

NEC

TFT COLOR LCD MODULE

NL128102BC28-09

46cm (18.1 Type)

SXGA

LVDS interface (2 port)

Preliminary Data Sheet

(3rd Edition)

All information is subject to change without notice.

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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

NL128102BC28-09 module is composed of the driver LSIs for driving the TFT (Thin Film Transistor) array with an amorphous silicon thin film transistor liquid crystal display (a-Si TFT LCD) panel structure and a backlight.

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

RGB (Red, Green, Blue) data signals from a source system are modulated into a form suitable for active matrix addressing by the onboard signal processor and sent to the driver LSIs which in turn address the individual TFT cells.

Working as an electro-optical switch, each TFT cell regulates transmitted light from the backlight assembly when worked by the data source. Color images are created by regulating the amount of transmitted light through the array of red, green and blue dots.

1.2 APPLICATIONS

- Desk top PCs, Engineering work stations
- Display terminals for control systems
- Monitors

1.3 FEATURES

- LVDS interface
- 8-bit digital RGB signals
- Ultra-wide viewing angle (with lateral electric field)
- Small foot print
- Thin thickness
- Incorporated edge type backlight **Note1**
- High contrast
- Wide color gamut
- Acquisition product for UL/c-UL (File No.E170632)

Note1: Backlight lamp is not replaceable by customers.

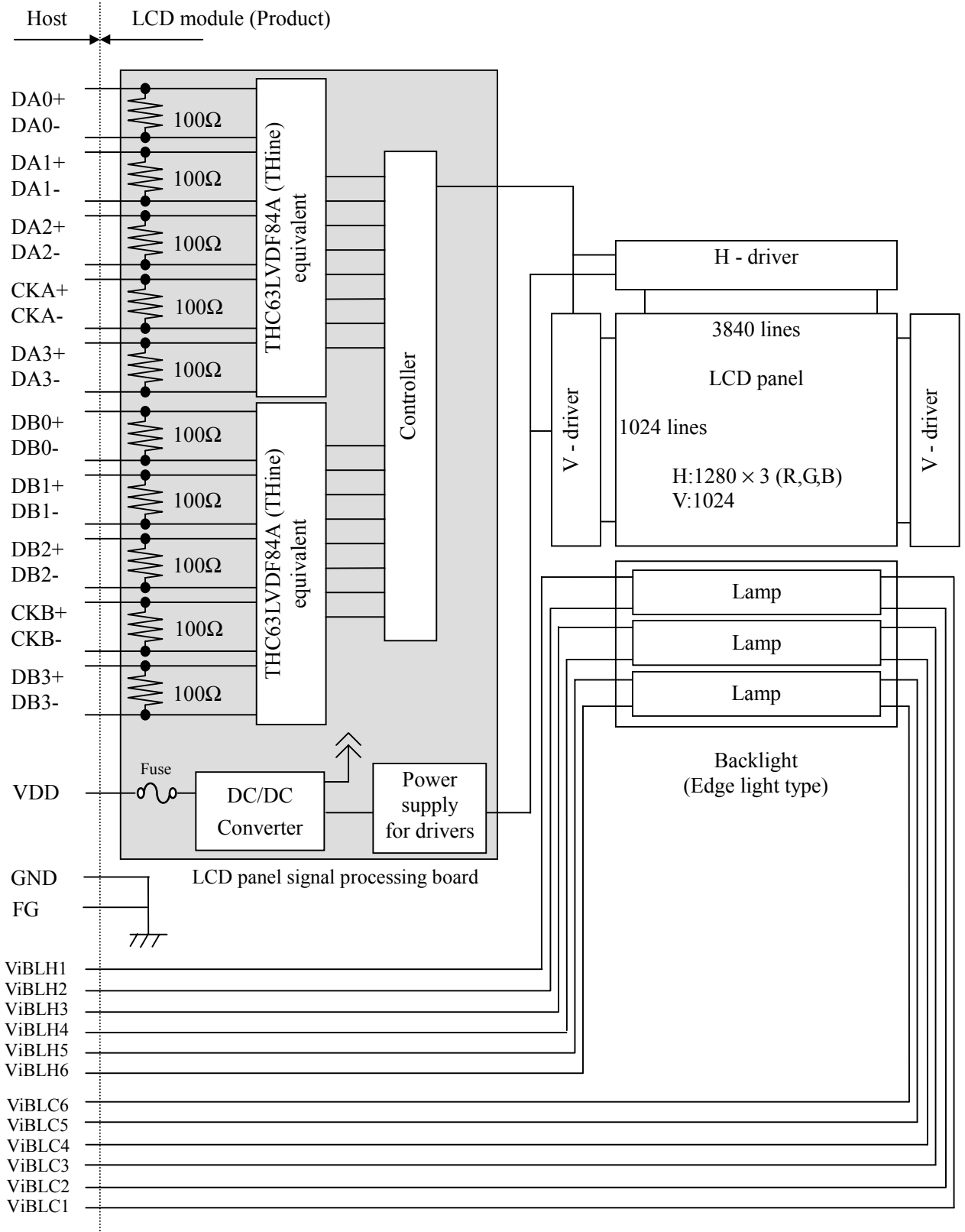
2. GENERAL SPECIFICATIONS

Display area	359.04 (H) × 287.232 (V) mm
Diagonal size of display	46 cm (18.1 inches)
Drive system	a-Si TFT active matrix
Display color	16,777,216 colors
Pixel	1280 (H) × 1024 (V) pixels
Pixel arrangement	RGB (Red, Green, Blue) vertical stripe
Dot pitch	0.0935 (H) × 0.2805 (V) mm
Pixel pitch	0.2805 (H) × 0.2805 (V) mm
Module size	383.0 (H) × 310.2 (V) × 25.0 (D) mm typ.
Weight	2,940 g (typ.)
Contrast ratio	350:1 (typ.)
Viewing angle	<p><i>At the contrast ratio 10:1</i></p> <ul style="list-style-type: none"> • Horizontal: 85° (typ., left side), 85°(typ., right side) • Vertical: 85° (typ., up side), 85°(typ., down side)
Designed viewing direction	<ul style="list-style-type: none"> • Viewing direction with contrast peak: normal axis (perpendicular) • Viewing angle with optimum grayscale ($\gamma=2.2$): normal axis (perpendicular)
Polarizer pencil-hardness	2H (min.) [by JIS K5400]
Color gamut	<p><i>At LCD panel center</i></p> <p>60 % (typ.) [against NTSC color space]</p>
Response time	<p><i>Ton (black 10%→white 90%)</i></p> <p>17 ms (typ.)</p>
Luminance	<p><i>At lamp current $I_L = 6mA / lamp$</i></p> <p>240 cd/m² (typ.)</p>
Signal system	<p>2 port LVDS (Receiver: THC63LVDF84A, THine Electronics Inc. or equivalent)</p> <p>[8-bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE)]</p>
Supply voltages	LCD panel signal processing board: 12V
Backlight	Edge light type: 6 cold cathode fluorescent lamps (Inverter less)
Power consumption	<p><i>At lamp current $I_L = 6mArms / lamp$ and checkered flag pattern</i></p> <p>27.2 W (typ.)</p>

3

3

3. BLOCK DIAGRAM



Note1: GND is signal ground for logic and LCD driving. GND is connected to FG (frame ground) in the LCD module. These grounds should be connected to system ground in customer equipment.

4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification	Unit
Module size	383.0 ± 0.5 (H) \times 310.2 ± 0.5 (V) \times 25.0 ± 0.5 (D) Note1,2	mm
Display area	359.04 (H) \times 287.232 (V) Note2	mm
Weight	2,940 (typ.), 3,100 (max.)	g

Note1: Poles, lamp cables and connectors are excepted.

Note2: See "7.OUTLINE DRAWINGS".

