NEC

TFT COLOR LCD MODULE

Type: NL128102AC28-04
46cm (18.1 Type), SXGA

SPECIFICATIONS

(First Edition)

PRELIMINARY

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

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The devices listed in this document are not suitable for use of aerospace equipment, submarine cables, nuclear reactor control systems and life support systems. If customers intend to use NEC devices for above applications or they intend to use "Standard" quality grade NEC devices for applications not intended by NEC, please contact our sales people in advance.

Application examples recommended by NEC Corporation

Standard: Computer, Office equipment, Communication equipment, Test and Measurement equipment, Machine tools, Industrial robots, Audio and Visual equipment, Other consumer products, etc.

Special: Automotive and Transportation equipment, Traffic control systems, Antidisaster systems, Anticrime systems, etc.

CONTENTS

1. DESCRIPTION

NL128102AC28-04 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. NL128102AC28-04 has a built-in backlight with inverter.
The 46cm(18.1 Type) diagonal display area contains 1280 × 1024 pixels and can display 16,777,216 colors simultaneously.

2. FEATURES

- Ultra-wide viewing angle and low reflection
- LVDS interface (THC63LVDF84A x 2pcs, THine Electronics, Inc.)
- High luminance and Low reflection
- Incorporated direct type backlight (Eight lamps in a lamp unit, Inverter)
- Lamp unit replaceable (Part No. : 181LHS02)

3. APPLICATIONS

- Engineering work station, Desk-top type of PCs
- Display terminals for control systems
- Monitors for process controller

4. STRUCTURE AND FUNCTIONS

A color TFT (thin film transistor) LCD module is comprised of a TFT liquid crystal panel structure, LSIs for driving the TFT array, and a backlight assembly. Sandwiching liquid crystal material in the narrow gap between a TFT array glass substrate and a color filter glass substrate creates the TFT panel structure. After the driver LSIs are connected to the panel, the backlight assembly is attached to the backside of the panel.
RGB (red, green, blue) data signals from a source system is 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.
Acting as an Electro-optical switch, each TFT cell regulates light transmission from the backlight assembly when activated by the data source. By regulating the amount of light passing through the array of red, green, and blue dots, color images are created with clarity.

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 × 1024
Pixel arrangement	RGB vertical stripe
Pixel pitch	0.2805(H) × 0.2805(V)mm
Module size	424.0(H) × 337.0(V) × 40.0 max.(D) mm
Weight	1910 g (typ.)
Contrast ratio	400:1 (typ.)

Viewing angle (more than the contrast ratio of 10:1)

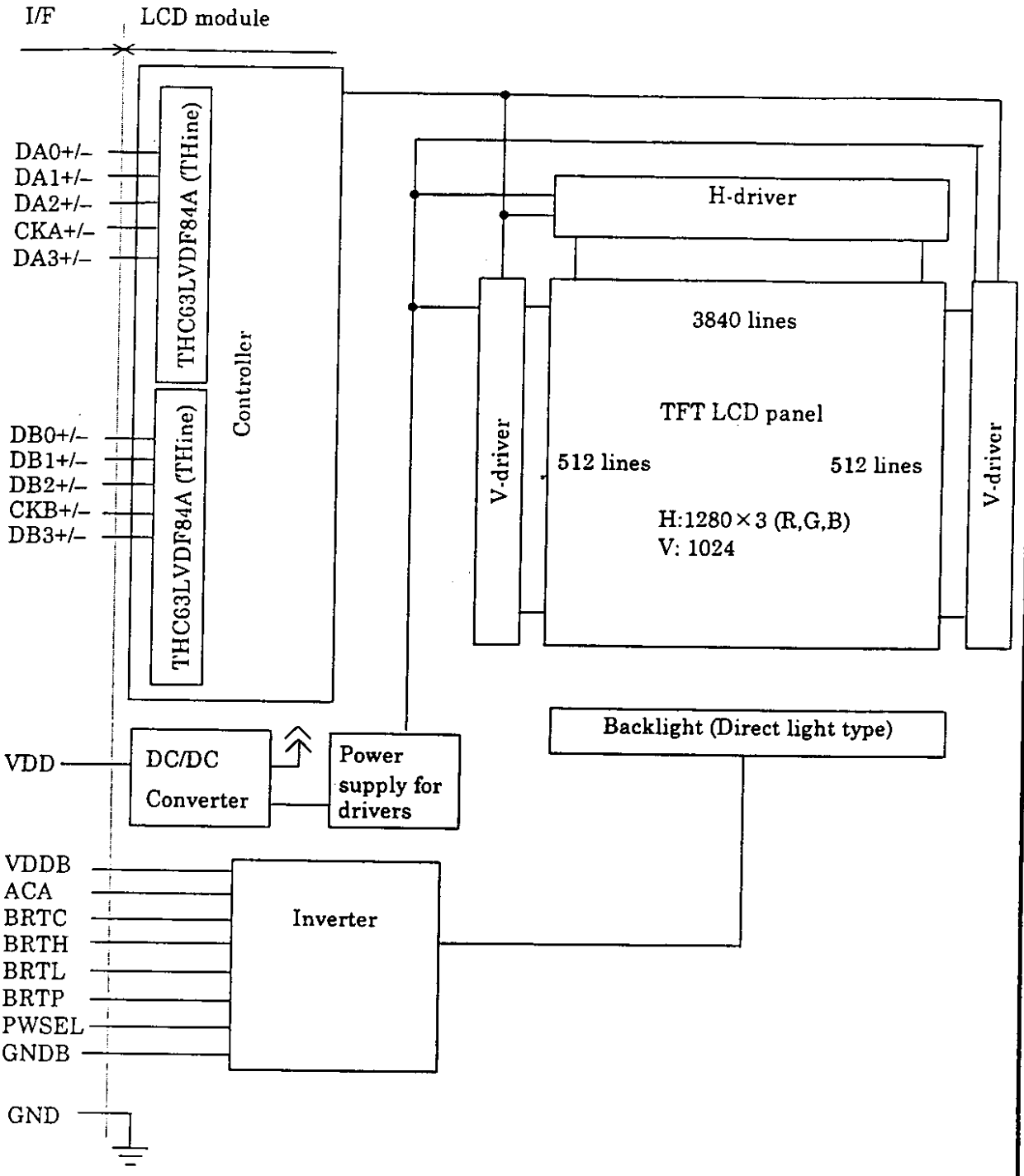
- Horizontal: 85 ° (typ. , left side, right side)
- Vertical: 85 ° (typ. , up side, down side)

Designed viewing direction

- Optimum grayscale (γ =2.2): perpendicular

Polarizer Pencil-hardness	3 H(min., at JIS K5400)
Color gamut	60 %(typ. At center, To NTSC)
Response time	45 ms(typ.), "black" to "white"
Luminance	200 cd/m^2(typ.)
Signal system	RGB 8-bit signals, Synchronous signals(Hsync, Vsync), DE 2 ports LVDS interface (THC63LVDF84A x 2pcs, THine Electronics, Inc.)
Supply voltage	12V (Logic, LCD driving) , 12V (Backlight)
Backlight	Direct light type: Eight cold cathode fluorescent lamps with inverter 【Replaceable parts】 · Lamp holder unit Parts No.: 181LHS02 · Inverter Parts No.: 181PW021
Power consumption	42.6 W (typ.)

6. BLOCK DIAGRAM



Note 1: Neither GND nor GNDB connected to FG (Frame Ground) in this LCD module.
GND and GNDB should be connected to FG in customer equipment.

