



SmarterGlass

state-of-the-art display solutions

www.smarterglass.com
978 997 4104
sales@smarterglass.com

NEC

TFT COLOR LCD MODULE

NL128102AC28-07

46cm (18.1 Type)

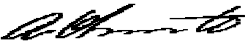
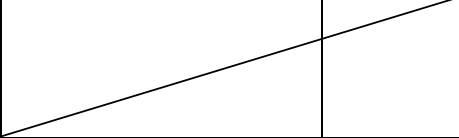

SXGA

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		Mar. 27, 2001
Checked		
Prepared		
		Mar. 27, 2001

INTRODUCTION

No part of this SPECIFICATIONS shall be copied in any form or by any means without the prior written consent of NEC Corporation.

NEC Corporation does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from use of a product described herein or any other liability arising from use of such application. No license, express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Corporation or of others.

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	P4
2. FEATURES	P4
3. APPLICATIONS	P4
4. STRUCTURE AND FUNCTION	P4
5. OUTLINE OF CHARACTERISTICS (at room temperature)	P5
6. BLOCK DIAGRAM	P6
7. GENERAL SPECIFICATIONS	P7
8. ABSOLUTE MAXIMUM RATINGS	P7
9. ELECTRICAL CHARACTERISTICS	P7
10. SUPPLY VOLTAGE SEQUENCE	P9
11. INTERFACE PIN CONNECTIONS	P11
12. METHOD OF CONNECTION FOR THC63LVDM83A	P15
13. DISPLAY COLORS vs. INPUT DATA SIGNALS	P16
14. INPUT SIGNAL TIMINGS	P17
15. OPTICAL CHARACTERISTICS	P21
16. RELIABILITY TEST	P23
17. GENERAL CAUTIONS	P24
18. OUTLINE DRAWINGS	P26
18.1 FRONT VIEW	P26
18.2 REAR VIEW	P27

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.

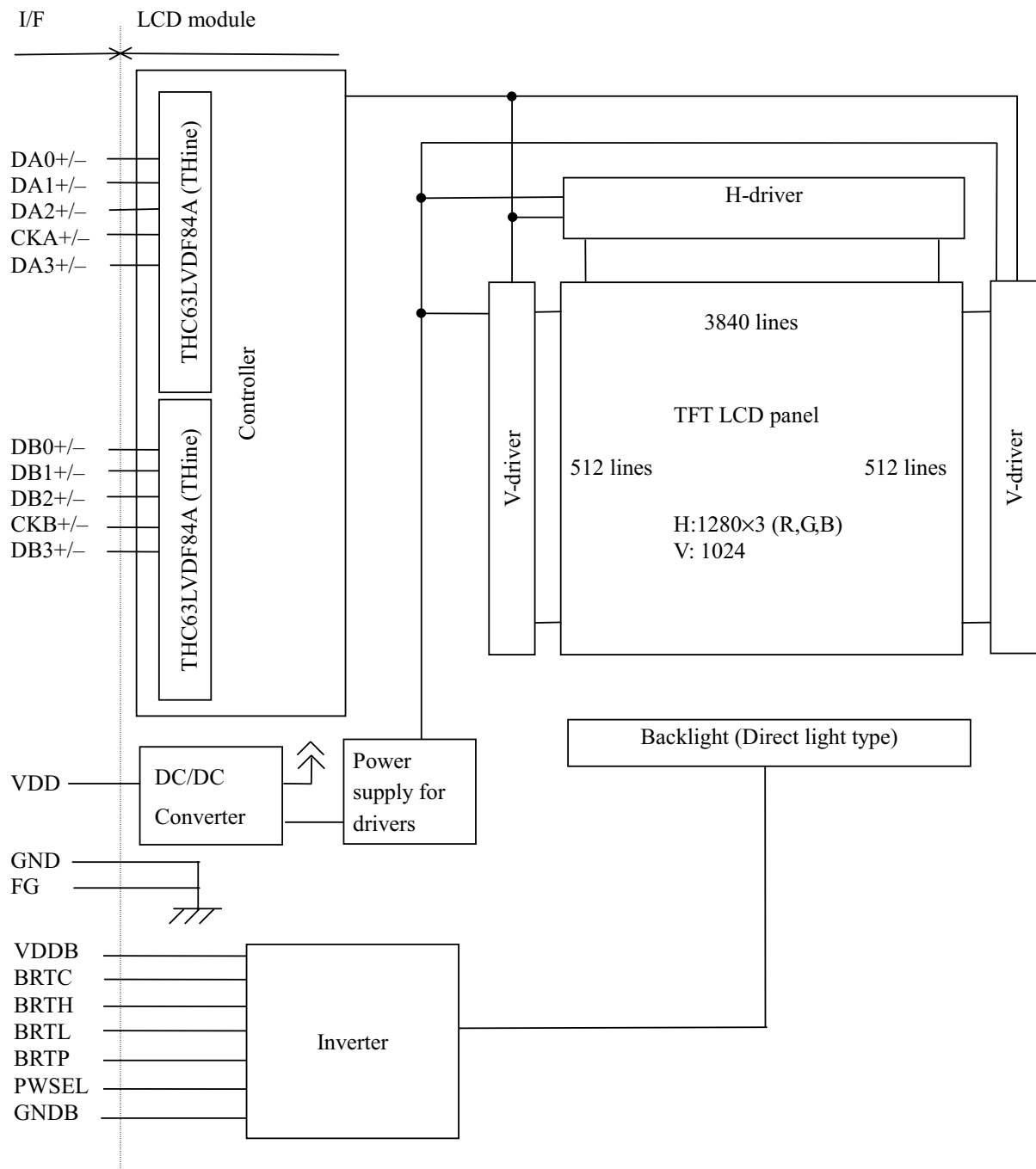
RGB (red, green, blue) data signals from a source system are modulated into a form suitable for active matrix addressing by the onboard signal processor and sent to the driver LSIs which in turn addresses the individual TFT cells.

