

NEC

TFT COLOR LCD MODULE

Type No. NL6448BC33-31D

26 cm (10.4 Type) , VGA

SPECIFICATIONS

First Edition

NEC Corporation
Display Device Operations Unit
Color LCD Division
Application Engineering Department

Approved	<i>A. Tach.</i>	Dec. 15, 1999
Checked	<i>/</i>	Dec. 15, 1999
Prepared	<i>y. Okuda</i>	Dec. 15, 1999

NEC Corporation

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1. DESCRIPTION

NL6448BC33-31D 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. NL6448BC33-31D has a built-in backlight. The backlight includes long-life-lamps and the lamps are replaceable.

The 26cm diagonal display area contains 640×480 pixels and can display 262,144 colors simultaneously.

NL6448BC33-31D is suitable for industrial application use because of the wide viewing angle and the high luminance. Also, the viewing direction is selectable either upper or lower side by changing scan direction.

NL6448BC33-31D interface is compatible with NL6448AC33-18, -18A, -18B and -27.

2. FEATURES

- Wide viewing angle (with Retardation Film)
- Polarizer antiglare treatment
- High luminance (350cd/m² Typ.:saturated value, at room temp.)
- Low reflection
- Reversible scan direction (with DPS pin)
- Best viewing angle select function (with MVA terminal)
- Luminance control
- Easy to attach a touch panel
- Backlight with two long-life-time lamps (one lamp holder, inverter-less)
- Replaceable lamp holders (Type No.:104LHS31)
- Recommended inverter (Part No.:104PWBR1)
- 6-bit digital RGB signals
- Data enable function

3. APPLICATIONS

- Industrial PCs
- Display terminals for control system
- 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. The TFT panel structure is created by sandwiching liquid crystal material in the narrow gap between a TFT array glass substrate and a color filter glass substrate. 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 211.2(H)×158.4(V)mm

Drive system a-Si TFT active matrix

Display colors 262144 colors

Number of pixels 640×480

Pixel arrangement RGB vertical stripe

Pixel pitch 0.33 (H)×0.33 (V)mm

Module size 243.0(H)×185.1(V)×10.75 Typ. (D)mm

Weight 530g(Typ.)

Contrast ratio 300:1(Typ.)

Viewing angle (more than the contrast ratio of 10:1)

- Horizontal: 50° (Typ. left side, right side)
- Vertical : 40° (Typ. up side), 45° (Typ. down side)

Designed viewing direction

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

Polarizer pencil-hardness 3H(Min., at JIS K5400)

Color gamut 43%(Typ. At center, To NTSC)

Response time 15ms(Typ.), "white" to "black"

Luminance 350cd/m²(Typ.)

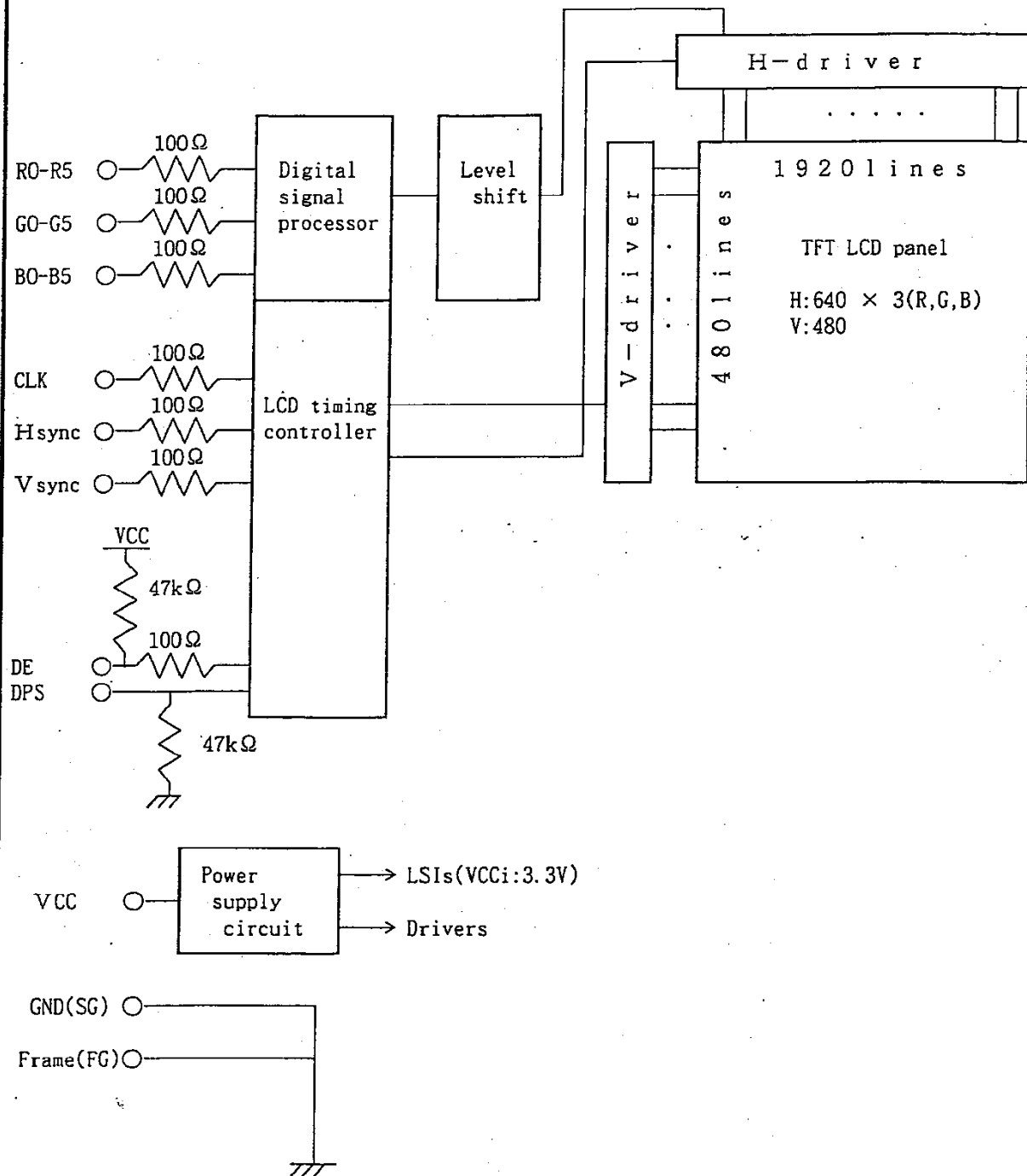
Signal system 6-bit digital signals for each of RGB primary colors,
Synchronous signals(Hsync, Vsync), Dot clock(CLK)

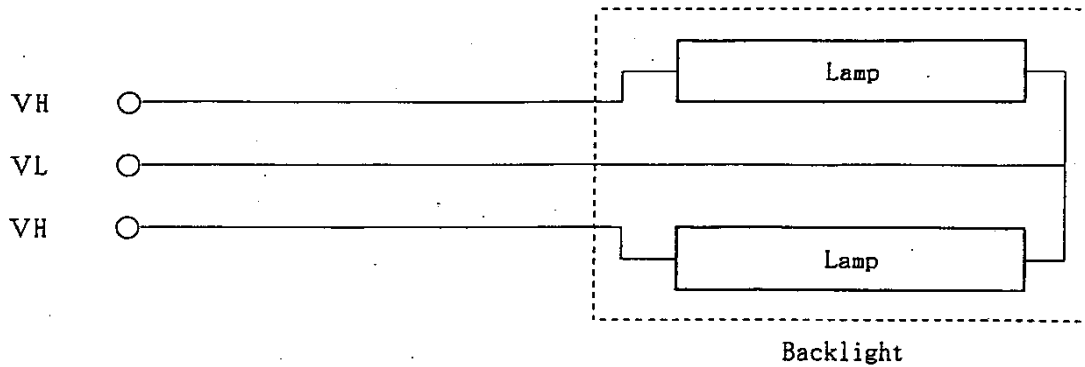
Supply voltage 3.3V [5.0V](Logic, LCD driving),12.0V(Backlight)

