

**38 cm (15.0 inches), 1024 × 768 pixels, 262,144 colors,  
LVDS interface, Wide viewing angle, High luminance**

**DESCRIPTION**

NL10276AC30-04R 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. NL10276AC30-04R has a built-in backlight with inverter.

The 38 cm (15.0 inches) diagonal display area contains 1024 × 768 pixels and can display 262,144 colors simultaneously.

**FEATURES**

- Wide viewing angle (with retardation film)
- High luminance
- Low reflection
- LVDS interface (Equivalent of THC63LVDF64A, THine Electronics, Inc.)
- Incorporated edge type backlight (two lamps, inverter) and Lamp holder replaceable

**APPLICATIONS**

- Desk-top type of PC
- Engineering work station
- Display terminal for control system
- Monitor for process controller



The information in this document is subject to change without notice.

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

**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. The TFT panel structure is created by sandwiching liquid crystal material in the narrow gap between a TFT array glass substrate and a color filter glass substrate. After the driver LSIs are connected to the panel, the backlight assembly is attached to the backside of the panel.

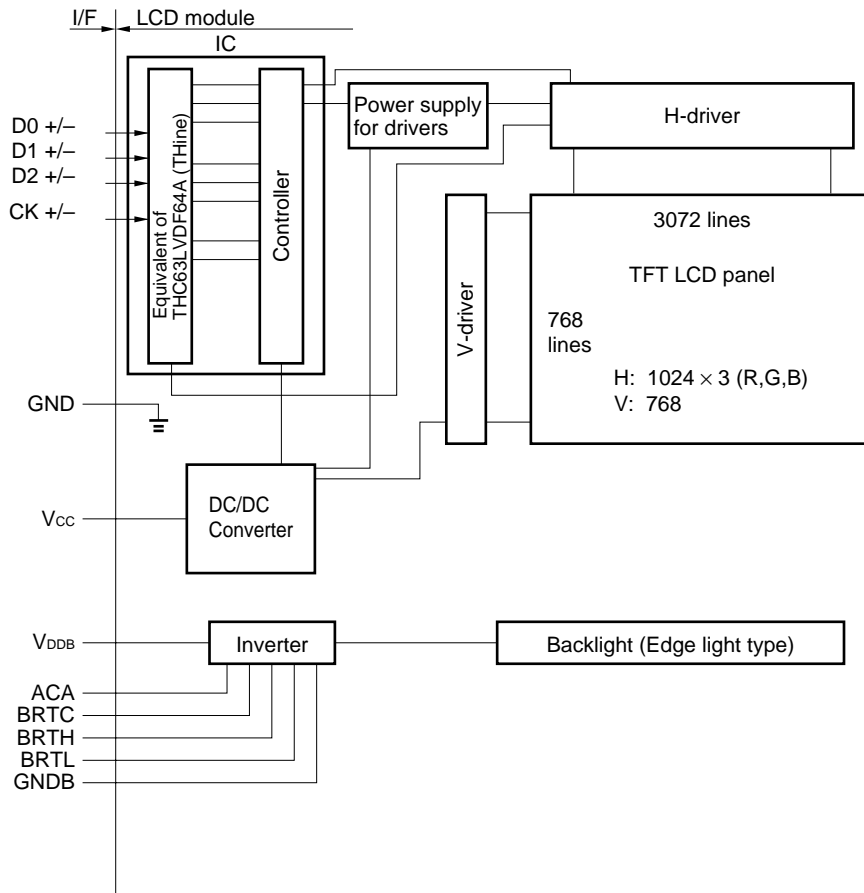
RGB (red, green, blue) data signals from a source system is modulated into a form suitable for active matrix addressing by the onboard signal processor and sent to the driver LSIs which in turn addresses the individual TFT cells.

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.

**OUTLINE OF CHARACTERISTICS (at room temperature)**

Items	Description
Display area	304.128 (H) × 228.096 (V) mm
Drive system	a-Si TFT active matrix
Display colors	262,144 colors
Number of pixels	1024 × 768 pixels
Pixel arrangement	RGB vertical stripe
Pixel pitch	0.297 (H) × 0.297 (V) mm
Module size	350.0 (H) × 265.0 (V) × 20.0 (typ.) (D) mm
Weight	1350 g (typ.)
Contrast ratio	200 : 1 (typ.)
Viewing angle (more than the contrast ratio of 10 : 1)	<ul style="list-style-type: none"> <li>• Horizontal : 60° (typ., left side, right side)</li> <li>• Vertical : 40° (typ., up side), 50°(typ., down side)</li> </ul>
Designed viewing direction	<ul style="list-style-type: none"> <li>• Wider viewing angle without image reversal : up side (12 o'clock)</li> <li>• Wider viewing angle with contrast ratio: down side (6 o'clock)</li> <li>• Optimum grayscale (<math>\gamma = 2.2</math>): perpendicular</li> </ul>
Color gamut	40% (typ., at center, to NTSC)
Response time	15 ms (typ.), "white 100%" to "black 10%"
Luminance	200 cd/m <sup>2</sup> (typ.)
Signal system	RGB 6-bit signals, Synchronous signals (Hsync, Vsync), Dot clock (CLK) LVDS interface (Equivalent of THC63LVDF64A, THine Electronics, Inc.) 1 port
Supply voltage	5 V (Logic, LCD driving), 12 V (Backlight)
Backlight	Edge light type: Two cold cathode fluorescent lamps with inverter <ul style="list-style-type: none"> <li>• Lamp holder: type No.150 LHS11</li> <li>• Inverter: type No.141PW201</li> </ul>
Power consumption	11.8 W (typ.)

BLOCK DIAGRAM OF BASIC STRUCTURE



**Note:** Neither GND nor GNDB is connected to FG (Frame Ground).  
 GND and GNDB should be connected to customer equipment FG.

**GENERAL SPECIFICATIONS**

Items	Specifications	Unit
Module size	350.0 ± 0.6 (H) × 265.0 ± 0.6 (V) × 20.5 (max.) (D)	mm
Display area	304.128 (H) × 228.096 (V)	mm
Number of pixels	1024 (H) × 768 (V)	pixel
Dot pitch	0.099 (H) × 0.297 (V)	mm
Pixel pitch	0.297 (H) × 0.297 (V)	mm
Pixel arrangement	RGB (Red, Green, Blue) vertical stripe	–
Display colors	262,144 (RGB, 6 bit)	color
Weight	1350 (typ.), 1500 (max.)	g

**ABSOLUTE MAXIMUM RATINGS**

Parameters	Symbols	Ratings	Unit	Remarks
Supply voltage	V <sub>CC</sub>	–0.3 to +6.0	V	T <sub>a</sub> = 25°C
	V <sub>DDB</sub>	–0.3 to +14	V	
Logic input voltage	V <sub>I</sub>	–0.3 to V <sub>CC</sub> + 0.3	V	
Logic input voltage (backlight-logic signal)	V <sub>IBL1</sub>	–0.3 to +5.5	V	
Logic input voltage (backlight-BRTL signal)	V <sub>IBL2</sub>	–0.3 to +1.5	V	
Storage temp.	T <sub>ST</sub>	–20 to +60	°C	
Operating temp.	T <sub>OP</sub>	0 to +50	°C	Module surface <b>Note 1</b>
Relative humidity (RH)	<b>Note 2</b>	≤ 95	%	T <sub>a</sub> ≤ 40°C
		≤ 85	%	40 < T <sub>a</sub> ≤ 50°C
Absolute humidity	<b>Note 2</b>	Absolute humidity shall not exceed T <sub>a</sub> = 50°C, Relative humidity = 85% level.	g/m <sup>3</sup>	T <sub>a</sub> > 50°C