4.2 ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Rating	Unit	Remarks
Supply voltage	LCD panel signal board and driver	VDD	-0.3 to +14	V	Ta = 25°C
LVDS input voltage	Display signals Note1	Vi	-0.3 to 3.6	V	
Lamp voltage		VL	2000	Vrms	Ta = 25°C
Storage temperature		Tst	-20 to +60	°C	-
Operating temperature		Top1	0 to +55	°C	Front surface Note2
		Top2	0 to +65		Rear surface Note3
Relative humidity Note4		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 Note4		-	≤ 78 Note5	g/m ³	Ta $> 55^\circ\text{C}$
Operating altitude		-	$\leq 4,850$	m	$0^\circ\text{C} \leq \text{Ta} \leq 55^\circ\text{C}$
Storage altitude		-	$\leq 13,600$	m	$-20^\circ\text{C} \leq \text{Ta} \leq 60^\circ\text{C}$

Note1: Display signals are DA0+/-, DA1+/-, DA2+/-, DA3+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, CKA+/- and CKB+/-.

Note2: Measured at the LCD panel surface center (including self-heat)

Note3: Measured at the rear shield center (including self-heat)

Note4: No condensation

Note5: 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	VDD	10.8	12.0	13.2	V	-
Ripple voltage	VRP	-	-	100	mV	for VDD
Supply current	IDD	-	315 Note1	500 Note2	mA	VDD = 12.0V
Differential input threshold voltage for LVDS driver	Low	VTL	-100	-	mV	VCM=1.2V Note3
	High	VTH	-	-	+100	
Input voltage width for LVDS driver	Vi	0	-	2.4	V	-
Terminating resistor	RT	-	100	-	Ω	-

Note1: Checkered flag pattern [by EIAJ ED-2522]

Note2: Pattern for maximum current

Note3: Common mode voltage for LVDS driver

4.3.2 Driving for backlight

(Ta = 25°C, Note1)

Parameters	Symbol	min.	typ.	max.	Units	Remarks
Lamp current Note3	IL	3.0	6.0	7.0	mArms	IL=6.0mArms: 240cd/m ²
Lamp voltage Note2	VL	-	650	-	Vrms	-
Lamp turn on voltage Note3	VS	1000	-	-	Vrms	Ta = 25°C
		1300	-	-	Vrms	Ta = 0°C
Oscillator frequency	FO	40	48	55	kHz	Note3

Note1: This module consists of 6 lamps, and these specifications are for each lamp.

Note2: The supply voltage cycle between lamps should be kept on a same phase. Also "VS" and "VL" are the voltage value between low voltage side (Cold) and high voltage side (Hot).

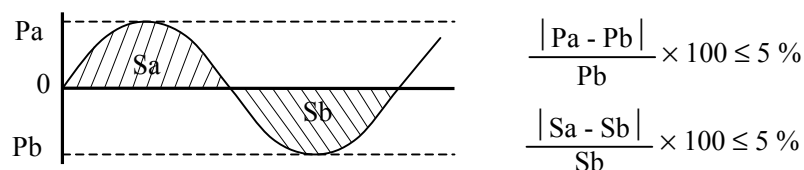
Note3: When IL and VS are lower than minimum value, lamps will not turn on.

Note4: In case "FO" is not the recommended value, beat noise may display on the screen, because of interference between "FO" and "1/th". Recommended value of "FO" is as following.

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

th: Horizontal cycle period
(See 4.7.1 **Timing specifications**)
n: Natural number (1, 2, 3 ………)

Note5: The asymmetric ratio of working waveform for lamps (Supply voltage peak ratio, supply current peak ratio and waveform space ratio) should be less than 5 % (See the following figure.). If the waveform is asymmetric, DC (Direct current) element apply into the lamp. In this case, a lamp lifetime may be shortened, because a distribution of a lamp enclosure substance inclines toward one side between low voltage terminal (Cold terminal) and high voltage terminal (Hot terminal).



Pa: Supply voltage/current peak for positive, Pb: Supply voltage/current peak for negative
Sa: Waveform space for positive part, Sb: Waveform space for negative part

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
VDD (for LCD panel signal processing board; 12.0V)	≤ 100		mVp-p

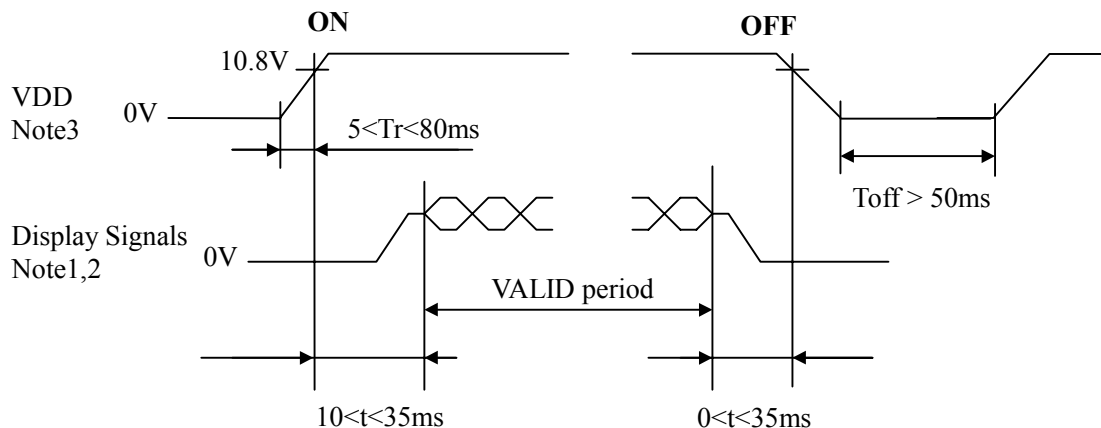
Note1: The permissible ripple voltage includes spike noise.

4.3.4 Fuse

Item	Fuse		Rating	Unit	Remarks
	Type	Supplier			
VDD	ICP-S1.8	ROHM Co., Ltd	4.0	A	Fusing current Note1
			50	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 SUPPLY VOLTAGE SEQUENCE



Note1: Display signals should be measured at the terminal of 100Ω resistor.

Note2: Display signals (DA0+/-, DA1+/-, DA2+/-, DA3+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, CKA+/- and CKB+/-) must be "0" voltage, exclude the VALID period (See above sequence diagram). If these display signals are higher than 0.3 V, the internal circuit will be damaged.

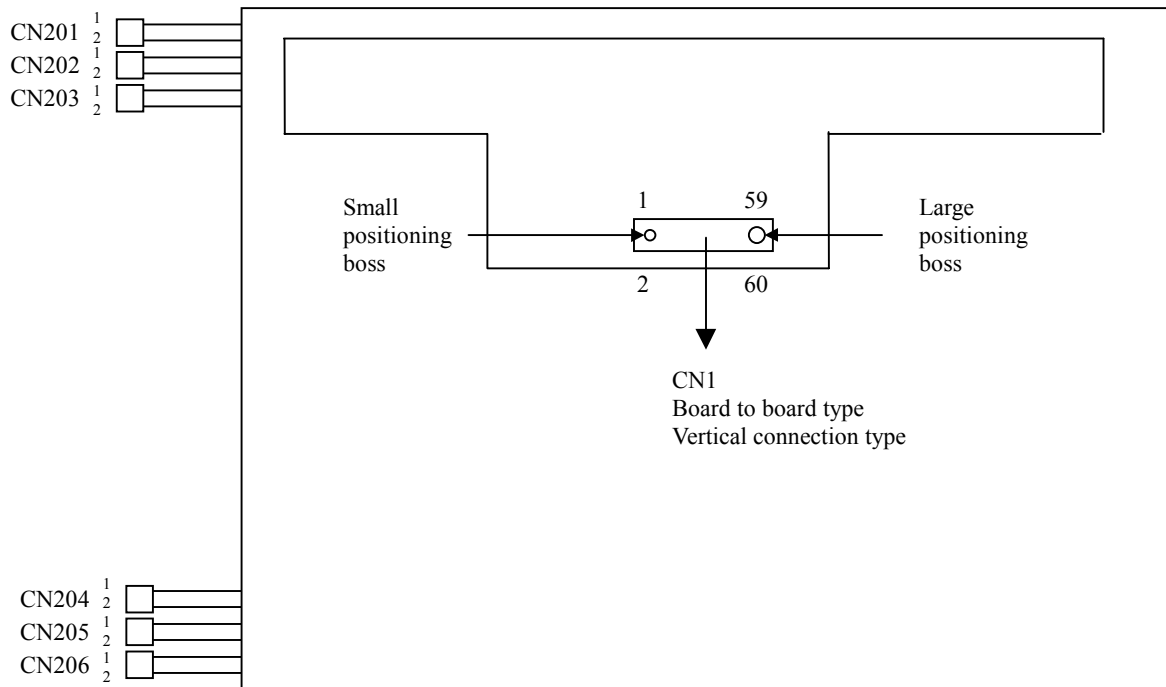
If some of display signals of this product are cut while this product is working, even if the signal input to it once again, it might not work normally. If customer stop display signals, they should be cut VDD.

