NEC

TFT COLOR LCD MODULE

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

DATA SHEET

(1st Edition)

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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 (with lateral electric field)
· Low reflection
· LVDS interface (THC63LVDF84A ×2pcs, THine Electronics, Inc.)
· High luminance and Low reflection
· Incorporated direct type backlight (Eight lamps in a lamp unit, Inverter)
· Replaceable lamp unit (Part No.: 181LHS05)
· Approved by UL1950 Third Edition (File No. E170632) and CSA-C22.2 No. 950-95 (File No. E170632)

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 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.
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)

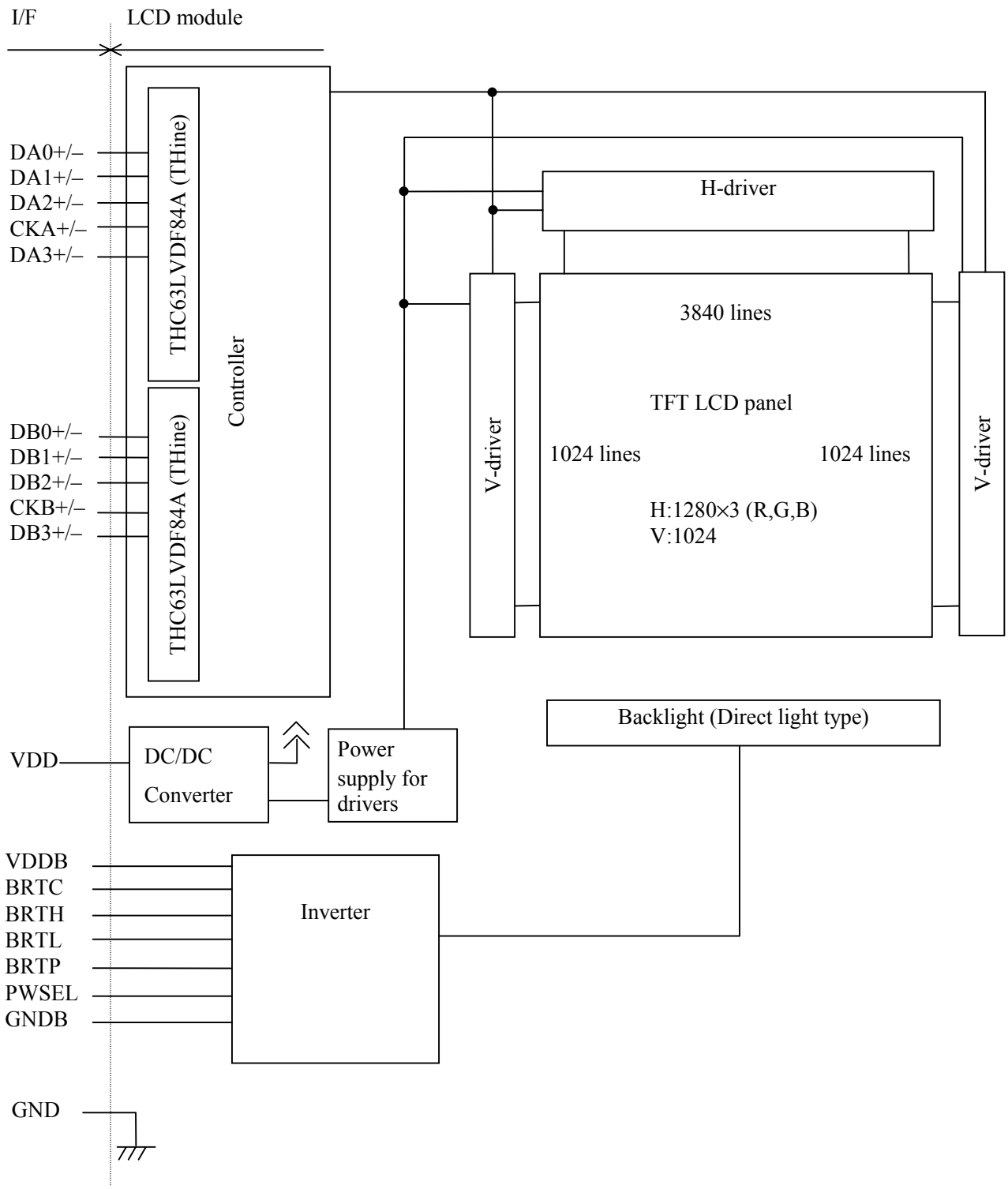
Display area	359.04 (H)×287.232 (V) mm
Drive system	a-Si TFT active matrix
Display colors	16,777,216 colors
Number of pixels	1280×1024
Pixel arrangement	RGB vertical stripe
Pixel pitch	0.2805(H) ×0.2805(V)mm
Module size	424.0(H) ×337.0(V) ×38.5 typ.(D) mm
Weight	1950 g (typ.)
Contrast ratio	300:1 (typ.)

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	40 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.: 181LHS05 · Inverter Parts No.: 181PW031
Power consumption	34.2 W (typ.)

6. BLOCK DIAGRAM



Note 1: GND is connected to Frame (FG). GNDB is not connected to GND.
GND and GNDB should be connected to FG in customer equipment.