**Note 1:** Measured at the LCD panel of the module.

**Note 2:** No Condensation.

**ELECTRICAL CHARACTERISTICS**

**(1) Logic, LCD driving**

T<sub>a</sub> = 25°C

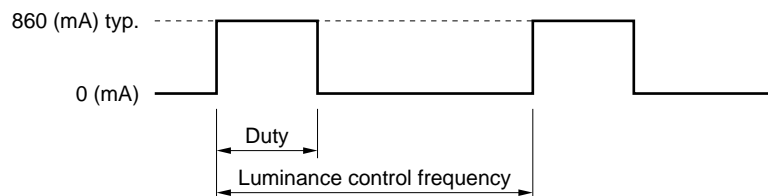
Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	V <sub>CC</sub>	4.75	5.0	5.25	V	–
Ripple voltage	V <sub>RP</sub>	–	–	100	mV	for V <sub>CC</sub>
LVDS signal input “L” voltage	V <sub>IL</sub>	–100	–	–	mV	V <sub>CM</sub> = 1.2 V V <sub>CM</sub> : Common mode voltage in LVDS driver
LVDS signal input “H” voltage	V <sub>IH</sub>	–	–	+100	mV	
Input voltage	V <sub>I</sub>	0.25	0.35	0.45	V	–
Common mode voltage	V <sub>CM</sub>	1.125	1.25	1.375	V	R <sub>T</sub> = 100Ω
Terminating resistor	R <sub>T</sub>	–	100	–	Ω	–
Supply current	I <sub>CC</sub>	–	300 <b>Note</b>	600	mA	V <sub>CC</sub> = 5.0 V

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

**(2) Backlight**

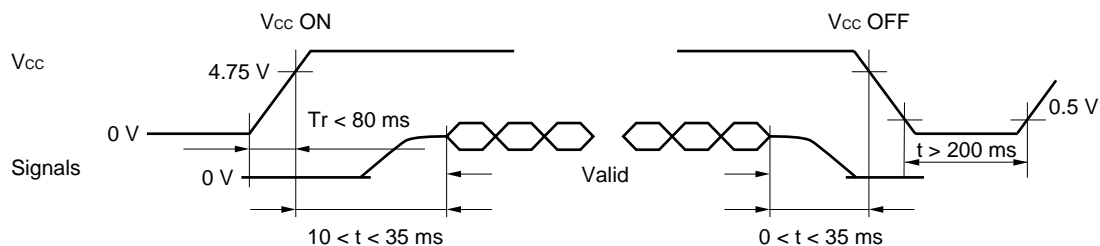
T<sub>a</sub> = 25°C

Parameters	Symbols	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	V <sub>DDB</sub>	10.8	12.0	13.2	V	–
Logic input “L” voltage 1	V <sub>IL1</sub>	0	–	0.6	V	for BRTP
Logic input “H” voltage 1	V <sub>IH1</sub>	4.5	–	5.25	V	
Logic input “L” voltage 2	V <sub>IL2</sub>	0	–	0.8	V	for BRTC, ACA, BRTL
Logic input “H” voltage 2	V <sub>IH2</sub>	2.2	–	5.25	V	
Logic input “L” current 1	I <sub>IL1</sub>	–1.0	–	–	mA	for BRTP
Logic input “H” current 1	I <sub>IH1</sub>	–	–	10	mA	
Logic input “L” current 2	I <sub>IL2</sub>	–1.0	–	–	mA	for BRTC, ACA, BRTL
Logic input “H” current 2	I <sub>IH2</sub>	–	–	0.8	mA	
Supply current	I <sub>DDB</sub>	–	860	1000	mA	V <sub>DDB</sub> = 12.0 V (at max. luminance)



maximum luminance control: 100 % (Duty)  
 minimum luminance control: 20 % (Duty)  
 Luminance control frequency: 243 to 297 Hz    270 Hz (typ.)

## SUPPLY VOLTAGE SEQUENCE



- Notes**
- Logic signals (synchronous signals and control signals) must be "0" voltage(V), when  $V_{CC}$  is not input. If input voltage to signal lines is higher than 0.3 V, the internal circuit will be damaged.
  - The supply voltage for input signals should be the same as  $V_{CC}$ .
  - Apply  $V_{DDb}$  within the LCD operation period. (more than 4  $V_{sync}$  after the  $V_{CC}$  are input.) When the backlight turns on before LCD operation or the LCD operation turns off before the backlight turns off, the display may momentarily become white. However, 12 V for backlight should be started up within 80 ms, otherwise, the protection circuit makes the backlight turns off.
  - When the power is off, please keep whole signals low level or high impedance.

**INTERFACE AND CONNECTOR PIN ASSIGNMENT**

(1) Interface connector for signal and power

Part No. : FI-SE20P-HF  
 Adaptable socket: FI-SE20M  
 Supplier : Japan Aviation Electronics Industry Limited (JAE)

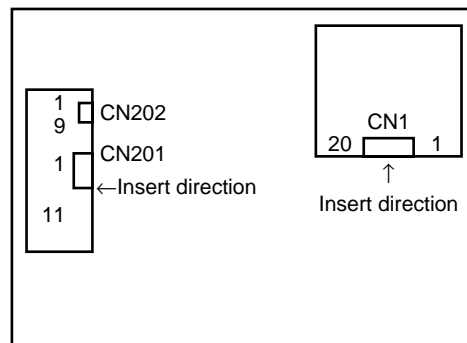
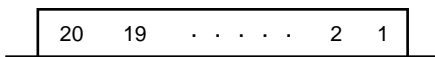
CN1

Pin No.	Symbol	Signal type	Function
1	GND	Ground	<b>Note 1</b>
2	GND		
3	NC	Non-connection	-
4	NC		
5	GND	Ground	<b>Note 1</b>
6	CK+	Pixel clock	CLK for pixel data f = 65 MHz (typ.) (LVDS level)
7	CK-		
8	GND	Ground	<b>Note 1</b>
9	D2+	Pixel data	LVDS differential data input
10	D2-		
11	GND	Ground	<b>Note 1</b>
12	D1+	Pixel data	LVDS differential data input
13	D1-		
14	GND	Ground	<b>Note 1</b>
15	D0+-	Pixel data	LVDS differential data input
16	D0-		
17	GND	Ground	<b>Note 1</b>
18	GND		
19	V <sub>CC</sub>	+5.0 V power supply	Supply +5.0 V ±5%
20	V <sub>CC</sub>		

**Notes 1:** GND is Signal ground for logic and LCD driving. The GND should be connected to system ground. The GND is not connected to FG (Frame Ground) in this module.

