

**46 cm (18.1 inches), 1280 × 1024 pixels, 16,777,216 colors,  
LVDS interface, Ultra-wide viewing angle**

## DESCRIPTION

The NL128102AC28-07 is a TFT (thin film transistor) active-matrix color liquid crystal display (LCD) comprising an amorphous silicon TFT attached to each signal electrode, a driving circuit, and a backlight. The NL128102AC28-07 has a built-in backlight. Backlight includes long-life-lamps.

The 46 cm (18.1 inch) diagonal display area contains 1280 × 1024 pixels and can display 16,777,216 colors simultaneously.

## APPLICATIONS

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

## 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 (240 cd/m<sup>2</sup>, TYP.)
- Wide color gamut
- Small foot print
- Light weight
- Slim type
- 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)



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Please confirm with the delivery specification before statting to design the system.

## STRUCTURE AND PRINCIPLE

NL128102AC28-07 module is composed of the driver LSIs for driving the TFT (Thin Film Transistor) array with an amorphous silicon thin film transistor liquid crystal display (a-Si TFT LCD) panel structure and a backlight.

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

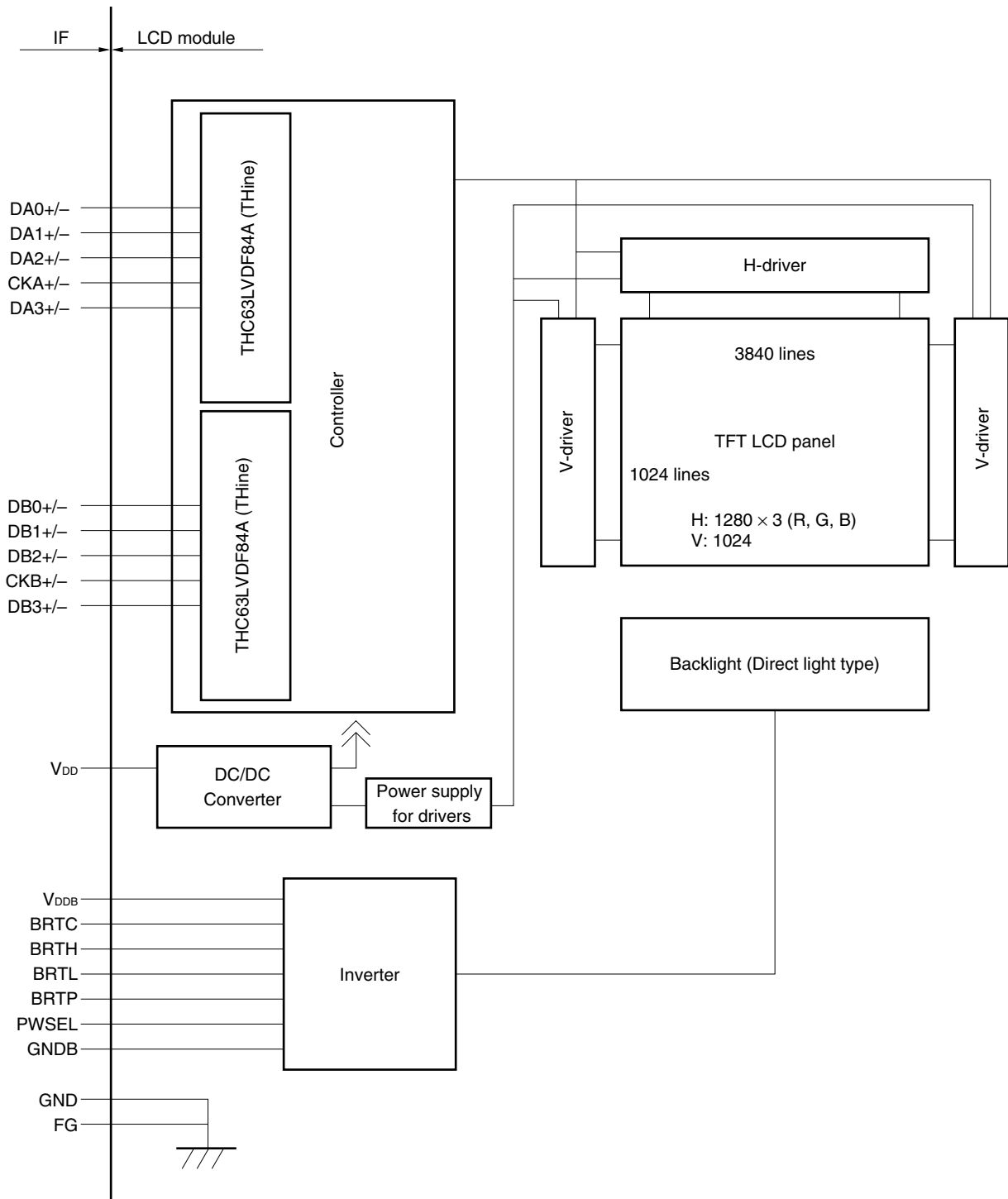
RGB (Red, Green, Blue) data signals from a source system are modulated into a form suitable for active matrix addressing by the onboard signal processor and sent to the driver LSIs which in turn address the individual TFT cells.

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

## GENERAL SPECIFICATION

Display area	359.04 (H) × 287.232 (V) mm
Diagonal size of display	46 cm (18.1 inches)
Drive system	a-Si TFT active matrix
Display color	16,777,216 colors
Number of pixels	1280 (H) × 1024 (V)
Pixel arrangement	RGB (Red, Green, Blue) vertical stripe
Dot pitch	0.0935 (H) × 0.2805 (V) mm
Pixel pitch	0.2805 (H) × 0.2805 (V) mm
Module size	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"> <li>• Horizontal: 85° (Typ., left side, right side)</li> <li>• Vertical: 85° (Typ., up side, down side)</li> </ul>
Designed viewing direction	<ul style="list-style-type: none"> <li>• Optimum grayscale (<math>\gamma = 2.2</math>): perpendicular</li> </ul>
Color gamut	60% (Typ.) At center, to NTSC
Response time	15 ms (Typ.), black (10%) to white (90%)
Luminance	240 cd/m <sup>2</sup> (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 voltages	12 V (for Logic, LCD driving) 12 V (for Backlight inverter)
Backlight	Direct light type: 12 cold cathode fluorescent lamps and an inverter [Replaceable parts] <ul style="list-style-type: none"> <li>• Backlight unit: type No. 181LHS07</li> <li>• Inverter: type No. 181PW051</li> </ul>
Power consumption	38.7 W (Typ.)