Note3: In terms of voltage variation (voltage drop) while VDD rising edge is below 10.8V, a protection circuit may work, and then this product may not work.

Note4: The backlight power voltage should be inputted within the valid period of display signals, in order to avoid unstable data display.

4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

4.5.1 Positions of socket and plugs



4.5.2 LCD panel signal processing board

CN1 socket (Module side): KX14-60K5D1 (Japan Aviation Electronics Industry Limited)

Adaptable plug: KX15-60K3D1 (Japan Aviation Electronics Industry Limited)

Pin No.	Symbol	Function	Description
1	GND	Ground	Connect to system ground.
2	VDD	Power supply	12V±10%
3	DA0-	Odd pixel data 0	LVDS differential signal Note1
4	VDD	Power supply	12V±10%
5	DA0+	Odd pixel data 0	LVDS differential signal Note1
6	VDD	Power supply	12V±10%
7	GND	Ground	Connect to system ground.
8	GND	Ground	Connect to system ground.
9	DA1-	Odd pixel data 1	LVDS differential signal Note1
10	GND	Ground	Connect to system ground.
11	DA1+	Odd pixel data 1	LVDS differential signal Note1
12	GND	Ground	Connect to system ground.
13	GND	Ground	Connect to system ground.
14	GND	Ground	Connect to system ground.
15	DA2-	Odd pixel data 2	LVDS differential signal Note1
16	GND	Ground	Connect to system ground.
17	DA2+	Odd pixel data 2	LVDS differential signal Note1
18	GND	Ground	Connect to system ground.
19	GND	Ground	Connect to system ground.
20	GND	Ground	Connect to system ground.

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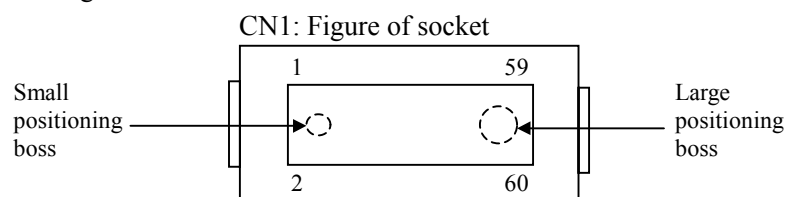
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CN1 socket (Module side): KX14-60K5D1 (Japan Aviation Electronics Industry Limited)

Adaptable plug: KX15-60K3D1 (Japan Aviation Electronics Industry Limited)

Pin No.	Symbol	Function	Description
21	CKA-	Odd pixel clock	LVDS differential signal Note1
22	GND	Ground	Connect to system ground.
23	CKA+	Odd pixel clock	LVDS differential signal Note1
24	GND	Ground	Connect to system ground.
25	GND	Ground	Connect to system ground.
26	GND	Ground	Connect to system ground.
27	DA3-	Odd pixel data 3	LVDS differential signal Note1
28	GND	Ground	Connect to system ground.
29	DA3+	Odd pixel data 3	LVDS differential signal Note1
30	GND	Ground	Connect to system ground.
31	GND	Ground	Connect to system ground.
32	GND	Ground	Connect to system ground.
33	DB0-	Even pixel data 0	LVDS differential signal Note1
34	GND	Ground	Connect to system ground.
35	DB0+	Even pixel data 0	LVDS differential signal Note1
36	GND	Ground	Connect to system ground.
37	GND	Ground	Connect to system ground.
38	GND	Ground	Connect to system ground.
39	DB1-	Even pixel data 1	LVDS differential signal Note1
40	GND	Ground	Connect to system ground.
41	DB1+	Even pixel data 1	LVDS differential signal Note1
42	GND	Ground	Connect to system ground.
43	GND	Ground	Connect to system ground.
44	GND	Ground	Connect to system ground.
45	DB2-	Even pixel data 2	LVDS differential signal Note1
46	GND	Ground	Connect to system ground.
47	DB2+	Even pixel data 2	LVDS differential signal Note1
48	GND	Ground	Connect to system ground.
49	GND	Ground	Connect to system ground.
50	GND	Ground	Connect to system ground.
51	CKB-	Even pixel clock	LVDS differential signal Note1
52	GND	Ground	Connect to system ground.
53	CKB+	Even pixel clock	LVDS differential signal Note1
54	GND	Ground	Connect to system ground.
55	GND	Ground	Connect to system ground.
56	GND	Ground	Connect to system ground.
57	DB3-	Even pixel data 3	LVDS differential signal Note1
58	GND	Ground	Connect to system ground.
59	DB3+	Even pixel data 3	LVDS differential signal Note1
60	GND	Ground	Connect to system ground.

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



4.5.3 Backlight

Attention: ViBLH and ViBLC must be connected correctly. If customer connects wrongly, customer will be hurt and the module will be broken.

CN201 plug (Module side): BHSR-02VS-1 (J.S.T. Mfg Co., Ltd.)

Adaptable socket: SM02B-BHSS-1-TB (J.S.T. Mfg Co., Ltd.)

Pin No.	Symbol	Function	Remarks
1	ViBLH1	Upper side lamp, High voltage terminal	The cable color is pink
2	ViBLC1	Upper side lamp, Low voltage terminal	The cable color is gray

CN202 plug (Module side): BHSR-02VS-1 (J.S.T. Mfg Co., Ltd.)

Adaptable socket: SM02B-BHSS-1-TB (J.S.T. Mfg Co., Ltd.)

Pin No.	Symbol	Function	Remarks
1	ViBLH2	Upper side lamp, High voltage terminal	The cable color is white
2	ViBLC2	Upper side lamp, Low voltage terminal	The cable color is gray

CN203 plug (Module side): BHSR-02VS-1 (J.S.T. Mfg Co., Ltd.)

Adaptable socket: SM02B-BHSS-1-TB (J.S.T. Mfg Co., Ltd.)

Pin No.	Symbol	Function	Remarks
1	ViBLH3	Upper side lamp, High voltage terminal	The cable color is pink
2	ViBLC3	Upper side lamp, Low voltage terminal	The cable color is gray

CN204 plug (Module side): BHSR-02VS-1 (J.S.T. Mfg Co., Ltd.)

Adaptable socket: SM02B-BHSS-1-TB (J.S.T. Mfg Co., Ltd.)

Pin No.	Symbol	Function	Remarks
1	ViBLH4	Lower side lamp, High voltage terminal	The cable color is pink
2	ViBLC4	Lower side lamp, Low voltage terminal	The cable color is gray

CN205 plug (Module side): BHSR-02VS-1 (J.S.T. Mfg Co., Ltd.)

Adaptable socket: SM02B-BHSS-1-TB (J.S.T. Mfg Co., Ltd.)