Backlight Edge light type: two fluorescent lamps (cold cathode type)
[Replaceable parts]
Lamp holder: type No.104LHS31

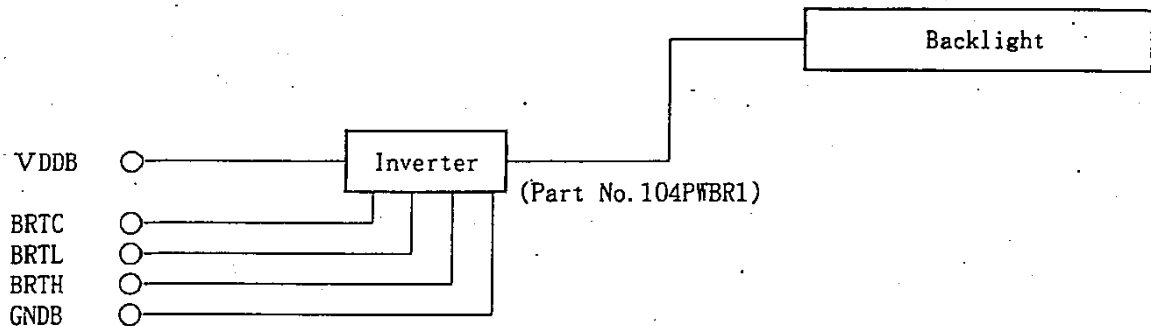
Power consumption 6.8 W(Typ. at 3.3V, 12.0V)

6. BLOCK DIAGRAM





(In case of connecting NEC recommended inverter)



7. SPECIFICATIONS

7.1. GENERAL SPECIFICATIONS

Items	Specifications	Unit
Module size	243.0 $\pm$ 0.5 (H) $\times$ 185.1 $\pm$ 0.5 (V) $\times$ 11.5(D) max.	mm
Display area	211.2 (H) $\times$ 158.4 (V)	mm
Number of pixels	640 $\times$ 3 (H) $\times$ 480 (V)	pixel
Dot pitch	0.11 (H) $\times$ 0.33 (V)	mm
Pixel pitch	0.33 (H) $\times$ 0.33 (V)	mm
Pixel arrangement	RGB (Red,Green,Blue) vertical stripe	-
Display colors	262144	color
Weight	550 (max.)	g

7.2. ABSOLUTE MAXIMUM RATINGS

Parameters	Symbols	Ratings	Unit	Remarks
Supply voltage	VCC	-0.3 to 6.5	V	Ta=25°C
Input voltage	VI	-0.3 to VCC + 0.3	V	
Lamp voltage	VL	2000	Vrms	-
Storage temp.	Vst	-20 to 60	°C	-
Operation temp.	Vop	0 to 50	°C	module surface note 1
Humidity (no condensation)	RH	≤ 95% relative humidity		Ta ≤ 40°C
		≤ 85% relative humidity		40 < Ta ≤ 50°C
		Absolute humidity(g/m³) shall not exceed Ta=50°C, 85% relative humidity level.		Ta > 50°C

note 1: measured at the display area

7.3. ELECTRICAL CHARACTERISTICS

(1) Logic, LCD driving

Ta = 25°C

Parameters	Symbols	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	VCC	3.0 (4.75)	3.3 (5.0)	3.6 (5.25)	V	VCC=3.3V (VCC=5.0V)
Logic input "L" voltage	VIL	0	-	VCC×0.3	mV	CMOS level
Logic input "H" voltage	VIH	VCC×0.7	-	5.25	V	
Supply current	ICC	-	*1)325 (250)	370 (300)	mA	VCC=3.3V (VCC=5.0V)

*1): Checker flag pattern (in EIAJ ED-2522)

(2) Backlight

Parameters	Symbols	Min.	Typ.	Max.	Unit	Remarks
Lamp current	IL	2.0	5.0	5.5	mA _{rms}	with one lamp
Lamp voltage	VL	-	510	-	V _{rms}	-
Lamp turn on voltage	VS	840	-	-	V _{rms}	Ta = 25°C
		1265	-	-		Ta = 0°C
Oscillator frequency	Ft	50	54	58	kHz	note

note: Recommended value of "Ft"

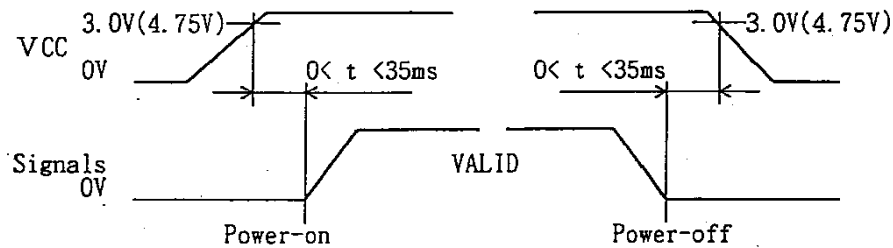
· Ft is within the specification.
and

$$Ft = \frac{1}{4th} \times (2n-1)$$

t h: 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: Hsync, Vsync, CLK, DE, DATA

- *1 Wrong power sequence may damage to the module.
- *2 The supply voltage for input signals should be the same as VCC.
- *3 Apply VDDDB 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.
- *4 While the power is off, please keep whole signals(Hsync, Vsync, CLK, DE, and DATA) at low level or high impedance.

7.5. INTERFACE PIN CONNECTIONS

(1) Interface signals, power supply

Module side connector

CN1 ... DF9C-31P-1V(No.1 to 31)

Mating connector

DF9-31S-1V or DF9M-31S-1R ... (1)

IL-310-T31S-VF (2)

Supplier: (1) HIROSE ELECTRIC CO., LTD.

(2) Japan Aviation Electronics Industry Limited(JAE)

Pin NO.	Symbols	Functions
1	GND	Ground
2	CLK	Dot clock
3	Hsync	Horizontal sync.
4	Vsync	Vertical sync.
5	GND	Ground
6	R0	Red data (LSB)
7	R1	Red data
8	R2	Red data
9	R3	Red data
10	R4	Red data
11	R5	Red data (MSB)
12	GND	Ground
13	G0	Green data (LSB)
14	G1	Green data
15	G2	Green data
16	G3	Green data
17	G4	Green data
18	G5	Green data (MSB)

Pin NO.	Symbols	Functions
19	GND	Ground
20	B0	Blue data (LSB)
21	B1	Blue data
22	B2	Blue data
23	B3	Blue data
34	B4	Blue data
25	B5	Blue data (MSB)
26	GND	Ground
27	DE	Data enable
28	VCC	Power supply
29	VCC	Power supply
30	MVA	Best viewing select
31	DPS	Scan derrection select

LSB: Least Significant Bit

MSB: Most Significant Bit

note 1: VCC: All VCC terminals should be connected to 3.3V or 5.0V.

note 2: DE: DE/Fixed mode select is as follows.

{ Data enable signal = DE mode
VCC or Open = Fixed mode

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

{ VCC or Open = Perpendicular (best viewing angle: 0°)
GND = down side (best viewing angle: -10°)

note 4: DPS: DPS changes display scan direction.

{ GND or Open = Scan direction will be decided by the setting of SW1.
VCC = Reverse scan

See 7.8. DISPLAY POSITION about another way for reversible scan.

When DPS is VCC, reverse scan is selected even if SW1 is set at normal scan.

note 5: GND is connected to the frame of the LCD module.