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) × 287.232 (V) mm
Drive system	a-Si TFT active matrix
Display colors	16,777,216 colors
Number of pixels	1280 (H) × 1024 (V)
Pixel arrangement	RGB vertical stripe
Pixel pitch	0.2805 (H) × 0.2805 (V) mm
Module size	389.0 (Typ., H) × 317.2 (Typ., V) × 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)	<ul style="list-style-type: none"> · Horizontal : 85 ° (Typ., left side, right side) · Vertical : 85 ° (Typ., up side, down side)
Designed viewing direction	<ul style="list-style-type: none"> · Optimum gray-scale ($\gamma=2.2$): 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 × 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] <ul style="list-style-type: none"> · Backlight unit: 181LHS07 · Inverter: 181PW051
Power consumption	38.7 W (Typ.)

6. BLOCK DIAGRAM



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
	VDDDB	-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 VDDDB= 12V
BRTL input voltage (BRTL)	ViB3	-0.3 to +1.5		
Storage temperature	Tst	-20 to +60	°C	-
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/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: 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

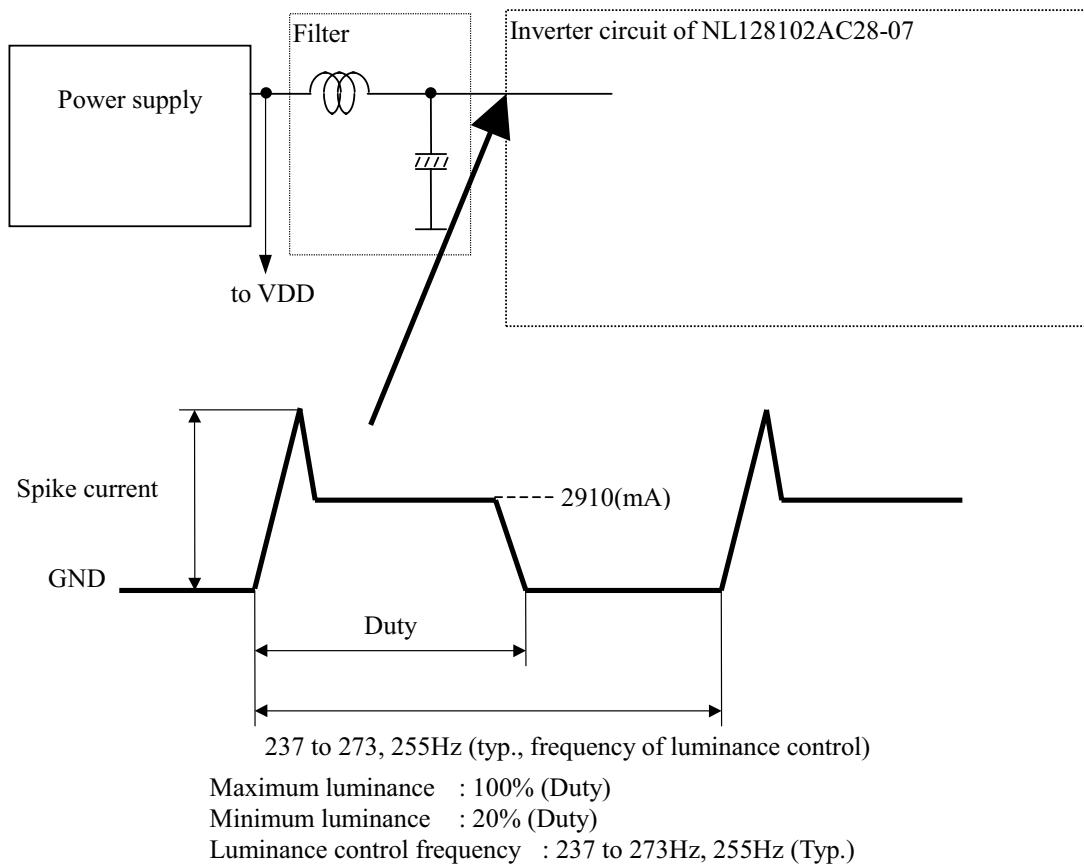
Note2: Checker flag pattern (in EIAJ ED-2522)

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	-	-	μ A	for BRTP
Logic input "H" current	IiBH1	-	-	3500	μ A	
Logic input "L" current	IiBL2	-810	-	-	μ A	for BRTC, PWSEL
Logic input "H" current	IiBH2	-	-	440	μ A	
BRTL input current	IiB3	-130	-	-	μ A	for BRTL
Supply current	IDDB	-	2910	3500	MA	VDDB=12.0V (at Max. luminance)