7. GENERAL SPECIFICATIONS

Item	Specification	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	2050 (max.)	g

8. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit	Remarks
Supply voltage	VDD	-0.3 to +14.0	V	Ta = 25°C
	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	°C	-
Operating temperature	Top	0 to +55	°C	Module surface Note 1
Relative humidity (RH) Note 2		≤ 95	%	Ta ≤ 40°C
		≤ 85	%	40°C < Ta ≤ 50°C
		≤ 70	%	50°C < Ta ≤ 55°C
Absolute humidity Note 2		≤ 78 Note 3	g/m^3	Ta > 55°C

Note 1: Measured at the display area (Including self heat)
Note 2: No condensation
Note 3: Ta=55°C, RH=70%

9. ELECTRICAL CHARACTERISTICS

(1) Logic/ LCD driving

Ta = 25°C

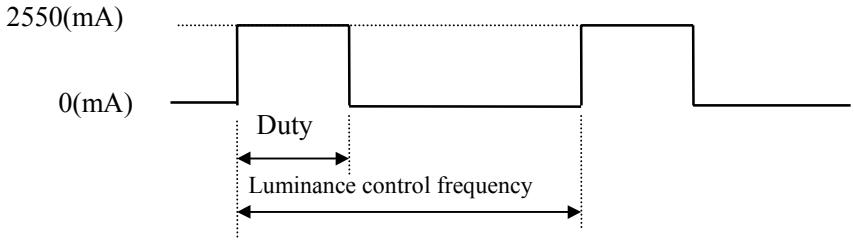
Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	VDD	11.4	12.0	12.6	V	-
Ripple voltage	Vrp	-	-	100	mV	for VCC
LVDS signal input "L" voltage	ViL	-100	-	-	mV	VCM=1.2V VCM: Common mode voltage in LVDS driver
LVDS signal input "H" voltage	ViH	-	-	+100	mV	
Input voltage width	Vi	-	-	2.4	V	-
Common mode voltage	VCM	1.125	1.25	1.375	V	Rt=100Ω
Terminating resistor	Rt	-	100	-	Ω	-
Supply current	IDD	-	300 Note 1	700	mA	VDD=12.0V

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

(2) Backlight

Ta = 25°C

Parameter	Symbol	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, 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, PWSEL
Logic input "H" current	IiH	-	-	440	µA	
Supply current	IDDB	-	2550	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	① R429005	Littel fuse	5A	① or ② is used.
	② MMCT 5A	SOC	5A	

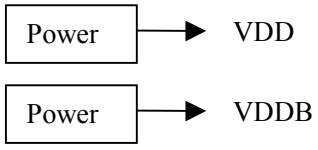
(4) Ripple of supply voltage

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

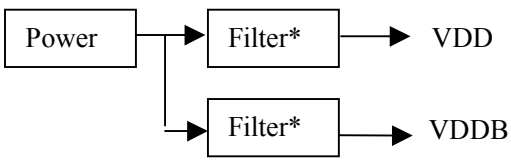
Note 1:The acceptable range of ripple voltage includes spike noise.

Example of the power supply connection

a) Separate the power supply

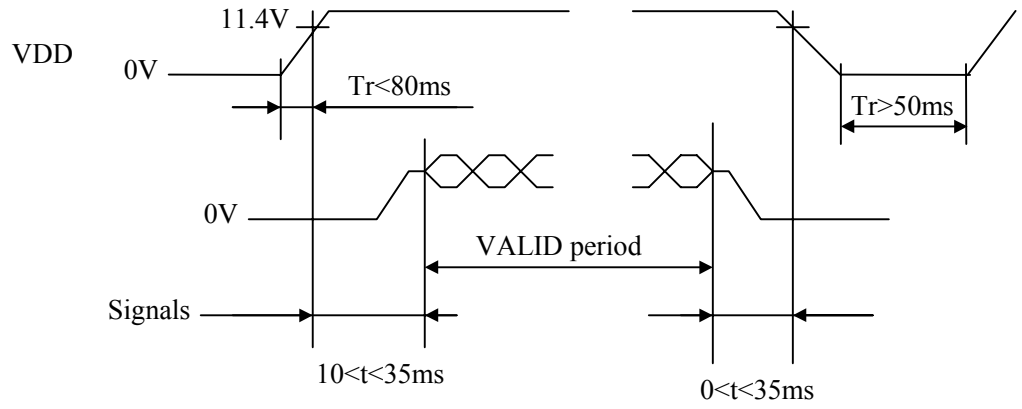


b) Put the filter

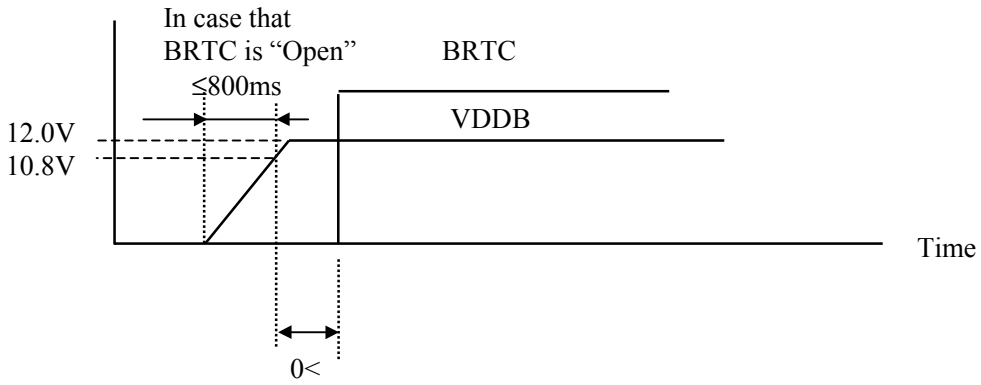


Filter* (reference value)
L = 10µH to 100µH
C = 10µF to 100µF

10. SUPPLY VOLTAGE SEQUENCE



Voltage



*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" PWSEL, when VDDB is 0V or BRTC is "L".