**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.

## DETAILED SPECIFICATION

Item	Contents	Unit
Module size	389.0±1.0 (H) × 317.2*±1.0 (V) × 30.3±1.0 (D)	mm
Display area	359.04 (H) × 287.232 (V)	mm
Number of dots	1,280 × 3 (H) × 1024 (V)	dots
Pixel pitch	0.2805 (H) × 0.2805 (V)	mm
Dot pitch	0.0935 (H) × 0.2805 (V)	mm
Pixel arrangement	RGB (Red, Green, Blue) vertical stripe	–
Display colors	16,777,216	colors
Weight	1650 (Typ.), 1750 (Max.)	g

\* Exclude the mounting space

## ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit	Remarks
Supply voltage	V <sub>DD</sub>	–0.3 to +14	V	Ta = 25°C
	V <sub>DDB</sub>	–0.3 to +14		
LVDS input voltage (LCD)	V <sub>i</sub>	–0.3 to +3.6	V	Ta = 25°C V <sub>DD</sub> = 12 V
Logic input voltage (BRTC, BRTP, PWSEL)	V <sub>iB1,2</sub>	–0.3 to +5.5		Ta = 25°C V <sub>DDB</sub> = 12 V
BRTL input voltage (BRTL)	V <sub>iB3</sub>	–0.3 to +1.5		
Storage temperature	T <sub>st</sub>	–20 to +60	°C	–
Operating temperature	Top1	0 to +55		Module front surface <b>Note 1</b>
	Top2	0 to +66		Module rear surface <b>Note 2</b>
Relative humidity (RH)	<b>Note 3</b>	≤ 95	%	Ta ≤ 40 °C
		≤ 85		40°C < Ta ≤ 50°C
		≤ 70		50°C < Ta ≤ 55°C
Absolute humidity	<b>Note 3</b>	Absolute humidity shall not exceed Ta = 55°C, RH = 70%	g/m <sup>3</sup>	Ta > 55°C
Operating altitude		≤ 4,850	m	0°C ≤ Ta ≤ 55°C
Storage altitude		≤ 13,600	m	–20°C ≤ Ta ≤ 60°C

**Note 1:** Measure at the surface of display area (including self-heat)

**Note 2:** Measure at the rear shield (including self-heat)

**Note 3:** No condensation

**ELECTRICAL CHARACTERISTICS**

(1) Logic/LCD driving

(Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	V <sub>DD</sub>	10.8	12.0	13.2	V	–
Ripple voltage	V <sub>RP</sub>	–	–	+100	mV	for V <sub>DD</sub>
Differential input (H) Threshold voltage	V <sub>TH</sub>	–	–	+100	mV	V <sub>CM</sub> = 1.2 V
Differential input (L) Threshold voltage	V <sub>TL</sub>	–100	–	–	mV	<b>Note 1</b>
Differential Input voltage	V <sub>I</sub>	0	–	2.4	V	–
Terminating resistor	R <sub>T</sub>	–	100	–	Ω	–
Supply current	I <sub>DD</sub>	–	315 <b>Note 2</b>	600 <b>Note 3</b>	mA	V <sub>DD</sub> = 12.0 V

**Note 1:** Common mode voltage in LVDS transmitter

**Note 2:** Checker flag pattern (in EIAJ ED-2522)

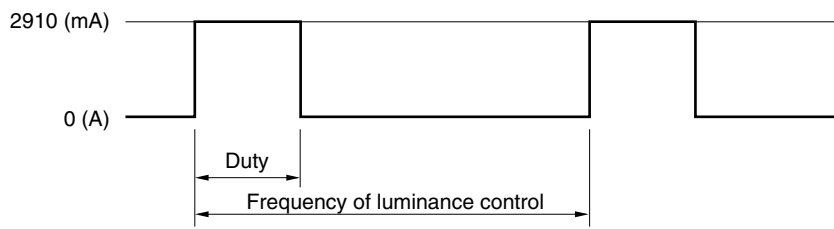
**Note 3:** Theoretical maximum current pattern

(2) Backlight driving

(Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	V <sub>DDB</sub>	11.4	12.0	12.6	V	Backlight power supply
Logic input “L” level 1	V <sub>IBL1</sub>	0	–	0.8	V	for BRTP
Logic input “H” level 1	V <sub>IBH1</sub>	2	–	5	V	
Logic input “L” level 2	V <sub>IBL2</sub>	0	–	0.8	V	for BRTC, PWSEL
Logic input “H” level 2	V <sub>IBH2</sub>	2	–	5	V	
Logic input “L” current 1	I <sub>IBL1</sub>	–1580	–	–	μA	for BRTP
Logic input “H” current 1	I <sub>IBH1</sub>	–	–	3500	μA	
Logic input “L” current 2	I <sub>IBL2</sub>	–810	–	–	μA	for BRTC, PWSEL
Logic input “H” current 2	I <sub>IBH2</sub>	–	–	440	μA	
BRTL input current	I <sub>IB3</sub>	–130	–	–	μA	for BRTL
Supply current	I <sub>DDB</sub>	–	2910	3500	mA	V <sub>DDB</sub> = 12.0 V (at Max. luminance)

(3) Inverter current wave

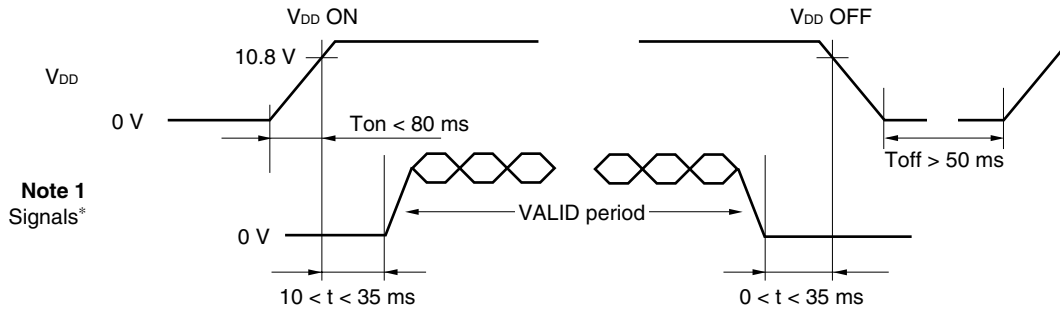


Maximum luminance : 100% (Duty)  
 Minimum luminance : 20% (Duty)  
 Luminance control frequency: 237 to 273 Hz, 255 Hz (TYP.)<sup>Note 1</sup>

