

NEC

TFT COLOR LCD MODULE

NL10276AC28-05R

35.7cm (14.1 Type)

XGA

DATA SHEET 

(1st edition)

All information is subject to change without notice.

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Anti-radioactive design is not implemented in this product.

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1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

NL10276AC28-05R module is composed of the amorphous silicon thin film transistor liquid crystal display (a-Si TFT LCD) panel structure with driver LSIs for driving the TFT (Thin Film Transistor) array and a backlight unit.

The a-Si TFT LCD panel structure is injected liquid crystal material into a narrow gap between the TFT array glass substrate and a color-filter glass substrate.

Color (Red, Green, Blue) data signals from a host system (e.g. PC, signal generator, etc.) are modulated into best form for active matrix system by a signal processing board, and sent to the driver LSIs which drive the individual TFT arrays.

The TFT array as an electro-optical switch regulates the amount of transmitted light from the backlight assembly, when it is controlled by data signals. Color images are created by regulating the amount of transmitted light through the TFT array of red, green and blue dots.

1.2 APPLICATIONS

- PC monitor

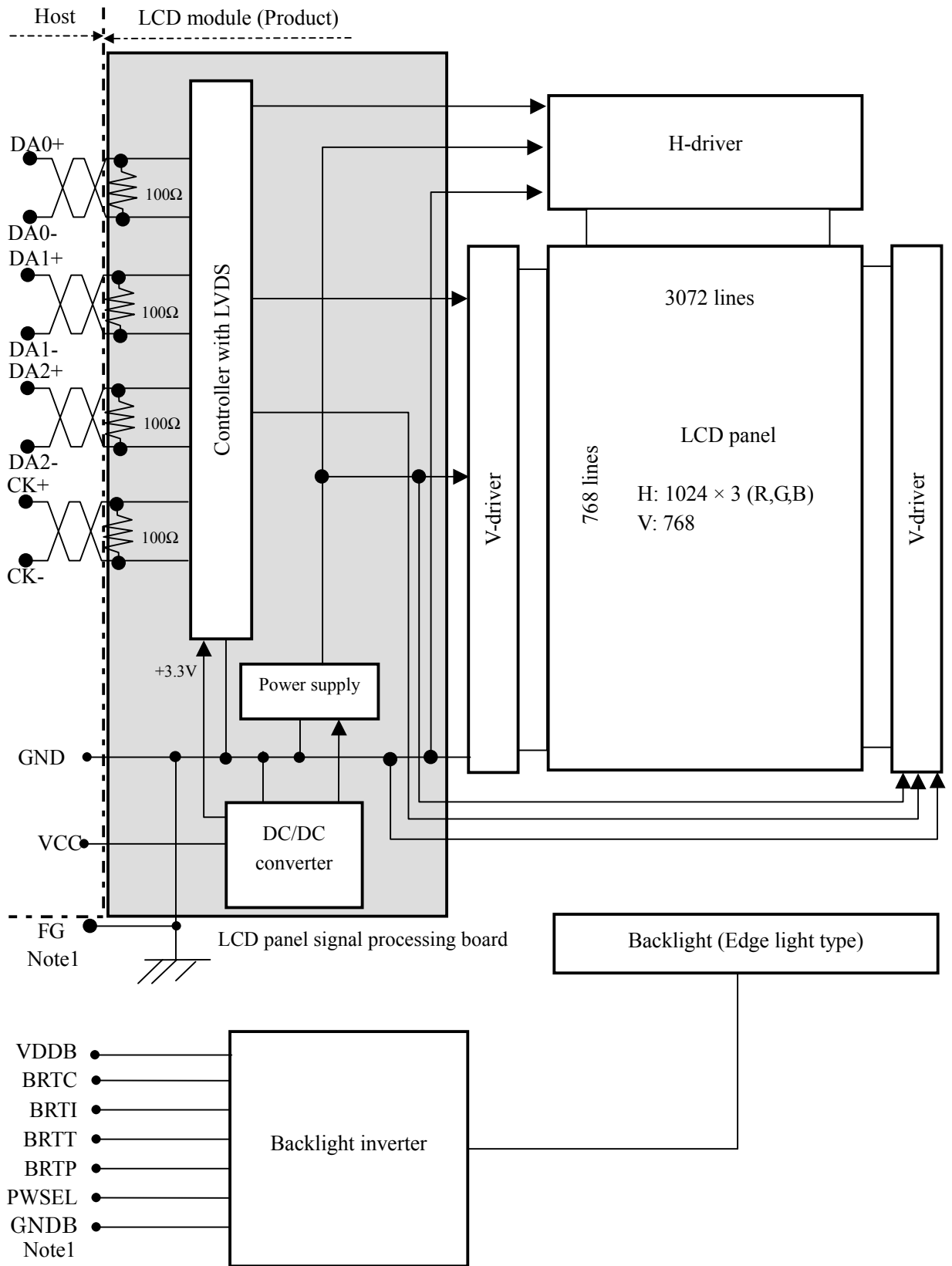
1.3 FEATURES

- High luminance
- 6-bit digital RGB signals
- LVDS interface
- Edge light type
- Replaceable backlight unit and inverter

2. GENERAL SPECIFICATIONS

Display area	285.7 (H) × 214.3 (V) mm (typ.)
Diagonal size of display	35.7 cm (14.1 inches)
Drive system	a-Si TFT active matrix
Display color	262,144 colors
Pixel	1024 (H) × 768 (V) pixels
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe
Dot pitch	0.0930 (H) × 0.2790 (V) mm
Pixel pitch	0.2790 (H) × 0.2790 (V) mm
Module size	330.0 (H) × 255.0 (V) × 20.0 (D) mm (typ.)
Weight	1,180 g (typ.)
Contrast ratio	150:1 (typ.)
Viewing angle	<p><i>At the contrast ratio 10:1</i></p> <ul style="list-style-type: none"> • Horizontal: Left side 50° (typ.), Right side 50° (typ.) • Vertical: Up side 20° (typ.), Down side 35° (typ.)
Designed viewing direction	<ul style="list-style-type: none"> • Viewing direction without image reversal: up side (12 o'clock) • Viewing direction with contrast peak: down side 5° (6 o'clock) • Optimum grayscale ($\gamma=2.2$): normal axis
Polarizer surface	Antiglare treatment
Polarizer pencil-hardness	3H (min.) [by JIS K5400]
Color gamut	<p><i>At LCD panel center</i></p> <p>40 % (typ.) [against NTSC color space]</p>
Response time	11 ms (typ.)
Luminance	220 cd/m ² (typ.)
Signal system	<p>1 port LVDS (THine Electronics Inc. THC63LVDF64A)</p> <p>[6-bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE), Horizontal synchronous signal (Hsync), Vertical synchronous signal (Vsync)]</p>
Supply voltages	<p>LCD panel signal processing board: 5.0V</p> <p>Backlight inverter: 12.0V</p>
Backlight	<p>Edge light type: 2 cold cathode fluorescent lamps</p> <p>(Replaceable parts)</p> <ul style="list-style-type: none"> • Lamp holder: type No. 141LHS08 • Inverter: type No. 141PW201
Power consumption	<p><i>At maximum luminance and checkered flag pattern</i></p> <p>11 W (typ.)</p>

3. BLOCK DIAGRAM



Note 1: GND is connected to FG (Frame ground). GNDB is not connected to FG.
 GND and GNDB should be connected together in customer equipment.

4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification	Unit
Module size	330.0 ± 0.5 (H) \times 255.0 ± 0.5 (V) \times 20.0 ± 0.5 (D) Note1	mm
Display area	285.7 ± 0.5 (H) \times 214.3 ± 0.5 (V) Note1	mm
Weight	1,180 (typ.), 1,300 (max.)	g

Note1: See "7.OUTLINE DRAWINGS".