**2:** Connect all pins (except 3,4) to the appointed places to avoid noise problems.  
 Use 100 Ω twist pair wires for the cable.

CN1: Figure from socket view



**Note:** CN202 should be opened.

(2) Connector for backlight unit

Part No. : IL-Z-11PL1-SMTY

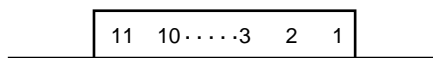
Adaptable socket: IL-Z-11S-S125C3

Supplier : Japan Aviation Electronics Industry Limited (JAE)

CN201

Pin No.	Symbol	Signal type	Function
1	V <sub>DDB</sub>	12 V power supply	Supply +12 V ±10 %
2	V <sub>DDB</sub>		
3	V <sub>DDB</sub>		
4	GNDB	Ground for backlight	<b>Note 1</b>
5	GNDB		
6	GNDB		
7	ACA	Luminance control signal	“H” or “Open”: Normal luminance (100%) “L” : Low luminance (1/2 of the normal luminance)
8	BRTC	Backlight ON/OFF control signal	“H” or “Open”: Backlight ON “L” : Backlight OFF
9	BRTH	Luminance control signal	<b>Note 2</b>
10	BRTL	Luminance control signal	
11	N.C.		

CN201: Figure from socket view





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

CN202

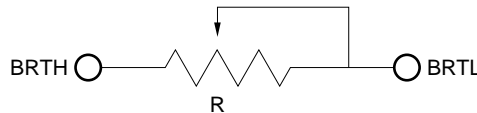
Pin No.	Symbol	Signal type	Function
1	GNDB	Ground for backlight	<b>Note 1</b>
2	GNDB		
3	ACA	Luminance control signal	“H” or “Open”: Normal luminance (100%) “L” : Low luminance (1/2 of the normal luminance)
4	BRTC	Backlight ON/OFF control signal	“H” or “Open”: Backlight ON “L” : Backlight OFF
5	BRTH	Luminance control signal-1	<b>Note 2</b>
6	BRTL	Luminance control signal-1	
7	B RTP	Luminance control signal-2	<b>Note 3</b>
8	GNDB	Ground for backlight	<b>Note 1</b>
9	PWSEL	Luminance control select signal	“H” or “Open”: Variable resistor control or voltage control (Note 2) “L” : B RTP signal control (Note 3)

**Notes 1:** Neither GND nor GNDB connected to FG (Frame Ground) in this module. They should be connected to the FG of customer equipment.

**2:** The ways to controll luminance are as follows.

(1) A way of luminance control by a variable resistor.

The variable resistor for luminance control should be 10 kΩ , and zero point of the resistor corresponds to the minimum of luminance.



Mating variable resistor : 10 kΩ ±5% (1/10 W), B curve  
 Maximum luminance (100 %) : R = 10 KΩ  
 Minimum luminance (30 %) : R = 0 Ω

(2) A way of luminance control by voltage

B RTH should be fixed to 0 V to control luminance by voltage. The range of input voltage between B RTL and GNDB is as follows.

Maximum luminance (100%, ACA = H) : 1 V (typ.)

Minimum luminance (30%, ACA = H) : 0 V

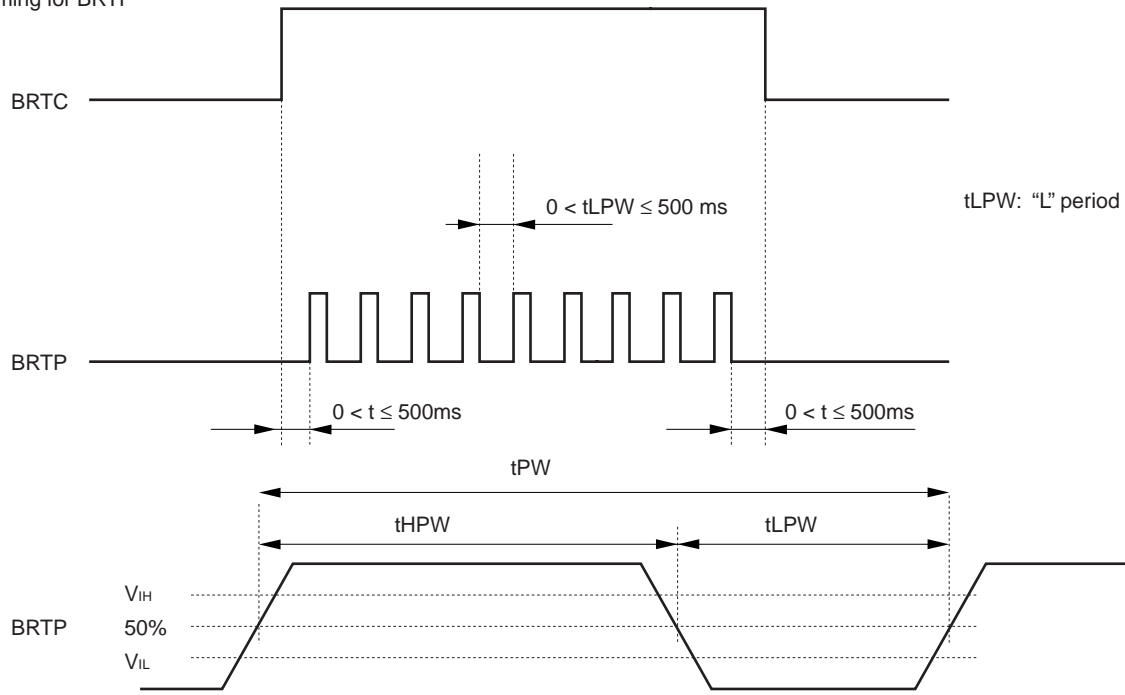
3: The way of luminance control with BRTTP signal

When PWSEL is "L," inputting signal pulse from the outside to BRTTP enables to control the luminance.  
 The luminance can be controlled by the duty value of the input signal.

Duty = 100%: luminance is maximum. (100%)

Duty = 20%: luminance is minimum. (30%)

