NEC

TFT COLOR LCD MODULE

Type: NL6448BC63-01
51cm (20.1 Type), VGA

SPECIFICATIONS

(First Edition)

PRELIMINARY

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

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1. DESCRIPTION

NL6448BC63-01 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.
NL6448BC63-01 has a built-in backlight. The backlight includes long-life-lamps and the lamps are replaceable with a backlight unit.

The 51cm(20.1" Type) diagonal display area contains 640×480 pixels and can display equivalent to 16.7 million colors simultaneously.

NL6448BC63-01 is suitable for industrial application use because the viewing angle is wide and the luminance is high. Also, the viewing direction is selectable either up or down side by changing scan direction.

2. FEATURES

- High luminance (500cd/m^2 Typ.: saturated value, at room temp.)
- Wide viewing angle (with Retardation film)
- Low reflection
- Reversible scan direction (with R/L and U/D terminals)
- Best viewing angle select function (with MVA terminal)
- Backlight with twenty long-life-time lamps.
- Replaceable backlight unit (Type No.:TBD)
- Recommended inverter (Part No.:TBD)
- 8-bit digital RGB signals
- Data enable function

3. APPLICATIONS

- Display terminals for control system
- Monitors

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 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. OUTLINE OF CHARACTERISTICS (at room temperature)

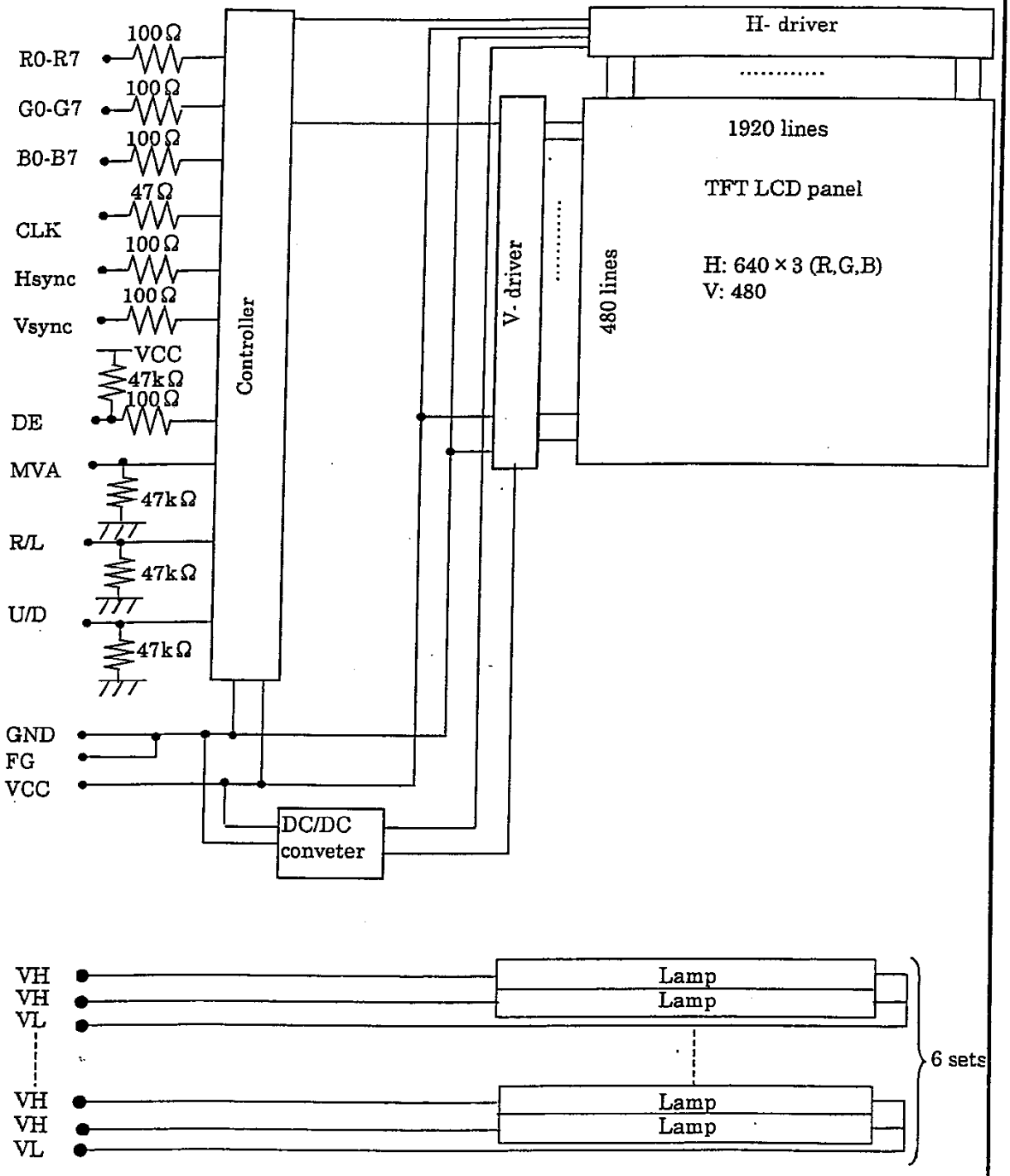
Display area	408.0 (H) × 306.0 (V) mm
Drive system	a-Si TFT active matrix
Display colors	Equivalent to 16.7 million colors
Number of pixels	640 × 480
Pixel arrangement	RGB vertical stripe
Pixel pitch	0.6375 (H) × 0.6375 (V) mm
Module size	448.0 (H) × 348.0 (V) × 27.1 Max. (D) mm
Weight	2120 g (Typ.)
Contrast ratio	300:1 (Typ.)

Viewing angle (more than the contrast ratio of 10:1)
- Horizontal: 60° (Typ. , left side, right side)
- Vertical: 40° (Typ. , up side) , 50° (Typ. , down side)

Designed viewing direction
- wider viewing angle without image reversal: up side (12 o'clock, normal scan)
- wider viewing angle with contrast ratio: down side (6 o'clock, normal scan)
- optimum grayscale (γ =2.2): perpendicular

Polarizer surface	Antiglare treatment
Polarizer pencil-hardness	3H (Min., at JIS K5400)
Color gamut	60% (Typ., At center, To NTSC)
Response time	TBD (Typ.) , " white " to "black"
Luminance	500 cd/m^2 (Typ.)
Signal system	8-bit digital signals for each of RGB primary colors, Synchronous signals (Hsync, Vsync), Dot clock (CLK)
Supply voltage	3.3V (Logic, LCD driving)
Backlight	Direct light type: twenty cold fluorescent lamps (cold cathode type) 【Replaceable parts】 Backlight unit: type No. TBD
Power consumption	TBD (Typ. , at 3.3V)

6. BLOCK DIAGRAM



Note 1: GND is connected to FG (Frame ground).