4.2 ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Rating	Unit	Remarks	
Supply voltage	LCD panel signal board and driver	VCC	-0.3 to +6.0	V	Ta = 25°C	
	Backlight inverter	VDDDB	-0.3 to +14	V		
Input voltage	LCD panel signal board	Display signals Note1	Vi	-0.3 to 3.4	V	Ta = 25°C VDDDB = 12.0V
	Backlight inverter	BRTI signal	ViBI	-0.3 to +1.5	V	
		BRTT signal	ViBT	-0.3 to +5.5	V	
		BRTP signal	ViBP	-0.3 to +5.5	V	
		BRTC signal	ViBC	-0.3 to +5.5	V	
		PWSEL signal	ViBS	-0.3 to +5.5	V	
Storage temperature		Tst	-20 to +60	°C	-	
Operating temperature Note2		TopF	0 to +50	°C	Front view surface	
Relative humidity Note3		RH	≤ 95	%	Ta $\leq 40^\circ\text{C}$	
			≤ 85	%	$40 < \text{Ta} \leq 50^\circ\text{C}$	
			≤ 70	%	$50 < \text{Ta} \leq 55^\circ\text{C}$	
Absolute humidity Note3		-	≤ 78 Note4	g/m ³	Ta $> 55^\circ\text{C}$	

Note1: Display signals are DA0+/-, DA1+/-, DA2+/- and CK+/- . Also controller with LVDS receiver are worked by +3.3V from DC/DC converter.

Note2: Measured at the LCD panel surface

Note3: No condensation

Note4: Ta = 55°C, RH = 70%

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 Driving for LCD panel signal processing board

(Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks	
Supply voltage	VCC	4.8	5.0	5.2	V	-	
Supply current	ICC	-	270 Note1	600 Note2	mA	VCC = 5.0V	
Input voltage for LVDS receiver	VI	0	-	2.4	V	-	
Differential input threshold voltage for LVDS receiver	Low	VTL	-100	-	-	mV	VOC=1.2V Note3
	High	VTH	-	-	+100	mV	

Note1: Checkered flag pattern (by EIAJ ED-2522)

Note2: Pattern for maximum current

Note3: Common mode voltage for LVDS

4.3.2 Driving for backlight inverter

(Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks	
Supply voltage	VDDB	10.8	12.0	13.2	V	-	
Supply current	IDDB	-	820	860	mA	at maximum luminance, VDDB = 12.0V Note1	
Input voltage for control system	BRTI signal		ViBI	0	-	1.2	V
	BRTT signal	Low	ViBTL	0	-	0.8	V
		High	ViBTH	2.0	-	5.2	V
	BRTP signal	Low	ViBPL	0	-	0.8	V
		High	ViBPH	2.0	-	5.2	V
	BRTC signal	Low	ViBCL	0	-	0.8	V
		High	ViBCH	2.0	-	5.2	V
	PWSEL signal	Low	ViBSL	0	-	0.8	V
High		ViBSH	2.0	-	5.2	V	
Input current for control system	BRTI signal		IiBI	-130	-	-	μA
	BRTT signal	Low	IiBTL	-810	-	-	μA
		High	IiBTH	-	-	440	μA
	BRTP signal	Low	IiBPL	-1,580	-	-	μA
		High	IiBPH	-	-	3,500	μA
	BRTC signal	Low	IiBCL	-610	-	-	μA
		High	IiBCH	-	-	440	μA
	PWSEL signal	Low	IiBSL	-610	-	-	μA
High		IiBSH	-	-	440	μA	

Note1: The power supply lines (VDDB and GNDB) occurs large ripple voltage while dimming.

There is the possibility that the ripple voltage produces acoustic noise and signal wave noise in audio circuit and so on. Put a capacitor (5,000 to 6,000μF) between the power source lines (VDDB and GNDB) to reduce the noise, if the noise occurred in the circuit.

4.3.3 Supply voltage ripple

This product works, even if the ripple voltage levels are beyond the permissible values as following the table, but there might be noise on the display image.

Supply voltage	Ripple voltage (Measure at input terminal of power supply)	Note1	Unit
VCC (for LCD panel signal processing board; 5.0V)	≤ 100		mVp-p
VDDDB (for backlight inverter; 12.0V)	≤ 200		mVp-p

Note1: The permissible ripple voltage includes spike noise.

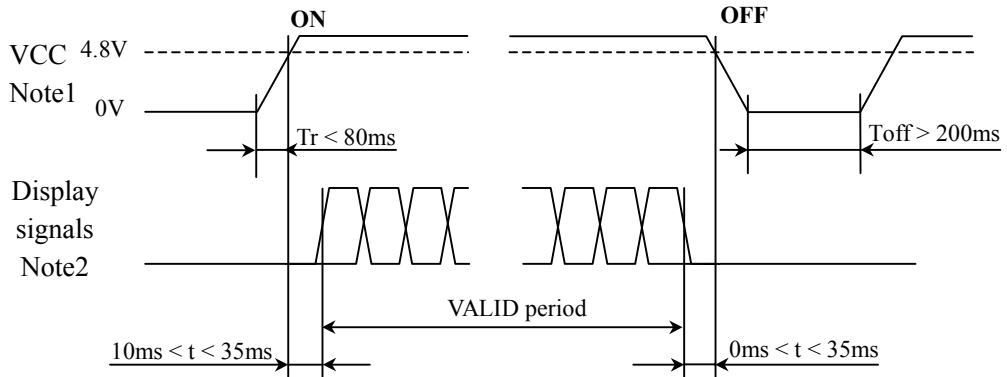
4.3.4 Fuses

Fuse		Rating Note1	Unit	Remarks
Type	Supplier			
KAB2402162	Matsuo Electric Co., Ltd.	1.6	A	VCC (for LCD panel signal processing board)
		24	V	
R433002	Littel Fuse Inc.	2.0	A	VDDDB (for backlight inverter)
		63	V	

Note1: The power capacity should be more than twice of fuse current ratings. If the power capacity is less than the criteria value, the fuse may not blow, and then nasty smell, smoking and so on may occur.

4.4 SUPPLY VOLTAGE SEQUENCE

4.4.1 Sequence for LCD panel signal processing board

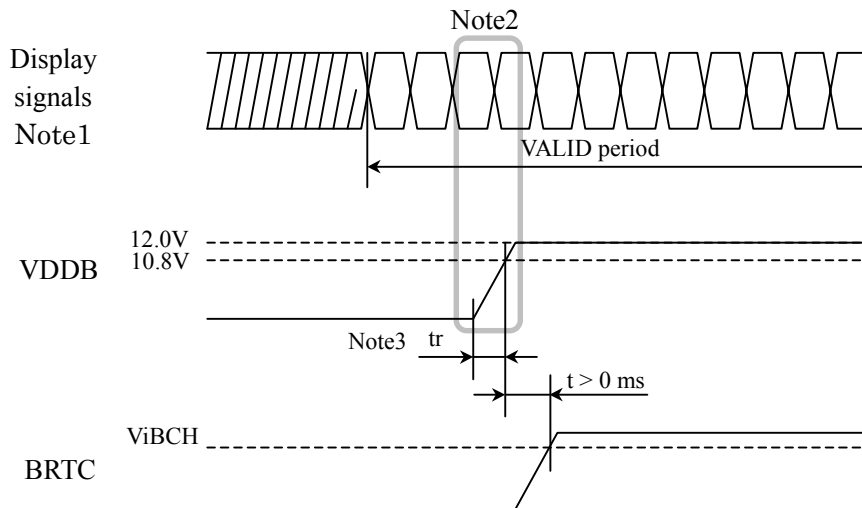


Note1: In terms of voltage variation (voltage drop) while VCC rising edge is below 4.8V, a protection circuit may work, and then this product may not work.

Note2: Display signals (DA0+/-, DA1+/-, DA2+/- and CK+/-) with 100Ω (Characteristic impedance) must be Low or High-impedance, exclude the VALID period (See above sequence diagram), in order to avoid that internal circuits is damaged.

