NEC

TFT COLOR LCD MODULE

NL12876AC39-01

58.4cm (23.0 Type)
WXGA

DATA SHEET

(6th edition)

PRELIMINARY

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Display Device Operations Unit
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INTRODUCTION

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Anti-radioactive design is not implemented in this product.

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1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

NL12876AC39-01 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

- Multimedia monitor

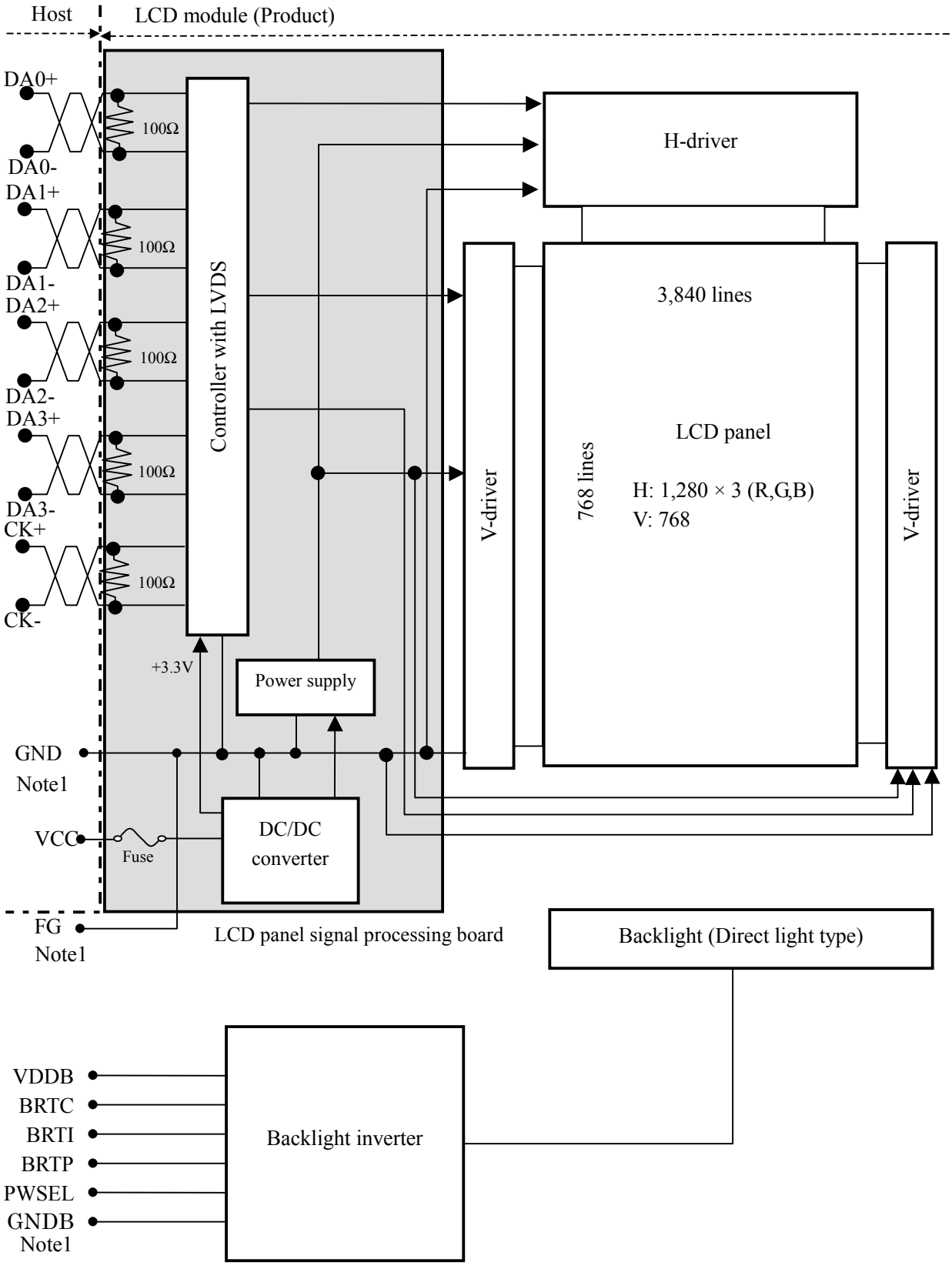
1.3 FEATURES

- High luminance
- Ultra wide viewing angles (Lateral electric field)
- High contrast
- High definition
- 8-bit digital RGB signals
- Single link LVDS interface
- Direct light type
- Replaceable backlight unit and inverter

2. GENERAL SPECIFICATIONS

Display area	501.1 (W) × 300.7 (H) mm (typ.)
Diagonal size of display	58.4 cm (23.0 inches)
Drive system	a-Si TFT active matrix
Display color	16,777,216 colors
Pixel	1,280 (H) × 768 (V) pixels
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe
Dot pitch	0.1305 (W) × 0.3915 (H) mm
Pixel pitch	0.3915 (W) × 0.3915 (H) mm
Module size	528.0 (W) × 326.0 (H) × 30.1 (D) mm (typ.)
Weight	2,600 g (typ.)
Contrast ratio	350:1 (typ.)
Viewing angle	*At the contrast ratio 10:1* • Horizontal: Left side 85° (typ.), Right side 85° (typ.) • Vertical: Up side 85° (typ.), Down side 85° (typ.)
Designed viewing direction	• Viewing angle with optimum grayscale (γ=2.2): normal axis
Polarizer surface	Low reflection treatment
Polarizer pencil-hardness	2H (min.) [by JIS K5400]
Color gamut	*At LCD panel center* 72 % (typ.) [against NTSC color space]
Response time	12 ms (typ.)
Luminance	450 cd/m^2 (typ.)
Signal system	Single link LVDS (Receiver: THC63LVD824, THine Electronics Inc.) [8-bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE)]
Power supply voltage	LCD panel signal processing board: 5.0V Backlight inverter: 12.0V
Backlight	Direct light type: 12 cold cathode fluorescent lamps Replaceable parts • Backlight unit: type No. 230LHS01 • Inverter: type No. 230PW011
Power consumption	*At maximum luminance and checkered flag pattern* 57.4W (typ.)

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	528.0 ± 0.5 (W) × 326.0 ± 0.5 (H) × 30.1 ± 2.0 (D) Note1	mm
Display area	501.1 ± 0.5 (W) × 300.7 ± 0.5 (H) Note1	mm
Weight	2,600 (typ.), 2,900 (max.)	g

Note1: See "**7.OUTLINE DRAWINGS**".

4.2 ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Rating	Unit	Remarks
Power supply voltage	LCD panel signal board	VCC	-0.3 to +6.0	V	Ta = 25°C
	Backlight inverter	VDDB	-0.3 to +14	V	
Input voltage for signals	Display signals Note1	VD	-0.3 to 3.4	V	
	BRTI signal	VBI	-0.3 to +1.5	V	Ta = 25°C VDDB = 12.0V
	BRTP signal	VBP	-0.3 to +5.5	V	
	BRTC signal	VBC	-0.3 to +5.5	V	
	PWSEL signal	VBS	-0.3 to +5.5	V	
Storage temperature		Tst	-20 to +60	°C	-
Operating temperature	Front surface	TopF	0 to +55	°C	
	Rear surface	TopR	0 to +66	°C	
Relative humidity Note2		RH	≤ 95	%	Ta ≤ 40°C
			≤ 85	%	40 < Ta ≤ 50°C
			≤ 70	%	50 < Ta ≤ 55°C
Absolute humidity Note2		AH	≤ 73 Note3	g/m^3	Ta > 55°C

Note1: Display signals are DA0+/-, DA1+/-, DA2+/-, DA3+/- and CK+/-. Also controller with LVDS receiver are worked by +3.3V from DC/DC converter.

Note2: No condensation

Note3: 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
Power supply voltage		VCC	4.7	5.0	5.3	V	-
Power supply current		ICC	-	670 Note1	1,000 Note2	mA	VCC = 5.0V
Input voltage for LVDS receiver	Low	VDRL	0	-	0.8	V	-
	High	VDRH	2.0	-	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 receiver

4.3.2 Driving for backlight inverter

(Ta = 25°C)

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage			VDDB	11.4	12.0	12.6	V	-
Power supply current			IDDB	-	4,500	5,000	mA	at maximum luminance, VDDB = 12.0V Note1
Input voltage for control system signals	BRTI signal		VBI	0	-	1.0	V	-
	BRTP signal	Low	VBPL	0	-	0.8	V	
		High	VBPH	2.0	-	5.0	V	
	BRTC signal	Low	VBCL	0	-	0.8	V	
		High	VBCH	2.0	-	5.0	V	
	PWSEL signal	Low	VBSL	0	-	0.8	V	
		High	VBSH	2.0	-	5.0	V	
Input current for control system signals	BRTI signal		IBI	-130	-	-	μA	
	BRTP signal	Low	IBPL	-1580	-	-	μA	
		High	IBPH	-	-	3500	μA	
	BRTC signal	Low	IBCL	-610	-	-	μA	
		High	IBCH	-	-	440	μA	
	PWSEL signal	Low	IBSL	-610	-	-	μA	
		High	IBSH	-	-	440	μA	

Note1: The power supply lines (VDDB and GNDB) occurs large ripple voltage (See "4.3.3 Power supply voltage ripple".) while luminance control. 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 Power 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.