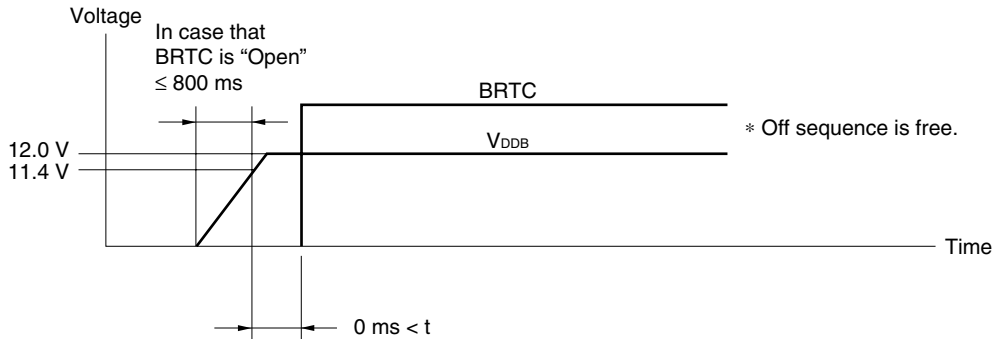
- Note 1:** The power supply lines ( $V_{DDB}$  and  $GNDB$ ) have large ripple voltage while dimming. There is the possibility that the ripple voltage produces an acoustic noise and signal wave noise in a system circuit (e.g. audio circuit). If the noise occurred in a system circuit, put an aluminum electrolytic capacitor (5,000 to 6,000  $\mu F$ ) between the power source lines ( $V_{DDB}$  and  $GNDB$ ), and the capacitor will be able to reduce the noise.
- Note 2:** Luminance control frequency indicates the input pulse frequency, when select the external pulse luminance control. See “**Luminance control with external pulse**”.

**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



**Note 1:** The values of signals are measured at the termination of resistor of 100 Ω.

**Note 2:** Logic signals (Hsync, Vsync, DE, CLK, RA0 to RB7, GA0 to GB7, Ba0 to BB7) must be "0" voltage (V), exclude the VALID period (See above sequence diagram). If these input voltages are higher than 0.3 V, the internal circuit will be damages.

**Note 3:** When turn on the LCD module, if VDD has the chance of fall-down during the rising period up to 11.4 V, the LCD module may not start to work because of the protection circuit.

**Note 4:** Backlight ON/OFF should be controlled, while logic signals are supplied. The backlight power supply (VDDDB) 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.

(2) Supply voltage ripple

This product works, even if the ripple levels are beyond the below values (See following the Table1.), but might have noise on the display image. Consider and evaluate enough before installing this product into customer's system.

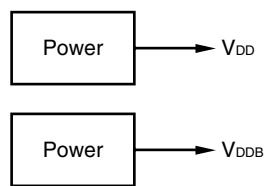
Table1: Ripple (Measurement to input terminal of power supply)

Supply voltage (Acceptable level)	
V <sub>DD</sub> (for logic and LCD driver: 12 V)	V <sub>DDB</sub> (for backlight: 12 V)
≤ 100 mVp-p <b>Note 1</b>	≤ 200 mVp-p <b>Note 1</b>

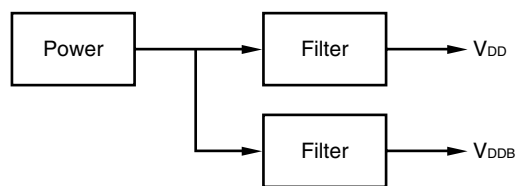
**Note 1:** The acceptable ripple voltage level includes spike noise.

Example of the power supply connections

a) Separate the power supplies



b) Put in the filters



(3) Fuses

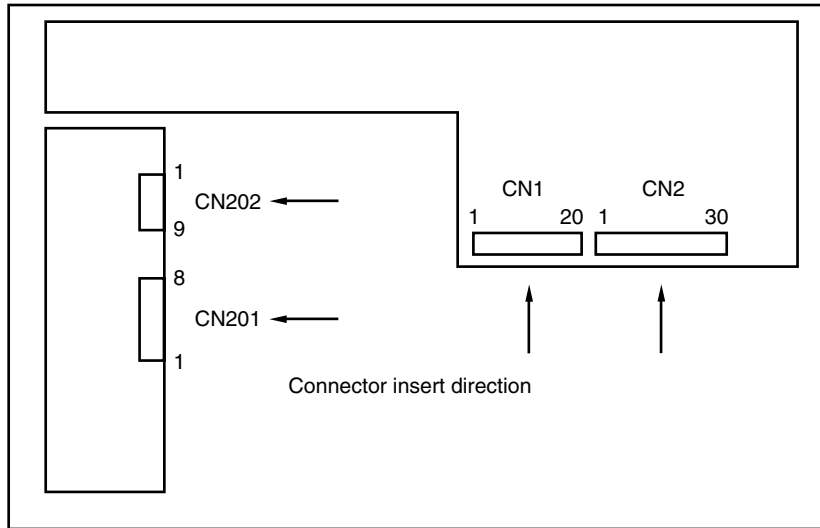
This product has fuses listed below. Check and evaluate power supplies of customer's system.

Supply voltage	Type	Supplier	Rating
V <sub>DD</sub>	ICP-S1.8	ROHM	1.8 A
V <sub>DDB</sub>	MMCT5A	SOC	5A

**Note 1:** The power capacitor should be more than 2 times of fuse ratings from safety point of view. If the power capacity of customer system is less than above request, check and evaluate it carefully.

CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

(1) Interface connectors for signals and powers



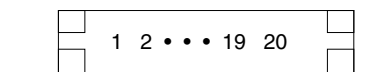
CN1 socket (module side): 53780-2010  
 Adaptable plug: 51146-2000  
 Supplier: Molex Incorporated.

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

**Note 1:** Do not keep pins open (except 1, 2 and 20 pin) to avoid noise problem.

**Note 2:** Use 100Ω twist pair wires for the cable.

CN1: Figure of socket



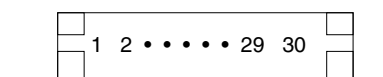
CN2 socket (module side): 53780-3010  
 Adaptable plug: 51146-3000  
 Supplier: Molex Incorporated.

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

**Note 1:** Do not keep pins open (except 1, 2, 20, 21, 22, 23 and 27 pin) to avoid noise problem.

**Note 2:** Use 100Ω twist pair wires for the cable.

CN2: Figure of socket



(2) Connectors for backlight unit

CN201 socket (Inverter side): DF3-8P-2H

Adaptable plug: DF3-8S-2C

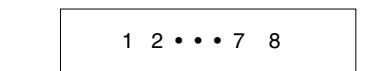
Supplier: HIROSE ELECTRIC Co., Ltd.

