

TFT COLOR LCD MODULE

NL160120BC27-14

54cm (21.3 Type)

UXGA

LVDS Interface (2 ports)

DATA SHEET 

DOD-PD-1335 (1st edition)

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starting to design your system.**

INTRODUCTION

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Examples: Military systems, aircraft control equipment, aerospace equipment, nuclear reactor control systems, medical equipment/devices/systems for life support, etc.

The quality grade of this product is the "**Standard**" unless otherwise specified in this document.

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1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL160120BC27-14 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.

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. 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 APPLICATION

- Monitor for PC

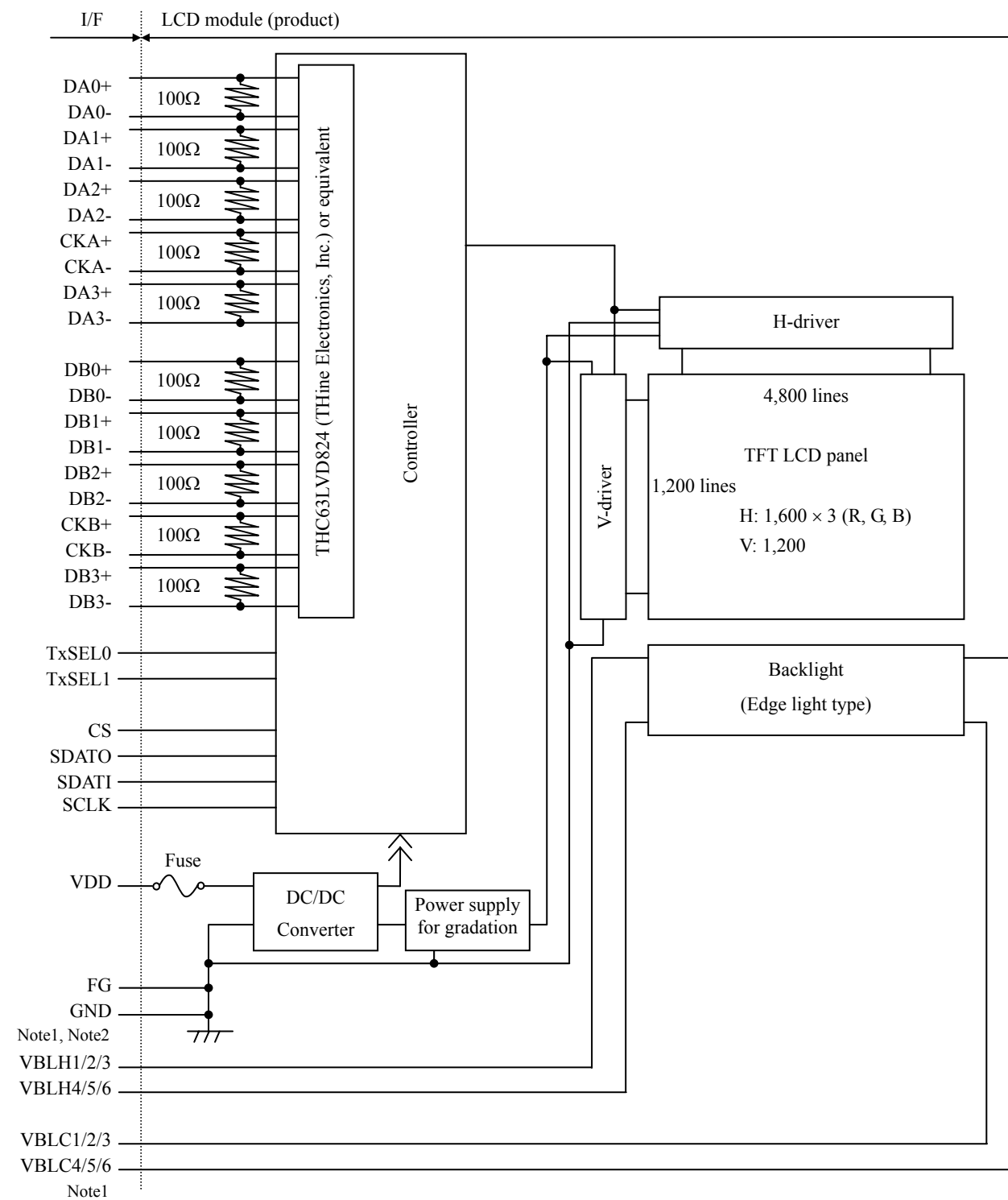
1.3 FEATURES

- Ultra-wide viewing angle (Adoption of Super-Advanced Super Fine TFT (SA-SFT))
- Wide color gamut
- High resolution
- LVDS interface
- Adjustable gamma characteristics by using built-in 10-bit LUT (look up table)
- Selectable LVDS data input map
- Small foot print
- Incorporated edge light type backlight (without inverter)
- Acquisition product for UL60950-1/CSA C22.2 No.60950-1-03 (File number: E170632)

2. GENERAL SPECIFICATIONS

Display area	432.0 (H) × 324.0 (V) mm
Diagonal size of display	54cm (21.3 inches)
Drive system	a-Si TFT active matrix
Display color	16,777,216 colors
Pixel	1,600 (H) × 1,200 (V) pixels
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe
Dot pitch	0.090 (H) × 0.270 (V) mm
Pixel pitch	0.270 (H) × 0.270 (V) mm
Module size	457.0 (W) × 350.0 (H) × 25.0 (D) mm (typ.)
Weight	3,750g (typ.)
Contrast ratio	550:1 (typ.)
Viewing angle	At the contrast ratio ≥ 10:1 • Horizontal: Right side 85° (typ.), Left 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 (Perpendicular)
Polarizer surface	Antiglare
Polarizer pencil-hardness	2H (min.) [by JIS K5400]
Color gamut	At LCD panel center 72% (typ.) [against NTSC color space]
Response time	Ton+Toff (10%←→90%) 20ms (typ.)
Luminance	At IBL= 6.0mAmps / lamp 250cd/m ² (typ.)
Signal system	2 ports LVDS interface (THC63LVD824 THine Electronics, Inc. or equivalent) [RGB 8-bit signals, Data enable signal (DE), Dot clock (CLK)]
Power supply voltage	LCD panel signal processing board: 12.0V
Backlight	Edge light type: 6 cold cathode fluorescent lamps (without inverter)
Power consumption	At IBL= 6.0mAmps / lamp, Checkered flag pattern 30.7W (typ., Power dissipation of the inverter is not included.)

3. BLOCK DIAGRAM



Note1: Connections between GND (Signal ground), FG (Frame ground) and VBLC (Lamp low voltage terminal) in the LCD module

GND - FG	Connected
GND - VBLC	Not connected
FG - VBLC	Not connected

Note2: GND and FG must be connected to customer equipment's ground, and it is recommended that GND, FG and customer inverter ground are connected together in customer equipment.

4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification	Unit
Module size	457.0 +0.4/-0.3 (W) × 350.0 +0.4/-0.3 (H) × 25.0 ± 0.3 (D) Note1, Note2	mm
Display area	432.0 (H) × 324.0 (V) Note1	mm
Weight	3,750 (typ.), 4,000 (max.)	g

Note1: Excluding warpage of the signal processing board cover and the connection board cover

Note2: See "7. OUTLINE DRAWINGS".