Parameter	Power supply voltage	Ripple voltage Note1 (Measure at input terminal of power supply)	Unit
VCC	5.0 V	≤ 100	mVp-p
VDDB	12.0 V	≤ 200	mVp-p

Note1: The permissible ripple voltage includes spike noise.

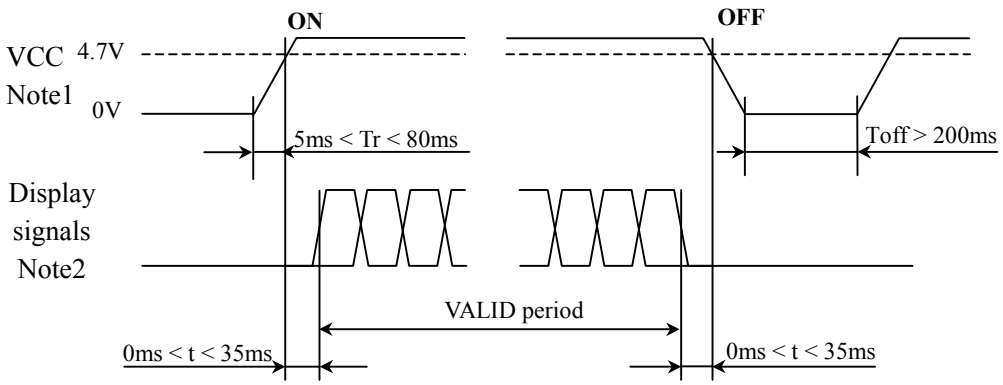
4.3.4 Fuses

Fusing line	Fuse		Rating	Unit	Remark
	Type	Supplier			
VCC	ICP-S2.3	Rohm Co., Ltd.	4.6	A	Fusing current Note1
			50	V	-
VDDB	R451010	Littelfuse Inc.	20	A	Fusing current Note1
			125	V	-

Note1: The power capacity should be more than the fusing current rating. 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 POWER SUPPLY VOLTAGE SEQUENCE

4.4.1 Sequence for LCD panel signal processing board

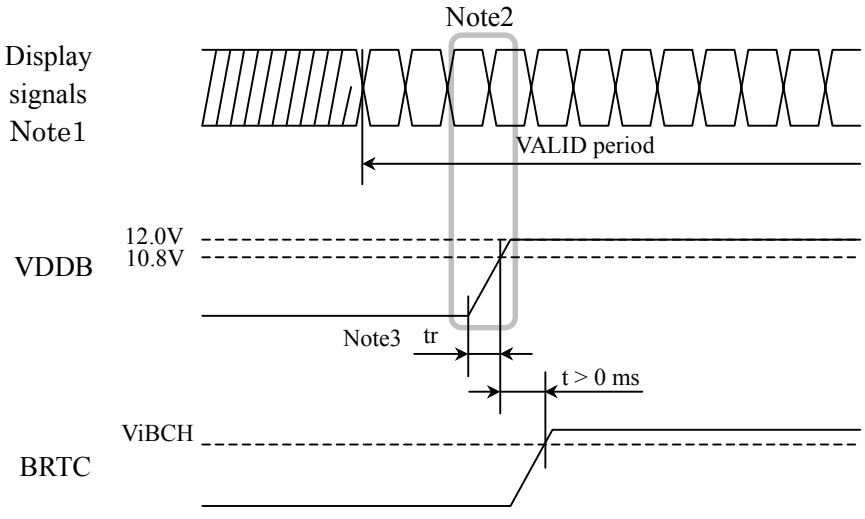


Note1: In terms of voltage variation (voltage drop) while VCC rising edge is below 4.7V, a protection circuit may work, and then this product may not work.

Note2: Display signals (DA0+/-, DA1+/-, DA2+/-, DA3+/- 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 stops the 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 tr should be less than 800ms when BRTC terminal [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

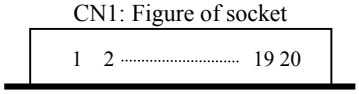
CN1 socket (Module side): FI-SEB20P-HF (Japan Aviation Electronics Industry Limited)
Adaptable plug: FI-SE20M / FI-S20S (Japan Aviation Electronics Industry Limited)

6

Pin No.	Symbol	Function	Remarks
1	VCC	Power supply	-
2	VCC		
3	GND	Ground	
4	GND		
5	D0-	Pixel data	Note1
6	D0+		
7	GND	Ground	-
8	D1-	Pixel data	Note1
9	D1+		
10	GND	Ground	-
11	D2-	Pixel data	Note1
12	D2+		
13	GND	Ground	-
14	CK-	Pixel clock	Note1
15	CK+		
16	GND	Ground	-
17	D3-	Pixel data	Note1
18	D3+		
19	GND	Ground	-
20	GND		

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

CN1: Figure of socket

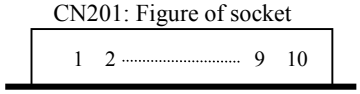


4.5.2 Backlight inverter

CN201 socket: DF3-10P-2H (Hirose Electric Co., Ltd.)
Adaptable plug: DF3-10S-2C (Hirose Electric Co., Ltd.)

Pin No.	Symbol	Function	Remarks
1	GNDB	Backlight ground	-
2	GNDB	Backlight ground	
3	GNDB	Backlight ground	
4	GNDB	Backlight ground	
5	GNDB	Backlight ground	
6	VDDB	Power supply	
7	VDDB	Power supply	
8	VDDB	Power supply	
9	VDDB	Power supply	
10	VDDB	Power supply	

CN201: Figure of socket

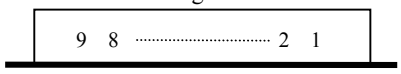


CN202 socket: IL-Z-9PL1-SMTY (Japan Aviation Electronics Industry Limited)
Adaptable plug: IL-Z-9S-S125C3 (Japan Aviation Electronics Industry Limited)

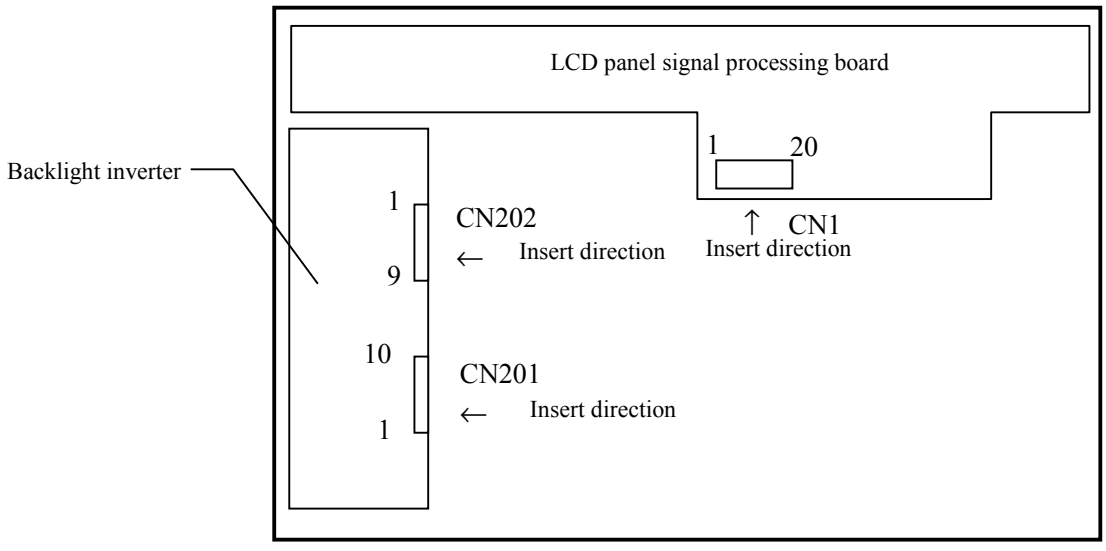
Pin No.	Symbol	Function	Remarks
1	GNDB	Backlight ground	-
2	GNDB	Backlight ground	
3	N.C.	Non-connection	
4	BRTC	Backlight ON/OFF signal	ON: High or Open, OFF: Low
5	GNDB	Backlight ground	-
6	BRTI	Luminance control by resistor method or voltage method	Note1
7	BRTP	PWM signal	
8	GNDB	Backlight ground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

Note1: See "4.6.1 Luminance control methods".