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

**Note 1:** GNDB should be connected to system ground in customer equipment.

**Note 2:** Do not keep pins open to avoid noise problem.

CN201: Figure of socket



CN202 socket (Inverter side): IL-Z-9PL1-SMTY

Adaptable plug: IL-Z-9S-S125C3

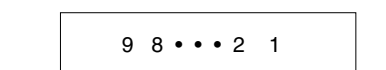
Supplier: Japan Aviation Electronics Industry Limited (JAE)

Pin No.	Symbol	Function	Description
1	GNDB	Ground for backlight	<b>Note 1, 2</b>
2			
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	See “(3) luminance control”
6	BRTL	Luminance control	
7	BRTP	Luminance control signal (TTL level)	
8	GNDB	Ground for backlight	<b>Note 1, 2</b>
9	PWSEL	Luminance control select signal (TTL level)	See “(3) luminance control”

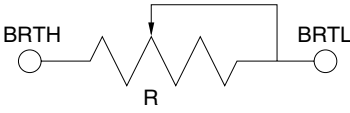
**Note 1:** GNDB should be connected to system ground in customer equipment.

**Note 2:** Do not keep pins open (except 3) to avoid noise problem.

CN202: Figure of socket



(3) Luminance Control

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

**Note 1:** 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.

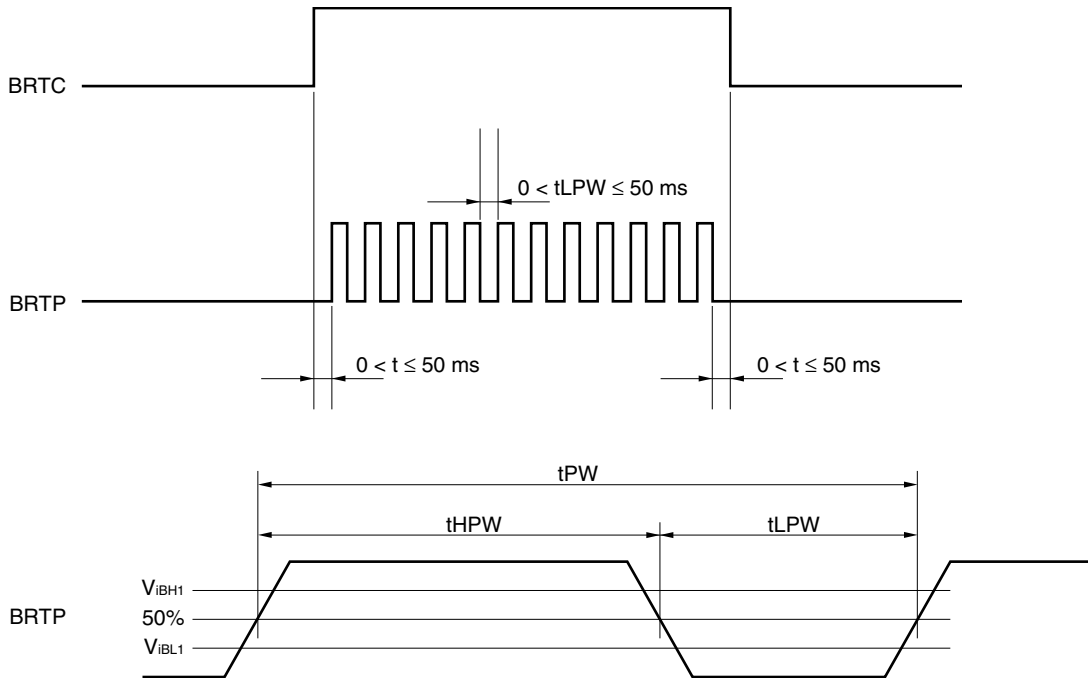
(4) Luminance control with external pulse

Luminance control with external pulse is valid, when PWSEL = "L" and external pulse signal is inputted to B RTP. 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 working when B RTP 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 B RTP 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	<b>Note 1</b>
"L" period	tLPW	–	–	50	ms	<b>Note 2</b>
Pulse-width	tHPW/tPW	20	–	100	%	<b>Note 3</b>
Luminance ratio	–	–	30 to 100	–	%	–
Input voltage	V <sub>iBL1</sub>	0	–	0.8	V	–
	V <sub>iBH1</sub>	2.0	–	5	V	–

**Note 1:** See the following formula for luminance control frequency.

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

**Note 2:** In case tLPW is out of 50 ms, backlight will turn off by its protection circuits.

**Note 3:** Max. Luminance at 100%

**The display image may be disturbed by luminance control with external pulse when set up frequency is interfered with internal signal frequency.**

METHOD OF CONNECTION FOR THC63LVDM83A

		TRANSMITTER				I/F CN				RECEIVER				INPUT to LCD	
		pin	THC63LVDF83A	pin	pin	CN1	pin	THC63LVDF84A	pin	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	
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		
Use 100Ω twist pair wires for the Cable.															
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-	RA5	35	→	RB7	
	GB2	→ 4	TA6		6	DB0+	→	10	RA+	RA6	37	→	GB2		
	GB3	→ 6	TB0	TB- 46	→	7	GND				RA7	38	→	GB3	
	GB4	→ 7	TB1	TB+ 45	→	8	DB1-	→	11	RB-	RB0	39	→	GB4	
	GB5	→ 11	TB2		9	DB1+	→	12	RB+	RB1	39	→	GB5		
	GB6	→ 12	TB3	TC- 42	→	10	GND				RB2	43	→	GB6	
	GB7	→ 14	TB4	TC+ 41	→	11	DB2-	→	15	RC-	RB3	45	→	GB7	
	BB2	→ 15	TB5		12	DB2+	→	16	RC+	RB4	46	→	BB2		
	BB3	→ 19	TB6	TCLK- 40	→	13	GND				RB5	47	→	BB3	
	BB4	→ 20	TC0	TCLK+ 39	→	14	CKB-	→	17	RCLK-	RB6	51	→	BB4	
	BB5	→ 22	TC1		15	CKB+	→	18	RCLK+	RC0	53	→	BB5		
	BB6	→ 23	TC2	TD- 38	→	16	GND				RC1	54	→	BB6	
	BB7	→ 24	TC3	TD+ 37	→	17	DB3-	→	19	RD-	RC2	55	→	BB7	
	RSVD	→ 27	TC4		18	DB3+	→	20	RD+	RC3	1	→	RSVD		
	RSVD	→ 28	TC5		19	GND					RC4	3	→	RSVD	
RSVD	→ 30	TC6		20	Reserved					RC5	5	→	RSVD		
RB0	→ 50	TD0		21	Reserved					RC6	6	→	RSVD		
RB1	→ 2	TD1		22	Reserved					RD0	7	→	RB0		
GB0	→ 8	TD2		23	Reserved					RD1	34	→	RB1		
GB1	→ 10	TD3		24	GND					RD2	41	→	GB0		
BB0	→ 16	TD4		25	GND					RD3	42	→	GB1		
BB1	→ 18	TD5		26	GND					RD4	49	→	BB0		
RSVD	→ 25	TD6		27	N.C.					RD5	50	→	BB1		
CLK	→ 31	CLKIN		28	V <sub>DD</sub> : 12 V					RD6	2	→	RSVD		
				29	V <sub>DD</sub> : 12 V					CLKOUT	26	→	CLKB		
				30	V <sub>DD</sub> : 12 V										

Note 1: RSVD must connect to system GND.

