulse width	thp *	12	—	—	CLK	—
	Back-porch	thb *	2	—	—	CLK	—
	* thp + thb		15	—	—	CLK	—
	Hsync-CLK timing	ths	note 1			ns	—
	CLK-Hsync timing	thh				ns	—
	DE-CLK timing	tes				ns	—
	CLK-DE timing	teh				ns	—
Rise, fall	thrf	ns				—	
Vsync	Period	tv	13.3	16.666	18.5	ms	60.004Hz(typ.)
			780	806	—	H	
	Display period	tvd	768			H	—
	Front-porch	tvf	1	—	—	H	—
	Pulse width	tvp *	1	3	—	H	—
	Back-porch	tvb *	1	—	—	H	—
	* tvp + tvb		3	—	—	H	—
	Vsync-Hsync timing	tvS	1	—	—	CLK	—
	Hsync-Vsync timing	tvh	1	—	—	CLK	—
Rise, fall	tvrf	note 1			ns	—	
DATA	DATA-CLK (Set up)				Tds	ns	—
	CLK-DATA (Hold)				Tdh	ns	—

Note 1: These values are in the timing standard of THC63LVDF63A.
Timing standard prescribes in the input of LVDS transmitter.
THC63LVDF63A is recommended in LVDS transmitter.

(2) Input signal of LVDS LECEIVER (It is prescribed in the part CN1 input)

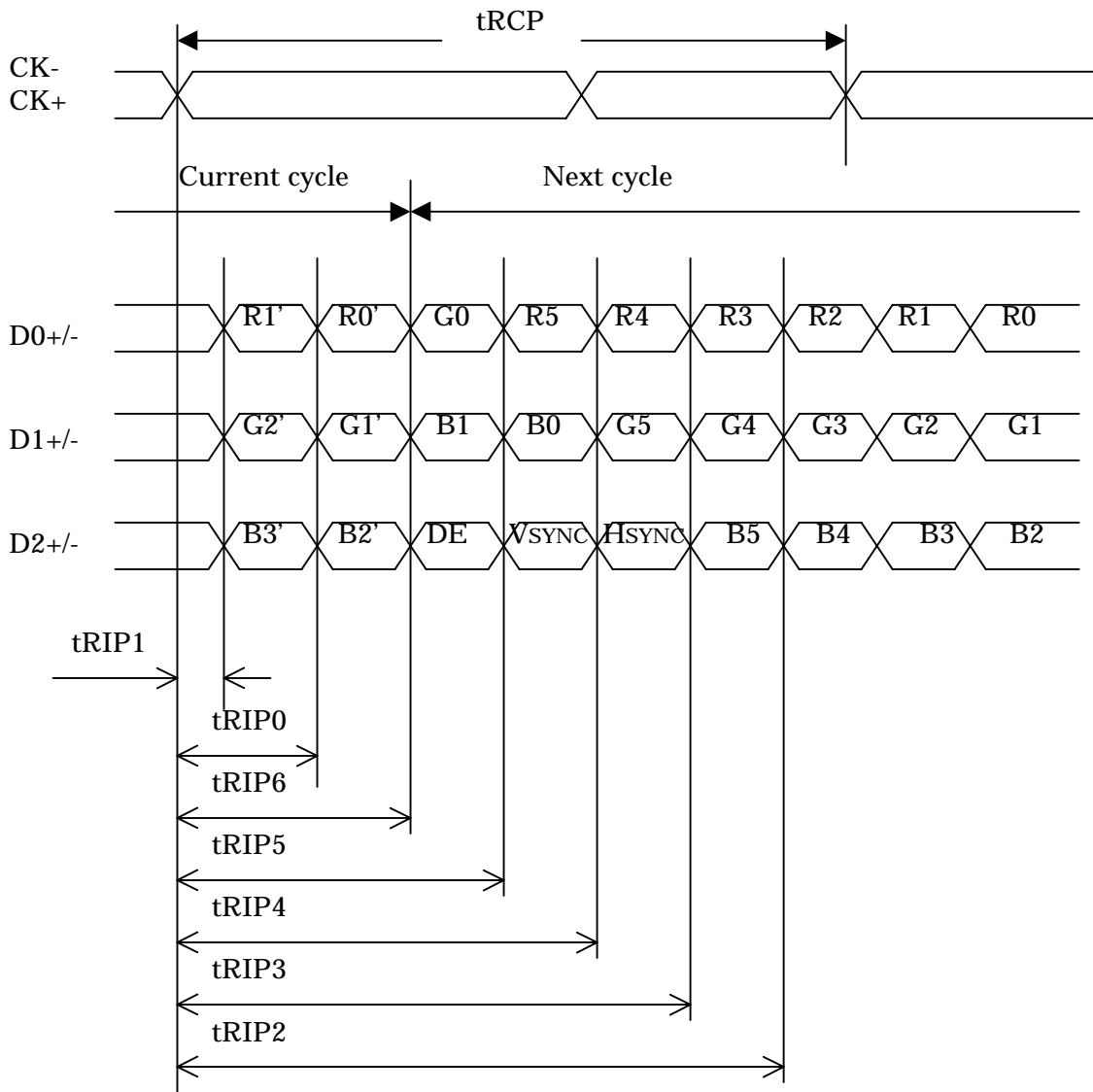
Parameter	Symbol	min.	typ.	max.	Unit	Remarks
CLK Frequency	TRCP	14.71	T	16.66	ns	—
Bit0 position	TRIP1	-0.5	0	0.5	ns	T=15.38ns
Bit1 position	TRIP0	T/7-0.5	T/7	T/7+0.5	ns	T=15.38ns
Bit2 position	TRIP6	2T/7-0.5	2T/7	2T/7+0.5	ns	T=15.38ns
Bit3 position	TRIP5	3T/7-0.5	3T/7	3T/7+0.5	ns	T=15.38ns
Bit4 position	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 1: See the specifications of LVDS manufactures for detailed design.