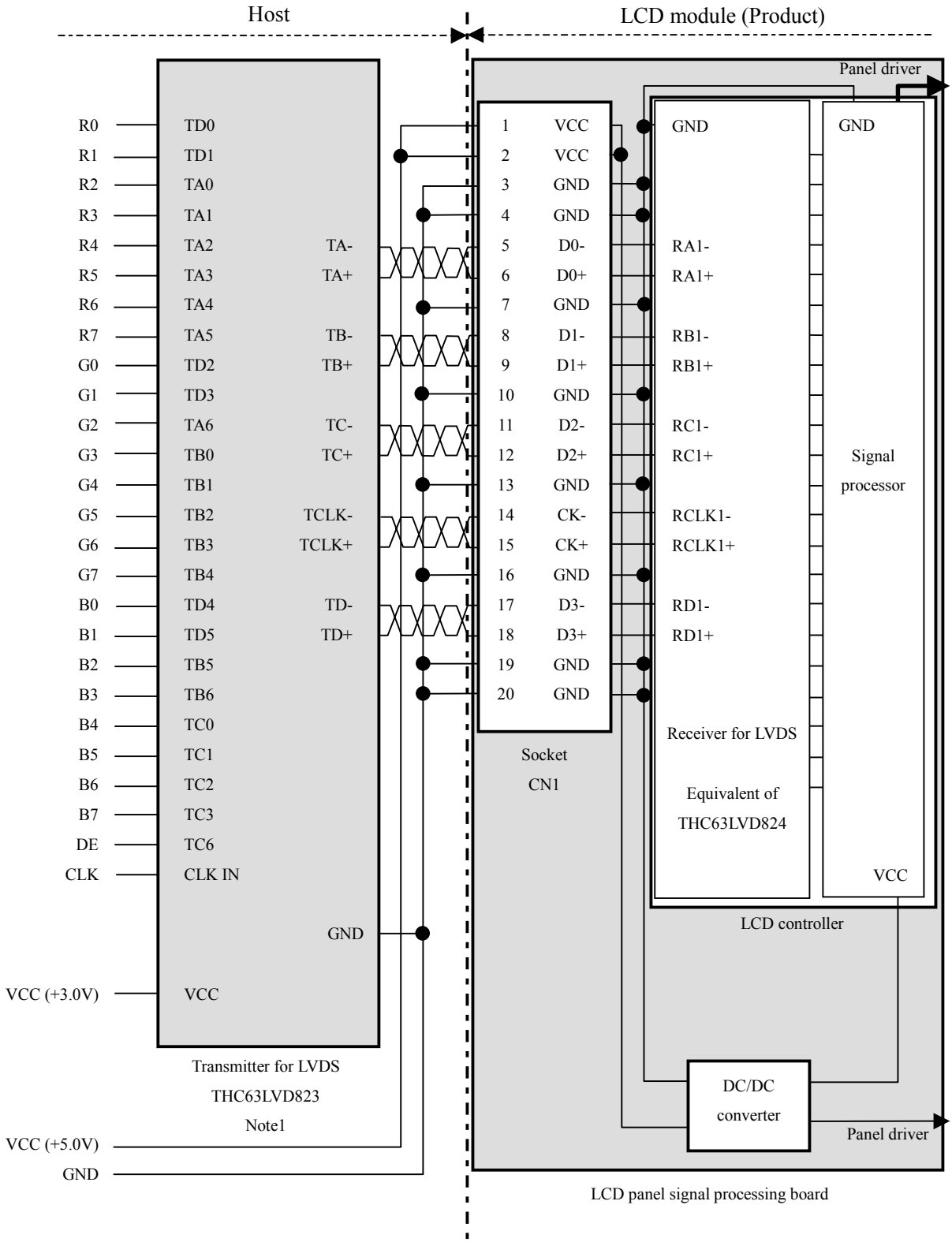
CN202: Figure of socket



4.5.3 Positions of sockets



4.5.4 Connection between receiver and transmitter for LVDS

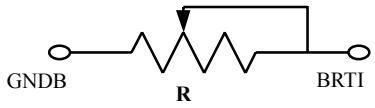


Note1: Recommended transmitter
See the data sheet for THC63LVD823 (THein Electronics Inc.).

4.6 LUMINANCE CONTROLS

4.6.1 Luminance control methods

<table>
<tr><th>Method</th><th>Adjustment and luminance ratio</th><th>PWSEL signal</th><th>BRTP signal</th></tr>
<tr><td>Resistor control

Note1</td><td>• Adjustment
The variable resistor (R) for luminance control should be 10kΩ ±5%, B curve, 1/10W. Minimum point of the resistor is the minimum luminance. Also maximum point of the resistor is the maximum luminance.
 

• Luminance ratio Note3
<table><tr><th>Resistance</th><th>Luminance ratio</th></tr><tr><td>0 kΩ</td><td>20% (Minimum)</td></tr><tr><td>10 kΩ</td><td>100% (Maximum)</td></tr></table></td><td rowspan="2">High or Open</td><td rowspan="2">Open</td></tr>
<tr><td>Voltage control

Note1</td><td>• Adjustment
This control method can carry out continuation adjustment of luminance, if it is adjusted within the rated voltage for BRTI signal (VBI).
• Luminance ratio Note3
<table><tr><th>BRTI Voltage (VBI)</th><th>Luminance ratio</th></tr><tr><td>0V</td><td>20% (Minimum)</td></tr><tr><td>1.0V</td><td>100% (Maximum)</td></tr></table></td></tr>
<tr><td>Pulse width modulation
Note1
Note2</td><td>• 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.
• Luminance ratio Note3
<table><tr><th>Duty ratio Note4</th><th>Luminance ratio</th></tr><tr><td>0.2</td><td>20% (Minimum)</td></tr><tr><td>1.0</td><td>100% (Maximum)</td></tr></table></td><td>Low</td><td>PWM signal</td></tr>
</table>

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.

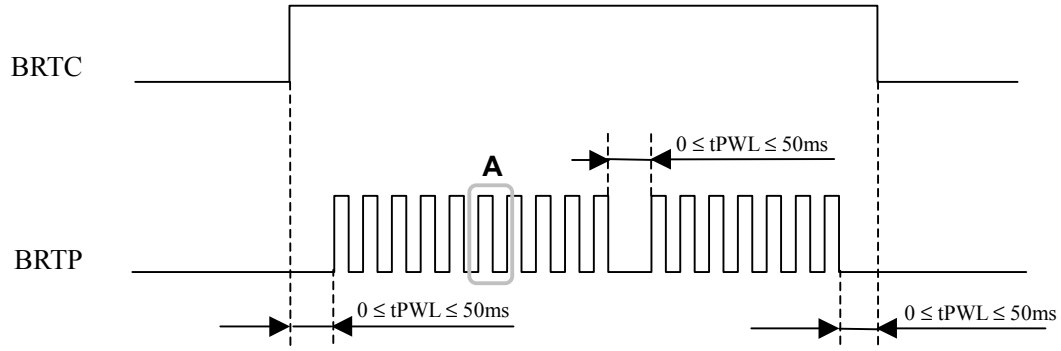
Note3: These data are the target values.

Note4: See "4.6.2 Detail of PWM timing".

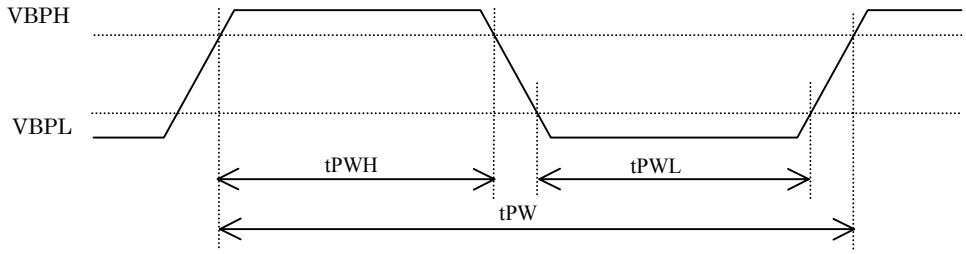
4.6.2 Detail of PWM timing

(1) Timing diagrams

• Outline chart



• Detail of **A** part



(2) Each parameter

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Luminance control frequency	FL	230	255	280	Hz	Note1, Note2
Duty ratio	DL	0.2	-	1.0	-	Note1, Note3
Non signal period	tPWL	0	-	50	ms	Note4

Note1: Definition of parameters is as follows.

$$FL = \frac{1}{tPW},\ DL = \frac{tPWH}{tPW}$$

Note2: See the following formula for luminance control frequency.