7. GENERAL SPECIFICATIONS

Items	Specifications	Unit
Module size	424.0±1.0 (H) × 337.0±1.0 (V) × 40.0(max.)(D)	mm
Display area	359.04 (H) × 287.232 (V)	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 (RGB, 8bit)	color
Weight	(2100) (max.)	g

8. ABSOLUTE MAXIMUM RATINGS

Parameters	Symbols	Ratings	Unit	Remarks
Supply voltage	VDD	-0.3 to +14.0	V	Ta = 25℃
	VDDB	-0.3 to +14.0	V	
Logic input voltage	Vi	-0.3 to 3.6	V	
Logic input voltage (backlight-logic signal)	ViBL1	-0.3 to +5.5	V	
Logic input voltage (backlight-BRTL signal)	ViBL2	-0.3 to +1.5	V	
Storage temperature	Tst	-20 to +60	℃	——
Operating temperature	Top	0 to +55	℃	Module surface Note 1
Relative humidity (RH) Note 2		≦ 95	%	Ta≦40℃
		≦ 70	%	40℃<Ta≦55℃
Absolute humidity Note 2		Absolute humidity shall not exceed Ta=55℃, RH=70% level.	g/m^3	Ta>55℃

Note 1: Measured at the display area (Including self heat)
Note 2: No condensation

9. ELECTRICAL CHARACTERISTICS

(1) Logic/ LCD driving

Ta = 25℃

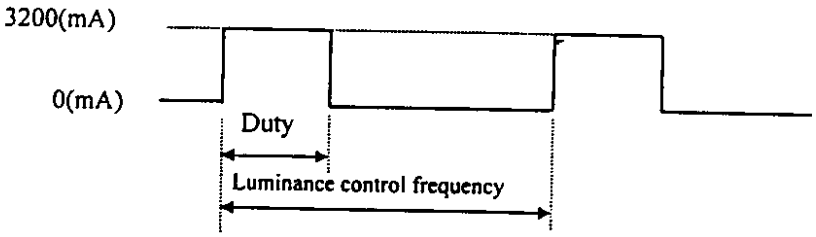
Parameters	Symbols	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	VDD	11.4	12.0	12.6	V	——
Ripple voltage	Vrp	—	—	100	mV	for VCC
LVDS signal input "L" voltage	ViL	-100	—	—	mV	VCM=1.2V VCM: Common mode voltage in LVDS driver
LVDS signal input "H" voltage	ViH	—	—	+100	mV	
Input voltage width	Vi	—	—	2.4	V	——
Common mode voltage	VCM	1.125	1.25	1.375	V	Rt=100Ω
Terminating resistor	Rt	—	100	—	Ω	——
Supply current	IDD	—	(350) Note 1	(1000)	mA	VDD=12.0V

Note 1: Checker flag pattern (in EIAJ ED-2522)

(2) Backlight

Ta = 25°C

Parameters	Symbols	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	VDDB	11.4	12.0	12.6	V	——
Logic input "L" voltage	ViL1	0	—	0.6	V	for BRTP
Logic input "H" voltage	ViH1	2.2	—	5.25	V	
Logic input "L" voltage	ViL2	0	—	0.8	V	for BRTC, ACA, BRTL
Logic input "H" voltage	ViH2	2.2	—	5.25	V	
Logic input "L" current	IiL	-1580	—	—	μA	for BRTP
Logic input "H" current	IiH	—	—	3500	μA	
Logic input "L" current	IiL	-810	—	—	μA	for BRTC, ACA, PWSEL
Logic input "H" current	IiH	—	—	440	μA	
Supply current	IDDB	—	(3200)	(3500)	mA	VDDB=12.0V (at max. luminance)



maximum luminance control : 100%
minimum luminance control : 20%
Luminance control frequency : 237 to 273 Hz 255Hz(typ.)

(3)Fuse

Supply voltage	Part No.	Supplier	Ratings	Remarks
VDD	CCP2E40	KOA	1.6A	-
VDDB	R429005	Littel fuse	5A	-

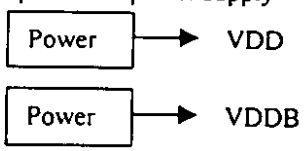
(4)Ripple of supply voltage

Supply voltage	VDD (for logic and LCD driver)	VDDB (for backlight)
Acceptable range	≦ 100mVp-p	≦ 200mVp-p

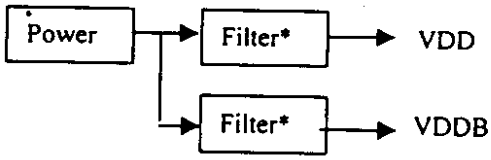
note 1:The acceptable range of ripple voltage includes spike noise.

Example of the power supply connection

a) Separate the power supply

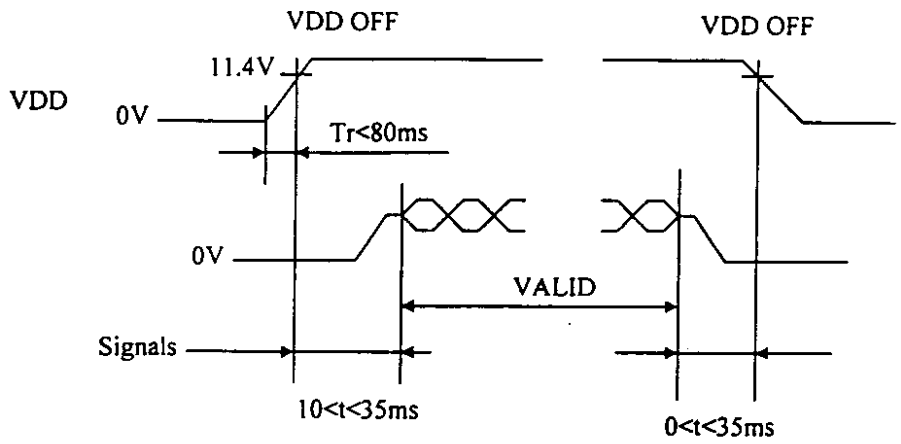


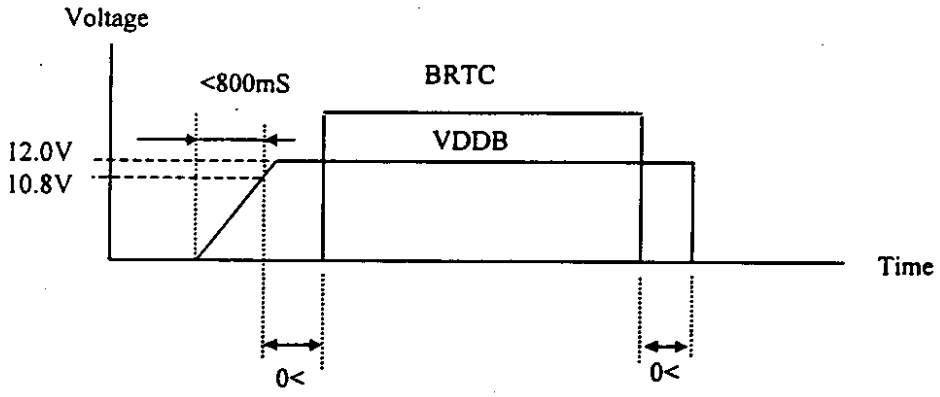
b) Put the filter



Filter* (reference value)
L = 10 μH to 100 μH
C = 10 μF to 100 μF

10. SUPPLY VOLTAGE SEQUENCE





*1 Logic signals (synchronous signals and control signals) must be "0" voltage (V), when VDD is not input. If input voltage to signal lines is higher than 0.3 V, the internal circuit will be damaged.
*2 The supply voltage for input signals should be the same as VDD.
*3 The 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 will be displayed when the backlight power is turned ON with no logic signals
*4 12V for backlight should be started up within 800ms, otherwise, the protection circuit makes the backlight turn off.
*5 The backlight is turned off with safety circuit, when "L" period of BRTP signal is input more than 50 ms.
*6 Do not input "H" ACA and PWSEL, when VDDB is 0V or BRTC is "L".