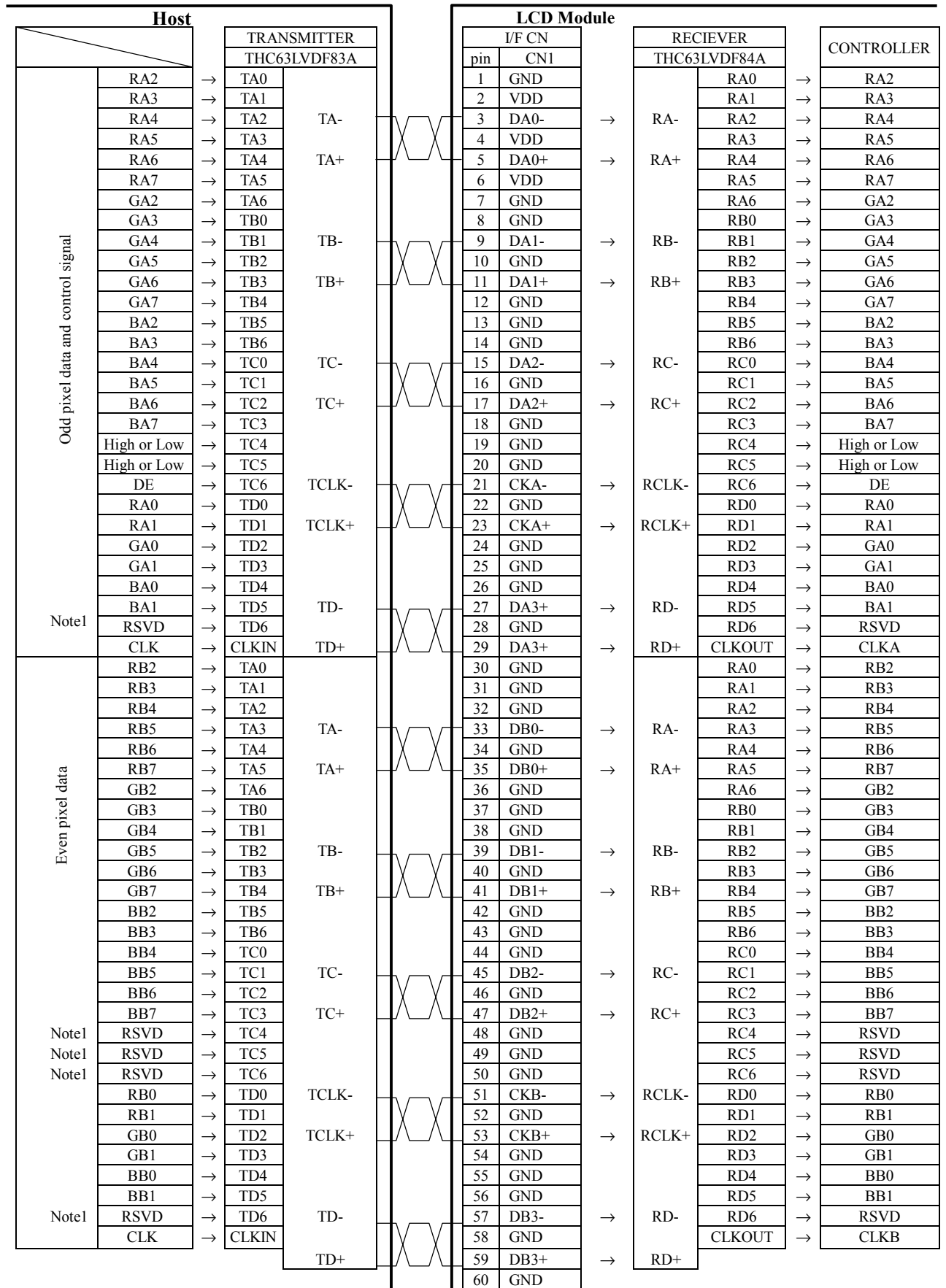
Pin No.	Symbol	Function	Remarks
1	ViBLH5	Lower side lamp, High voltage terminal	The cable color is white
2	ViBLC5	Lower side lamp, Low voltage terminal	The cable color is gray

CN206 plug (Module side): BHSR-02VS-1 (J.S.T. Mfg Co., Ltd.)

Adaptable socket: SM02B-BHSS-1-TB (J.S.T. Mfg Co., Ltd.)

Pin No.	Symbol	Function	Remarks
1	ViBLH6	Lower side lamp, High voltage terminal	The cable color is pink
2	ViBLC6	Lower side lamp, Low voltage terminal	The cable color is gray

4.5.4 Connection between receiver and transmitter for LVDS



Note1: RSVD must be low level.

4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

Display colors		Data signal (0: Low level, 1: High level)																							
		RA7 RA6 RA5 RA4 RA3 RA2 RA1 RA0								GA7 GA6 GA5 GA4 GA3 GA2 GA1 GA0								BA7 BA6 BA5 BA4 BA3 BA2 BA1 BA0							
		RB7 RB6 RB5 RB4 RB3 RB2 RB1 RB0								GB7 GB6 GB5 GB4 GB3 GB2 GB1 GB0								BB7 BB6 BB5 BB4 BB3 BB2 BB1 BB0							
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑				⋮																				
	↓																								
bright	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Green grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	↑				⋮																				
	↓																								
bright	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	
Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	
Blue grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	↑				⋮																				
	↓																								
bright	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	
Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	

Note: The combination of 8-bit signals (256-grayscale level) results in equivalent to 16,777,216 colors.

4.7 INPUT SIGNAL TIMINGS FOR LCD PANEL SIGNAL PROCESSING BOARD

4.7.1 Timing specifications

Parameter		Symbol	min.	typ.	max.	Unit	Remarks	
CLK	Frequency	1/ tc	51.5 -	54.0 18.52	56.5 -	MHz ns	-	
	Duty	tc / tcl	Note1			-	-	
	Rise, fall	tcrf				ns	-	
Horizontal	Cycle period	th	12.3 750	15.630 844	- -	μs CLK	typ=64.0kHz Note 2, 3	
	Display period	thd	640			CLK	-	
	Front-porch	thf	-	-	-	CLK	-	
	Pulse width	thp *	-	56	-	CLK	-	
	Back-porch	thb *	-	124	-	CLK	-	
	* thp + thb			110	-	-	CLK	-
	Vertical	Cycle period	tv	- 1028	16.661 1066	17.47 -	ms H	typ=60.0Hz
Display period		tvd	1024			H	-	
Front-porch		tvf *	-	1	-	H	-	
Pulse width		tvp *	-	3	-	H	-	
Back-porch		tvb *	-	38	-	H	-	
* tvf + tvp + tvb			4	-	-	H	-	
Vsync-Hsync timing		tvhs	1	-	-	CLK	for Hsync	
Hsync-Vsync timing		tvhh	1	-	-	CLK	for Hsync	
DATA	DATA-CLK (Set up)	ts	Note1			ns	-	
	CLK-DATA (Hold)	th				ns	-	
	Rise, fall	trf				ns	-	

Note1: Timing specifications are defined by the input signals of LVDS transmitter.