If some of display signals of this product are cut while this product is working, even if the signal input to it once again, it might not work normally. If customer stop display signals, they should be cut VCC.

4.4.2 Sequence for backlight inverter



Note1: These are the display signals for LCD panel signal processing board.

Note2: The backlight power voltage (VDDb) should be inputted within the valid period of display signals, in order to avoid unstable data display.

Note3: The t_r should be less than 800ms when BRTC terminal [Socket: CN201, Pin No.: 8 or Socket: CN202, Pin No.: 4] (See '4.5.2 Backlight inverter'.) is Open.

4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

4.5.1 LCD panel signal processing board

CN1 socket (Module side): FI-SEB20P-HF (Japan Aviation Electronics Industry Limited)

Adaptable plug: FI-SE20M (Japan Aviation Electronics Industry Limited)

Pin No.	Symbol	Function	Remarks
1	GND	Ground	-
2	GND		
3	N.C.	Non-connection	
4	N.C.		
5	GND	Ground	
6	CK+	Pixel clock	Note1
7	CK-		
8	GND	Ground	-
9	D1-	Pixel data	Note1
10	D1+		
11	GND	Ground	-
12	D1-	Pixel data	Note1
13	D1+		
14	GND	Ground	-
15	D0+	Pixel data	Note1
16	D0-		
17	GND	Ground	-
18	GND		
19	VCC	Power supply	
20	VCC		

Note1: Twist pair wires with 100Ω (Characteristic impedance) should be connected between LCD panel signal processing board and LVDS transmitter.

CN1: Figure of socket

20 19 2 1

4.5.2 Backlight inverter

Select only one of the terminals of CN201 or CN202 about use of the terminal with the same function such as BRTT, BRTC and BRTI!

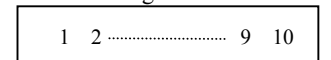
CN201 socket: IL-Z-11PL1-SMTY (Japan Aviation Electronics Industry Limited)

Adaptable plug: IL-Z-11S-S125C3 (Japan Aviation Electronics Industry Limited)

Pin No.	Symbol	Function	Remarks
1	VDDDB	Power supply	-
2	VDDDB	Power supply	
3	VDDDB	Power supply	
4	GNDB	Backlight ground	
5	GNDB	Backlight ground	
6	GNDB	Backlight ground	
7	BRTT	Luminance control by two step method	Note1
8	BRTC	Backlight ON/OFF signal	ON: High or Open, OFF: Low
9	GNDB	Backlight ground	-
10	BRTI	Input of luminance control by voltage method	
11	N.C.	Non-connection	

Note1: See "4.7.1 Luminance control method".

CN201: Figure of socket



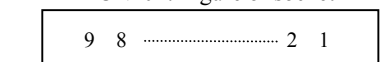
CN202 socket: IL-Z-9PL1-SMTY (Japan Aviation Electronics Industry Limited)

Adaptable plug: IL-Z-9S-S125C3 (Japan Aviation Electronics Industry Limited)

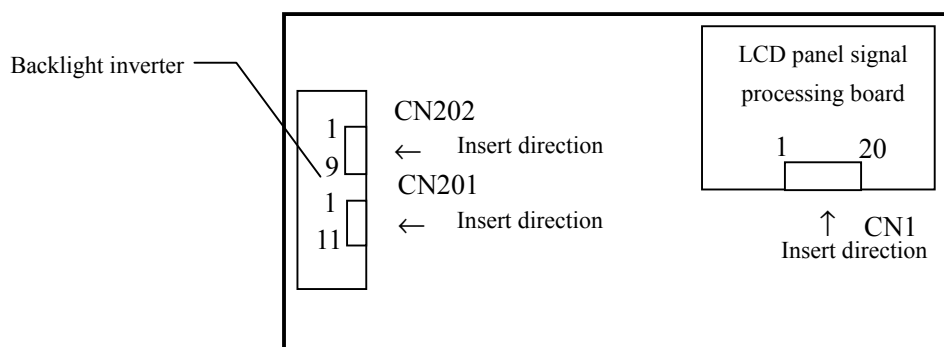
Pin No.	Symbol	Function	Remarks
1	GNDB	Backlight ground	-
2	GNDB		
3	BRTT	Luminance control by two step method	Note1
4	BRTC	Backlight ON/OFF signal	ON: High or Open, OFF: Low
5	GNDB	Backlight ground	-
6	BRTI	Luminance control by resistor method or voltage method	Note1
7	BRTP		
8	GNDB	Backlight ground	-
9	PWSEL	Select of luminance control method	Note1

Note1: See "4.7.1 Luminance control method".

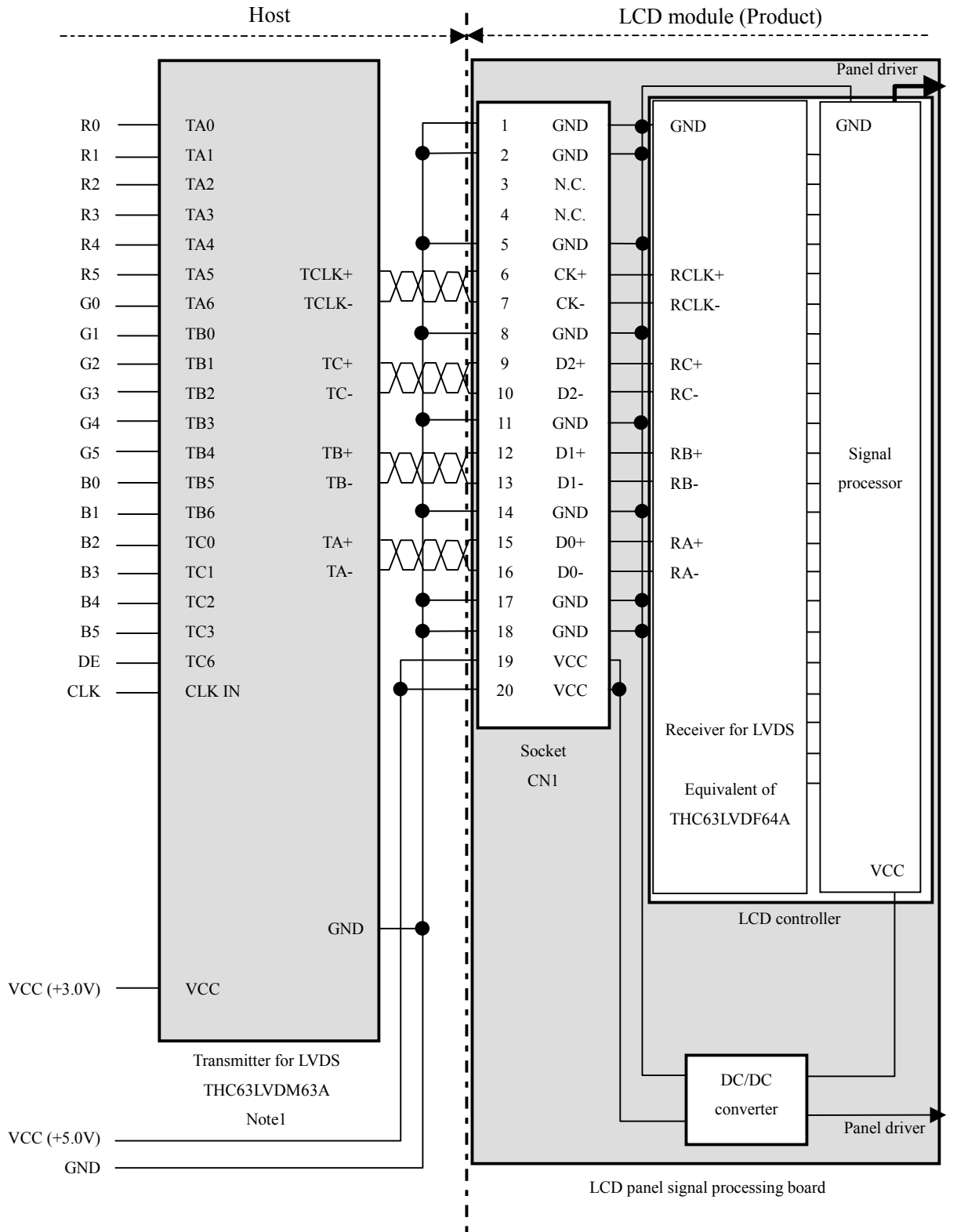
CN202: Figure of socket



4.5.3 Positions of sockets



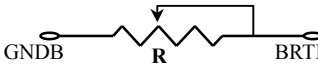
4.5.4 Connection between receiver and transmitter for LVDS



Note1: Recommended transmitter
See the data sheet for THC63LVDM63A (Thein Electronics Inc.).