11. INTERFACE PIN CONNECTIONS

(1) Interface connector for signal and power

CN1

Part No. : 53780-2010
Adaptable socket : 51146-2000
Supplier : Molex Incorporated.

Pin No.	Symbols	Signal type	Function
1	N.C.	N.C.	Keep the terminal open
2	N.C.		
3	GND	Ground	Connect to system ground
4	GND		
5	DA0-	Odd pixel Data0	Odd pixel data input0 (LVDS level)
6	DA0+		
7	GND	Ground	Connect to system ground
8	DA1-	Odd pixel Data1	Odd pixel data input1 (LVDS level)
9	DA1+		
10	GND	Ground	Connect to system ground
11	DA2-	Odd pixel Data2	Odd pixel data input2 (LVDS level)
12	DA2+		
13	GND	Ground	Connect to system ground
14	CKA-	Odd pixel Clock	Odd pixel clock input (LVDS level)
15	CKA+		
16	GND	Ground	Connect to system ground
17	DA3-	Odd pixel Data3	Odd pixel data input3 (LVDS level)
18	DA3+		
19	GND	Ground	Connect to system ground
20	N.C.	N.C.	Keep the terminal open

* N.C. means "non connection"

Note 1: GND is signal ground for logic and LCD driving. GND should be connected to system ground. GND is not connected to FG (Frame Ground) in this LCD module.
Note 2: Connect all pins (except 1,2) to avoid noise issue. Use 100Ω twist pair wires for the Cable.

CN1: Figure from socket view

CN2

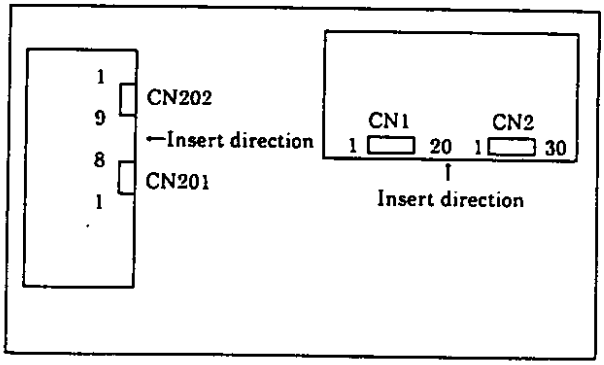
Part No. : 53780-3010
Adaptable socket : 51146-3000
Supplier : Molex Incorporated.

Pin No.	Symbols	Signal type	Function
1	N.C.	N.C.	Keep the terminal open
2	N.C.		
3	GND	Ground	Connect to system ground
4	GND		
5	DB0-	Even Pixel Data0	Even pixel data input0 (LVDS level)
6	DB0+		
7	GND	Ground	Connect to system ground
8	DB1-	Even Pixel Data1	Even pixel data input1 (LVDS level)
9	DB1+		
10	GND	Ground	Connect to system ground
11	DB2-	Even Pixel Data2	Even pixel data input2 (LVDS level)
12	DB2+		
13	GND	Ground	Connect to system ground
14	CKB-	Even Pixel Clock	Even pixel clock input (LVDS level)
15	CKB+		
16	GND	Ground	Connect to system ground
17	DB3-	Even Pixel Data3	Even pixel data input3 (LVDS level)
18	DB3+		
19	GND	Ground	Connect to system ground
20	Res.	Res.	Keep the terminal open
21	Res.		
22	Res.		
23	Res.		
24	GND	Ground	Connect to system ground
25	GND		
26	GND		
27	N.C.	N.C.	Keep the terminal open
28	VDD	+12V Power Supply	12V±5%
29	VDD		
30	VDD		

* N.C. means "non connection"

Note 1: GND is signal ground for logic and LCD driving. GND should be connected to system ground. GND is not connected to FG (Frame Ground) in this LCD module.
Note 2: Connect all pins (except 20,27) to avoid noise issue. Use 100Ω twist pair wires for the Cable.

CN2: Figure from socket view



Note: Choice CN201 or CN202 and use one.

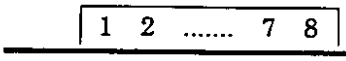
(2) Connector for backlight unit

CN201

Part No. : DF3-8P-2H
Adaptable socket : DF3-8S-2C
Supplier : HIROSE ELECTRIC CO.. LTD.

Pin No.	Symbols	Signal type	Function
1	GNDB	Ground for backlight	Note 1
2	GNDB		
3	GNDB		
4	GNDB		
5	VDDB	12V power supply	+12V±5%
6	VDDB		
7	VDDB		
8	VDDB		

CN201: Figure from socket view



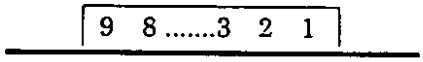
CN202

Part No. : IL-Z-9PL1-SMTY
Adaptable socket : IL-Z-9S-S125C3
Supplier : Japan Aviation Electronics Industry Limited (JAE)

Pin No.	Symbols	Signal type	Function
1	GNDB	Ground for backlight	Note 1
2	GNDB		
3	ACA	Luminance control signal	"H" or "Open" : Normal luminance (100%) "L" :Low luminance (1/2 of normal luminance)
4	BRTC	Backlight ON/OFF control signal	"H" or "Open" : Backlight on "L" : Backlight off
5	BRTH	Luminance control signal-1	Note 2
6	BRTL	Luminance control signal-1	
7	BRTP	Luminance control signal-2	Note 3
8	GNDB	Ground for backlight	Note 1
9	PWSEL	Luminance control select signal	"H" or "Open" : Variable resistor control or voltage control (note 2) "L" : BRTP signal control(note 3)

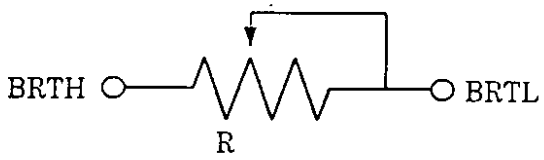
Note 1: Neither GND nor GNDB connected to FG (Frame Ground) in this LCD module.
GND and GNDB should be connected to FG in customer equipment.

CN202: Figure from socket view



Note 2: The ways to luminance control by a variable resistor and voltage.

(1) A way of luminance control by a variable resistor.
The variable resistor for luminance control should be 10 kΩ type, and zero point of the resistor corresponds to the minimum of luminance.



