



TFT COLOR LCD MODULE

Type No. NL10276BC20-04

26cm(10.4type),XGA

SPECIFICATIONS

(2nd edition)

PRELIMINARY

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

NEC Corporation

NEC Electron Device
Display Device Operations unit
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1. DESCRIPTION

NL10276BC20-04 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. NL10276BC20-04 has a built-in backlight. The backlight includes long-life-lamps and its lamps are replaceable with a holder.

The 26cm(10.4 Type) diagonal display area contains 1024×768 pixels and can display 262,144 colors simultaneously

NL10276BC20-04 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.

2. FEATURES

- Wide viewing angle(with Retardation film)
- Smooth polarizer surface(No antiglare treatment)
- High luminance (300cd/m^2 typ. :saturated value, at room temp.)
- Edge type backlight with two long-life-time lamps(one lamp holder, inverter less)
- Reversible scan direction
- LVDS interface
- Lamp holder replaceable(Part No.:104LHS35)
- Recommended inverter(Type No. : TBD)

3. APPLICATIONS

Measuring instrument
Industrial PCs
Display terminals for control system

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 backside of the panel.

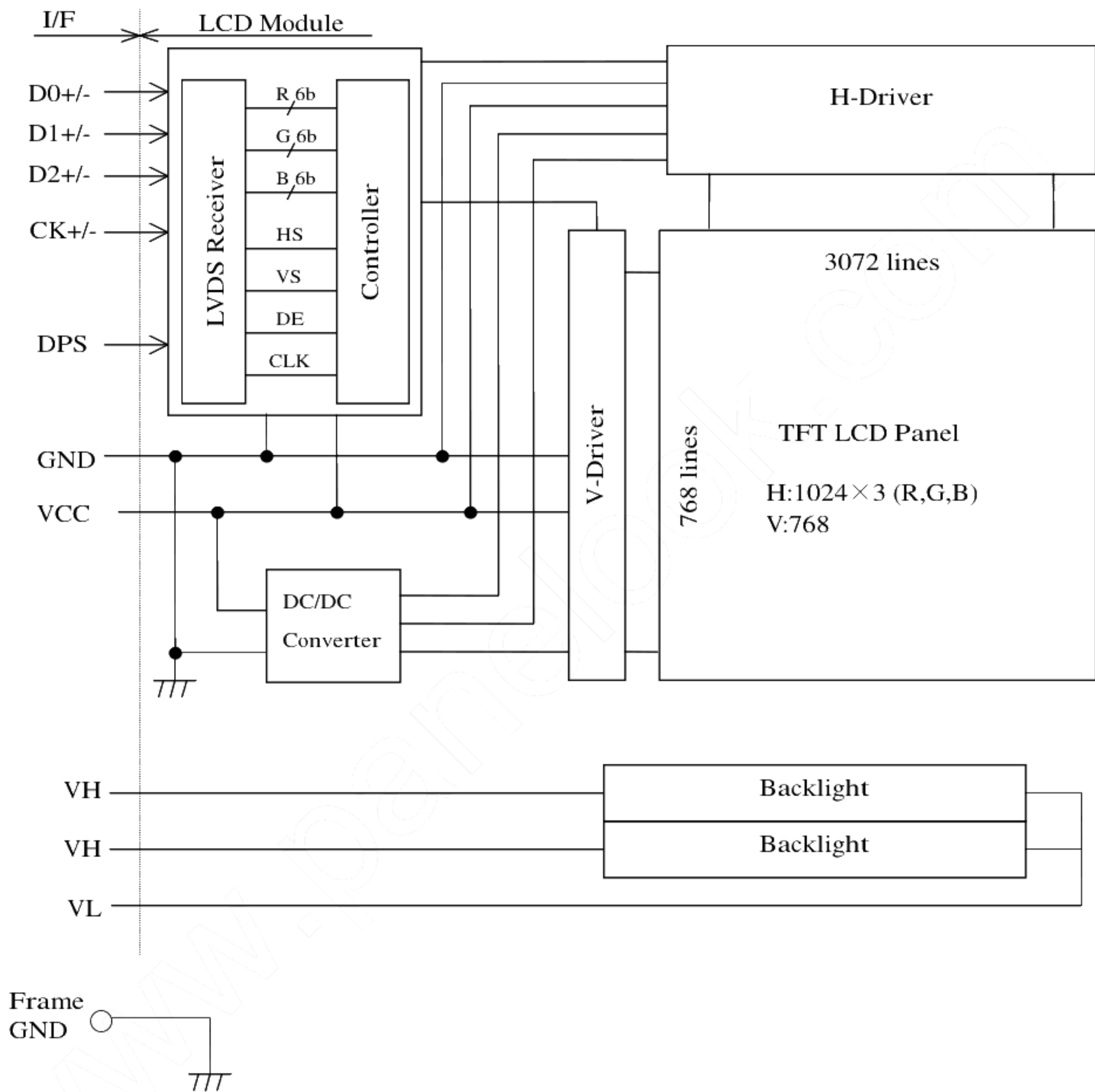
RGB(red,green,blue) data signals from a source system is modulated into a form suitable for active matrix addressing by the onboard signal processor and sent to the driver LSIs which in turn addresses the individual TFT cells.

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	210.432(H) × 157.824(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	0.2055 (H) ×0.2055 (V)mm
Module size	243.0(H) ×185.1(V) ×11.0(D)mm (typ.)
Recommendation inverter size	TBD
Weight	530g (typ.)
Contrast ratio	300:1 (typ.)
Viewing angle (more than the contrast ratio of 10:1)	
Horizontal:	60° (typ. left side, right side)
Vertical	: 45° (typ. up side) ,60° (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)
Smooth polarizer surface(No antiglare treatment)	
Polarizer pencil-hardness	3H(at JIS K5400)
Color gamut	40% (typ., at center, to NTSC)
Response time	15ms (typ., "white" to "black")
Luminance	300 cd/m ² (typ.)
Signal system	LVDS interface(Receiver : TBD) RGB 6-bit digital, Synchronous signals(Hsync, V sync),Dot clock(CLK) Data enable signal(DE)
Supply voltage	3.3V (Logic, LCD driving)
Backlight	Edge light type : Two cold cathode fluorescent lamps Replaceable parts Lamp holder : type No. 104LHS35
Power consumption	TBD[w] (typ., VCC=3.3V, IL=5.0mA _{rms})

6.BLOCK DIAGRAM



note1 : GND is not connected to FG(Frame GND)in the LCD module.

note2 : Frame GND is not connected to the lamp holder.

note3 : Lamp holder is connected to the VL.

7.GENERAL SPECIFICATIONS

Item	Specifications	Unit
Module size	243.0±0.5 (H) × 185.1±0.5 (V) × 11.5(D)max.	mm
Display area	210.432 (H) × 157.824 (V)	mm
Number of pixels	1024×3 (H) × 768 (V)	pixel
Dot pitch	0.0685 (H) × 0.2055 (V)	mm
Pixel pitch	0.2055 (H) × 0.2055 (V)	mm
Pixel arrangement	RGB (Red, Green, Blue) vertical stripe	-
Display colors	262144	color
Weight	550 max.	g

8.ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Ratings	Unit	Remarks
Supply voltage	VCC	-0.3 to 4.0	V	Ta=25°C
Input voltage	VI	-0.3 to Vcc+0.3	V	
Lamp voltage	VL	1500	Vrms	
Storage temp.	T st	-20 to 70	°C	-
Operation temp.	T op	0 to 60	°C	module surface note 1
Relative humidity(RH) note 2		≤ 95% relative humidity	%	Ta≤40°C
		≤ 85% relative humidity	%	40<Ta≤50°C
Absolute humidity note 2		Absolute humidity shall not exceed Ta=50°C,85% relative humidity level.		g/m ³ Ta>50°C

note 1 : Measured at the display area(including self heat)

note 2 : No condensation

9.ELECTRICAL CHARACTERISTICS

(1) Logic, LCD driving

Ta = 25 °C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	VCC	3.0	3.3	3.6	V	-
Ripply voltage	VRP	-	-	100	mV	for VCC
Logic input "L" voltage	ViL	-100	-	-	mV	VCM=1.2V
Logic input "H" voltage	ViH	-	-	+100	mV	VCM:Common mode voltage in LVDS driver
Input voltage for DPS(Low)	VDPSL	0	-	0.8	V	-
Input voltage for DPS(High)	VDPSH	2.0	-	VCC	V	-
Terminating resistor	RT	-	100	-	Ω	-
Supply current	ICC	-	TBD note 1	TBD note 2	mA	VCC=3.3V

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

note 2 : Theoretical maximum current pattern

(2)Backlight

Ta = 25°C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Lamp current	IL	2.0	5.0	5.5	mArms	with one lamp
Lamp voltage	VL	–	520	–	Vrms	–
Lamp turn on voltage	VS	850	–	–	Vrms	Ta=+25°C
		1100	–	–	Vrms	Ta= 0°C
Oscillator frequency	Ft	TBD	(60.5)	TBD	KHz	note 1

note 1:Recommended value of "Ft"