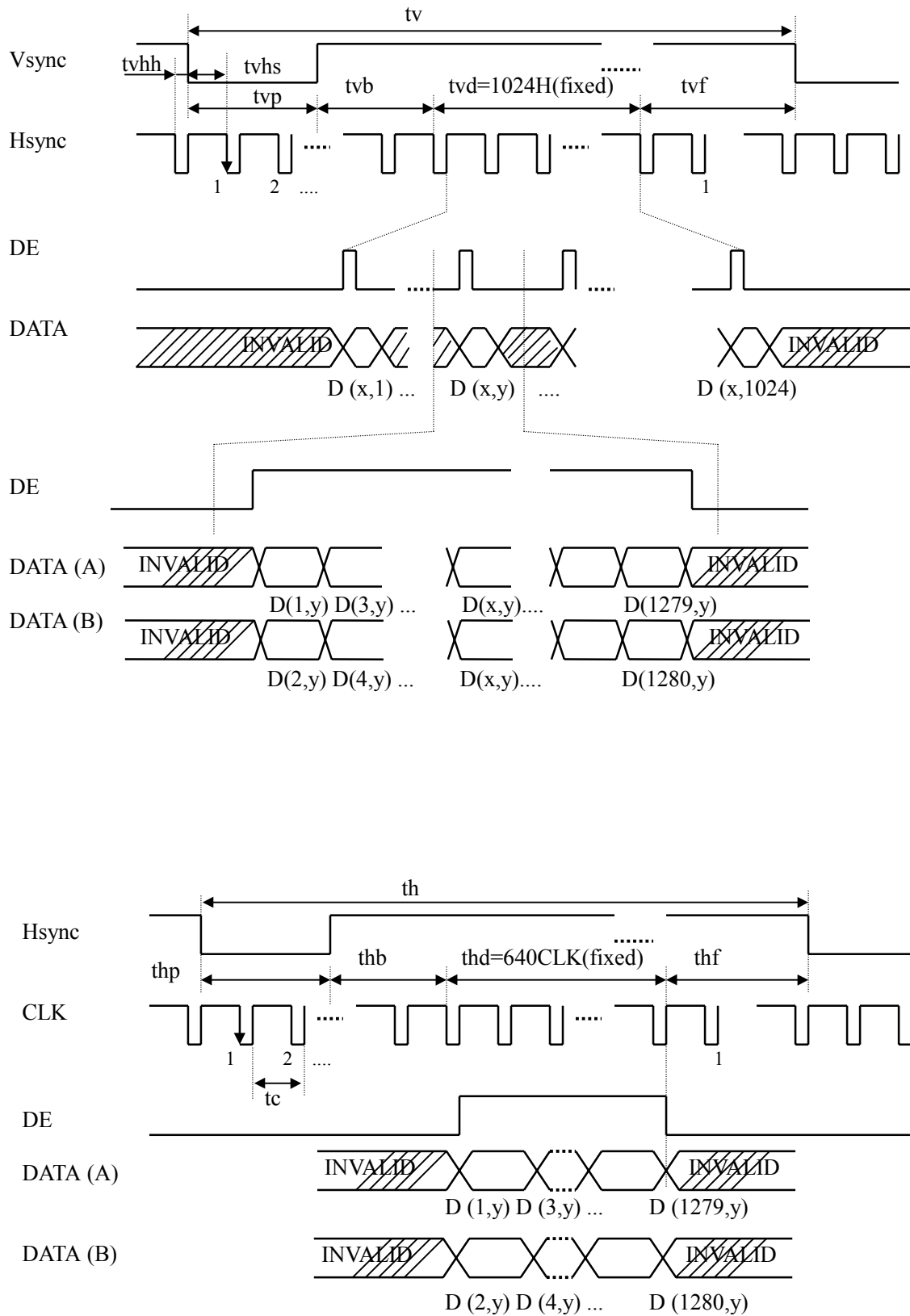
THC63LVDF83A (THine) or equivalent products are recommended for LVDS transmitter.

Note2: Both of "time" and "CLK number" of the "th" must keep the Minimum value of specification.

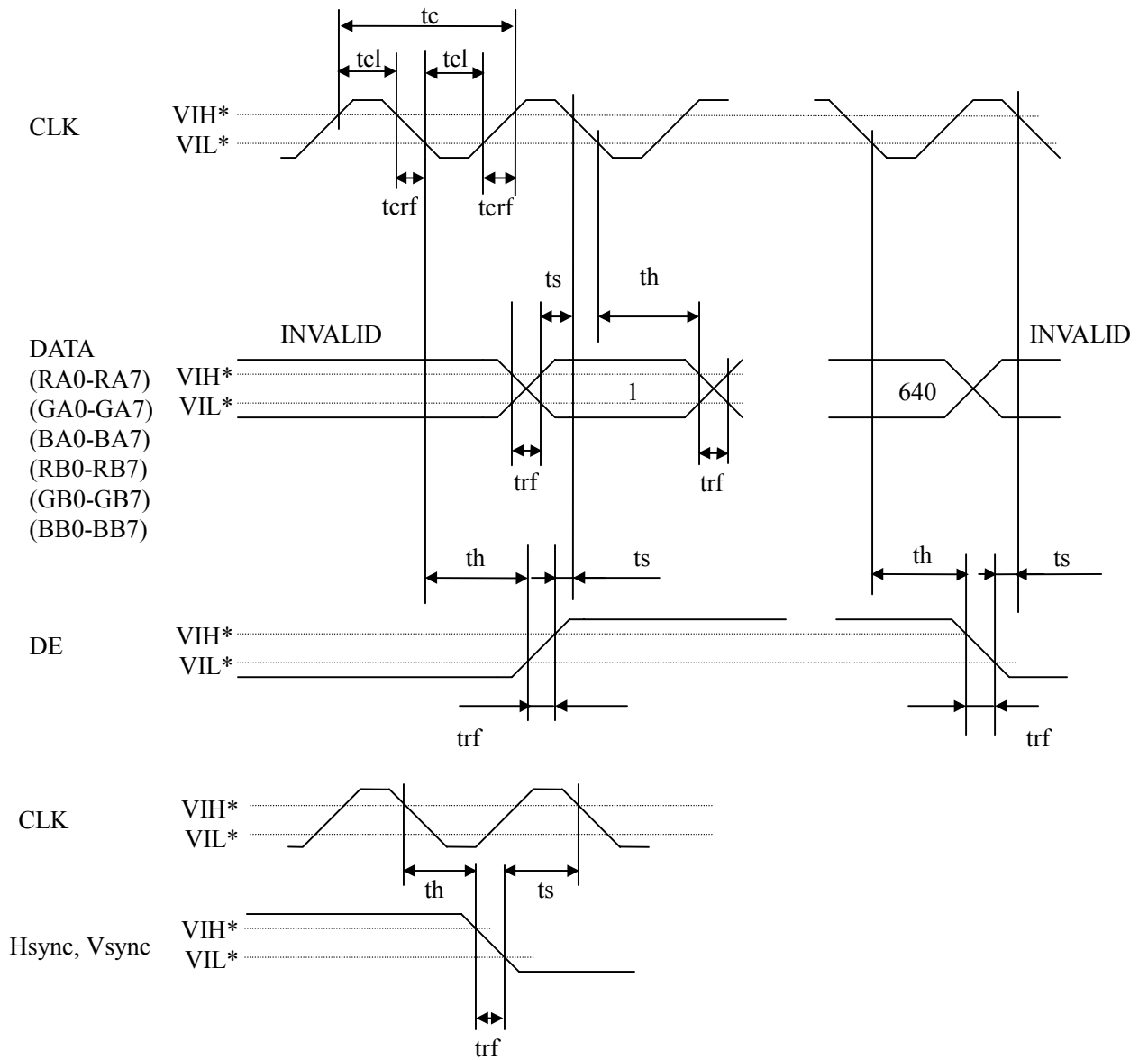
Note3: During operation, fluctuation of horizontal cycle period must not exceed ± 1 CLK. Otherwise function errors will occur in LCD module.

e.g.: Acceptable fluctuation range is 799-801 CLK, when the horizontal cycle period is 800 CLK.