7. SPECIFICATIONS

7.1. GENERAL SPECIFICATIONS

Items	Specifications	Unit
Module size	448.0±1.0 (H) × 348.0±1.0 (V) × 27.1 Max. (D) Note 1	mm
Display area	408.0 (H) × 306.0 (V)	mm
Number of pixels	640 (H) × 480 (V)	pixel
Dot pitch	0.2125 (H) × 0.6375 (V)	mm
Pixel pitch	0.6375 (H) × 0.6375 (V)	mm
Pixel arrangement	RGB (Red, Green, Blue) vertical stripe	—
Display colors	Equivalent to 16.7 million	color
Weight	2300 (Max.)	g

Note 1: Except the signal circuit board.

7.2. ABSOLUTE MAXIMUM RATINGS

Parameters	Symbols	Ratings	Unit	Remarks
Supply voltage	VCC	-0.3 to 6.5	V	Ta=25℃
Input voltage	VI	-0.3 to VCC + 0.3	V	
Lamp voltage	VL	2100	Vrms	—
Storage temp.	Tst	-20 to 60	℃	—
Operation temp.	Top	0 to 50	℃	module surface Note 1
Relative humidity Note 2		≤95	%	Ta ≤ 40 ℃
		≤85	%	40< Ta ≤ 50 ℃
Absolute humidity Note 2		Absolute humidity shall not exceed Ta=50℃, RH= 85%	g/m^3	Ta > 50 ℃

Note 1: Measure at the panel surface.
Note 2: No condensation

7.3. ELECTRICAL CHARACTERISTICS

(1) Logic, LCD driving (Ta=25℃)

Parameters	Symbols	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	VCC	3.0	3.3	3.6	V	VCC=3.3V
Logic input " L " voltage	VIL	0	—	VCC×0.3	V	CMOS level
Logic input " H " voltage	VIH	VCC×0.7	—	VCC	V	
Supply current	ICC	—	TBD Note 1	TBD	mA	VCC=3.3V

Note 1: Checkered flag pattern (in EIAJ ED-2522)

(2)Backlight

Parameters	Symbols	Min.	Typ.	Max.	Unit	Remarks
Lamp current	IL	2.0	4.0	4.5	mArms	With one lamp
Lamp voltage	VL	—	850	—	Vrms	—
Lamp turn on voltage	VS	1060	—	—	Vrms	Ta=25℃
		1380	—	—		Ta= 0℃
Oscillator frequency	Ft	52	56	60	kHz	Note 1

Note 1: Recommended value of "Ft".

- Ft is within the specification.

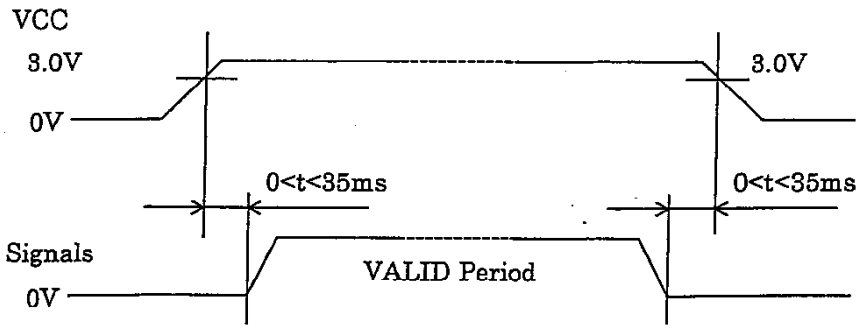
and

- Ft = 1/4Th × (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.

7.4. SUPPLY VOLTAGE SEQUENCE



Signals: CLK, Hsync, Vsync, DE, R0-R7, G0-G7, B0-B7, MVA, RL and UD

Note 1:The supply voltage for input signals should be the same as VCC.
Note 2: Apply VH 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 3: When the power is off, please keep whole signals (Hsync, Vsync, CLK, DE, R0-R7, G0-G7, and B0-B7) low level or high impedance.
Note 4: Wrong power sequence is not may damaged to the module.
Note 5: The signal must not be down during operation. Even if signal coule recover, LCD module may not be operated correctly or the display may have unevenness. In case of signal down, VCC should be turned off and then turn VCC and signals on as above sequence.

7.5. INTERFACE PIN CONNECTIONS

(1) Interface signals, power supply

Module side connector

CN1: 04 6240 040 003 800 (KYOCERA ELCO CORPORATION)

Pin No.	Symbols	Function	Pin No.	Symbols	Function
1	GND	Ground	21	G6	Green data
2	CLK	Dot clock	22	G7	Green data (MSB)
3	Hsync	Horizontal sync.	23	GND	Ground
4	Vsync	Vertical sync.	24	B0	Blue data (LSB)
5	GND	Ground	25	B1	Blue data
6	R0	Red data (LSB)	26	B2	Blue data
7	R1	Red data	27	B3	Blue data
8	R2	Red data	28	B4	Blue data
9	R3	Red data	29	B5	Blue data
10	R4	Red data	30	B6	Blue data
11	R5	Red data	31	B7	Blue data (MSB)
12	R6	Red data	32	GND	Ground
13	R7	Red data (MSB)	33	DE	Data enable
14	GND	Ground	34	VCC	Power supply
15	G0	Green data (LSB)	35	VCC	Power supply
16	G1	Green data	36	MVA	Best viewing select
17	G2	Green data	37	R/L	Scan direction select
18	G3	Green data	38	U/D	Scan direction select
19	G4	Green data	39	N.C.	Non-connection
20	G5	Green data	40	GND	Ground

LSB: Least Significant Bit

MSB: Most Significant Bit

Note 1) VCC: All VCC terminals should be connected to 3.3V.

Note 2) DE: This function recognizes Fixed or DE mode when Vsync rise.

Data enable signal = DE mode

"High" = Fixed mode

Note 3) MVA: MVA changes best viewing angle at gray scale screen.

"High" = Down side (best viewing angle: -10 °)

"Low" or "open" = Perpendicular (best viewing angle: 0 °)

Note 4) RL: can change scan at horizontal direction (normal scan and reverse scan).

"High" = normal scan

"Low" or "open" = reverse scan (at horizontal direction)

See 7-8 DISPLAY POSITION about another way for reversible scans.

Note 5) UD: can change scan at vertical direction (normal scan and reverse scan).

"High" = normal scan

"Low" or "open" = reverse scan (at vertical direction)

See 7-8 DISPLAY POSITION about another way for reversible scans.

