NEC

TFT COLOR LCD MODULE

NL128102AC28-07

46cm (18.1 Type)
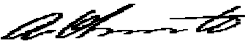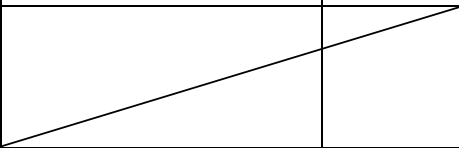## SXGA
LVDS interface (2 port)

Data Sheet

（Second Edition）

All information in this document is subject to change without prior notice.

1st Engineering Department Color LCD Division Display Device Operations Unit NEC Electron Devices NEC Corporation		
Approved	*(signature)*	Mar. 27, 2001
Checked		
Prepared	*R. Kawashima*	Mar. 27, 2001

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INTRODUCTION

While NEC Corporation has been making continuous effort to enhance the reliability of its products, the possibility of failures cannot be eliminated entirely. To minimize risks of damage to property or injury to person arising from a failure in an NEC product, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment and anti-failure features.

NEC products are classified into the following three quality grades:
"Standard", *"Special"*, *"Specific"*

The *"Specific"* quality grade applies only to applications developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a product depend on its quality grade, as indicated below. Customers must check the quality grade of each application before using it in a particular application.

Standard: Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

Specific: Military systems, aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems (medical equipment, etc.) and any other equipment

The quality grade of this product is *"Standard"* unless otherwise specified in this SPECIFICATIONS. If customers intend to use this product for applications other than those specified for *"Standard"* quality grade, they should contact an NEC Corporation sales representative in advance.

Anti-radioactive design is not implemented in this product.

CONTENTS

1. OUTLINE

NL128102AC28-07 is a TFT (thin film transistor) active matrix color liquid crystal display (LCD) comprising amorphous silicon TFT attached to each signal electrode, a driving circuit and a backlight with an inverter.

This product has a 46cm (18.1 inches) display area by a diagonal, and contains 1280×1024 pixels in it. Also it can display 16,777,216 colors.

2. FEATURES

・LVDS interface (adapted THC63LVDF84A ×2,THine Electronics, Inc. as a receiver)
・Ultra-wide viewing angle (with lateral electric field)
・Fast response time
・High luminance
・Wide color gamut
・Small foot print
・Light weight
・Thin thickness
・Low reflection
・Incorporated direct type backlight
・Replaceable backlight unit and inverter
・Approved by UL1950 Third Edition (File No. E170632) and CSA-C22.2 No. 950-95 (File No. E170632)

3. APPLICATIONS

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

4. PRINCIPLE AND STRUCTURE

A color TFT (thin film transistor) LCD module is composed of a TFT liquid crystal panel structure, LSIs for driving the TFT array, and a backlight assembly. The TFT liquid crystal panel structure is injected liquid crystal material into the narrow gap between a TFT array glass substrate and a color filter glass substrate. Also, LCD module is connected the driver LSIs with a TFT liquid crystal panel structure, and then the backlight assembly is attached to the backside of the panel.

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 addresses 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.

5. OUTLINE OF CHARACTERISTICS (at room temperature)

Display area	359.04 (H) $\times$ 287.232 (V) mm
Drive system	a-Si TFT active matrix
Display colors	16,777,216 colors
Number of pixels	1280 (H) $\times$ 1024 (V)
Pixel arrangement	RGB vertical stripe
Pixel pitch	0.2805 (H) $\times$ 0.2805 (V) mm
Module size	389.0 (Typ., H) $\times$ 317.2 (Typ., V) $\times$ 30.3 (Typ., D) mm
Weight	1650 g (Typ.)
Contrast ratio	300:1 (Typ.)

Viewing angle (To be out of 10:1 for the contrast ratio)
- Horizontal : 85 ° (Typ., left side, right side)
- Vertical :　85 ° (Typ., up side, down side)

Designed viewing direction
- Optimum gray-scale (γ=2.2): Perpendicular

Polarizer pencil-hardness	2 H (Min., at JIS K5400)
Color gamut	60 % (Typ., at center, To NTSC)
Response time	15ms (Typ.), "black" to "white"
Luminance	240 cd/m^2 (Typ.)

Signal system　　LVDS interface (Receiver: THC63LVDF84A$\times$2, THine Electronics, Inc.)
RGB 8-bit signals, Synchronous signals (Hsync, Vsync), Data enable signal (DE)
and Dot clock (CLK)

Supply voltage　　12 V (Logic, LCD driving)

Backlight　　Direct light type: Twelve cold cathode fluorescent lamps and an inverter
〔Replaceable parts〕
· Backlight unit:　181LHS07
· Inverter:　　181PW051

Power consumption　　38.7 W (Typ.)

6. BLOCK DIAGRAM

I/F   LCD module

DA0+/–
DA1+/–
DA2+/–
CKA+/–
DA3+/–

THC63LVDF84A (THine)

DB0+/–
DB1+/–
DB2+/–
CKB+/–
DB3+/–

THC63LVDF84A (THine)

Controller

H-driver

3840 lines

TFT LCD panel

V-driver

512 lines   512 lines

H:1280×3 (R,G,B)
V: 1024

V-driver

Backlight (Direct light type)

VDD

DC/DC Converter

Power supply for drivers

GND
FG

VDDB
BRTC
BRTH
BRTL
BRTP
PWSEL
GNDB

Inverter
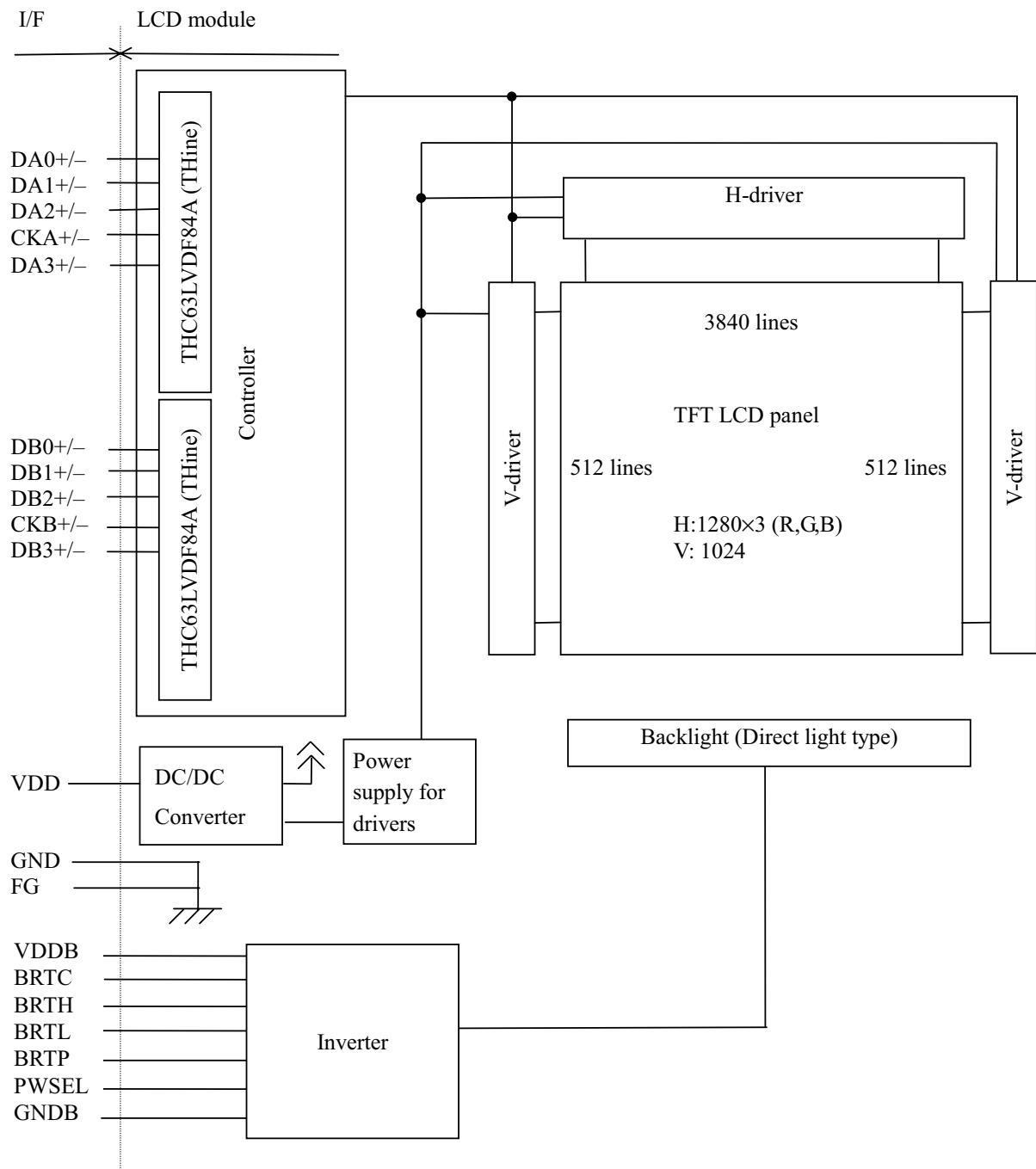
Note: GND is signal ground for logic and LCD driving. GND is connected to FG (frame ground) in the
         LCD module and neither GND nor FG are connected to GNDB (backlight ground). These grounds
         should be connected to system ground in customer equipment.