Timing for BRTTP



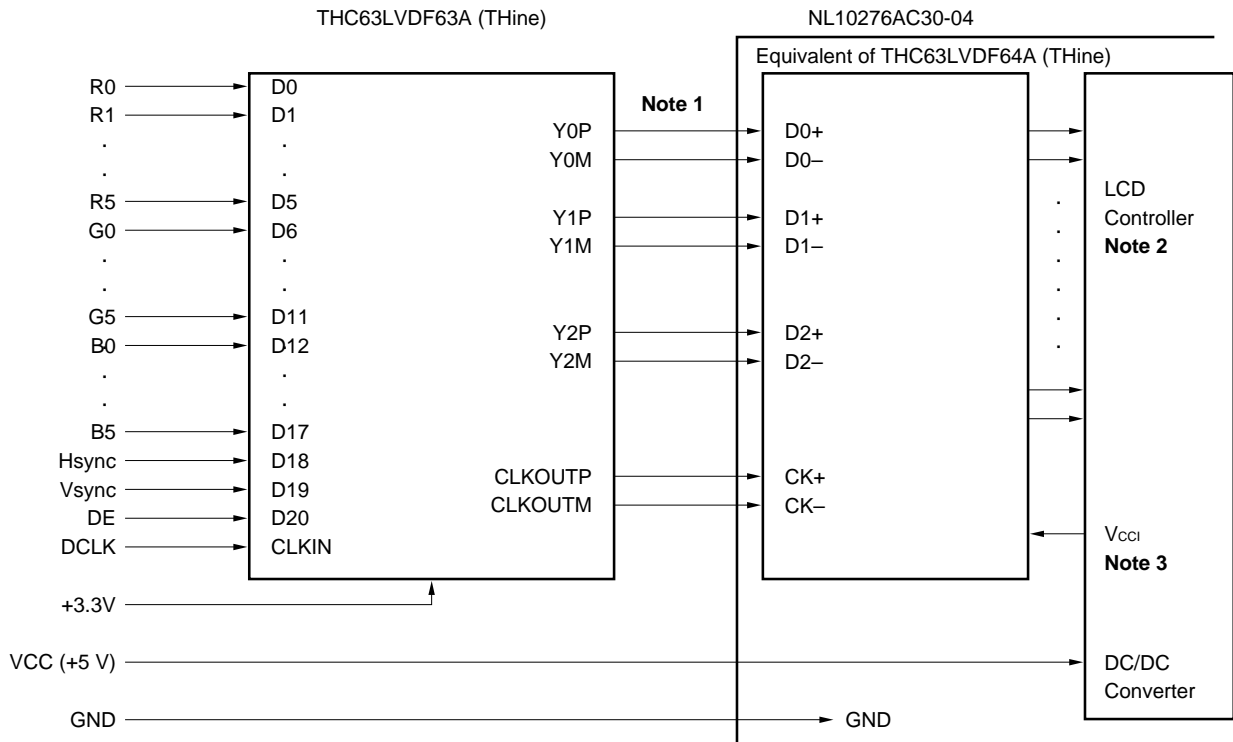
Parameters	Symbols	Min.	Typ.	Max.	Unit	Remarks
Frequency	$1/t_{PW}$	185	–	340	Hz	–
Pulse-width	$t_{HPW}/t_{PW}$	20	–	100	%	at max. luminance (100%)
Input voltage	$V_{IL}$	0	–	0.6	V	–
	$V_{IH}$	4.5	–	5.0	V	–

Regarding set up for frequency, refer to the below formula.

Set up frequency = Vsync frequency × (n + 0.25) or (n + 0.75)

But, please fix the frequency after evaluating the display quality sufficiently, because it can be disturbed due to the frequency.

METHOD OF CONNECTION FOR THC63LVDF63A



- Notes 1:** 100 Ω twist pair.
- 2:** These signals should be kept the range specified by Page 13 **INPUT SIGNAL TIMING**.
- 3:** VCCI = 3.3 V (LCD internal voltage)
- 4:** THC63LVDF63A is used as LVDS transmitter at the shipping inspection.

**DISPLAY COLORS vs. INPUT DATA SIGNALS**

Display colors		Data signal (0: Low level, 1: High level)																	
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic colors	Black	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	1	1	1	1	1	1
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	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	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
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	1	0	0	0	0	0	0	0	0	0	0	0	0
	dark	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑				↓					↓						↓			
	↓				↑					↑						↑			
	bright	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	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	1	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	↑				↓					↓						↓			
	↓				↑					↑						↑			
	bright	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	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	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	1	0
	↑				↓					↓						↓			
	↓				↑					↑						↑			
	bright	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

**Note:** Colors are developed in combination with 6-bit signals (64 steps in grayscale) of each primary red, green, and blue color.  
 This process can result in up to 262,144 (64 × 64 × 64) colors.

**INPUT SIGNAL TIMING**

(1) Input signal specifications for LCD controller

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency	1/tc	60.0	65.0	68.0	MHz	15.385 ns (typ.)
	Duty	tch/tc	<b>Note</b>			–	–
	Rise, fall	tcrf				ns	–
Hsync	Period	th	16.0	20.676	22.7	μs	48.363 kHz (typ.)
			1110	1344	–	CLK	
	Display period	thd	–	1024	–	CLK	–
	Front-porch	thf	0	–	–	CLK	–
	Pulse width	thp*	12	–	–	CLK	–
	Back-Porch	thb*	2	–	–	CLK	–
	*thp + thb		86	–	–	CLK	–
	Hsync-CLK timing	ths	<b>Note</b>			ns	–
	CLK-Hsync timing	thh				ns	–
	DE-CLK timing	tes				ns	–
	CLK-DE timing	teh				ns	–
	Rise, fall	thrf				ns	–
Vsync	Period	tv	–	16.666	–	ms	60.004 Hz (typ.)
			–	806	–	H	
	Display period	tvd	–	768	–	H	–
	Front-porch	tvf	1	–	–	H	–
	Pulse width	tvp*	1	3	–	H	–
	Back-porch	tvb*	1	–	–	H	–
	*tvp + tvb		3	–	–	H	–
	Vsync-Hsync timing	tvS	1	–	–	CLK	–
	Hsync-Vsync timing	tvh	1	–	–	CLK	–
Rise, fall	tvrf	<b>Note</b>			ns	–	
DATA	DATA-CLK (set up)				tds	ns	–
	CLK-DATA (Hold)				tdh	ns	–

**Note:** These values are in the timing standards of THC63LVDF63A. The timing standard prescribes in the input of LCD transmitter. THC63LVDF63A is recommended for LVDS transmitter.

(2) Input signal of LVDS RECEIVER (It is prescribed for the part CN1 input)

Parameters	Symbols	Min	Typ.	Max.	Unit	Remarks
CLK Frequency	TRCP	14.71	T	16.66	ns	-
Bit0 position	TRIP1	-0.5	0	0.5	ns	T = 15.38 ns
Bit1 position	TRIP0	T/7-0.5	T/7	T/7+0.5	ns	T = 15.38 ns
Bit2 position	TRIP6	2T/7-0.5	2T/7	2T/7+0.5	ns	T = 15.38 ns
Bit3 position	TRIP5	3T/7-0.5	3T/7	3T/7+0.5	ns	T = 15.38 ns
Bit4 position	TRIP4	4T/7-0.5	4T/7	4T/7+0.5	ns	T = 15.38 ns
Bit5 position	TRIP3	5T/7-0.5	5T/7	5T/7+0.5	ns	T = 15.38 ns
Bit6 position	TRIP2	6T/7-0.5	6T/7	6T/7+0.5	ns	T = 15.38 ns