(2) Backlight

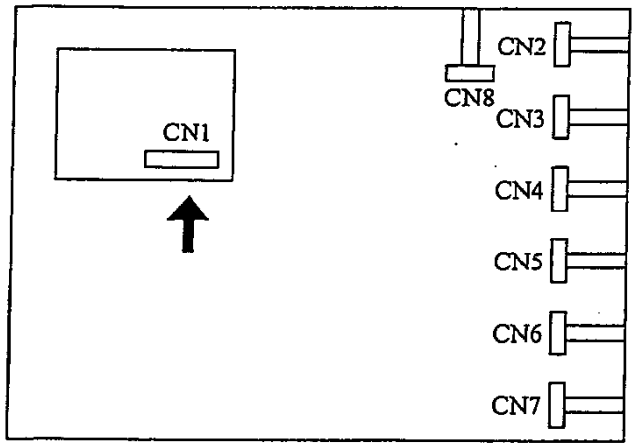
CN2, 3, 4, 5, 6, 7: BHR-03-VS-1 (J.S.T TRADING COMPANY, LTD.)
Adaptable socket: SM03 (4.0) B-BHS-TB (J.S.T TRADING COMPANY, LTD.)

Pin No.	Symbols	Functions
1	VH	Power supply (high)
2	N.C.	Non-connection
3	VH	Power supply (high)

CN8: ZHR-2 (J.S.T TRADING COMPANY, LTD.)
Adaptable socket: B 2B-ZR (J.S.T TRADING COMPANY, LTD.)
S 2B-ZR (J.S.T TRADING COMPANY, LTD.)

Pin No.	Symbols	Functions
1	VL	Power supply (low)
2	VL	Power supply (low)

(3) Connector locations



7.6. DISPLAY COLORS vs. INPUT DATA SIGNALS

Display colors		Data signal (0: Low level, 1: High level)																									
		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 colors	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
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	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	1	1	1	1	0	0	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	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	0
		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑				:	.							:								:				
	↓				:								:								:				
	bright	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	↑				:								:								:				
	↓				:								:								:				
	bright	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	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	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	0	0	0	0	0	0	1	0
	↑				:								:								:				
	↓				:								:								:				
	bright	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

Note 1: The combination of 8-bit signals (256-grayscale level) results in equivalent to 16.7 million colors.

7.7. INPUT SIGNAL TIMINGS

(1) Input signal specifications (DE mode is default)

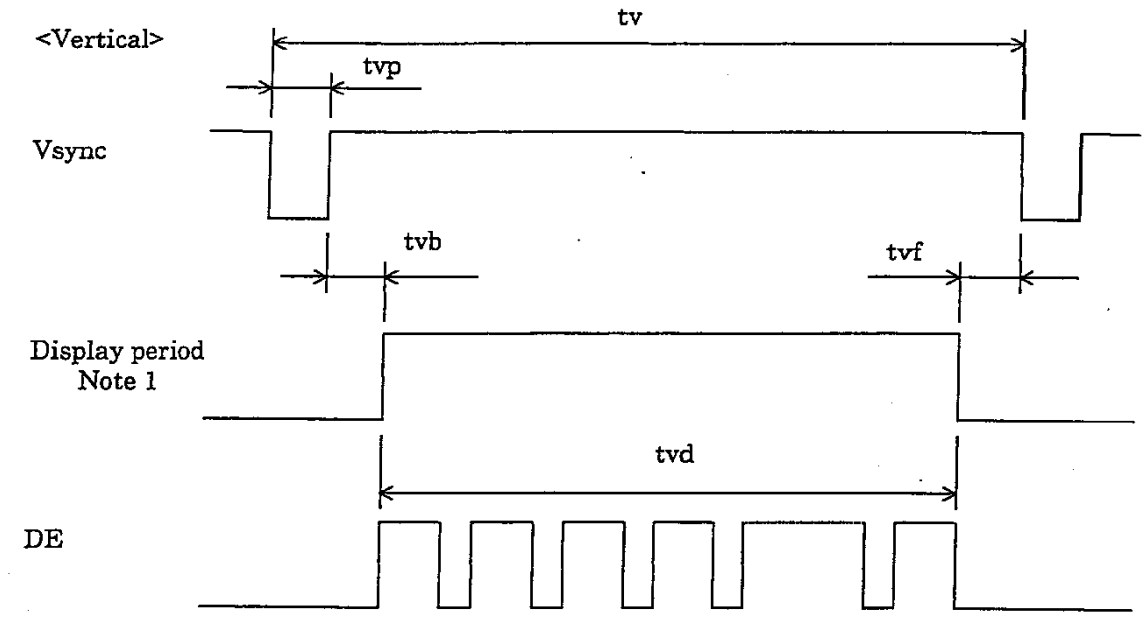
Parameters		Symbols	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency	1/tc	—	25.175	—	MHz	39.72ns(Typ.)
	Duty	tch/tc	0.4	0.5	0.6	—	—
	Rise, fall	tcrf	—	—	10	ns	—
Hsync	Period	th	30.0	31.778	33.6	μs	31.468kHz(Typ.)
			—	800	—	CLK	
	Display period	thd		640		CLK	—
	Front-porch	thf	—	16	—	CLK	Fixed mode
			2	16	—	CLK	DE mode
	Pulse width	thp *	10	96	—	CLK	Fixed mode
			10	96	—	CLK	DE mode
	Back-porch	thb *	—	48	134	CLK	Fixed mode
			5	48	—	CLK	DE mode
	*) thp + thb			144		CLK	Fixed mode
			15	144	—	CLK	Adjustable range by DE signal
	CLK-Hsync timing	thch	12	—	—	ns	—
	Hsync-CLK timing	thcs	8	—	—	ns	—
	Hsync-Vsync timing	thv	1	—	—	CLK	—
	Vsync-Hsync timing	tvh	30	—	—	ns	—
	Rise, fall	thrf	—	—	10	ns	—
Vsync	Period	tv	16.1	16.683	17.2	ms	59.94Hz(Typ.)
			—	525	—	H	
	Display period	tvd		480		H	—
	Front-porch	tvf	—	12	—	H	Fixed mode
			1	12	—	H	DE mode
	Pulse width	tvp*	1	2	—	H	Fixed mode
			1	2	—	H	DE mode
	Back-porch	tvb*	—	31	—	H	Fixed mode
			4	31	—	H	DE mode
	*) tvp + tvb		—	33	—	H	Fixed mode
			5	33	—	H	DE mode
	Rise, fall	tvrf	—	—	10	ns	—
DATA	CLK-DATA timing	tds	8	—	—	ns	—
	DATA-CLK timing	tdh	12	—	—	ns	
	Rise, fall	tdrf	—	—	10	ns	
DE	DE-CLK timing	tes	8	—	—	ns	DE mode
	CLK-DE timing	teh	12	—	—	ns	
	Rise, fall	terf	—	—	10	ns	