In case that CLK jitter value between current cycle and next cycle is big, skew time of the next cycle decreases with the value of the jitter.

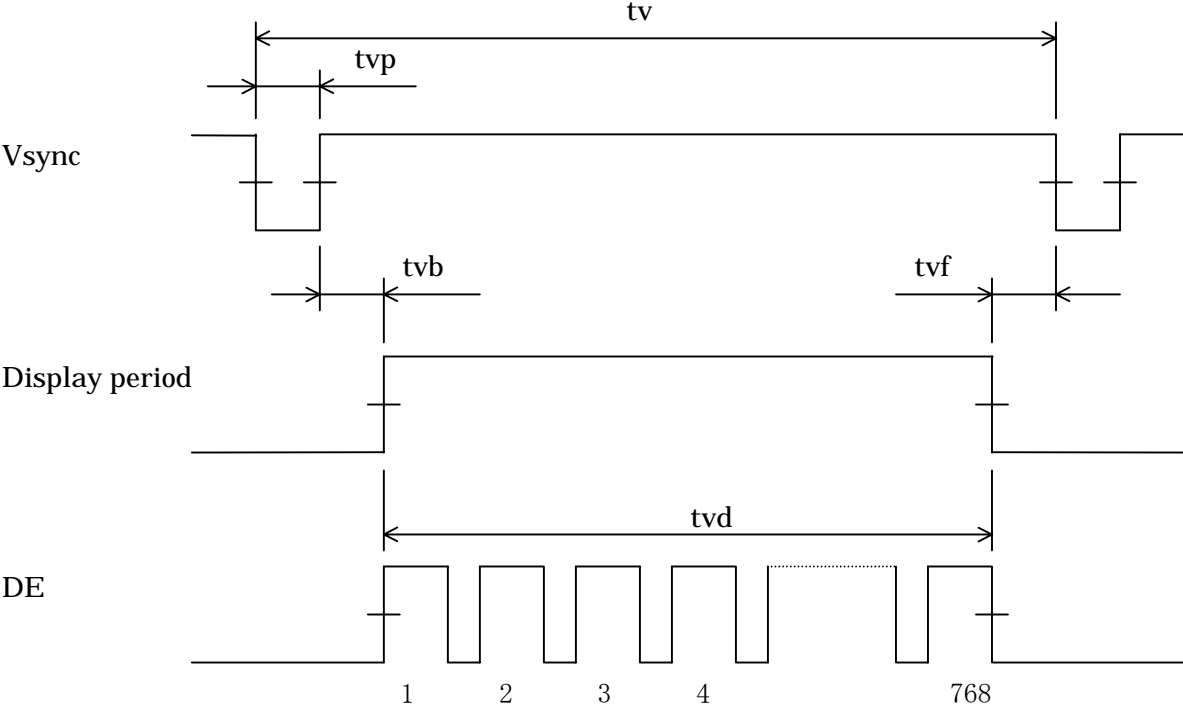
$$\text{CLK jitter} + \text{LVDS output skew} + \text{cable skew} \leq 500\text{ps}$$

e. q. LVDS output skew: $\pm 200\text{ps}$
 Cable skew: $\pm 100\text{ps}$ } acceptable CLK jitter $\pm 200\text{ps}$ ($500 - (200 + 100) = 200\text{ps}$)