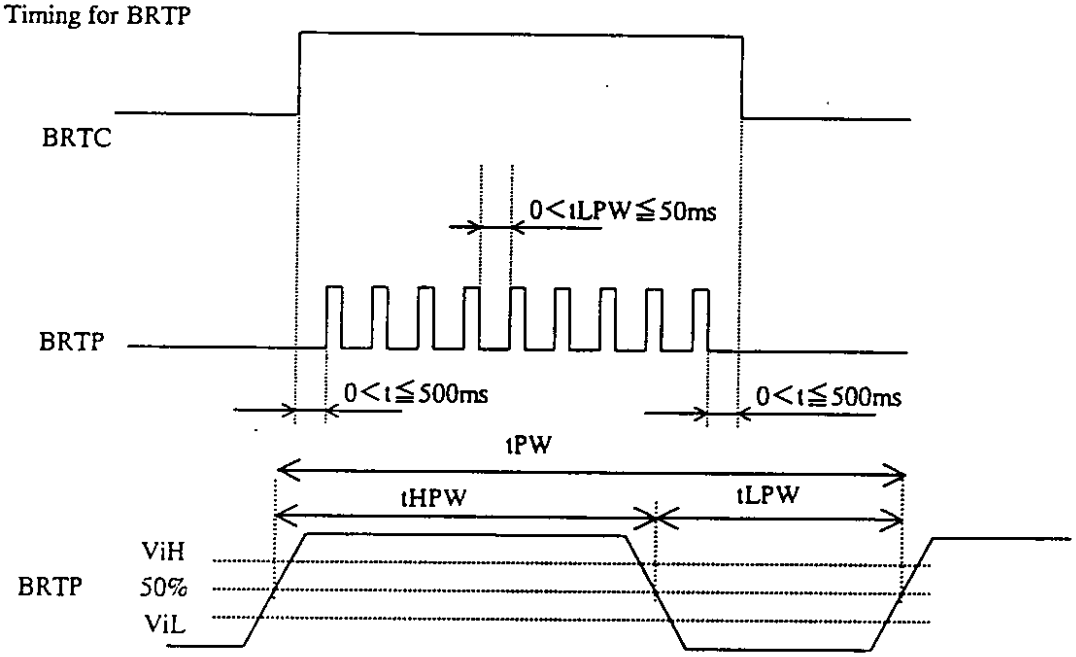
Mating variable resistor: 10kΩ ±5%, B curve
Maximum luminance (100%) : R=10kΩ
Minimum luminance (30%) : R=0Ω

(2) A way of luminance control by voltage
BRTH should be fixed to 0V to control luminance by voltage. The range of input voltage between BRTL and GNDB is as follows.
Maximum luminance (100%,ACA=H): 1 V (typ.)
Minimum luminance (30%,ACA=H): 0 V

Note 3: The way of luminance control with BRTP signal

Outside control is valid, when PWSEL="L" and input signal for BRTP. Luminance can be controlled by the duty value of input signal for BRTP.
Duty=100%: luminance is maximum. (100%)
Duty=20%: luminance is minimum. (30%)

Timing for BRTP



Parameters	Symbols	Min.	Typ.	Max.	Unit	Remarks
Frequency	1/tPW	185	–	325	Hz	–
"L" period	tLPW	–	–	50	ms	
Pulse-width	tHPW/tPW	20	–	100	%	at max. luminance (100%)
Input voltage	ViL	0	–	0.8	V	–
	ViH	2.0	–	5.25	V	–

Regarding set up for frequency, refer to the below method.
Set up frequency = Vsync frequency × (n+0.25) or (n+0.75)
Adopt the frequency evaluating the display quality, because the display will be disturbed depend on frequency.

12. METHOD OF CONNECTION FOR THC63LVDF83A

System side ◄——► LCD module side

		TRANSMITTER			I/F CN		RECIEVER			INPUT to LCD
		pin	THC63LVDM83A	pin	pin	CN1	pin	THC63LVDM84A	pin	
Odd pixel data and control signal	RA2	51	TA0		1	NC		RA0	27	RA2
	RA3	52	TA1		2	NC		RA1	29	RA3
	RA4	54	TA2		3	GND		RA2	30	RA4
	RA5	55	TA3		4	GND		RA3	32	RA5
	RA6	56	TA4	48	5	DA0-	9	RA4	33	RA6
	RA7	3	TA5	47	6	DA0+	10	RA5	35	RA7
	GA2	4	TA6		7	GND		RA6	37	GA2
	GA3	6	TB0	46	8	DA1-	11	RB0	38	GA3
	GA4	7	TB1	45	9	DA1+	12	RB1	39	GA4
	GA5	11	TB2		10	GND		RB2	43	GA5
	GA6	12	TB3	42	11	DA2-	15	RB3	45	GA6
	GA7	14	TB4	41	12	DA2+	16	RB4	46	GA7
	BA2	15	TB5		13	GND		RB5	47	BA2
	BA3	19	TB6	40	14	CKA-	17	RB6	51	BA3
	BA4	20	TC0	39	15	CKA+	18	RC0	53	BA4
	BA5	22	TC1		16	GND		RC1	54	BA5
	BA6	23	TC2	38	17	DA3-	19	RC2	55	BA6
	BA7	24	TC3	37	18	DA3+	20	RC3	1	BA7
	Hsync	27	TC4		19	GND		RC4	3	Hsync
	Vsync	28	TC5		20	Reserved		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
Even pixel data	RB2	51	TA0		1	NC		RA0	27	RB2
	RB3	52	TA1		2	NC		RA1	29	RB3
	RB4	54	TA2		3	GND		RA2	30	RB4
	RB5	55	TA3		4	GND		RA3	32	RB5
	RB6	56	TA4	48	5	DB0-	9	RA4	33	RB6
	RB7	3	TA5	47	6	DB0+	10	RA5	35	RB7
	GB2	4	TA6		7	GND		RA6	37	GB2
	GB3	6	TB0	46	8	DB1-	11	RB0	38	GB3
	GB4	7	TB1	45	9	DB1+	12	RB1	39	GB4
	GB5	11	TB2		10	GND		RB2	43	GB5
	GB6	12	TB3	42	11	DB2-	15	RB3	45	GB6
	GB7	14	TB4	41	12	DB2+	16	RB4	46	GB7
	BB2	15	TB5		13	GND		RB5	47	BB2
	BB3	19	TB6	40	14	CKB-	17	RB6	51	BB3
	BB4	20	TC0	39	15	CKB+	18	RC0	53	BB4
	BB5	22	TC1		16	GND		RC1	54	BB5
	BB6	23	TC2	38	17	DB3-	19	RC2	55	BB6
	BB7	24	TC3	37	18	DB3+	20	RC3	1	BB7
	RSVD	27	TC4		19	GND		RC4	3	RSVD
	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	NC		RD5	50	BB1
	RSVD	25	TD6		28	VDD:12V		RD6	2	RSVD
	CLK	31	CLKIN		29	VDD:12V		CLKOUT	26	CLKB
					30	VDD:12V				

※ RSVD must be connected to the GND.

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	0
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	↑					:								:								:			
	↓					:								:								:			
	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: Colors are developed in combination with 8-bit signals (256 steps in grayscale) of each primary red, green, and blue color. This process can result in up to 16,777,216 (256×256×256) colors.