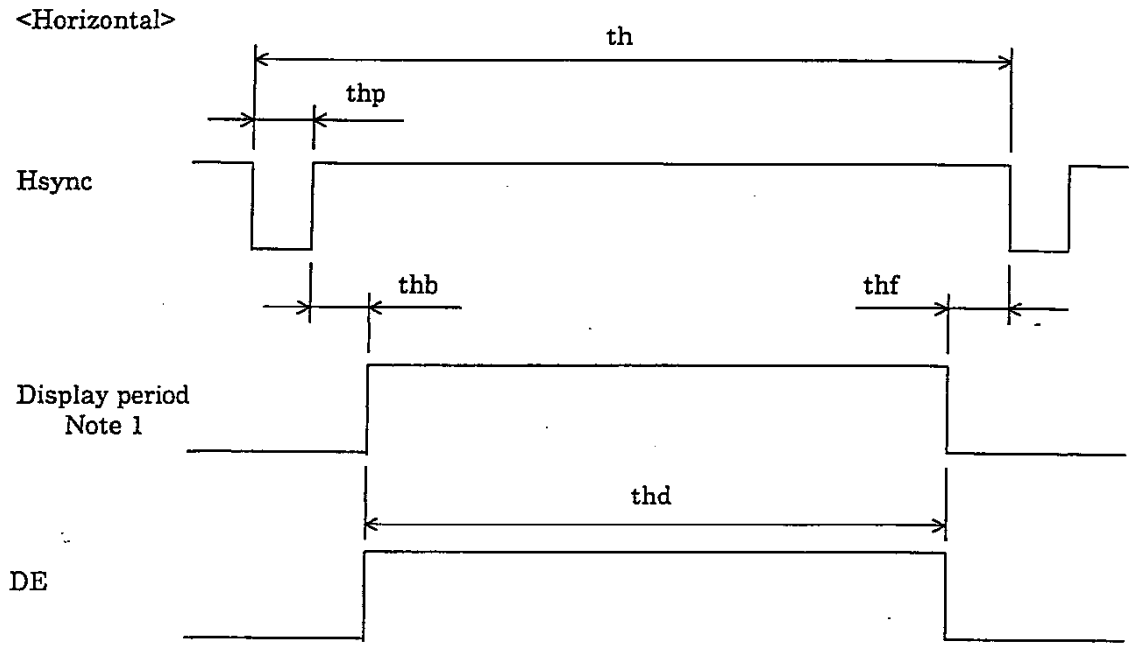
Remark 1: All parameters should be kept within the specified range.