4.7.2 Input signals timing chart



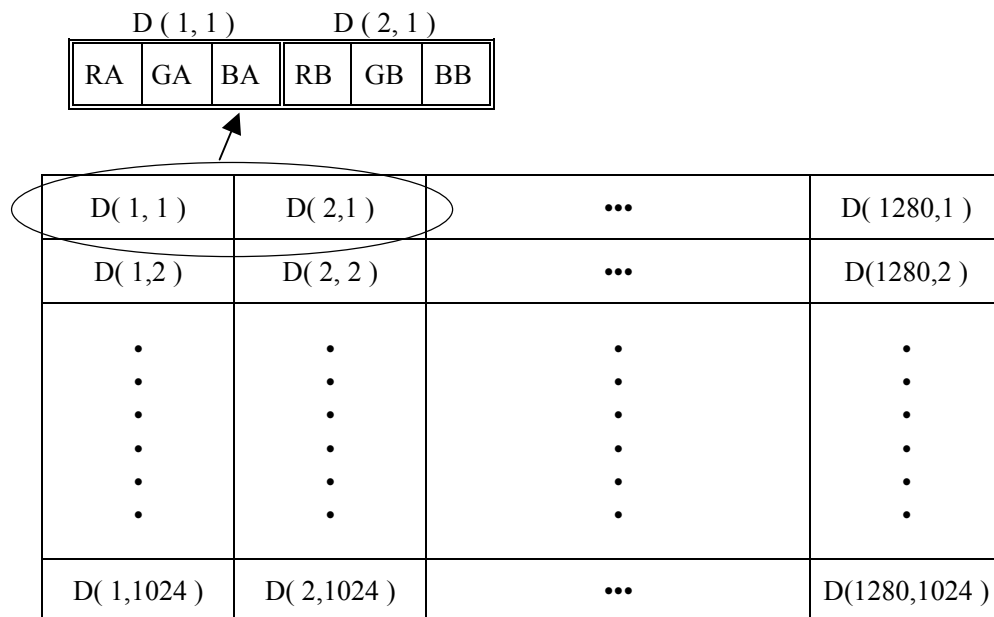
Notel: DATA (A): RA0-RA7, GA0-GA7, BA0-BA7
 DATA (B): RB0-RBA7, GB0-GB7, BB0-BB7



* See the specifications of LVDS manufactures for detailed design.

4.7.3 Display positions

Odd Pixel: RA= R DATA Even Pixel : RB=R DATA
 Odd Pixel: GA= G DATA Even Pixel : GB=G DATA
 Odd Pixel: BA= B DATA Even Pixel : BB=B DATA



4.8 OPTICS

4.8.1 Optical characteristics

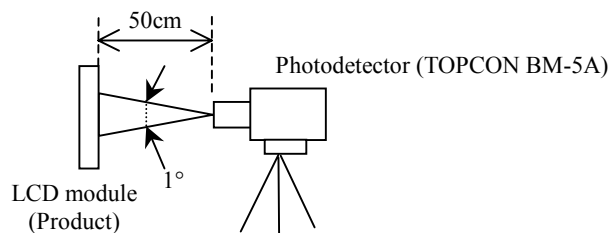
Parameter	Note1	Symbol	Condition	min.	typ.	max.	Unit	Remarks
Contrast ratio		CR	White/Black at center $\theta_R = 0^\circ, \theta_L = 0^\circ, \theta_U = 0^\circ, \theta_D = 0^\circ$	250	350	-	-	Note2
Luminance		L	White at center $\theta_R = 0^\circ, \theta_L = 0^\circ, \theta_U = 0^\circ, \theta_D = 0^\circ$	180	240	-	cd/m ²	-
Luminance uniformity		LU	-	-	1.1	1.3	-	Note3
Chromaticity		W	White (x, y)	-	0.300, 0.315	-	-	-
		R	Red (x, y)	-	0.61, 0.35	-	-	
		G	Green (x, y)	-	0.30, 0.60	-	-	
		B	Blue (x, y)	-	0.15, 0.10	-	-	
Color gamut		C	$\theta_R = 0^\circ, \theta_L = 0^\circ, \theta_U = 0^\circ, \theta_D = 0^\circ$ at center, against NTSC color space	50	60	-	%	
Response time Note4		Ton	Black to White	-	17	27	ms	Note4 Note5
		Toff	White to Black	-	16	26	ms	
Viewing angle	CR = 10	Right	θ_R	$\theta_U = 0^\circ, \theta_D = 0^\circ$	70	85	-	Note6
		Left	θ_L	$\theta_U = 0^\circ, \theta_D = 0^\circ$	70	85	-	
		Up	θ_U	$\theta_R = 0^\circ, \theta_L = 0^\circ$	70	85	-	
		Down	θ_D	$\theta_R = 0^\circ, \theta_L = 0^\circ$	70	85	-	

Note1: Measurement conditions are as follows.

Ta = 25°C, VDD = 12V, IL=6.0mAmps/lamp

Display mode: 60Hz

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 "4.8.2 Definition of contrast ratio".

Note3: See "4.8.3 Definition of luminance uniformity".

Note4: Product surface temperature: 32.5 °C

Note5: See "4.8.4 Definition of response times".

Note6: See "4.8.5 Definition of viewing angles".

4.8.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

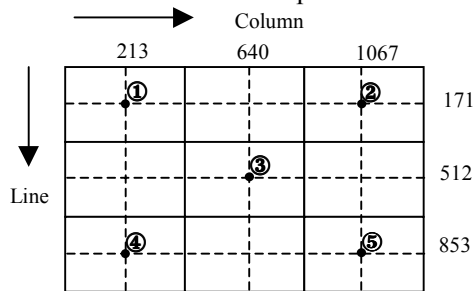
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.8.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

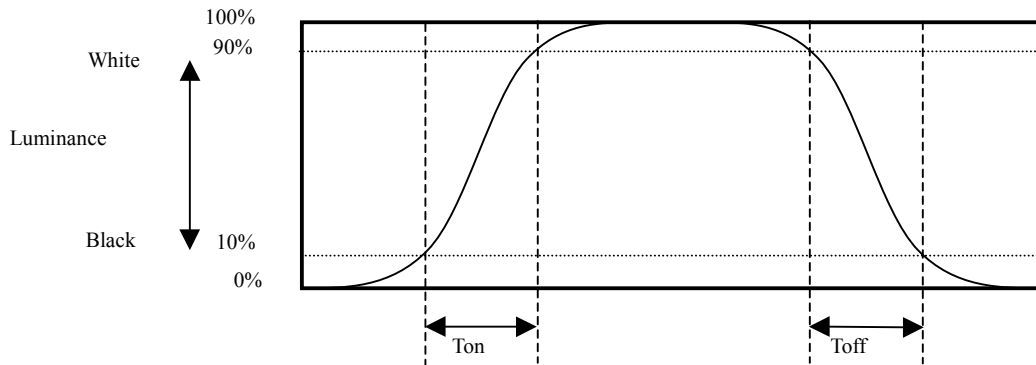
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

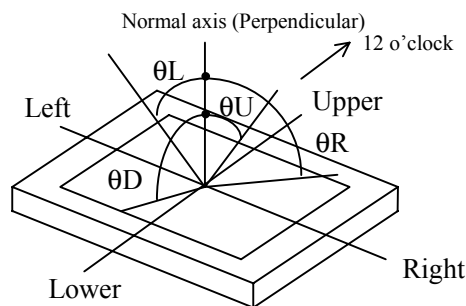


4.8.4 Definition of response times

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.).



4.8.5 Definition of viewing angles

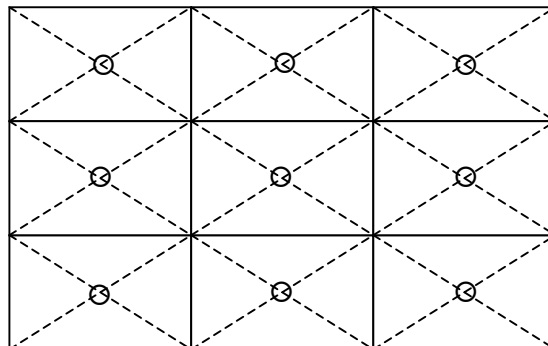


5. RELIABILITY TESTS

Test item	Condition	Judgment
High temperature and humidity (Operation)	① $60 \pm 2^{\circ}\text{C}$, RH = 60%, 240hours ② Display data is white.	No display malfunctions Note1
Heat cycle (Operation)	① $0 \pm 3^{\circ}\text{C}$...1hour $55 \pm 3^{\circ}\text{C}$...1hour ② 50cycles, 4hours/cycle ③ Display data is white.	No display malfunctions Note1
Thermal shock (Non operation)	① $-20 \pm 3^{\circ}\text{C}$...30minutes $60 \pm 3^{\circ}\text{C}$...30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.	No display malfunctions Note1
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	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 Sample dust: No.15 (by JIS-Z8901) ② 15 seconds stir ③ 8 times repeat at 1 hour interval	No display malfunctions Note1
Low pressure	operation	No display malfunctions Note1
	non-operation	
	① 53.3 kPa ② $0^{\circ}\text{C} \pm 3^{\circ}\text{C}$...24 hours ③ $55^{\circ}\text{C} \pm 3^{\circ}\text{C}$...24 hours	
	① 15 kPa ② $-20^{\circ}\text{C} \pm 3^{\circ}\text{C}$...24 hours ③ $-60^{\circ}\text{C} \pm 3^{\circ}\text{C}$...24 hours	

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 the lamp cables while turn on. Customer will be in danger of an electric shock.