11. INTERFACE PIN CONNECTIONS

(1) Interface connector for signal and power

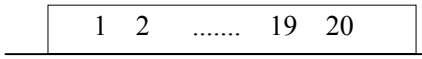
CN1

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

Pin No.	Symbol	Signal type	Function
1	N.C.	Non-Connection	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.	Non-Connection	Keep the terminal open

Note 1: GND is signal ground for logic and LCD driving. GND is connected to FG.
Note 2: Connect all pins (except 1,2 and 20) to avoid noise issue. Use 100Ω twist pair wires for the Cable.

CN1: Figure from socket view



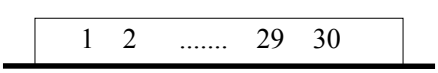
CN2

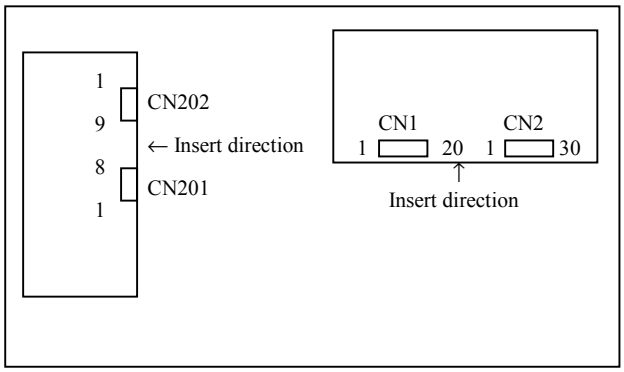
Part No. : 53780-3010
Adaptable socket : 51146-3000
Supplier : Molex Incorporated.

Pin No.	Symbol	Signal type	Function
1	N.C.	Non-Connection	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	Reserved	Reserved	Keep the terminal open
21	Reserved		
22	Reserved		
23	Reserved		
24	GND	Ground	Connect to system ground
25	GND		
26	GND		
27	N.C.	Non-Connection	Keep the terminal open
28	VDD	+12V Power Supply	12V±5%
29	VDD		
30	VDD		

Note 1: GND is signal ground for logic and LCD driving. GND is connected to FG.
Note 2: Connect all pins (except 1,2,20-23,27) to avoid noise issue. Use 100Ω twist pair wires for the cable.

CN2: Figure from socket view





(2) Connector for backlight unit

CN201

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

Pin No.	Symbol	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		

Note 1: GNDB is not connected to FG.
GND and GNDB should be connected to FG in customer equipment.

CN201: Figure from socket view

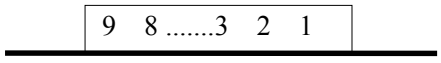
CN202

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

Pin No.	Symbol	Signal type	Function
1	GNDB	Ground for backlight	Note 1
2	N.C.	Non-Connection	Keep the terminal open
3	N.C.		
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)

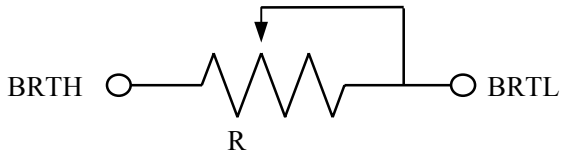
Note 1: GNDB is not connected to FG.
GND and GNDB should be connected to FG in customer equipment.

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 10kΩtype, and zero point of the resistor corresponds to the minimum of luminance.



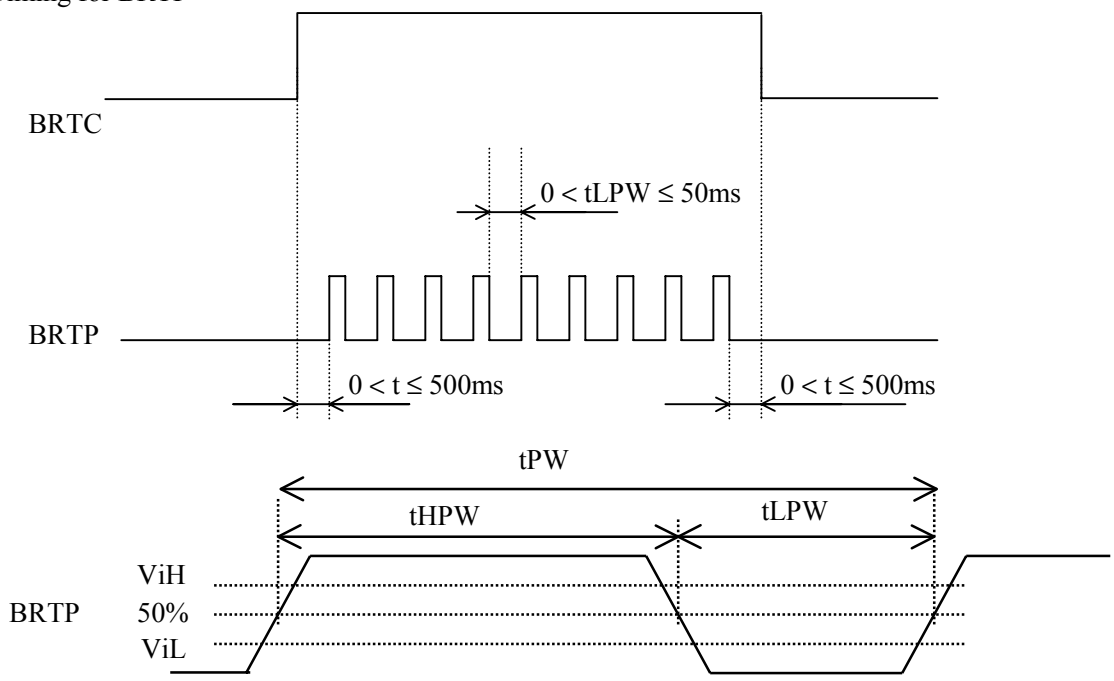
Mating variable resistor: 10kΩ ± 5%, B curve
Maximum luminance (100%): R=10kΩ
Minimum luminance (30%): R=0Ω

(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



Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Frequency	1/tPW	185	-	325	Hz	Note 1
"L" period	tLPW	-	-	50	ms	Note 2
Pulse-width	tHPW/tPW	20	-	100	%	at max. luminance (100%)
Luminance ratio	-	-	30 to 100	-	%	-
Input voltage	ViL	0	-	0.8	V	-
	ViH	2.0	-	5.25	V	-

Note 1: 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.