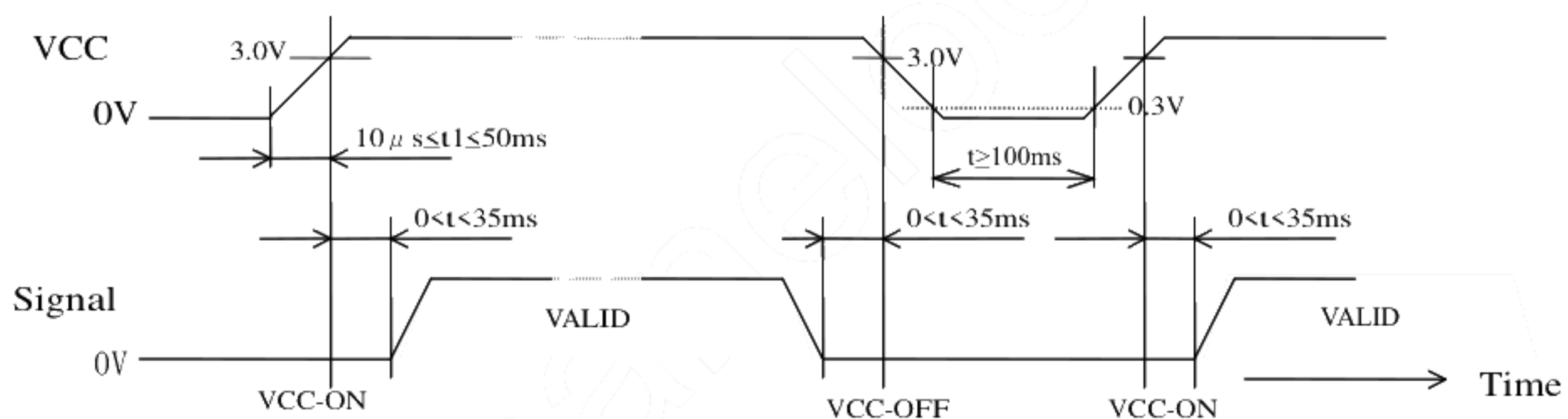
Ft is within the specification.

Ft=(2n-1)/4th th:Hsync period

n :a natural number(1,2,3···)

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

10.SUPPLY VOLTAGE SEQUENCE



Signals:CLK,Hsync,Vsync,DE,RO-R5,G0-G5,B0-B5,DPS

Remark 1:The supply voltage for input signals should be the same as VCC.

Remark 2:When the power is off, please keep whole signals(Hsync,Vsync,CLK,DE,RO-R5,G0-G5, B0-B5,DPS) low level or high impedance.

Remark 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.

Remark 4:The signal should not be down during operation. Even if signal could 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.

Remark 5:Wrong power sequence is not may damaged to the module.

11.INTERFACE PIN CONNECTION

(1) Interface signals, power supply

CN1 : FI-SE20P-HF

Adaptable socket : FI-S20S

Supplier : Japan Aviation Electronics Industry Limited(JAE)

Pin No.	Symbol	Signal type	Function
1	GND	Ground	note 1
2	GND		
3	DPS	Display scan select	"L" :normal scan, "H" :reverse scan note 4
4	N.C.	Non-connection	–
5	GND	Ground	note 1
6	CK+	Pixel clock	CLK for pixel data f=65.0MHz(typ.) (LVDS level) note 2
7	CK-		
8	GND	Ground	note 1
9	D2+	Pixel data etc.	LVDS differential data input note 2
10	D2-		
11	GND	Ground	note 1
12	D1+	Pixel data etc.	LVDS differential data input note 2
13	D1-		
14	GND	Ground	note 1
15	D0+	Pixel data etc.	LVDS differential data input note 2
16	D0-		
17	GND	Ground	note 1
18	GND		
19	VCC	Power supply	Supply 3.3±0.3 note 3
20	VCC		

note 1) GND is not connected to FG(Frame Ground)in the LCD module

note 2) Use 100Ω twist pair wires for the cable

note 3) VCC : All VCC terminals should be connected to 3.3V

note 4) DPS : can change scan at horizontal direction(normal scan and reverse scan).

