

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

**DESCRIPTION**

The NL10276AC30-04R is a TFT (thin film transistor) active-matrix color liquid crystal display (LCD) module comprising an amorphous silicon TFT attached to each signal electrode, a driving circuit, and a backlight. The NL10276AC30-04R has a built-in backlight with an inverter.

The 38 cm (15.0 inch) 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 to the THC63LVDF64A, THine Electronics, Inc.)
- Incorporated edge-type backlight (two lamps, inverter) and replaceable lamp holder

**APPLICATIONS**

- Desktop PCs
- Engineering workstations
- Display terminal for control systems
- Monitors for process controllers



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

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

**STRUCTURE AND FUNCTION**

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 back side of the panel.

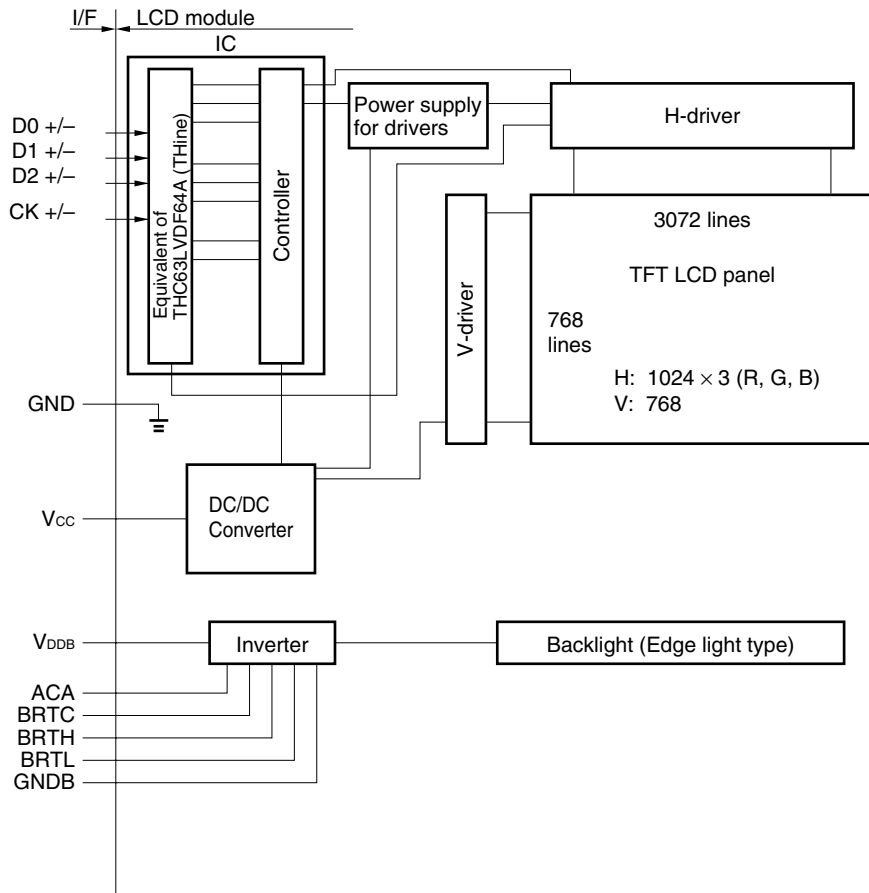
RGB (red, green, blue) data signals from a source system are modulated into a form suitable for active-matrix addressing by the onboard signal processor and sent to the driver LSIs, which in turn address the individual TFT cells.

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.

**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 gray-scale (<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



**Notes:** Neither GND nor GNDB is connected to FG (frame ground).  
 GND and GNDB should be connected to customer equipment FG.

**GENERAL SPECIFICATIONS**

Item	Specification	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**

Parameter	Symbol	Rating	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

- Notes:** 1. Measured at the LCD panel of the module.  
2. No condensation.