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

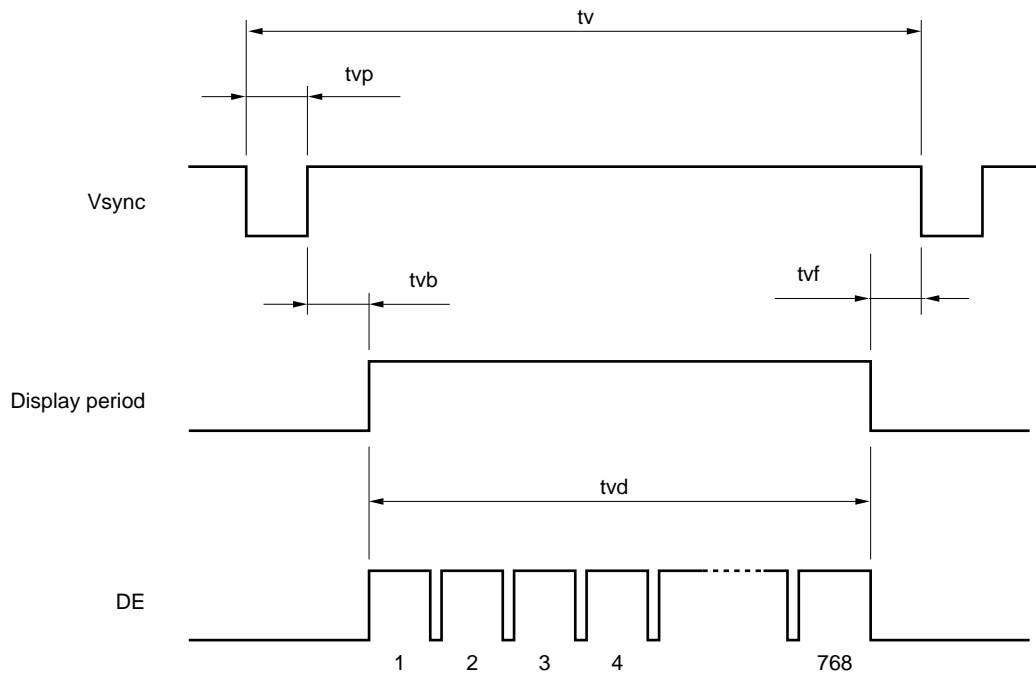
In case that CLK jitter value between current cycle and next cycle is big, skew time of the next cycle decreases with the value of the jitter.

CLK jitter + LVDS output skew + cable skew ≤ 500 ps

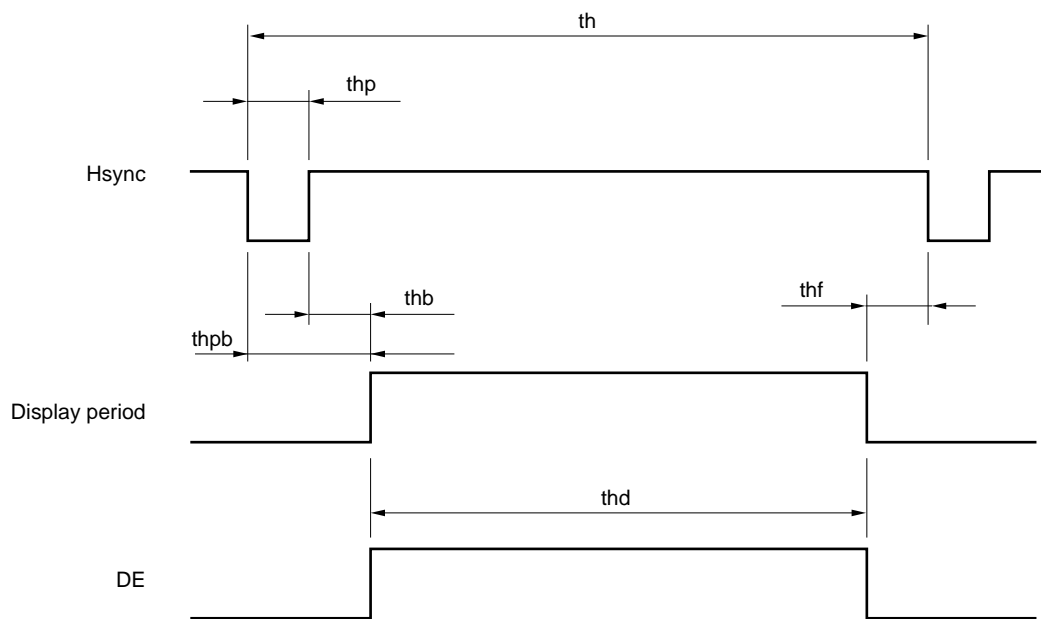
e.g. LVDS output skew: ± 200 ps } acceptable CLK jitter = ± 200 ps (500 - (200 + 100) = 200 ps)  
 Cable skew: ± 100 ps }