"Low"(0.8V max.) = Normal scan

"High"(2.0V min.) = Reverse scan

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

(2) Backlight

CN2 : BHR-03VS-1

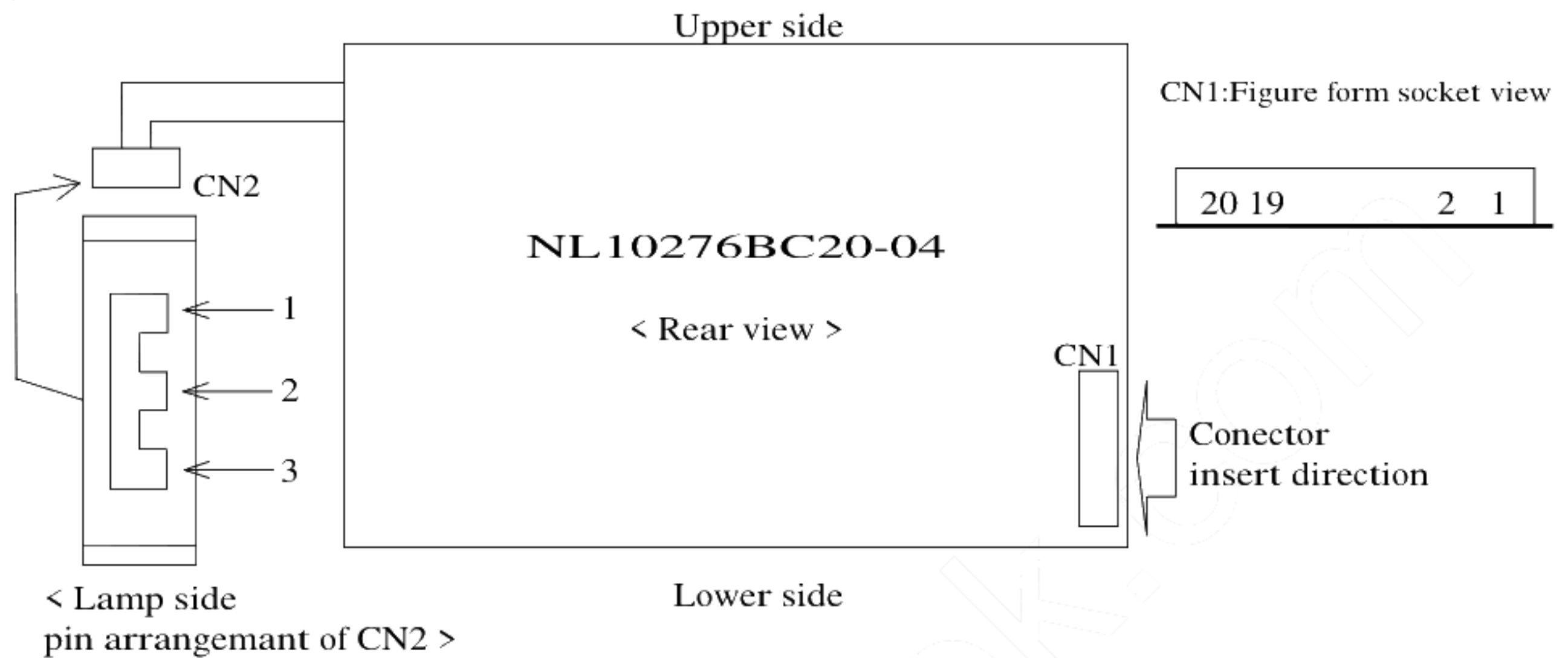
Adaptable socket : SM03(4.0)B-BHS-1-TB

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

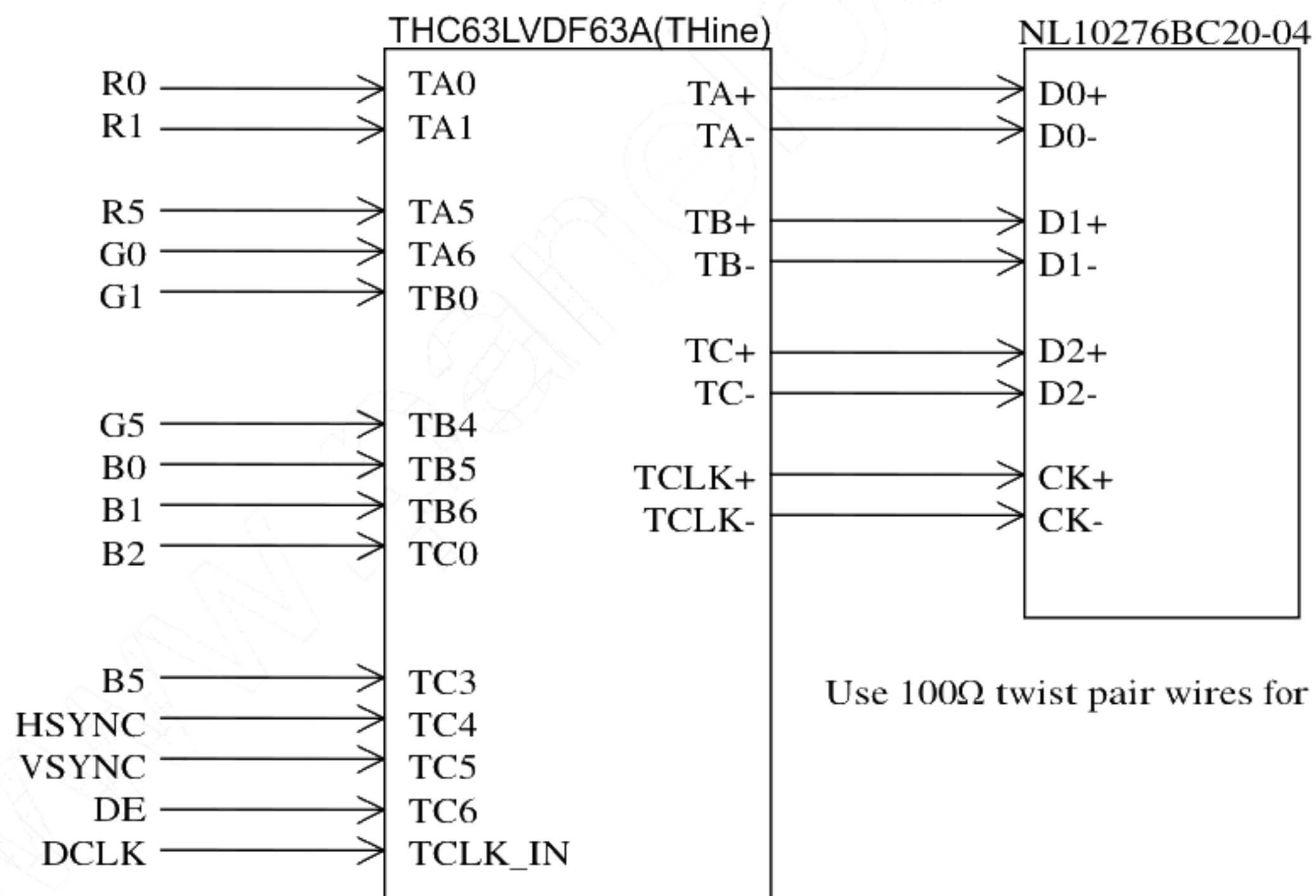
Pin No.	Symbol	Function
1	VL	Low voltage terminal
2	VH	High voltage terminal
3	VH	High voltage terminal

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

(3) Connector location



(4) METHOD OF CONNECTION FOR LVDS chip



Note 1 : These signals should be kept in the specified range **13 INPUT SIGNAL TIMINGS.**

12.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 gray scale	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
Green gray scale	Red	1	1	1	1	1	1	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	0	1	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
	↑				:					:						:			
	↓				:					:						:			
	bright	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
Blue gray scale		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
	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	1	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
		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

Remark1 : Colors are developed in combination with 6 bit signals (64 steps in gray scale) of each primary red, green, and blue color.

This process can result in up to 262144 ($64 \times 64 \times 64$) colors.

13.INPUT SIGNAL TIMING

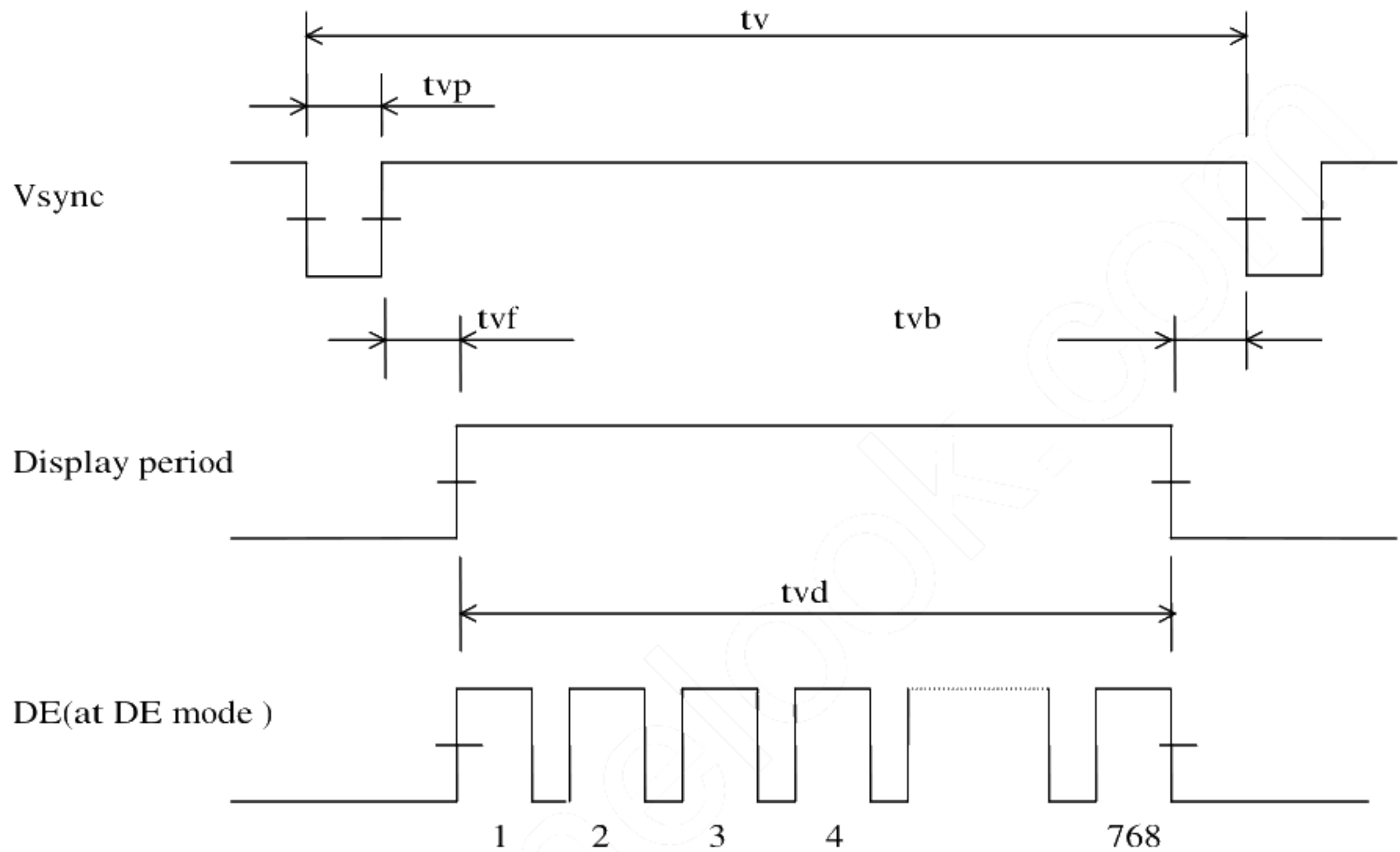
(1)Input signal specifications for LCD controller

Parameter		Synbol	Min.	Typ.	Max.	Unit	Remarks
DCLK	Frequency	1/tc	60.0	65.0	68.0	MHz	15.358ns(typ.)
	Duty	tch/tc	0.4	0.5	0.6	—	—
	Rise, fall	terf	—	—	10	ns	—
Hsync	Period	th	TBD	20.676	TBD	μs	48.363KHz(typ.)
			—	1344	—	CLK	
	Display period	thd	1024			CLK	—
	Front-porch	thf	1	40	—	CLK	—
	Pulse width	thp *	2	208	—	CLK	—
	Back-porch	thb *	21	72	—	CLK	—
	*) thp + thb		81	320	1000	CLK	—
	CLK-Hsync timing	thh	2.5	—	—	ns	—
	Hsync-CLK timing	ths	2.5	—	—	ns	—
	Hsync-Vsync timing	thv	1	—	—	CLK	—
	Vsync-Hsync timing	tvh	10	—	—	ns	—
	Rise, fall	thrf	—	—	—	ns	—
Vsync	Period	tv	13.3	16.666	18.5	ms	59.94Hz(typ.)
			780	806	—	H	
	Display period	tvd	768			H	—
	Front-porch	tvf	1	3	—	H	—
	Pulse width	tvp *	2	—	—	H	—
	Back-porch	tvb *	1	33	—	H	—
	*) tvp + tvb		4	38	—	H	—
DATA	Rise, fall	tvr	—	—	10	ns	—
	DATA-CLK(Set up)	tds	2.5	—	—	ns	—
D E	CLK-DATA (Hold)	tdh	2.5	—	—	ns	—
	DE-CLK timing	tes	2.5	—	—	ns	—
	CLK-DE timing	the	2.5	—	—	ns	—
D E	Rise, fall	terf	—	—	10	ns	—