(3) Inverter current wave

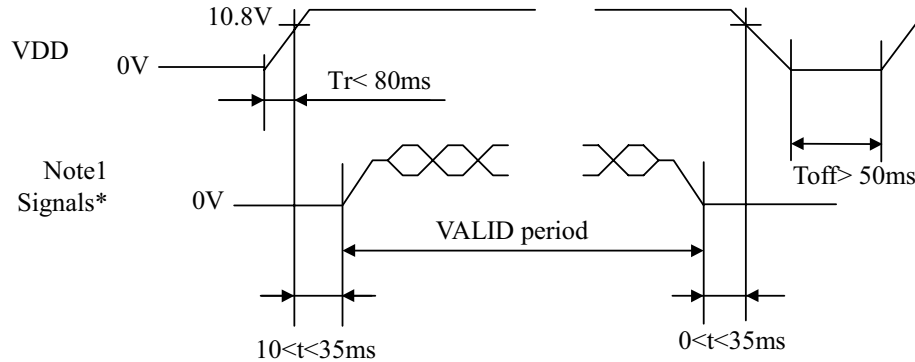


Note1: The power supply lines (VDDB and GNDB) have large ripple voltage while dimming. There is the possibility that the ripple voltage produce an acoustic noise and signal wave noise in a system circuit (e.g. audio circuit). If the noise occurred in a system circuit, put an aluminum electrolytic capacitor (5,000 to 6,000 μ F) between the power source lines (VDDB and GNDB), and the capacitor will be able to reduce the noise.

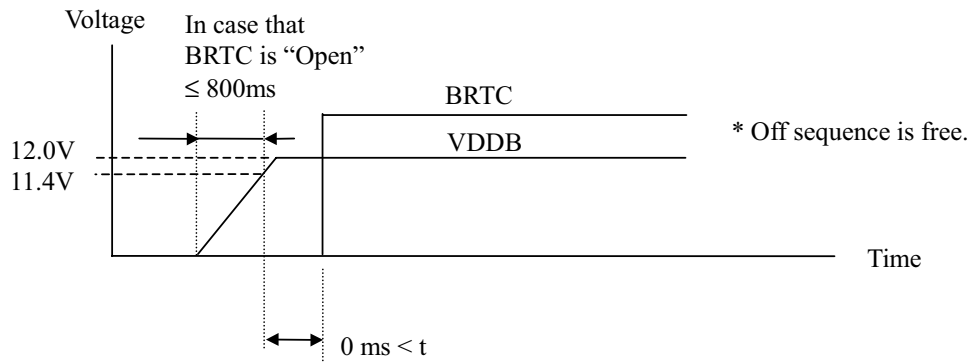
Note2: Luminance control frequency indicate the input pulse frequency, when select the external signaling luminance control. See '11.INTERFACE PIN FUNCTIONS (4) External pulse control for luminance '.

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 $100\ \Omega$.

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.

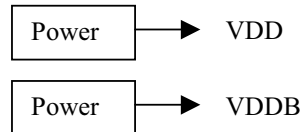
(2) Ripple of supply voltage

Supply voltage	VDD (for logic and LCD driver)	VDDDB (for backlight)
Acceptable level	$\leq 100 \text{ mV p-p}$	$\leq 200 \text{ mV p-p}$

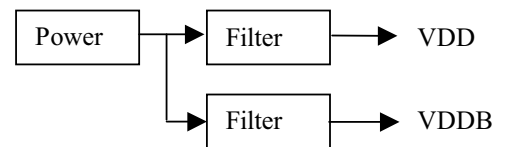
Note1: The acceptable level of ripple voltage includes spike noise.

Example of the power supply connection

a) Separate the power supplies



b) Put in the filters



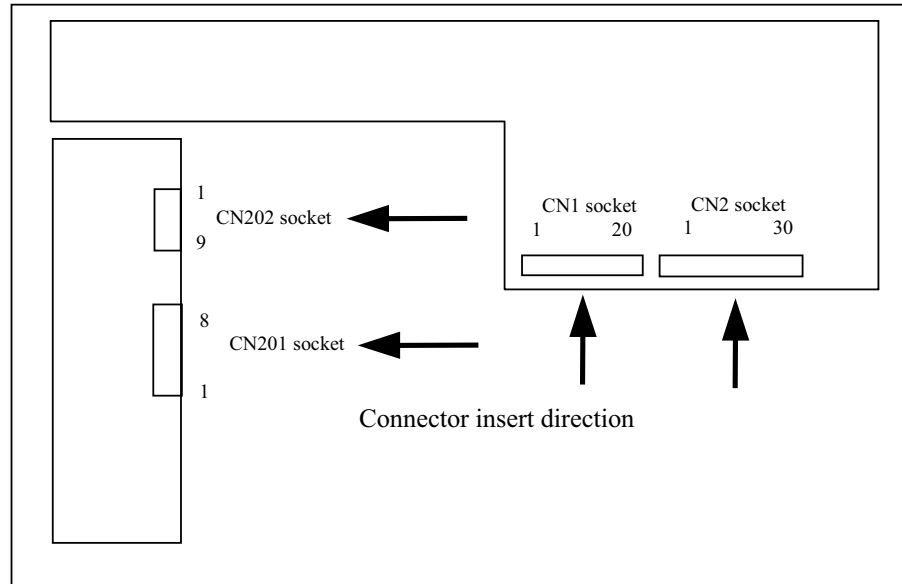
(3) This product has fuses listed below. Check and evaluate power supplies of customer's system..