4.6 LUMINANCE CONTROLS

4.6.1 Luminance control methods

Method	Adjustment and luminance ratio	PWSEL signal	BRTP signal						
Resistor control Note1	<ul style="list-style-type: none"> Adjustment The variable resistor (R) for luminance control should be $10\text{k}\Omega \pm 5\%$, B curve, 1/10W. Minimum point of the resistor is the minimum luminance. Also maximum point of the resistor is the maximum luminance.  <ul style="list-style-type: none"> Luminance ratio Note3 <table border="1"> <thead> <tr> <th>Resistance</th> <th>Luminance ratio</th> </tr> </thead> <tbody> <tr> <td>0 kΩ</td> <td>30% (Minimum)</td> </tr> <tr> <td>10 kΩ</td> <td>100% (Maximum)</td> </tr> </tbody> </table>	Resistance	Luminance ratio	0 k Ω	30% (Minimum)	10 k Ω	100% (Maximum)	High or Open	Open
Resistance	Luminance ratio								
0 k Ω	30% (Minimum)								
10 k Ω	100% (Maximum)								
Voltage control Note1	<ul style="list-style-type: none"> Adjustment This control method can carry out continuation adjustment of luminance, if it is adjusted within the rated voltage for BRTI signal (V_{iBI}). <ul style="list-style-type: none"> Luminance ratio Note3 <table border="1"> <thead> <tr> <th>BRTI voltage (V_{iBI})</th> <th>Luminance ratio</th> </tr> </thead> <tbody> <tr> <td>0V</td> <td>30% (Minimum)</td> </tr> <tr> <td>1.0V</td> <td>100% (Maximum)</td> </tr> </tbody> </table>	BRTI voltage (V_{iBI})	Luminance ratio	0V	30% (Minimum)	1.0V	100% (Maximum)		
BRTI voltage (V_{iBI})	Luminance ratio								
0V	30% (Minimum)								
1.0V	100% (Maximum)								
Two step control	<ul style="list-style-type: none"> Adjustment This control method can carry out two step adjustment of luminance by BRTT signal (V_{iBT}). <ul style="list-style-type: none"> Luminance ratio Note3 <table border="1"> <thead> <tr> <th>BRTT voltage (V_{iBT})</th> <th>Luminance ratio</th> </tr> </thead> <tbody> <tr> <td>Low (V_{iBTL}) Note4</td> <td>50%</td> </tr> <tr> <td>High (V_{iBTH}) Note4</td> <td>100%</td> </tr> </tbody> </table>	BRTT voltage (V_{iBT})	Luminance ratio	Low (V_{iBTL}) Note4	50%	High (V_{iBTH}) Note4	100%		
BRTT voltage (V_{iBT})	Luminance ratio								
Low (V_{iBTL}) Note4	50%								
High (V_{iBTH}) Note4	100%								
Pulse width modulation Note1 Note2	<ul style="list-style-type: none"> Adjustment Pulse width modulation (PWM) method works, when PWSEL signal is Low and PWM signal (BRTP signal) is inputted into BRTP terminal. The luminance is controlled by duty ratio of BRTP signal. <ul style="list-style-type: none"> Luminance ratio Note3 <table border="1"> <thead> <tr> <th>Duty ratio Note5</th> <th>Luminance ratio</th> </tr> </thead> <tbody> <tr> <td>0.3</td> <td>30% (Minimum)</td> </tr> <tr> <td>1.0</td> <td>100% (Maximum)</td> </tr> </tbody> </table>	Duty ratio Note5	Luminance ratio	0.3	30% (Minimum)	1.0	100% (Maximum)	Low	PWM signal
Duty ratio Note5	Luminance ratio								
0.3	30% (Minimum)								
1.0	100% (Maximum)								

Note1: In case of the resistor control method and the voltage control method, noises may appear on the display image depending on the input signals timing for LCD panel signal processing board. **Use PWM method, if interference noises appear on the display image!**

Note2: In case BRTC signal is High or Open, the inverter will stop work when BRTP signal is fixed to Low. In this case, backlight will not turn on, even if BRTP signal is inputted again. This is not out of order. Backlight inverter will start to work when power is supplied again.

Note3: These data are the target values.

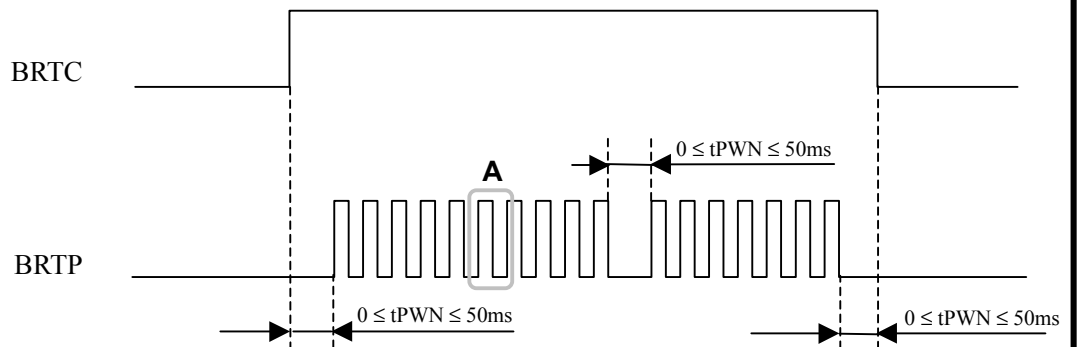
Note4: See '4.3.2 Driving for backlight inverter'.

Note5: See '4.6.2 Detail of PWM timing'.

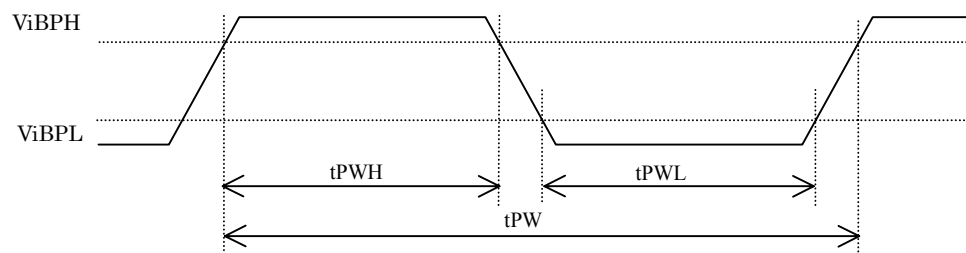
4.6.2 Detail of PWM timing

(1) Timing diagrams

• Outline chart



• Detail of A part



(2) Each parameter

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Luminance control frequency	$1/t_{PW}$	185	270	340	Hz	Note1
Duty ratio	t_{PWH}/t_{PW}	0.3	-	1.0	-	Note2
Non signal period	t_{PWN}	0	-	50	ms	Note3

Note1: See the following formula for luminance control frequency.

$$\text{Luminance control frequency} = t_v \times (n+0.25) \text{ [or } (n + 0.75)]$$

$$n = 1, 2, 3 \dots \dots$$

t_v : See '4.10.4 Timing characteristics'.

The interference noise of luminance control frequency and input signal frequency for LCD panel signal processing board may appear on a display. Set up luminance control frequency so that the interference noise does not appear!