Note 2: The protection circuit makes the backlight turns off, when tLPW is more than 50ms.

12. METHOD OF CONNECTION FOR THC63LVDF83A

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	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	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	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
Note1	CLK	→	31	CLKIN			pin	CN2				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	TA-	48	→ 5	DB0-	→	9	RA-	RA4	33	→ RB6
	RB7	→	3	TA5	TA+	47	→ 6	DB0+	→	10	RA+	RA5	35	→ RB7
	GB2	→	4	TA6			7	GND				RA6	37	→ GB2
	GB3	→	6	TB0	TB-	46	→ 8	DB1-	→	11	RB-	RB0	38	→ GB3
	GB4	→	7	TB1	TB+	45	→ 9	DB1+	→	12	RB+	RB1	39	→ GB4
	GB5	→	11	TB2			10	GND				RB2	43	→ GB5
	GB6	→	12	TB3	TC-	42	→ 11	DB2-	→	15	RC-	RB3	45	→ GB6
	GB7	→	14	TB4	TC+	41	→ 12	DB2+	→	16	RC+	RB4	46	→ GB7
	BB2	→	15	TB5			13	GND				RB5	47	→ BB2
	BB3	→	19	TB6	TCLK-	40	→ 14	CKB-	→	17	RCLK-	RB6	51	→ BB3
	BB4	→	20	TC0	TCLK+	39	→ 15	CKB+	→	18	RCLK+	RC0	53	→ BB4
	BB5	→	22	TC1			16	GND				RC1	54	→ BB5
	BB6	→	23	TC2	TD-	38	→ 17	DB3-	→	19	RD-	RC2	55	→ BB6
	BB7	→	24	TC3	TD+	37	→ 18	DB3+	→	20	RD+	RC3	1	→ BB7
	RSVD	→	27	TC4			19	GND				RC4	3	→ RSVD
Note1	RSVD	→	28	TC5			20	Reserved				RC5	5	→ RSVD
	RSVD	→	30	TC6			21	Reserved				RC6	6	→ RSVD
	RB0	→	50	TD0			22	Reserved				RD0	7	→ RB0
	RB1	→	2	TD1			23	Reserved				RD1	34	→ RB1
	GB0	→	8	TD2			24	GND				RD2	41	→ GB0
	GB1	→	10	TD3			25	GND				RD3	42	→ GB1
	BB0	→	16	TD4			26	GND				RD4	49	→ BB0
	BB1	→	18	TD5			27	NC				RD5	50	→ BB1
	RSVD	→	25	TD6			28	VDD:12V				RD6	2	→ RSVD
Note1	CLK	→	31	CLKIN			29	VDD:12V				CLKOUT	26	→ CLKB
							30	VDD:12V						

Note 1: RSVD must be low level.

13. DISPLAY COLORS vs INPUT DATA SIGNALS

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

Note: 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

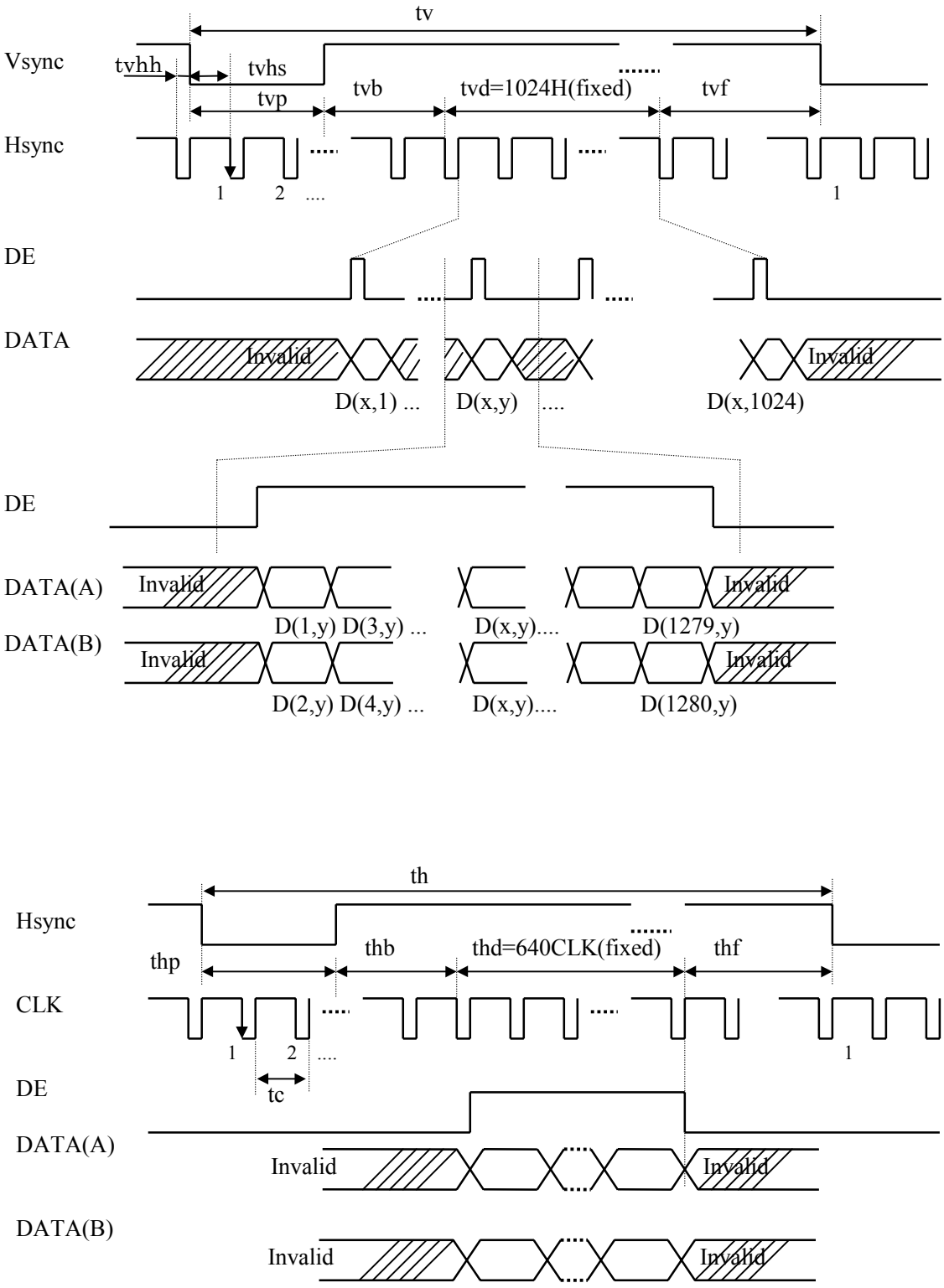
(1) Input signal specification for LCD controller