7. GENERAL SPECIFICATIONS

Item	Specification	Unit
Module size	389.0 ±1.0 (H) × 317.2* ±1.0 (V) × 30.3 ±1.0 (D) * Exclude the mounting space	mm
Display area	359.04 (H) × 287.232 (V) [Diagonal display size: 46cm (Type 18.1)]	mm
Number of pixels	1280 (H) × 1024 (V)	pixel
Dot pitch	0.0935 (H) × 0.2805 (V)	mm
Pixel pitch	0.2805 (H) × 0.2805 (V)	mm
Pixel arrangement	RGB (Red, Green, Blue) vertical stripe	─
Display colors	16,777,216	color
Weight	1650 (Typ.), 1750 (Max.)	g

8. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit	Remarks
Supply voltage	VDD	-0.3 to +14	V	Ta = 25°C
	VDDB	-0.3 to +14		
Logic input voltage (LCD)	Vi	-0.3 to +3.6	V	Ta = 25°C VDD= 12V
Logic input voltage (BRTC, BRTP, PWSEL)	ViB1,2	-0.3 to +5.5		Ta = 25°C VDDB= 12V
BRTL input voltage (BRTL)	ViB3	-0.3 to +1.5		
Storage temperature	Tst	-20 to +60	℃	-
Operating temperature	Top1	0 to +55		Module front surface Note1
	Top2	0 to +66		Module rear surface Note2
Relative humidity (RH)	Note 3	≤ 95	%	Ta≤ 40°C
		≤ 85		40°C <Ta≤ 50°C
		≤ 70		50°C<Ta≤ 55°C
Absolute humidity	Note 3	Absolute humidity shall not exceed Ta = 55°C, RH = 70%	g/m³	Ta>55°C
Operating altitude		≤ 4,850	m	0°C≤ Ta ≤ 55°C
Storage altitude		≤ 13,600	m	-20°C≤ Ta ≤ 60°C

Note1: Measure at the surface of display area (including self-heat)
Note2: Measure at the rear shield (including self-heat)
Note3: No condensation

9. ELECTRICAL CHARACTERISTICS

(1) Logic/ LCD driving   (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
Differential input (H) Threshold voltage	VTH	-	-	+100	mV	VCM=1.2V Note1
Differential input (L) Threshold voltage	VTL	-100	-	-	mV	
Differential Input voltage	VI	0	-	2.4	V	─
Terminating resistor	RT	-	100	-	Ω	─
Supply current	IDD	-	315 Note 2	600 Note 3	mA	VDD= 12.0V

Note1: Common mode voltage in LVDS transmitter
Note2: Checker flag pattern (in EIAJ ED-2522)
Note3: Theoretical maximum current pattern

(2) Backlight

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	VDDB	11.4	12.0	12.6	V	Backlight power supply
Logic input "L" level	ViBL1	0	-	0.8	V	for BRTP
Logic input "H" level	ViBH1	2	-	5	V	
Logic input "L" level	ViBL2	0	-	0.8	V	for BRTC, PWSEL
Logic input "H" level	ViBH2	2	-	5	V	
Logic input "L" current	IiBL1	-1580	-	-	μA	for BRTP
Logic input "H" current	IiBH1	-	-	3500	μA	
Logic input "L" current	IiBL2	-810	-	-	μA	for BRTC, PWSEL
Logic input "H" current	IiBH2	-	-	440	μA	
BRTL input current	IiB3	-130	-	-	μA	for BRTL
Supply current	IDDB	-	2910	3500	MA	VDDB=12.0V (at Max. luminance)

(3) Inverter current wave

237 to 273, 255Hz (typ., frequency of luminance control)

Maximum luminance   : 100% (Duty)
Minimum luminance   : 20% (Duty)
Luminance control frequency   : 237 to 273Hz, 255Hz (Typ.)
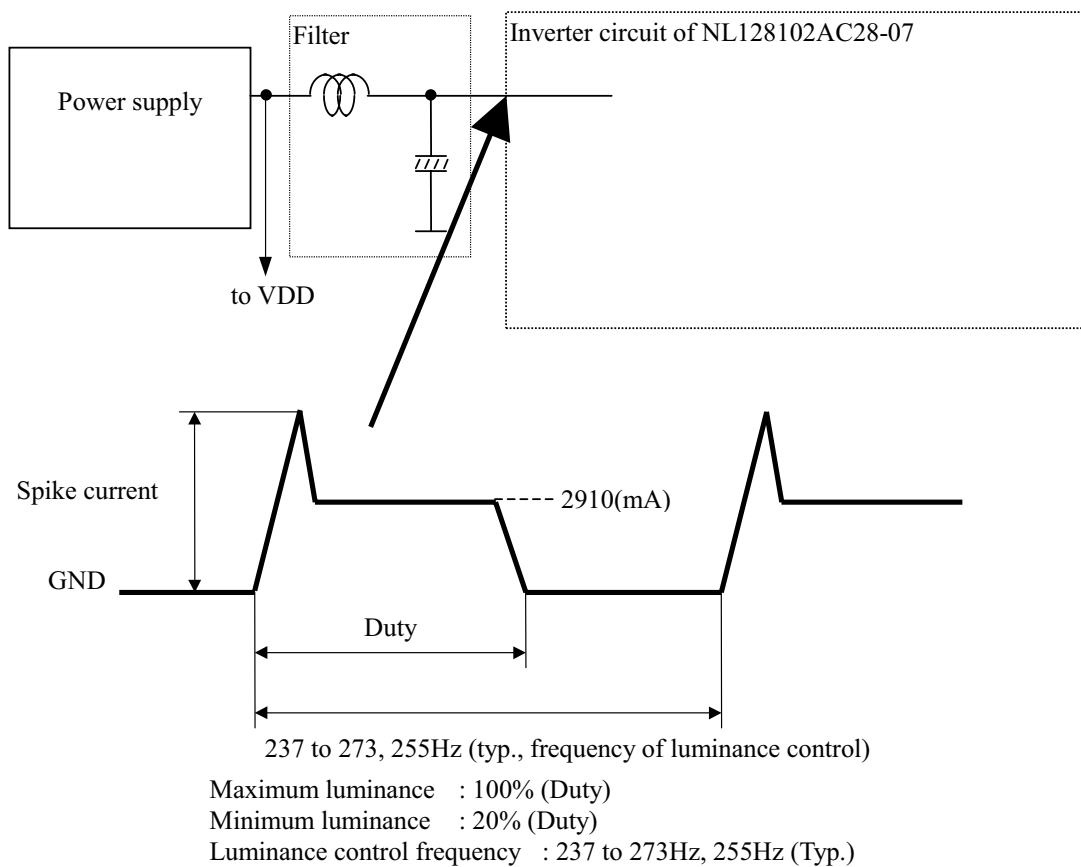
Note1: The power supply lines (VDDB and GNDB) have large ripple voltage while dimming. There is the possibility that the ripple voltage produce an acoustic noise and signal wave noise in a system circuit (e.g. audio circuit). If the noise occurred in a system circuit, put an aluminum electrolytic capacitor (5,000 to 6,000μF) between the power source lines (VDDB and GNDB), and the capacitor will be able to reduce the noise.