	Type name	Supplier	Rating
VDD	ICP-S1.8	ROHM	1.8A
VDDDB	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	VDDDB	12V power supply	+12V \pm 10%
6	VDDDB		
7	VDDDB		
8	VDDDB		

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)	-

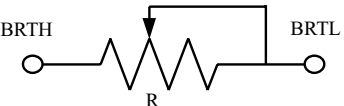
Note1: GNDB should be connected to system ground in customer equipment.

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	<p>The variable resistor for luminance control should be 10kΩ type, and zero point of the resistor corresponds to the minimum of luminance.</p>  <p>Max. luminance (100%): R=10kΩ Min. luminance (30%): R=0Ω Mating variable resistor: 10kΩ \pm5%, B curve, 1/10W</p>	"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.

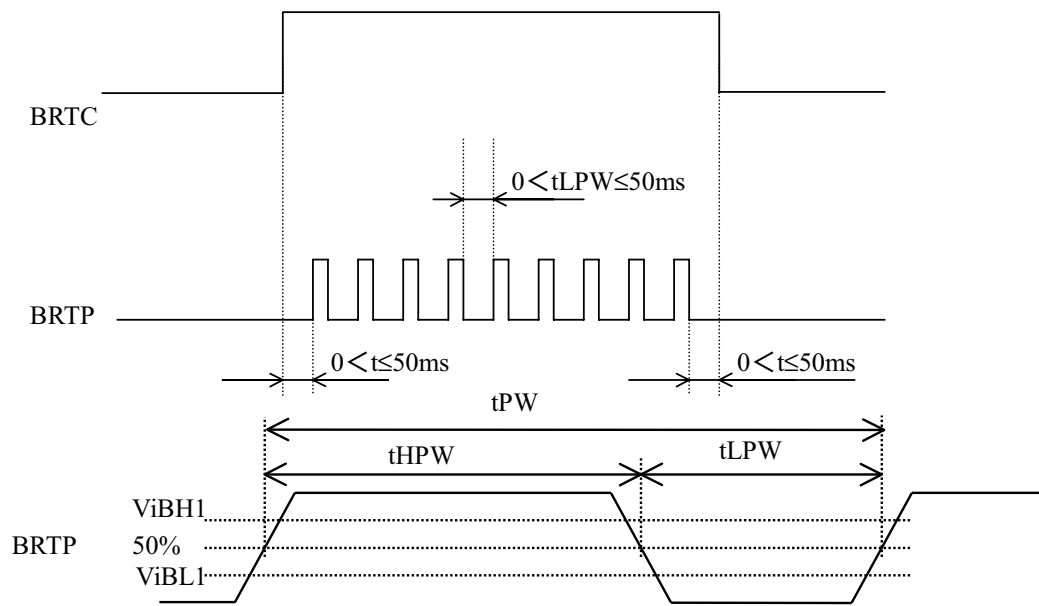
(4) External pulse control for luminance

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.



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.

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

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

		TRANSMITTER				I/F CN		RECIEVER				INPUT to LCD
		pin	THC63LVDF83A	pin	pin	CN1	pin	THC63LVDF84A	pin			
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
Note1	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						RD3	42	GA1	
	BA0	16	TD4						RD4	49	BA0	
	BA1	18	TD5						RD5	50	BA1	
	RSVD	25	TD6						RD6	2	RSVD	
	CLK	31	CLKIN						CLKOUT	26	CLKA	
	Even pixel data	RB2	51	TA0		pin	CN2			RA0	27	RB2
		RB3	52	TA1		1	N.C.			RA1	29	RB3
		RB4	54	TA2		2	N.C.			RA2	30	RB4
RB5		55	TA3		3	GND			RA3	32	RB5	
RB6		56	TA4	TA	48	4	GND		RA4	33	RB6	
RB7		3	TA5	TA+	47	5	DB0	9	RA	RA4	33	RB7
GB2		4	TA6			6	DB0+	10	RA+	RA5	35	GB2
GB3		6	TB0	TB	46	7	GND		RA6	37	GB2	
GB4		7	TB1	TB+	45	8	DB1	11	RB	RB0	38	GB3
GB5		11	TB2			9	DB1+	12	RB+	RB1	39	GB4
GB6		12	TB3	TC	42	10	GND		RB2	43	GB5	
GB7		14	TB4	TC+	41	11	DB2	15	RC	RB3	45	GB6
BB2		15	TB5			12	DB2+	16	RC+	RB4	46	GB7
BB3		19	TB6	TCLK	40	13	GND		RB5	47	BB2	
BB4		20	TC0	TCLK+	39	14	CKB	17	RCLK	RB6	51	BB3
BB5		22	TC1			15	CKB+	18	RCLK+	RC0	53	BB4
BB6		23	TC2	TD	38	16	GND		RC1	54	BB5	
BB7		24	TC3	TD+	37	17	DB3	19	RD	RC2	55	BB6
RSVD		27	TC4			18	DB3+	20	RD+	RC3	1	BB7
RSVD		28	TC5			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	
	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.

Use 100Ω twist pair wires for the Cable.

Note1: RSVD must connect to system GND.