Note2: See '4.6.1 Luminance control methods'.

Note3: If t_{PWN} is more than 50ms, the backlight will be turned off by a protection circuit for inverter.

4.7 DISPLAY COLORS AND INPUT DATA SIGNALS

Display colors Note1		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 scale	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
Green scale	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	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 scale	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
Red scale	Black	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	1	0
Blue scale	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	0	0	0
	↑																		
	↓																		
	bright	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Note 1: The combination of 6-bit signals (64-scale level) is 262,144 colors.

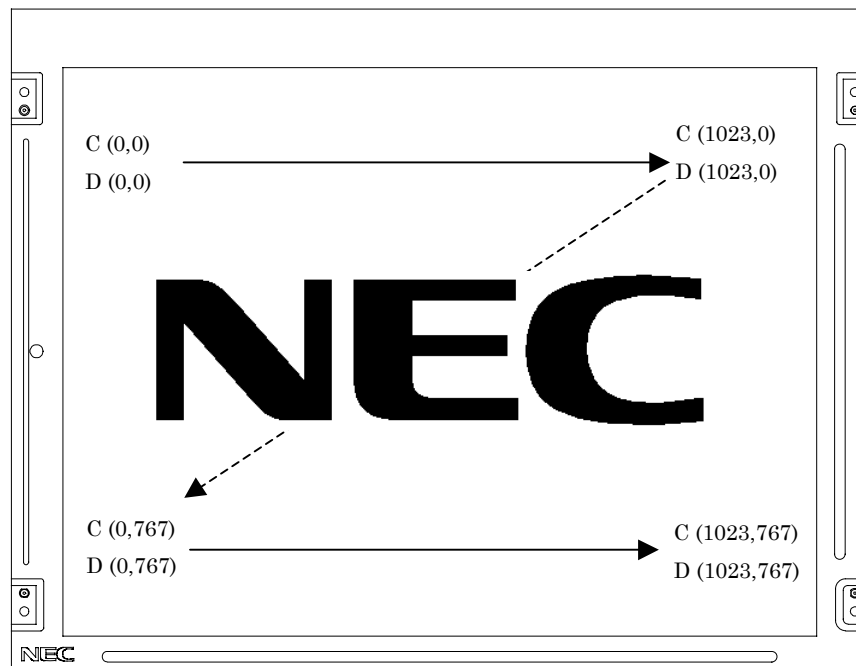
4.8 DISPLAY POSITIONS

The following table is the coordinates per pixel (See figure of "4.9 SCANNING DIRECTIONS").

C(0, 0)	C(1, 0)	...	C(X, 0)	...	C(1022, 0)	C(1023, 0)
C(0, 1)	C(1, 1)	...	C(X, 1)	...	C(1022, 1)	C(1023, 1)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
C(0, Y)	C(1, Y)	...	C(X, Y)	...	C(1022, Y)	C(1023, Y)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
C(0,766)	C(0,766)	...	C(X,766)	...	C(1022,766)	C(1023,766)
C(0,767)	C(1,767)	...	C(X,767)	...	C(1022,767)	C(1023,767)

4.9 SCANNING DIRECTIONS

The following figures are seen from a front view. Also the arrow shows the direction of scan.



Note1: Meaning of C (X, Y) and D (X, Y)

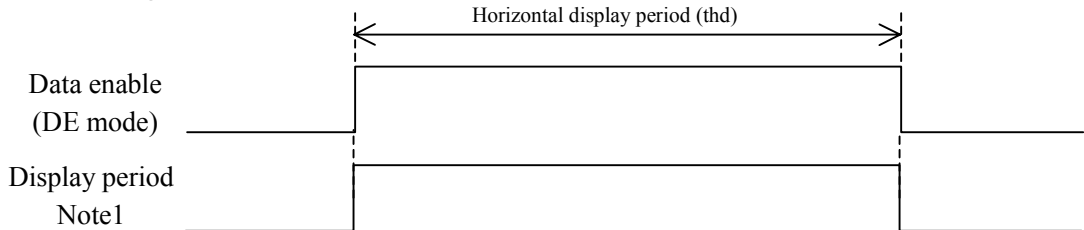
C (X, Y): The coordinates of the display position (See "4.8 DISPLAY POSITIONS".)

D (X, Y): The data number of input signal for LCD panel signal processing board

4.10 INPUT SIGNAL TIMINGS FOR LCD PANEL SIGNAL PROCESSING BOARD

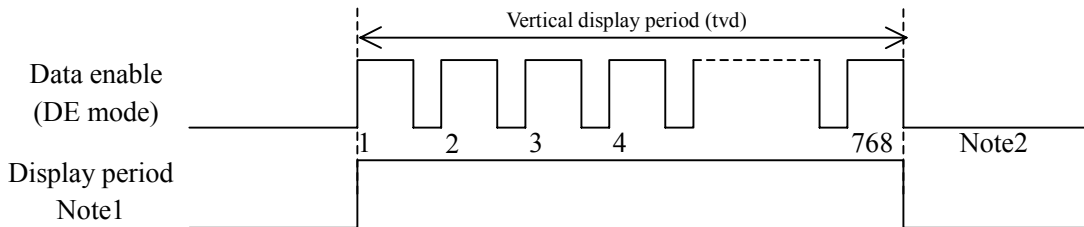
4.10.1 Outline of input signal timings

- Horizontal signal



Note1: This diagram indicates virtual signal for set up to timing.

- Vertical signal

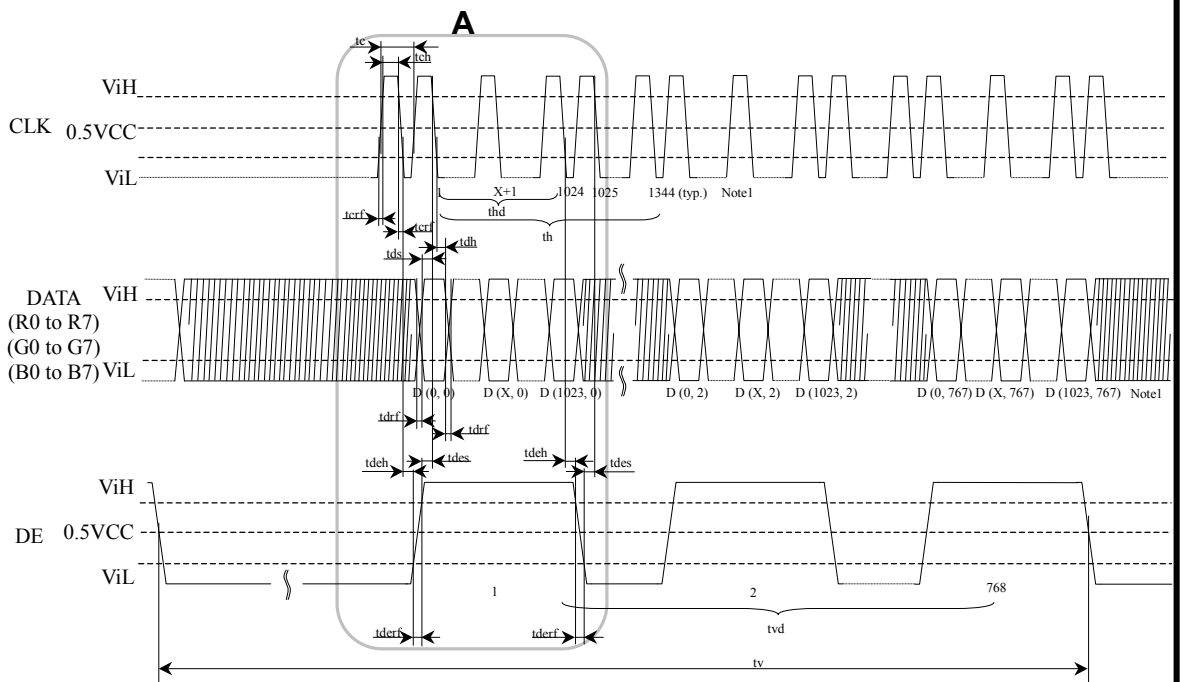


Note1: This diagram indicates virtual signal for set up to timing.