(3) Definition of input signal timing for LCD controller

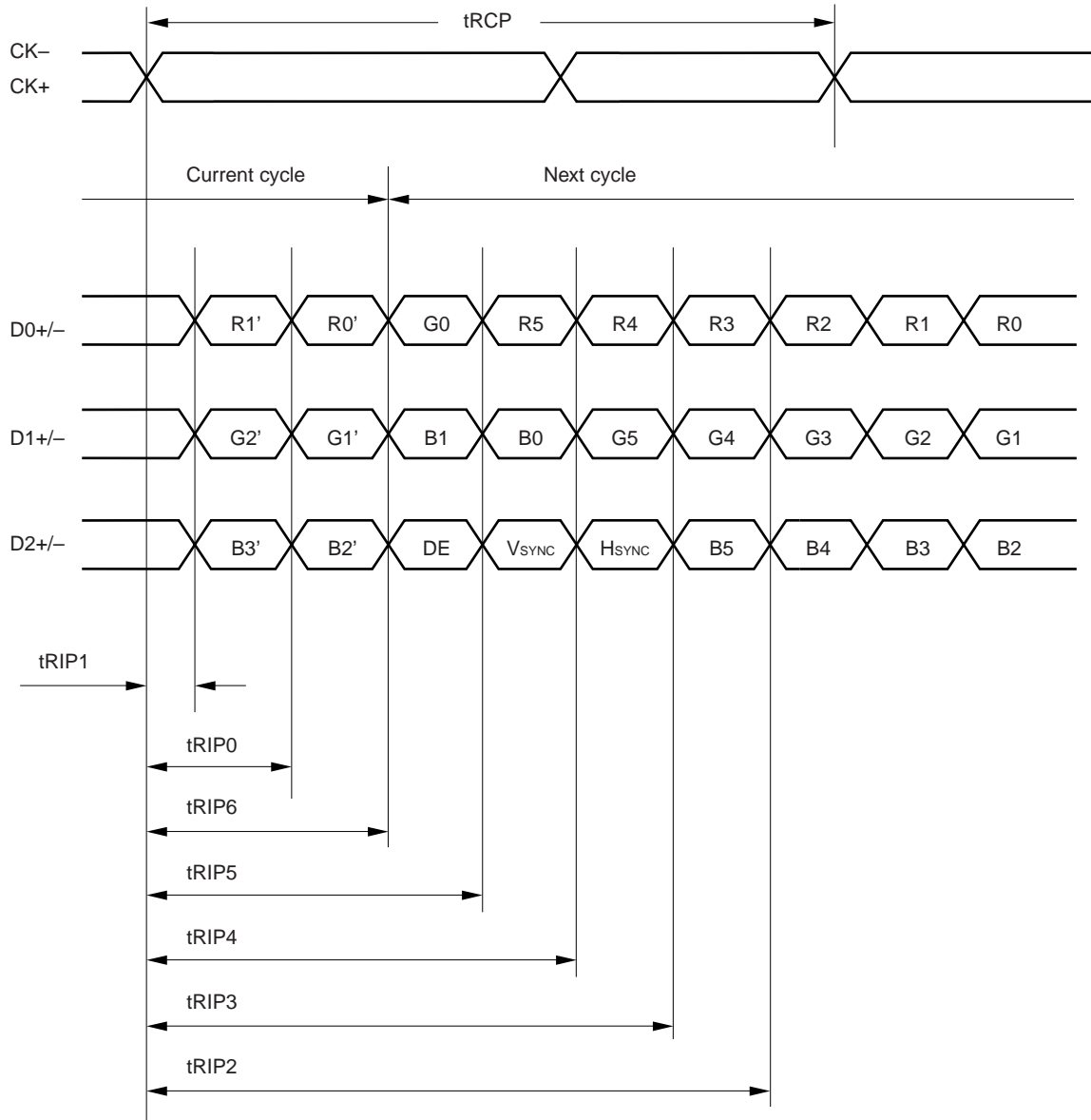
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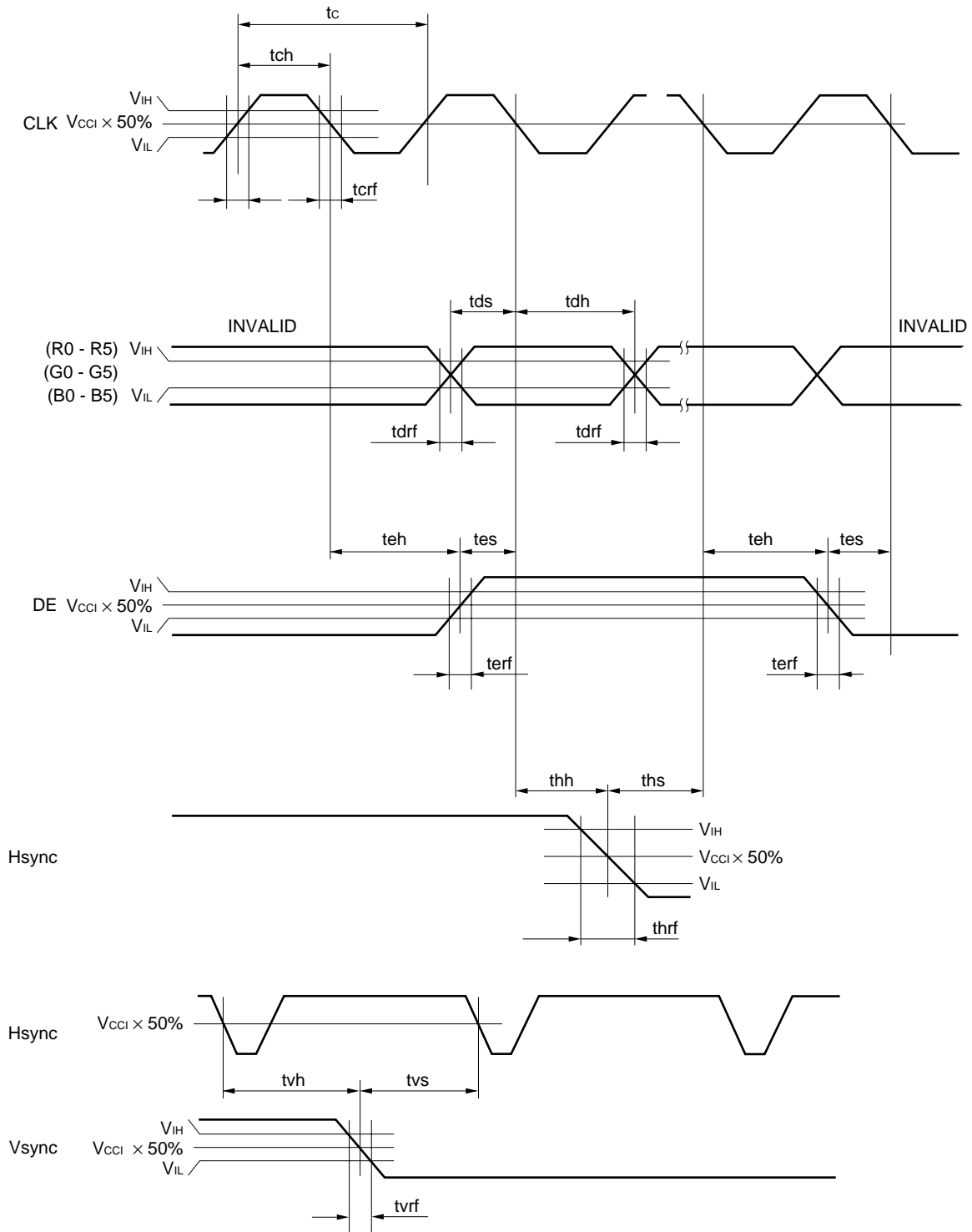
<Horizontal>