13. DISPLAY COLORS vs. INPUT DATA SIGNALS

[illegible]

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		trf				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	Note 1			ns	—
	CLK-DATA (Hold)		th				ns	—
	Rise, fall		trf				ns	—

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

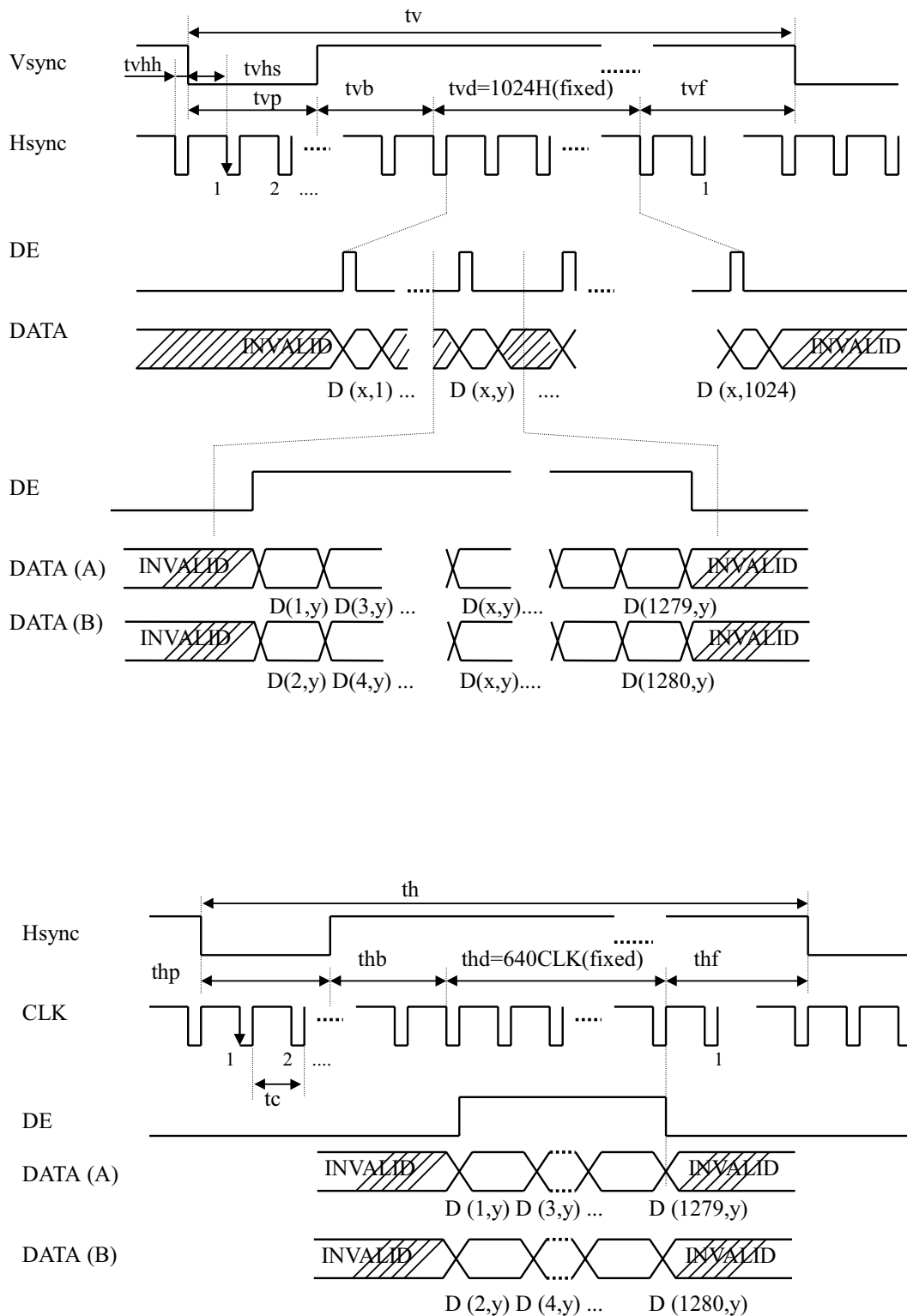
THC63LVDF83A (THine) or equivalent products are recommended for LVDS transmitter.

Note 2: Both of “time” and “CLK number” of the “th” must keep the Minimum value of specification.