Luminance control frequency = tv × (n+0.25) [or (n + 0.75)]

n = 1, 2, 3 · · · · · ·

tv: 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!

Note3: See "4.6.1 Luminance control methods".

Note4: If tPWL is more than 50ms, the backlight will be turned off by a protection circuit for inverter.

4.7 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display in equivalent to 16,777,216 colors in 256 scale. Also the relation between display colors and input data signals is as the following table.

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 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	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 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	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 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	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

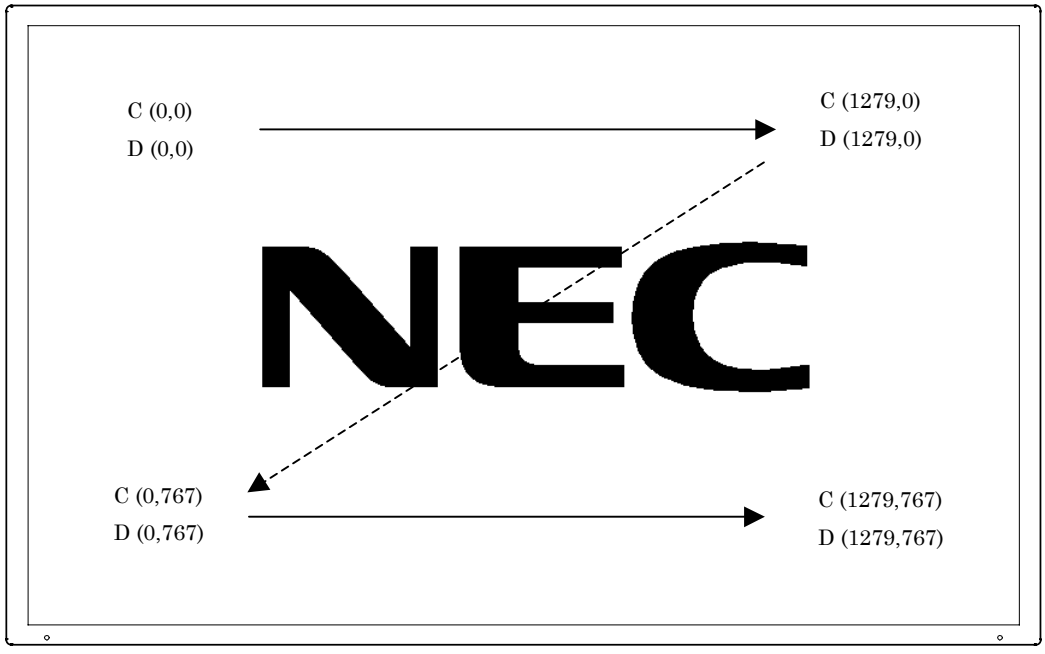
4.8 DISPLAY POSITIONS

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(1278, 0)	C(1279, 0)
C(0, 1)	C(1, 1)	•••	C(X, 1)	•••	C(1278, 1)	C(1279, 1)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
C(0, Y)	C(1, Y)	•••	C(X, Y)	•••	C(1278, Y)	C(1279, Y)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
C(0,766)	C(0,766)	•••	C(X,766)	•••	C(1278,766)	C(1279,766)
C(0,767)	C(1,767)	•••	C(X,767)	•••	C(1278,767)	C(1279,767)

4.9 SCANNING DIRECTIONS

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



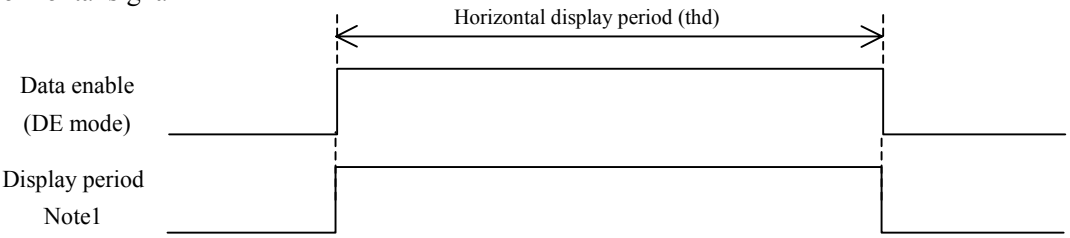
Note1

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

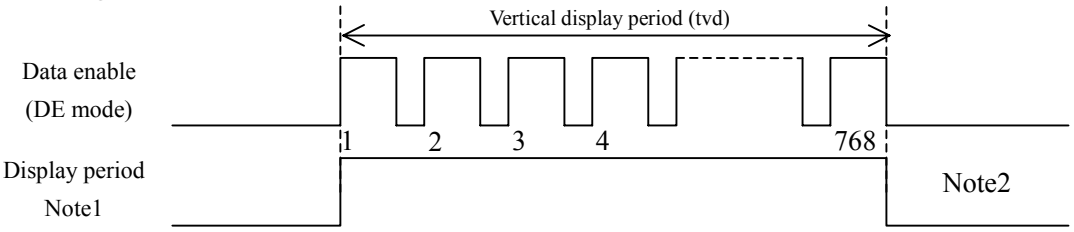
4.10.1 Outline of input signal timings

- Horizontal signal



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

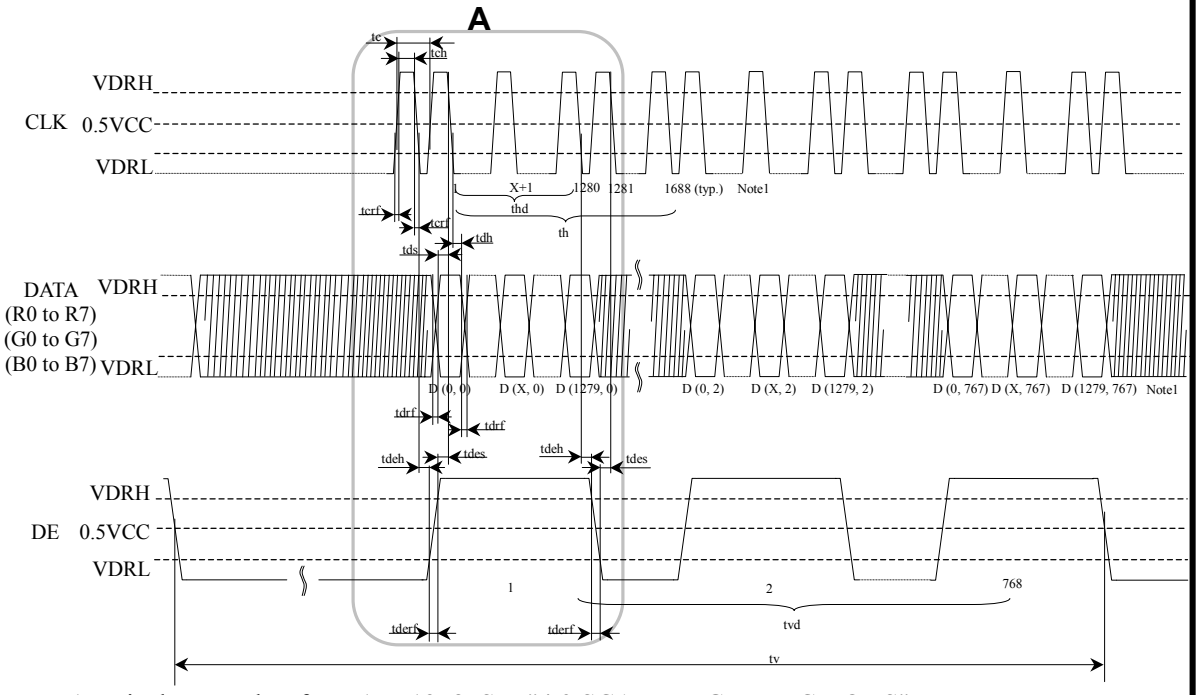
- Vertical signal



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.