Note2: See "4.10.2 Detailed input signal timing chart for DE mode" for numeration of pulse.

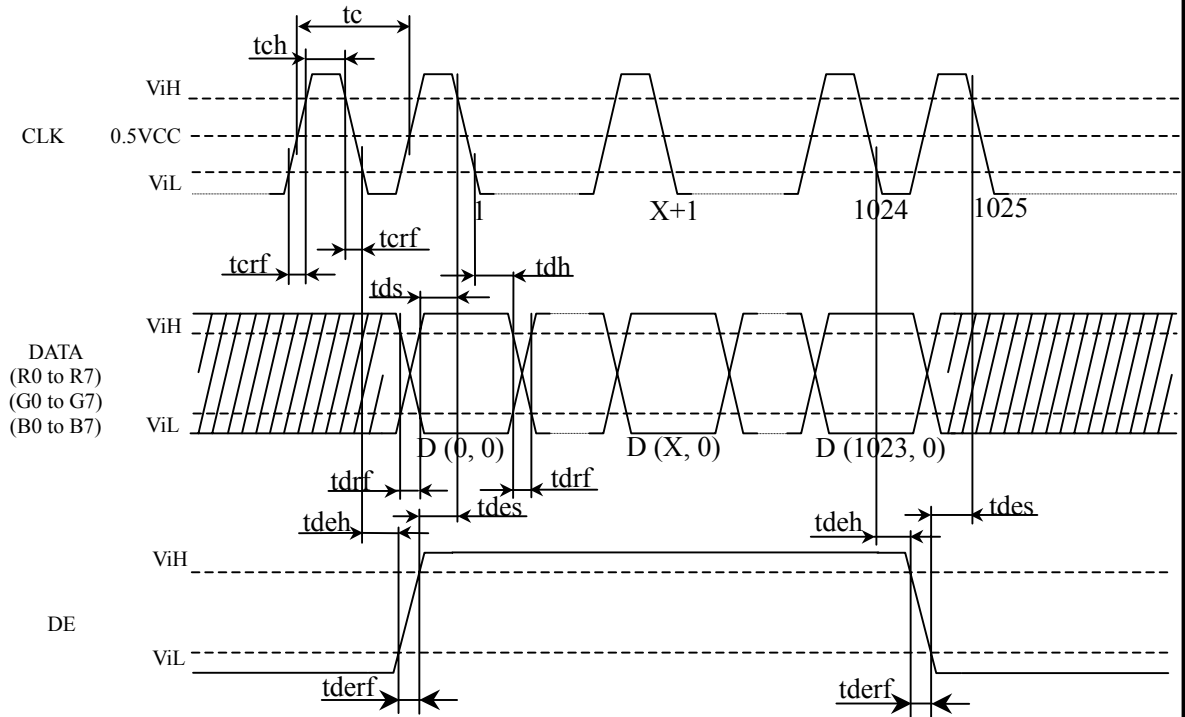
4.10.2 Detailed input signal timing chart for DE mode

- Outline chart



Note1: X is data number from 1 to 1022. See '4.9 SCANNING DIRECTIONS'.

• Detail of **A** part



Note1: X is data number from 1 to 1022. See '4.9 SCANNING DIRECTIONS'.

4.10.3 Timing characteristics

Parameter	Note1	Symbol	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency (LVDS receiver)	$1/t_c$	60.0	65.0	68.0	MHz	15.39 ns (typ.)
	Duty	t_{ch}/t_c					
	Rise time, Fall time	t_{crf}					
DATA	CLK-DATA	Setup time	t_{ds}				
		Hold time	t_{dh}				
	Rise time, Fall time	t_{drf}					
DE	Horizontal	Cycle	t_h				
		Display period	t_{hd}				
	Vertical (One frame)	Cycle	t_v				
		Display period	t_{vd}				
	CLK-DE	Setup time	t_{des}				
		Hold time	t_{deh}				
	Rise time, Fall time	t_{derf}					

Note1: See the data sheet of LVDS transmitter.

4.11 OPTICS

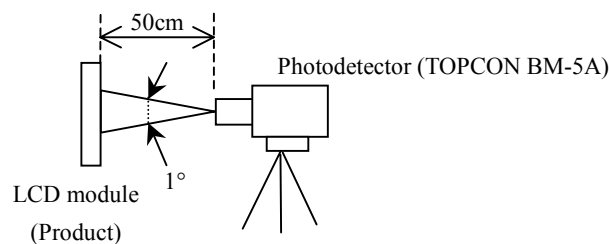
4.11.1 Optical characteristics

Parameter	Note1	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks	
Contrast ratio		CR	White/Black at center, $\theta_{x\pm} = 0^\circ$, $\theta_{y\pm} = 0^\circ$	80	150	-	-	Note2	
Luminance		L	White at center, $\theta_{x\pm} = 0^\circ$, $\theta_{y\pm} = 0^\circ$	165	220	-	cd/m ²	-	
Luminance uniformity		LU	-	-	-	1.30	-	Note3	
Chromaticity		W	White (x, y)	-	0.300, 0.310	-	-	-	
		R	Red (x, y)	-	0.570, 0.330	-	-		
		G	Green (x, y)	-	0.320, 0.510	-	-		
		B	Blue (x, y)	-	0.150, 0.110	-	-		
Color gamut		C	$\theta_{x\pm} = 0^\circ$, $\theta_{y\pm} = 0^\circ$ at center, to NTSC space	35	40	-	%		
Response time Note4		Ton	White to Black	-	11	25	ms	Note5	
		Toff	Black to White	-	40	80	ms		
Viewing angle	CR =10	Right	θ_{x+}	$\theta_{y\pm} = 0^\circ$	-	50	-	$^\circ$	Note6
		Left	θ_{x-}	$\theta_{y\pm} = 0^\circ$	-	50	-	$^\circ$	
		Up	θ_{y+}	$\theta_{x\pm} = 0^\circ$	-	20	-	$^\circ$	
		Down	θ_{y-}	$\theta_{x\pm} = 0^\circ$	-	35	-	$^\circ$	

Note1: Measurement conditions are as follows.

$T_a = 25^\circ\text{C}$, $V_{CC} = 3.3\text{V}$, $V_{DDB} = 12.0\text{V}$

Optical characteristics are measured at luminance saturation after 20minutes from working the product, in the dark room. Also measurement method for luminance is as follows.



Note2: See '4.11.2 Definition of contrast ratio'.

Note3: See '4.11.3 Definition of luminance uniformity'.

Note4: Product surface temperature: 25°C

Note5: See '4.11.4 Definition of response times'.

Note6: See '4.11.5 Definition of viewing angles'.

4.11.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

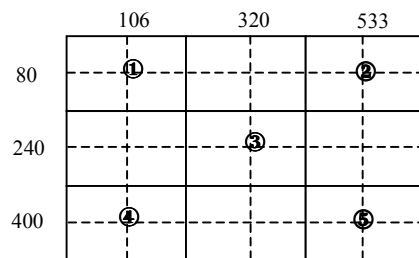
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.11.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

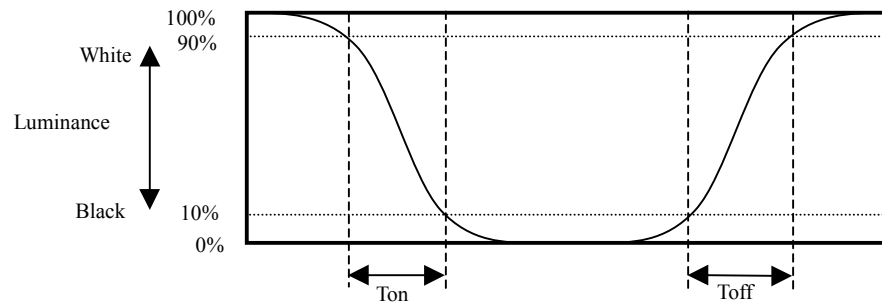
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

The luminance is measured at near the 5 points shown below.