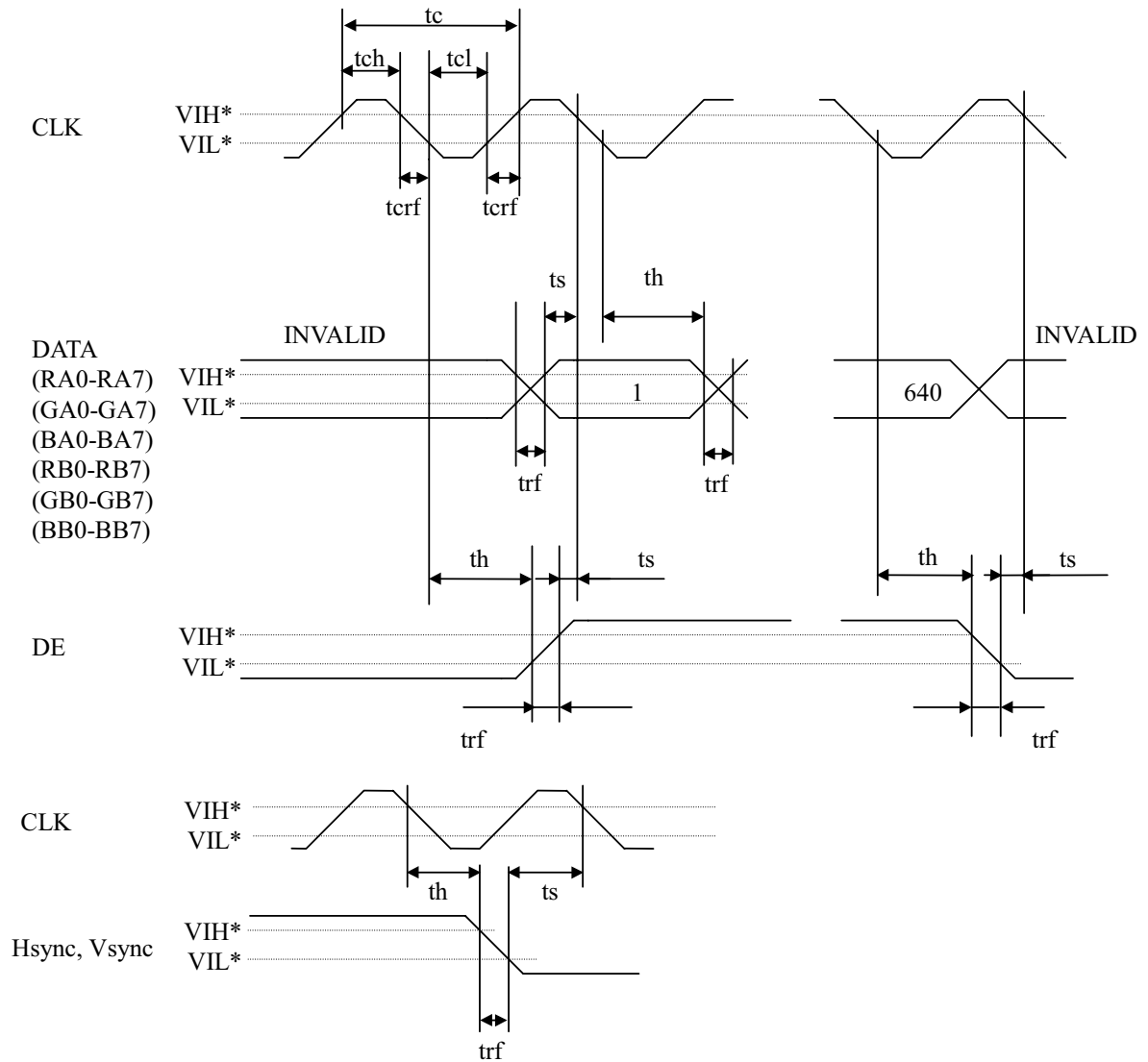
Note 3: During operation, fluctuation of Hsync period must not exceed ± 1 CLK. Otherwise function errors will occur in LCD module.

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



* V_{IH} , V_{IL} : Refer to LVDS transmitter specifications.

(3) Display positions of input data

Odd Pixel: RA= R DATA

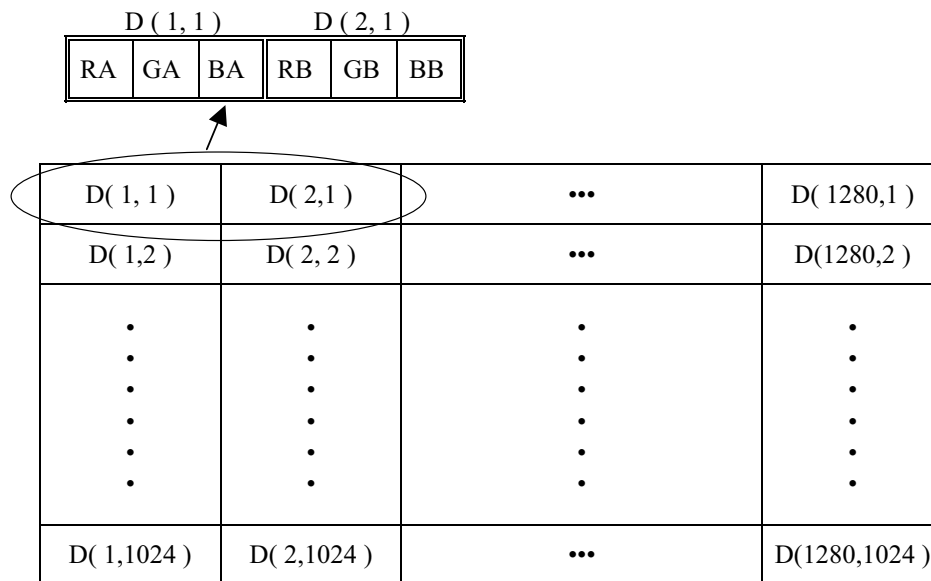
Even Pixel : RB=R DATA

Odd Pixel: GA= G DATA

Even Pixel : GB=G DATA

Odd Pixel: BA= B DATA

Even Pixel : BB=B DATA



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

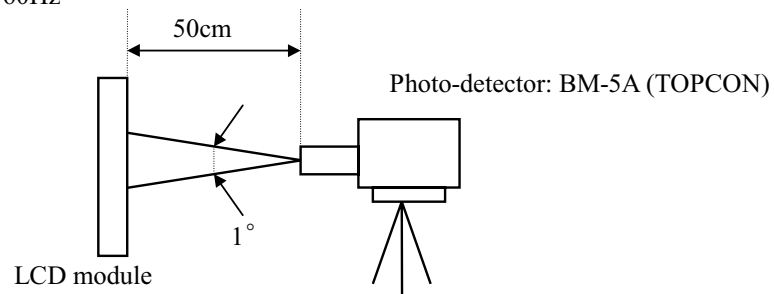
(Ta = 25°C, VDD= 12V, VDDB=12V, Note1)