(2) Backlight

Lamp side connector

Mating connector

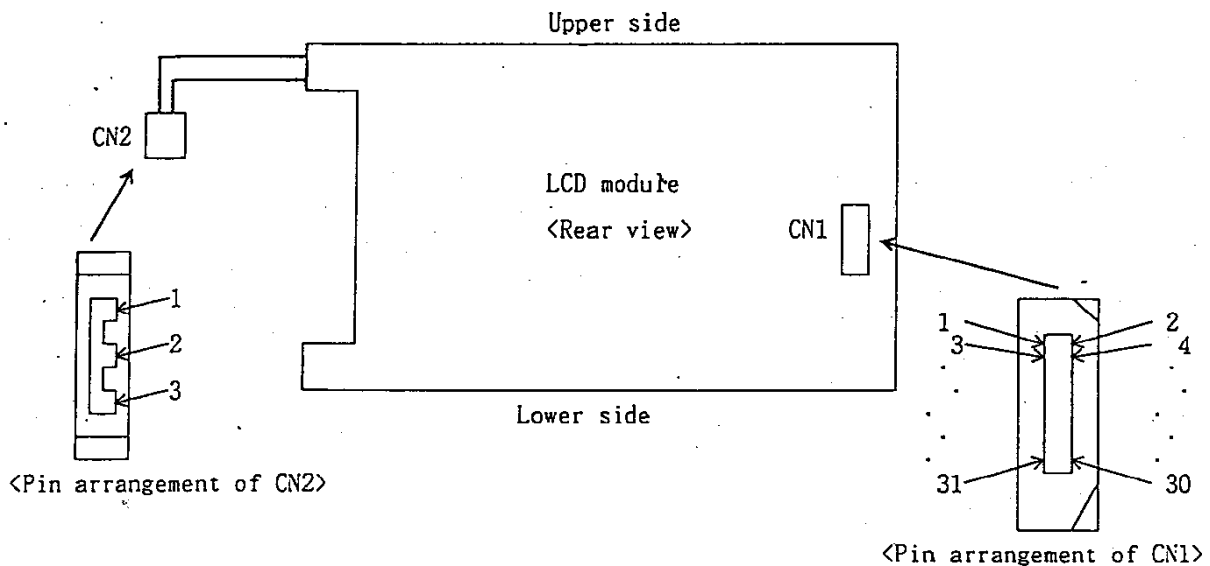
CN2 ... BHR-03VS-1

SM03(4.0)B-BHS-TB

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

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

(3) Connector locations



<In case of connecting NEC recommended inverter>

- Inverter side connector 1 Mating connector 1
CN1 ... LZ-5P-SL-SMT LZ-5S-SC3

Supplier: Japan Aviation Electronics Industry Limited (JAE)

Pin No.	Symbols	Functions	Pin No.	Symbols	Functions
1	VDDB	Power supply (12V)	4	GNDB	Backlight ground
2	VDDB	Power supply (12V)	5	BRTHL	Luminance select *1
3	GNDB	Backlight ground			

- *1: High luminance (100 %) ... BRTHL = High(+5V) or Open
Low luminance (60 %) ... BRTHL = Low(GNDB level)

- Inverter side connector 2 Mating connector 2
CN3 ... IL-Z-3PL-SMTY IL-Z-3S-S125C3

Supplier: Japan Aviation Electronics Industry Limited (JAE)

Pin No.	Symbols	Functions
1	BRTC	Backlight ON/OFF signal *1
2	BRTH	Luminance control input *2
3	BRTL	Luminance control input *2

*1: CMOS level

Backlight ON ... BRTC = High(+5V) or Open
Backlight OFF ... BRTC = Low(GNDB level)

- *2: ① A way of luminance control by a variable resistor
This way works when BRTHL(No.5 pin) of CN1 is opened.

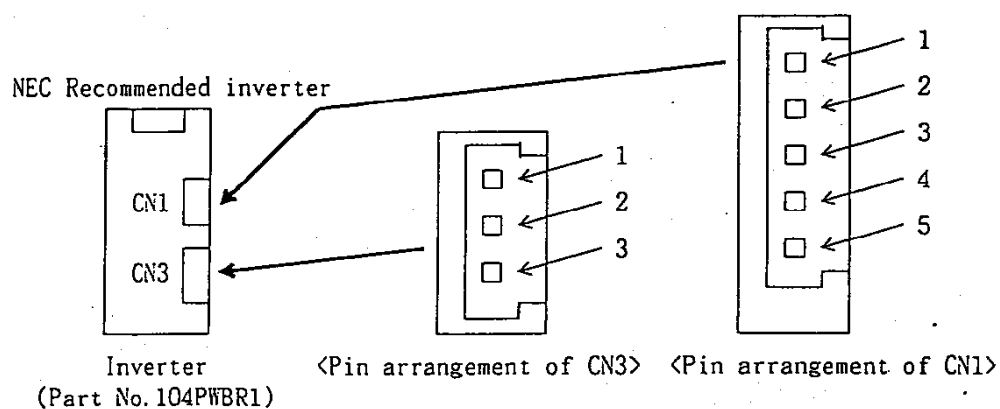


Mating variable resistor: $10\text{ K}\Omega \pm 5\%$
Minimum luminance (50%) : $R = 0\ \Omega$
Maximum luminance (100%): $R = 10\text{ K}\Omega$

- ② A way of luminance control by a voltage

This way works when BRTHL and BRTL are opened. The range of input voltage between BRTH and GNDB is as follows.

Minimum luminance (50%) : 2.5 V
Maximum luminance (100%): $\leq 1.2\text{ V}$



7.6.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
	dark	0	0	0	0	0	1	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
	Red	1	1	1	1	1	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
	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
	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
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	↑																		
	↓																		
	bright	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

note: The combination of 6 bit signals(64 grayscale level)
results in 262144 (64×64×64) colors.