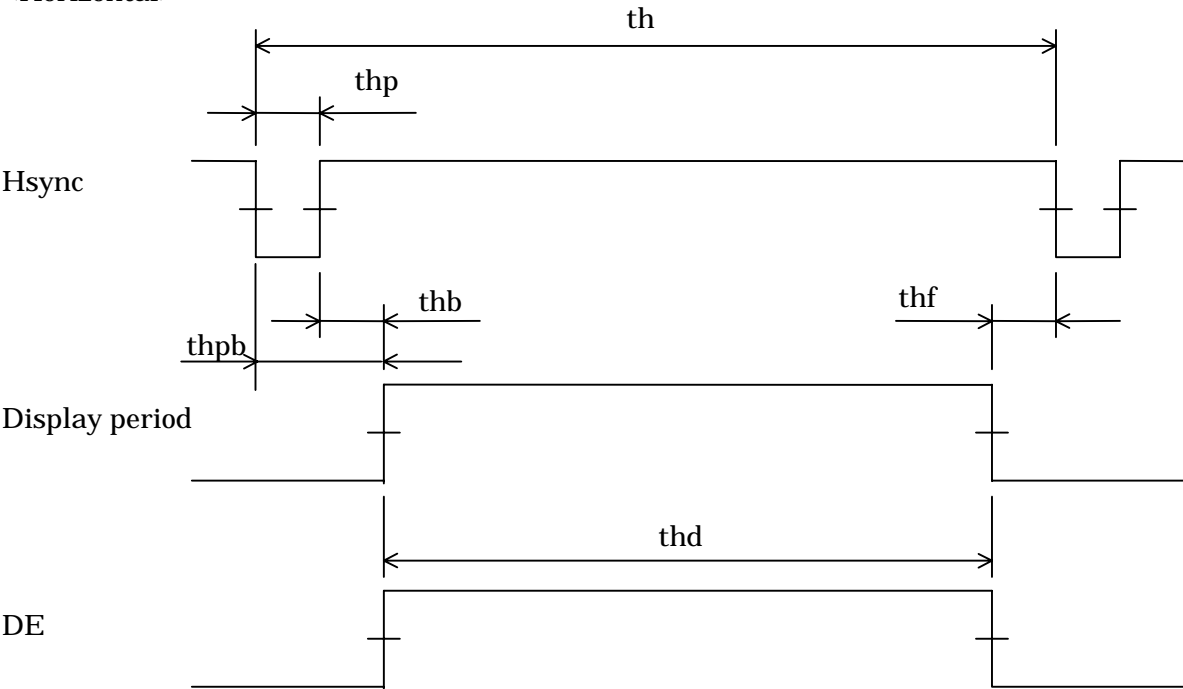


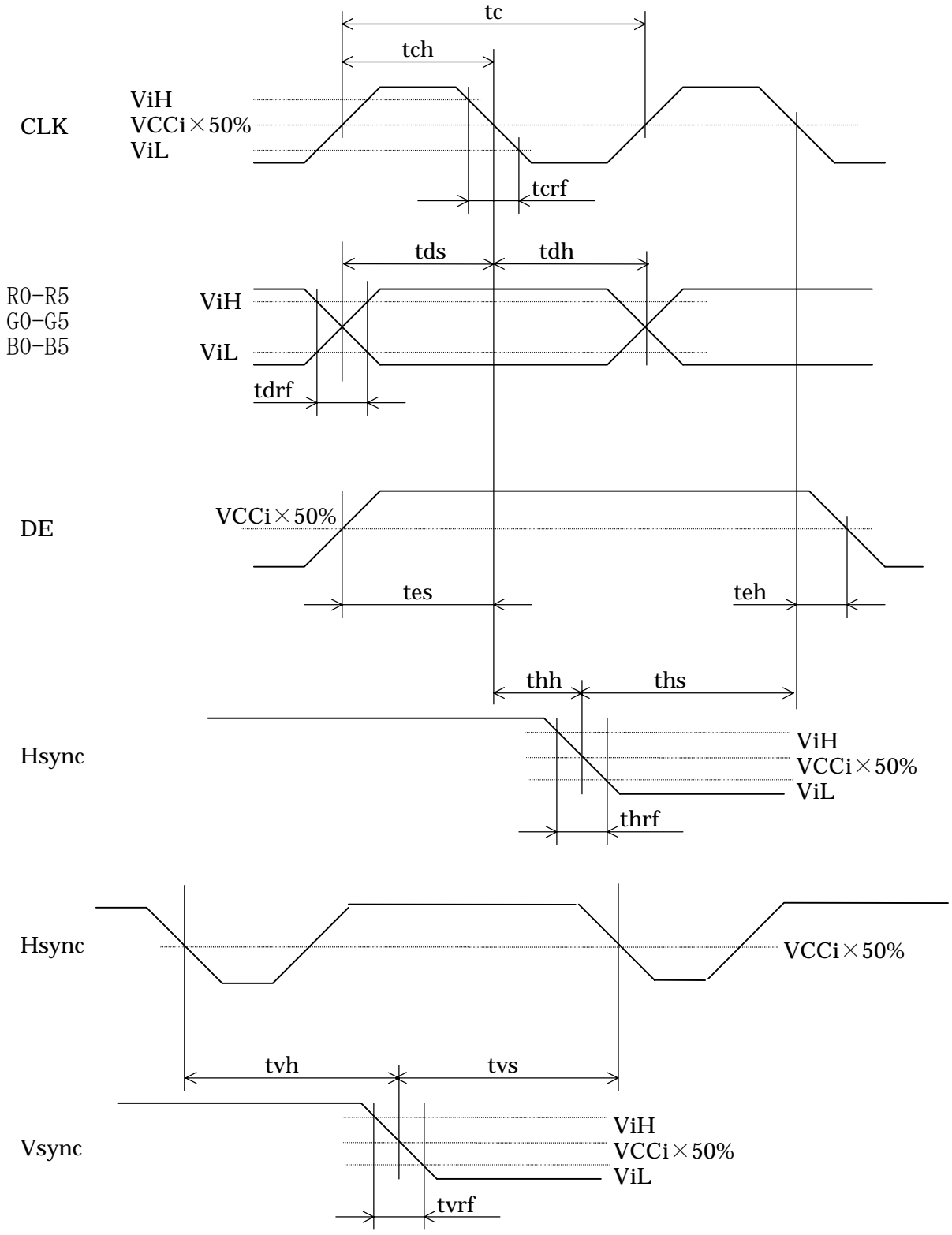
(3) Definition of input signal timing for LCD controller