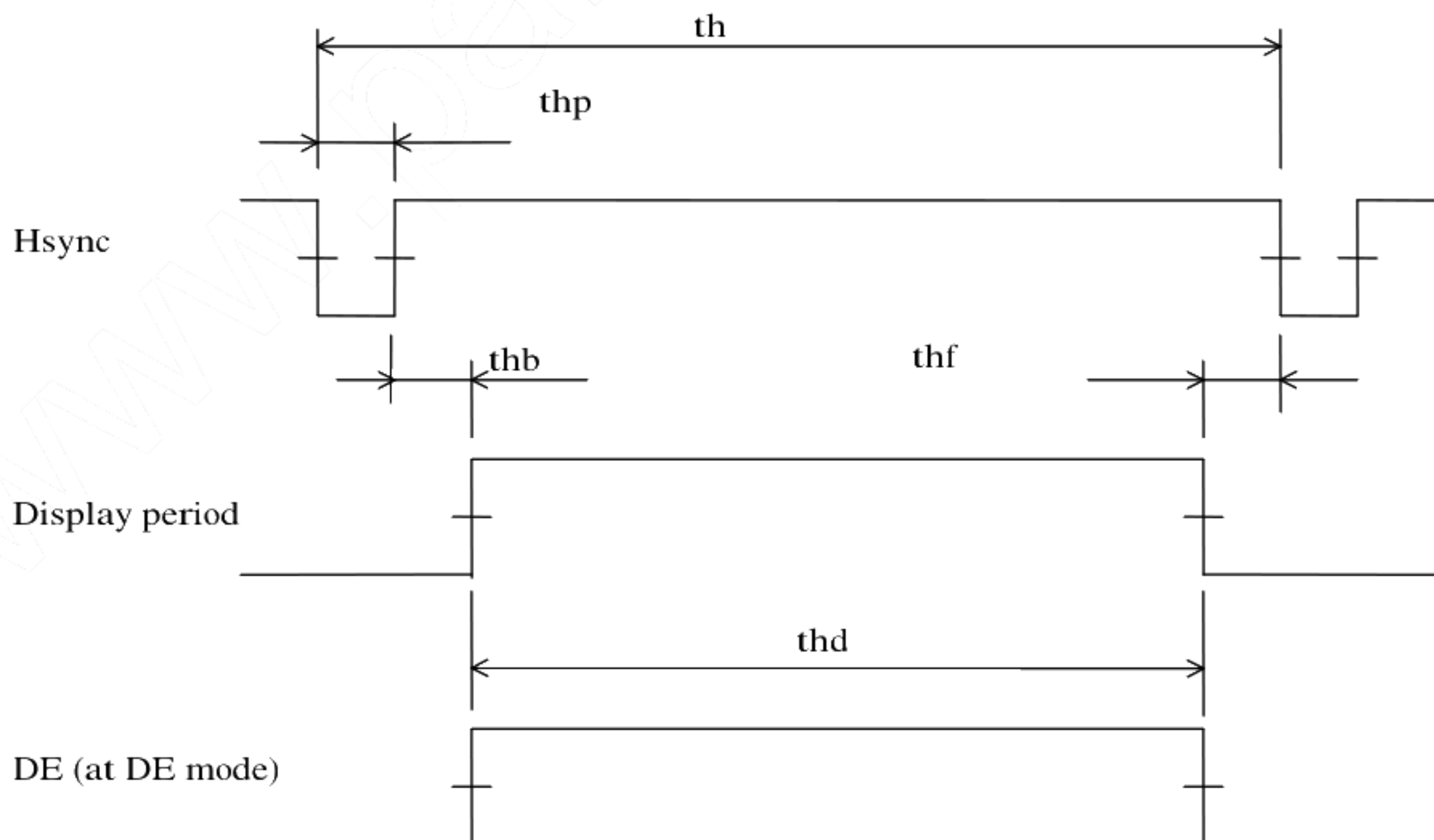
Remark : All parameters should be kept within the specified range.

(2) Definition of input signal timing

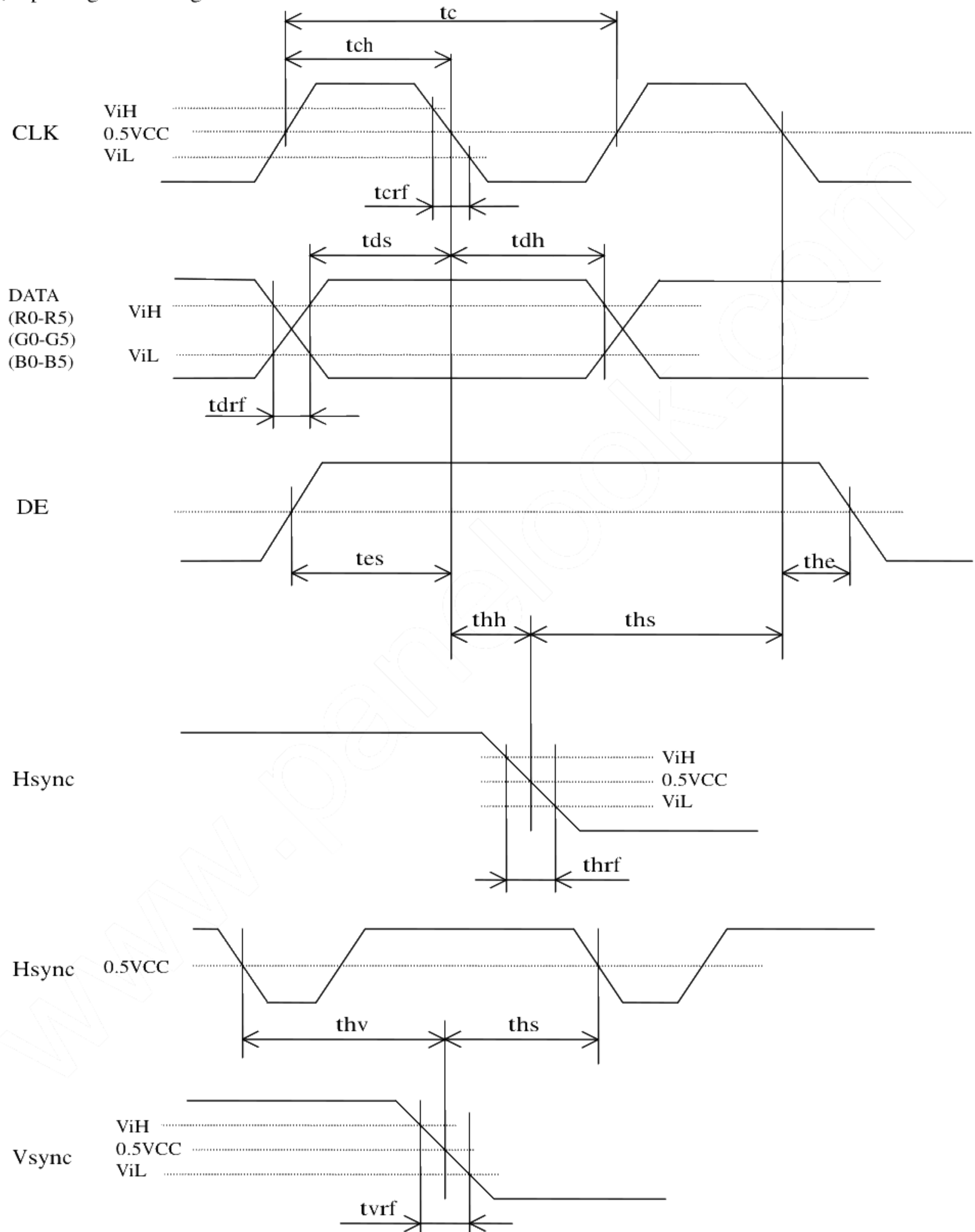
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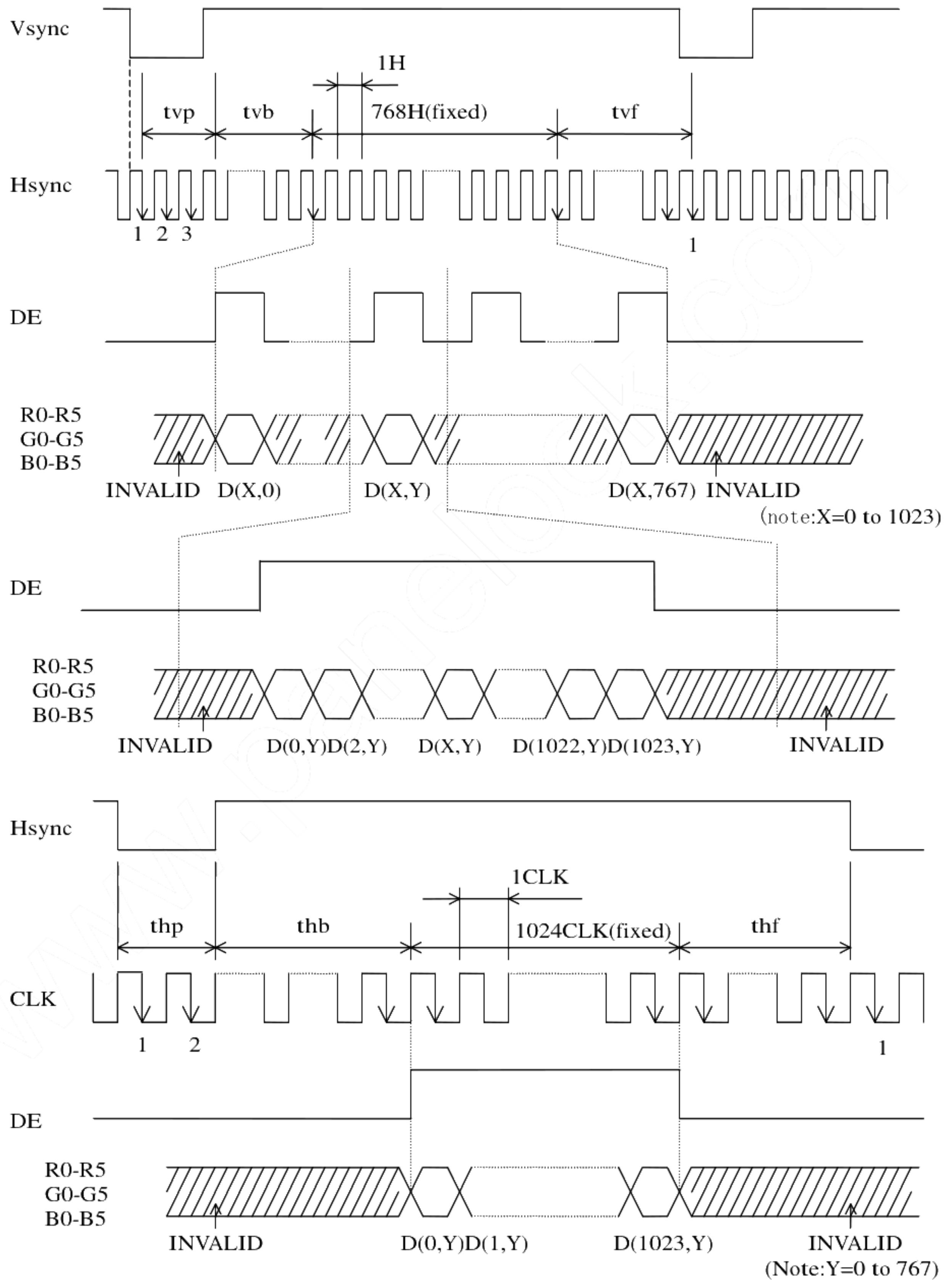
< Horizontal >