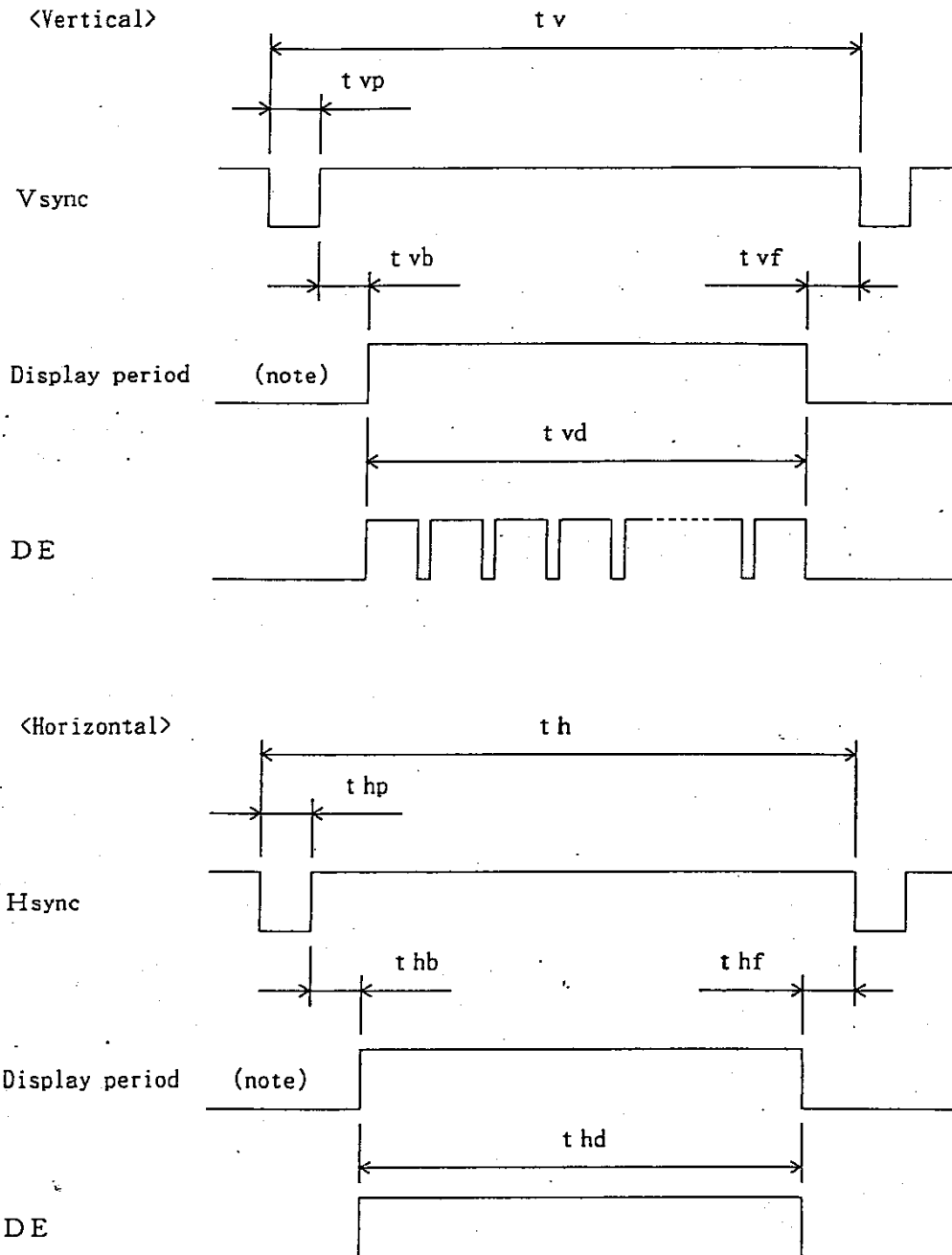
7.7. INPUT SIGNAL TIMINGS

(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	μ s	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
			4	48	—	CLK	DE mode
	*) thp + thb		144			CLK	Fixed mode
			14	144	—	CLK	adjustable range by DE signal
	CLK-Hsync timing	thch	12	—	—	ns	—
	Hsync-CLK timing	thcs	8	—	—	ns	—
Vsync	Hsync-Vsync timing	tvh	1	—	—	CLK	—
	Vsync-Hsync timing	tvs	30	—	—	ns	—
	Rise,fall	thrf	—	—	10	ns	—
	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
			0	12	—	H	DE mode
	Pulse width	tvb	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
DATA R0-R5 G0-G5 B0-B5			5	33	—	H	DE mode
	Rise,fall		—	—	10	ns	—
	CLK-DATA timing	tds	8	—	—	ns	—
DE	DATA-CLK timing	tdh	12	—	—	ns	—
	Rise,fall	tdrf	—	—	10	ns	—
	DE-CLK timing	tes	8	—	—	ns	DE mode
	CLK-DE timing	teh	12	—	—	ns	
	Rise,fall	terf	—	—	10	ns	

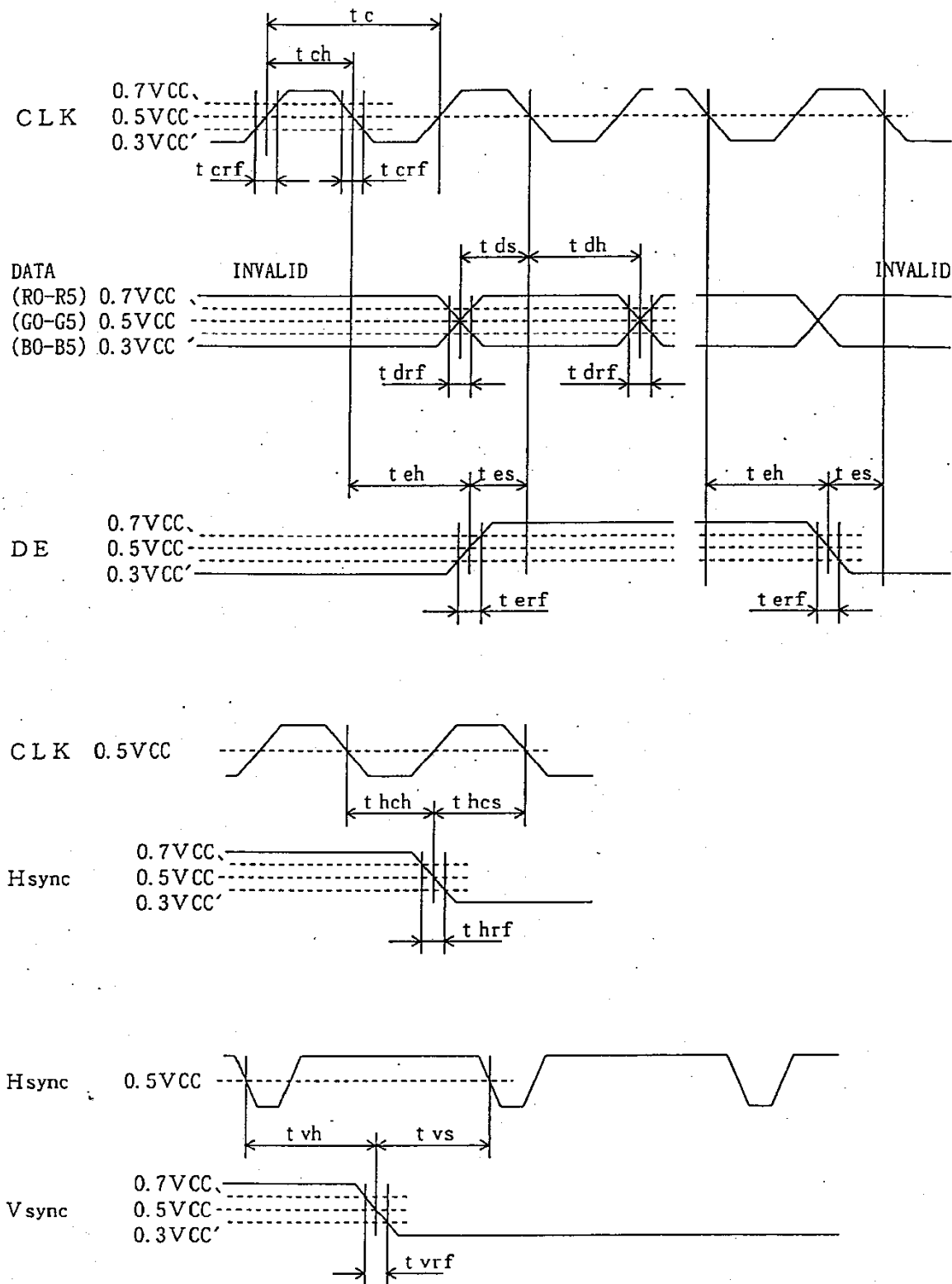
note: All parameters should be kept within the specified range.