DISPLAY COLORS TO INPUT DATA SIGNALS

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

**INPUT SIGNAL TIMINGS**

(1) Input signal specifications for LCD controller

	Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks	
CLK	Frequency	1/tc	51.5 –	54.0 18.52	56.5 –	MHz ns	–	
	Duty	tc/tcl	<b>Note 1</b>			–	–	
	Rise, fall	tcrf				ns	–	
Hsync	Period	th	12.3 750	15.630 844	– –	μs CLK	Typ = 64.0 kHz <b>Note 2, 3</b>	
	Display period	thd	–	640	–	CLK	–	
	Front-porch	thf	–	–	–	CLK	–	
	Pulse width	thp*	–	56	–	CLK	–	
	Back-porch	thb*	–	124	–	CLK	–	
	*thp + thb			110	–	–	CLK	–
Vsync	Period	tv	– 1028	16.661 1066	17.47 –	ms H	Typ = 60.0 Hz	
	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	<b>Note 1</b>			ns	–	
	CLK-DATA (Hold)	th				ns	–	
	Rise, fall	trf				ns	–	

**Note 1:** Timing specifications are defined by the input signals of LVDS transmitter.

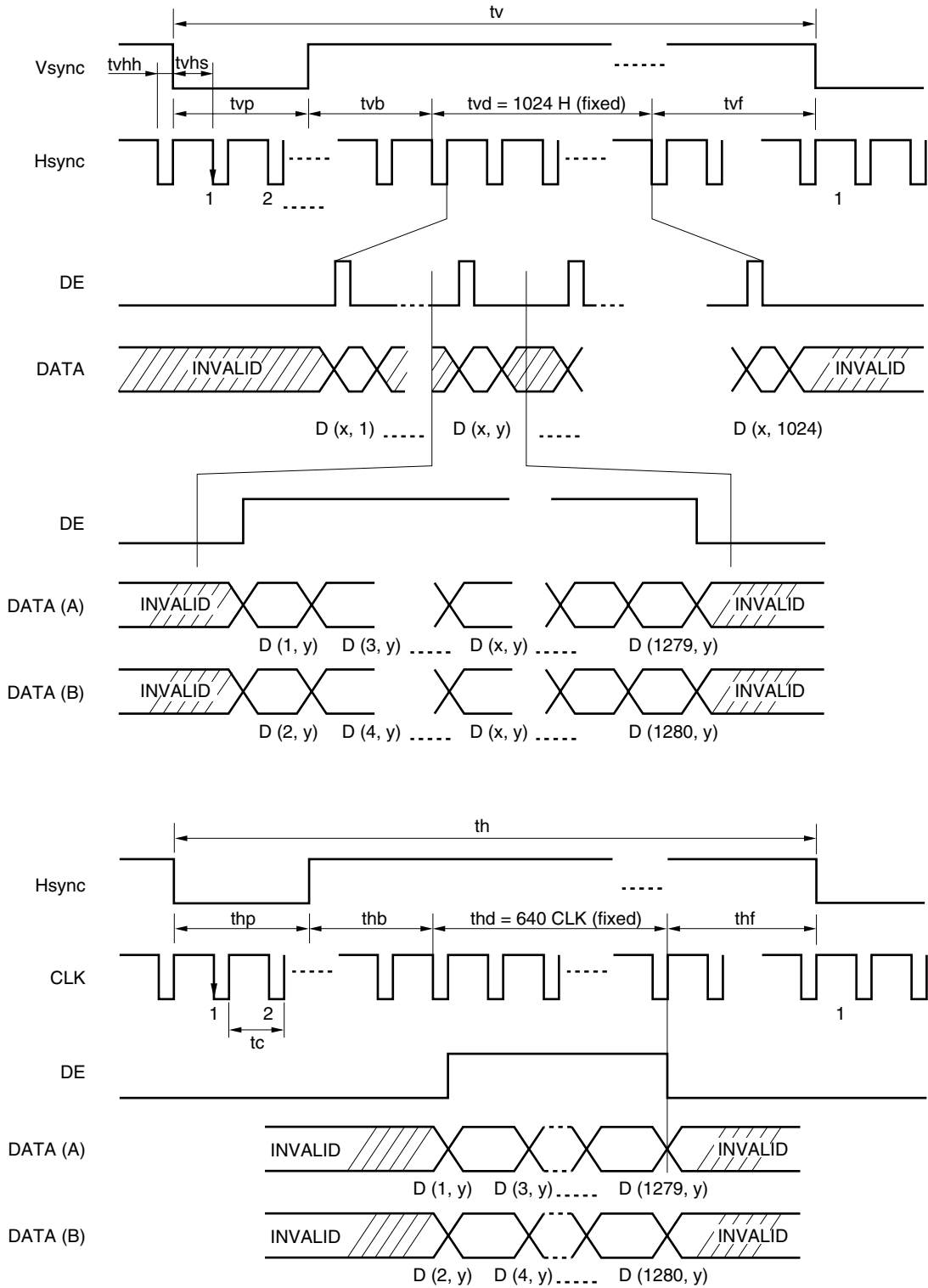
THC63LVDF83A (THine) or equivalent products are recommended for LVDS transmitter.