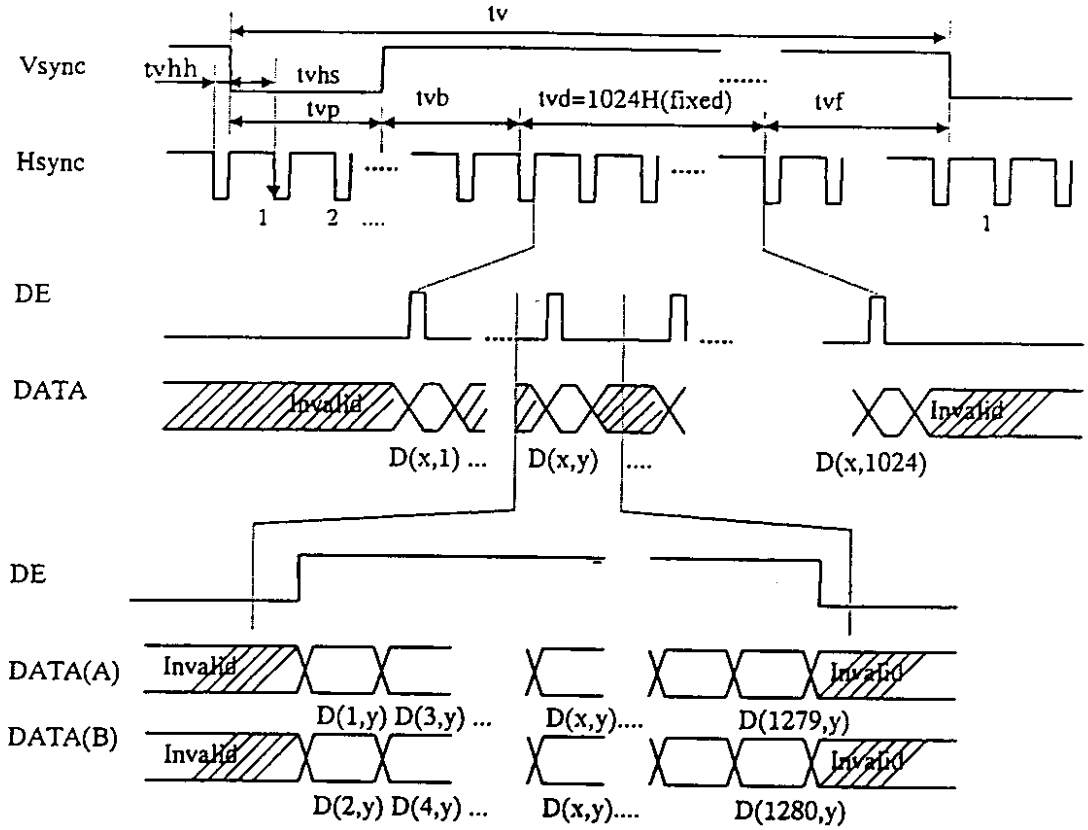
14. INPUT SIGNAL TIMINGS

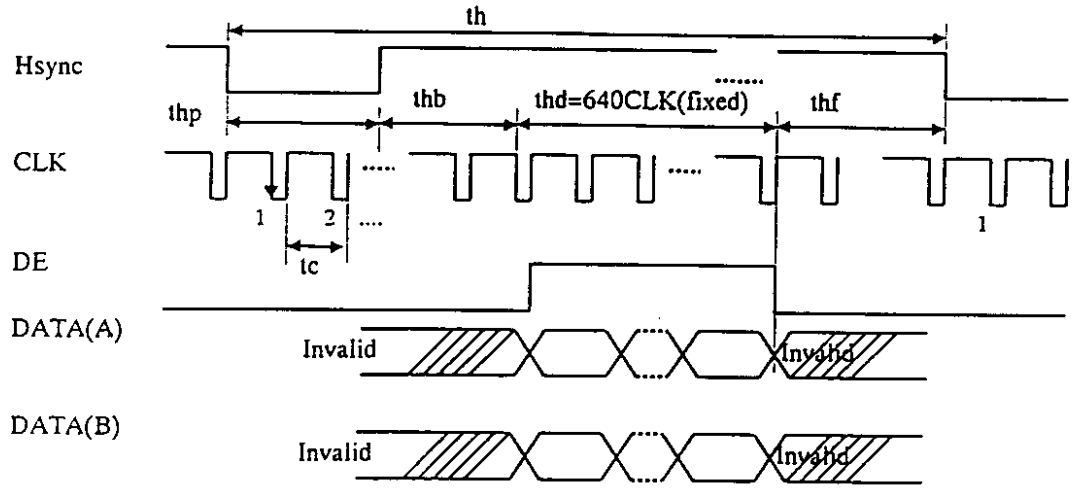
(1) Input signal specification for LCD controller

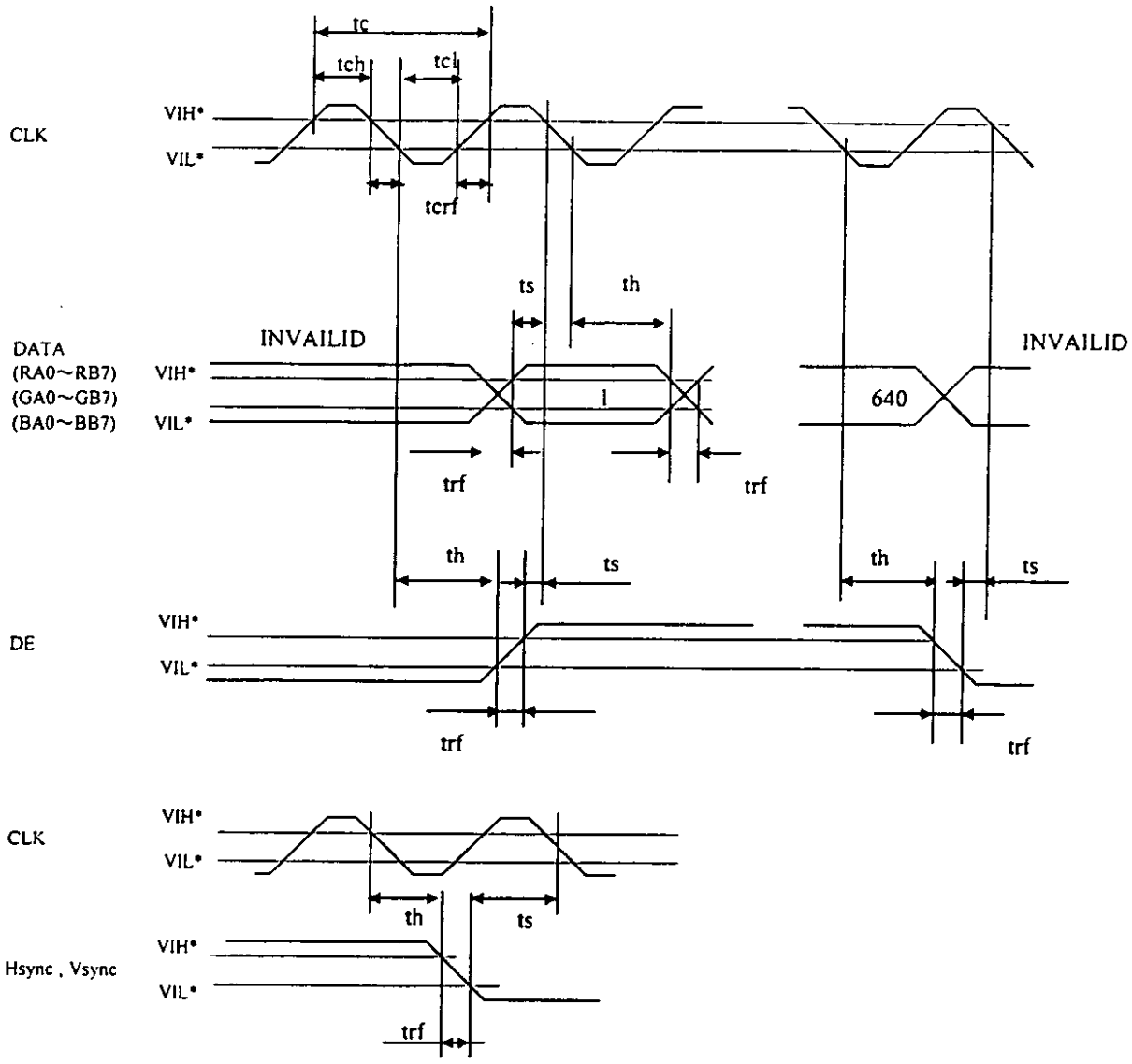
	Parameters		Symbols	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency	Vf=75Hz	1/tc	65.0 —	67.5 14.815	70.0 —	MHz ns	—
		Vf=60Hz		51.5 —	54.0 18.52	56.5 —	MHz ns	
	Duty		tch/tcl	note 1			—	—
	Rise, fall		tcrf				ns	—
Hsync	Period	Vf=75Hz	th	(12.3) (750)	12.504 844	— —	ms CLK	Typ=80.0kHz
		Vf=60Hz		(12.3) (750)	15.630 844	— —	ms CLK	Typ=64.0kHz
	Display period		thd	—	640	—	CLK	—
	Front-porch		thf	—	—	—	CLK	—
	Pulse width	Vf=75Hz	thp *	—	72	—	CLK	—
		Vf=60Hz		—	56	—	CLK	
	Back-porch		thb *	—	124	—	CLK	—
	* thp + thb			(110)	—	—	CLK	—
Vsync	Period	Vf=75Hz	tv	— (1027)	13.329 1066	— —	ms H	Typ=75.0Hz
		Vf=60Hz		— (1027)	16.661 1066	— —	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	—
	* tvp + tvb +tvf			(1980)	—	—	H	—
	Vsync-Hsync timing		tvhs	1	—	—	CLK	—
	Hsync-Vsync timing		tvhh	1	—	—	CLK	—
	Rise, fall		trf	note 1			ns	—
DATA	DATA-CLK (Set up)		ts				ns	—
	CLK-DATA (Hold)		th				ns	—