(2) Definition of input signal timings



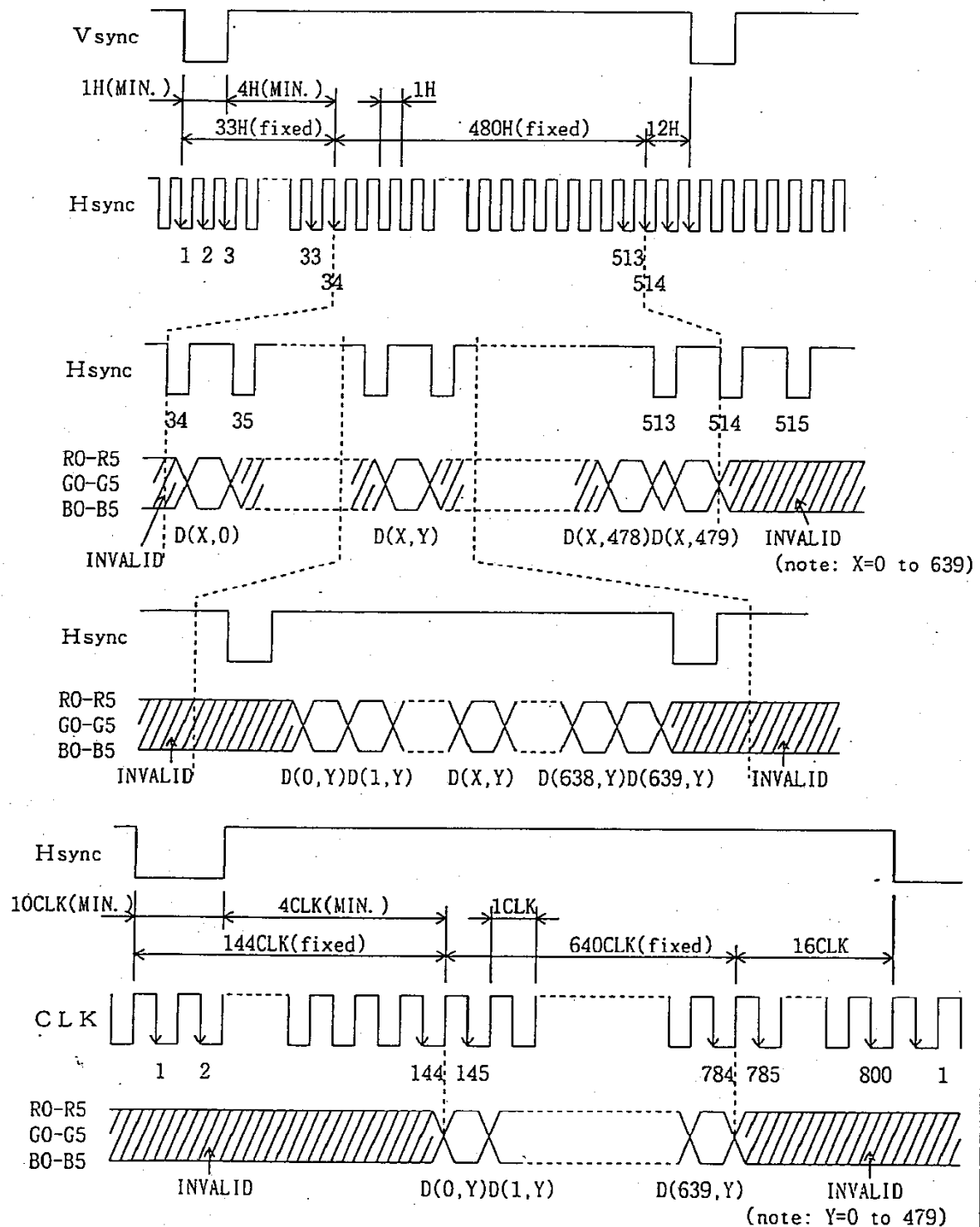
note 1: These do not exist a signal.

2: Keep $t_{hp} + t_{hb}$ and $t_{vp} + t_{vb}$ within the value shown in page 12/25, otherwise, display position is shifted to right or left side, or to up or down side.

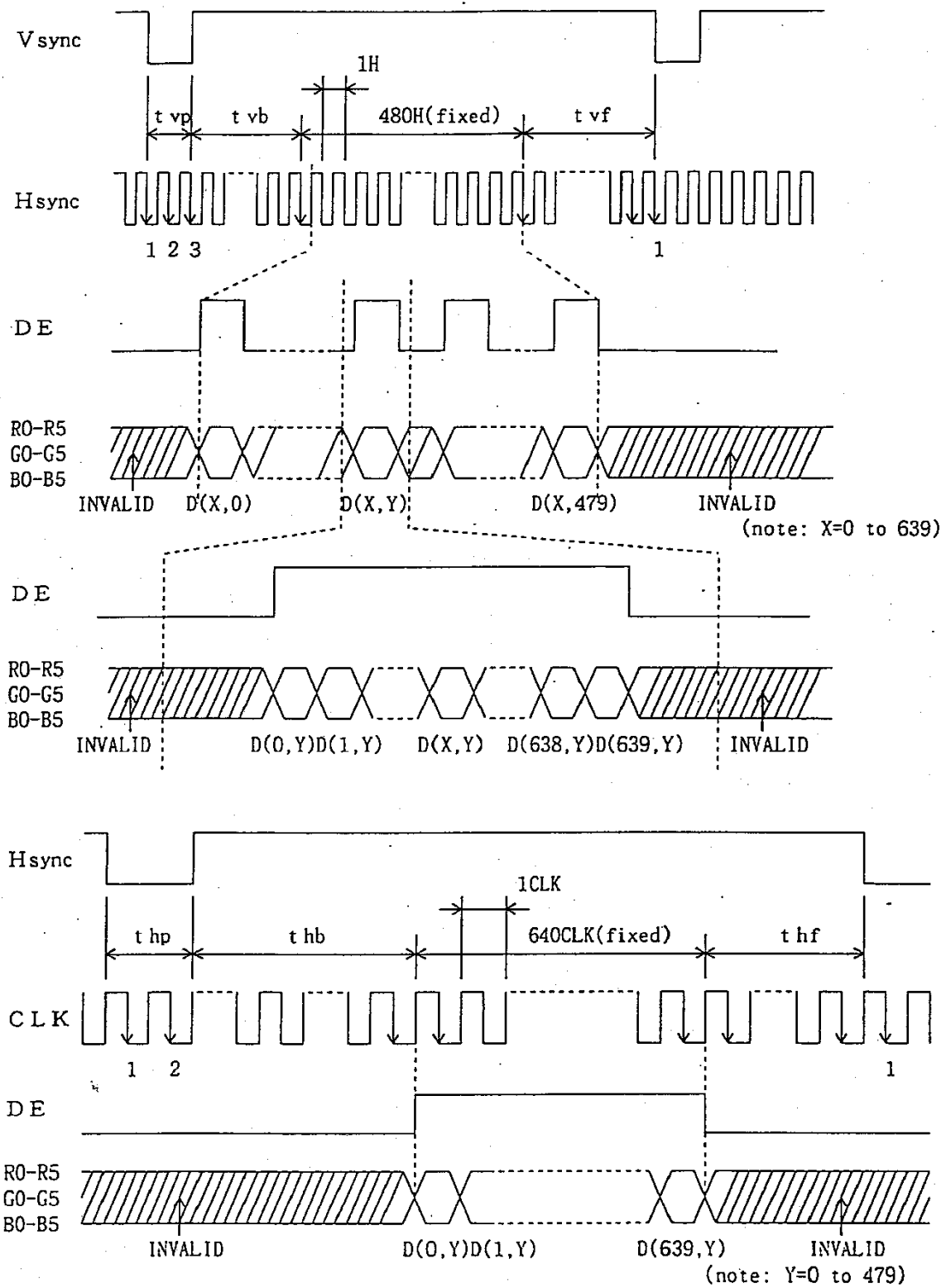


(3) Input signal timing chart

(a) Fixed mode



b) DE mode



7.8. DISPLAY POSITIONS

Normal scan (DPS = "GND" or "Open")

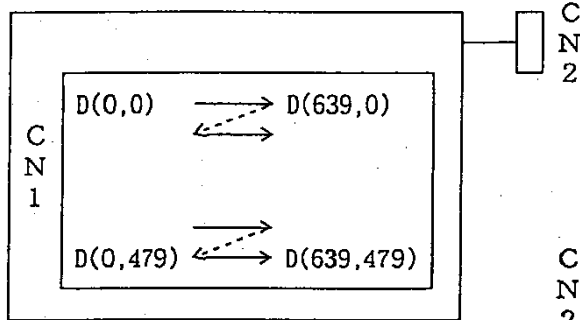
D(0,0)	D(1,0)	----	D(X,0)	----	D(638,0)	D(639,0)
D(1,0)	D(1,1)	----	D(X,1)	----	D(638,1)	D(639,1)
⋮	⋮	+	⋮	+	⋮	⋮
D(0,Y)	D(1,Y)	----	D(X,Y)	----	D(638,Y)	D(639,Y)
⋮	⋮	+	⋮	+	⋮	⋮
D(1,Y)	D(0,Y)	----	D(X,478)	----	D(638,478)	D(639,478)
D(0,479)	D(1,479)	----	D(X,479)	----	D(638,479)	D(639,479)

Reverse scan (DPS = "VCC")

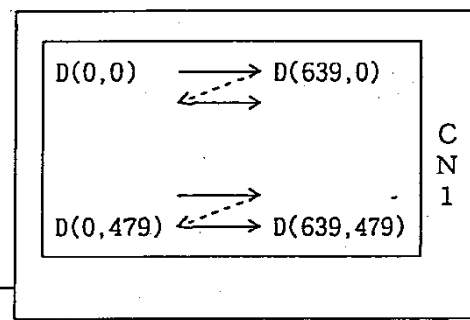
D(639,479)	D(638,479)	----	D(X,479)	----	D(1,479)	D(0,479)
D(639,478)	D(638,478)	----	D(X,478)	----	D(1,478)	D(0,478)
⋮	⋮	+	⋮	+	⋮	⋮
D(639,Y)	D(638,Y)	----	D(X,Y)	----	D(1,Y)	D(0,Y)
⋮	⋮	+	⋮	+	⋮	⋮
D(639,1)	D(638,1)	----	D(X,1)	----	D(1,1)	D(0,1)
D(639,0)	D(638,0)	----	D(X,0)	----	D(1,0)	D(0,0)

note 1: Below drawings show relations between the scan direction and the viewing direction.