Remark 2: 1CLK=39.722ns

1H=th

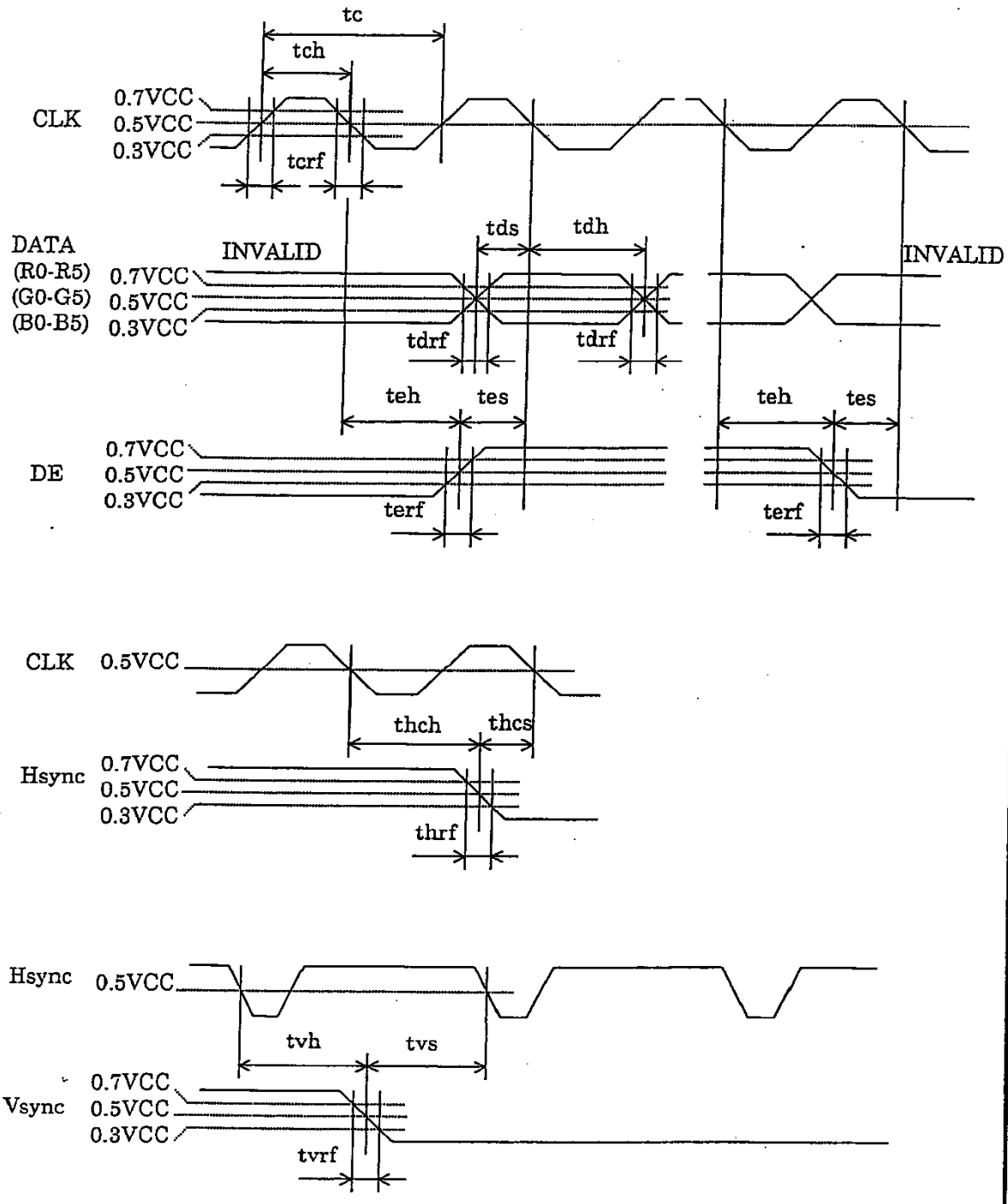
(2) Definition of input signal timings



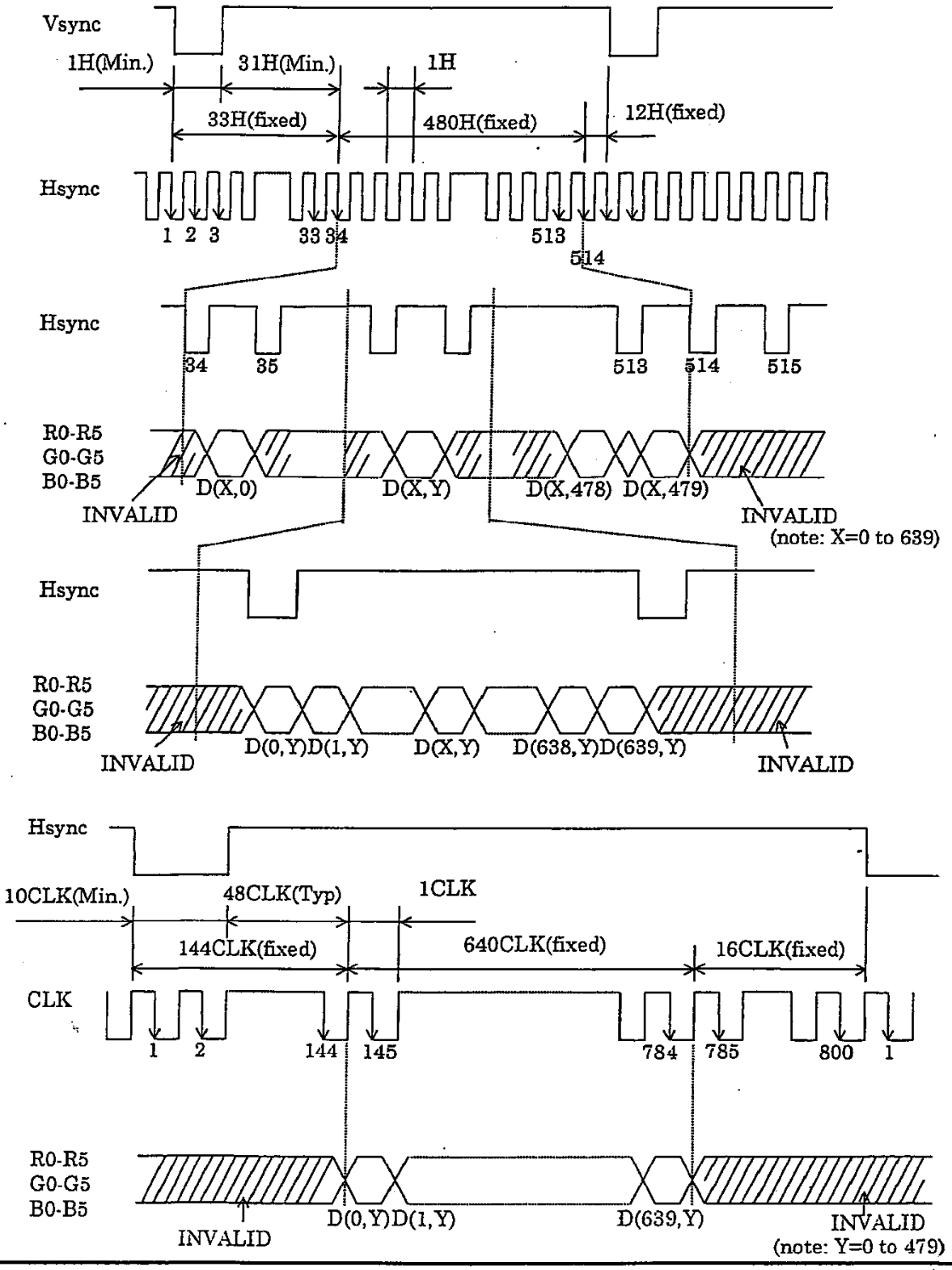


Note 1: These do not exist signals.
Note 2: Keep thp + thb and tvp + tvb within the value shown in page 12/25, otherwise, display position is shifted to right or left side, or to up or down side.