Note2: Luminance control frequency indicate the input pulse frequency, when select the external signaling luminance control. See '11.INTERFACE PIN FUNCTIONS (4) External pulse control for luminance '.

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10. SUPPLY VOLTAGE SEQUENCE

(1) Supply voltage sequence and backlight control sequence
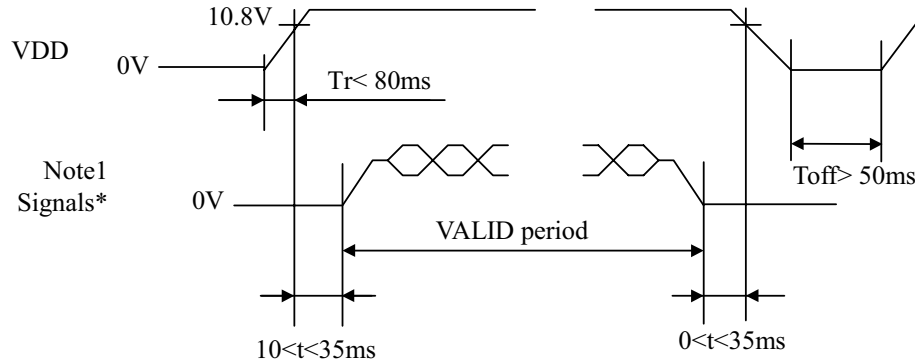
* Signals: Hsync, Vsync, DE, CLK, RA0 to RB7, GA0 to GB7, BA0 to BB7
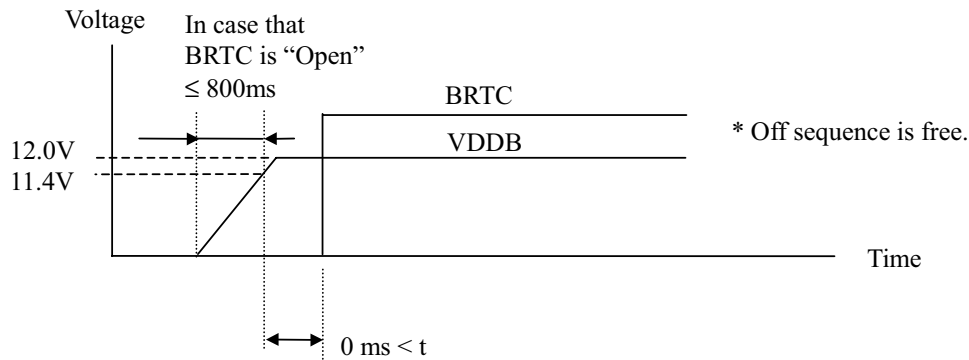
Note1: The values of signals are at the terminal of resistor of 100 Ω.

Note2: When VCC is not supplied, Logic signals (synchronous signals and control signals) should be "0" voltage (V). If these input voltages are higher than 0.3 V, the internal circuit will be damaged.

Note3: When turn on the LCD module, if VCC voltage has the chance of fall-down during the rising period up to 11.4V, the LCD module may not start to work because of the protection circuit.

Note4: Backlight ON/OFF (BRTC signal) should be controlled, while logic signals are supplied. The backlight power supply (VDDB) is not related to the power supply sequence. However, unstable data may be displayed when the backlight power is turned ON/OFF during logic signals out.

Note5: Rising time of backlihght power supply (12V) should be less the 800ms, otherwise, the protection circuit will work, and backlight will be turned off.

Note6: When "L" period of BRTP is more than 50 ms, the backlight will be turned off by safety circuit.

(2) Ripple of supply voltage

Supply voltage	VDD (for logic and LCD driver)	VDDB (for backlight)
Acceptable level	≤ 100 m V p-p	≤ 200 m V p-p

Note1: The acceptable level of ripple voltage includes spike noise.

Example of the power supply connection

    a) Separate the power supplies   b) Put in the filters

Power	→ VDD		Power	→ Filter	→ VDD

Power	→ VDDB			→ Filter	→ VDDB
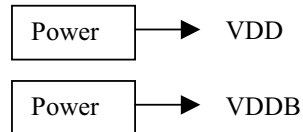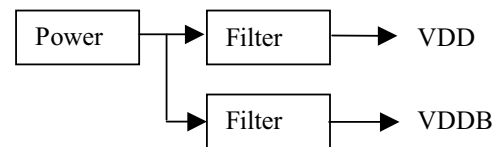
(3) This product has fuses listed below. Check and evaluate power supplies of customer's system..

	Type name	Supplier	Rating
VDD	ICP-S1.8	ROHM	1.8A
VDDB	MMCT5A	SOC	5A

Note: The power capacity should be more than 2 times of fuse ratings from safety point of view. If the power capacity of your system is less than above request, check and evaluate it carefully.

11. INTERFACE PIN CONNECTIONS
  (1) Interface connectors for signals and power
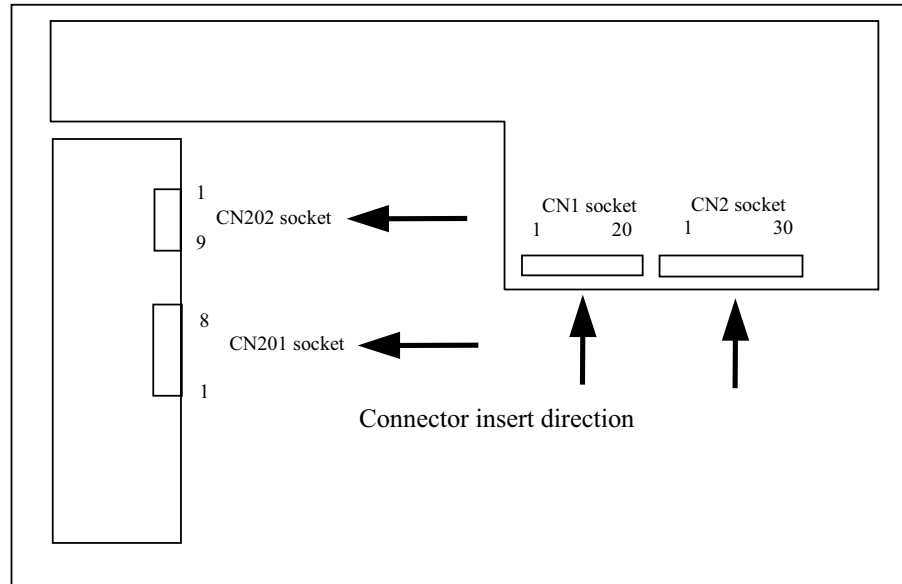
CN1 socket: 53780-2010
    Adaptable plug: 51146-2000
    Supplier: Molex Incorporated.

Pin No.	Symbol	Function	Description
1	N.C.	Non-connection	Keep the terminal open
2	N.C.		
3	GND	Ground	Signal ground Note 1
4			
5	DA0-	Odd pixel data 0	LVDS differential signal Note 2
6	DA0+		
7	GND	Ground	Signal ground Note 1
8	DA1-	Odd pixel data 1	LVDS differential signal Note 2
9	DA1+		
10	GND	Ground	Signal ground Note 1
11	DA2-	Odd pixel data 2	LVDS differential signal Note 2
12	DA2+		
13	GND	Ground	Signal ground Note 1
14	CKA-	Odd pixel clock	LVDS differential signal Note 2
15	CKA+		
16	GND	Ground	Signal ground Note 1
17	DA3-	Odd pixel data 3	LVDS differential signal Note 2
18	DA3+		
19	GND	Ground	Signal ground Note 1
20	N.C.	Non-connection	Keep the terminal open

  Note1: Do not keep pins open (except 1, 2 and 20 pin) to avoid noise problem.
  Note2: Use 100Ω twist pair wires for the cable.

Figure from socket view

1	2	· · · · ·	19	20

CN2 socket: 53780-3010
    Adaptable plug: 51146-3000
    Supplier: Molex Incorporated.