Note 1: These values are in the timing standard of THC63LVDF83A.
Timing standard prescribes in the input of LVDS transmitter.
THC63LVDF83A is recommended in LVDS transmitter.

(2) Input signal timing chart for LCD





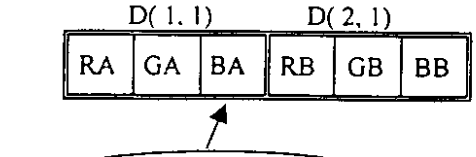


Note 1: See the specifications of LVDS manufactures for detailed design.

(3) Display position of input data

Odd Pixel: RA=R DATA
Odd Pixel: GA=G DATA
Odd Pixel: GA=B DATA

Even Pixel : RB=R DATA
Even Pixel : GB=G DATA
Even Pixel : BB=B DATA



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 ℃, VDD=12V, VDDB=12V, Note 1)

Parameters	Symbols	Conditions	Min.	Typ.	Max.	Unit	Remarks
Contrast ratio	CR	White / Black	—	400	—	—	Note 2
Luminance	Lumax	"White"	150	200	—	cd/m^2	Note 5
Luminance uniformity	—	max. / min.	—	1.1	1.30	—	Note 6

Reference data

(Ta=25℃, VDD=12V, VDDB=12V)

Parameters	Symbols	Conditions	Min.	Typ.	Max.	Unit	Remarks
Chromaticity Coordinates	W	White (x, y)	-	0.31, 0.31	-	-	-
	R	Red (x, y)	-	0.61, 0.34	-	-	-
	G	Green (x, y)	-	0.32, 0.60	-	-	-
	B	Blue (x, y)	-	0.15, 0.09	-	-	-
Color gamut	C	θR=0°, θL=0°,θU=0°, θD=0°, at center, to NTSC	50	60	-	%	-
Viewing angle range (CR>10)	θ R	CR > 10, White/Black θU=0°, θD=0°	70	85	-	deg.	Note 3
	θ L		70	85	-	deg.	
	θ U	CR > 10, White/Black θR=0°, θL=0°	70	85	-	deg.	
	θ D		70	85	-	deg.	
Viewing angle range (CR>5)	θ R	CR > 5, White/Black θU=0°, θD=0°	-	85	-	deg.	
	θ L		-	85	-	deg.	
	θ U	CR > 5, White/Black θR=0°, θL=0°	-	85	-	deg.	
	θ D		-	85	-	deg.	
Response time	Ton	Black to White	-	45	70	ms	Note 4
	Toff	White to Black	-	35	60		
Luminance control range	—	Maximum luminance: 100%	-	30 to 100	-	%	-

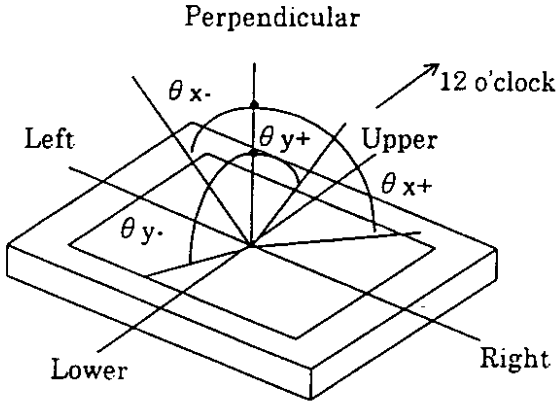
Note 1: Viewing angle is $\theta x = \pm 0^\circ$, $\theta y = \pm 0^\circ$. At center.

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

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

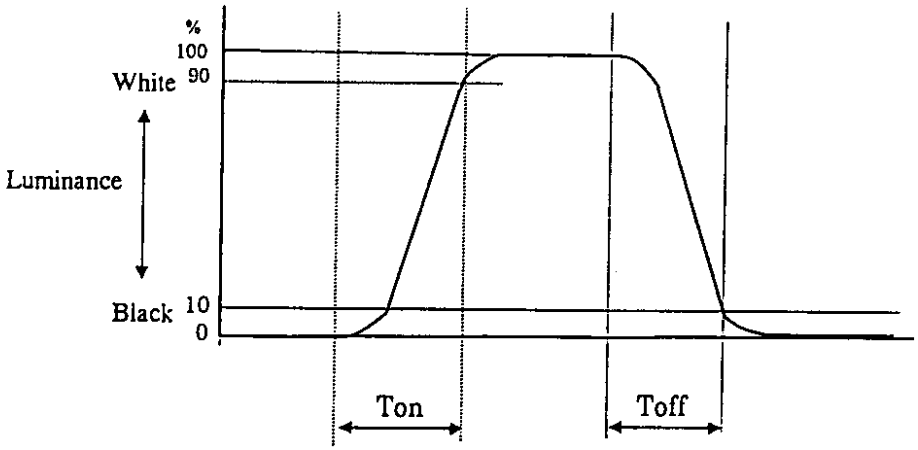
The luminance is measured in a darkroom.

Note 3: Definitions of viewing angle are as follows.