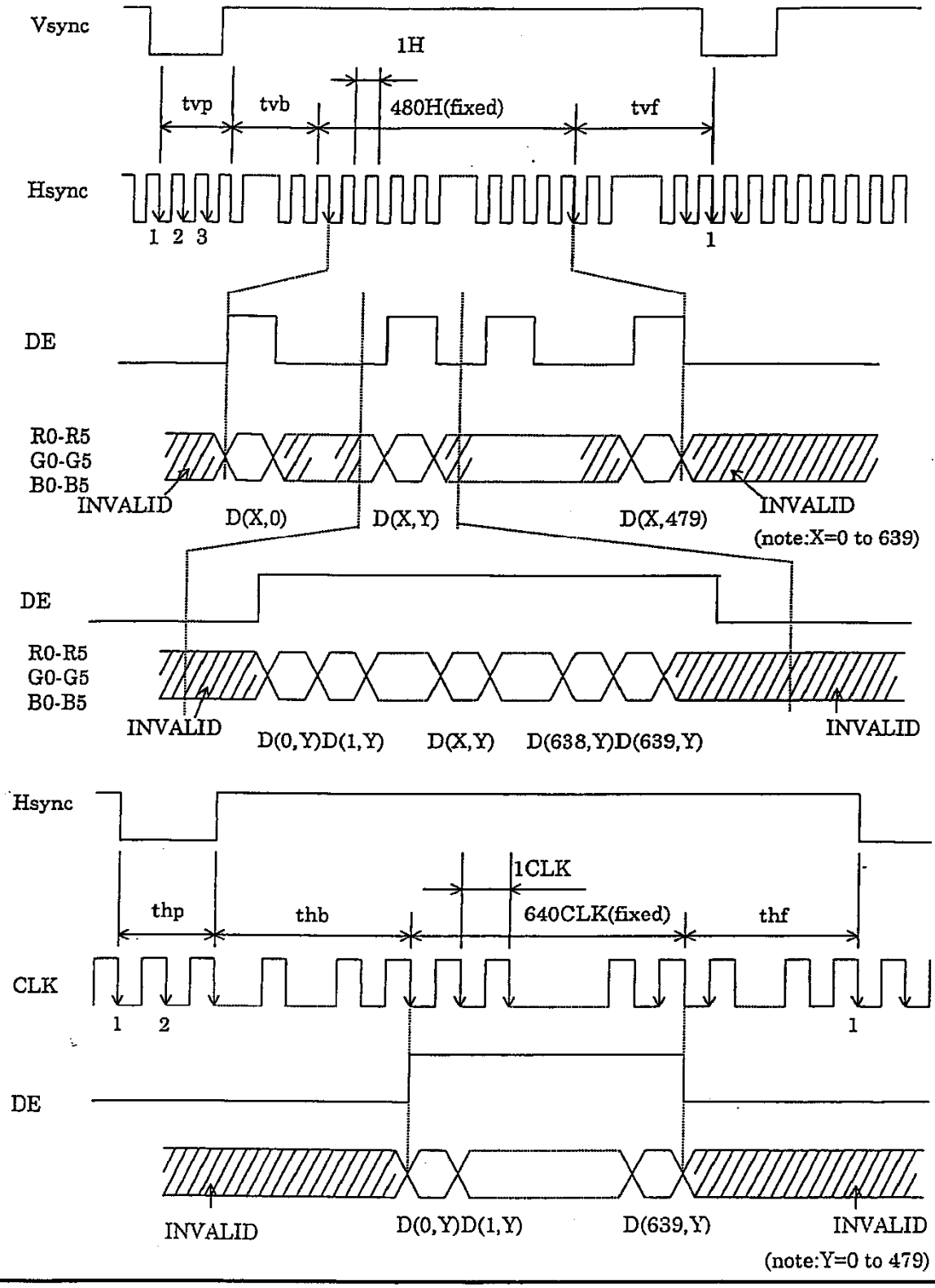
(3) Input signal timing chart



(4) Input signal timing chart
(a) Fixed mode



(b) DE mode


Vsync
1H
tvp
tvb
480H(fixed)
tvf
Hsync
1 2 3
1
DE
R0-R5
G0-G5
B0-B5
INVALID
D(X,0)
D(X,Y)
D(X,479)
INVALID
(note:X=0 to 639)
DE
R0-R5
G0-G5
B0-B5
INVALID
D(0,Y)D(1,Y)
D(X,Y)
D(638,Y)D(639,Y)
INVALID
Hsync
1CLK
thp
thb
640CLK(fixed)
thf
CLK
1 2
1
DE
INVALID
D(0,Y)D(1,Y)
D(639,Y)
INVALID
(note:Y=0 to 479)

7.8. DISPLAY POSITION

Normal scan (RL="Low" or "Open", UD="Low" or "Open")

D(0,0)	D(1,0)	-	D(X,0)	-	D(638,0)	D(639,0)
D(0,1)	D(1,1)	-	D(X,1)	-	D(638,1)	D(639,1)
|	|	+	|	+	|	|
D(0,Y)	D(1,Y)	-	D(X,Y)	-	D(638,Y)	D(639,Y)
|	|	+	|	+	|	|
D(0,478)	D(1,478)	-	D(X,478)	-	D(638,478)	D(639,478)
D(0,479)	D(1,479)	-	D(X,479)	-	D(638,479)	D(639,479)

Reverse san at horizontal direction. Normal scan at vertical direction. (RL="High", UD="Low" or "Open")

D(639,0)	D(638,0)	-	D(X,0)	-	D(1,0)	D(0,0)
D(639,1)	D(638,1)	-	D(X,1)	-	D(1,1)	D(0,1)
|	|	+	|	+	|	|
D(639,Y)	D(638,Y)	-	D(X,Y)	-	D(1,Y)	D(0,Y)
|	|	+	|	+	|	|
D(639,478)	D(638,478)	-	D(X,478)	-	D(1,478)	D(0,478)
D(639,479)	D(638,479)	-	D(X,479)	-	D(1,479)	D(0,479)

Normal san at horizontal direction. Reverse scan at vertical direction. (RL="Low" or "Open", UD="High")

D(0,479)	D(1,479)	-	D(X,479)	-	D(638,479)	D(639,479)
D(0,478)	D(1,478)	-	D(X,478)	-	D(638,478)	D(639,478)
|	|	+	|	+	|	|
D(0,Y)	D(1,Y)	-	D(X,Y)	-	D(638,Y)	D(639,Y)
|	|	+	|	+	|	|
D(0,1)	D(1,1)	-	D(X,1)	-	D(638,1)	D(639,1)
D(0,0)	D(1,0)	-	D(X,0)	-	D(638,0)	D(639,0)

Reverse san at horizontal direction. Reverse scan at vertical direction. (RL="High",UD="High")

D(639,479)	D(638,479)	-	D(X,479)	-	D(1,479)	D(0,479)
D(639,478)	D(638,478)	-	D(X,478)	-	D(1,478)	D(0,478)
|	|	+	|	+	|	|
D(639,Y)	D(638,Y)	-	D(X,Y)	-	D(1,Y)	D(0,Y)
|	|	+	|	+	|	|
D(639,1)	D(638,1)	-	D(X,1)	-	D(1,1)	D(0,1)
D(639,0)	D(638,0)	-	D(X,0)	-	D(1,0)	D(0,0)

8. OPTICAL CHARACTERISTICS

(Ta = 25℃, Note1)

Items	Symbols	Condition	Min.	Typ.	Max.	Unit	Remarks
Contrast ratio	CR	Note 3	—	300	—	—	Note 4
Luminance	Lvmax	Note 3	—	500	—	cd/m^2	Note 6
Luminance uniformity	—	Max. / Min.	—	1.25	1.40	—	Note 7

Reference data

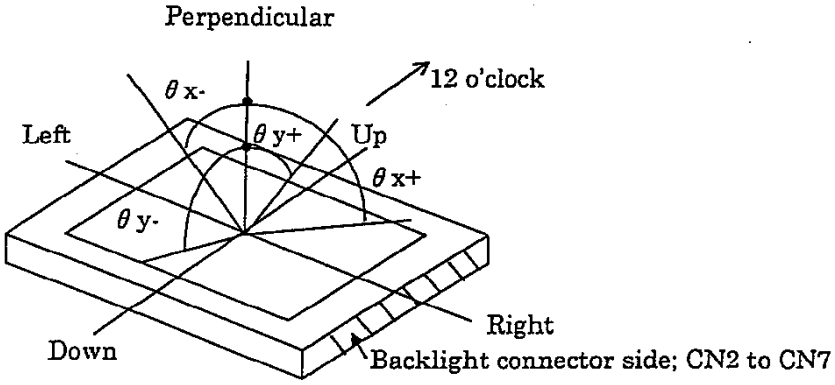
(Ta = 25℃, Note1)

Parameters		Symbols	Condition	Min.	Typ.	Max.	Unit	Remarks
Viewing angle range	Horizontal	θ x+	CR > 10, θ y=±0°	—	60	—	deg.	Note 2
		θ x-	CR > 10, θ y=±0°	—	60	—	deg.	
	Vertical	θ y+	CR > 10, θ x=±0°	—	40	—	deg.	
		θ y-	CR > 10, θ x=±0°	—	50	—	deg.	
Response time		t on	White to Black	—	TBD	TBD	ms	Note 5
		t off	Black to White	—	TBD	TBD		
		t on+ t off		—	40	TBD		
Color gamut		C	at center, to NTSC	—	60	—	%	—

Note 1: VCC = 3.3V, MVA = "VCC", at normal scan with NEC recommended inverter (Part No.TBD; IL=4mA)

Note 2: Definitions of viewing angle are as follows.

The viewing angles are reference.