4.2 ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Rating	Unit	Remarks
Power supply voltage	LCD panel signal processing board	VDD	-0.3 to +14.0	V	-
	Lamp voltage	VLH	3,000	Vrms	
Input signal voltage Note1		Vi	-0.3 to +2.8	V	VDD= 12.0V
Storage temperature		Tst	-20 to +60	°C	-
Operating temperature	Front surface	TopF	0 to +55	°C	Note2
	Rear surface	TopR	0 to +65	°C	Note3
Relative humidity Note4		RH	≤ 95	%	Ta ≤ 40°C
			≤ 85	%	40°C < Ta ≤ 50°C
			≤ 70	%	50°C < Ta ≤ 55°C
Absolute humidity Note4		AH	≤ 73 Note5	g/m ³	Ta > 55°C
Operating altitude		-	≤ 4,850	m	0°C ≤ Ta ≤ 55°C
Storage altitude		-	≤ 13,600	m	-20°C ≤ Ta ≤ 60°C

Note1: DA0+/-, DA1+/-, DA2+/-, DA3+/-, CKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, CKB+/-
CS, SDAT1, SCLK, TxSEL0, TxSEL1

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

Note3: Measured at center of LCD module's rear shield surface (including self-heat)

Note4: No condensation

Note5: Water amount at Ta= 55°C and RH= 70%

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 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	-
Supply current		IDD	-	310 Note1	700 Note2	mA	at VDD= 12.0V
Ripple voltage		VRP	-	-	100	mVp-p	for VDD
Differential input Threshold voltage	High	VTH	-	-	+100	mV	at VCM= 1.2V Note3, Note4
	Low	VTL	-100	-	-	mV	
Input voltage swing		VI	0	-	2.4	V	Note4
Terminating resistance		RT	-	100	-	Ω	-
Control signal input threshold voltage	High	VIH	Keep this pin open.			-	Note5
	Low	VIL	0	-	0.5	V	
Control signal input current	Low	IIL	-10	-	10	μA	
Serial communication signal input threshold voltage	High	V+	-	1.4	1.9	V	Note6
	Low	V-	0.4	0.7	-	V	
	Hysteresis	VH	0.3	-	-	V	
Output signal threshold voltage	High	VOH	1.9	-	-	V	Note7
	Low	VOL	-	-	0.4	V	
Output signal current	High	IOH	-4	-	-	mA	
	Low	IOL	-	-	4	mA	

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

Note2: Pattern for maximum current

Note3: Common mode voltage for LVDS driver

Note4: DA0+/-, DA1+/-, DA2+/-, DA3+/-, CKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, CKB+/-

Note5: T_XSEL0, T_XSEL1

Note6: CS, SDAT_I, SCLK

Note7: SDAT_O

4.3.2 Backlight lamp

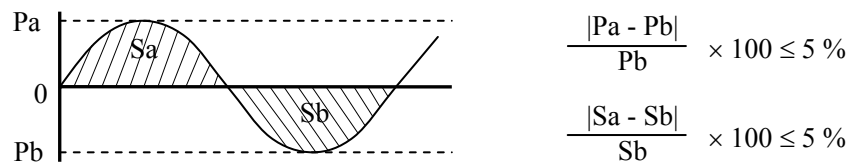
(Ta= 25°C, Note1)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Lamp current	IBL	3.0	6.0	7.0	mA _{rms}	at IBL= 6.0mA _{rms} : L= 250cd/m ² (typ.) Note3
Lamp voltage	VBLH	-	750	-	V _{rms}	Note2, Note3
Lamp starting voltage	VS	1,220	-	-	V _{rms}	Ta= 25°C Note2, Note3, Note4
		1,460	-	-	V _{rms}	Ta= 0°C Note2, Note3, Note4
Lamp oscillation frequency	FO	50	56	60	kHz	Note5

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

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

Note3: The asymmetric ratio of working waveform for lamps (Lamp voltage peak ratio, Lamp 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). When designing the inverter, evaluate asymmetric of lamp working waveform sufficiently.



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

Note4: The inverter should be designed so that the lamp starting voltage can be maintained for more than 1 second. Otherwise the lamp may not be turned on.

Note5: 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 "4.8.1 Timing characteristics".)

n: Natural number (1, 2, 3)

Note6: Method of lamp cable installation may invite fluctuation of lamp current and voltage or asymmetric of lamp working waveform. When designing method of lamp cable installation, evaluate the fluctuation of lamp current, voltage and working waveform sufficiently.

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.

Power supply voltage		Ripple voltage (Measure at input terminal of power supply)	Note1 Unit
VDD	12.0V	≤ 100	mVp-p

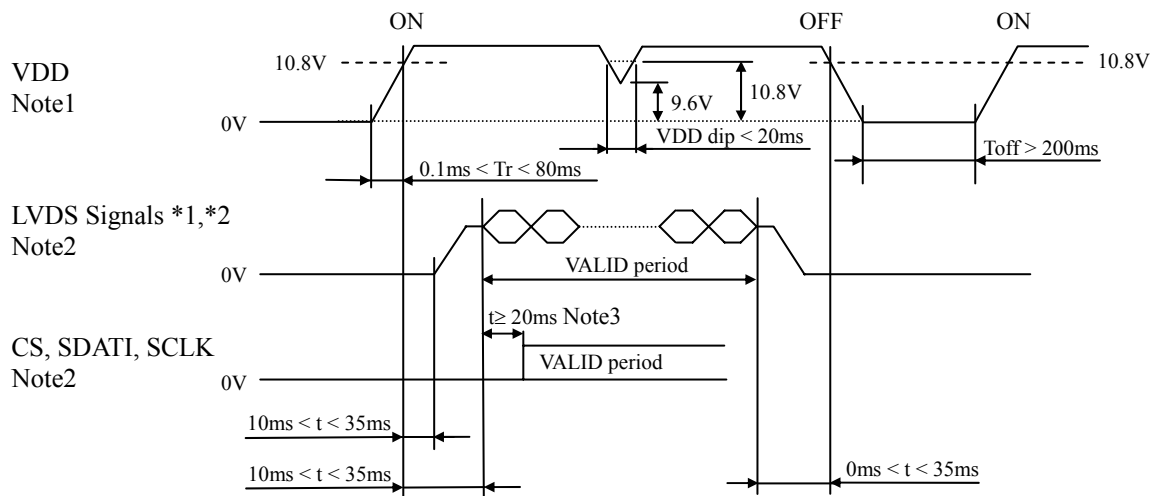
Note1: The permissible ripple voltage includes spike noise.

4.3.4 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VDD	FCC16132AB	KAMAYA ELECTRIC Co., Ltd.	1.25A	2.5A, 5 seconds maximum	Note1
			32V		

Note1: The power supply capacity should be more than the fusing current. If it is less than the fusing current, the fuse may not blow in a short time, and then nasty smell, smoke and so on may occur.

4.4 POWER SUPPLY VOLTAGE SEQUENCE



*1: DA0+/-, DA1+/-, DA2+/-, DA3+/-, CKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, CKB+/-

*2: LVDS signals should be measured at the terminal of 100Ω resistance.

Note1: 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.

Note2: LVDS signals and CS, SDAT1, SCLK 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 signals are cut while this product is working, even if the signal input to it once again, it might not work normally. VDD should be cut when the display and function signals are stopped.

Note3: At the beginning of the serial communication mode, take 20ms or more after the LVDS signal input. When writing and reading the LUT data, see “**4.10 TEN-bit LOOK UP TABLE FOR GAMMA ADJUSTMENT**”.

Note4: The backlight should be turned on within the valid period of LVDS signals, in order to avoid unstable data display.

4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

4.5.1 LCD panel signal processing board

(1) CN1

Socket (LCD module side): DF19G-30P-1H (56) (Hirose Electric Co., Ltd. (HRS))

Adaptable plug: DF19-30S-1C (Hirose Electric Co., Ltd. (HRS))

Pin No.	Symbol	Signal	Remarks			
1	DA0-	Pixel data A0	Odd pixel data Input (LVDS differential signal)		Note1	
2	DA0+					
3	DA1-	Pixel data A1	Odd pixel data Input (LVDS differential signal)		Note1	
4	DA1+					
5	DA2-	Pixel data A2	Odd pixel data Input (LVDS differential signal)		Note1	
6	DA2+					
7	GND	Ground	Signal ground		Note2	
8	CKA-	Pixel clock	Odd pixel clock Input (LVDS differential signal)		Note1	
9	CKA+					
10	DA3-	Pixel data A3	Odd pixel data Input (LVDS differential signal)		Note1	
11	DA3+					
12	DB0-	Pixel data B0	Even pixel data Input (LVDS differential signal)		Note1	
13	DB0+					
14	GND	Ground	Signal ground		Note2	
15	DB1-	Pixel data B1	Even pixel data Input (LVDS differential signal)		Note1	
16	DB1+					
17	GND	Ground	Signal ground		Note2	
18	DB2-	Pixel data B2	Even pixel data Input (LVDS differential signal)		Note1	
19	DB2+					
20	CKB-	Pixel clock	Even pixel clock Input (LVDS differential signal)		Note1	
21	CKB+					
22	DB3-	Pixel data B3	Even pixel data Input (LVDS differential signal)		Note1	
23	DB3+					
24	GND	Ground	Signal ground		Note2	
25	TxSEL0	Selection of LVDS data input map	Note3, Note4			
26	TxSEL1			TxSEL1	TxSEL0	Mode
				Open	Open	A
				Open	Low	B
				Low	Open	C
		Low	Low	A		
27	GND	Ground	Signal ground		Note2	
28	VDD	Power supply	12V		Note2	
29	VDD					
30	VDD					

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

Note2: All GND and VDD terminals should be used without any non-connected lines.