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

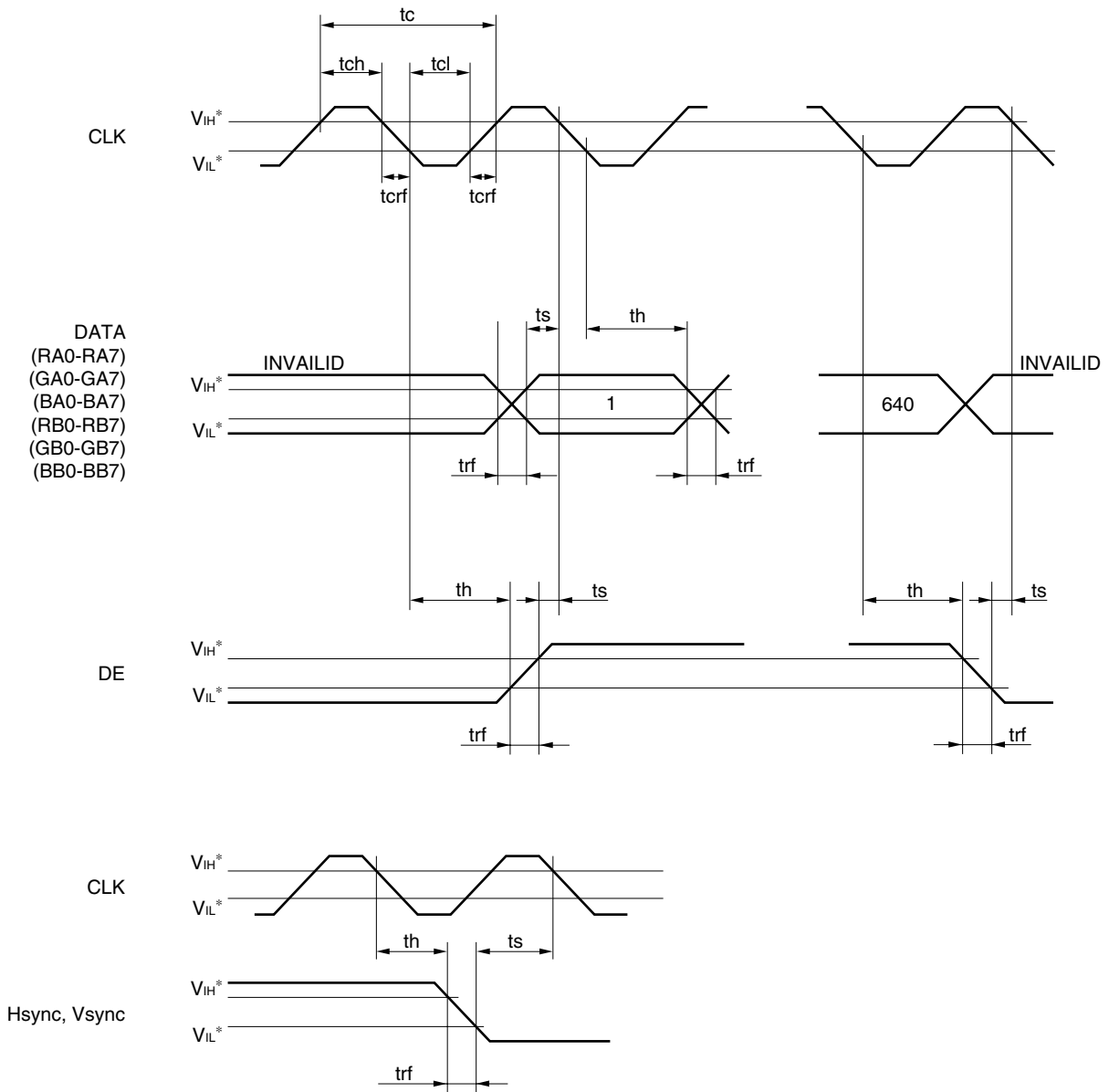
**Note 3:** During operation, fluctuation of Hsync period must not exceed ±1 CLK. Otherwise function error will occur in LCD module.

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

(2) Input signals timing chart for LCD



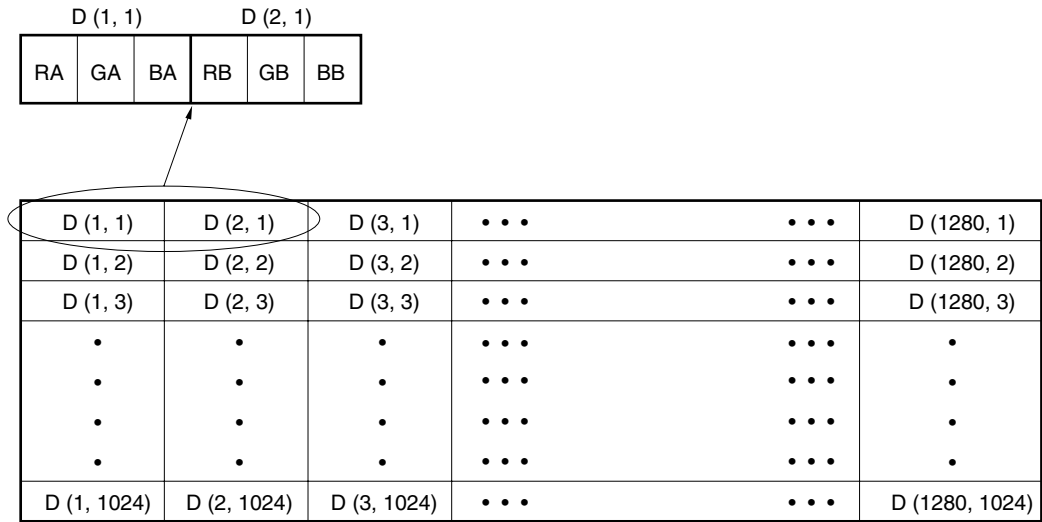
**Note 1:** DATA (A): RA0-RA7, GA0-GA7, BA0-BA7  
 DATA (B): RB0-RBA7, GB0-BG7, BB0-BB7



\*  $V_{IH}$ ,  $V_{IL}$ : 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



**OPTICAL CHARACTERISTICS**

(Ta = 25°C, V<sub>DD</sub> = 12 V, V<sub>DDB</sub> = 12 V, **Note 1**)