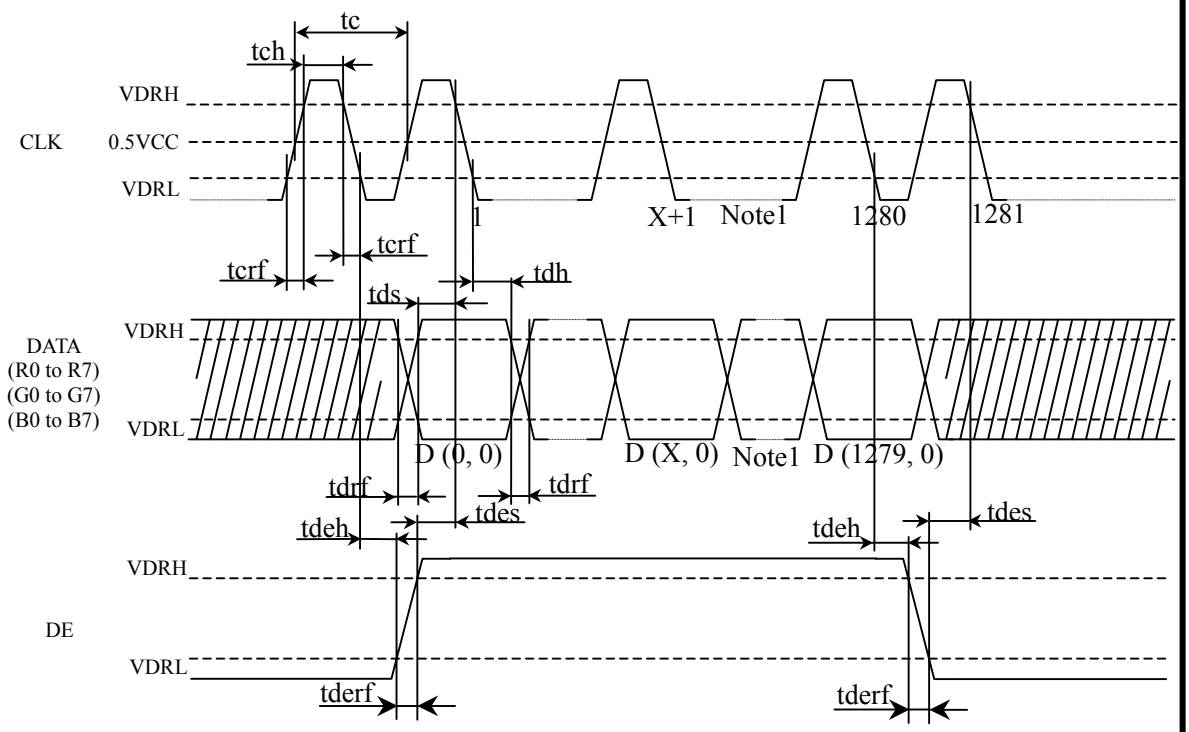
4.10.2 Detailed input signal timing chart for DE mode

- Outline chart



Note1: X is data number from 1 to 1278. See "4.9 SCANNING DIRECTIONS".

• Detail of **A** part



Note1: X is data number from 1 to 1278. See "4.9 SCANNING DIRECTIONS".

4.10.3 Timing characteristics

Parameter Note1			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency (LVDS receiver)		tcf	78.0	81.0	84.0	MHz	12.3 ns (typ.) Note1
	Duty		tcd	-	-	-	-	Note1, Note2
	Rise time, Fall time		tcrf	-	-	-	-	Note2
DATA	CLK-DATA	Setup time	tds	-	-	-	-	
		Hold time	tdh	-	-	-	-	
	Rise time, Fall time		tdrf	-	-	-	-	
DE	Horizontal	Cycle	th	-	1,688	-	CLK	Note1, Note3
		Display period	thd		1,280		CLK	Note1
	Vertical (One frame)	Cycle	tv	-	806	-	H	
		Display period	tvd		768		H	
	CLK-DE	Setup time	tdes	-	-	-	-	Note2
		Hold time	tdeh	-	-	-	-	
	Rise time, Fall time		tderf	-	-	-	-	

Note1: Definition of parameters is as follows.

tcf = 1/tc, tcd = tch/tc = tch×tcf, tc = 1CLK, th = 1H

Note2: See the data sheet of LVDS transmitter.

Note3: "th" must keep the fluctuation within ±1 CLK, because of avoidance of image sticking.

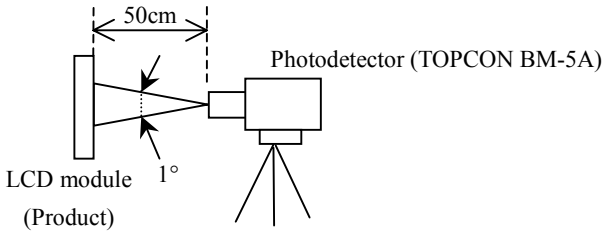
4.11 OPTICS

4.11.1 Optical characteristics

Parameter Note1		Condition	Symbol	min.	typ.	max.	Unit	Remarks
Contrast ratio		White/Black at center θR = 0°, θL = 0°, θU = 0°, θD = 0°	CR	200	350	-	-	Note2
Luminance		White at center θR = 0°, θL = 0°, θU = 0°, θD = 0°	L	TBD	450	-	cd/m^2	-
Luminance uniformity		-	LU	-	TBD	1.30	-	Note3
Chromaticity	White	**x** coordinate	Wx	-	0.300	-	-	Note4
		y coordinate	Wy	-	0.315	-	-	
	Red	**x** coordinate	Rx	-	TBD	-	-	
		y coordinate	Ry	-	TBD	-	-	
	Green	**x** coordinate	Gx	-	TBD	-	-	
		y coordinate	Gy	-	TBD	-	-	
	Blue	**x** coordinate	Bx	-	TBD	-	-	
		y coordinate	By	-	TBD	-	-	
Color gamut		θR = 0°, θL = 0°, θU = 0°, θD = 0° at center, against NTSC color space	C	50	72	-	%	
Response time		Black to white	Ton	-	12	TBD	ms	Note5 Note6
		White to black	Toff	-	12	TBD	ms	
Viewing angle	Right	θU = 0°, θD = 0°, CR = 10	θR	-	85	-	°	Note7
	Left	θU = 0°, θD = 0°, CR = 10	θL	-	85	-	°	
	Up	θR = 0°, θL = 0°, CR = 10	θU	-	85	-	°	
	Down	θR = 0°, θL = 0°, CR = 10	θD	-	85	-	°	

Note1: Measurement conditions are as follows.
Ta = 25°C, VCC = 5.0V, VDDB = 12.0V

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: These coordinates are found on CIE 1931 chromaticity diagram.
Note5: Product surface temperature: TopF = 25°C
Note6: See "4.11.4 Definition of response times".
Note7: 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.

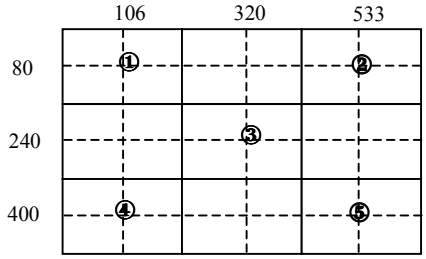
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.11.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

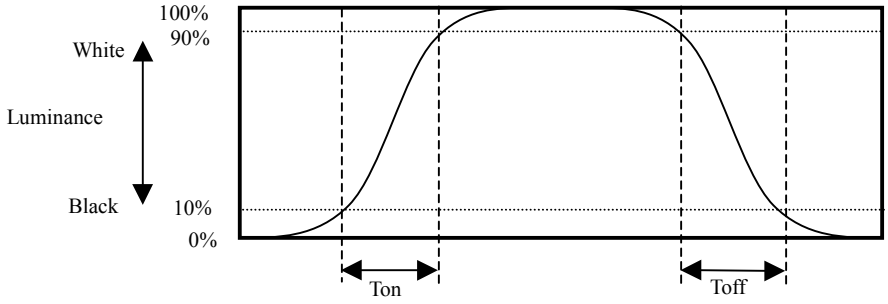
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