Note3: This terminal is pulled-up in the product. (Pull-up resistance: 50kΩ)

Note4: See "4.6 LVDS DATA INPUT MAP".

(2) CN3

Socket (LCD module side): SM10B-SRSS-TB(LF)(SN) (J.S.T. Mfg Co., Ltd.)

Adaptable plug: SHR-10V-S, SHR-10V-S-B or 10SR-3S (J.S.T. Mfg Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	RSVD	Reserved	Keep these pins open.
2	RSVD		
3	RSVD		
4	GND	Ground	Signal ground Note1
5	CS	Chip selection	For LUT communication control Note2
6	SDATO	Serial data output	For LUT output signal
7	SDATI	Serial data input	For LUT communication control Note3
8	SCLK	Serial clock	For LUT communication control Note3
9	GND	Ground	Signal ground Note1
10	RSVD	Reserved	Keep this pin open.

Note1: All GND terminals should be used without any non-connected lines.

Note2: This terminal is pulled-up in the product. (Pull-up resistance: 50kΩ)

Note3: These terminals are pulled-down in the product. (Pull-down resistance: 50kΩ)

4.5.2 Backlight lamp

Attention: VBLH and VBLC must be connected correctly. Wrong connections will cause electric shock and also break down of the product.

CN201 plug (LCD module side): BHSR-02VS-1 (J.S.T. Mfg Co., Ltd.)
 Adaptable socket: SM02B-BHSS-1-TB(LF)(SN)
 SM02B-BHSS-1-TB (J.S.T. Mfg Co., Ltd.)

Pin No.	Symbol	Function	Remarks
1	VBLH1	Upper side lamp, High voltage (Hot)	Cable color: Pink
2	VBLC1	Upper side lamp, Low voltage (Cold)	Cable color: Gray

CN202 plug (LCD module side): BHSR-02VS-1 (J.S.T. Mfg Co., Ltd.)
 Adaptable socket: SM02B-BHSS-1-TB(LF)(SN)
 SM02B-BHSS-1-TB (J.S.T. Mfg Co., Ltd.)

Pin No.	Symbol	Function	Remarks
1	VBLH2	Upper side lamp, High voltage (Hot)	Cable color: White
2	VBLC2	Upper side lamp, Low voltage (Cold)	Cable color: Gray

CN203 plug (LCD module side): BHSR-02VS-1 (J.S.T. Mfg Co., Ltd.)
 Adaptable socket: SM02B-BHSS-1-TB(LF)(SN)
 SM02B-BHSS-1-TB (J.S.T. Mfg Co., Ltd.)

Pin No.	Symbol	Function	Remarks
1	VBLH3	Upper side lamp, High voltage (Hot)	Cable color: Red
2	VBLC3	Upper side lamp, Low voltage (Cold)	Cable color: Gray

CN204 plug (LCD module side): BHSR-02VS-1 (J.S.T. Mfg Co., Ltd.)
 Adaptable socket: SM02B-BHSS-1-TB(LF)(SN)
 SM02B-BHSS-1-TB (J.S.T. Mfg Co., Ltd.)

Pin No.	Symbol	Function	Remarks
1	VBLH4	Lower side lamp, High voltage (Hot)	Cable color: Pink
2	VBLC4	Lower side lamp, Low voltage (Cold)	Cable color: Gray

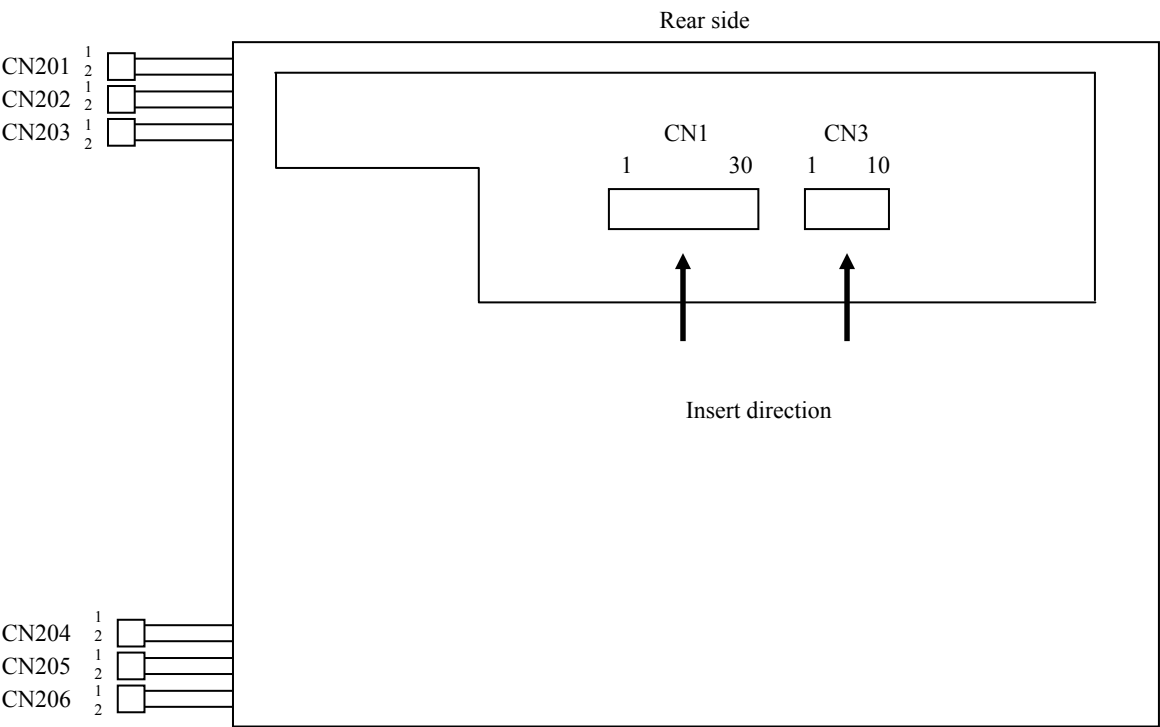
CN205 plug (LCD module side): BHSR-02VS-1 (J.S.T. Mfg Co., Ltd.)
 Adaptable socket: SM02B-BHSS-1-TB(LF)(SN)
 SM02B-BHSS-1-TB (J.S.T. Mfg Co., Ltd.)

Pin No.	Symbol	Function	Remarks
1	VBLH5	Lower side lamp, High voltage (Hot)	Cable color: White
2	VBLC5	Lower side lamp, Low voltage (Cold)	Cable color: Gray

CN206 plug (LCD module side): BHSR-02VS-1 (J.S.T. Mfg Co., Ltd.)
 Adaptable socket: SM02B-BHSS-1-TB(LF)(SN)
 SM02B-BHSS-1-TB (J.S.T. Mfg Co., Ltd.)

Pin No.	Symbol	Function	Remarks
1	VBLH6	Lower side lamp, High voltage (Hot)	Cable color: Red
2	VBLC6	Lower side lamp, Low voltage (Cold)	Cable color: Gray