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

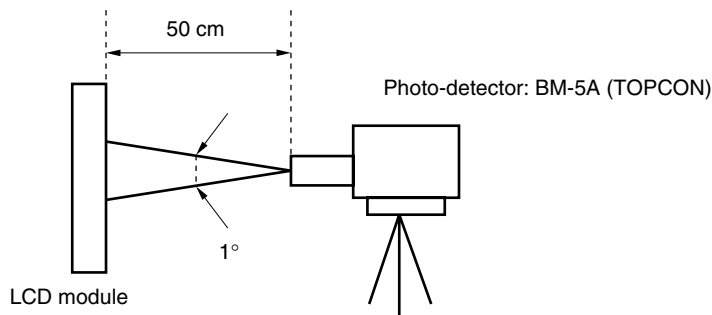
**Reference data**

(Ta = 25°C, V<sub>DD</sub> = 12 V, V<sub>DDB</sub> = 12 V, **Note 1**)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Units	Remarks	
Color gamut	C	To NTSC	50	60	–	%	<b>Note 3</b>	
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	$\theta_{x+}$	CR > 10, $\theta_y = \pm 0^\circ$	70	85	–	Deg.	<b>Note 4</b>
				$\theta_{x-}$	70	85	–	
	Vertical	$\theta_{y+}$	CR > 10, $\theta_x = \pm 0^\circ$	70	85	–	Deg.	
				$\theta_{y-}$	70	85	–	
Response time (Module front surface temperature = 33.9°C)	Ton	White to black	10%→90%	–	15	25	ms	<b>Note 5</b>
	Toff	Black to white	90%→10%	–	14	25		
Luminance control range	–	Maximum luminance: 100%	–	30 to 100	–	–	%	

**Note 1:** Measurement conditions

Optical characteristics are measured after 20 minutes from lighting the backlight with all pixels in white, in the dark room. The typical value is measured after luminance saturation.

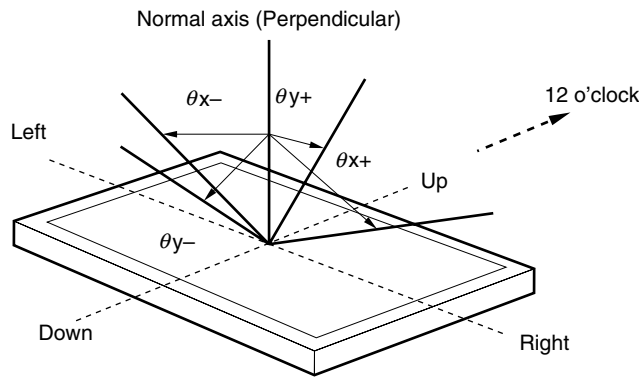


**Note 2:** The contrast ratio is calculated by using the following formula.

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

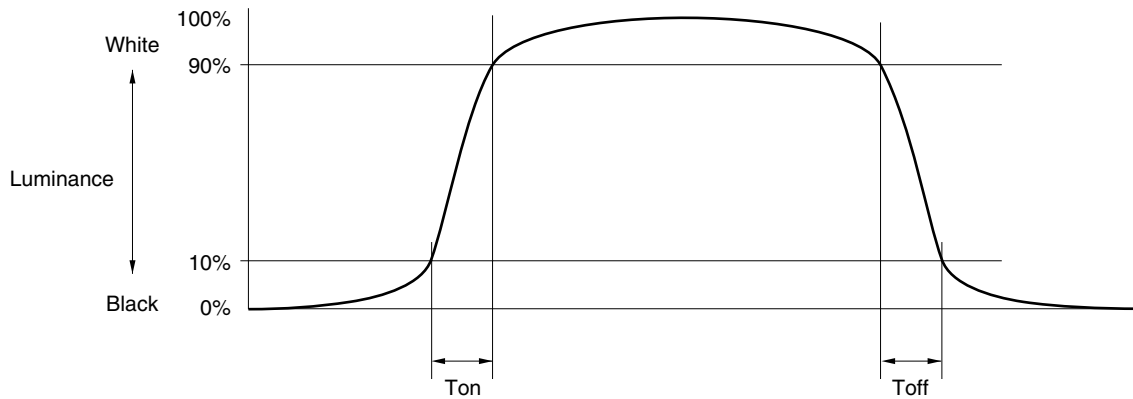
**Note 3:** Viewing angle is  $\theta_x = \pm 0^\circ$ ,  $\theta_y = \pm 0^\circ$  and at center.

**Note 4:** Definitions of viewing angles are as follows



**Note 5:** Definitions of response times are as follows.

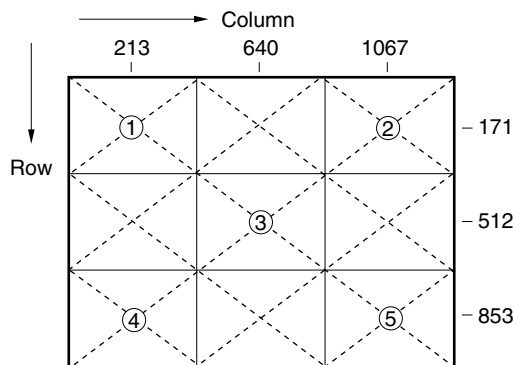
Response time is measured by photo-detector's out put level, when the luminance changes "white" to "black", or "black" to "white" on the same screen point. Ton is the time it takes the luminance to go from 10% on condition to 90% on condition. Toff is the reverse of Ton. (See the following diagram.)



**Note 6:** 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.



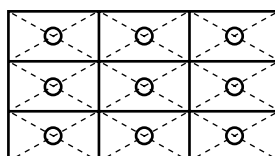
RELIABILITY TEST

Test item		Test condition	Judgment
High temperature/humidity operation		60±2°C, RH = 60% 240 hours, Display data is white.	<b>Note 1</b>
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 white.	<b>Note 1</b>
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.	<b>Note 1</b>
Vibration (non-operation)		① 5-100 Hz, 11.76 m/s <sup>2</sup> 1 minute/cycle, X, Y, Z direction ② 10 times each direction	<b>Note 1</b> <b>Note 2</b>
Mechanical shock (non-operation)		① 294 m/s <sup>2</sup> , 11 ms X, Y, Z direction ② 3 times each direction	<b>Note 1</b> <b>Note 2</b>
ESD (operation)		150 pF, 150 Ω, ±10 kV 9 places on a panel Note3 10 times each place at one-second intervals	<b>Note 1</b>
Dust (operation)		15 kinds of dust (JIS-Z 8901) Hourly 15 seconds stir, 8 times repeat	<b>Note 1</b>
Low pressure	Operation	53.3 kPa 0°C±3°C --- 24 hours 55°C±3°C --- 24 hours	<b>Note 1</b>
	non-operation	15 kPa -20°C±3°C --- 24 hours -60°C±3°C --- 24 hours	

**Note 1:** No display malfunctions (Display functions are checked under the same conditions as out-going inspection.)

**Note 2:** No physical damages


**Note 3:** See the following figure for discharge points





**PRECAUTIONS**

**MEANING OF CAUTION SIGNS**

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


	<b>CAUTION</b>	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 customer makes a mistake in operations.	
---	--	--

	This sign has a meaning that customer will be injured oneself, if customer makes a mistake in operations.	
---	---	--