**ELECTRICAL CHARACTERISTICS**

**(1) Logic, LCD Driving**

T<sub>a</sub> = 25°C

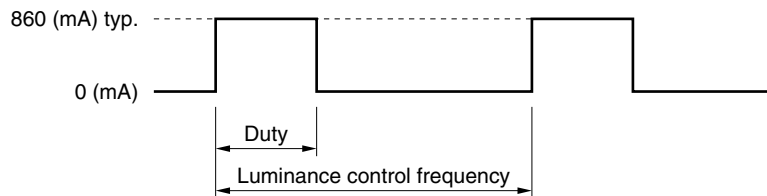
Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	V <sub>CC</sub>	4.75	5.0	5.25	V	–
Ripple voltage	V <sub>RP</sub>	–	–	100	mV	for V <sub>CC</sub>
LVDS signal input “L” voltage	V <sub>IL</sub>	–100	–	–	mV	V <sub>CM</sub> = 1.2 V V <sub>CM</sub> : Common mode voltage in LVDS driver
LVDS signal 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**

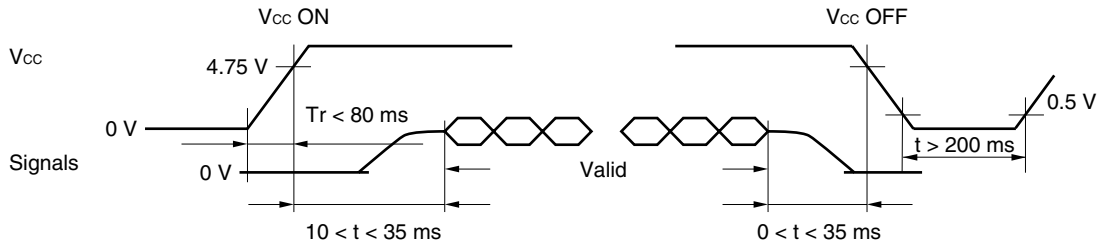
T<sub>a</sub> = 25°C

Parameter	Symbol	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:**
1. 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.
  2. The supply voltage for input signals should be the same as  $V_{CC}$ .
  3. Apply  $V_{DDB}$  within the LCD operation period (more than 4  $V_{sync}$  after the  $V_{CC}$  signals are input). If 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 the backlight should be started up within 80 ms; otherwise, the protection circuit makes the backlight turn off.
  4. When the power is off, please keep whole signals at low level or high impedance.

INTERFACE AND CONNECTOR PIN ASSIGNMENT

(1) Interface Connector for Signal and Power

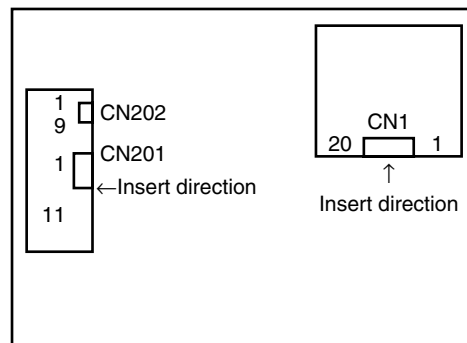
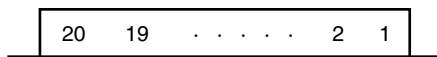
Part No.: FI-SE20P-HF  
 Adaptable socket: FI-SE20M  
 Supplier: Japan Aviation Electronics Industry, Limited (JAE)

CN1

Pin No.	Symbol	Signal Type	Function
1	GND	Ground	Note 1
2	GND		
3	NC	Nonconnection	-
4	NC		
5	GND	Ground	Note 1
6	CK+	Pixel clock	CLK for pixel data f = 65 MHz (typ.) (LVDS level)
7	CK-		
8	GND	Ground	Note 1
9	D2+	Pixel data	LVDS differential data input
10	D2-		
11	GND	Ground	Note 1
12	D1+	Pixel data	LVDS differential data input
13	D1-		
14	GND	Ground	Note 1
15	D0+	Pixel data	LVDS differential data input
16	D0-		
17	GND	Ground	Note 1
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 and 4) to the appointed places to avoid noise problems. Use 100 Ω twisted-pair wires for the cable.

CN1: Figure from socket view



**Note:** CN202 should be open.

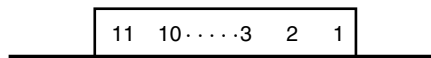
**(2) Connector for Backlight Unit**

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**

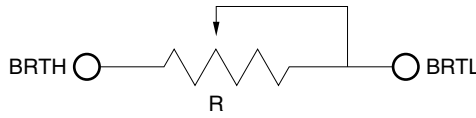
Pin No.	Symbol	Signal Type	Function
1	GNDB	Ground for backlight	<b>Note 1</b>
2	GNDB		
3	ACA	Luminance control signal	“H” or “Open”: Normal luminance (100%) “L”: Low luminance (1/2 of the normal luminance)
4	BRTC	Backlight ON/OFF control signal	“H” or “Open”: Backlight ON “L”: Backlight OFF
5	BRTH	Luminance control signal 1	<b>Note 2</b>
6	BRTL	Luminance control signal 1	
7	BRTP	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 ( <b>Note 2</b> ) “L”: BRTP signal control ( <b>Note 3</b> )



- Notes:** 1. Neither GND nor GNDB should be connected to FG (frame ground) in this module. They should be connected to the FG of customer equipment.  
 2. The ways to control luminance are as follows.