- * Pay attention to burn injury for the working backlight and IC! 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

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 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 0.69N·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 bend lamp cables from the foundation of the lamp holder, cables may break and the lamp may not light. There is danger that the operation abnormality of the high-voltage circuit may occur by breaking.
- ⑨ CN1 is vertical connection type and it is a tallest mounting part on the LCD panel signal processing board. Pay attention to treat the connector because there is a danger of breaking when connecting and disconnecting the connector or installing the LCD module in customer equipment.

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.

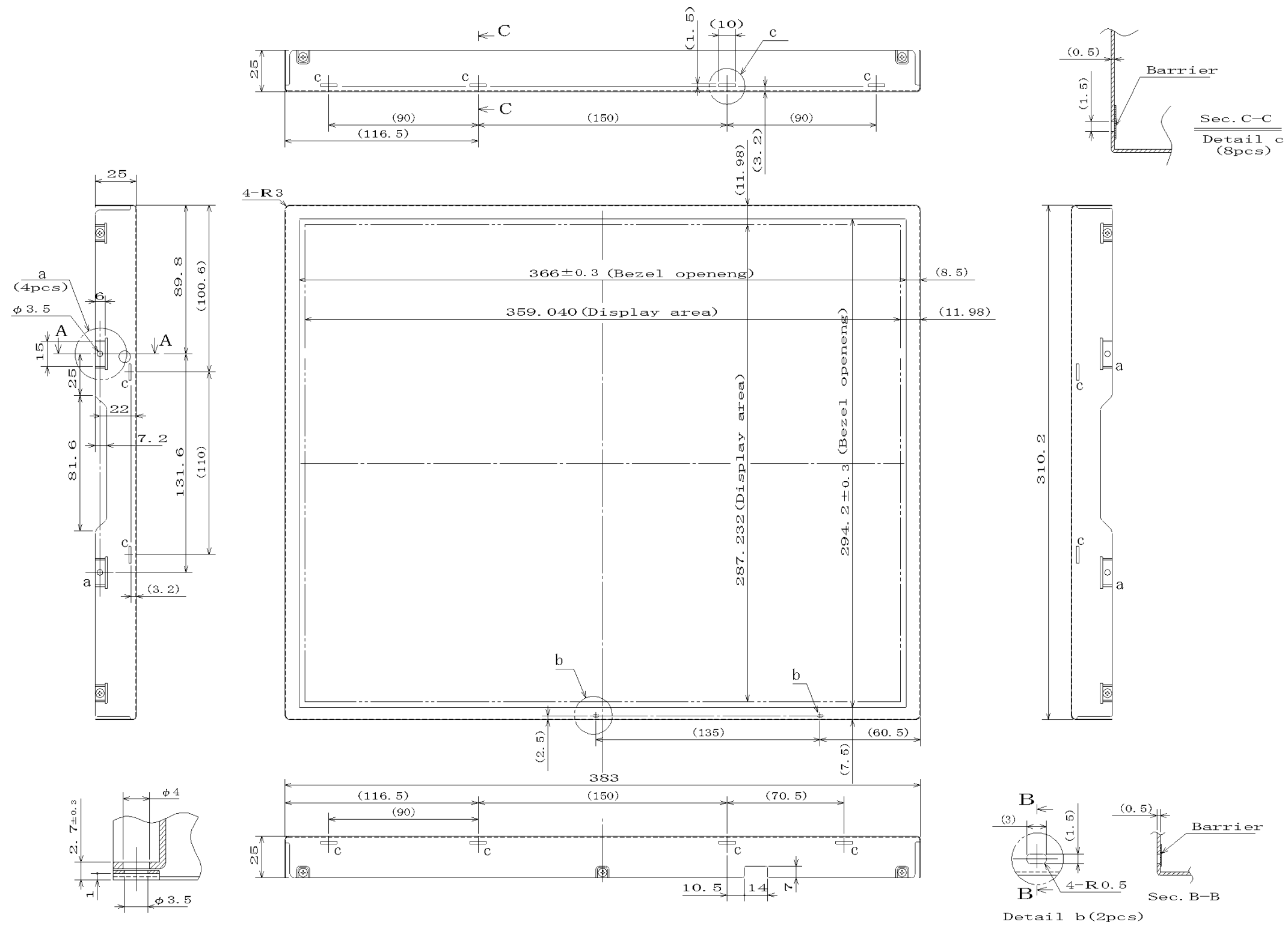
- ① Response time, luminance and color may be changed by ambient temperature.
- ② The LCD may be seemed luminance non-uniformity, flicker, vertical seam or small spot by display patterns.
- ③ Optical characteristics (e.g. luminance, display uniformity, etc.) gradually is going to change depending on 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 Optical characteristics may be changed by input signal timings.
- ⑥ The interference noise of input signal frequency for this product's signal processing board and luminance control frequency of customer's backlight inverter may appear on a display. Set up luminance control frequency of backlight inverter so that the interference noise does not appear.

6.3.4 Other

- ① All GND and VDD terminals should be used without a non-connected line.
- ② Do not disassemble a product or adjust volume without permission of NEC Corporation.
- ③ Pay attention not to insert waste materials inside of products, if customer uses screwdrivers.
- ④ 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.
- ⑤ Not only the module but also the equipment that used the module should be packed and transported as the module becomes vertical. Otherwise, there is the fear that a display dignity decreases by an impact or vibrations.
- ⑥ When installing the LCD module in customer equipment, screw the side-mounting part on the customer equipment without hold down the back of the LCD module and don't distort the side-mounting part. Otherwise, there is the fear that a display dignity decreases.

7.OUTLINE DRAWINGS (Unit:mm)