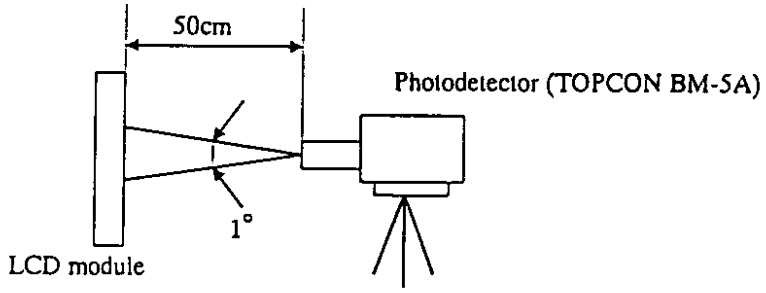


Note 4: Definition of response time is as follows.

Photo-detector output signal is measured when the luminance changes "black to white" or "white to black".



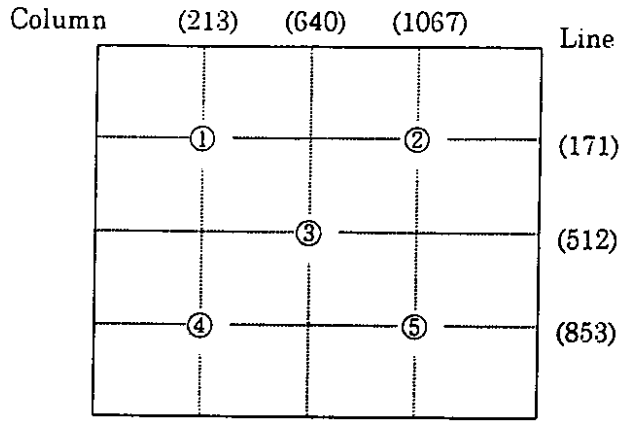
Note 5: The luminance is measured after 20 minutes from the module works, with all pixels in "white".



Note 6: The luminance uniformity is calculated by using following formula.

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

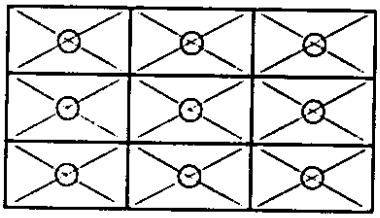
The luminance is measured at near the five points shown below.



16. RELIABILITY TEST

Test items	Test conditions	Judgment
High temperature/humidity operation	60±2℃, RH=60% 240 hours, Display data is black.	*1
Heat cycle (operation)	① 0℃±3℃···1 hour 55℃±3℃···1 hour ② 50 cycles , 4 hours/cycle ③ Display data is black.	*1
Thermal shock (non-operation)	① -20℃±3℃···30 minutes 60℃±3℃···30 minutes ② 100 cycles ③ Temperature transition time is within 5 minutes.	*1
Vibration (non-operation)	① 5-100Hz, 11.76m/s^2 (1.2G), 1 minute/cycle, X,Y,Z direction ② 10 times each direction	*1, *2
Mechanical shock (non-operation)	① 294m/s^2 (30G), 11ms X,Y,Z direction ② 3 times each direction	*1, *2
ESD (operation)	150pF, 150Ω, ±10kV 9 places on a panel *3 10 times each place at one-second intervals	*1
Dust (operation)	15 kinds of dust (JIS-Z 8901) Hourly 15 seconds stir, 8 times repeat	*1

*1: Display function is checked by the same condition as LCD module out-going inspection.
*2: Physical damage
*3: Discharge points are shown in the figure.



17. EXPECTED LIFE-TIME OF THE LAMP

	Lamp
Conditions	Luminance Maximum Room temp. (25±2℃) , Continuous operation
Expected value (MTTF)	50,000h
Criteria	Half value luminance (compared with initial value.)

Note 1: The lifetime is expected value (reference).
Note 2: This module consists of eight lamps.
Note 3: Chromaticity coordinates change after the expected lifetime.

18. GENERAL CAUTIONS

Because next figures and sentences are very important, please understand these contents as follows.

⚠ CAUTION	This figure is a mark that you will get hurt and/or the module will have damages when you make a mistake to operate.

	This figure is a mark that you will get an electric shock when you make a mistake to operate.
	This figure is a mark that you will get hurt when you make a mistake to operate.

⚠ CAUTIONS

	Do not touch an inverter –on which a caution label is stucked– while the LCD module is under the operation, because of dangerous high voltage.

(1) Caution when taking out the module

a. Pick a pouch only, when taking out the module from a carrier box.

(2) Cautions for handling the module

a. As the electrostatic discharges may break the LCD module, handle the LCD module with care against electrostatic discharges.

b.  As the LCD panel and backlight element are made from fragile glass material, impulse and pressure to the LCD module should be avoided.

c. As the surface of polarizer is very soft and easily scratched, use a soft dry cloth without chemicals for cleaning.

d. Do not pull the interface connectors in or out while the LCD module is operating.

e. Put the module display side down on a flat horizontal plane.

f. Handle connectors and cables with care.

g. When the module is operating, do not lose CLK, HS, or Vsync signal. If any one or more of these signals is lost, the LCD panel would be damaged.

h. The torque for mounting screw should never exceed 0.451 N · m (4.6kgf · cm).

i. Don't push or rub the surface of LCD module.
If you do, the scratches or the rubbing marks may be left on the surface of the module.

j. Do not put front side (display surface side) of the module on a desk or a table for a long time, because the display may become un-uniformity

(3) Cautions for the atmosphere

a. Dew drop atmosphere must be avoided.

b. Do not store and/or operate the LCD module in a high temperature and/or high humidity atmosphere. Storage in an anti-static pouch and under the room temperature atmosphere is recommended.

c. This module uses cold cathode fluorescent lamps. Therefore, the life of lamps becomes short if the module is operated in the low temperature environment.

d. Do not operate the LCD module in high magnetic field.

(4) Cautions for the module characteristics

a. Do not apply any fixed patterns for a long time to the LCD module. It may cause image sticking. Please use the screen savers if the display pattern is fixed for a long time.

b. This module has the retardation film, which may cause the variation of the color hue in the different viewing angles. The ununiformity may appear on the screen under the high temperature operation.

c. The light vertical stripe may be observed depending on the display pattern. This is not defects nor malfunctions.

d. The noise from the inverter circuit may be observed in the luminance control mode. This is not defects nor malfunctions.

(5) Other cautions

a. Do not disassemble and/or reassemble LCD module.

b. Do not readjust any variable resistors or switches in the module.