(1) Luminance control by a variable resistor

The variable resistor for luminance control should be 10 KΩ; the zero point of the resistor corresponds to the minimum 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) Luminance control by voltage

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

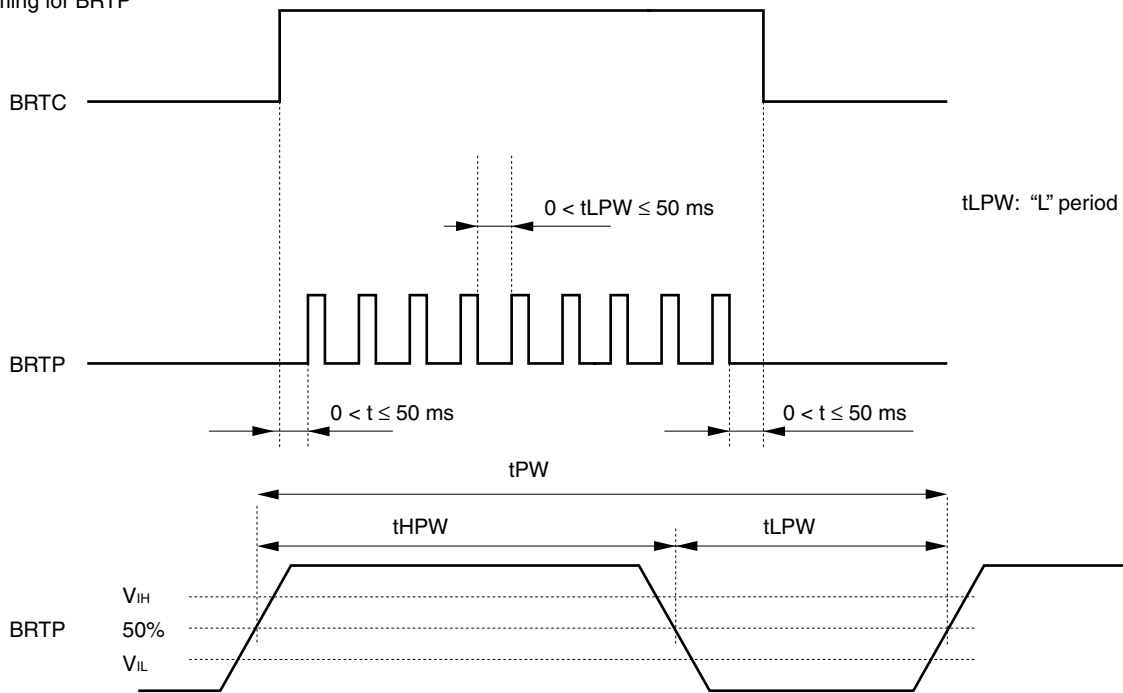
Maximum luminance (100%, ACA = H): 1 V (typ.)  
 Minimum luminance (30%, ACA = H): 0 V

3. Luminance control with the BRTP signal

When PWSEL is “L,” inputting a signal pulse from the outside to BRTP enables control of 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 BRTP