7.1 Front view



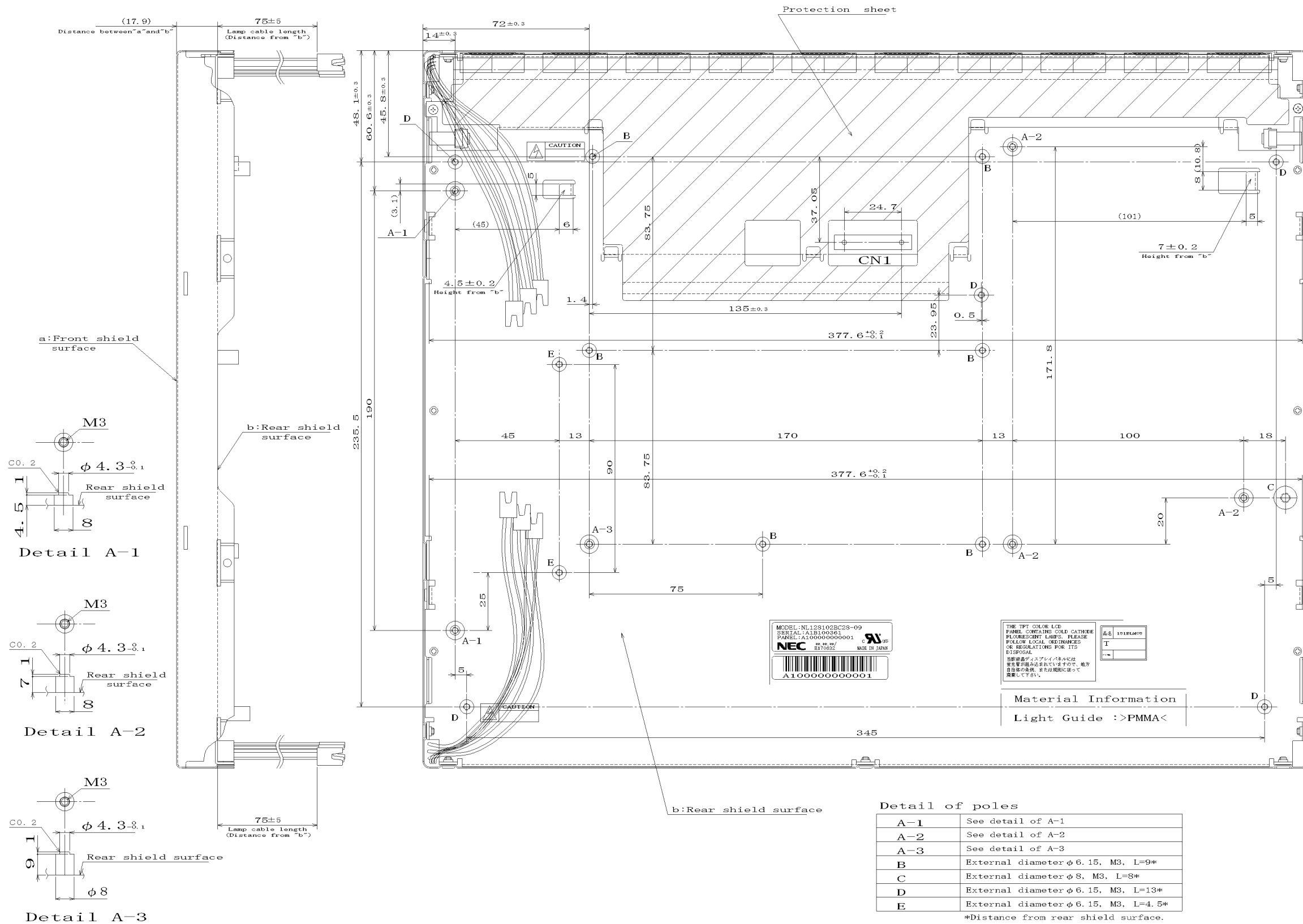
Sec. A-A
Detail a(4pcs)

Sec. B-B
Detail b(2pcs)

Sec. C-C
Detail c
(8pcs)

- Note1: Not shown tolerances of the dimensions are ±0.5mm.
- Note2: The right and left side are symmetric figure for vertical axis.
- Note3: The torque for mounting screw should never exceed 0.69N·m.

7.2 Rear view

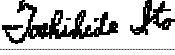


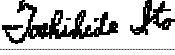


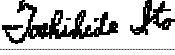




Note1: Not shown tolerances of the dimensions are ±0.5mm.

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 - 0570	Aug. 22, 2001	<p>Revision contents New issue</p> <p>Signature of writer</p> <p style="text-align: center;"><i>Approved by</i> <i>Checked by</i> <i>Prepared by</i></p> <p style="text-align: center;">T. ITO _____ R. KAWASHIMA</p>
2nd edition	DOD-M-0746	Nov. 5, 2001	<p>Revision contents</p> <p>P5 GENERAL SPECIFICATIONS</p> <ul style="list-style-type: none"> • Weight: 3,300g (typ.)→2940g (typ.) • Contrast ratio: 300:1 typ.→350:1 typ. • Viewing angle is decided. • Power consumption: 30.6W→27.2W <p>P6 BLOCK DIAGRAM</p> <ul style="list-style-type: none"> • Backlight: Symbols are corrected. <p>P7 MECHANICAL SPECIFICATIONS</p> <ul style="list-style-type: none"> • Weight: 3,300 (typ.), 3,400 (max.)→2,940 (typ.), 3,100 (max.) • Top2: TBD→(0 to +65°C) <p>P8 Driving for LCD panel signal processing board</p> <ul style="list-style-type: none"> • IDD: 300mA (typ.) →315mA (typ.) <p>Driving for backlight</p> <ul style="list-style-type: none"> • VL: 750Vrms (typ.) →650Vrms (typ.) <p>P9 Fuse</p> <ul style="list-style-type: none"> • Expression of fuse is changed. Rating current: 1.8A→Fusing current: 4.0A <p>SUPPLY VOLTAGE SEQUENCE</p> <ul style="list-style-type: none"> • VDD: Tr<80ms →5<Tr<80ms <p>P19 Optical characteristics</p> <ul style="list-style-type: none"> • Contrast ratio: 200 (min.), 300 (typ.)→250 (min.), 350 (typ.) • Luminance: 150 (min.)→180 (min.) <p>P21 RELIABILITY TESTS</p> <ul style="list-style-type: none"> • Thermal shock: 30minutes/cycle→1hour/cycle • Dust: 15 kinds of dust (by JIS-Z8901)→Sample dust: No.15 (by JIS-Z8901) <p>P22 Handling of the product</p> <ul style="list-style-type: none"> • ⑤ The torque for mounting screws: 0.45N·m→0.69N·m • ⑨ is added. <p>P24,P25 OUTLINE DRAWINGS</p> <ul style="list-style-type: none"> • Outline drawings are revised. <p>Signature of writer</p> <p style="text-align: center;"><i>Approved by</i> <i>Checked by</i> <i>Prepared by</i></p> <p style="text-align: center;">T. ITO _____ R. KAWASHIMA</p>

Edition	Document number	Prepared date	Revision contents and writer									
3rd edition	DOD-M-0813	Dec.17, 2001	<p>Revision contents</p> <p>P4 FEATURES is revised.</p> <p>P5 GENERAL SPECIFICATIONS</p> <ul style="list-style-type: none"> • Polarizer pencil-hardness: TBD→2H • Backlight: Replaceable parts are deleted. <p>P7 ABSOLUTE MAXIMUM RATINGS- Operating temperature: Top2 is decided.</p> <p>P8 Driving for backlight-</p> <ul style="list-style-type: none"> • Oscillator frequency: Ft→FO, FO is decided. • Note5 is revised. <p>P19 Optical characteristics</p> <ul style="list-style-type: none"> • Chromaticity: R,G and B are decided. • Response time is decided. • Note4 Product surface temperature: TBD→32.5 °C <p>P20 Definition of response times are corrected.</p> <p>P23 ATTENTIONS</p> <ul style="list-style-type: none"> • "Environment": ① is revised. • "Characteristics" is revised. • "Other" is revised. <p>P24, P25 OUTLINE DRAWINGS are revised.</p> <p>Signature of writer</p> <table style="width: 100%; border: none;"> <tr> <td style="text-align: center; vertical-align: top;"><i>Approved by</i></td> <td style="text-align: center; vertical-align: top;"><i>Checked by</i></td> <td style="text-align: center; vertical-align: top;"><i>Prepared by</i></td> </tr> <tr> <td style="text-align: center;"></td> <td style="text-align: center;"></td> <td style="text-align: center;"><i>R. Kawashima</i></td> </tr> <tr> <td style="text-align: center;">T. ITO</td> <td style="text-align: center;"></td> <td style="text-align: center;">R. KAWASHIMA</td> </tr> </table>	<i>Approved by</i>	<i>Checked by</i>	<i>Prepared by</i>			<i>R. Kawashima</i>	T. ITO		R. KAWASHIMA
<i>Approved by</i>	<i>Checked by</i>	<i>Prepared by</i>										
		<i>R. Kawashima</i>										
T. ITO		R. KAWASHIMA										