<Vertical>



<Horizontal>

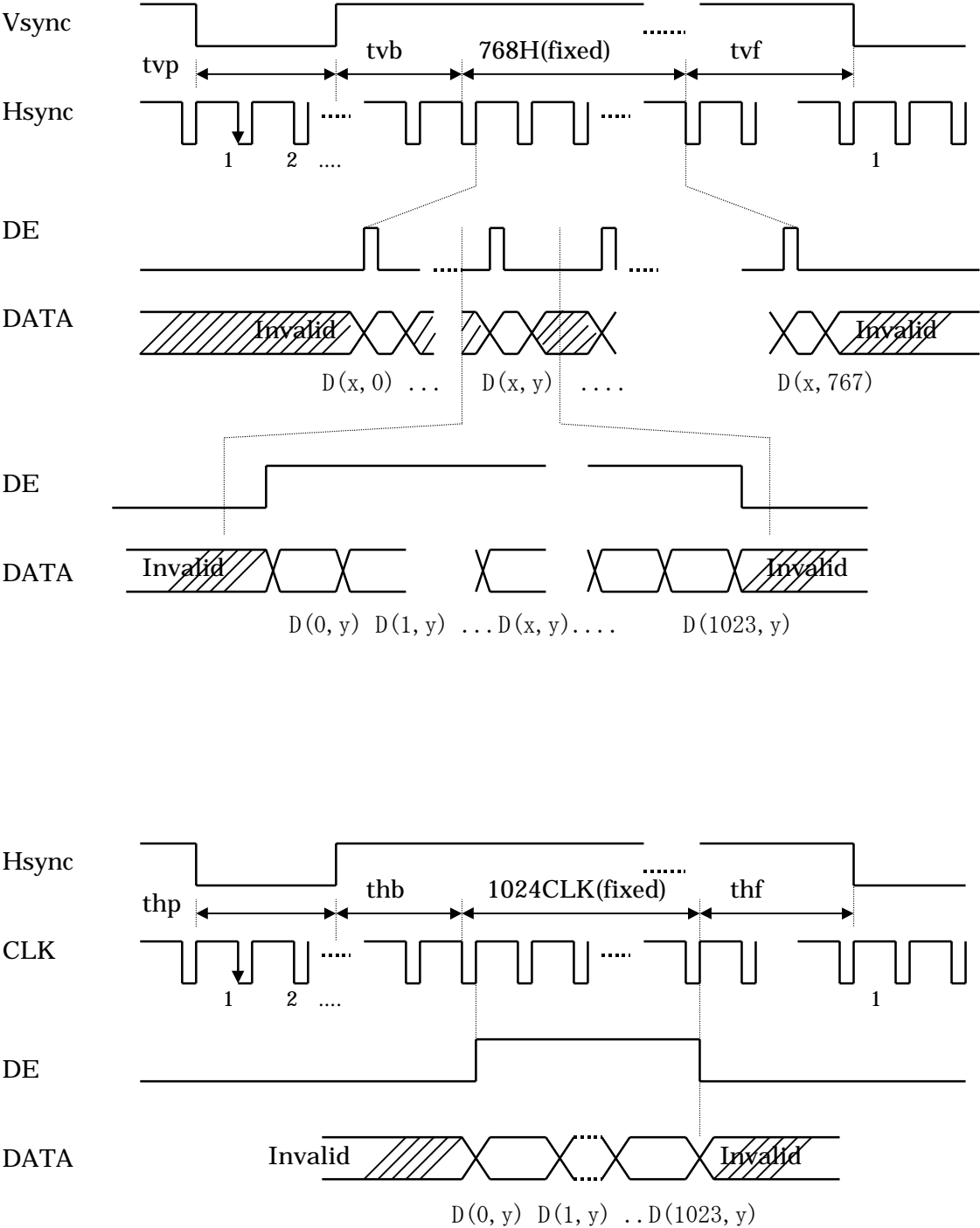




$V_{iH} = V_{CCi} \times 0.7(\text{Min.})$
 $V_{iL} = V_{CCi} \times 0.3(\text{Max.})$

note 1: $V_{CCi} = 3.3V$ (LCD internal voltage)

(4) Input signal timing chart for LCD



note 1: These values are in the output of THC63LVDF64A.
 (Refer to 12. METHOD OF CONNECTION FOR THC63LVDF63A).

(5) Display position of input data

D(0, 0)	D(1, 0)	...	D(X, 0)	...	D(1023, 0)
D(0, 1)	D(1, 1)	...	D(X, 1)	...	D(1023, 1)
•	•	•	•	•	•
•	•	•••	•	•••	•
•	•	•	•	•	•
D(0, Y)	D(1, Y)	...	D(X, Y)	...	D(1023, Y)
•	•	•	•	•	•
•	•	•••	•	•••	•
•	•	•	•	•	•
D(0,767)	D(1,767)	...	D(X,767)	...	D(1023,767)

15. OPTICAL CHARACTERISTICS

(Ta = 25°C, VCC=5V, IL=6.5mArms, Note 1)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Contrast ratio	CR	White / Black	80	200	—	—	Note 2
Luminance	Lumax	“White”	150	200	—	cd/m ²	Note 5
Luminance uniformity	—	max. / min.	—	—	1.30	—	Note 6