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

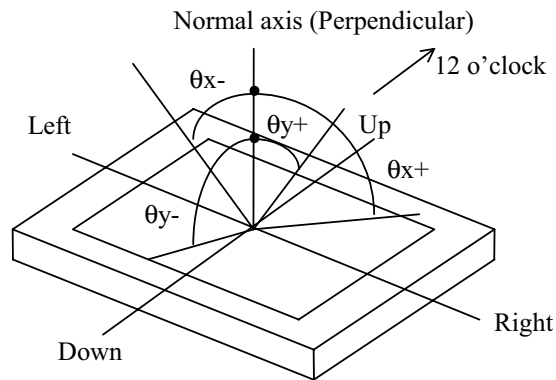


Note2: The contrast ratio is calculated by using the following formula.

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

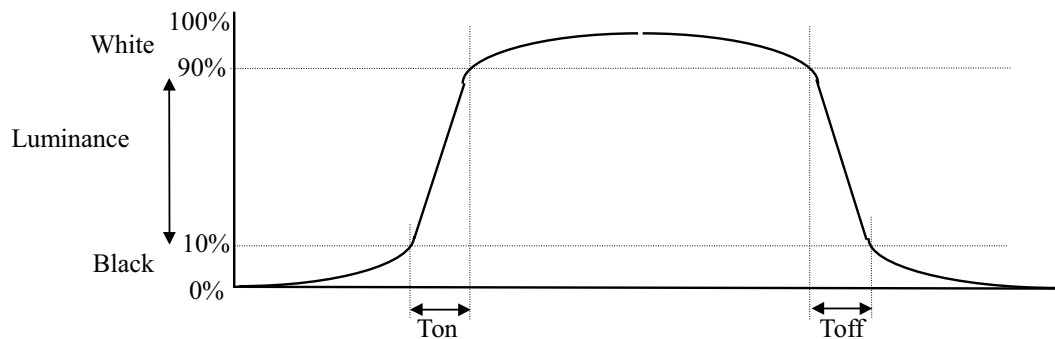
Note3: Viewing angle is $\theta_x = \pm 0^\circ$, $\theta_y = \pm 0^\circ$ and at center.

Note4: Definitions of viewing angle are as follows



Note5: Definitions of response time is as follows.

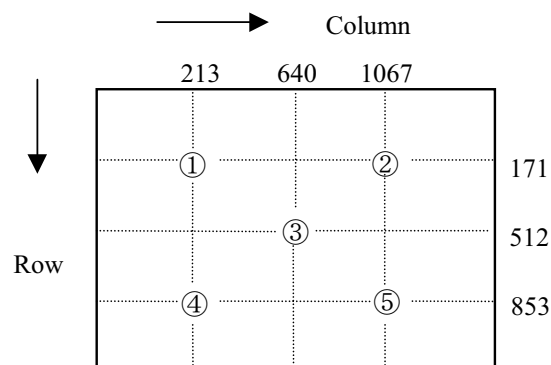
Response time is measured by photo-detector's out put level, when the luminance change "white" to "black", or "black" to "white" on the same screen point. Ton is the time it takes the luminance to go from 10% on condition to 90% on condition. Toff is the reverse of Ton. (See the following diagram.)



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.



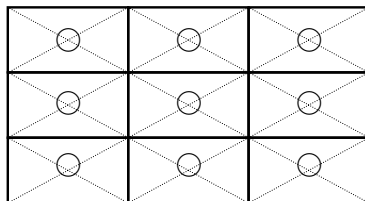
16. RELIABILITY TEST

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 outgoing 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.**