4.5.3 Positions of plug and socket



4.6 LVDS DATA INPUT MAP

4.6.1 Mode A

Input data		Note1		Transmitter		Note2		CN1	
				Pin	THC63LVDF83A	Pin	THC63LVD823	Pin	Symbol
Odd pixel data and control signal	RA2	→	51	TA0	53	R12	TA1- →	1	DA0-
	RA3	→	52	TA1	54	R13		2	DA0+
	RA4	→	54	TA2	57	R14	TB1- →	3	DA1-
	RA5	→	55	TA3	58	R15		4	DA1+
	RA6	→	56	TA4	59	R16	TC1- →	5	DA2-
	RA7	→	3	TA5	60	R17		6	DA2+
	GA2	→	4	TA6	63	G12	TCLK1- →	7	GND
	GA3	→	6	TB0	64	G13		8	CKA-
	GA4	→	7	TB1	65	G14	TD1- →	9	CKA+
	GA5	→	11	TB2	66	G15		10	DA3-
	GA6	→	12	TB3	67	G16	TD1+ →	11	DA3+
	GA7	→	14	TB4	68	G17			
	BA2	→	15	TB5	73	B12			
	BA3	→	19	TB6	74	B13			
	BA4	→	20	TC0	75	B14			
	BA5	→	22	TC1	76	B15			
	BA6	→	23	TC2	77	B16			
	BA7	→	24	TC3	78	B17			
	Note3 RSVD	→	27	TC4	7	RSVD			
	Note3 RSVD	→	28	TC5	8	RSVD			
	DE	→	30	TC6	9	DE			
	RA0	→	50	TD0	51	R10			
	RA1	→	2	TD1	52	R11			
	GA0	→	8	TD2	61	G10			
	GA1	→	10	TD3	62	G11			
	BA0	→	16	TD4	69	B10			
	BA1	→	18	TD5	70	B11			
	Note3 RSVD	→	25	TD6	-				
	CLK	→	31	CLKIN	10	CLK			
Even pixel data	RB2	→	51	TA0	81	R22	TA2- →	12	DB0-
	RB3	→	52	TA1	82	R23		13	DB0+
	RB4	→	54	TA2	83	R24	TB2- →	14	GND
	RB5	→	55	TA3	84	R25		15	DB1-
	RB6	→	56	TA4	85	R26	TB2+ →	16	DB1+
	RB7	→	3	TA5	86	R27		17	GND
	GB2	→	4	TA6	91	G22	TC2- →	18	DB2-
	GB3	→	6	TB0	92	G23		19	DB2+
	GB4	→	7	TB1	93	G24	TCLK2- →	20	CKB-
	GB5	→	11	TB2	94	G25		21	CKB+
	GB6	→	12	TB3	95	G26	TD2- →	22	DB3-
	GB7	→	14	TB4	96	G27		23	DB3+
	BB2	→	15	TB5	99	B22	TD2+ →	24	GND
	BB3	→	19	TB6	100	B23		25	TxSEL0
	BB4	→	20	TC0	1	B24		26	TxSEL1
	BB5	→	22	TC1	2	B25		27	GND
	BB6	→	23	TC2	5	B26		28	VDD
	BB7	→	24	TC3	6	B27		29	VDD
	Note3 RSVD	→	27	TC4	-			30	VDD
	Note3 RSVD	→	28	TC5	-				
	Note3 RSVD	→	30	TC6	-				
	RB0	→	50	TD0	79	R20			
	RB1	→	2	TD1	80	R21			
	GB0	→	8	TD2	89	G20			
	GB1	→	10	TD3	90	G21			
	BB0	→	16	TD4	97	B20			
	BB1	→	18	TD5	98	B21			
	Note3 RSVD	→	25	TD6	-				
	CLK	→	31	CLKIN	-				

4.6.2 Mode B

Input data		Transmitter		CN1	
Note1		Pin	DS90CF383, C385	Pin	Symbol
Odd pixel data and control signal	RA7 →	51	TXIN0	Note2	1 DA0-
	RA6 →	52	TXIN1		2 DA0+
	RA5 →	54	TXIN2		
	RA4 →	55	TXIN3		
	RA3 →	56	TXIN4	TB1- →	3 DA1-
	RA2 →	3	TXIN6	TB1+ →	4 DA1+
	GA7 →	4	TXIN7		
	GA6 →	6	TXIN8	TC1- →	5 DA2-
	GA5 →	7	TXIN9	TC1+ →	6 DA2+
	GA4 →	11	TXIN12		7 GND
	GA3 →	12	TXIN13	TCLK1- →	8 CKA-
	GA2 →	14	TXIN14	TCLK1+ →	9 CKA+
	BA7 →	15	TXIN15		
	BA6 →	19	TXIN18	TD1- →	10 DA3-
	BA5 →	20	TXIN19	TD1+ →	11 DA3+
	BA4 →	22	TXIN20		
	BA3 →	23	TXIN21		
	BA2 →	24	TXIN22		
	Note3 RSVD →	27	TXIN24		
	Note3 RSVD →	28	TXIN25		
	DE →	30	TXIN26		
	RA1 →	50	TXIN27		
	RA0 →	2	TXIN5		
	GA1 →	8	TXIN10		
	GA0 →	10	TXIN11		
	BA1 →	16	TXIN16		
	BA0 →	18	TXIN17		
	Note3 RSVD →	25	TXIN23		
	CLK →	31	CLKIN		
Even pixel data	RB7 →	51	TXIN0		
	RB6 →	52	TXIN1	TA2- →	12 DB0-
	RB5 →	54	TXIN2	TA2+ →	13 DB0+
	RB4 →	55	TXIN3		14 GND
	RB3 →	56	TXIN4	TB2- →	15 DB1-
	RB2 →	3	TXIN6	TB2+ →	16 DB1+
	GB7 →	4	TXIN7		17 GND
	GB6 →	6	TXIN8	TC2- →	18 DB2-
	GB5 →	7	TXIN9	TC2+ →	19 DB2+
	GB4 →	11	TXIN12		
	GB3 →	12	TXIN13	TCLK2- →	20 CKB-
	GB2 →	14	TXIN14	TCLK2+ →	21 CKB+
	BB7 →	15	TXIN15		
	BB6 →	19	TXIN18	TD2- →	22 DB3-
	BB5 →	20	TXIN19	TD2+ →	23 DB3+
	BB4 →	22	TXIN20		24 GND
	BB3 →	23	TXIN21		25 TxSEL0
	BB2 →	24	TXIN22		26 TxSEL1
	Note3 RSVD →	27	TXIN24		27 GND
	Note3 RSVD →	28	TXIN25		28 VDD
	Note3 RSVD →	30	TXIN26		29 VDD
	RB1 →	50	TXIN27		30 VDD
	RB0 →	2	TXIN5		
	GB1 →	8	TXIN10		
	GB0 →	10	TXIN11		
	BB1 →	16	TXIN16		
	BB0 →	18	TXIN17		
	Note3 RSVD →	25	TXIN23		
	CLK →	31	CLKIN		

4.6.3 Mode C

Input data		Transmitter		CN1	
Note1		Pin	DS90CF383, C385	Pin	Symbol
Odd pixel data and control signal	RA0	→	51 TXIN0	Note2	1 DA0-
	RA1	→	52 TXIN1		2 DA0+
	RA2	→	54 TXIN2		
	RA3	→	55 TXIN3		3 DA1-
	RA4	→	56 TXIN4		4 DA1+
	RA5	→	3 TXIN6		
	GA0	→	4 TXIN7		
	GA1	→	6 TXIN8		5 DA2-
	GA2	→	7 TXIN9		6 DA2+
	GA3	→	11 TXIN12		7 GND
	GA4	→	12 TXIN13		8 CKA-
	GA5	→	14 TXIN14		9 CKA+
	BA0	→	15 TXIN15		
	BA1	→	19 TXIN18		10 DA3-
	BA2	→	20 TXIN19 1st		11 DA3+
	BA3	→	22 TXIN20		
	BA4	→	23 TXIN21		
	BA5	→	24 TXIN22		
	Note3 RSVD	→	27 TXIN24		
	Note3 RSVD	→	28 TXIN25		
	DE	→	30 TXIN26		
	RA6	→	50 TXIN27		
	RA7	→	2 TXIN5		
	GA6	→	8 TXIN10		
	GA7	→	10 TXIN11		
	BA6	→	16 TXIN16		
	BA7	→	18 TXIN17		
	Note3 RSVD	→	25 TXIN23		
	CLK	→	31 CLKIN		
Even pixel data	RB0	→	51 TXIN0		12 DB0-
	RB1	→	52 TXIN1		13 DB0+
	RB2	→	54 TXIN2		14 GND
	RB3	→	55 TXIN3		15 DB1-
	RB4	→	56 TXIN4		16 DB1+
	RB5	→	3 TXIN6		17 GND
	GB0	→	4 TXIN7		18 DB2-
	GB1	→	6 TXIN8		19 DB2+
	GB2	→	7 TXIN9		
	GB3	→	11 TXIN12		20 CKB-
	GB4	→	12 TXIN13		21 CKB+
	GB5	→	14 TXIN14		
	BB0	→	15 TXIN15		22 DB3-
	BB1	→	19 TXIN18		23 DB3+
	BB2	→	20 TXIN19 2nd		24 GND
	BB3	→	22 TXIN20		25 TxSEL0
	BB4	→	23 TXIN21		26 TxSEL1
	BB5	→	24 TXIN22		27 GND
	Note3 RSVD	→	27 TXIN24		28 VDD
	Note3 RSVD	→	28 TXIN25		29 VDD
	Note3 RSVD	→	30 TXIN26		30 VDD
	RB6	→	50 TXIN27		
	RB7	→	2 TXIN5		
	GB6	→	8 TXIN10		
	GB7	→	10 TXIN11		
	BB6	→	16 TXIN16		
	BB7	→	18 TXIN17		
	Note3 RSVD	→	25 TXIN23		
	CLK	→	31 CLKIN		

Note1: LSB (Least Significant Bit) – RA0, GA0, BA0, RB0, GB0, BB0

MSB (Most Significant Bit) – RA7, GA7, BA7, RB7, GB7, BB7

Note2: Twist pair wires with 100Ω (Characteristic impedance) should be used between LCD panel signal processing board and LVDS transmitter.