Reference data

(Ta=25°C, VCC=5V, IL=6.5mArms, Note 1)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks	
Contrast ratio	CR	Best contrast angle θR=0°, θL=0°, θD=5° White / Black, at center	-	450	-	-	Note 2	
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	-	-	-	
Color gamut	C	θR=0°, θL=0°, θU=0°, θD=0°, at center, to NTSC	35	40	-	%	-	
Viewing angle range (CR>10)	θ R	CR > 10, White/Black	50	60	-	deg.	Note 3	
	θ L	θU=0°, θD=0°	50	60	-	deg.		
	θ U	CR > 10, White/Black	30	40	-	deg.		
	θ D	θR=0°, θL=0°	35	50	-	deg.		
Viewing angle range (CR>5)	θ R	CR > 5, White/Black	-	80	-	deg.	Note 3	
	θ L	θU=0°, θD=0°	-	80	-	deg.		
	θ U	CR > 5, White/Black	-	60	-	deg.		
	θ D	θR=0°, θL=0°	-	65	-	deg.		
Response time	Ton	White to Black	(100%→10%)	-	15	40	ms	Note 4
			(90%→10%)	-	TBD	-		
	Toff	Black to White	(0%→90%)	-	40	80		
			(10%→90%)	-	TBD	-		
Luminance control range	—	Maximum luminance: 100%	-	30 to 100	-	%	-	

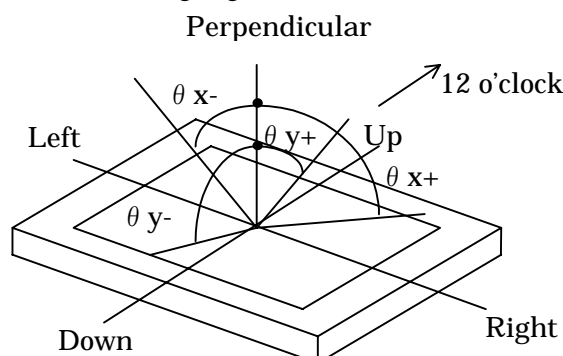
Note 1: Viewing angle is $\theta x = \pm 0^\circ$, $\theta y = \pm 0^\circ$. at center.

Note 2: The contrast ratio is calculated by using the following formula.

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

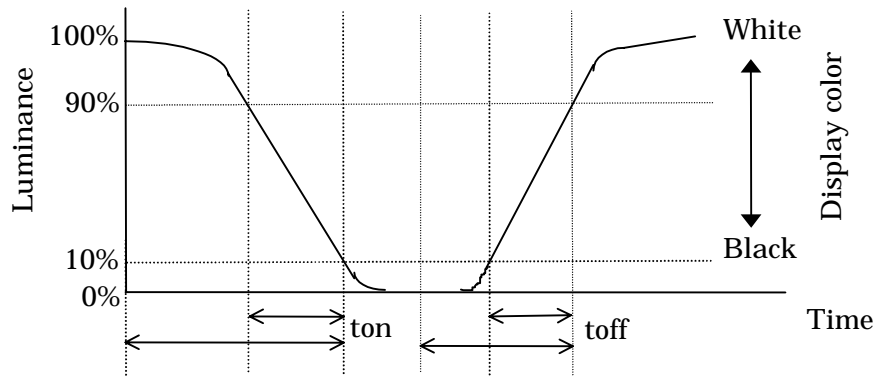
The luminance is measured in a darkroom.

Note 3: Definitions of viewing angle are as follows.

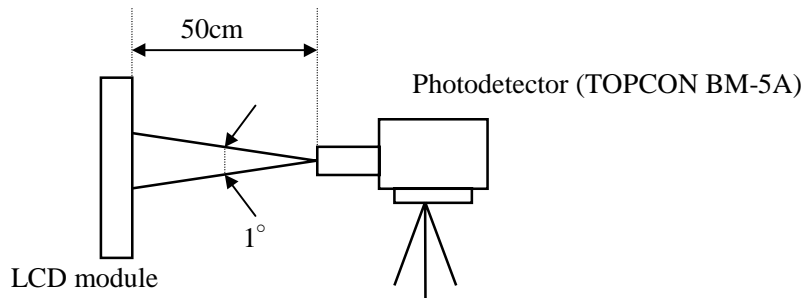


Note 4: Definition of response time is as follows.

Photo-detector output signal is measured when the luminance changes “white to black” or “black to white”.



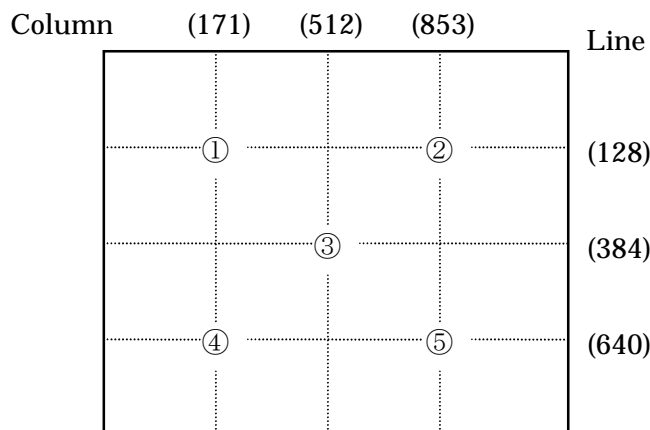
Note 5: The luminance is measured after 20 minutes from the module works, with all pixels in “white”.



Note 6: The luminance uniformity is calculated by using following formula.

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

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



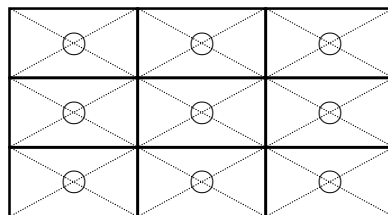
16. RELIABILITY TEST

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

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

*2: Physical damage

*3: Discharge points are shown in the figure.