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

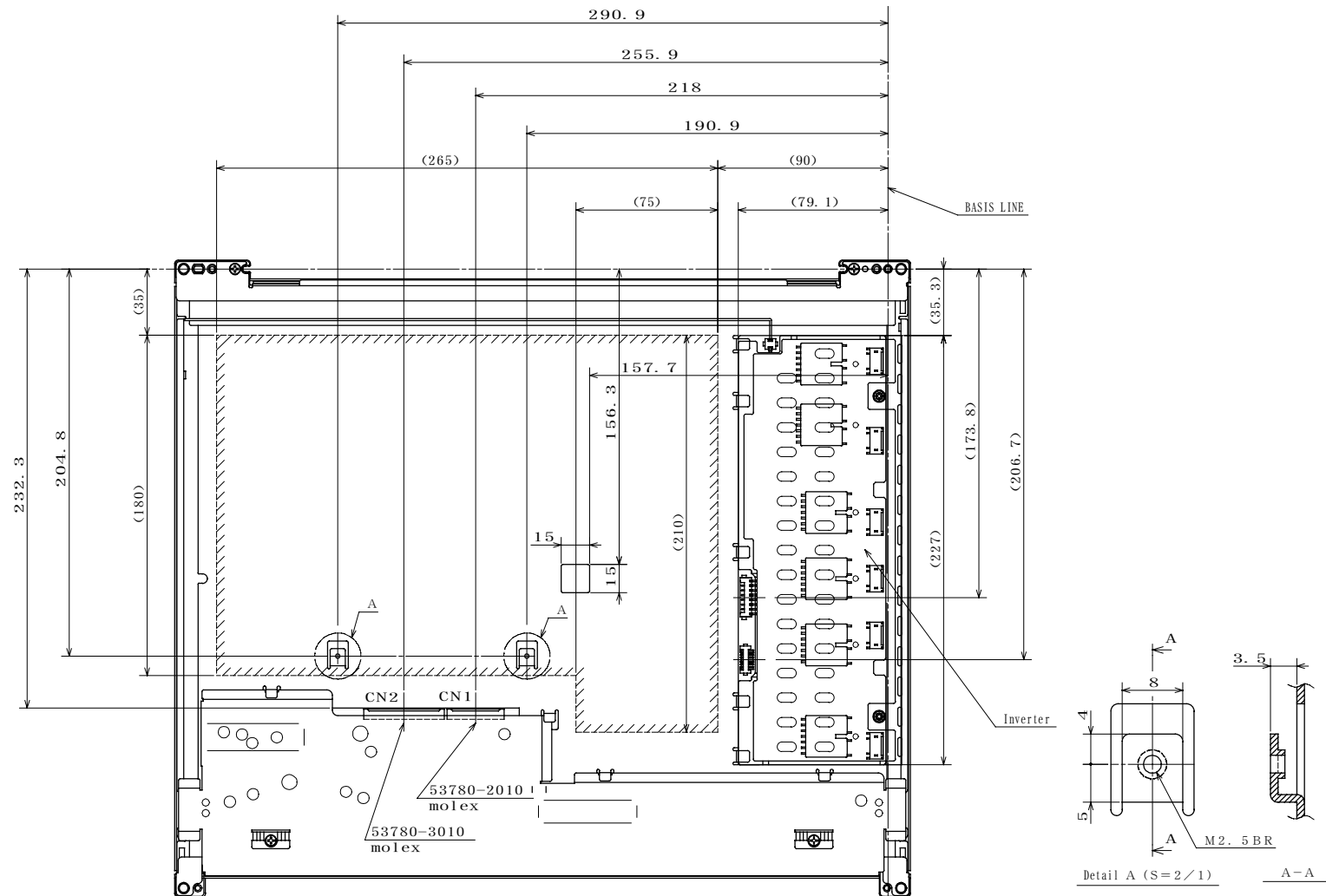
- ① Do not disassemble a product and/or adjust volume.
- ② If customer would like to replace backlight lamps, see 'REPLACEMENT MANUAL FOR BACKLIGHT'.
- ③ If customer use screwdrivers, pay attention not to insert waste materials in inside of products.
- ④ When customer returns product for repair, etc., 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.

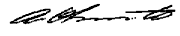
- * Response time, luminance and color gamut may be changed by ambient temperature.**
- * The LCD may be seemed luminance uniformity, flicker, vertical seam and/or small spot by display patterns.**
- * Optical characteristics (e.g. luminance, display uniformity, etc.) gradually is going to change depending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

18.2 Rear view



Note1: The torque for mounting screws should never exceed $0.45\text{N}\cdot\text{m}$.

Note2: Tolerances of dimensions not shown is $\pm 0.5\text{mm}$.

Revision History			DOD-M-0226	28/28
Rev.	Prepared date	Revision contents and approval	Signature of writer	
1st edition	Mar. 14, 2001	<p>DOD-M-0214</p> <p>Preliminary specifications → Data sheet</p> <p>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.</p> <p>P5: Replaceable parts · Backlight unit: TBD → 181LHS07 · Inverter: TBD → 181PW051</p> <p>P7: ABSOLUTE MAXIMUM RATINGS · Operating Altitude: ≤ 13,600 → ≤ 4,850 · Storage Altitude: ≤ 4,850 → ≤ 13,600</p> <p>P8: (2)Backlight Add "BRTL input current (IiB3)" specification</p> <p>P13: (2)Connector for backlight unit, CN202 Pin No.2: N.C. → GNDB</p>	<p><i>Approved by</i></p> <p><u>A.Okamoto</u></p> <p><i>Checked by</i></p> <p>_____</p> <p><i>Prepared by</i></p> <p><u>N.Kano</u></p>	
2nd edition	Mar. 27, 2001	<p>DOD-M-0226</p> <p>P7 Operation temperature Top2: 60°C → 66°C</p> <p>P9 Note7 is deleted.</p> <p>P14 External pulse control for luminance Input voltage-ViBH1: 5.25VMAX. → 5.0VMAX.</p> <p>P24 Attentions (1) ④0.39 N·m → 0.45N·m</p>	<p><i>Approved by</i></p> <p><u></u></p> <p><i>Checked by</i></p> <p>_____</p> <p><i>Prepared by</i></p> <p><u>R. Kawashima</u></p>	