Note3: Input signal RSVD is not used inside the product, but do not keep this pin open to avoid noise problem.

4.7 DISPLAY COLORS AND INPUT DATA SIGNALS

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

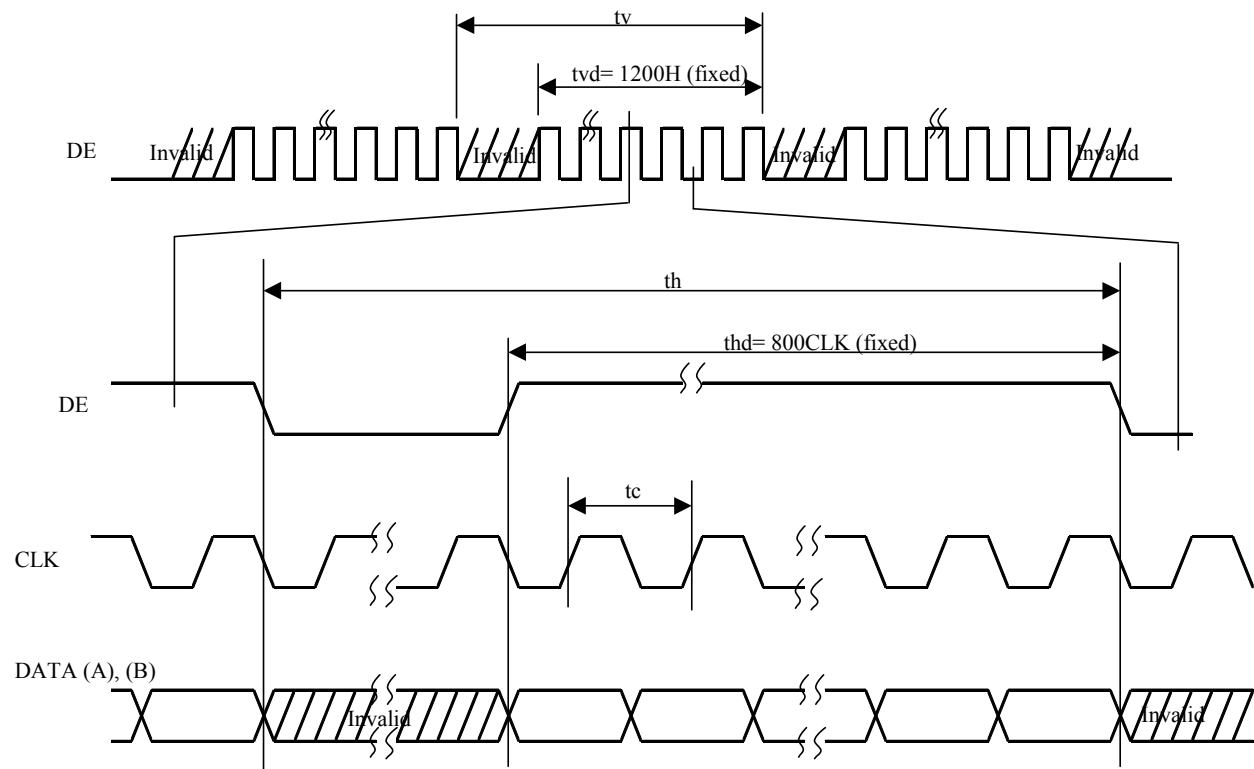
Display colors		Data signal (0: Low level, 1: High level)																							
		RA7 RA6 RA5 RA4 RA3 RA2 RA1 RA0								GA7 GA6 GA5 GA4 GA3 GA2 GA1 GA0								BA7 BA6 BA5 BA4 BA3 BA2 BA1 BA0							
		RB7 RB6 RB5 RB4 RB3 RB2 RB1 RB0	GB7 GB6 GB5 GB4 GB3 GB2 GB1 GB0	BB7 BB6 BB5 BB4 BB3 BB2 BB1 BB0			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

4.8 INPUT SIGNAL TIMINGS

4.8.1 Timing characteristics

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency	1/ tc	60.0	64.5	67.0	MHz	LVDS transmitter input
	Pulse width	tc	14.9	15.5	-	ns	
	Duty	-	See the data sheet of LVDS transmitter.			-	-
	Rise, fall	-				ns	
Horizontal	Cycle period	th	13.1	13.3	19.2	μs	-
			848	860	1,156	CLK	
	Display period	thd	800			CLK	-
Vertical	Cycle period	1/tv	59	60	61	Hz	-
		tv	1,206	1,250	-	H	
	Display period	tvd	1,200			H	-
DE, DATA	Setup time	-	See the data sheet of LVDS transmitter.			ns	-
	Hold time	-				ns	
	Rise, fall	-				ns	

4.8.2 Input signal timing chart



4.9 DISPLAY POSITIONS

The following table is the coordinates per pixel

Odd pixel: RA= Red data
 GA= Green data
 BA= Blue data

Even pixel: RB= Red data
 GB= Green data
 BB= Blue data

D (1, 1) D (2, 1)

RA	GA	BA	RB	GB	BB
----	----	----	----	----	----

D(1, 1)	D(2, 1)	...	D(X, 1)	...	D(1599, 1)	D(1600, 1)
D(1, 2)	D(2, 2)	...	D(X, 2)	...	D(1599, 2)	D(1600, 2)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
D(1, Y)	D(2, Y)	...	D(X, Y)	...	D(1599, Y)	D(1600, Y)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
D(1, 1199)	D(2, 1199)	...	D(X, 1199)	...	D(1599, 1199)	D(1600, 1199)
D(1, 1200)	D(2, 1200)	...	D(X, 1200)	...	D(1599, 1200)	D(1600, 1200)

4.10 TEN-bit LOOK UP TABLE FOR GAMMA ADJUSTMENT

Adjustment of gamma characteristics for each 8-bit RGB color data is possible by using built-in 10-bit LUT (look up table) for Gamma characteristics.

The LUT is set with the serial data. The combination of the control command determines the R/W actions.: READ, Random/Sequential Address WRITE and Individual/Simultaneous RGB setting.

The serial data is composed as Table 1.

Table1: Serial data Composition

DATA	DATA name	Function	Remarks
D31	CMD5	Control Command	See Table2 and 3.
D30	CMD4	Control Command	
D29	CMD3	Control Command	
D28	CMD2	Control Command	
D27	CMD1	Control Command	
D26	CMD0	Control Command	
D25	ADD9	LUT Address (MSB)	See Table4.
D24	ADD8	LUT Address	
D23	ADD7	LUT Address	
D22	ADD6	LUT Address	
D21	ADD5	LUT Address	
D20	ADD4	LUT Address	
D19	ADD3	LUT Address	
D18	ADD2	LUT Address	
D17	ADD1	LUT Address	
D16	ADD0	LUT Address (LSB)	
D15	Dummy	Dummy Data "0"	See Table5.
D14	Dummy	Dummy Data "0"	
D13	Dummy	Dummy Data "0"	
D12	Dummy	Dummy Data "0"	
D11	Dummy	Dummy Data "0"	
D10	Dummy	Dummy Data "0"	
D9	DATA9	LUT Data (MSB)	
D8	DATA8	LUT Data	
D7	DATA7	LUT Data	
D6	DATA6	LUT Data	
D5	DATA5	LUT Data	
D4	DATA4	LUT Data	
D3	DATA3	LUT Data	
D2	DATA2	LUT Data	
D1	DATA1	LUT Data	
D0	DATA0	LUT Data (LSB)	

Table2: Command table (CMD5 to CMD0: 6-bit)

DATA name	Parameter	Remarks
CMD5	Selection of WRITE/READ mode "1": WRITE mode "0": READ mode	In case of "0", must be set as follows. CMD4: "1", CMD3: "0", CMD2: "1" CMD1: "0", CMD0: "0"
CMD4	Must be set to "1".	-
CMD3	Selection of Random/Sequential Address WRITE "1": Random Address WRITE "0": Sequential Address WRITE	-
CMD2	Must be set to "1".	-
CMD1	Selection of Individual/Simultaneous RGB setting "1": Individual RGB setting "0": Simultaneous RGB setting	"1": Select the color by using ADD9 and ADD8. (See Table4.) "0": ADD9 and ADD8 are invalid.
CMD0	Must be set to "0".	-

Table3: Command Combination table (CMD5 to CMD0: 6-bit)

CMD5	CMD4	CMD3	CMD2	CMD1	CMD0	Mode
1	1	1	1	1	0	Random Address WRITE, Individual RGB setting
1	1	1	1	0	0	Random Address WRITE, Simultaneous RGB setting
1	1	0	1	1	0	Sequential Address WRITE, Individual RGB setting
1	1	0	1	0	0	Sequential Address WRITE, Simultaneous RGB setting
0	1	0	1	0	0	READ mode

*Other combinations are prohibited, and may cause function error.