17. ESTIMATED LIFE-TIME OF THE BARE LAMP

	Bare lamp
Conditions	Luminance Maximum Room temp. (25±2°C), Continuous operation
MTTF	40,000h
Criteria	Half value luminance (compared with initial value.)

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


Note 2: Chromaticity coordinates change after the expected lifetime.



Note 3: This estimated value is based on the test results with a bare lamp operation. The MTTF for the module may be different from these values, because of the influence of ambient and clamshell conditions.

Note 4: The lifetime becomes short if the module is operated under the low temperature environment.


18. GENERAL CAUTIONS

Because 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 a caution label is stucked— while the LCD module is under the operation, because of dangerous high voltage.
---	--

- (1) Caution when taking out the module
 - a. Pick a pouch only, when taking out the module from a carrier box.
- (2) Cautions for handling the module
 - a. As the electrostatic discharges may break the LCD module, handle the LCD module with care against electrostatic discharges.
 - b.

	As the LCD panel and backlight element are made from fragile glass material, impulse and pressure to the LCD module should be avoided.
---	--
 - c. As the surface of polarizer is very soft and easily scratched, use a soft dry cloth without chemicals for cleaning.
 - d. Do not pull the interface connectors in or out while the LCD module is operating.
 - e. Put the module display side down on a flat horizontal plane.
 - f. Handle connectors and cables with care.
 - g. When the module is operating, do not lose CLK, HS, or Vsync signal. If any one or more of these signals is lost, the LCD panel would be damaged.
 - h. The torque for mounting screw should never exceed 0.392 N · m (4kgf · cm).
 - i. Don't push or rub the surface of LCD module.
If you do, the scratches or the rubbing marks may be left on the surface of the module.
 - j. The LCD module should be mounted in strong body such as magnesium alloy. If the press or twist are added to the module, the display may have un-uniformity image. When the module is mounted to customer chassis, please evaluate the display condition carefully.
 - k. Do not give the stress to interface connectors. The module may become function deficiency by a contact defective and damages. Pay attention to handling at the time of matching connector connection and in the connection condition.

(3) Cautions for the atmosphere

- a. Dew drop atmosphere must be avoided.
- b. 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.
- c. This module uses cold cathode fluorescent lamps. Therefore, the life of lamps becomes short if the module is operated in the low temperature environment.
- d. Do not operate the LCD module in high magnetic field.

(4) Cautions for the module characteristics

- a. Do not apply any fixed patterns for a long time to the LCD module. It may cause image sticking. Please use the screen savers if the display pattern is fixed for a long time.
- b. 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.
- c. The light vertical stripe may be observed depending on the display pattern. This is not defects nor malfunctions.
- d. The noise from the inverter circuit may be observed in the luminance control mode. This is not defects nor malfunctions.

(5) Cautions for assembling of an inverter

- a. Please insert an insulation sheet between the inverter and the mold chassis when the inverter is assembled to the mold chassis. If you do not insert the insulation sheet, electric discharge may occur from the inverter to the module.
Before 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
Thickness of the insulation sheet	: t0.4
Material	: Polyethylene terephthalate (UL class: 94V-0)

(6) Other cautions

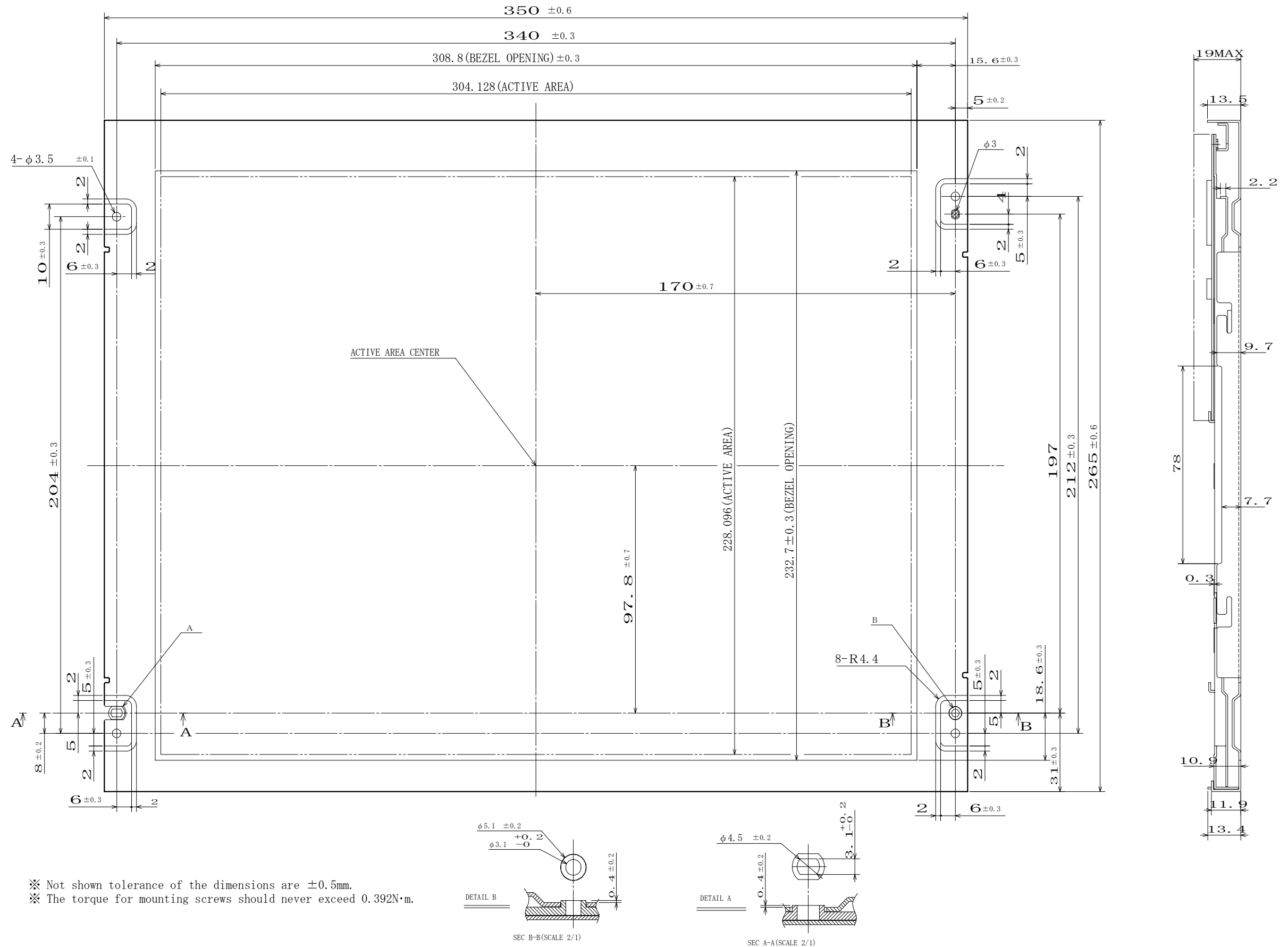
- a. Do not disassemble and/or reassemble LCD module.
- b. Do not readjust any variable resistors or switches in the module.
- c. When returning the module for repair or etc., please pack the module properly to avoid any damages. We recommend using the original shipping packages.