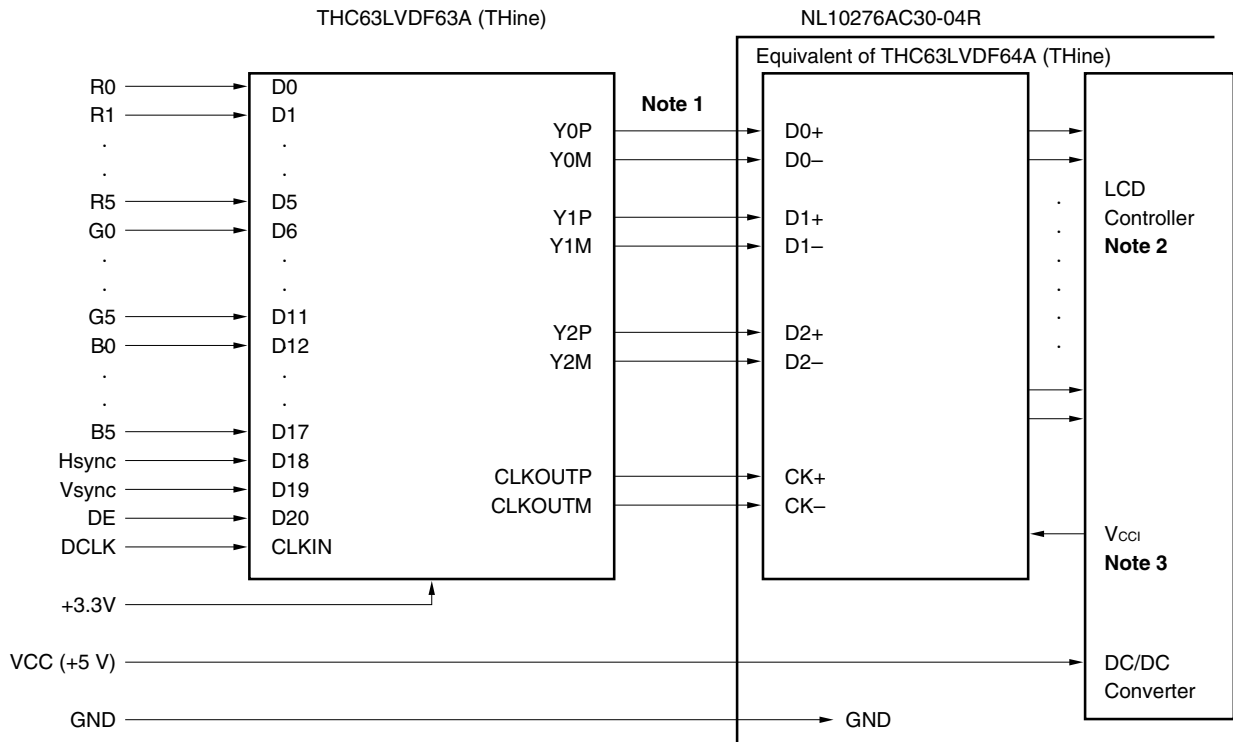
Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Frequency	1/tPW	185	–	340	Hz	–
Pulse width	tHPW/tPW	20	–	100	%	at max. luminance (100%)
Input voltage	V <sub>IL</sub>	0	–	0.6	V	–
	V <sub>IH</sub>	4.5	–	5.0	V	–

Regarding setup for frequency, refer to the formula below.

Setup frequency = Vsync frequency × (n + 0.25) or (n + 0.75)

Please readjust the frequency after evaluating the display quality sufficiently, because display quality can be disturbed due to the frequency.

CONNECTING THE THC63LVDF63A



- Notes:**
1. 100 Ω twisted pair
  2. These signals should be kept in the range specified on page 13, **INPUT SIGNAL TIMING**.
  3. V<sub>CCI</sub> = 3.3 V (LCD internal voltage)
  4. THC63LVDF63A is used as an 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 gray-scale	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
		1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Green gray-scale	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
		0	0	0	0	0	0	1	1	1	1	1	0	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 gray-scale	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
		0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	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 gray-scale) 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 the 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
–				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		tvhs	1	–	–	CLK	–
Hsync-Vsync timing		tvhs	1	–	–	CLK	–
Rise, fall	tvrf	<b>Note</b>			ns	–	
DATA	DATA-CLK (setup)				tds	ns	–
	CLK-DATA (hold)				tdh	ns	–

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

(2) Input Signal of the LVDS Receiver (For CN1 Input)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
CLK Frequency	TRCP	14.71	T	16.66	ns	–
Bit 0 position	TRIP1	-0.5	0	0.5	ns	T = 15.38 ns
Bit 1 position	TRIP0	T/7-0.5	T/7	T/7+0.5	ns	T = 15.38 ns
Bit 2 position	TRIP6	2T/7-0.5	2T/7	2T/7+0.5	ns	T = 15.38 ns
Bit 3 position	TRIP5	3T/7-0.5	3T/7	3T/7+0.5	ns	T = 15.38 ns
Bit 4 position	TRIP4	4T/7-0.5	4T/7	4T/7+0.5	ns	T = 15.38 ns
Bit 5 position	TRIP3	5T/7-0.5	5T/7	5T/7+0.5	ns	T = 15.38 ns
Bit 6 position	TRIP2	6T/7-0.5	6T/7	6T/7+0.5	ns	T = 15.38 ns