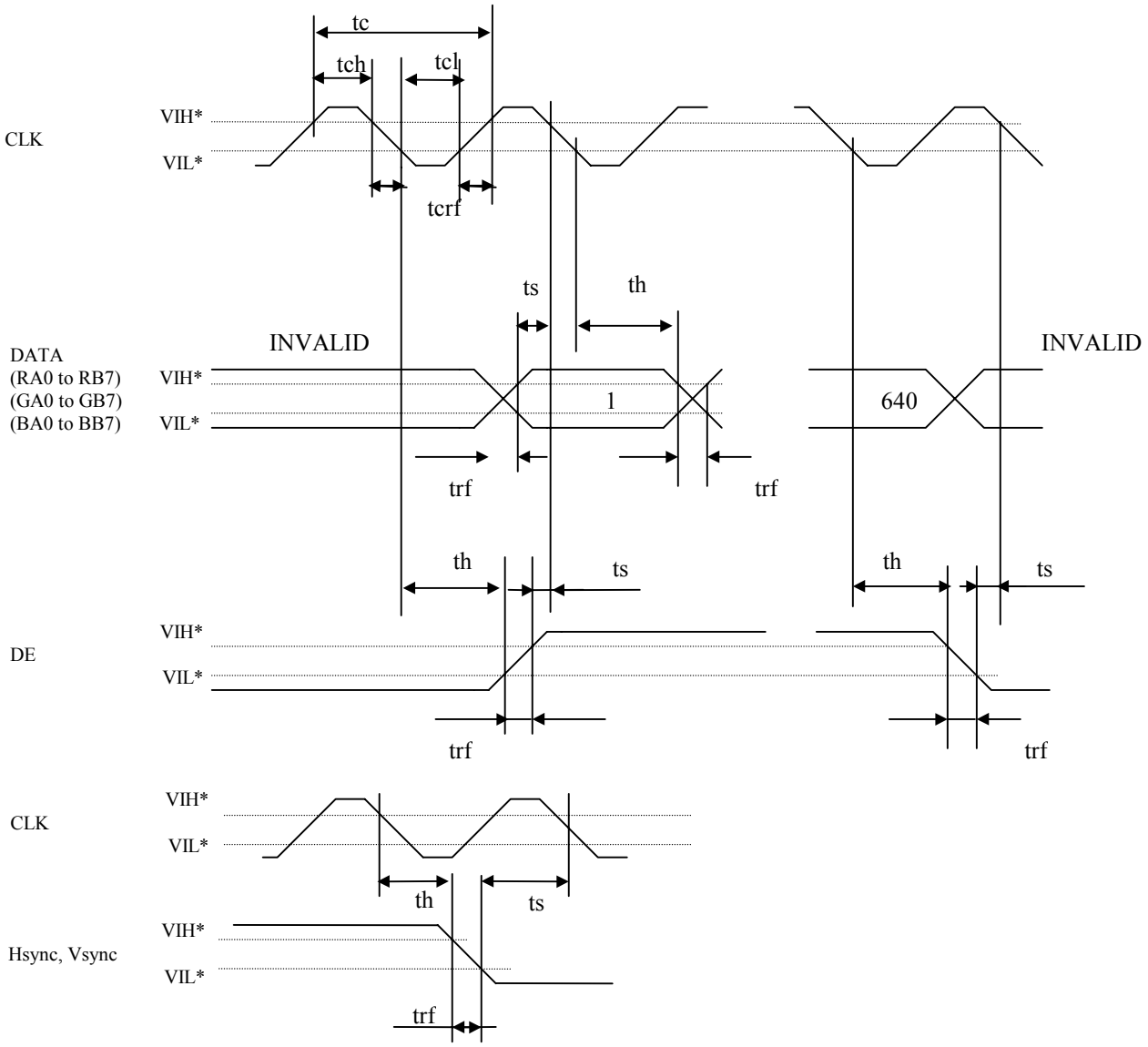
	Parameter		Symbol	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency	Vf=75Hz	1/tc	65.0	67.5	70.0	MHz	-
				-	14.815	-	ns	
		Vf=60Hz		51.5	54.0	56.5	MHz	
				-	18.52	-	ns	
	Duty		tch/tcl	note 1			-	-
	Rise, fall		tcrf				ns	-
Hsync	Period	Vf=75Hz	th	12.3	12.504	-	ms	Typ=80.0kHz
				750	844	-	CLK	
		Vf=60Hz		12.3	15.630	-	ms	Typ=64.0kHz
				750	844	-	CLK	
	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	-	13.329	17.47	ms	Typ=75.0Hz
				1027	1066	-	H	
		Vf=60Hz		-	16.661	17.47	ms	Typ=60.0Hz
				1027	1066	-	H	
	Display period		tvd	-	1024	-	H	-
	Front-porch		tvf *	-	1	-	H	-
	Pulse width		tvp *	-	3	-	H	-
	Back-porch		tvb *	-	38	-	H	-
	* tvp + tvb +tvf			4	-	-	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.