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

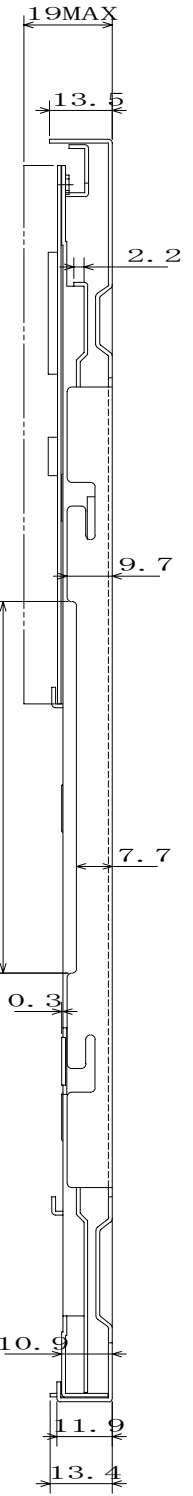
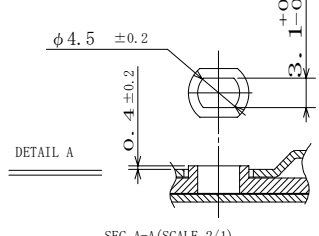
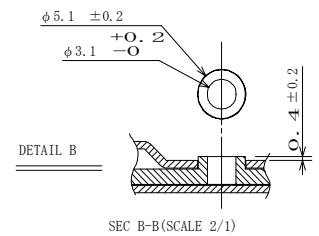
The ambient temperature may affect the optical characteristics of this module.
This module has cold cathode tube for backlight. Optical characteristics, like luminance or uniformity, will be changed by the progress in time.