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

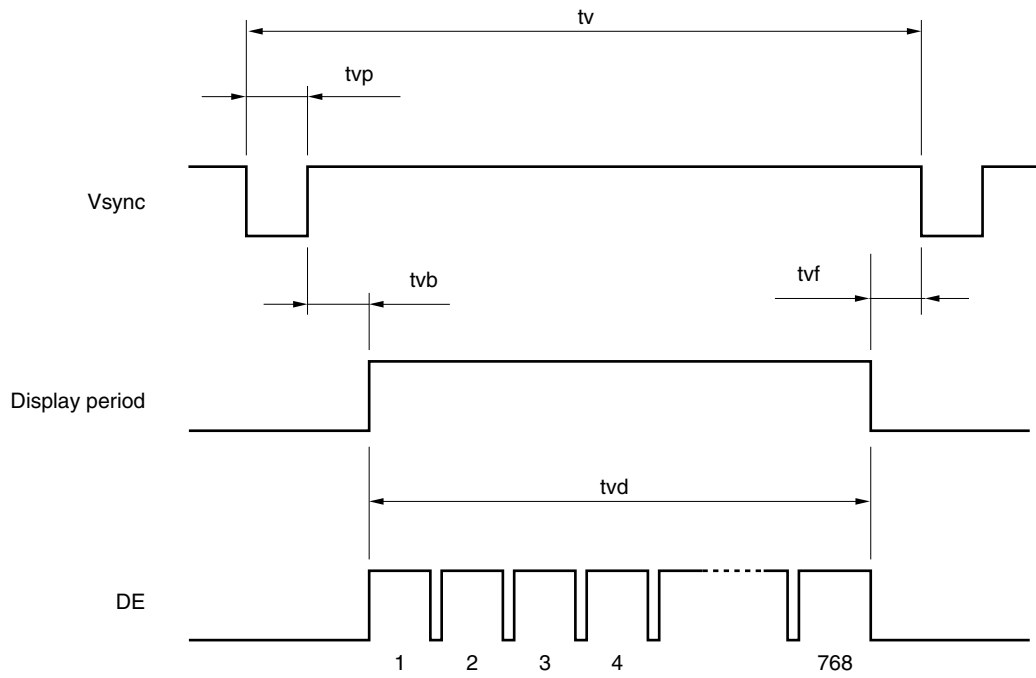
If there is a large CLK jitter value between the current cycle and the next cycle, the skew time of the next cycle will decrease with the value of the jitter.

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

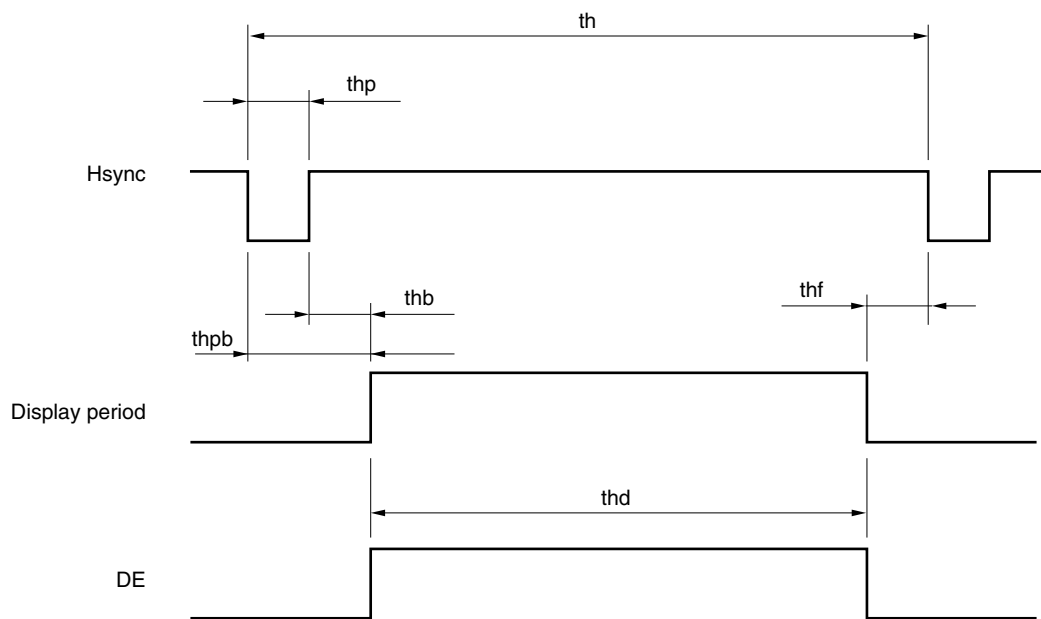
e.g., LVDS output skew: ± 200 ps  
 Cable skew: ± 100 ps } acceptable CLK jitter = ± 200 ps (500 – (200 + 100) = 200 ps)