Table4: Address table (ADD9 to ADD0: 10-bit)

DATA name	Parameter	Remarks
ADD9	Color Selection ADD[9:8]= 0:0 Red 0:1 Green 1:0 Blue 1:1 ON/OFF selection of Gamma Correction	When "ADD[9:8]=1:1", ON/OFF of Gamma correction can select according to the GMA[2:0]. (See Table6 and Table7.)
ADD8		
ADD7		
ADD6		
ADD5		
ADD4	LUT Address 256 address = 00h - FFh	When ADD[9:8] = 1:1, ADD[7:0] must be set to 00h.
ADD3		
ADD2		
ADD1		
ADD0		

Table5: Data table (DATA15 to DATA0: 16-bit)

DATA	DATA name	Parameter	Remarks
DATA15	Dummy	Dummy Data Must be set to "0".	-
DATA14	Dummy		
DATA13	Dummy		
DATA12	Dummy		
DATA11	Dummy		
DATA10	Dummy		
DATA9	DATA9	[MSB] 10-bit LUT Data 000h - 3FFh [LSB]	-
DATA8	DATA8		
DATA7	DATA7		
DATA6	DATA6		
DATA5	DATA5		
DATA4	DATA4		
DATA3	DATA3		
DATA2	DATA2		
DATA1	DATA1		
DATA0	DATA0		

Table6: Gamma correction table (DATA15 to DATA0: 16bit)

DATA	DATA name	Parameter	Remarks
DATA15	Dummy	Dummy Data Must be set to "0".	-
DATA14	Dummy		
DATA13	Dummy		
DATA12	Dummy		
DATA11	Dummy		
DATA10	Dummy		
DATA9	Dummy		
DATA8	Dummy		
DATA7	Dummy		
DATA6	Dummy		
DATA5	Dummy		
DATA4	Dummy		
DATA3	Dummy		
DATA2	GMA2	[MSB]	See Table7.
DATA1	GMA1	GMA Data	
DATA0	GMA0	[LSB]	

Table7: Control code GMA[2:0]

GMA2	GMA1	GMA0	Function
0	0	0	No correction (Initial setting)
0	0	1	Correction according to the LUT Data. Note1

*Other combinations are prohibited, and may cause function error.

Note1: Initial setting of the LUT is undefined data. The LUT should be enabled by setting of the GMA after writing the LUT data in all the 256 addresses, in order to avoid undefined data display.

Note2: Transfer the data every power-on, because the LUT data isn't stored in the LCD module.

Note3: As writing and reading the LUT data, a noise may appear on the display image. In order to prevent the noise appearing on the display, following measures should be performed.

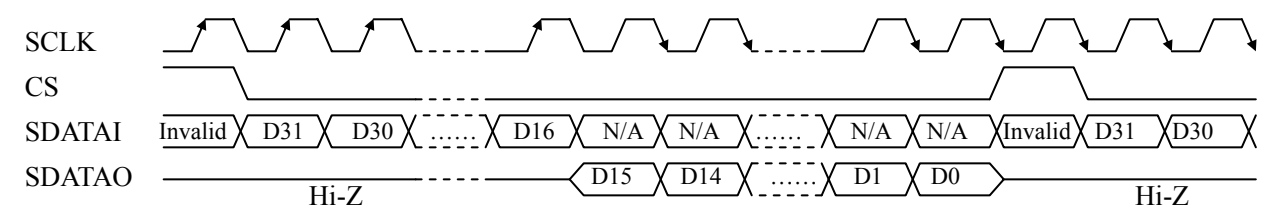
(1) The LUT data should be rewritten during invalid period of pixel data (See "4.8 INPUT SIGNAL TIMINGS").

(2) The LUT data should be rewritten when the Gamma Correction is OFF (GMA[2:0]= 000).

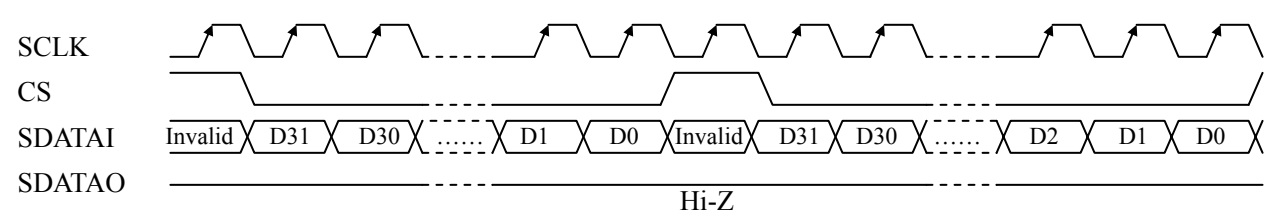
4.11 LUT SERIAL COMMUCATION TIMINGS

4.11.1 Timing Chart

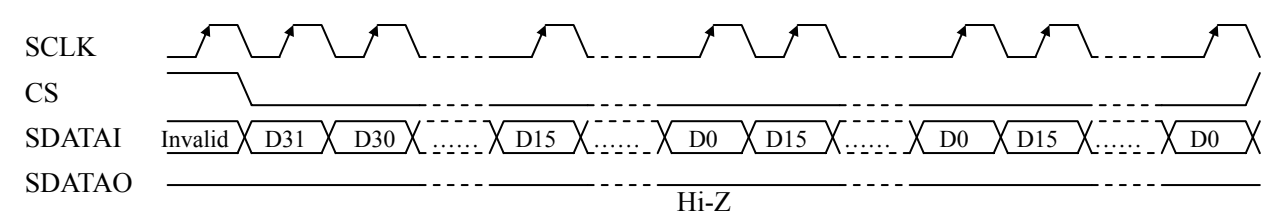
(1) READ Timing Chart



(2) Random Address WRITE Timing Chart



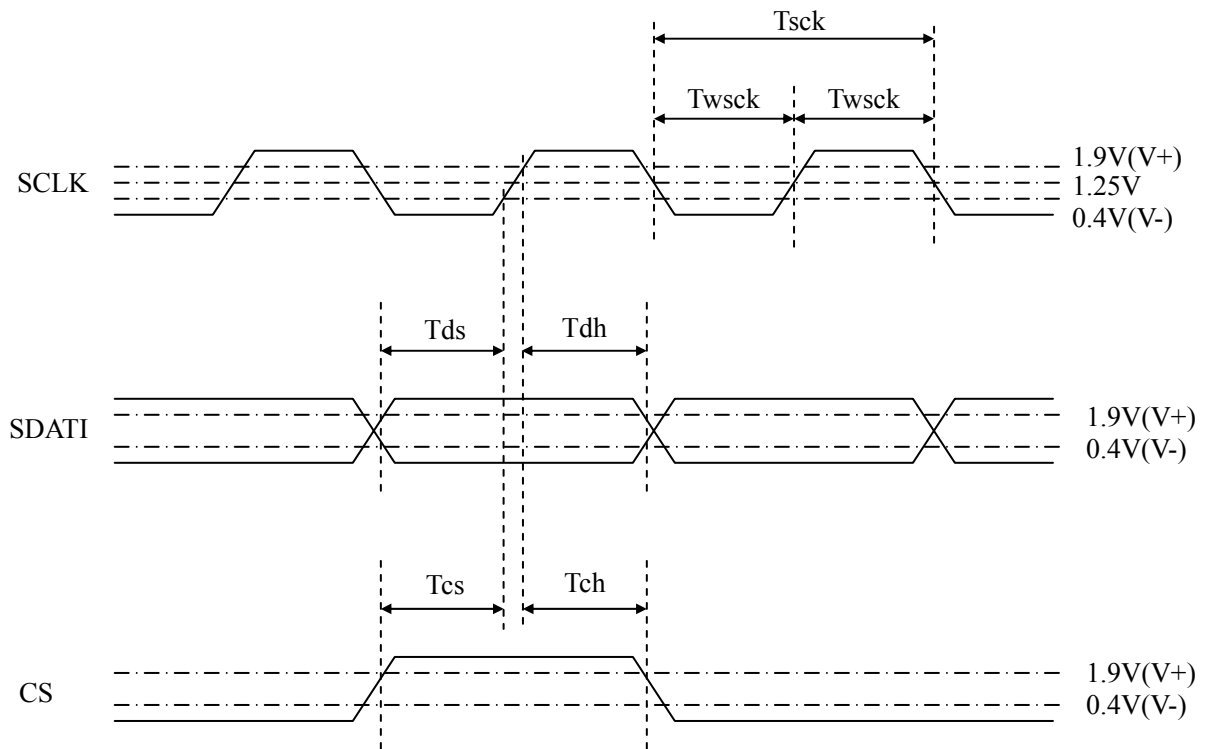
(3) Sequential Address WRITE Timing Chart