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

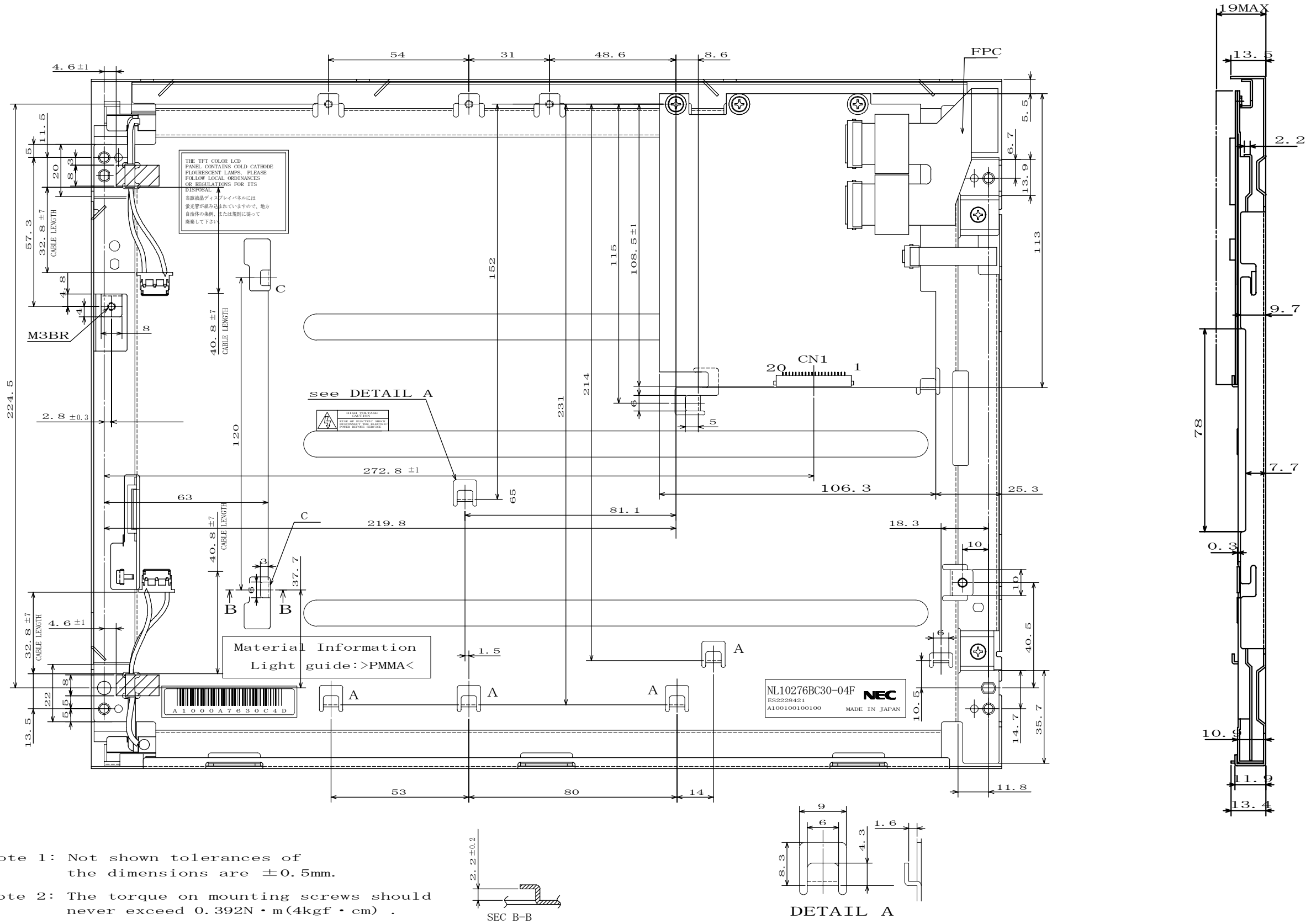
19.OUTLINE DRAWINGS
19.1 Front view (Unit: mm)



※ Not shown tolerance of the dimensions are ±0.5mm.
 ※ The torque for mounting screws should never exceed 0.392N·m.

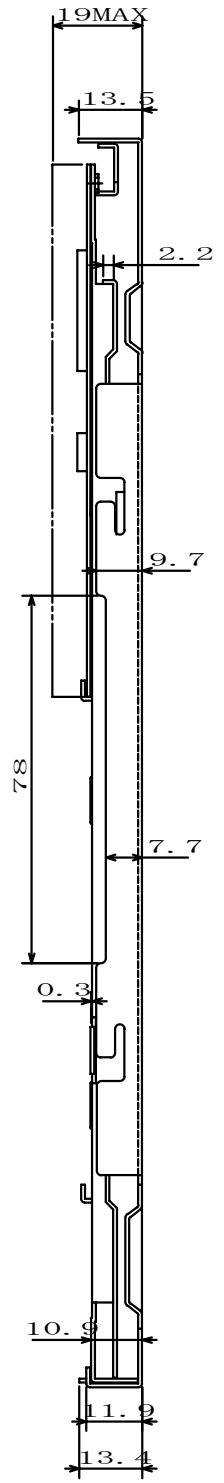
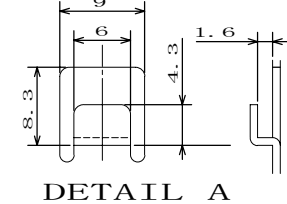
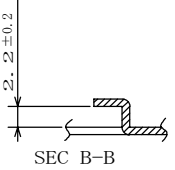


20.2 Rear view



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

Note 2: The torque on mounting screws should never exceed $0.392\text{N} \cdot \text{m}$ ($4\text{kgf} \cdot \text{cm}$).



Revision History				DOD-M-0002		26/26
Rev.	prepared date	Revision contents	Approved	Checked	Prepared	Issued date
1	Dec. 6, 2000	DOD-H-8238	<i>Aburatsubo</i>	<i>T. Kusanagi</i>	<i>N. Kano</i>	—
2	Dec. 12, 2000	DOD-M-0002 P.5 CHARACTERISTICS <ul style="list-style-type: none"> • 20.0 mm typ. → 18.0 mm typ. • “at IL=6.5mA” is added. • DE is added. • in a holder → in two holders • 12V (Backlight) is deleted. • 5.8W → 10.1W P.6 • BLOCK DIAGRAM Note 1 is corrected. <ul style="list-style-type: none"> • GENERAL SPECIFICATIONS 20.5 mm (max.) → 19.0 mm (max.) P.7 ABSOLUTE MAXIMUM RATINGS is corrected. P.8 ELECTRICAL CHARACTERISTICS (2) Backlight and (3) Fuse are corrected. P.9 Figure of CN1 is corrected. P.10 Connector for backlight unit is corrected. P.19 OPTICAL CHARACTERISTICS IL=6.5mArms is added. P.25 Rear view is corrected.	<i>Aburatsubo</i>		<i>N. Kano</i>	