**CAUTIONS**

	<b>Do not touch HIGH VOLTAGE PART of the inverter while turn on. Customer will be in danger of an electric shock.</b>
---	---

	<ul style="list-style-type: none"> <li>* <b>Pay attention to handling for the working backlight. It may be over 35°C from ambient temperature.</b></li> <li>* <b>Do not shock and press the LCD panel and the backlight. There will be in danger of breaking, because they are made of glass. (Shock: To be not greater 294 m/s<sup>2</sup> and to be not greater 11 ms, Pressure: To be not greater 19.6 N)</b></li> </ul>
---	---

**ATTENTIONS**

(1) Handling the product

- ① When customer pulls out products from carton box, take hold of both ends without touch the circuit board. If customer touches 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 avoid electrostatic discharge (e.g. Decrease with earth band, ionic shower, etc.), because products (LCD modules) may be damaged by electrostatic.
- ④ The torque for mounting screws should never exceed 0.45 N•m. Over torque may cause mechanical damage to the product.
- ⑤ Do not press or friction, because LCD panel surface is sensitive. If customer will clean the product surface, NEC Corporation or their supplier will recommended 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, and so on, are danger of damage. Do not hook cables nor pull them.

## (2) Environment

- ① Dewdrop atmosphere must be avoided.
- ② Do not operate and/or store in high temperature and/or high humidity atmosphere. If customer stores 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.

## (3) Specification for products

- ① Do not display the fixed pattern for a long time because it may cause image sticking. If the fixed pattern is displayed on the screen, 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 The product may be changed of luminance by voltage variation, even if power source applied recommended voltage to backlight inverter.
- ④ Optical characteristics may be changed by input signal timings.

## (4) Other

- ① All GND, GNDB, V<sub>DD</sub> and V<sub>DDB</sub> terminals should be connected without a non-connected signal line.
- ② Do not disassemble a product and/or adjust volume.
- ③ If customer would like to replace backlight lamps, see 'REPLACEMENT MANUAL FOR BACKLIGHT'.
- ④ If customer uses screwdrivers, pay attention not to insert waste materials in inside of products.
- ⑤ When customer returns product for repair and so on, pack it with original shipping package because of avoidance of some damages during transportation.

**General specifications for the LCD**

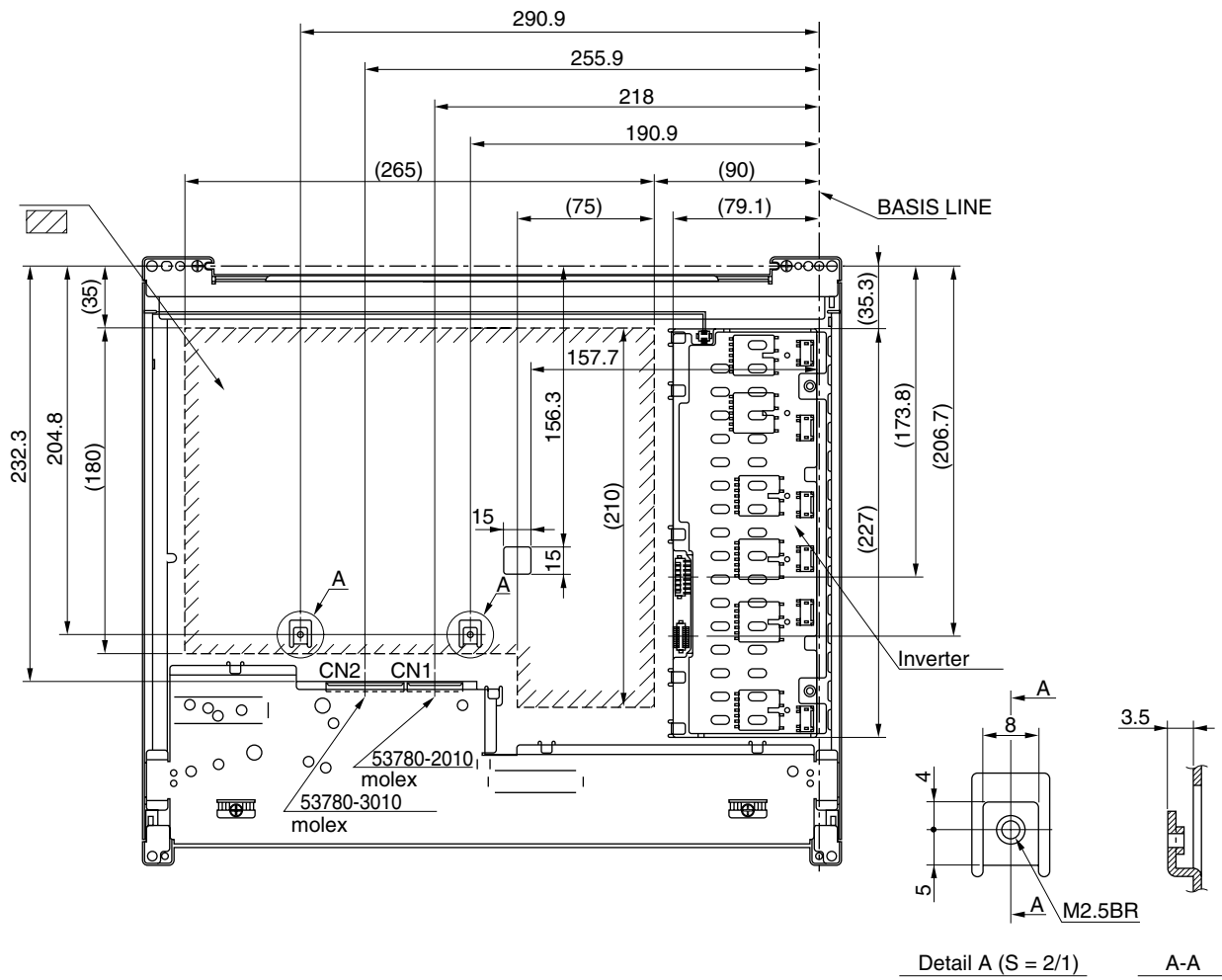
**The following items are neither defects nor failures.**

- \* **Response time, luminance and color gamut may be change by ambient temperature.**
- \* **The LCD may be seemed luminance uniformity, flicker, vertical seam and/or small sport 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.**



REAR VIEW

(Unit: mm)



**Note 1:** The torque for mounting screws should never exceed 0.45 N•m.

**Note 2:** Tolerances of dimensions not shown is  $\pm 0.5$  mm.

[MEMO]

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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: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

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