4.11.2 Timing specifications

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
SCLK Frequency	1/Tsck	-	-	5	MHz	-
SCLK Pulse Width (WRITE)	Twscck	50	-	-	ns	-
SCLK Pulse Width (READ)	Twscck	5	-	-	tc	Note1
SDATI-SCLK Setup Time	Tds	50	-	-	ns	-
SDATI-SCLK Hold Time	Tdh	50	-	-	ns	-
CS-SCLK Setup Time	Tcs	50	-	-	ns	-
CS-SCLK Hold Time	Tch	50	-	-	ns	-

Note1: At the READ of the serial communication mode, the SCLK Pulse Width (Twscck) must be greater than 5CLK (5 tc's). (See "4.8.1 Timing characteristics".)



Note2: During the serial communication mode, the display noise may appear because of rewriting the data. To avoid this, rewrite the LUT data when the pixel data is invalid or the Gamma Correction is OFF ($GMA[2:0] = 000$). The external noise may cause the data change, refresh the data regularly according to need.

4.12 OPTICS

4.12.1 Optical characteristics

(Note1, Note2)

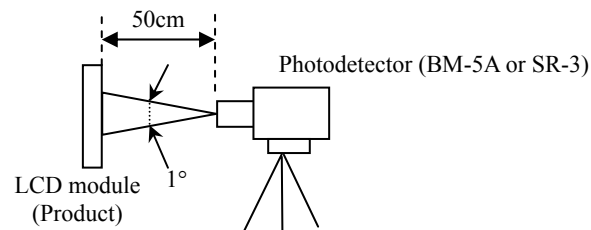
Parameter		Condition	Symbol	min.	typ.	max.	Unit	Measuring instrument	Remarks
Luminance		White at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	L	200	250	-	cd/m ²	BM-5A or SR-3	-
Contrast ratio		White/Black at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	CR	400	550	-	-	BM-5A or SR-3	Note3
Luminance uniformity		White θR= 0°, θL= 0°, θU= 0°, θD= 0°	LU	-	1.15	1.3	-	BM-5A	Note4
Chromaticity	White	x coordinate	Wx	-	0.313	-	-	SR-3	Note5
		y coordinate	Wy	-	0.329	-	-		
	Red	x coordinate	Rx	-	0.65	-	-		
		y coordinate	Ry	-	0.33	-	-		
	Green	x coordinate	Gx	-	0.29	-	-		
		y coordinate	Gy	-	0.61	-	-		
	Blue	x coordinate	Bx	-	0.14	-	-		
		y coordinate	By	-	0.079	-	-		
Color gamut		θR= 0°, θL= 0°, θU= 0°, θD= 0° at center, against NTSC color space	C	65	72	-	%		
Response time		Black to White	Ton	-	11	20	ms	BM-5A	Note6 Note7
		White to Black	Toff	-	9	20	ms		
Viewing angle	Right	θU= 0°, θD= 0°, CR≥ 10	θR	70	85	-	°	BM-5A	Note8
	Left	θU= 0°, θD= 0°, CR≥ 10	θL	70	85	-	°		
	Up	θR= 0°, θL= 0°, CR≥ 10	θU	70	85	-	°		
	Down	θR= 0°, θL= 0°, CR≥ 10	θD	70	85	-	°		

Note1: These are initial characteristics.

Note2: Measurement conditions are as follows.

Ta= 25°C, VDD= 12.0V, IBL= 6.0mA/m², Display mode: UXGA,
Horizontal cycle= 1/75.19kHz, Vertical cycle= 1/60.0Hz

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



Note3: See "4.12.2 Definition of contrast ratio".

Note4: See "4.12.3 Definition of luminance uniformity".

Note5: These coordinates are found on CIE 1931 chromaticity diagram.

Note6: Product surface temperature: TopF= 35°C

Note7: See "4.12.4 Definition of response times".

Note8: See "4.12.5 Definition of viewing angles".

4.12.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

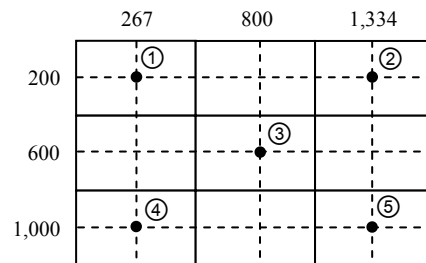
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.12.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

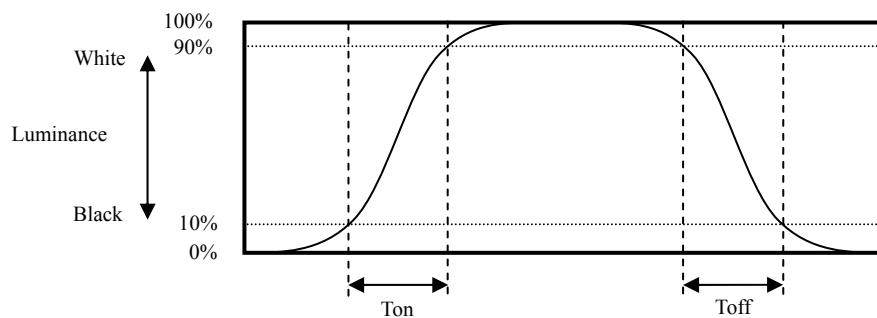
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

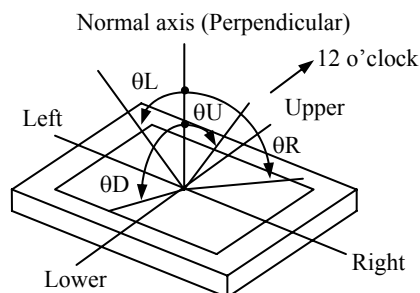


4.12.4 Definition of response times

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.).



4.12.5 Definition of viewing angles



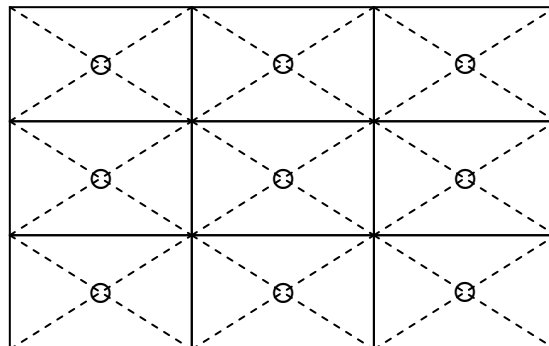
5. RELIABILITY TESTS

(Note1)

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
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 white.	
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, 1hour/cycle ③ Temperature transition time is within 5 minutes.	
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 No physical damages
Mechanical shock (Non operation)		① 294m/s^2 , 11ms ② X, Y, Z direction ③ 3 times each directions	
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
Dust (Operation)		① Sample dust: No.15 (by JIS-Z8901) ② 15 seconds stir ③ 8 times repeat at 1 hour interval	
Low pressure	Non-operation	① 15kPa (Equivalent to altitude 13,600m) ② $-20^{\circ}\text{C} \pm 3^{\circ}\text{C} \dots 24\text{hours}$ ③ $+60^{\circ}\text{C} \pm 3^{\circ}\text{C} \dots 24\text{hours}$	No display malfunctions
	Operation	① 53.3kPa (Equivalent to altitude 4,850m) ② $0^{\circ}\text{C} \pm 3^{\circ}\text{C} \dots 24\text{hours}$ ③ $+55^{\circ}\text{C} \pm 3^{\circ}\text{C} \dots 24\text{hours}$	

Note1: Display and appearance are checked under environmental conditions equivalent to the inspection conditions of defect criteria.