Pin No.	Symbol	Function	Description
1	N.C.	Non-connection	Keep the terminal open
2	N.C.		
3	GND	Ground	Signal ground Note 1
4	GND		
5	DB0-	Even pixel data 0	LVDS differential signal Note 2
6	DB0+		
7	GND	Ground	Signal ground Note 1
8	DB1-	Even pixel data 1	LVDS differential signal Note 2
9	DB1+		
10	GND	Ground	Signal ground Note 1
11	DB2-	Even pixel data 2	LVDS differential signal Note 2
12	DB2+		
13	GND	Ground	Signal ground Note 1
14	CKB-	Even pixel clock	LVDS differential signal Note 2
15	CKB+		
16	GND	Ground	Signal ground Note 1
17	DB3-	Even pixel data 3	LVDS differential signal Note 2
18	DB3+		
19	GND	Ground	Signal ground Note 1
20	Reserved	Reserved	
21	Reserved		
22	Reserved		
23	Reserved		
24	GND	Ground	Signal ground Note 1
25	GND		
26	GND		
27	N.C.	Non-connection	Keep the terminal open.
28	VDD	+12V Power Supply	12V±5%
29	VDD		
30	VDD		

Note1: Do not keep pins open (except 1, 2, 20, 21, 22, 23 and 27 pin) to avoid noise problem.
Note2: Use 100Ω twist pair wires for the cable.

Figure from socket view

| 1 | 2 | · · · · · | 29 | 30 |

(2) Connector for backlight unit

CN201 socket: DF3-8P-2H
Adaptable plug: DF3-8S-2C
Supplier: HIROSE ELECTRIC Co,. Ltd.

Pin No.	Symbol	Function	Description
1	GNDB	Ground for backlight	Note 1, 2
2	GNDB		
3	GNDB		
4	GNDB		
5	VDDB	12V power supply	+12V±10%
6	VDDB		
7	VDDB		
8	VDDB		

Note1: GNDB should be connected to system ground in customer equipment.
Note2: Do not keep pins open to avoid noise problem.

Figure from socket view

| 1 | 2 | .... | 7 | 8 |

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

Pin No.	Symbol	Function	Description
1	GNDB	Ground for backlight	Note 1, 2
2	GNDB		
3	N.C.	Non-connection	Keep the terminal open
4	BRTC	Backlight ON/OFF control signal (TTL level)	"H" or "Open" : Backlight on "L"　　　　 : Backlight off
5	BRTH	Luminance control	-
6	BRTL	Luminance control	
7	BRTP	Luminance control signal (TTL level)	-
8	GNDB	Ground for backlight	Note 1, 2
9	PWSEL	Luminance control select signal (TTL level)	-
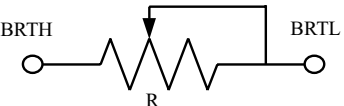
Note1: GNDB should be connected to system ground in customer equipment.
Note2: Do not keep pins open (except 2 and 3) to avoid noise problem.

Figure from socket view

| 9 | 8 | .....…….. | 2 | 1 |

(3) Luminance control

Control method	Function and adjustment	PWSEL	BRTP signal
PWM	Luminance controlled by BRTP signal. See "(4) External pulse control for luminance".	"L"	Input
Variable resistor Note1	The variable resistor for luminance control should be 10kΩ type, and zero point of the resistor corresponds to the minimum of luminance. BRTH ——/\/\/\—— BRTL R Max. luminance (100%): R=10kΩ Min. luminance (30%): R=0Ω Mating variable resistor: 10kΩ±5%,B curve, 1/10W	"H" or "OPEN"	"OPEN"
Voltage Note1	BRTH should be fixed to 0V, and input to BRTL as follows. Max. Luminance (100%): 1V(Typ.) Min. Luminance (30%): 0V		

Note1: Luminance control may be overlap noises on the display image depending on input signal timing. In this case, keep off the interference between input signal and backlight driving signal, by PWM method.

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(4) External pulse control for luminance

Luminance control with external pulse is valid, when PWSEL is "L" and external pulse signal is inputted to BRTP. This luminance control is controlled by duty ratio, and luminance is as follows.
Duty ratio=100%: Max. luminance
Duty ratio=20%: Min. luminance

In BRTC="H" or "OPEN", the inverter will stop work when BRTP terminal is fixed to "L" in the condition of PWSEL="L". In this case, backlight will not turn on, even if external pulse signal is inputted to BRTP again. This is not out of order. Inverter will start to work when power is supplied again.

BRTC

$0 < tLPW \leq 50ms$

BRTP

$0 < t \leq 50ms$ $0 < t \leq 50ms$

tPW

tHPW   tLPW

ViBH1

BRTP 50%
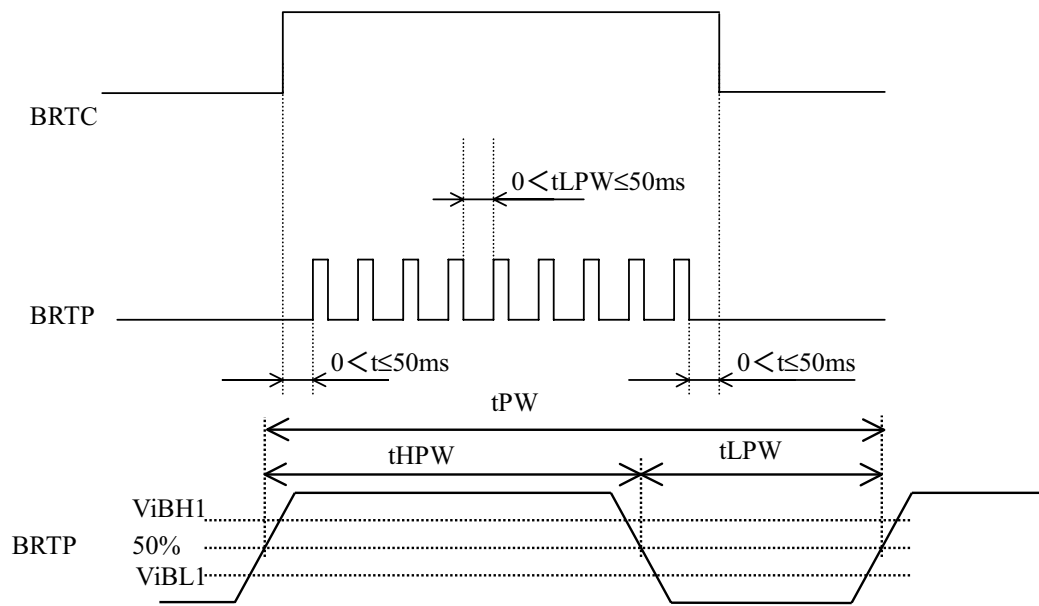
ViBL1

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Frequency	1/tPW	185	—	325	Hz	Note1
"L" period	tLPW	—	—	50	ms	Note2
Pulse-width	tHPW/tPW	20	—	100	%	Note3
Luminance ratio	—	—	30 to 100	—	%	—
Input voltage	ViBL1	0	—	0.8	V	—
	ViBH1	2.0	—	5.0	V	—

Note1: See the following formula for luminance control frequency.
Luminance control frequency = Vsync frequency $\times$ (n+0.25) [or (n + 0.75)]
Note2: In case tLPW is out of 50ms, backlight will turn off by its protection circuits.
Note3: Max. Luminance at 100%

Attention: External pulse control for luminance may be disturbed the display image when set up frequency is interfered with internal signal frequency.