Note 2: Shipping inspection is used THC63LVDF83A as LVDS transmitter.

(2) Input signal timing chart for LCD



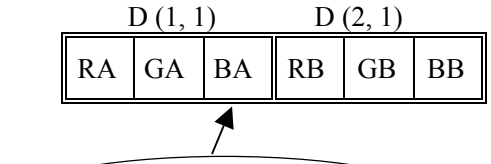


Note 1: See the specifications of LVDS manufactures for detailed design.

(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 °C, VDD=12V, VDDB=12V, Note 1)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Contrast ratio	CR	White / Black	200	300	-	-	Note 2
Luminance	Lvmax	"White"	150	200	-	cd/m^2	Note 5
Luminance uniformity	-	max. / min.	-	1.1	1.30	-	Note 6

Reference data

(Ta=25°C, VDD=12V, VDDB=12V)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Chromaticity Coordinates	W	White (x, y)	-	0.30, 0.31	-	-	-
	R	Red (x, y)	-	0.62, 0.34	-	-	-
	G	Green (x, y)	-	0.31, 0.59	-	-	-
	B	Blue (x, y)	-	0.14, 0.09	-	-	-
Color gamut	C	θR=0°, θL=0°,θU=0°, θD=0°, at center, to NTSC	50	60	-	%	-
Viewing angle range (CR>10)	θR	CR > 10, White/Black θU=0°, θD=0°	70	85	-	deg.	Note 3
	θL		70	85	-	deg.	
	θU	CR > 10, White/Black θR=0°, θL=0°	70	85	-	deg.	
	θD		70	85	-	deg.	
Viewing angle range (CR>5)	θR	CR > 5, White/Black θU=0°, θD=0°	-	85	-	deg.	
	θL		-	85	-	deg.	
	θU	CR > 5, White/Black θR=0°, θL=0°	-	85	-	deg.	
	θD		-	85	-	deg.	
Response time (Panel surface temperature =29°C)	Ton	Black to White	-	40	70	ms	Note 4
	Toff	White to Black	-	35	60		
Luminance control range	-	Maximum luminance: 100%	-	30 to 100	-	%	-

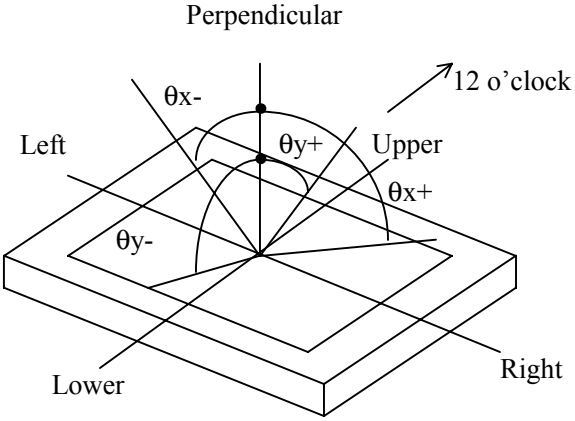
Note 1: Viewing angle is θx = ±0°, θy = ±0°, at center.

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

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

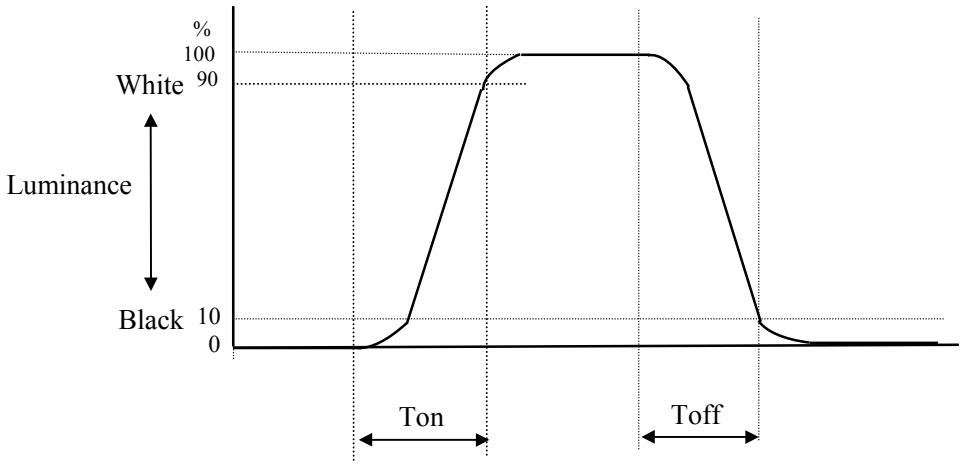
The luminance is measured in a darkroom.

Note 3: Definitions of viewing angle are as follows.