(3) Input signal timing chart



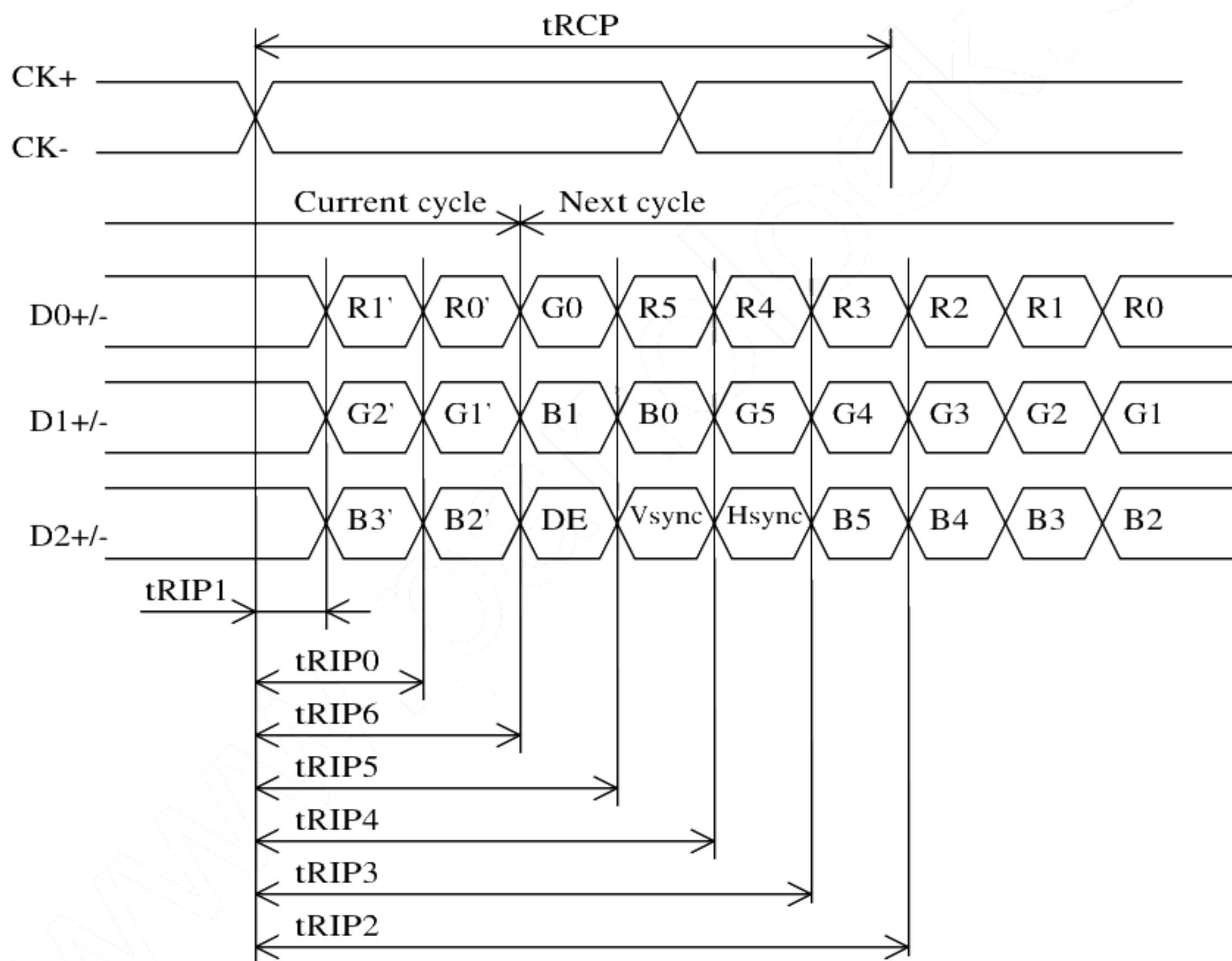
(4) Input signal timing chart



(5) Input signal specifications (It is prescribed in the part CN1 input)

Parameters	Symbol	min.	typ.	max.	Unit	Remark
CLK Frequency	tRCP	14.71	T	16.66	ns	–
Bit0 position	tRIP1	–	0	–	ns	T=15.38ns
Bit1 position	tRIP0	–	T/7	–	ns	T=15.38ns
Bit2 position	tRIP6	–	2T/7	–	ns	T=15.38ns
Bit3 position	tRIP5	–	3T/7	–	ns	T=15.38ns
Bit4 position	tRIP4	–	4T/7	–	ns	T=15.38ns
Bit5 position	tRIP3	–	5T/7	–	ns	T=15.38ns
Bit6 position	tRIP2	–	6T/7	–	ns	T=15.38ns

(6) Input signal timing chart (It is prescribed in the part CN1 input)



14.DISPLAY POSITION

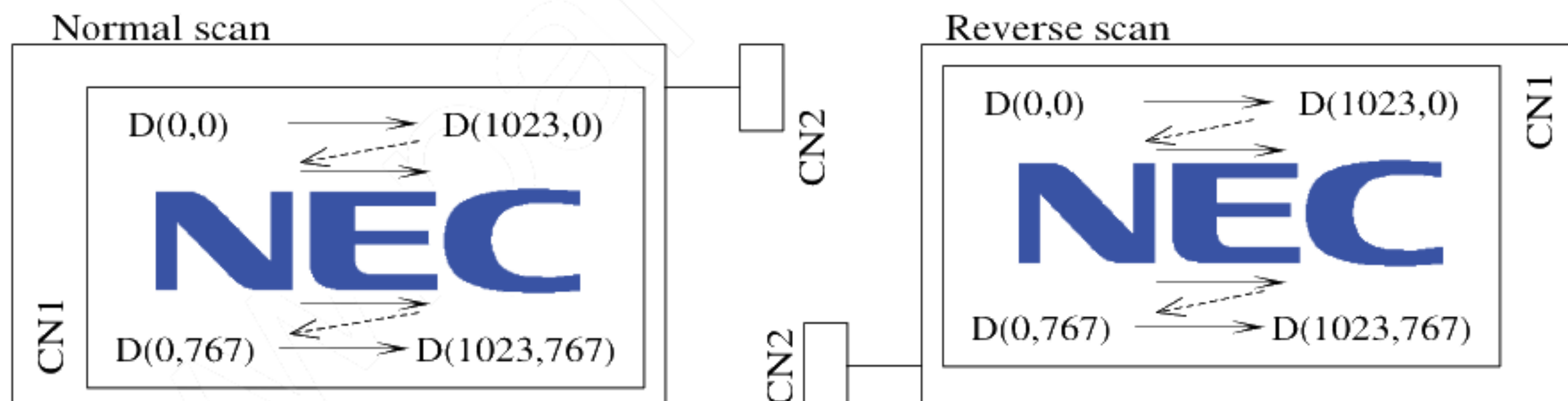
Normal scan (DPS = "Low")