12. METHOD OF CONNECTION FOR THC63LVDM83A

System side ←——→ LCD module side

Category	Signal	TRANSMITTER pin	THC63LVDF83A		pin	I/F CN pin	CN1	pin		RECIEVER THC63LVDF84A	pin	INPUT to LCD
Odd pixel data and control signal	RA2	51	TA0			1	N.C.			RA0	27	RA2
	RA3	52	TA1			2	N.C.			RA1	29	RA3
	RA4	54	TA2			3	GND			RA2	30	RA4
	RA5	55	TA3			4	GND			RA3	32	RA5
	RA6	56	TA4	TA-	48	5	DA0-	9	RA-	RA4	33	RA6
	RA7	3	TA5	TA+	47	6	DA0+	10	RA+	RA5	35	RA7
	GA2	4	TA6			7	GND			RA6	37	GA2
	GA3	6	TB0	TB-	46	8	DA1-	11	RB-	RB0	38	GA3
	GA4	7	TB1	TB+	45	9	DA1+	12	RB+	RB1	39	GA4
	GA5	11	TB2			10	GND			RB2	43	GA5
	GA6	12	TB3	TC-	42	11	DA2-	15	RC-	RB3	45	GA6
	GA7	14	TB4	TC+	41	12	DA2+	16	RC+	RB4	46	GA7
	BA2	15	TB5			13	GND			RB5	47	BA2
	BA3	19	TB6	TCLK-	40	14	CKA-	17	RCLK-	RB6	51	BA3
	BA4	20	TC0	TCLK+	39	15	CKA+	18	RCLK+	RC0	53	BA4
	BA5	22	TC1			16	GND			RC1	54	BA5
	BA6	23	TC2	TD-	38	17	DA3-	19	RD-	RC2	55	BA6
	BA7	24	TC3	TD+	37	18	DA3+	20	RD+	RC3	1	BA7
	Hsync	27	TC4			19	GND			RC4	3	Hsync
	Vsync	28	TC5			20	N.C.			RC5	5	Vsync
	DE	30	TC6							RC6	6	DE
	RA0	50	TD0							RD0	7	RA0
	RA1	2	TD1							RD1	34	RA1
	GA0	8	TD2							RD2	41	GA0
	GA1	10	TD3			Use 100Ω twist pair				RD3	42	GA1
	BA0	16	TD4			wires for the Cable.				RD4	49	BA0
	BA1	18	TD5							RD5	50	BA1
Note1	RSVD	25	TD6							RD6	2	RSVD
	CLK	31	CLKIN			pin	CN2			CLKOUT	26	CLKA
Even pixel data	RB2	51	TA0			1	N.C.			RA0	27	RB2
	RB3	52	TA1			2	N.C.			RA1	29	RB3
	RB4	54	TA2			3	GND			RA2	30	RB4
	RB5	55	TA3			4	GND			RA3	32	RB5
	RB6	56	TA4	TA-	48	5	DB0-	9	RA-	RA4	33	RB6
	RB7	3	TA5	TA+	47	6	DB0+	10	RA+	RA5	35	RB7
	GB2	4	TA6			7	GND			RA6	37	GB2
	GB3	6	TB0	TB-	46	8	DB1-	11	RB-	RB0	38	GB3
	GB4	7	TB1	TB+	45	9	DB1+	12	RB+	RB1	39	GB4
	GB5	11	TB2			10	GND			RB2	43	GB5
	GB6	12	TB3	TC-	42	11	DB2-	15	RC-	RB3	45	GB6
	GB7	14	TB4	TC+	41	12	DB2+	16	RC+	RB4	46	GB7
	BB2	15	TB5			13	GND			RB5	47	BB2
	BB3	19	TB6	TCLK-	40	14	CKB-	17	RCLK-	RB6	51	BB3
	BB4	20	TC0	TCLK+	39	15	CKB+	18	RCLK+	RC0	53	BB4
	BB5	22	TC1			16	GND			RC1	54	BB5
	BB6	23	TC2	TD-	38	17	DB3-	19	RD-	RC2	55	BB6
	BB7	24	TC3	TD+	37	18	DB3+	20	RD+	RC3	1	BB7
	RSVD	27	TC4			19	GND			RC4	3	RSVD
Note1	RSVD	28	TC5			20	Reserved			RC5	5	RSVD
	RSVD	30	TC6			21	Reserved			RC6	6	RSVD
	RB0	50	TD0			22	Reserved			RD0	7	RB0
	RB1	2	TD1			23	Reserved			RD1	34	RB1
	GB0	8	TD2			24	GND			RD2	41	GB0
	GB1	10	TD3			25	GND			RD3	42	GB1
	BB0	16	TD4			26	GND			RD4	49	BB0
	BB1	18	TD5			27	N.C.			RD5	50	BB1
Note1	RSVD	25	TD6			28	VDD:12V			RD6	2	RSVD
	CLK	31	CLKIN			29	VDD:12V			CLKOUT	26	CLKB
						30	VDD:12V					

Note1: RSVD must connect to system GND.

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13. DISPLAY COLORS vs. 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.

14. INPUT SIGNAL TIMINGS

(1) Input signal specifications for LCD controller

	Parameter		Symbol	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency	Vf=60Hz	1/ tc	51.5 —	54.0 18.52	56.5 —	MHz ns	—
	Duty		tc / tcl		Note 1		—	—
	Rise, fall		tcrf				ns	—
Hsync	Period	Vf=60Hz	th	12.3 750	15.630 844	— —	μ s CLK	Typ=64.0kHz Note 2, 3
	Display period		thd	—	640	—	CLK	—
	Front-porch		thf	—	—	—	CLK	—
	Pulse width	Vf=60Hz	thp *	—	56	—	CLK	—
	Back-porch		thb *	—	124	—	CLK	—
	* thp + thb			110	—	—	CLK	—
Vsync	Period	Vf=60Hz	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				ns	—
	CLK-DATA (Hold)		th		Note 1		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.