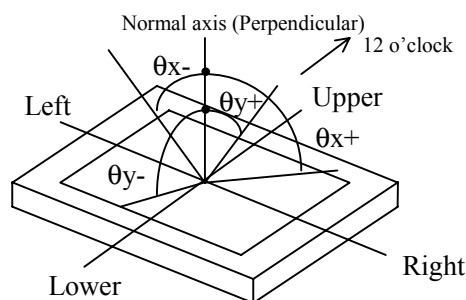


4.11.4 Definition of response times

Response time is measured, the luminance changes from "white" to "black", or "black" to "white" on the same screen point, by photo-detector. Ton is the time it takes the luminance change from 90% down to 10%. Also Toff is the time it takes the luminance change from 10% up to 90% (See the following diagram.).



4.11.5 Definition of viewing angles

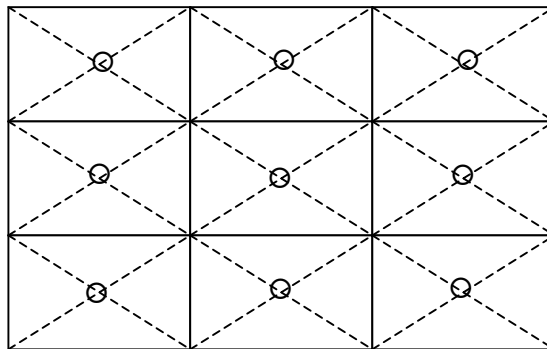


5. RELIABILITY TESTS

Test item	Condition	Judgment
High temperature and humidity (Operation)	① $50 \pm 2^{\circ}\text{C}$, RH = 85%, 240hours ② Display data is black.	No display malfunctions Note1
Heat cycle (Operation)	① $0 \pm 3^{\circ}\text{C} \dots 1\text{hour}$ $55 \pm 3^{\circ}\text{C} \dots 1\text{hour}$ ② 50cycles, 4hours/cycle ③ Display data is black.	No display malfunctions Note1
Thermal shock (Non operation)	① $-20 \pm 3^{\circ}\text{C} \dots 30\text{minutes}$ $60 \pm 3^{\circ}\text{C} \dots 30\text{minutes}$ ② 100cycles, 30minutes/cycle ③ Temperature transition time is within 5 minutes.	No display malfunctions Note1
Vibration (Non operation)	① 5 to 100Hz, 19.6m/s^2 ② 1 minute/cycle ③ X, Y, Z direction ④ 10 times each directions	No display malfunctions Note1 No physical damages
Mechanical shock (Non operation)	① 294m/s^2 , 11ms ② X, Y, Z direction ③ 3 times each directions	No display malfunctions Note1 No physical damages
ESD (Operation)	① 150pF, 150Ω , $\pm 10\text{kV}$ ② 9 places on a panel surface Note2 ③ 10 times each places at 1 sec interval	No display malfunctions Note1
Dust (Operation)	① 15 kinds of dust (by JIS-Z8901) ② 15 seconds stir ③ 8 times repeat at 1 hour interval	No display malfunctions Note1

Note1: Display functions are checked under the same conditions as product inspection.

Note2: See the following figure for discharge points.



6. PRECAUTIONS

6.1 MEANING OF CAUTION SIGNS

The following caution signs have very important meaning. **Be sure to read '6.2 CAUTIONS', after understanding this contents!**



CAUTION

This sign has the meaning that customer will be injured by himself, or the product will sustain a damage, if customer has wrong operations.



This sign has the meaning that customer will get an electrical shock, if customer has wrong operations.



This sign has the meaning that customer will be injured by himself, if customer has wrong operations.

6.2 CAUTIONS



Do not touch HIGH VOLTAGE PART of the inverter while turned on! Danger of an electrical shock.



- * Pay attention to burn injury for the working backlight! It may be over 35°C from ambient temperature.
- * Do not shock and press the LCD panel and the backlight! Danger of breaking, because they are made of glass. (Shock: To be not greater 294m/s² and to be not greater 11ms, Pressure: To be not greater 19.6N)

6.3 ATTENTIONS

(1) Handling of the product

- ① Take hold of both ends without touch the circuit board when customer pulls out products (LCD modules) from inner packing box. If customer touches it, products may be broken down or out of adjustment, because of stress to mounting parts.
- ② Do not hook cables nor pull connection cables such as flexible cable and so on, for fear of damage.
- ③ If customer puts down the product temporarily, the product puts on flat subsoil as a display side turns down.
- ④ Take the measures of electrostatic discharge such as earth band, ionic shower and so on, when customer deals with the product, because products may be damaged by electrostatic.
- ⑤ The torque for mounting screws must never exceed 0.39N·m. Higher torque values might result in distortion of the bezel.

- ⑥ Do not press or rub on the sensitive display surface. If customer clean on the panel surface, NEC Corporation recommends using the cloth with ethanolic liquid.
- ⑦ Do not push-pull the interface connectors while the product is working, because wrong power sequence may break down the product.

(2) Environment

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

(3) Characteristics

- ① Do not display the fixed pattern for a long time because it may cause image sticking. Use a screen saver, if the fixed pattern is displayed on the screen.
- ② The display color may be changed by viewing angle because of the use of condenser sheet in the backlight unit.
- ③ The luminance may be changed by voltage variation (voltage drop), even if power source applies recommended voltage to backlight inverter.
- ④ Optical characteristics may be changed by input signal timings.

(4) Other

- ① All GND, GNDB, VCC and VDDB terminals should be used without a non-connected line.
- ② Do not disassemble a product or adjust volume without permission of NEC Corporation.
- ③ See 'REPLACEMENT MANUAL FOR BACKLIGHT', if customer would like to replace backlight lamps.
- ④ Pay attention not to insert waste materials inside of products, if customer uses screwdrivers.
- ⑤ Pack the product with original shipping package, because of avoidance of some damages during transportation, when customer returns it to NEC Corporation for repair and so on.