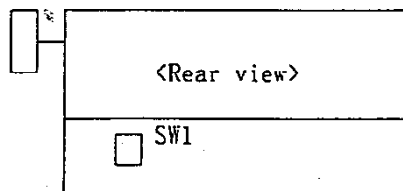
Normal scan



Reverse scan



note 2) The scan direction is set up with the switch(SW1) on the rear side.



The scan direction select



Normal scan
(Factory set)



Reverse scan

See 7.5. Interface pin connection(note 4) about another way for reversible scan.
When DPS is VCC, reverse scan is selected even if SW1 is set at normal scan.

8. OPTICAL CHARACTERISTICS

Ta = 25 °C note 1

Parameters	Symbols	Conditions	Min.	Typ.	Max.	Unit	Remarks
Contrast ratio	CR	note 3	150	300	—	—	note 4
Luminance	L VMAX	note 3	280	350	—	cd/m ²	note 6
Luminance uniformity	—	max./min.	—	1.25	1.40	—	note 7

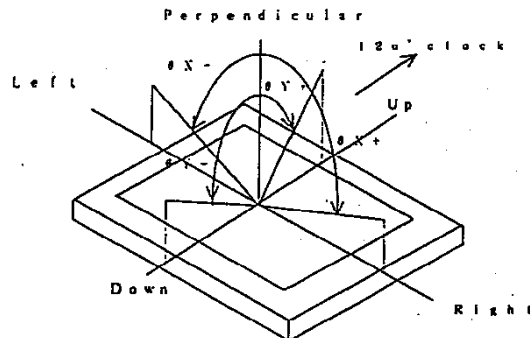
Reference data

Ta = 25 °C note 1

Parameters	Symbols	Conditions	Min.	Typ.	Max.	Unit	Remarks
Viewing angle range	Horizontal	$\theta X+$ CR>10, (CR>5) $\theta y = \pm 0^\circ$	45 —	50 (60)	— —	deg.	note 2
		$\theta X-$ CR>10, (CR>5) $\theta y = \pm 0^\circ$	45 —	50 (60)	— —	deg.	
	Vertical	$\theta Y+$ CR>10, (CR>5) $\theta x = \pm 0^\circ$	35 —	40 (50)	— —	deg.	
		$\theta Y-$ CR>10, (CR>5) $\theta x = \pm 0^\circ$	40 —	45 (55)	— —	deg.	
Response time	t on	white to black	—	15	40	ms	note 5
	t off	black to white	—	70	85	ms	
Color gamut	C	at center, to NTSC	35	43	—	%	—

note 1: VCC = 3.3V, VDDB = 12V, MAV = "VCC" or "Open", at normal scan with NEC recommended inverter (Part No.104PWBR1)

note 2: Definitions of viewing angle are as follows.
The viewing angles are reference.



note 3: Viewing angle is $\theta x = \pm 0^\circ$, $\theta y = \pm 0^\circ$. At center.

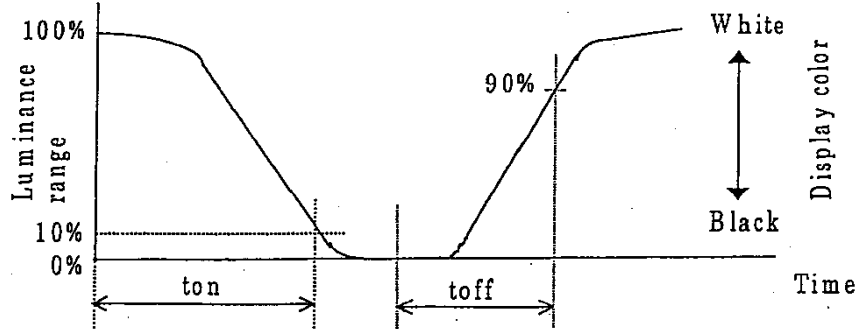
note 4: The contrast ratio is calculated by using the following formula.

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

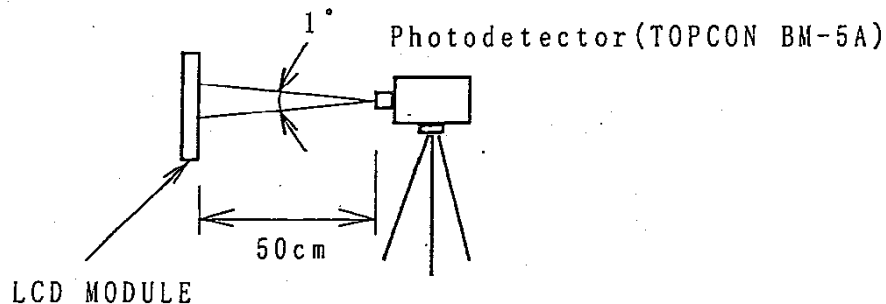
The luminance is measured in darkroom.

note 5: Definition of response time is as follows.

Photodetector output signal is measured when the luminance changes "white" to "black". Response time is the time between 10% and 100% of the photodetector output amplitude.



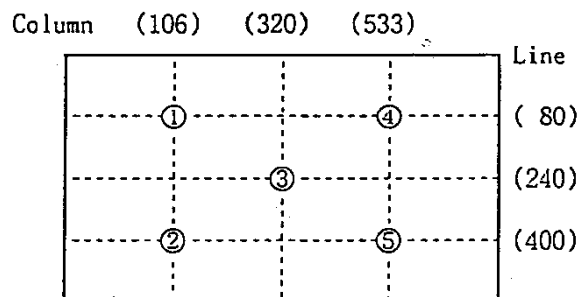
note 6: The luminance is measured after 20 minutes from the module works, with all pixels in "white". Typical value is measured after luminance saturation.



note 7: The luminance uniformity is calculated by using following formula.

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

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



9. DEFECT SPECIFICATIONS

a) Inspection conditions

Distance : The distance between the inspector's eye and the LCD panel is 20cm.

Temperature : Room temperature is $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$.

Viewing angle and illumination:

Display specifications : $-20^{\circ} \leq \theta x \leq +20^{\circ}$, $0^{\circ} \leq \phi y \leq +20^{\circ}$
60 lux at a LCD surface

Appearance specifications: $-45^{\circ} \leq \theta x \leq +45^{\circ}$, $-45^{\circ} \leq \phi y \leq +45^{\circ}$
700 lux at a operation table

b) Display specifications

Item	Specifications		
Line defect	Not allowed		
Luminous dots *1	Color	Distance between same color dots	Quantity
	Red,Green,Blue	—	$R + G + B \leq 5$
	Green	—	$G \leq 3$
	Red,Green,Blue	$\leq 6.5 \text{ mm}$ *4	$R, G, B \leq 0$
		Linked two or more dots *3	$R, G, B \leq 0$
Dark dots *2	Color	Distance between dark dots	Quantity
	Black	—	$R + G + B \leq 10$ $R, G, B \leq 5$
		Linked two dots *3	$\leq 1 \text{ pair}$
		Linked three or more dots *3	≤ 0
		$\leq 6.5 \text{ mm}$ *4	≤ 0
Luminous dots + Dark dots			≤ 12

*1 Defect area $> 1/3$ of one dot

Dot defects include intermittent luminous and dark dot.