Note 2: Both of "time" and "CLK number" of the "th" must keep the Minimum value of specification.
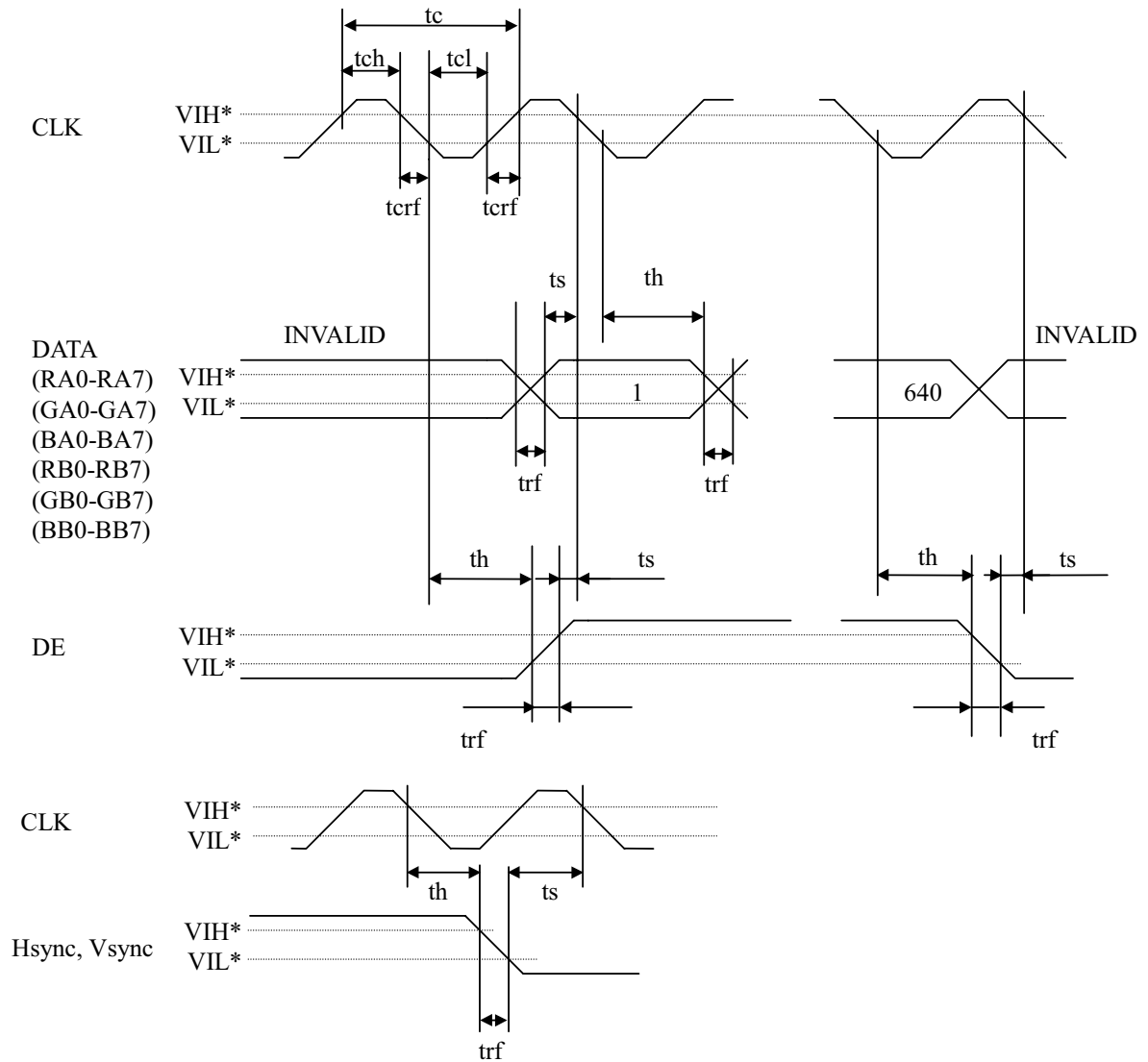
Note 3: During operation, fluctuation of Hsync period must not exceed ±1 CLK. Otherwise function errors will occur in LCD module.
e.g.: Acceptable fluctuation range is 799-801 CLK, when the Hsync period is 800 CLK.
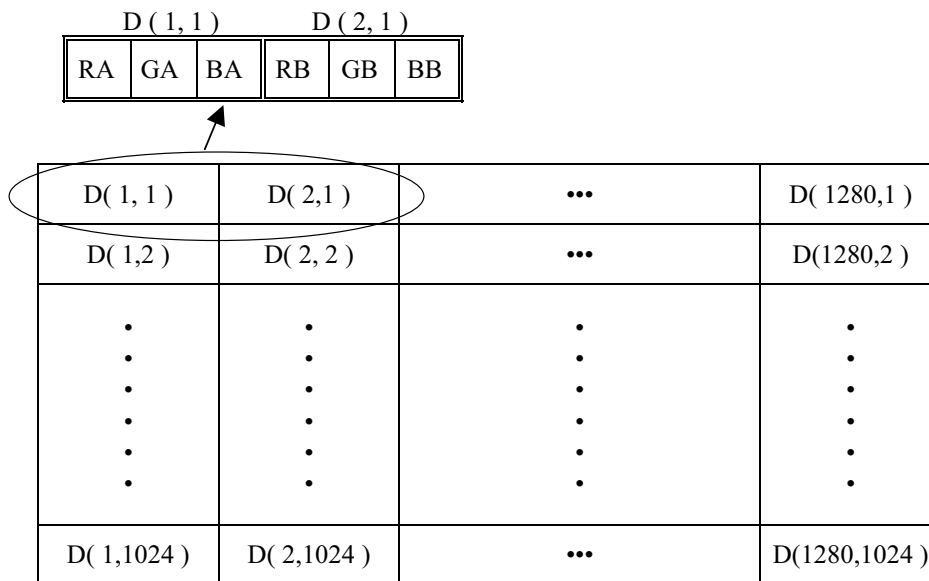
(2) Input signals timing chart for LCD
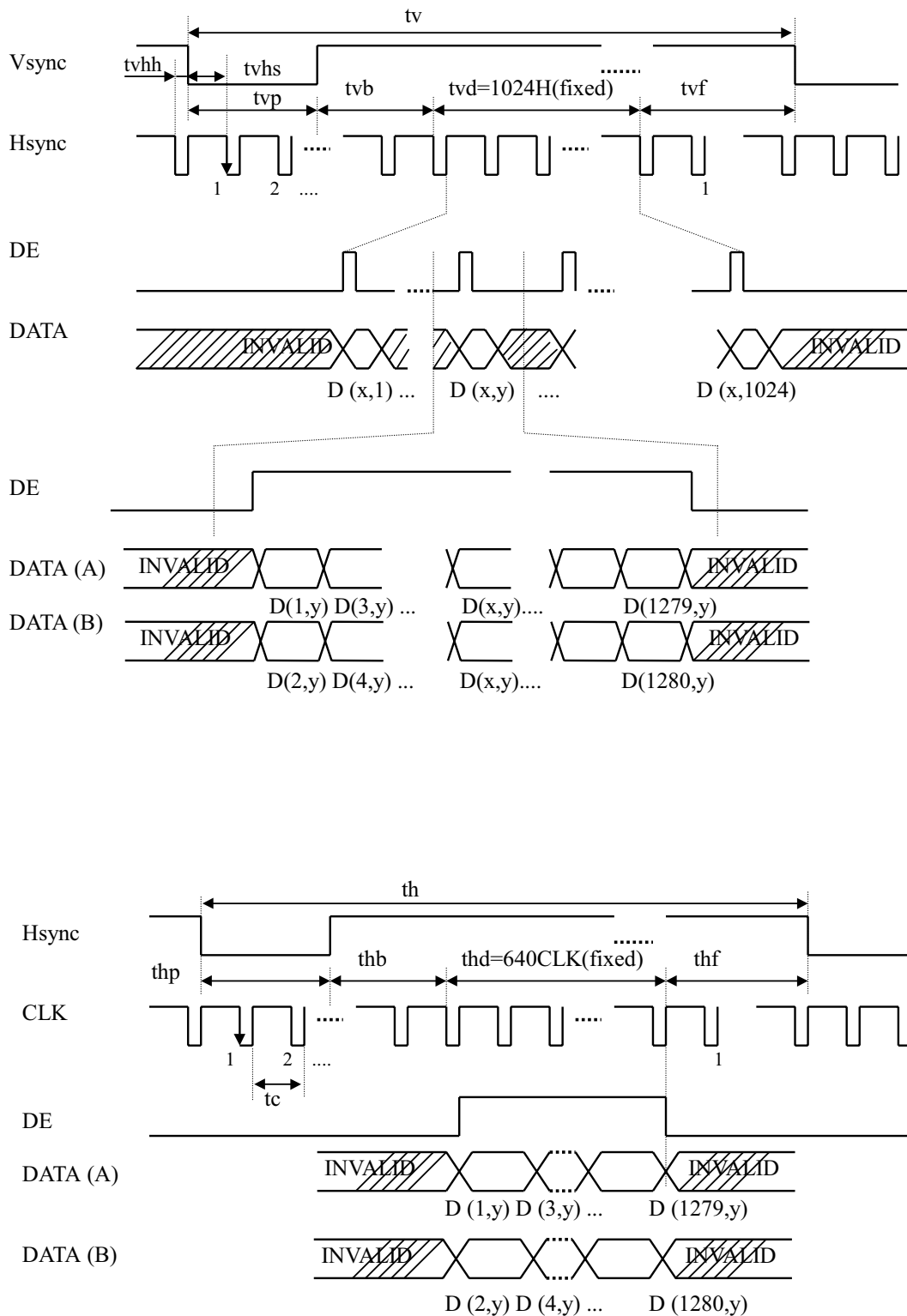
Note1: DATA (A): RA0-RA7, GA0-GA7, BA0-BA7
        DATA (B): RB0-RBA7, GB0-GB7, BB0-BB7

CLK

tc

tch tcl

VIH*
VIL*

tcrf tcrf

ts th

DATA
(RA0-RA7)
(GA0-GA7)
(BA0-BA7)
(RB0-RB7)
(GB0-GB7)
(BB0-BB7)

INVALID

VIH*
VIL*

1

640

INVALID

trf trf

th ts

th ts

DE

VIH*
VIL*

trf

trf

CLK

VIH*
VIL*

th ts

Hsync, Vsync

VIH*
VIL*

trf

∗ VIH, VIL: Refer to LVDS transmitter specifications.