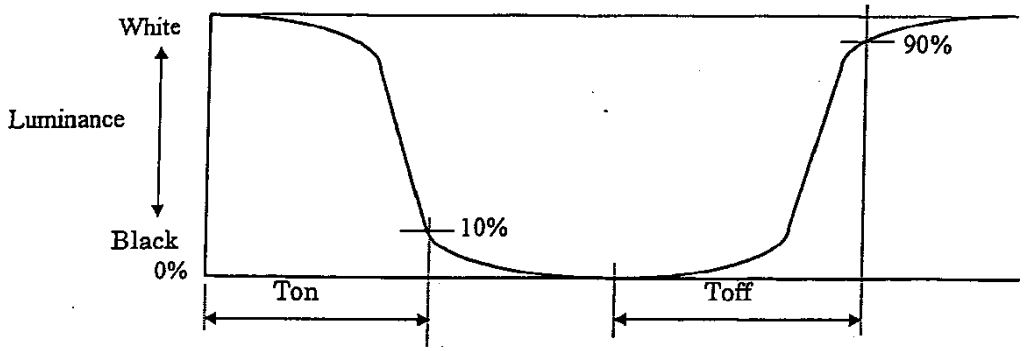
Note 3: Viewing angle is θ x = ±0°, θ y = ±0°, At center.

Note 4: The contrast ratio is calculated by using the following formula.

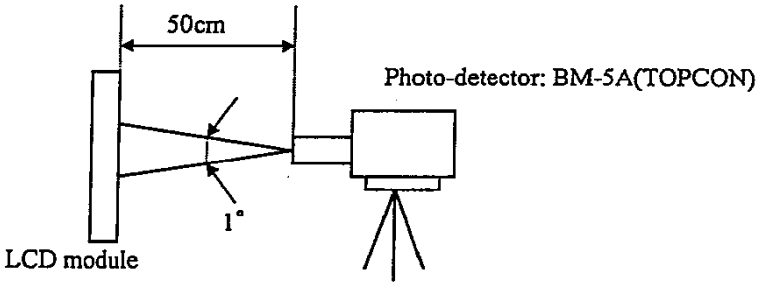
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance with all pixels in "white"}}{\text{Luminance with all pixels in "black"}}$$

The luminance is measured in darkroom.

Note 5: 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.



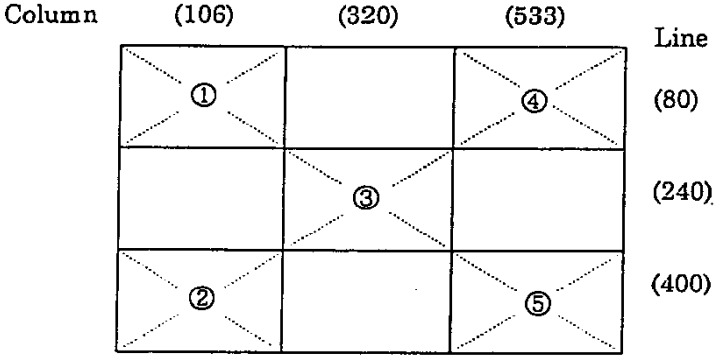
Note 6: The luminance is measured after 20 minutes from the module works, with all pixels in " white ". Typical value is measured after luminance saturation.



Note 7: The 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.



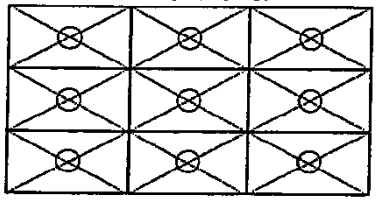
9. RELIABILITY TEST

No.	Test items	Test condition	Judgment
1.	High temperature/humidity operation	50±2℃, RH= 85% 240 hours, Display data is black.	*1
2.	Heat cycle (operation)	① 0℃±3℃···1 hour 55℃±3℃···1 hour ② 50 cycles , 4 hours/cycle ③ Display data is black.	*1
3.	Thermal shock (non-operation)	① -20℃±3℃···30 minutes 60℃±3℃···30 minutes ② 100 cycles ③ Temperature transition time is ④ Within 5 minutes.	*1
4.	Vibration (non-operation)	① 5-100Hz, 11.76m/s^2(1.2G) 1 minute/cycle, X,Y,Z direction ② 10 times each direction	*1, *2
5.	Mechanical shock (non-operation)	① 294 m/s^2 (30G), 11ms X,Y,Z direction ② 3 times each direction	*1, *2
6.	ESD (operation)	150pF, 150Ω, ±10kV 9 places on a panel *3 10 times each place at one-second intervals	*1
7.	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 as follows.



10. EXPECTED LIFE-TIME OF THE BARE LAMP

Note1,3.

	Bare lamp
Condition	IL=4mArms Room temp. (25±2℃) , Continuous operation
Expected value (MTTF)	TBD Note 2
Criteria	Half value luminance (compared with initial value)

Note 1: The life-time is expected value (reference).

Note 2: This expected 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 3: The life-time becomes short if the module is operated under the low temperature environment.

Remark: This module has two lamps. Even though a lamp goes off, the other lamp may go off.

11. 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

(1) Caution when taking out the module

① Pick the pouch only, when taking out 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.

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 of these signals is lost, the LCD panel would be damaged.

⑧ The torque to mounting screw should never exceed 0.42N · m (4.3kgf · cm).

⑨ 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

① Dew drop atmosphere should 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 the fixed pattern 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.

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.

(5) Other cautions

① Do not disassemble and/or reassemble LCD module.

② Do not readjust any variable resistors or switches in the module..