*2 Dark dots are measured while the screen is illuminated with Red, Green, or Blue.

*3 Linkage means linked two or more dots.

(■: Luminous or Dark dot)

To be counted

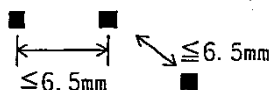


To be uncoun ted



*4 Neighborhood ($\leq 6.5 \text{ mm}$) is considered with:

(■: Luminous or Dark dot)



	To be counted	To be uncoun ted
Luminous dots	Same color	Different color
Dark dots	Same screen	Different screen

c) Appearance specifications

Item	Specifications		
	Measurement criteria	Quantity	
Other objects Stains Dust (dot shape)	Average diameter(ϕ) mm	Allowed value	
	$\phi \leq 0.2$	all allowed	
	$0.2 < \phi < 0.3$	≤ 10 points	
	$0.3 \leq \phi \leq 0.5$	≤ 3 points	
	$0.5 < \phi$	0 point	
	Linked other objects		
Other objects Stains Dust (line shape)	Width(W) mm	Length(L) mm	
	$W < 0.05$	-	all allowed
	$0.05 \leq W \leq 0.1$	$L < 0.7$	
		$0.7 \leq L \leq 1.0$	≤ 4 points
	$0.1 < W$	$1.0 < L$	0 point
		-	
Polarizer Bubbles Wrinkles Dent	Average diameter(ϕ) mm		
	$\phi \leq 0.5$	≤ 2 points	
Panel dent	$\phi \leq 0.5$	≤ 2 points	
Polarizer scratch	Remarkable scratches	0 point	
Form	Specified labels and parts are put.		

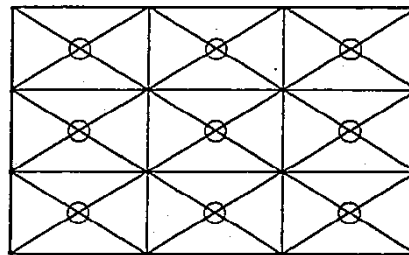
10. RELIABILITY TEST

No.	Test items	Test conditions	Judgement
1.	High temperature/humidity operation	50±2°C, 85% relative humidity 240 hours Display data is black.	*1
2.	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
3.	Thermal shock (non-operation)	① -20°C±3°C...30 minutes 60°C±3°C...30 minutes ② 100 cycles ③ Temperature transition time within 5 minutes	*1
4.	Vibration (non-operation)	① 5 - 100Hz, 2G 1 minute/cycle, X,Y,Z direction ② 120 times each direction	*1 *2
5.	Mechanical shock (non-operation)	① 55G, 11ms X,Y direction 30G, 11ms z direction ② 5 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 in the figure.



11. EXPECTED LIFE-TIME OF THE LAMP

	Lamp
Conditions	IL=5mA Room temp. (25±2°C), Continuous operation
Expected Life-time (MTTF)	55,000H
Criteria	Half value luminance (compared with initial value.)

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

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

12. MARKINGS

A nameplate bearing the following information and other labels are affixed to a shipped product at the specified location on each product.
(see outline drawings)

- (1) Parts number : NL6448BC33-31D
- (2) Serial number : Express in figures and alphabetical.
- Revision : One letter
 - Manufacturing time : Express in 1 figure or in alphabetical.

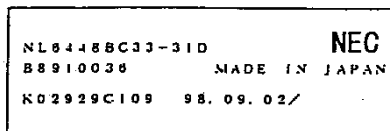
Example [Serial number: B8910036*]

B 8 9 1 0 0 3 6 *

- Product number
- Month (September)
- A, B, and C indicate October, November, and December respectively.
- Year (1998)
- Product revision (B revision)

(3) Indication examples

Nameplate



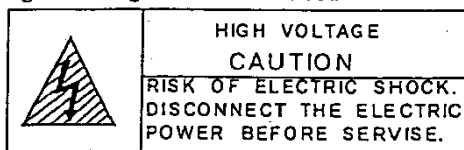
Parts name

Lot number, Production country
Panel number, Inspection date

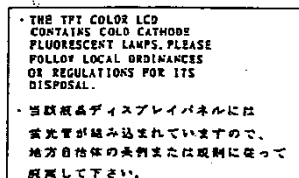
note 1: The contents of above label are necessary for NEC to identify the warranted period which specified in this specification.
Therefore we recommend the customer not to attach something (like customer's label) which hide the lot number, inspection date, etc.

note 2: In case, customer ship back to NEC for repair, if NEC can not read the original contents of label, NEC will give new lot number to the label.

High voltage caution label



Disposal method label



13. PACKING, TRANSPORTATION, AND DELIVERY

Supplier will pack products to be delivered to customer in accordance with supplier's packing specifications, and will deliver them to customer in such a state that they will not suffer damage during transportation. The delivery conditions are as follows.

(1) Shipping box

As shown in the following figure, shipping box is consisted of one box. Less than ten modules are packed in one shipping box.

There is a risk of damage to the products if the shipping box is dropped from a height of 60 cm or more, and therefore care should be taken in handling the box during transportation.

When a box is stored in a warehouse, etc., care should be taken to ensure that the storage temperature is not exceeded.

Model Number and quantity are shown on the shipping box, either printed directly or on a label.

When modules are delivered to abroad, the above shipping box is packed in a outer box for export.

(2) Inspection result sheet

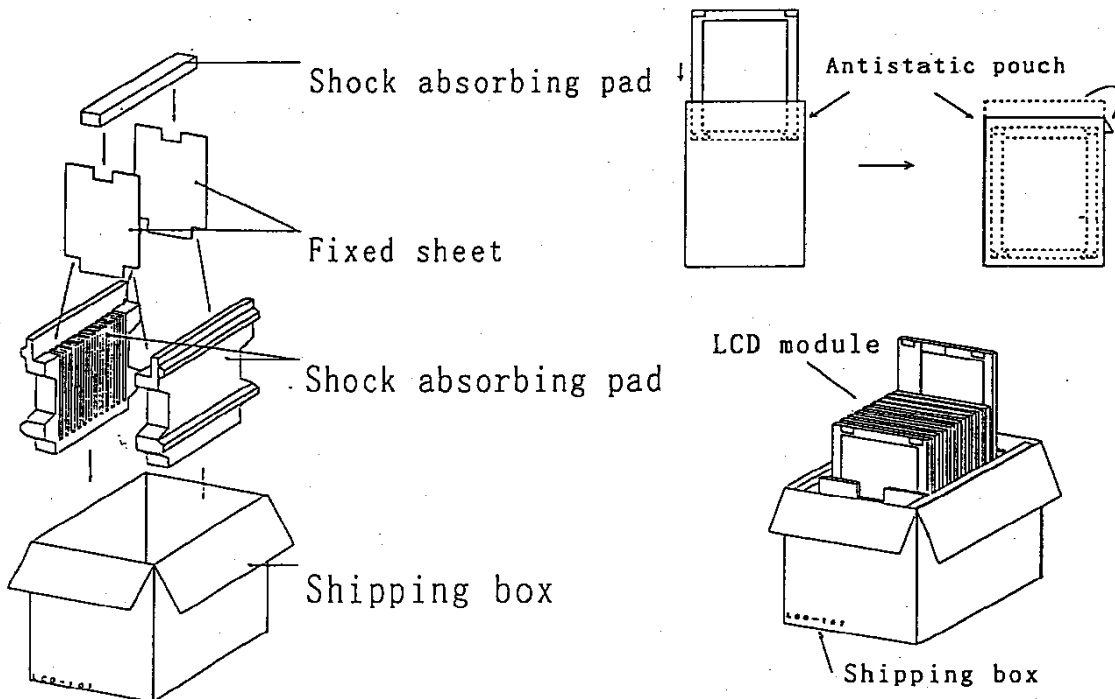
An inspection result sheet is included for delivered products with each inner box.

The inspection result sheet should summarize a number of products for which pass/fail assessment has been performed.