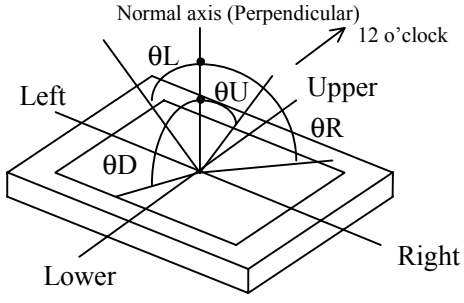


4.11.4 Definition of response times

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



4.11.5 Definition of viewing angles

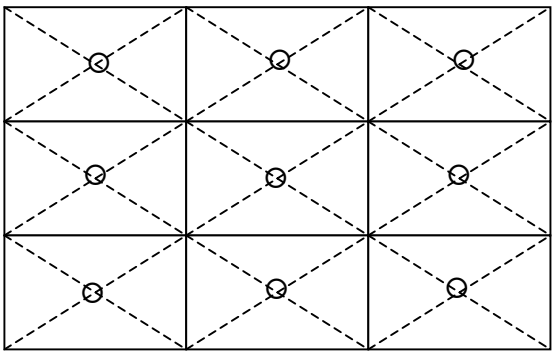


5. RELIABILITY TESTS

Test item	Condition	Judgment
High temperature and humidity (Operation)	① 60 ± 2°C, RH = 60%, 240hours ② Display data is black.	No display malfunctions Note1
Heat cycle (Operation)	① 0 ± 3°C…1hour 55 ± 3°C…1hour ② 50cycles, 4hours/cycle ③ Display data is black.	
Thermal shock (Non operation)	① -20 ± 3°C…30minutes 60 ± 3°C…30minutes ② 100cycles, 30minutes/cycle ③ Temperature transition time is within 5 minutes.	
ESD (Operation)	① 150pF, 150Ω, ±10kV ② 9 places on a panel surface Note2 ③ 10 times each places at 1 sec interval	
Dust (Operation)	① Sample dust: No. 15 (by JIS-Z8901) ② 15 seconds stir ③ 8 times repeat at 1 hour interval	
Vibration (Non operation)	① 5 to 100Hz, 11.76m/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	

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!**

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/s^2 and to be not greater 11ms, Pressure: To be not greater 19.6N)

6.3 ATTENTIONS

6.3.1 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 such as screen cleaner for LCD.
⑦ Do not push-pull the interface connectors while the product is working, because wrong power sequence may break down the product.
⑧ Do not give the shock or vibration to the normal direction of a display surface, because image quality may fall.

6.3.2 Environment

① Do not operate in dewdrop atmosphere and corrosive gases.
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.

6.3.3 Characteristics

The following items are neither defects nor failures.

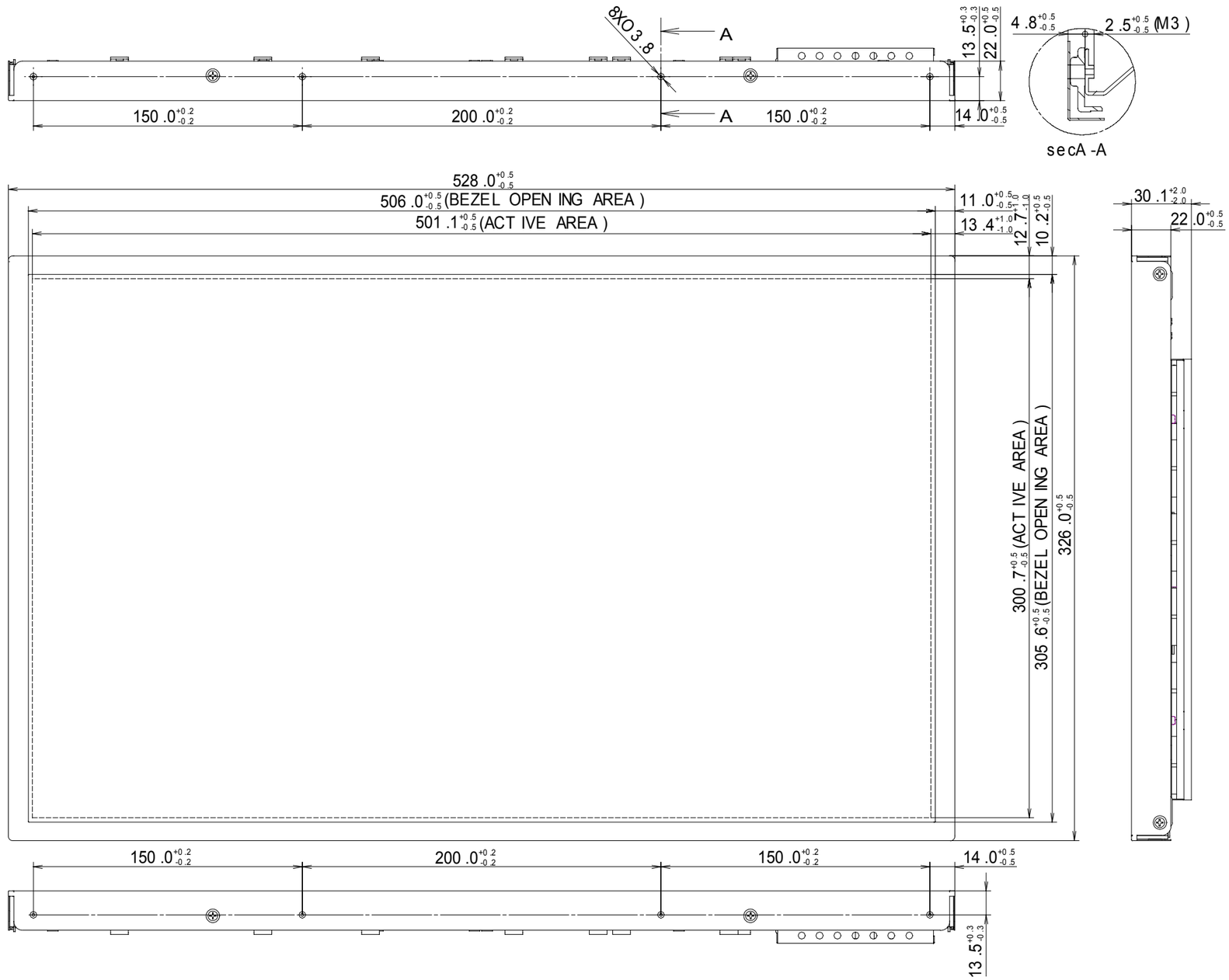
① Response time, luminance and color may be changed by ambient temperature.
② The LCD may be seemed luminance non-uniformity, flicker, vertical seam or small spot by display patterns.
③ Optical characteristics (e.g. luminance, display uniformity, etc.) gradually is going to change depending on operating time, and especially low temperature, because the LCD has cold cathode fluorescent lamps.
④ 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.
⑤ The display color may be changed by viewing angle because of the use of condenser sheet in the backlight unit.
⑥ The luminance may be changed by voltage variation (voltage drop), even if power source applies recommended voltage to backlight inverter.
⑦ Optical characteristics may be changed by input signal timings.

6.3.4 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 screwnails.
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.