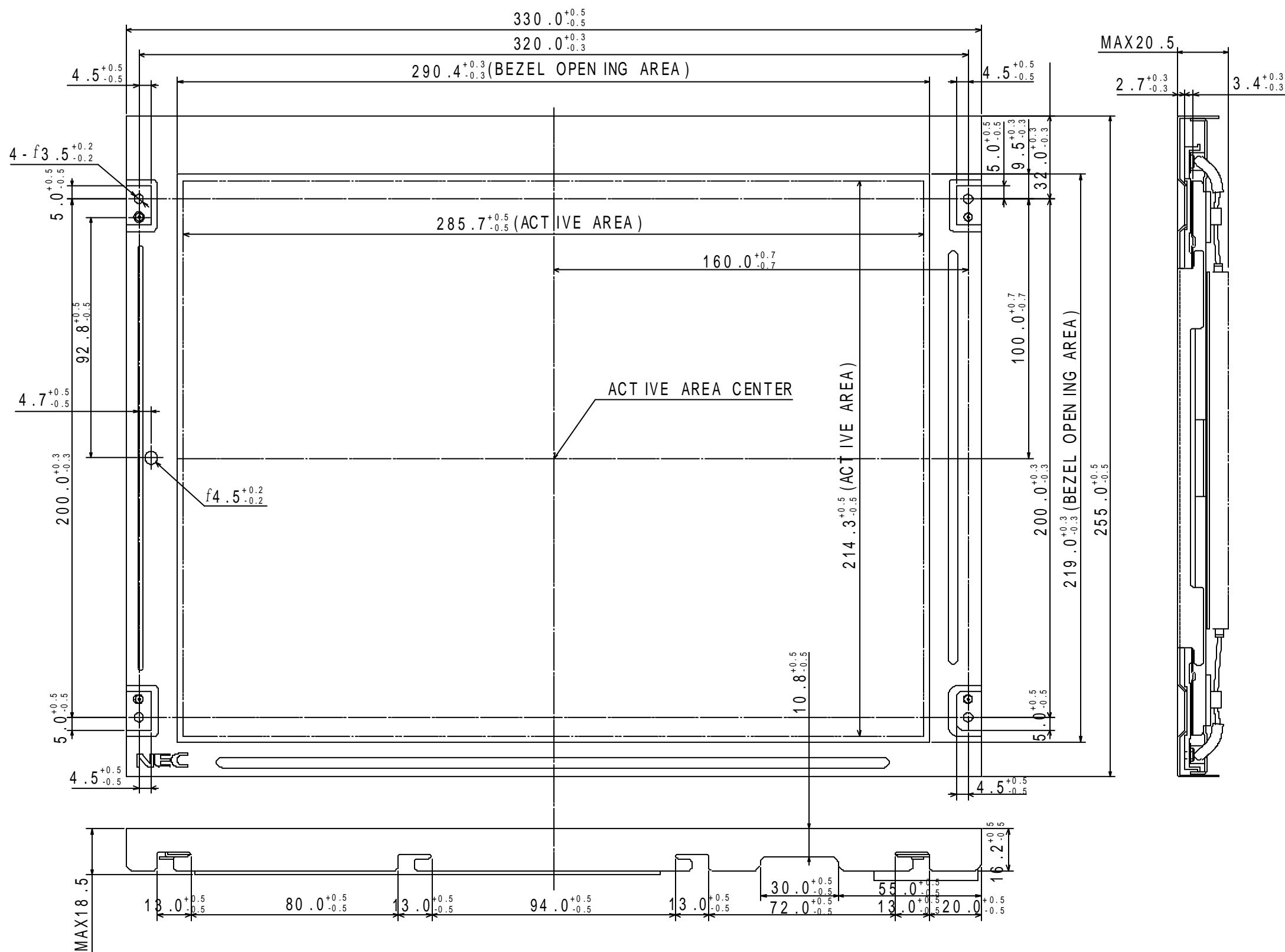
General characteristics for the LCD

The following items are neither defects nor failures.

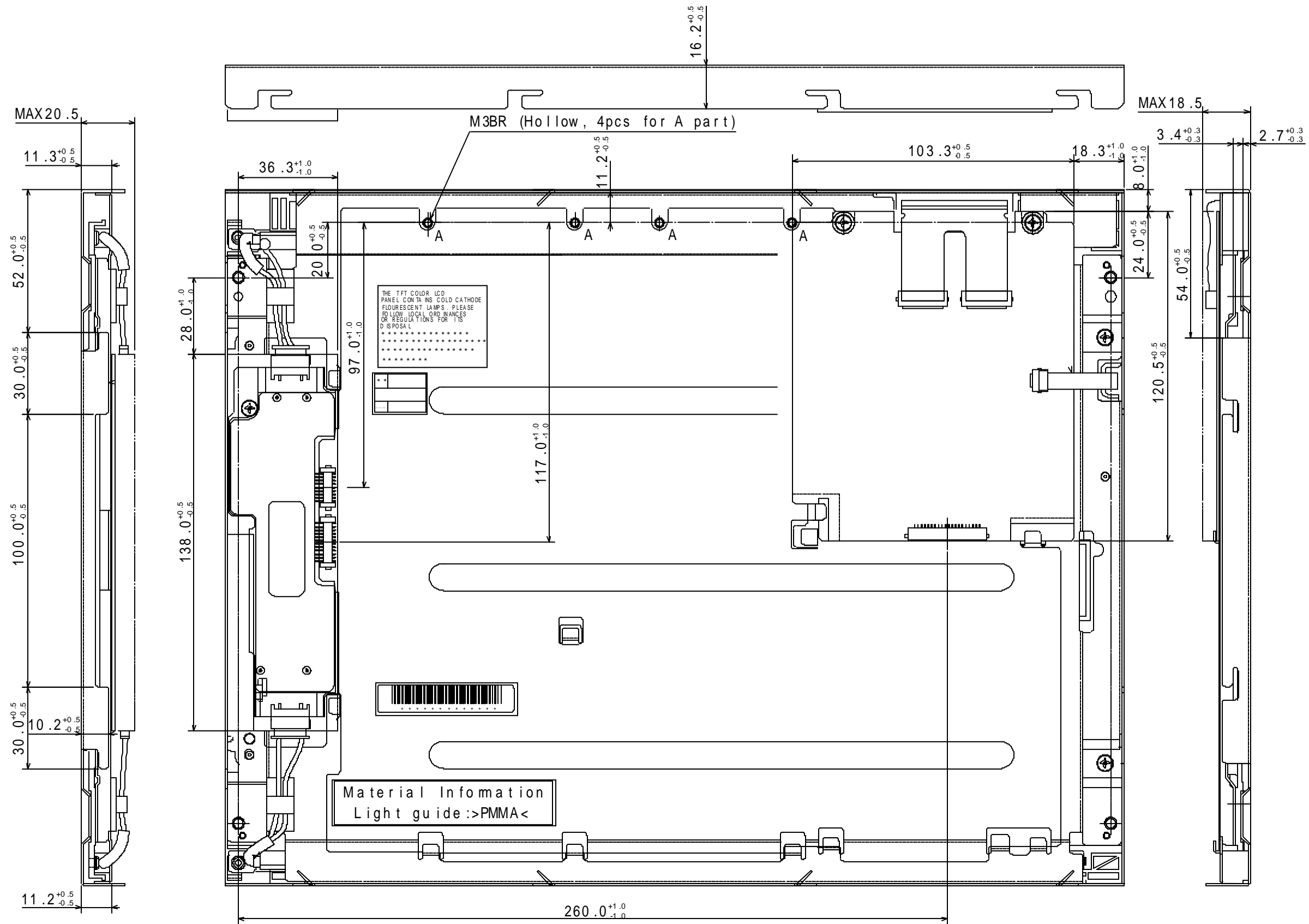
- * Response time, luminance and color may be changed by ambient temperature.**
- * The LCD may be seemed luminance non-uniformity, flicker, vertical seam or small spot by display patterns.**
- * Optical characteristics (e.g. luminance, display uniformity, etc.) gradually is going to change depending on operating time, and especially low temperature, because the LCD has cold cathode fluorescent lamps.**

7. OUTLINE DRAWINGS

7.1 FRONT VIEW

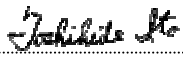

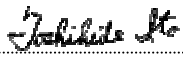

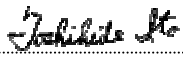



7.2 REAR VIEW



REVISION HISTORY

The inside of latest specifications is revised to the clerical error and the major improvement of previous edition. Only a changed part such as functions, characteristic value and so on that may affect a design of customers, are described especially below.

Edition	Document number	Prepared date	Revision contents and writer						
1st edition	DOD - M - 0500	Jul. 12, 2001	<p>Revision contents</p> <p>New issue</p> <p>Signature of writer</p> <table style="width: 100%; border: none;"> <tr> <td style="text-align: center; width: 33%;"><i>Approved by</i></td> <td style="text-align: center; width: 33%;"><i>Checked by</i></td> <td style="text-align: center; width: 33%;"><i>Prepared by</i></td> </tr> <tr> <td style="text-align: center;">  <u>T. ITOU</u> </td> <td style="text-align: center;"> _____ </td> <td style="text-align: center;">  <u>A. SAWADA</u> </td> </tr> </table>	<i>Approved by</i>	<i>Checked by</i>	<i>Prepared by</i>	 <u>T. ITOU</u> _____	 <u>A. SAWADA</u>
<i>Approved by</i>	<i>Checked by</i>	<i>Prepared by</i>							
 <u>T. ITOU</u> _____	 <u>A. SAWADA</u>							