D(0,0)	D(1,0)	-	D(X,0)	-	D(1022,0)	D(1023,0)
D(0,1)	D(1,1)	-	D(X,1)	-	D(1022,1)	D(1023,1)
I	I	+	I	+	I	I
D(0,Y)	D(1,Y)	-	D(X,Y)	-	D(1022,Y)	D(1023,Y)
I	I	+	I	+	I	I
D(0,766)	D(1,766)	-	D(X,766)	-	D(1022,766)	D(1023,766)
D(0,767)	D(1,767)	-	D(X,767)	-	D(1022,767)	D(1023,767)

Reverse scan (DPS = "High")

D(1023,767)	D(1022,767)	-	D(X,767)	-	D(1,767)	D(0,767)
D(1023,766)	D(1022,766)	-	D(X,766)	-	D(1,766)	D(0,766)
I	I	+	I	+	I	I
D(1023,Y)	D(1022,Y)	-	D(X,Y)	-	D(1,Y)	D(0,Y)
I	I	+	I	+	I	I
D(1023,1)	D(1022,1)	-	D(X,1)	-	D(1,1)	D(0,1)
D(1023,0)	D(1022,0)	-	D(X,0)	-	D(1,0)	D(0,0)

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



15.OPTICAL CHARACTERISTICS

Ta=25°C note 1

Parameter	Symbol	condition	Min.	Typ.	Max.	Unit	Remark
Luminance	Lvmax	note 3	TBD	300	—	cd/m ²	note 2
Contrast ratio	CR	note 3	TBD	300	—	—	note 4
Brightness uniformity	—	max./min.	—	—	1.4	—	note 7

Reference data

Ta=25°C note 1

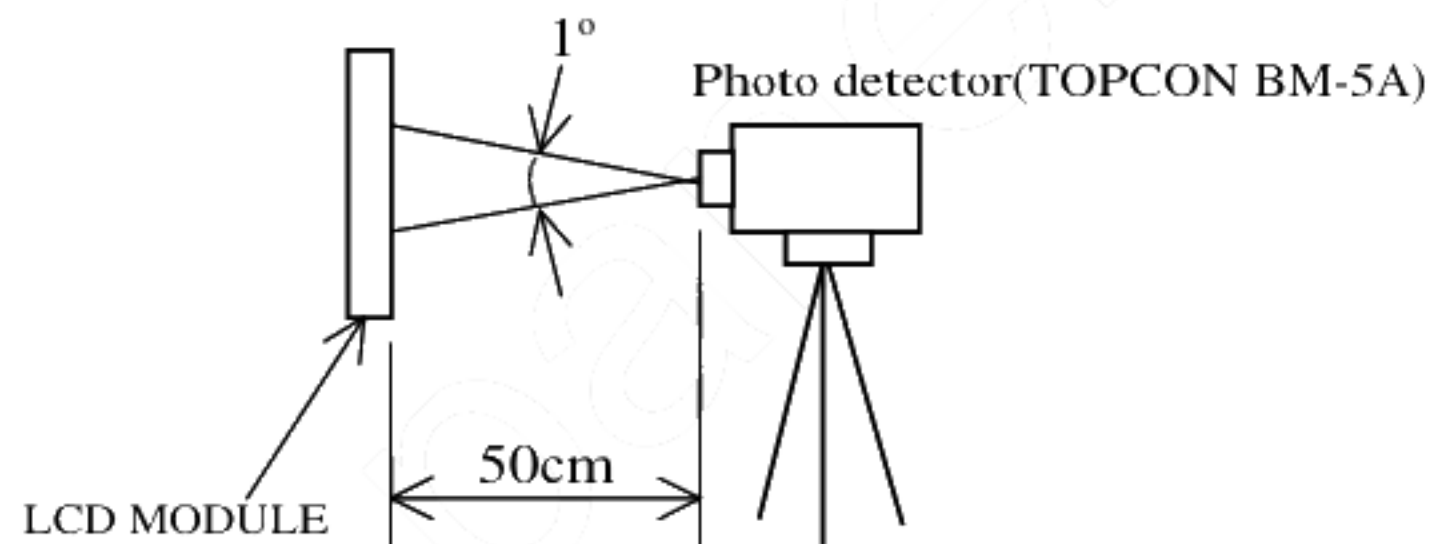
Parameter	Symbol	condition	Min.	Typ.	Max.	Unit	Remark
Color gamut	C	at center, to NTSC	35	40	—	%	—
Viewing angle range	Horizontal	θ_{x+}	TBD	60	—	deg.	note 5
		θ_{x-}	TBD	60	—		
	Vertical	θ_{y+}	TBD	45	—		
		θ_{y-}	TBD	60	—		
Chromaticity coordinate	White	Wx	—	(0.315)	—	—	—
		Wy	—	(0.340)	—		
Response time	ton	white to black	—	15	TBD	ms	note 6
	toff	black to white	—	45	TBD		

note 1) VCC = 3.3V, IL=5.0mA_{rms}, at normal scan.

note 2) The luminance is measured after 20 minute from the module works, with all pixels in "white".

Typical value is measured after luminance saturation.

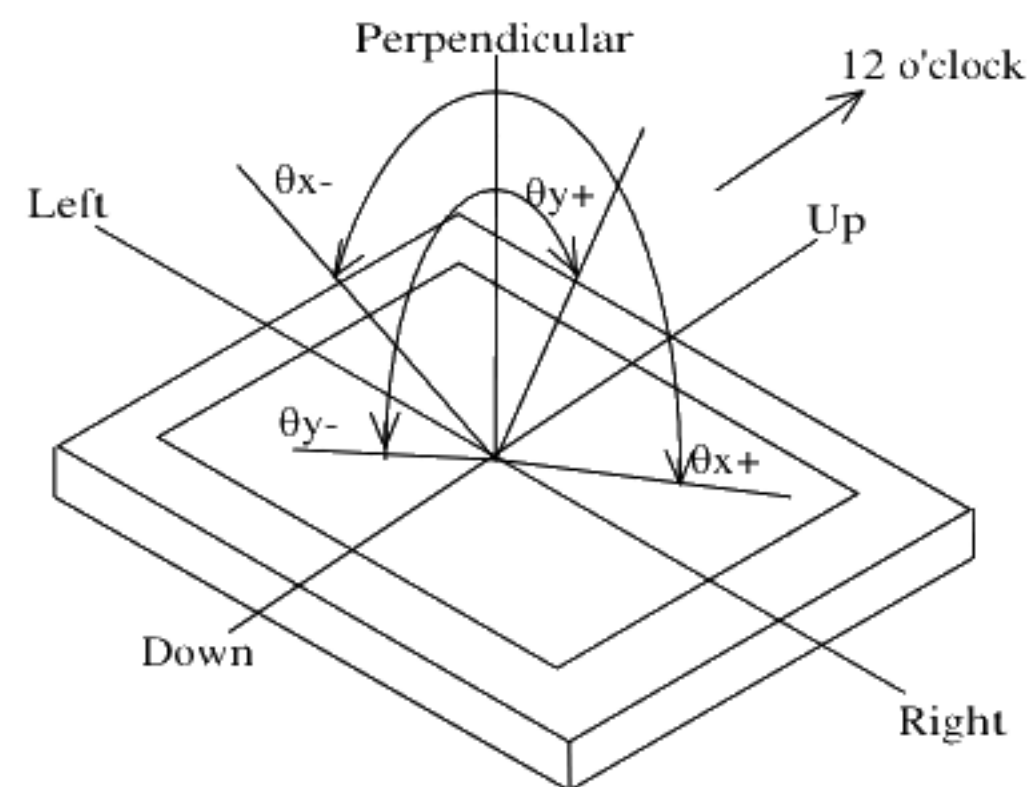
The luminance is measured in dark room

note 3) 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.