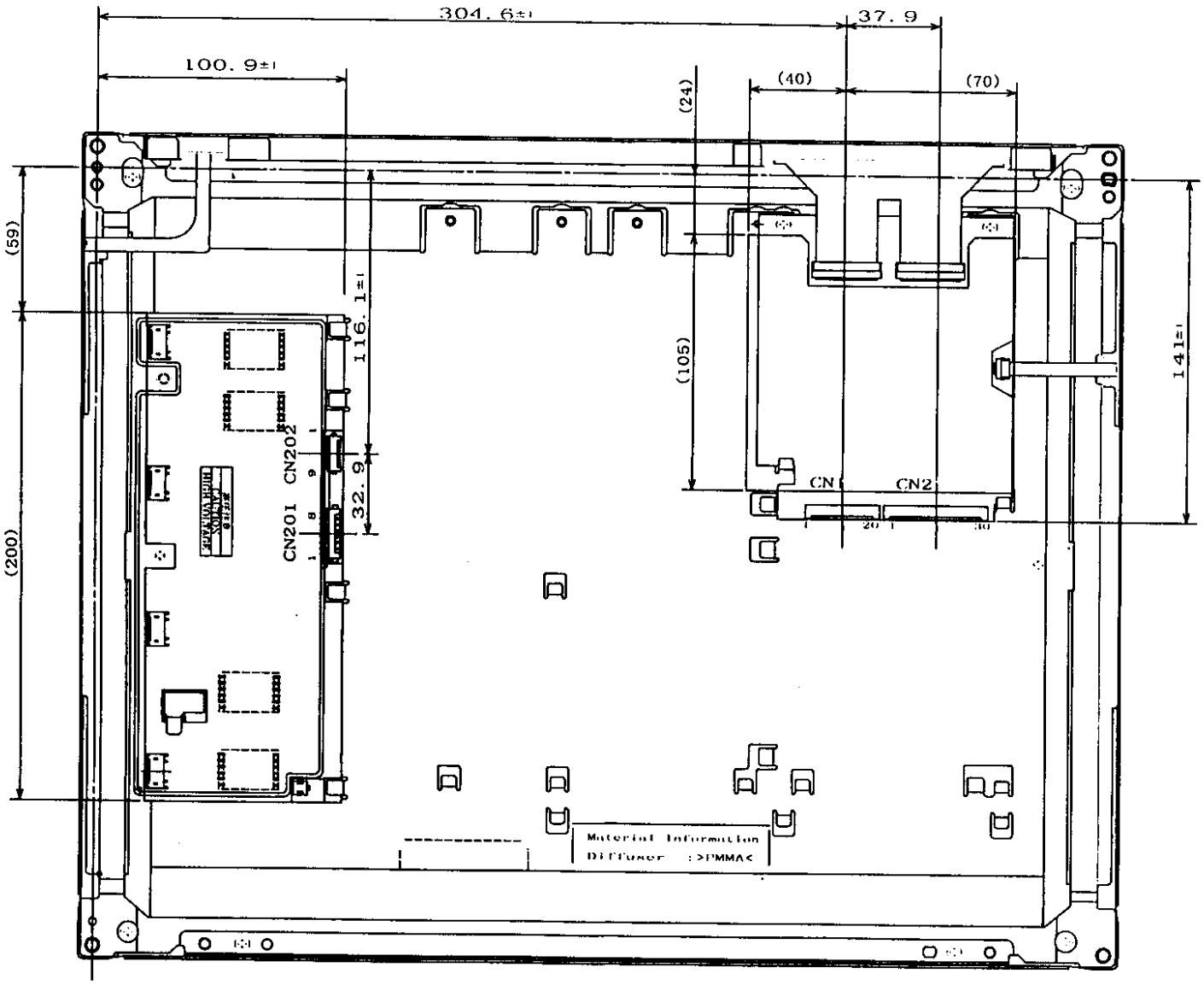
c. When returning the module for repair or etc., pack the module properly to avoid any damages. We recommend using the original shipping packages.

Liquid Crystal Display has the following specific characteristics. There are not defects or malfunctions.

The ambient temperature may affect the optical characteristics of this module.
This module has cold cathode tube for backlight. Optical characteristics, like luminance or uniformity, will be changed by the progress in time.

Uneven brightness and/or small spots may be observed depending on different display patterns.

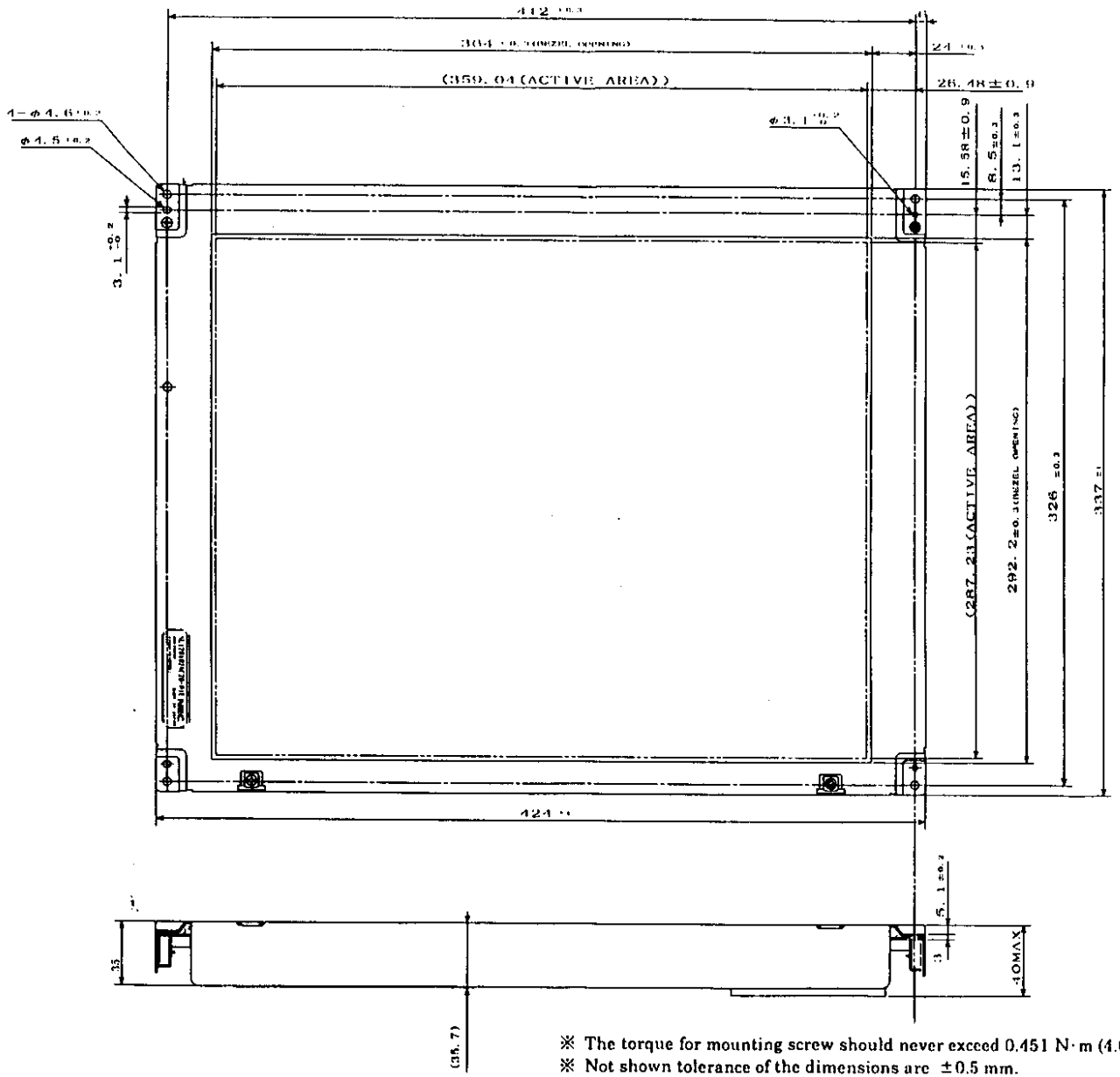
20.2 Rear view



※ The torque for mounting screw should never exceed 0.451 N·m (4.6 kgf·cm).
※ Not shown tolerance of the dimensions are ±0.5 mm.

19.OUTLINE DRAWINGS

19.1 Front view (Unit: mm)



※ The torque for mounting screw should never exceed 0.451 N·m (4.6 kgf·cm).

※ Not shown tolerance of the dimensions are ±0.5 mm.

Rev.	prepared date	Revision contents	Approved	Checked	Prepared	Issued date
1	Oct. 27, 1999	DOD-H-7485		—	Y. Okuda	