<LVDS Receiver>

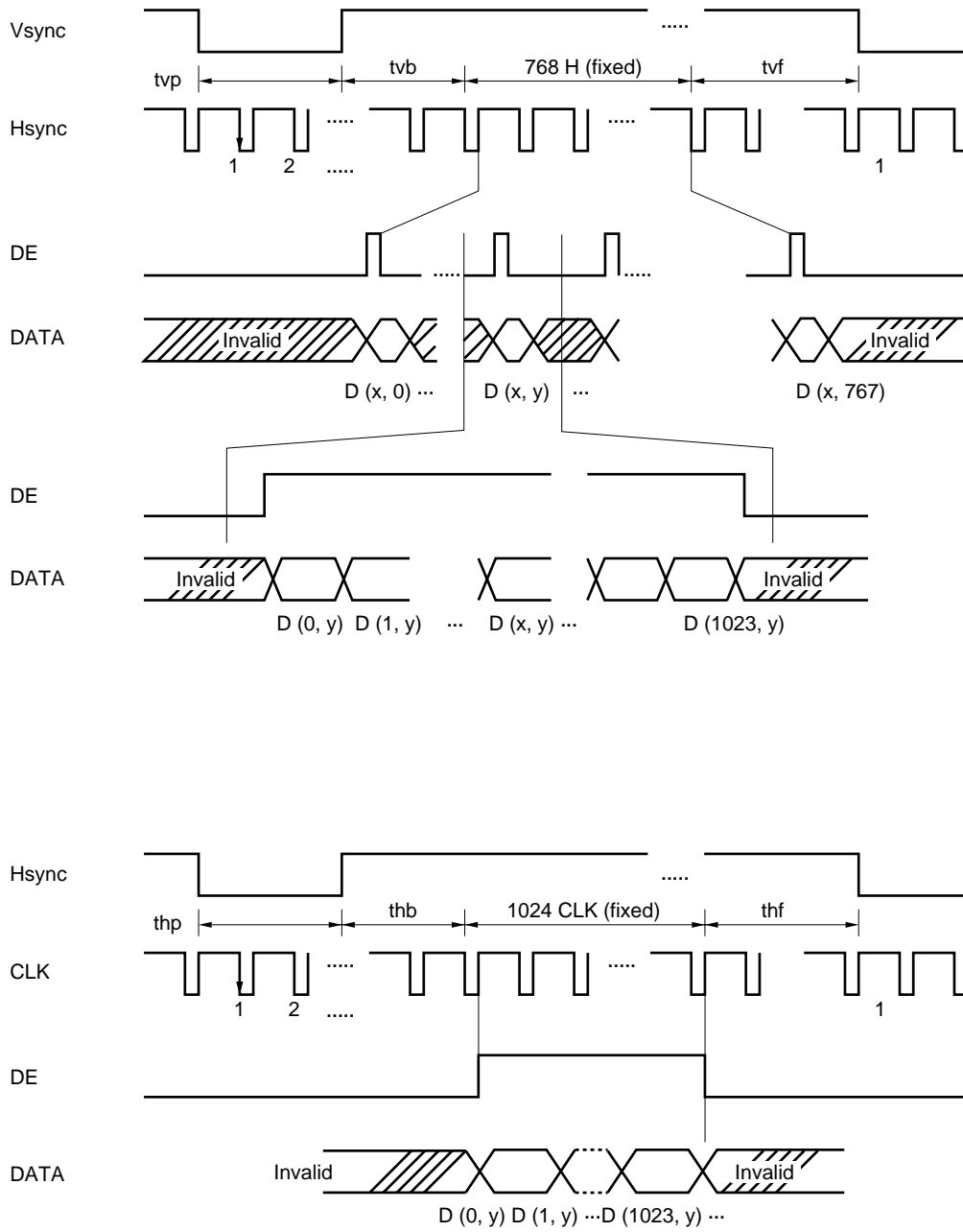






$V_{IH} = V_{CC1} \times 0.7$  (min.)  
 $V_{IL} = V_{CC1} \times 0.3$  (max.)  
 $V_{CC1} = 3.3$  V (LCD internal voltage)

(4) Input signal timing chart FOR LCD



**Note:** These values are in the output of THC63LVDF64A.  
 (Refer to Page 11 **METHOD OF CONNECTION FOR THC63LVDF63A**).

(5) Display position of input data

D (0, 0)	D (1, 0)	---	D (X, 0)	---	D (1022, 0)	D (1023, 0)
D (0, 1)	D (1, 1)	---	D (X, 1)	---	D (1022, 1)	D (1023, 1)
		+-		+-		
D (0, Y)	D (1, Y)	---	D (X, Y)	---	D (1022, Y)	D (1023, Y)
		+-		+-		
D (0, 766)	D (1, 766)	---	D (X, 766)	---	D (1022, 766)	D (1023, 766)
D (0, 767)	D (1, 767)	---	D (X, 767)	---	D (1022, 767)	D (1023, 767)

**OPTICAL CHARACTERISTICS**

(T<sub>a</sub> = 25°C, V<sub>CC</sub> = 5 V, V<sub>DDB</sub> = 12 V, **Note1**)

Parameters	Symbols	Conditions	Min.	Typ.	Max.	Unit	Remarks
Contrast ratio	CR	White/Black, <b>Note1</b>	80	200	–	–	<b>Note 2</b>
Luminance	Lumax	"White"	150	200	–	cd/m <sup>2</sup>	<b>Note 3</b>
Luminance uniformity	–	Maximum luminance	–	–	1.30	–	<b>Note 4</b>
		Minimum luminance					

Reference data

(T<sub>a</sub> = 25°C, V<sub>CC</sub> = 5 V, V<sub>DDB</sub> = 12 V)

Parameters	Symbols	Conditions	Min.	Typ.	Max.	Unit	Remarks	
Contrast ratio	CR	Best contrast angle, θ <sub>R</sub> = 0°, θ <sub>L</sub> = 0° θ <sub>D</sub> = 5° White/Black, at center	–	450	–	–	<b>Note 2</b>	
Color gamut	C	θ <sub>R</sub> , θ <sub>L</sub> , θ <sub>U</sub> , θ <sub>D</sub> = 0° At center, To NTSC	35	40	–	%	–	
Viewing angle range (CR>10)	Horizontal	θ <sub>R</sub>	CR > 10, White/Black	50	60	–	deg.	<b>Note 5</b>
		θ <sub>L</sub>	θ <sub>U</sub> = 0°, θ <sub>D</sub> = 0°	50	60	–	deg.	
	Vertical	θ <sub>U</sub>	CR > 10, White/Black	30	40	–	deg.	
		θ <sub>D</sub>	θ <sub>R</sub> = 0°, θ <sub>L</sub> = 0°	35	50	–	deg.	
Response time	T <sub>on</sub>	White (100%) to black (10%)	–	15	40	ms	<b>Note 6</b>	
	T <sub>off</sub>	Black (0%) to white (90%)	–	40	80			
Luminance control range	–	Maximum luminance: 100%	–	30 to100	–	%	–	

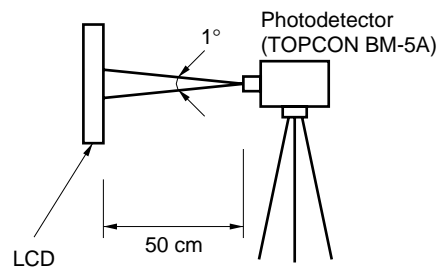
**Notes 1:** Viewing angle : θ<sub>R</sub> = 0°; θ<sub>L</sub> = 0°, θ<sub>U</sub> = 0°, θ<sub>D</sub> = 0°, At center

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

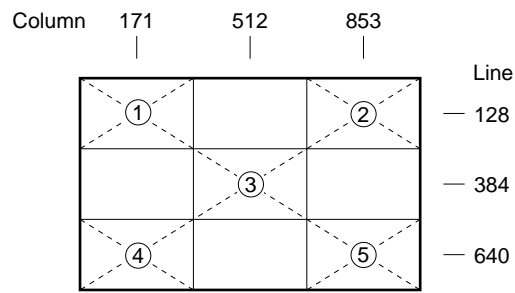
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance with all pixels in white}}{\text{Luminance with all pixels in black}}$$

The Luminance is measured in darkroom.

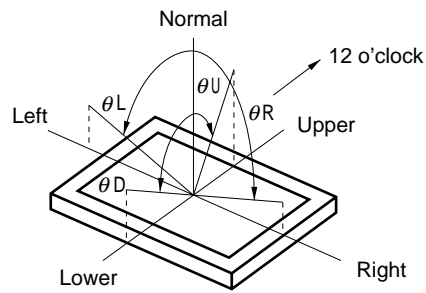
**3:** The luminance is measured after 20 minutes from the module works, with all pixels in white. Typical value is measured after luminance saturation.



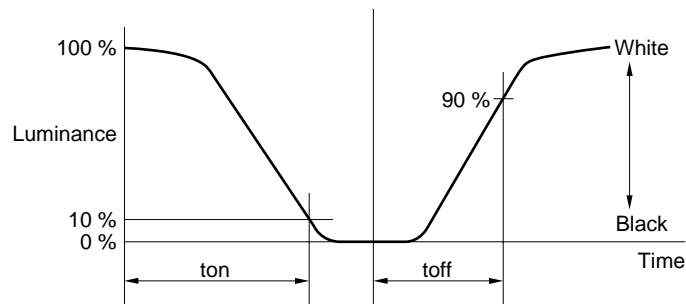
4. The luminance uniformity is calculated by using the formula in the table.  
The luminance is measured at near the five points shown below.