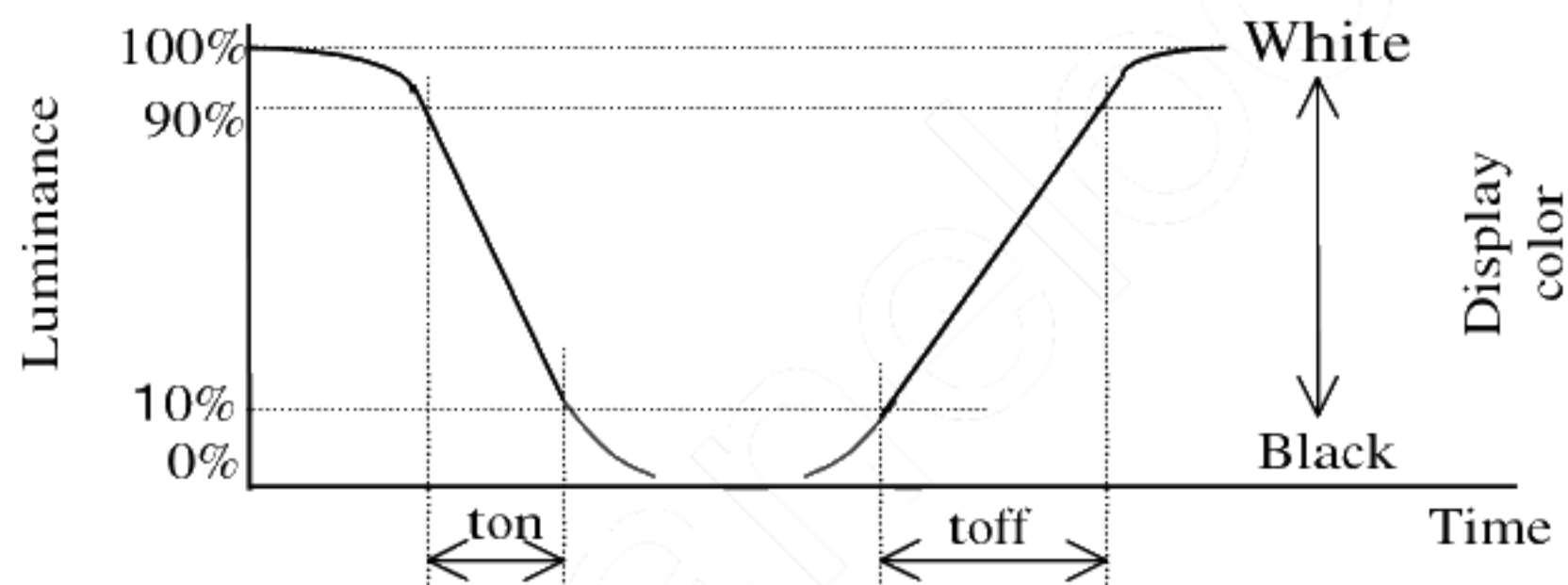
$$\text{Contrast ratio(CR)} = \frac{\text{Luminance with all pixels in "white"}}{\text{Luminance with all pixels in "black"}}$$

note 5) Definitions of viewing angle are as follows.



note 6) Definition of response time is as follows.

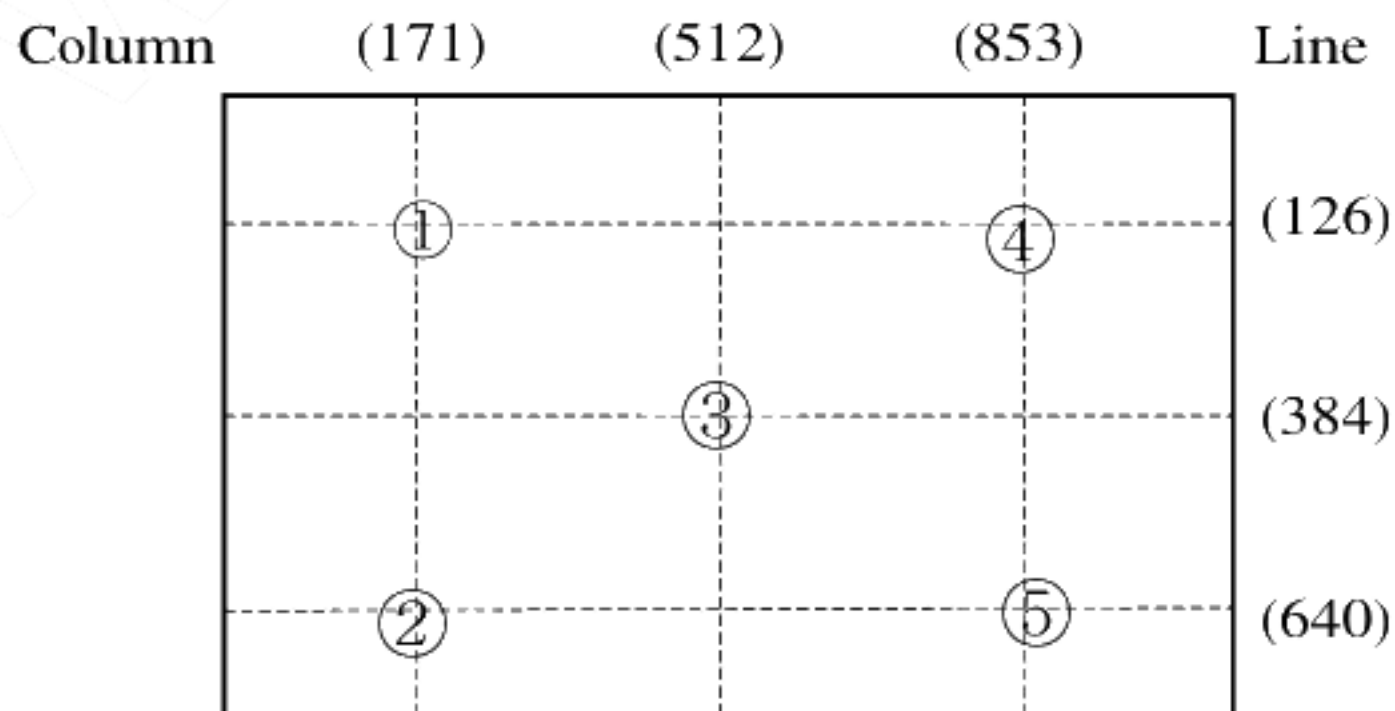
Photo detector output signal is measured when the luminance changes “black” to “white” (“white” to “black”). Response time is the time between 10% and 90% (90% and 10%) of the photo detector output amplitude.



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.



16. PRECAUTIONS

16-1 MEANING OF CAUTION SIGNS

The following caution signs have very important meaning.

Be sure to understand following contents, respectively.



CAUTION

This sign is a meaning that customer will be injured himself and/or the product will sustain a damage, if he makes a mistake in operations.



This sign has a meaning that customer will be injured himself if makes a mistake in operations

16-2 CAUTION



*Pay attention to handling for the working backlight. It may be over 35°C from ambient temperature.

*Do not shock and press the LCD panel and the backlight. There will be in danger of breaking, because they are made of glass. (Shock: To be not greater 294m/s²(30G), 11ms, Pressure: To be not greater 19.6N(2kgf))

16-3 ATTENTION

(1) Attention to handling the product

- ① When customer pulls out products from carton box, take hold of both ends without touch the circuit board. If customer touches it, products may be broken down and/or out of adjustment, because of stress to mounting parts.
- ② If customer places products temporarily, turn down the display side and on a flat table.
- ③ Handle products with care and avoid electrostatic discharge(e.g. Decrease with earth band, ionic shower, etc.), because product(LCD module) may be damaged by electrostatic.
- ④ The torque for mounting screws should never exceed 0.29N·m(3.0kgf·cm). Over torque may cause mechanical damage to the product.
- ⑤ Do not press or friction, because LCD panel surface is sensitive. If customer will clean the product surface, NEC Corporation will recommend using the cloth with ethanol liquid.
- ⑥ Do not push-pull the interface connectors while turn on, because wrong power sequence may break down the product/
- ⑦ Connection cables such as flexible cable, and so on, are danger of damage. Do not hook cables nor pull them.

(2)Attentions to environment

- ①Dewdrop atmosphere must be avoided.
- ②Do not operate and/or store in high temperature and/or high humidity atmosphere. If customer stores the product, keep in antistatic pouch in room temperature, because of avoidance for dusts and sunlight.
- ③Do not operate in high magnetic field. Circuit boards may be broken down by it.
- ④Use an original protection sheet on product surface(polarizer).Adhesive type protection sheet should be avoided, because it may change color and/or properties of the polarizer.

(3)Attentions to specification for products

- ①Do not display the fixed pattern for a long time because it may cause image sticking. If the fixed pattern is displayed on the screen saver.
- ②The product may be change of color by viewing angle because of the use of condenser sheet for backlight unit.
- ③Optical characteristics may be changed by input signal timing.
- ④Non uniformity may appear on the screen during high-temperature operation.

(4)Other attentions

- ①Do not disassemble a product and/or adjust volume.
- ②If customer would like to replace backlight lamps, see 'REPLACEMENT MANUAL FOR LAMP HOLDER'.
- ③If customer uses screwnails, pay attention not to insert waste materials in inside of products.
- ④When customer returns product for repair and so on, pack it with original shipping package because of avoidance of some damages during transportation.