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" and "6.3 ATTENTIONS", after understanding these contents!**



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 the working backlight. There is a danger of an electric shock.**



*** Do not touch the working backlight. There is a danger of burn injury.**
*** Do not shock and press the LCD panel and the backlight! There is a 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 (φ16mm jig))**

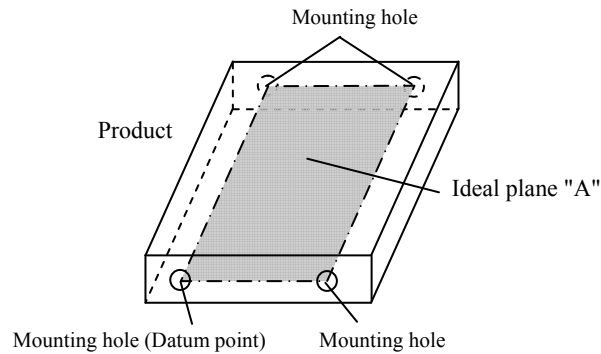


6.3 ATTENTIONS

6.3.1 Handling of the product

- ① Take hold of both ends without touching the circuit board when the product (LCD module) is picked up from inner packing box to avoid broken down or misadjustment, because of stress to mounting parts on the circuit board.
- ② Do not hook nor pull cables such as lamp cable, and so on, in order to avoid any damage.
- ③ When the product is put on the table temporarily, display surface must be placed downward.
- ④ When handling the product, take the measures of electrostatic discharge with such as earth band, ionic shower and so on, because the product may be damaged by electrostatic.
- ⑤ The torque for product mounting screws must never exceed 0.735N·m. Higher torque might result in distortion of the bezel. And the length of product mounting screws must be ≤ 5.3mm.

- ⑥ The product must be installed using mounting holes without undue stress such as bends or twist (See outline drawings). And do not add undue stress to any portion (such as bezel flat area). Bends or twist described above and undue stress to any portion may cause display mura.
Recommended installing method: Ideal plane "A" is defined by one mounting hole (datum point) and other mounting holes. The ideal plane "A" should be the same plane within $\pm 0.3\text{mm}$.



- ⑦ Do not press or rub on the sensitive product surface. When cleaning the product surface, use of the cloth with ethanolic liquid such as screen cleaner for LCD is recommended.
⑧ Do not push nor pull the interface connectors while the product is working.
⑨ If the lamp cable is attached on the metal part of the product directly, high frequency leak current to the metal part may occur, then the brightness may decrease or the lamp may not be turned on.
⑩ When handling the product, use of an original protection sheet on the product surface (polarizer) is recommended for protection of product surface. Adhesive type protection sheet may change color or characteristics of the polarizer.

6.3.2 Environment

- ① Do not operate or store in high temperature, high humidity, dewdrop atmosphere or corrosive gases. Keep the product in packing box with antistatic pouch in room temperature to avoid dusts and sunlight, when storing the product.
② In order to prevent dew condensation occurring by temperature difference, the product packing box should be opened after enough time being left under the environment of an unpacking room. Evaluate the leaving time sufficiently because a situation of dew condensation occurring is changed by the environmental temperature and humidity. (Recommended leaving time: 6 hours or more with packing state)
③ Do not operate in high magnetic field. Circuit boards may be broken down by it.
④ This product is not designed as radiation hardened.

6.3.3 Characteristics

The following items are neither defects nor failures.

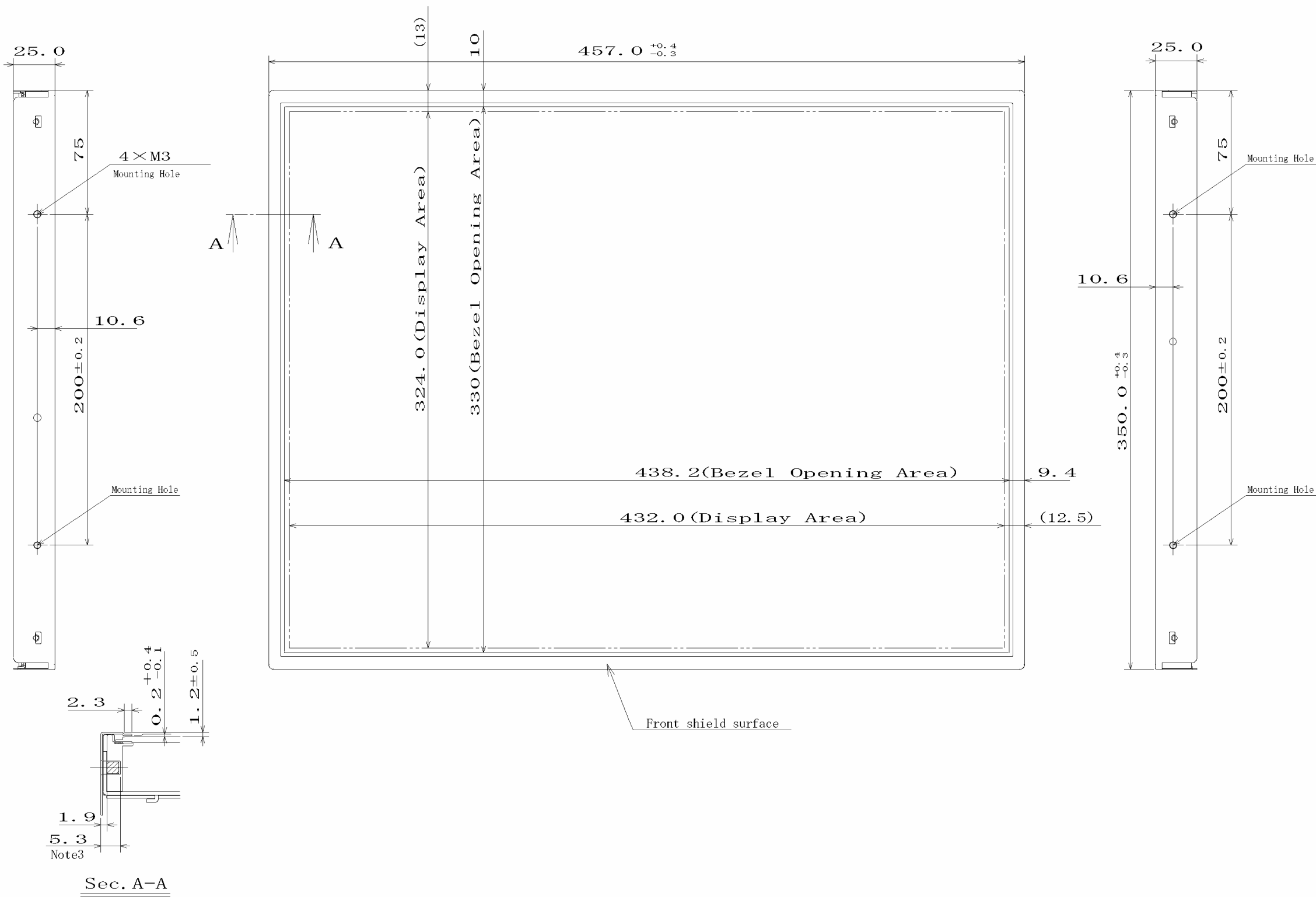
- ① Response time, luminance and color may be changed by ambient temperature.
- ② Display mura, flicker, vertical seam or small spot may be observed depending on display patterns.
- ③ Optical characteristics (e.g. luminance, display uniformity, etc.) gradually is going to change depending on operating 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 depending on viewing angle because of the use of condenser sheet in the backlight.
- ⑥ Optical characteristics may be changed depending on input signal timings.
- ⑦ The interference noise between input signal frequency for this product's signal processing board and luminance control frequency of the inverter may appear on a display. Set up luminance control frequency of the inverter so that the interference noise does not appear.

6.3.4 Other

- ① All GND and VDD terminals should be used without any non-connected lines.
- ② Do not disassemble a product or adjust variable resistors
- ③ Pack the product with original shipping package, in order to avoid any damages during transportation, when returning the product to NEC for repair and so on.
- ④ The LCD module by itself or integrated into end product should be packed and transported with display in the vertical position. Otherwise the display characteristics may be degraded.

7. OUTLINE DRAWINGS

7.1 FRONT VIEW



- Note1: Not shown tolerances of the dimensions are ±0.3mm.
- Note2: The torque for product mounting screws must never exceed 0.735N·m.
- Note3: The length of product mounting screws from surface of plate must be ≤ 5.3mm.
- Note4: The values in parentheses are for reference.

Unit: mm