5. Definitions of viewing angle are as follows.



6. Definition of response time is as follows.



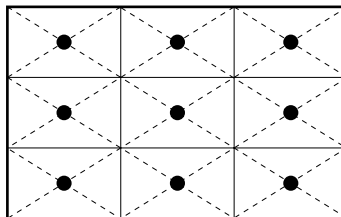
RELIABILITY TEST SPECIFICATIONS

Test items	Test conditions	Judgment
High temperature/humidity (operation)	50 ± 2°C, 85% relative humidity 240 hours Display data is black.	Note 1
Heat cycle (operation)	<1> 0°C ± 3°C ... 1 hour 55°C ± 3°C ... 1 hour <2> 50 cycles, 4 hours/cycle <3> Display data is black.	Note 1
Thermal shock (non-operation)	<1> -20°C ± 3°C ... 30 minutes 60°C ± 3°C ... 30 minutes <2> 100 cycles <3> Temperature transition time within 5 minutes.	Note 1
Vibration (non-operation)	<1> 5 - 100 Hz, 19.6 m/s <sup>2</sup> (2G) 1 minute/cycle X, Y, Z direction <2> 50 times each direction	Notes 1, 2
Mechanical shock (non-operation)	<1> 294 m/s <sup>2</sup> (30G), 11 ms X, Y, Z direction <2> 3 times each direction	Notes 1, 2
ESD (operation)	150 pF, 150 Ω, ±10 kV 9 places on a panel 10 times each place at one-second intervals	Notes 1, 3
Dust (operation)	15 kinds of dust (JIS Z 8901) Hourly 15 seconds stir, 8 times repeat	Note 1

**Notes 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.




**GENERAL CAUTIONS**

Next figures and sentence are very important. Please understand the following contents.

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

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




	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 the pouch only, in taking out 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, Hsync or Vsync signal. If any one or more of these signals is lost, the panel would be damaged.
- h) The torque to mounting screw should never exceed 0.392 N·m (4 kgf·cm).
- i) Don't push or rub the surface of the module. If you do it, the scratches or the rubbing marks may be left on the module surface.

(3) Cautions for the atmosphere

- a) Dew drop atmosphere should be avoided.
- b) Do not store and/or operate the 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 cathod fluorescent lamps. Therefore, the life time of the lamps become short if the module is operated under the low temperature environment.
- d) Do not operate the module in a high magnetic field.

## (4) Caution for the module characteristics

- a) Do not apply fixed pattern data signal for a long time to the module. It may cause image sticking. Please use screen savers if the display pattern is fixed more than one hour.
- b) This module has the retardation film which may cause the variation of the color hue in the different viewing angles. The nonuniformity 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 or malfunctions.
- d) The noise from the inverter circuit may be observed in the luminance control mode. This is not defects or malfunctions.

## (5) Other cautions

- a) Do not disassemble and/or reassemble LCD module.
- b) Do not readjust variable resistors or switches in the module.
- c) When returning the module for repair etc., please 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.

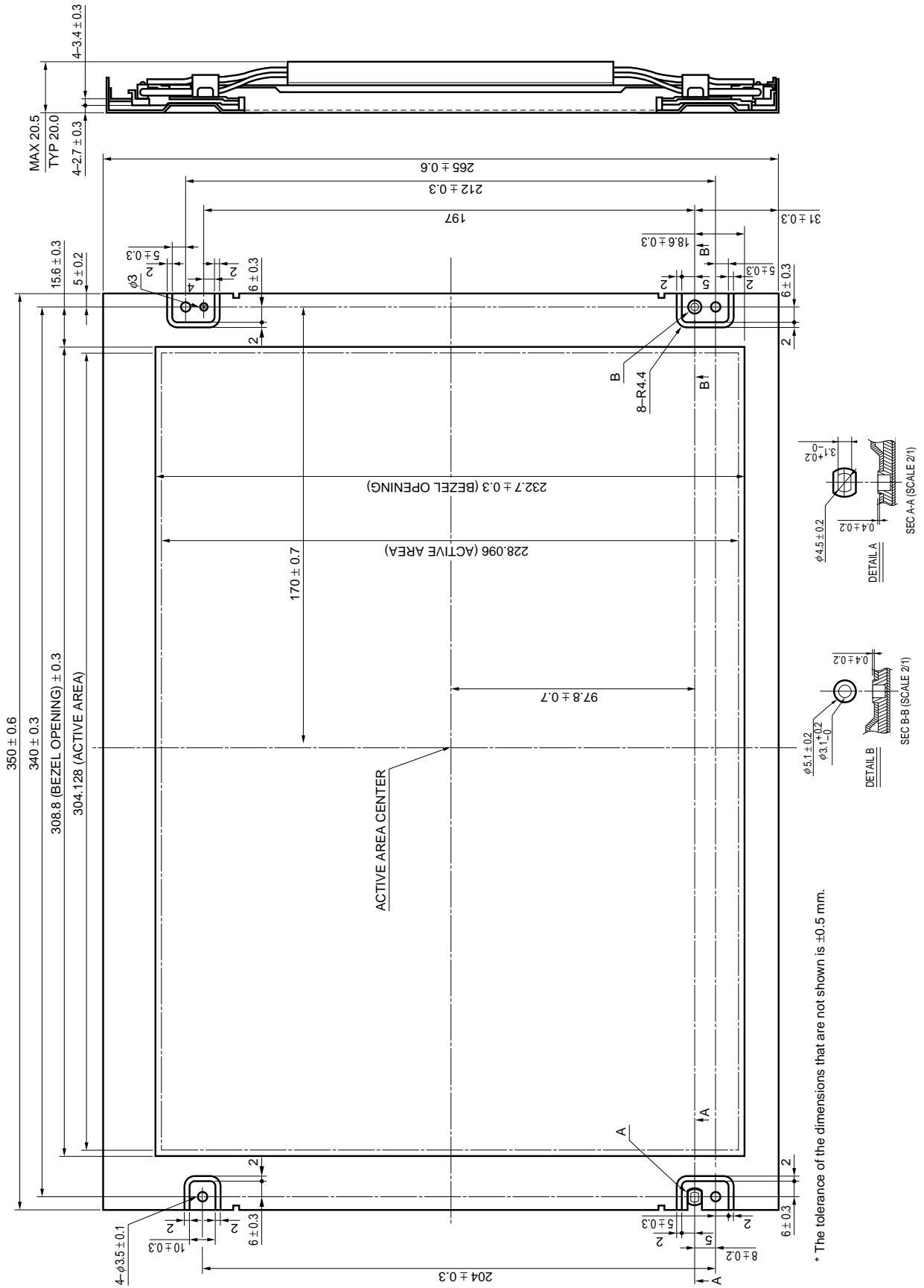
The optical characteristics of this module may be affected by the ambient temperature.

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.



OUTLINE DRAWING (1/2): Front View (Unit: mm)



\* The tolerance of the dimensions that are not shown is  $\pm 0.5$  mm.





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

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Anti-radioactive design is not implemented in this product.