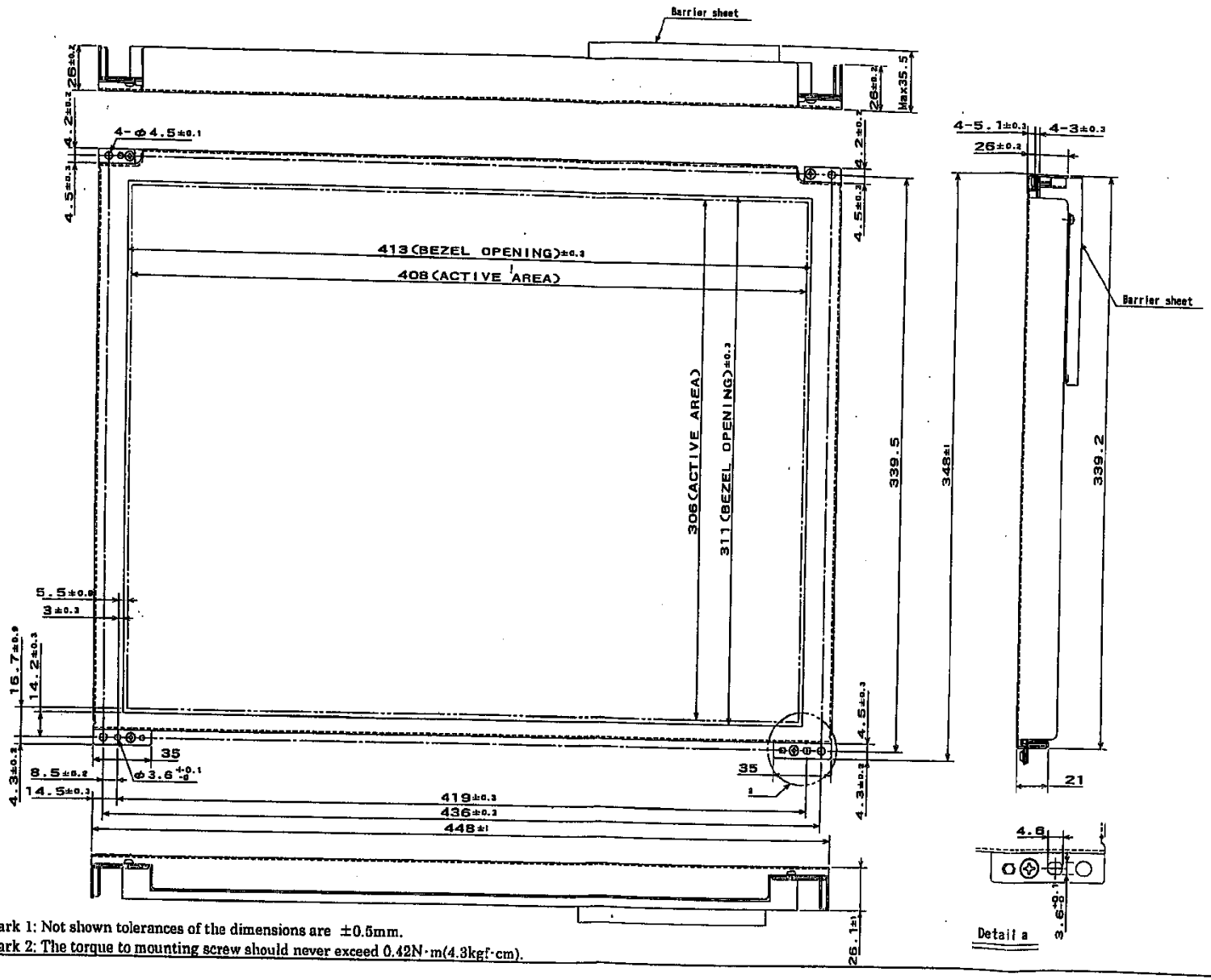
③ When returning the module for repair or etc., Please packs the module properly to avoid any damages. We recommend using the original shipping packages.

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.

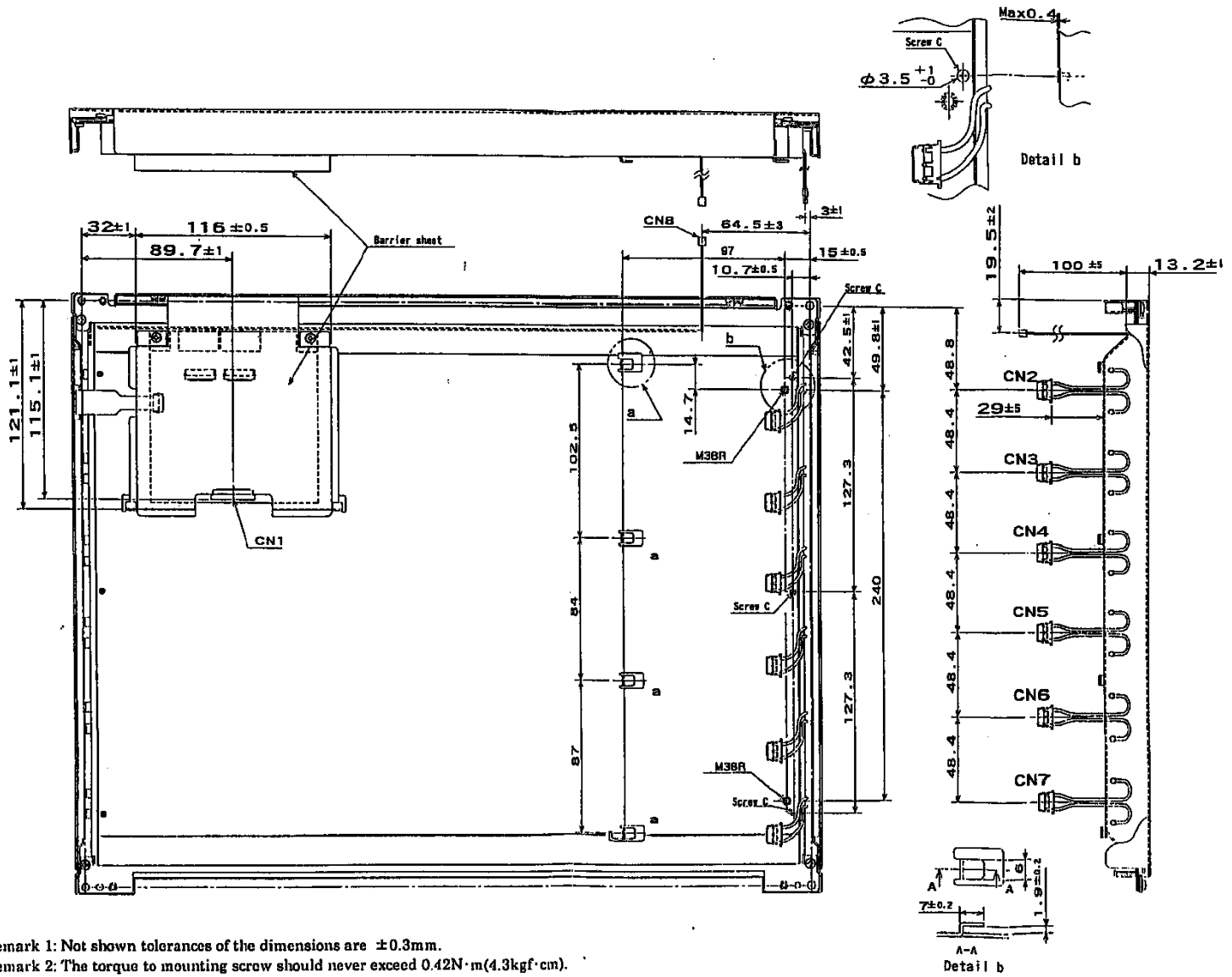
Uneven brightness and/or small spots may be observed depending on different display patterns.

12.OUTLINE DRAWINGS
12.1 FRONT VIEW (Unit: mm)



Remark 1: Not shown tolerances of the dimensions are ±0.5mm.
Remark 2: The torque to mounting screw should never exceed 0.42N·m(4.3kgf·cm).

12.2 REAR VIEW



Remark 1: Not shown tolerances of the dimensions are ±0.3mm.
Remark 2: The torque to mounting screw should never exceed 0.42N·m(4.3kgf·cm).

Revision History

Rev.	Prepared date	Revision contents	Approved	Checked	Prepared	Issued date
1	June 8, 2000	DOD-H-7930				