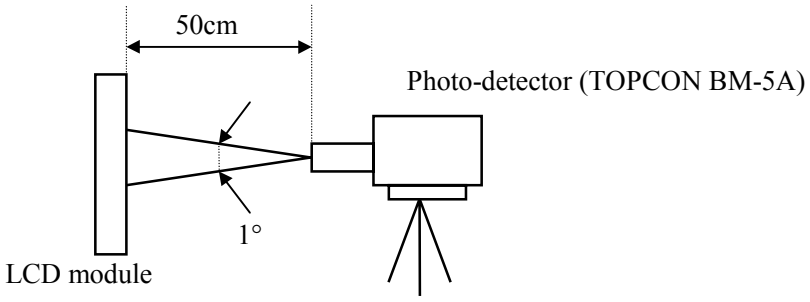


Note 4: Definition of response time is as follows.

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



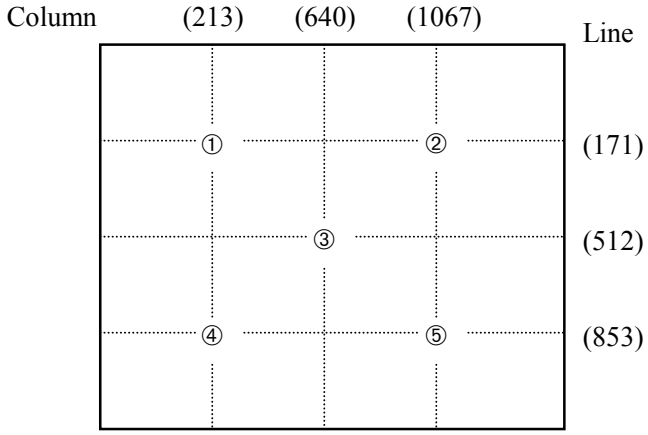
Note 5: The luminance is measured after 20 minutes from the module works, with all pixels in "white".



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

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

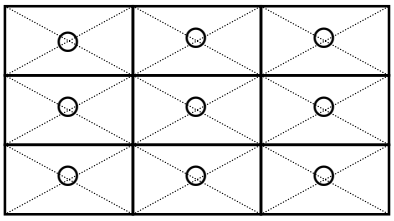
The luminance is measured at near the five points shown below.



16. RELIABILITY TEST

Test items	Test conditions	Judgment
High temperature/humidity operation	60 ± 2°C, RH=60% 240 hours, Display data is white.	*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 white.	*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.	*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. 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 stuck - 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 and high 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 un-uniformity 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.

d. Not only the module but also the equipment that used the module should be packed and transported, as the module becomes vertical. Otherwise, there is the fear that a display dignity decreases by an impact or vibrations.

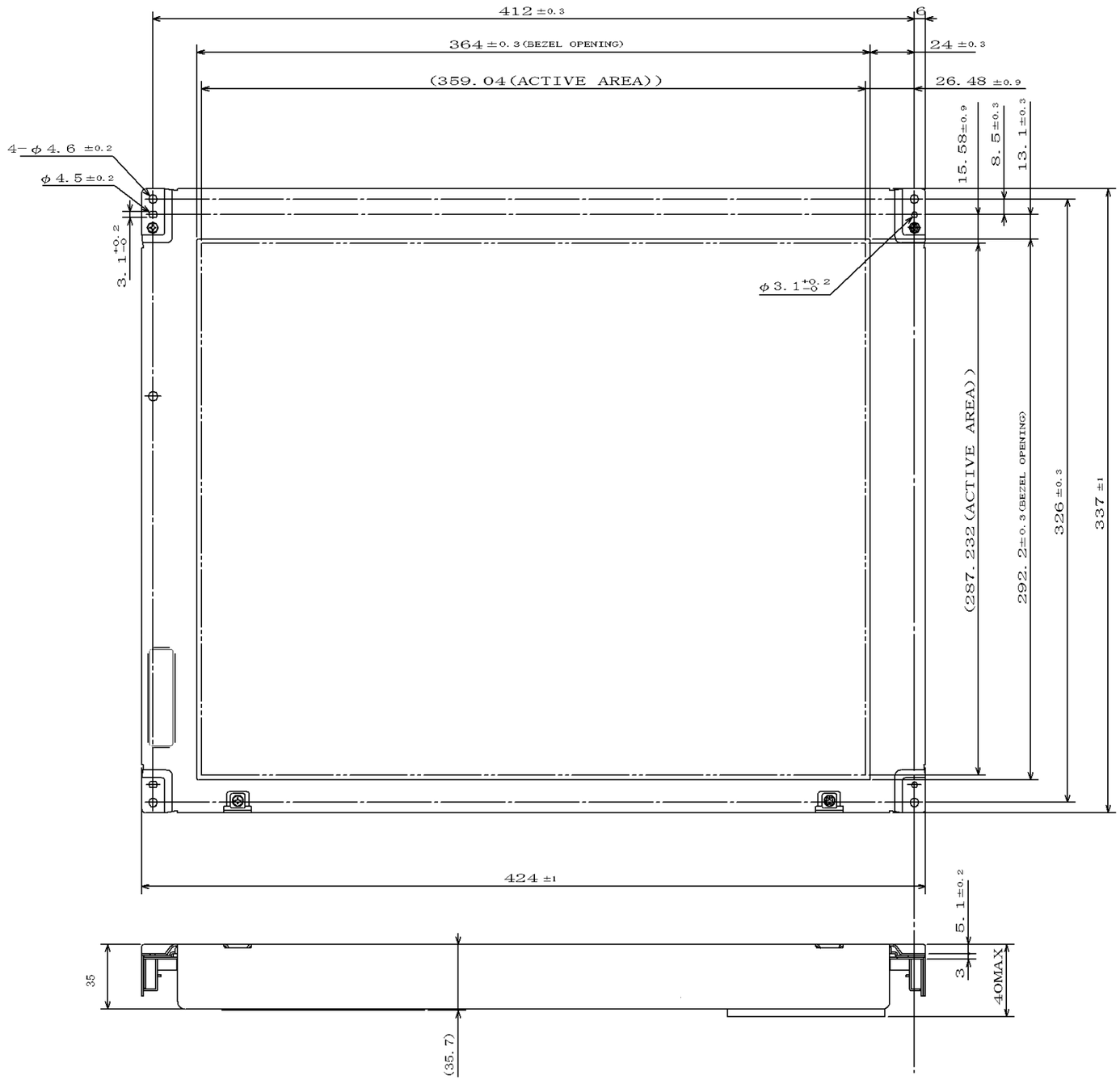
Liquid Crystal Display has the following specific characteristics. There are not defects or malfunctions.