(3) Display positions of input data

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

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

| RA | GA | BA | RB | GB | BB |

D(1, 1)	D(2,1)	•••	D(1280,1)
D(1,2)	D(2, 2)	•••	D(1280,2)
· · · · · ·	· · · · · ·	· · · · · ·	· · · · · ·
D(1,1024)	D(2,1024)	•••	D(1280,1024)

15. OPTICAL CHARACTERISTICS

(Ta = 25°C, VDD= 12V, VDDB=12V, Note1)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Contrast ratio	CR	Note 3	200	300	-	-	Note 2
Luminance	Lumax	Note 3	180	240	-	cd/m^2	-
Luminance uniformity	-	Max. / Min., Note 3	-	1.1	1.3	-	Note 6

Reference data

(Ta = 25°C, VDD= 12V, VDDB=12V, Note1)

Parameter		Symbol	Condition			Min.	Typ.	Max.	Units	Remarks
Color gamut		C	To NTSC			50	60	-	%	Note 3
Chromaticity Coordinates		W	White (x, y)			-	0.300, 0.315	-	-	-
		R	Red (x, y)			-	0.609, 0.346	-	-	
		G	Green (x, y)			-	0.300, 0.597	-	-	
		B	Blue (x, y)			-	0.145, 0.097	-	-	
Viewing Angle Range (CR>10)	Horizontal	θx+	CR>10, θy = ±0°			70	85	-	Deg.	Note 4
		θx-				70	85	-	Deg.	
	Vertical	θy+	CR>10, θx = ±0°			70	85	-	Deg.	
		θy-				70	85	-	Deg.	
Response time (Module front surface temperature = 33.9°C)		Ton	White to black	10% → 90%		-	15	25	ms	Note 5
		Toff	Black to white	90% → 10%		-	14	25		
Luminance control range		-	Maximum luminannce:100%			-	30 to 100	-	-	%

Note1: Measurement conditions

Optical characteristics are measured after 20minutes from lighting the backlight with all pixels in white, in the dark room. The typical value is measured after luminance saturation.
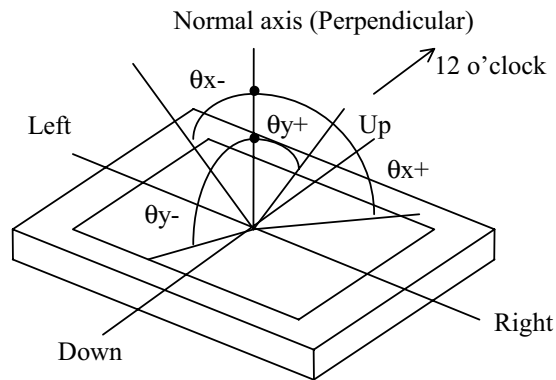
Display mode: 60Hz
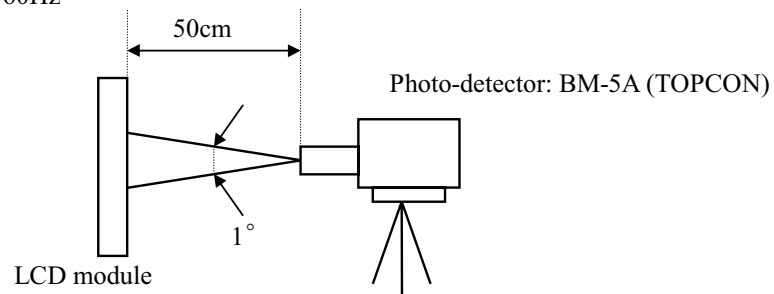
Note2: The contrast ratio is calculated by using the following formula.

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

Note3: Viewing angle is θx = ±0°, θy = ±0° and at center.

Note4: Definitions of viewing angle are as follows

Normal axis (Perpendicular)

θx-

12 o'clock

Left

θy+ Up

θx+

θy-

Right

Down

Note5: Definitions of response time is as follows.

Response time is measured by photo-detector's out put level, when the luminance change "white" to "black", or "black" to "white" on the same screen point. Ton is the time it takes the luminance to go from 10% on condition to 90% on condition. Toff is the reverse of Ton. (See the following diagram.)

100%
White
90%

Luminance

10%
Black
0%

Ton

Toff
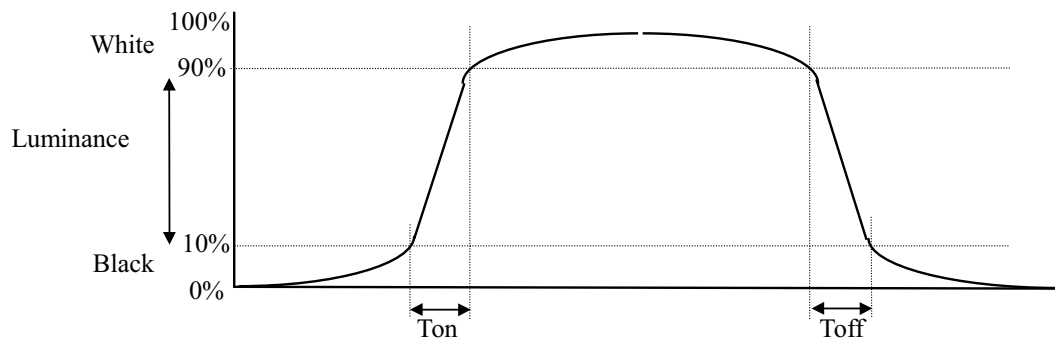
Note6: Luminance uniformity is calculated by using the following formula.

$$\text{Luminance uniformity} = \frac{\text{Maximum luminance}}{\text{Minimum luminance}}$$

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

Column

213   640   1067

①   ②   171

③   512

④   ⑤   853

Row
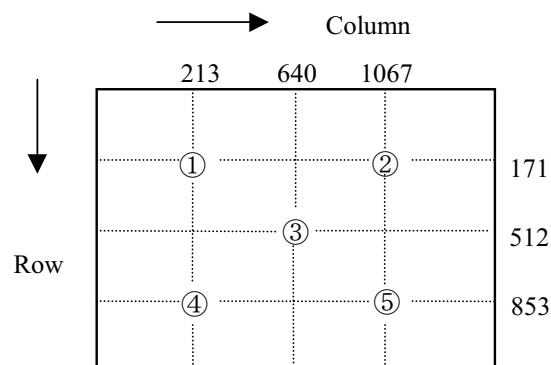
16. RELIABILITY TEST

Test item		Test condition	Judgment
High temperature / humidity operation		60±2°C, RH= 60% 240 hours, Display data is black.	Note 1
Heat cycle (operation)		① 0°C±3°C --- 1 hour 55°C±3°C --- 1 hour ② 50 cycles , 4 hours / cycle ③ Display data is black.	Note 1
Thermal shock (non-operation)		① -20°C±3°C --- 30 minutes 60°C±3°C --- 30 minutes ② 100 cycles ③ Temperature transition time is within 5 minutes.	Note 1

Vibration (non-operation)		① 5-100Hz, 11.76m/s^2
		   1 minute / cycle,
		   X,Y,Z direction
		② 10 times each direction
			Note 1
			Note 2

Mechanical shock (non-operation)		① 294 m/s^2 , 11ms X,Y,Z direction ② 3 times each direction	Note 1 Note 2
ESD (operation)		150pF, 150Ω, ±10kV 9 places on a panel Note 3 10 times each place at one-second intervals	Note 1
Dust (operation)		15 kinds of dust (JIS-Z 8901) Hourly 15 seconds stir, 8 times repeat	Note 1
Low pressure	operation	15 kPa 0°C±3°C --- 24 hours 55°C±3°C --- 24 hours	Note 1
	non-operation	53.3 kPa -20°C±3°C --- 24 hours -60°C±3°C --- 24 hours	

Note1: No display malfunctions (Display functions are checked under the same conditions as out-going inspection.)
Note2: No physical damages
Note3: See the following figure for discharge points
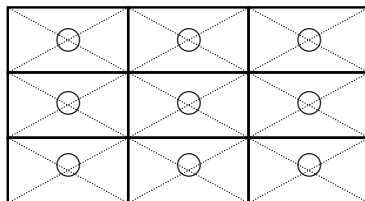
17. PRECAUTIONS

17.1 MEANING OF CAUTION SIGNS

   The following caution signs have very important meaning. **Be sure to understand following contents, respectively.**

$\triangle$!CAUTION	This sign has a meaning that customer will be injured himself and/or the product will sustain a damage, if he makes a mistake in operations.

⚡	This sign has a meaning that customer will get an electric shock if he makes a mistake in operations.

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

17.2 CAUTIONS

⚡
   Do not touch HIGH VOLTAGE PART of the inverter while turn on. Customer will be in danger of an electric shock.