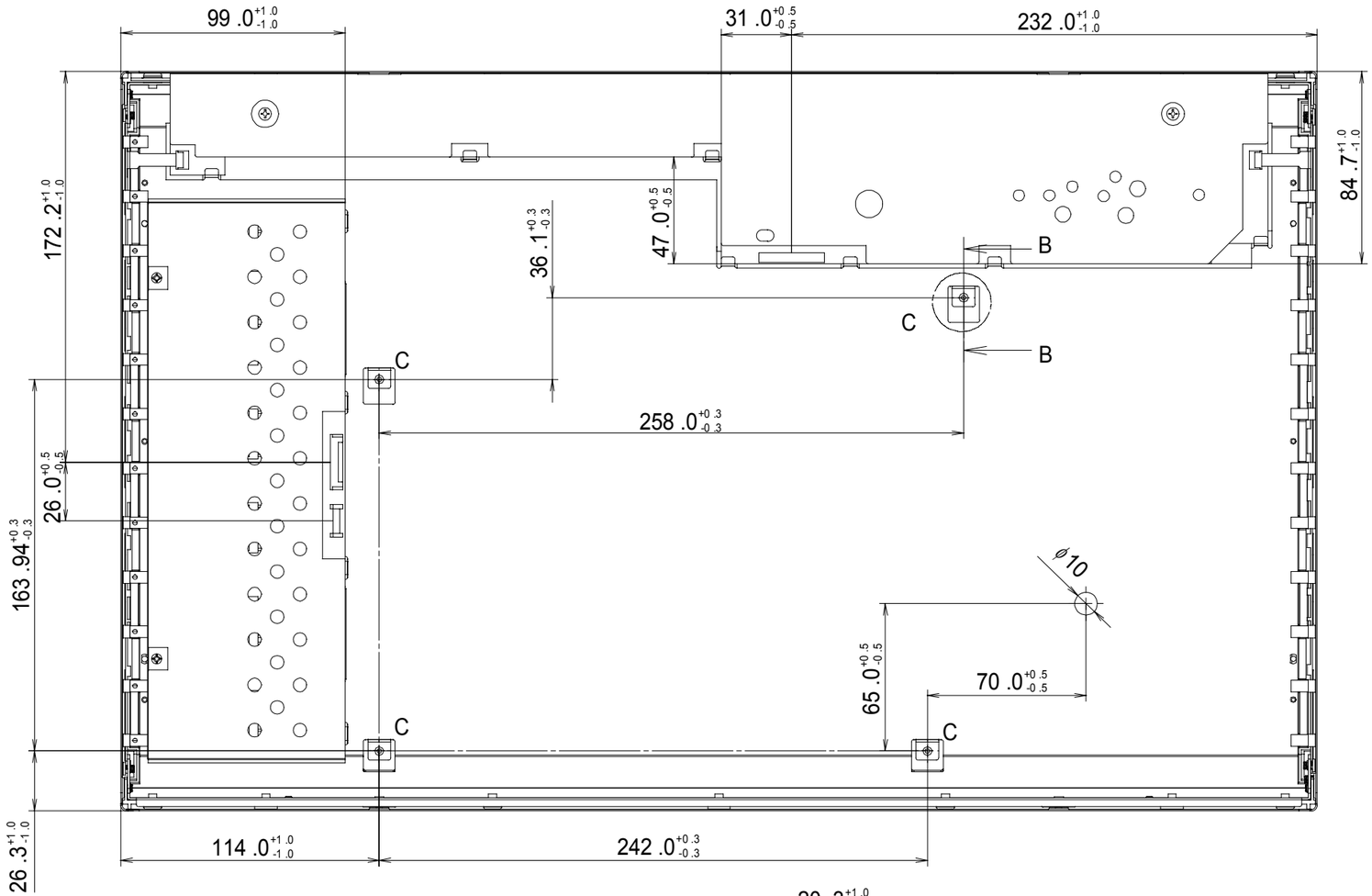
7. OUTLINE DRAWINGS

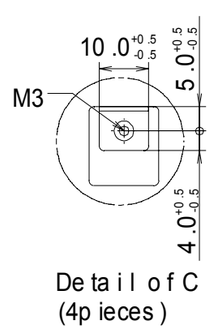
7.1 FRONT VIEW



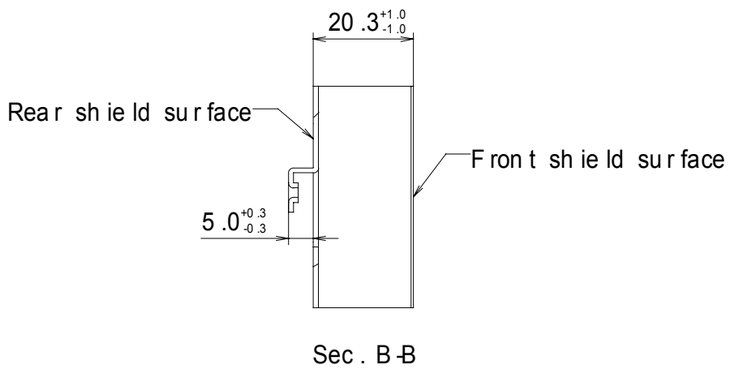
Unit: mm

7.2 REAR VIEW





Detail of C
(4pieces)



Sec. B-B

Unit: mm

REVISION HISTORY

The inside of latest specifications is revised to the clerical error, undecided mater (TBD, etc.) 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 signature
1st edition	DOD - M - 0290	Apr. 6, 2001	**Revision contents** New issue **Writer** *Approved by* A. OKAMOTO　*Checked by* ——————　*Prepared by* A. SAWADA
2nd edition	DOD - M - 0550	Jul. 30, 2001	**Revision contents** • Change part (Before-1st edition → After-2nd edition) **(1)** ***page*** **6/28** **2. GENERAL SPECIFICATIONS** ***Module size*** 530.0 (H) × 329.0 (V) × 36.0 (D) mm (typ.) ***Signal system*** 1port LVDS (Thine Electronics Inc. THC63LVDF84A) ***Backlight*** Direct light type: 16 cold cathode fluorescent lamps → ***page*** **6/29** **2. GENERAL SPECIFICATIONS** ***Module size*** 528.0 (H) × 326.0 (V) × 33.0 (D) mm (typ.) ***Signal system*** Single link LVDS (Receiver: THC63LVD824, THine Electronics Inc.) ***Backlight*** Direct light type: 12 cold cathode fluorescent lamps **(2)** ***page*** **8/28** 4.1 MECHANICAL SPECIFICATIONS Module size 530.0 ± 1.0 (H) × 329.0 ± 1.0 (V) × 36.0 ± 1.0 (D) → ***page*** **8/29** 4.1 MECHANICAL SPECIFICATIONS Module size 528.0 ± 0.5 (H) × 326.0 ± 0.5 (V) × 33.0 ± 0.5 (D) **(3)** ***page*** **9/28** 4.3.1 Driving for LCD panel signal processing board Supply current ICC TBD Note1 TBD Note2 mA → ***page*** **9/29** 4.3.1 Driving for LCD panel signal processing board Supply current ICC TBD Note1 1,000 Note2 mA

REVISION HISTORY

Edition	Document number	Prepared date	Revision contents and writer
2nd edition	DOD - M - 0550	Jul. 30, 2001	**(4)** ***page*** **14/28** 4.5.4 Connection between receiver and transmitter for LVDS Transmitter for LVDS THC63LVDM83A Receiver for LVDS Equivalent of THC63LVDF84A → ***page*** **14/29** 4.5.4 Connection between receiver and transmitter for LVDS Transmitter for LVDS THC63LVD823 Receiver for LVDS Equivalent of THC63LVD824 **(5)** ***page*** **20/28** 4.10.3 Timing characteristics

Parameter	Note1		Symbol	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency (LVDS receiver)		1/tc	78.0	81.0	84.0	MHz	12.34 ns (Typ.)
	Duty		tch/tc	Note2				-
	Rise, fall		tcrf					
DATA	CLK-DATA	Setup timing	tds					
		Hold timing	tdh					
	Rise, fall		tdrf					
DE	Horizontal	Cycle period	thc					
		Display period	thd					
	Vertical (One frame)	Cycle	tvc					
		Display period	tvd					
	CLK-DE	Setup timing	tes					
		Hold timing	teh					
	Rise, fall		terf					

Note1: All parameters should be kept within the specified range.

Note2: See the data sheet of LVDS transmitter.

→

page **20/29**

4.10.3 Timing characteristics

Parameter	Note1		Symbol	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency (LVDS receiver)		1/tc	78.0	81.0	84.0	MHz	12.3 ns (typ.)
	Duty		tch/tc	-	-	-	-	Note1
	Rise time, Fall time		tcrf	-	-	-	-	
DATA	CLK-DATA	Setup time	tds	-	-	-	-	
		Hold time	tdh	-	-	-	-	
	Rise time, Fall time		tdrf	-	-	-	-	
DE	Horizontal	Cycle	th	-	1,688	-	CLK	Note2, Note3
		Display period	thd		1,280		CLK	Note3
	Vertical (One frame)	Cycle	tv	-	806	-	H	
		Display period	tvd		768		H	
	CLK-DE	Setup time	tdes	-	-	-	-	Note1
		Hold time	tdeh	-	-	-	-	
	Rise time, Fall time		tderf	-	-	-	-	

Note1: See the data sheet of LVDS transmitter.

Note2: "th" must keep the fluctuation within ±1 CLK, because of avoidance of image sticking.

Note3: Definition of units is as follows.

Writer

Approved by	*Checked by*	*Prepared by*
T. ITO		A. SAWADA

REVISION HISTORY

Edition	Document number	Prepared date	Revision contents and writer
3rd edition	DOD - M - 0694	Oct. 22, 2001	**Revision contents** • Change part (Before-2nd edition → After-3rd edition) **(1)** ***page*** **6/29** **2. GENERAL SPECIFICATIONS** ***Contrast ratio*** TBD (typ.) ***Polarizer surface*** TBD ***Color gamut*** 60% (typ.) ***Response time*** 30 to 40 ms (typ.) Ton + Toff ***Backlight*** • Backlight unit: type No. TBD • Inverter: type No. TBD ***Power consumption*** TBD (typ.) → ***page*** **6/33** **2. GENERAL SPECIFICATIONS** ***Contrast ratio*** 350:1 (typ.) ***Polarizer surface*** Low reflection treatment ***Color gamut*** 72% (typ.) ***Response time*** 12 ms (typ.) ***Backlight*** • Backlight unit: type No. 230LHS01 • Inverter: type No. 230PW011 ***Power consumption*** 57.4W (typ.) **(2)** ***page*** **8/29** 4.1 MECHANICAL SPECIFICATIONS Weight 2,600 (typ.), TBD (max.) → ***page*** **8/33** 4.1 MECHANICAL SPECIFICATIONS Weight 2,600 (typ.), 2,900 (max.) **(3)** ***page*** **9/29** 4.3.1 Driving for LCD panel signal processing board Supply current ICC - TBD Note1 1,000 Note2 → ***page*** **9/33** 4.3.1 Driving for LCD panel signal processing board Supply current ICC - 670 Note1 1,000 Note2 **(4)** ***page*** **9/29** 4.3.2 Driving for backlight inverter Supply current IDDB - TBD TBD BRTP signal IiBPL -1,580 - - IiBPH - - 3,500 PWSEL signal IiBSL -810 - - IiBSH - - 440 ***(This part continues to the next page.)***