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.

18.OUTLINE DRAWINGS

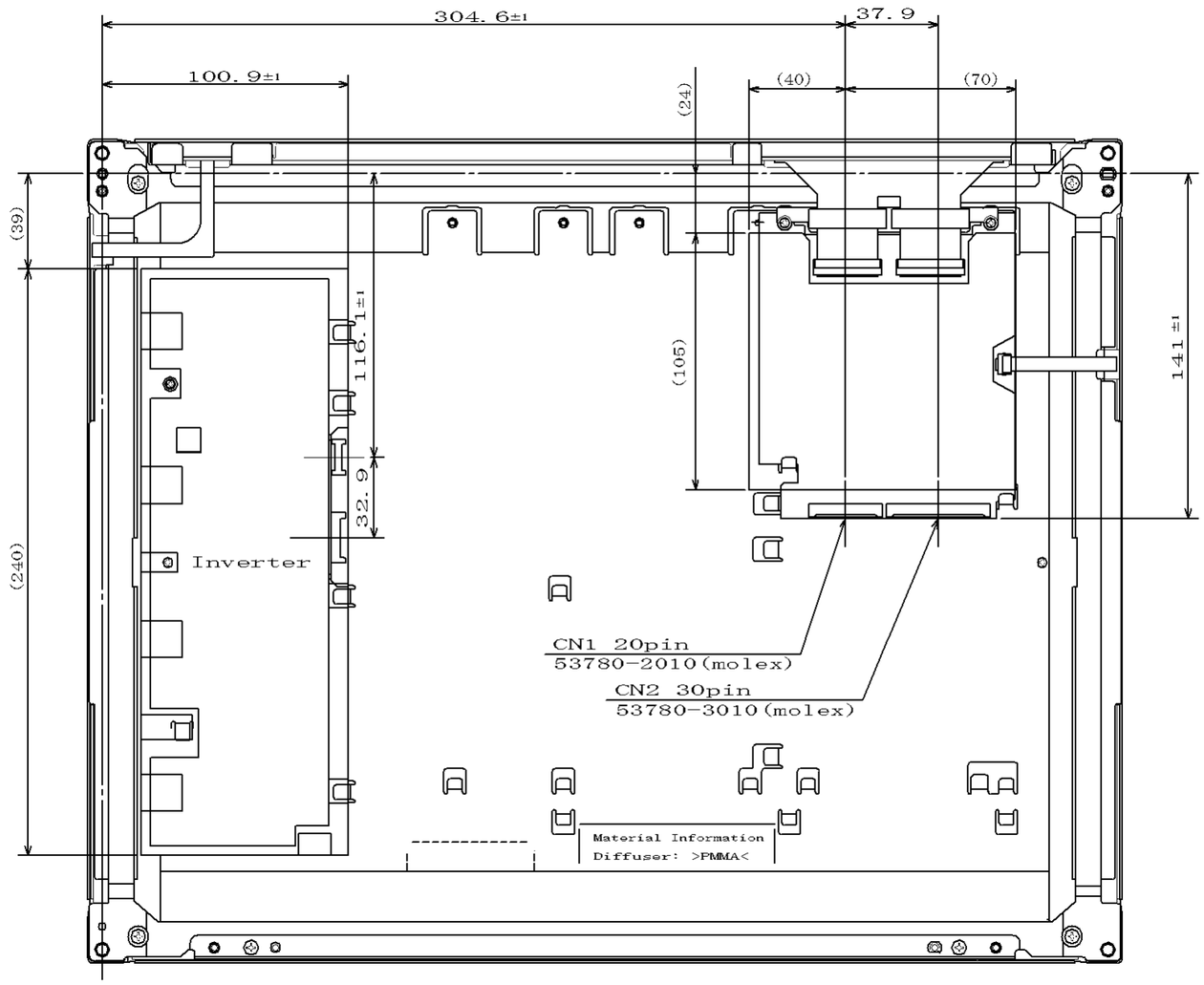
18.1 Front view (Unit: mm)



❊ 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.

18.2 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.

REVISION HISTORY

The inside of latest specifications is revised to the clerical error and the major improvement of previous edition. Only a changed part such as functions, characteristic value and so on that may affect a design of customers, are described especially below.

Edition	Document number	Prepared date	Revision contents and writer
1st edition	DOD - M – 0506	July 16, 2001	**Revision contents** Preliminary specifications (DOD-H-7822) → Data sheet (DOD-M-0506) P4 FEATURES: 181LHS03 → 181LHS05 P5 Backlight: 181LHS03 → 181LHS05 P6 512 lines → 1024 lines P7 Expression of absolute humidity is revised. P8 (3)Fuse: VDDB ② CCMT5A → MMCT5A P14 · Luminance ratio is added. · Note 2 is added. P24 Reliability test - test condition: black → white P24 Estimated life-time of the bare lamp is deleted. P26 (5) “d” is added. **Signature of writer** *Approved by* Toshihide Ito T. ITO *Checked by* _____ *Prepared by* N. Kano N. KANO