General specifications for the liquid crystal display(LCD)

The following items are neither defects nor failures.

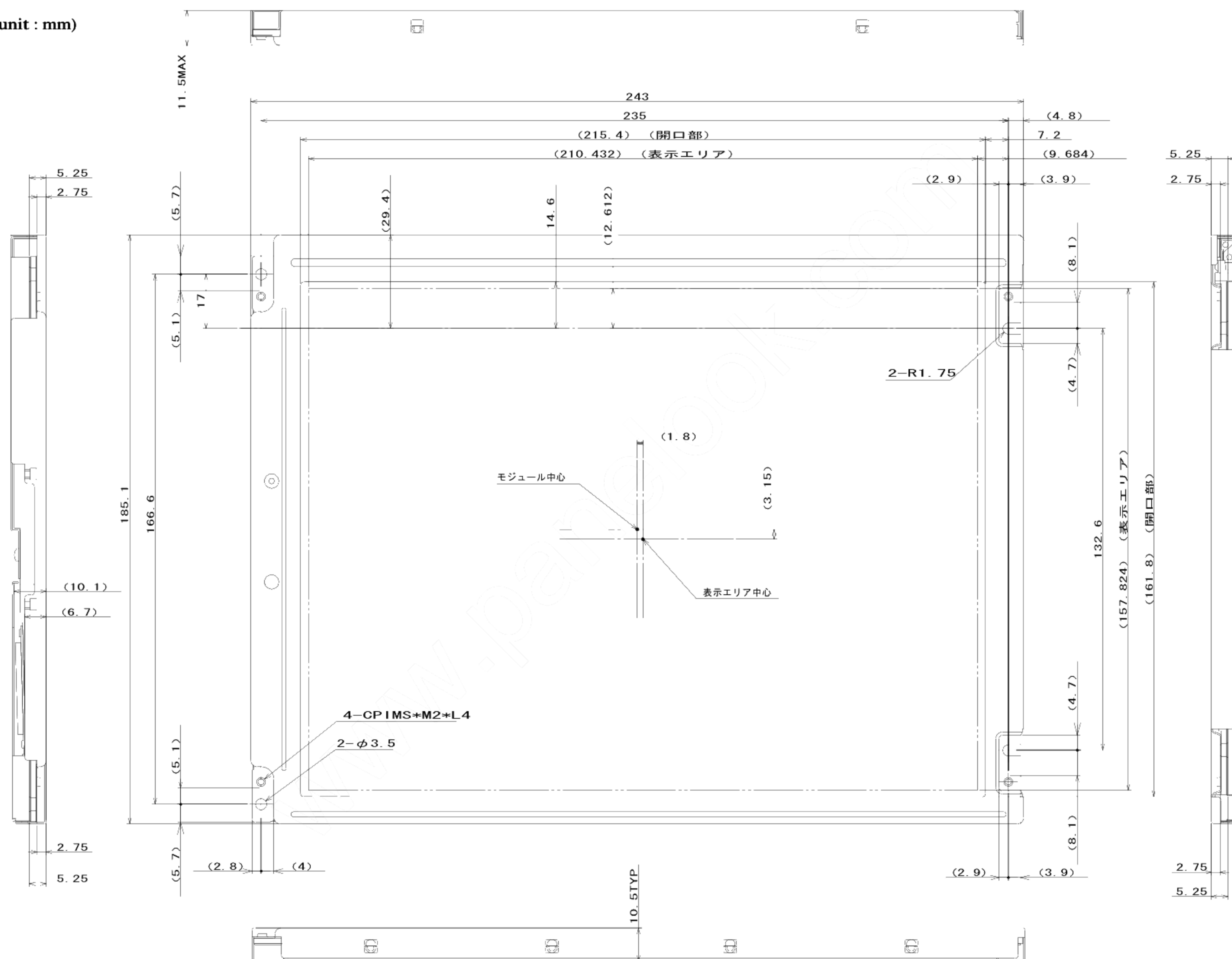
*Response time luminance and color gamut may be changed by ambient temperature.

*The LCD may be seemed luminance uniformity, flicker, vertical seam and/or small spot by display patterns.

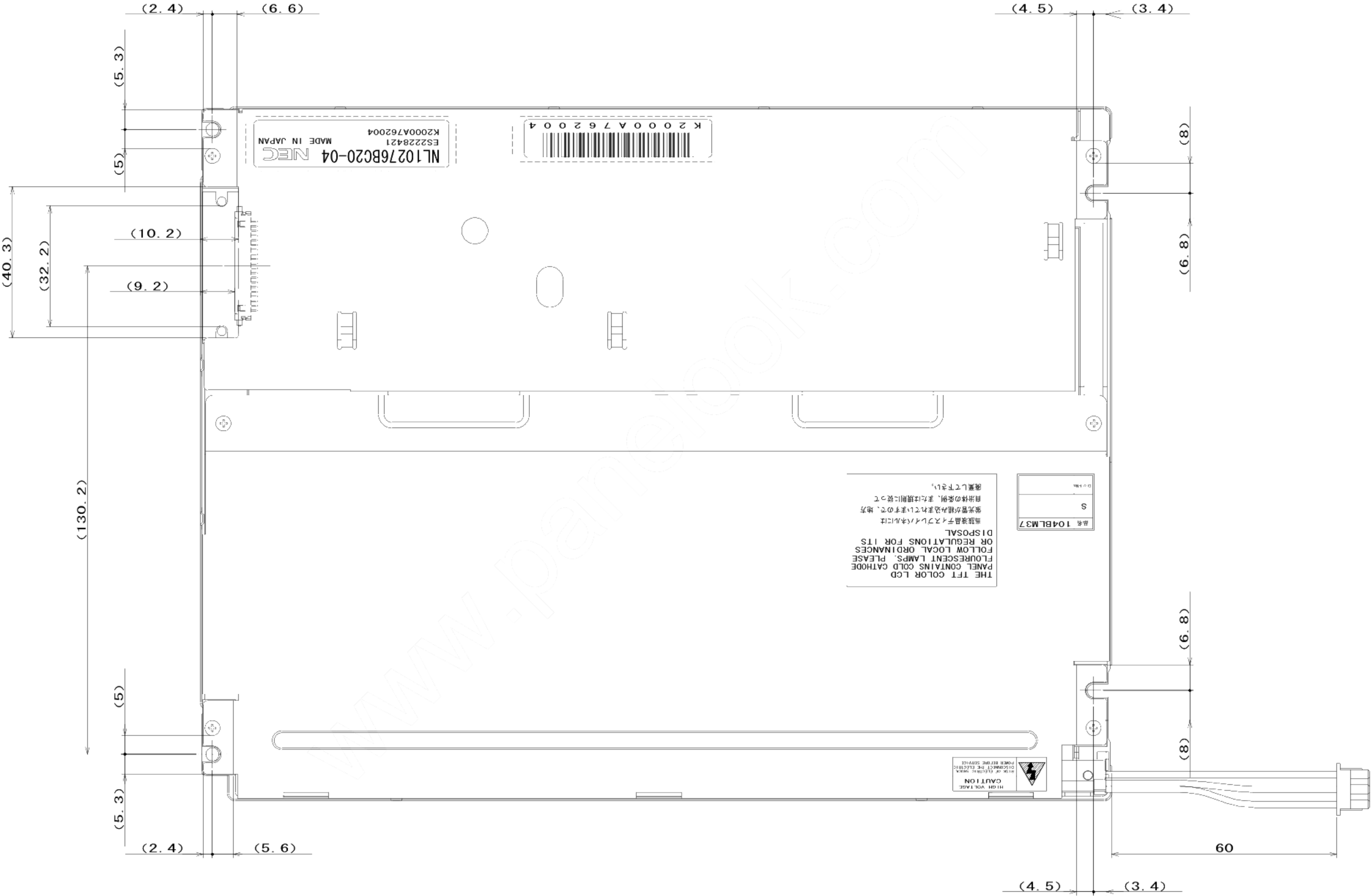
*Optical characteristics(e.g. luminance, display uniformity, etc.)gradually is going to change depending on operating time, and especially low temperature, because the LCD has cold cathode fluorescent lamps.

17. OUTLINE DRAWING

17-1 FRONT VIEW(unit : mm)



17-2 REAR VIEW (unit : mm)



Revision History				DOD-N-0228		23/23
No.	Prepared Date	Revision Contents	Approved	Checked	Prepared	Issued Date
1	May.9, 2001	DOD-N-0153	H.Kaneko	–	K.Yuge	May.9, 2001
2	July.6, 2001	DOD-N-0228 Page 4 Contrast ratio is corrected 300→300:1 Polarizer pencil-hardness is corrected 2H→3H Page 6 Logic input "L" voltage is corrected Logic input "H" voltage is corrected Page 21 FRONT VIEW is corrected Page 22 REAR VIEW is added	H.Kaneko	Y.Horie	K.Yuge	July.6, 2001