REVISION HISTORY

Edition	Document number	Prepared date	Revision contents and writer
3rd edition	DOD - M - 0694	Oct. 22, 2001	*(This part continues from the front page.)* → ***page* 9/33** 4.3.2 Driving for backlight inverter Supply current IDDB - 4,500 5,000 BRTP signal IBPL TBD - - IBPH - - TBD PWSEL signal IBSL TBD - - IBSH - - TBD **(5) *page* 10/29** 4.3.4 Fuses Fuse: Type TBD, Supplier TBD; Rating Note1: TBD A / TBD V; Remarks: VCC (for LCD panel signal processing board) Fuse: Type TBD, Supplier TBD; Rating Note1: TBD A / TBD V; Remarks: VDDB (for backlight inverter) 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. → ***page* 10/33** 4.3.4 Fuses VCC: Fuse Type ICP-S2.3, Supplier Rohm Co., Ltd.; Rating 4.6 A (Fusing current Note1) / 50 V (-) VDDB: Fuse Type R451010, Supplier Littelfuse Inc.; Rating 20 A (Fusing current Note1) / 125 V (-) Note1: The power capacity should be more than the fusing current rating. 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. **(6) *page* 11/29** 4.4.1 Sequence for LCD panel signal processing board Tr < 80ms → ***page* 11/33** 4.4.1 Sequence for LCD panel signal processing board 5ms < Tr <80ms **(7) *page* 13/29** 4.5.2 Backlight inverter CN202 2 N.C. Non-connection → ***page* 13/33** 4.5.2 Backlight inverter CN202 2 GNDB Backlight ground

REVISION HISTORY

Edition	Document number	Prepared date	Revision contents and writer
3rd edition	DOD - M - 0694	Oct. 22, 2001	**(8)** ***page*** **16/29** 4.6.2 Detail of PWM timing (2) Each parameter

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Luminance control frequency	1/tPW	185	255	325	Hz	Note1
Duty ratio	tPWH/tPW	0.2	-	1.0	-	Note2
Non signal period	tPWN	0	-	50	ms	Note3

→

page **16/33**
4.6.2 Detail of PWM timing
(2) Each parameter

Parameter	Symbol Note1	Min.	Typ.	Max.	Unit	Remarks
Luminance control frequency	FL	230	255	280	Hz	Note2
Duty ratio	DL	0.2	-	1.0	-	Note3
Non signal period	tPWN	0	-	50	ms	Note4

(9) ***page*** **21/29**
4.11.1 Optical characteristics

Parameter Note1			Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Contrast ratio			CR	White/Black at center θR = 0°, θL = 0°, θU = 0°, θD = 0°	200	TBD	-	-	Note2
Luminance			L	White at center θR = 0°, θL = 0°, θU = 0°, θD = 0°	TBD	450	-	cd/m^2	-
Luminance uniformity			LU	-	-	TBD	1.30	-	Note3
Chromaticity			W	White (x, y)	-	0.300, 0.315	-	-	-
			R	Red (x, y)	-	TBD, TBD	-	-	
			G	Green (x, y)	-	TBD, TBD	-	-	
			B	Blue (x, y)	-	TBD, TBD	-	-	
Color gamut			C	θR = 0°, θL = 0°, θU = 0°, θD = 0° at center, against NTSC color space	50	60	-	%	
Response time Note4			Ton	Black to White	-	TBD	TBD	ms	Note5
			Toff	White to Black	-	TBD	TBD	ms	
Viewing angle	CR =10	Right	θR	θU = 0°, θD = 0°	-	85	-	°	Note6
		Left	θL	θU = 0°, θD = 0°	-	85	-	°	
		Up	θU	θR = 0°, θL = 0°	-	85	-	°	
		Down	θD	θR = 0°, θL = 0°	-	85	-	°	

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REVISION HISTORY

<table>
<tr><th>Edition</th><th>Document number</th><th>Prepared date</th><th>Revision contents and writer</th></tr>
<tr><td>3rd edition</td><td>DOD - M - 0694</td><td>Oct. 22, 2001</td><td>

(This part continues from the front page.)

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4.6.2 Detail of PWM timing

Parameter Note1			Condition	Symbol	Min.	Typ.	Max.	Unit	Remarks
Contrast ratio			White/Black at center θR = 0°, θL = 0°, θU = 0°, θD = 0°	CR	200	350	-	-	Note2
Luminance			White at center θR = 0°, θL = 0°, θU = 0°, θD = 0°	L	TBD	450	-	cd/m^2	-
Luminance uniformity			-	LU	-	TBD	1.30	-	Note3
Chromaticity	White		**x** coordinate	Wx	-	0.300	-	-	Note4
			y coordinate	Wy	-	0.315	-	-	
	Red		**x** coordinate	Rx	-	TBD	-	-	
			y coordinate	Ry	-	TBD	-	-	
	Green		**x** coordinate	Gx	-	TBD	-	-	
			y coordinate	Gy	-	TBD	-	-	
	Blue		**x** coordinate	Bx	-	TBD	-	-	
			y coordinate	By	-	TBD	-	-	
Color gamut			θR = 0°, θL = 0°, θU = 0°, θD = 0° at center, against NTSC color space	C	50	72	-	%	
Response time			White to Black	Ton	-	12	TBD	ms	Note5 Note6
			Black to White	Toff	-	12	TBD	ms	
Viewing angle	CR = 10	Right	θU = 0°, θD = 0°	θR	-	85	-	°	Note7
		Left	θU = 0°, θD = 0°	θL	-	85	-	°	
		Up	θR = 0°, θL = 0°	θU	-	85	-	°	
		Down	θR = 0°, θL = 0°	θD	-	85	-	°	

Writer

Approved by T. ITO | *Checked by* | *Prepared by* A. SAWADA

</td></tr>
<tr><td>4th edition</td><td>DOD - M – 0807</td><td>Dec. 7, 2001</td><td>

Revision contents

• Change part (Before-3rd edition → After-4th edition)

(1) *page* 27/33

7.2 REAR VIEW

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***page* 27/33**

7.2 REAR VIEW is revised.

Writer

Approved by T. ITO | *Checked by* | *Prepared by* R. KAWASHIMA

</td></tr>
</table>

REVISION HISTORY

Edition	Document number	Prepared date	Revision contents and writer
5th edition	DOD - M - 0895	Feb. 21, 2002	**Revision contents** • Change part (Before-4th edition → After-5th edition) **(1) *page* 8/34** 4.2 ABSOLUTE MAXIMUM RATINGS Absolute humidity AH: ≤ 78 g/m^3 → ≤ 73 g/m^3 (correction) **(2) *page* 9/34** 4.3.2 Driving for backlight inverter min. typ. max. min. typ. max. VBI(V) 0 - 1.2 → 0 - 1.0 (correction) VBPH(V) 2.0 - 5.2 → 2.0 - 5.0 (correction) VBCL(V) TBD - TBD → 0 - 0.8 VBCH(V) TBD - TBD → 2.0 - 5.0 VBSL(V) TBD - TBD → 0 - 0.8 VBSH(V) TBD - TBD → 2.0 - 5.0 IBI(μA) TBD - - → -130 - - IBPL(μA) TBD - - → -1580 - - IBPH(μA) - - TBD → - - 3500 IBCL(μA) -810 - - → -610 - - (correction) IBSL(μA) TBD - - → -610 - - IBSH(μA) - - TBD → - - 440 **(3) *page* 16/34** 4.6.2 Detail of PWM timing Symbol is corrected. tPWN → tPWL **(4) *page* 26/34** 7.1 FRONT VIEW 33.0±0.5mm → 30.1±2.0mm **Writer** *Approved by* T. ITO — *Checked by* — *Prepared by* R. KAWASHIMA
6th edition	DOD-M-0921	Mar. 1, 2002	**Revision contents** • Change part (Before-5th edition → After-6th edition) **(1) *page* 6/34** Module size: 33.0(D) mm → 30.1(D) mm (correction) **(2) *page* 8/34** Module size: 33.0 ± 0.5 (D) mm → 30.1± 2.0 (D) mm (correction) **(3) *page* 12/34** Adaptable plug: "FI-S20S" is added. **Signature of writer** *Approved by* T. ITO — *Checked by* — *Prepared by* R. KAWASHIMA