(3) Means of transportation

Products are to be transported by hand, light van, truck, by air, or by sea.

Box dimensions	:305(L)x305(W)x377(H)mm
Box weight	:Approx. 0.9kg
Total weight	:Approx. 6.4kg(with 10 modules per 1 box)



14. PRODUCT INSPECTIONS

When products are shipped, the following inspections are to be carried out for all products or sampling products.

- (1) 100% inspection: ☐ Supply current(VCC=3.3V)
 ☐ Display appearance
 ☐ Appearance

- (2) Sampling inspection: ☐ Luminance
 ☐ Contrast
 ☐ Luminance uniformity

15. CHANGE CONTROL

Design changes may be made for this product relating to the specifications, appearance, parts used, circuits, and etc., for the purpose of product improvement.

If a design change is judged to affect the specifications of this product, supplier shall inform customer the change in advance.

16. QUALITY CONTROL

In the event of a product failure under normal operating conditions, and in the event of product trouble or a functional disorder that can be deemed to be the responsibility of supplier, supplier shall repair the fault or replace the product free of charge within one year from the date of product delivery.

However, supplier shall not bear responsibility for the quality of a product in the case of modifications other than those specified by supplier.

The repair of the product that has been passed one year from the date of shipment shall be chargeable on customers. The parts that has been replaced with charge shall be warranted for the period of six months from the date of replacement.

After the product discontinuation, we might replace the product instead of repairment.

17. MAINTENANCE

The specifications of maintenance parts may be partially changed within a range which provides for equivalent or better quality. Maintenance parts shall in principle be product units.

If the product discontinuation is planned, supplier shall notify customer in six months advance.

18. HANDLING OF DOUBTFUL POINTS

If any doubt arises concerning a matter not stipulated in this specification, the matter is to be resolved by mutual agreement between customer and supplier, and supplier shall make efforts for improvement.

19. GENERAL CAUTIONS

Next figures and sentence 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 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 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.
- 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 0.294 N·m (3 Kgf·cm).

(3) Cautions for atmosphere

- ① Dew drop atmosphere must be avoided.
- ② Do not store and/or operate the LCD module in high temperature and/or high humidity atmosphere. Storage in an electro-conductive polymer packing pouch and under relatively low temperature atmosphere is recommended.
- ③ This module uses cold cathod fluorescent lamps. Therefore, The life time of lamp becomes short conspicuously at low temperature.
- 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 signal to the LCD module at product aging. Applying fixed pattern for a long time may cause image sticking.
- 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

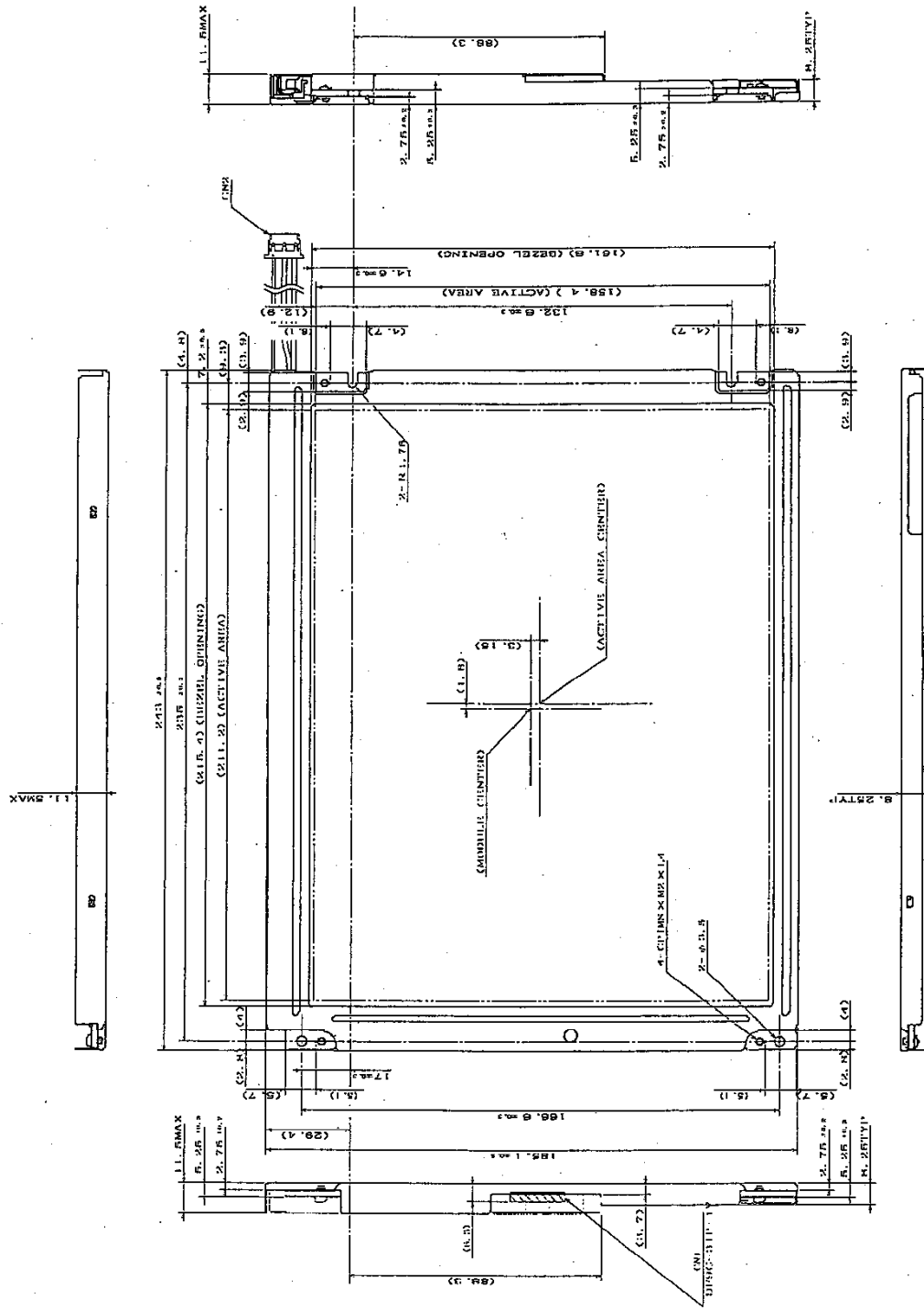
- ① Do not disassemble and/or reassemble LCD module.
- ② Do not readjust variable resistors nor switches etc.
- ③ When returning the module for repair or etc, pack the module not to be broken.
We recommend the original shipping packages.

Liquid Crystal Display has the following specific characteristics. These are not defects nor malfunctions.

The display condition of the LCD module may be affected by the ambient temperature. The LCD module uses cold cathode tube for backlighting. Optical characteristics, like luminance or uniformity, will change during time.

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

20. 1. FRONT SIDE (Unit in mm)



notes: The entries for methyl^1 and methyl^2 should however be moved to CH_3N^1 and CH_3N^2 . The values for methyl^1 and methyl^2 are for CH_3N^1 and CH_3N^2 .

20. 2. REAR SIDE (Unit in mm)

Technical drawing of the rear side of a NEC monitor, model NL6448BC3-31D. The drawing shows the monitor's outline with various dimensions in millimeters. Key dimensions include a total width of 893 mm, a height of 610 mm, and a depth of 164 mm. The drawing also shows the monitor's internal components, including the display panel, control panel, and power supply. A label on the right side of the monitor reads "NL6448BC3-31D NEC", "SHIMADZU 1231", "KODOKUWAHINSHU", and "MADE IN JAPAN". A warning label on the left side of the monitor reads "CAUTION: HOT SURFACE" and "DO NOT TOUCH THE SURFACE OF THE MONITOR WHEN IT IS HOT". The drawing is labeled "20. 2. REAR SIDE (Unit in mm)".

Note 1: Not shown tolerances of the dimensions are $\pm 0.5\text{mm}$.
Note 2: The value in parentheses are for reference.