✎
   ∗ Pay attention to handling for the working backlight. It may be over 35°C from ambient temperature.
   ∗ Do not shock and press the LCD panel and the backlight. There will be in danger of breaking, because there are made of glass. (Shock: To be not greater 294m/s² (30G) ,11ms, Pressure: To be not greater 19.6N (2kgf))

17.3 ATTENTIONS
   (1) Attentions to handling the product
      ① When customer pulls out products from carton box, take hold of both ends without touch the circuit board. If you touch it, products may be broken down and/or out of adjustment, because of stress to mounting parts.
      ② If customer places products temporarily, turn down the display side and place on a flat table.
      ③ Handle products with care and below 200V (e.g. Decrease with earth band, ionic shower, etc.), because electrostatic may be damaged products (LCD modules).
      ④ The torque for mounting screws should never exceed 0.45N·m (4.4kgf·cm). Over torque may cause mechanical damage to the product.
      ⑤ Do not press or friction, because LCD panel surface is sensitive. If customers will clean the product surface, NEC Corporation will recommend using the cloth with ethanolic liquid.
      ⑥ Do not push-pull the interface connectors while turn on, because wrong power sequence may break down the product.
      ⑦ Connection cables such as flexible cable, etc., are danger of damage. Do not hook cables nor pull them.

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

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

(5) Other attentions
① Do not disassemble a product and/or adjust volume.
② If customer would like to replace backlight lamps, see 'REPLACEMENT MANUAL FOR BACKLIGHT'.
③ If customer use screwnails, pay attention not to insert waste materials in inside of products.
④ When customer returns product for repair, etc., pack it with original shipping package because of avoidance of some damages during transportation.
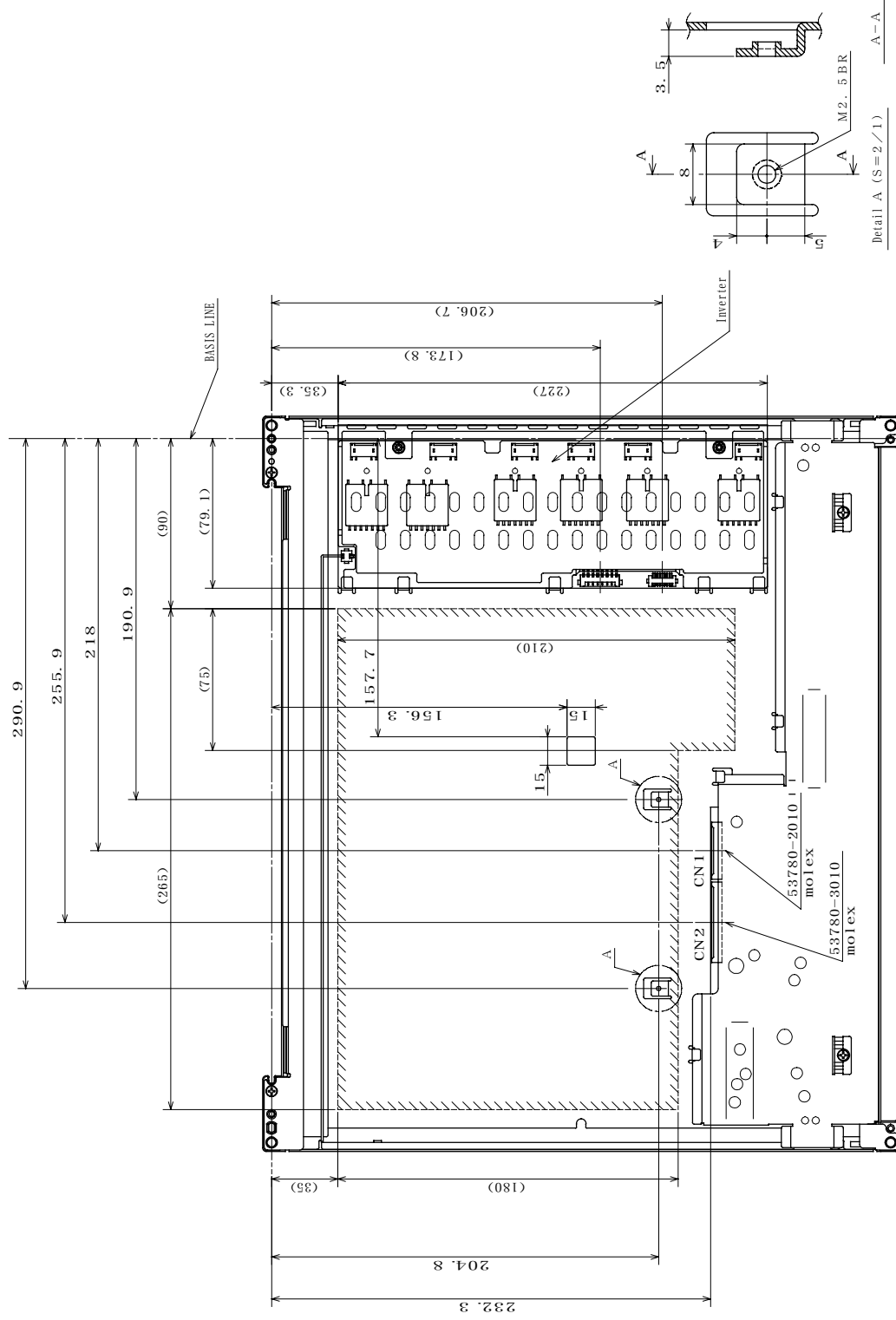

General specifications for the liquid crystal display (LCD)
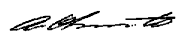**The following items are neither defects nor failures.**

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

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18. OUTLINE DRAWINGS (Unit: mm)
18.1 Front view

4－φ4.6

327.6±0.3
317.2±1.0
292.2±0.3 (BEZEL OPENING)
(287.232 (DISPLAY AREA))

10±0.3

5.2
17.7±0.3
(20.18)

φ3.1 +0.2 −0
7
11.8

11.5

4
23.45
25.9

3 +0 −0.2

364.0±0.3 (BEZEL OPENING)
(359.04 (DISPLAY AREA))

364.65±0.3
379.4±0.3
389.0±1.0

BASIS LINE

30.3±1.0
5.1±0.2
3

(23)

11.5

3 +0 −0.2
4
25
27.45

φ4.5±0.2
3 +0 −0.2
2−R1.55

26MAX

(23)

Note1: The torque for mounting screws should never exceed **0.45N·m**.
Note2: Tolerances of dimensions not shown is **±0.5mm**.

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18.2 Rear view

BASIS LINE

(206.7)

(173.8)

(35.3)

(227)

Inverter

(90)

(79.1)

290.9

255.9

218

190.9

(75)

157.7

(210)

156.3

15

15

(265)

A

A

CN1

CN2

53780-2010
molex

53780-3010
molex

(35)

(180)

204.8

232.3

Note1: The torque for mounting screws should never exceed 0.45N·m.
Note2: Tolerances of dimensions not shown is ±0.5mm.

3.5

8

M2.5 BR

A

A

A

A

Detail A (S=2/1)

A－A

		Revision History	DOD-M-0226	28/28
Rev.	**Prepared date**	**Revision contents and approval**		**Signature of writer**

1st edition	Mar. 14, 2001	DOD-M-0214
		  Preliminary specifications → Data sheet
		
		  The inside of this document is revised the clerical error and unclear expression in previous one.
		  The important changes such as specifications, characteristics and functions are as follows.
		
		P5: Replaceable parts
		  · Backlight unit: TBD → 181LHS07
		  · Inverter: TBD → 181PW051
		P7: ABSOLUTE MAXIMUM RATINGS
		  · Operating Altitude: ≤ 13,600 → ≤ 4,850
		  · Storage Altitude: ≤ 4,850 → ≤ 13,600
		P8: (2)Backlight
		  Add "BRTL input current (IiB3)" specification
		P13: (2)Connector for backlight unit, CN202
		  Pin No.2: N.C. → GNDB
				Approved by
				
				  A.Okamoto
				Checked by
				
				_____
				
				_____
				Prepared by
				
				  N.Kano

2nd edition	Mar. 27, 2001	DOD-M-0226
		P7 Operation temperature
		  Top2: 60°C → 66°C
		P9 Note7 is deleted.
		P14 External pulse control for luminance
		  Input voltage-ViBH1: 5.25VMAX. → 5.0VMAX.
		P24 Attentions
		  (1) ④0.39 N·m → 0.45N·m
				Approved by
				
				_____
				
				Checked by
				
				_____
				
				_____
				
				Prepared by
				
				R. Kawashima