(3) Input Signal Timing for the LCD Controller

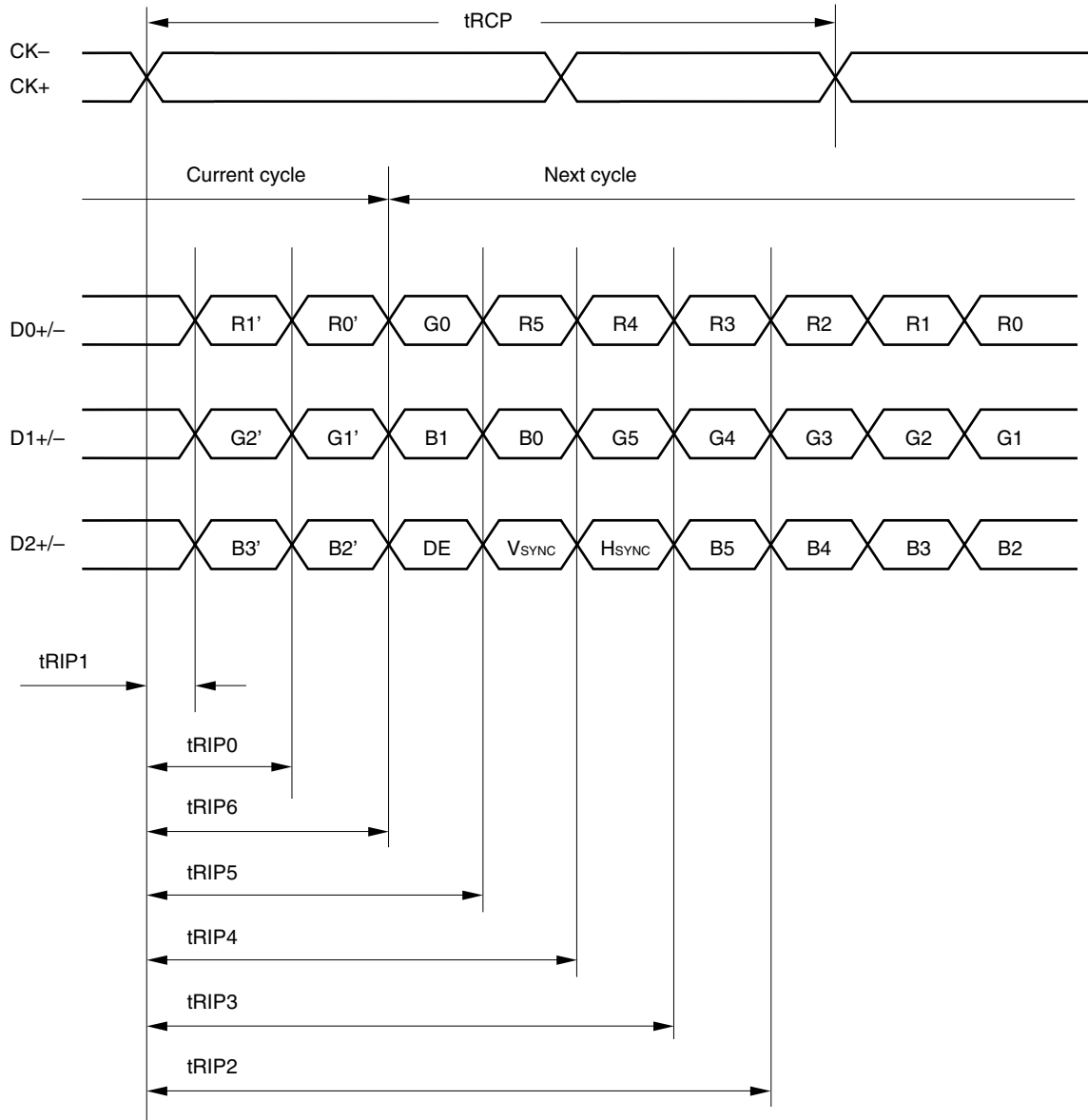
<Vertical>



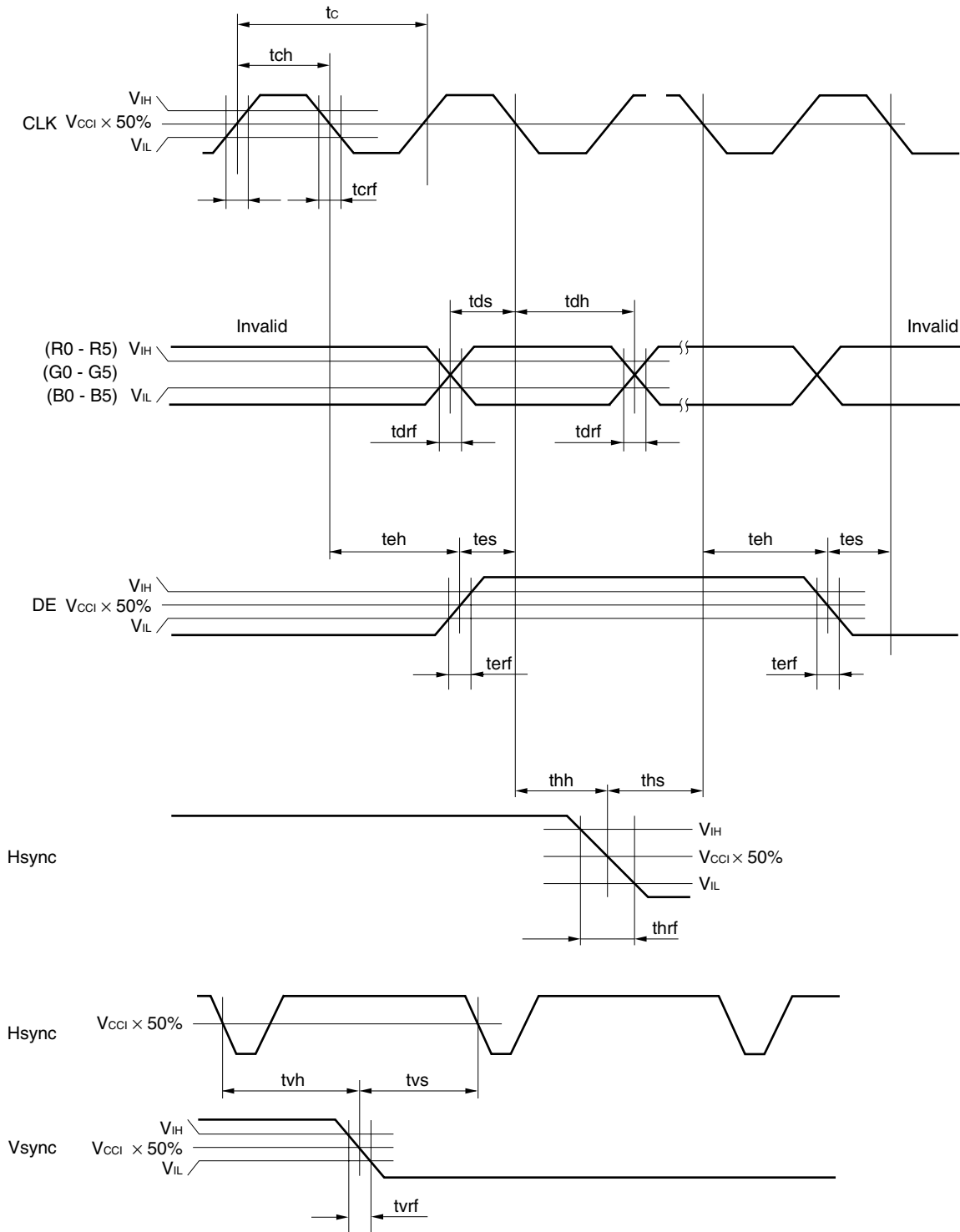
<Horizontal>



<LVDS Receiver>

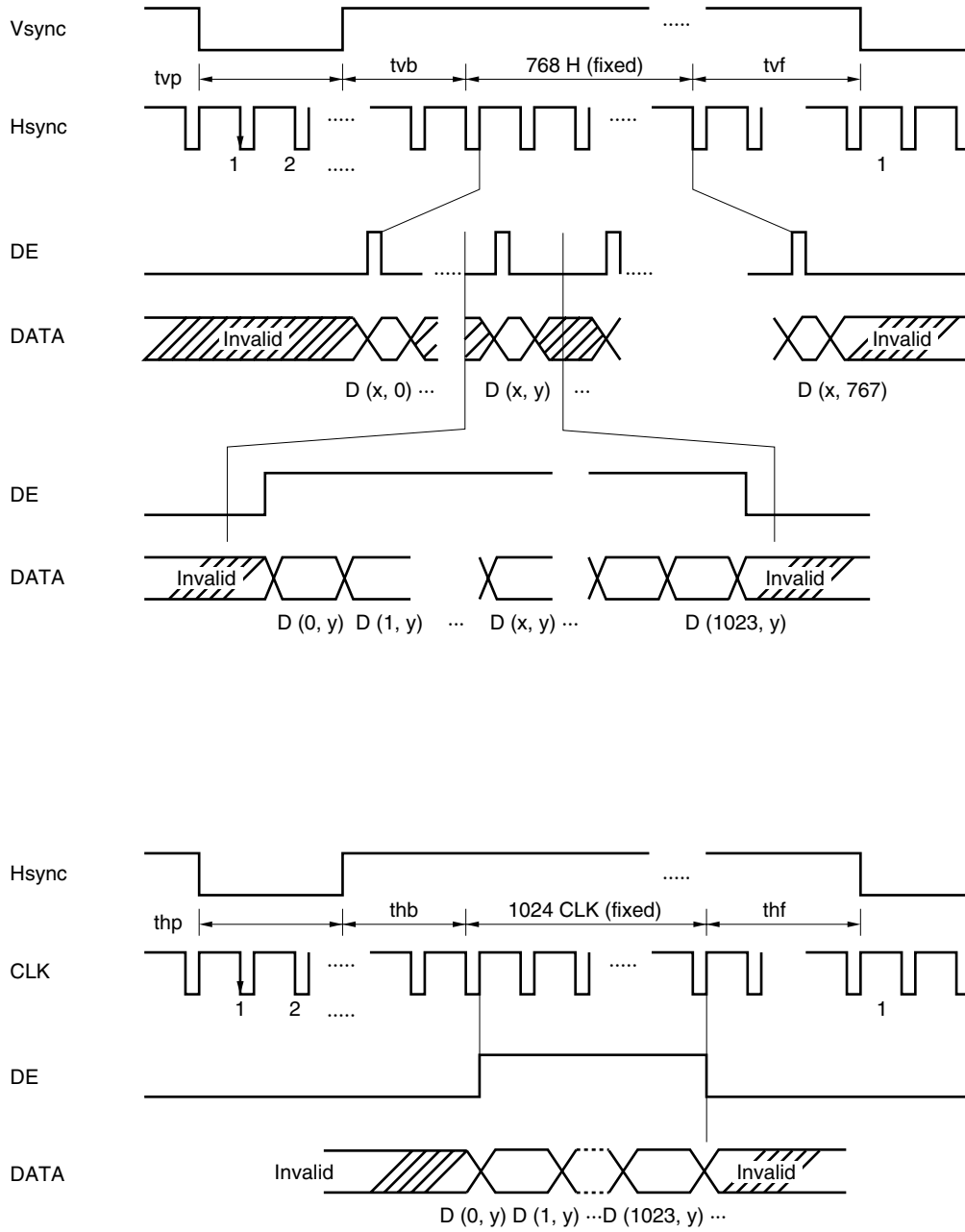






$V_{IH} = V_{CC1} \times 0.7$  (min.)  
 $V_{IL} = V_{CC1} \times 0.3$  (max.)  
 $V_{CC1} = 3.3$  V (LCD internal voltage)

(4) Input Signal Timing Chart



**Note:** These values are in the output of the THC63LVDF64A.  
 (Refer to page 11, **CONNECTING THE 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**

( $T_a = 25^\circ\text{C}$ ,  $V_{CC} = 5\text{ V}$ ,  $V_{DDB} = 12\text{ V}$ , **Note 1**)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Contrast ratio	CR	White/Black, <b>Note 1</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**

( $T_a = 25^\circ\text{C}$ ,  $V_{CC} = 5\text{ V}$ ,  $V_{DDB} = 12\text{ V}$ )

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks	
Contrast ratio	CR	Best contrast angle, $\theta_R = 0^\circ$ , $\theta_L = 0^\circ$ , $\theta_D = 5^\circ$ White/Black, at center	–	450	–	–	<b>Note 2</b>	
Color gamut	C	$\theta_R$ , $\theta_L$ , $\theta_U$ , $\theta_D = 0^\circ$ At center, to NTSC	35	40	–	%	–	
Viewing angle range (CR>10)	Horizontal	$\theta_R$	CR > 10, White/Black	50	60	–	deg.	<b>Note 5</b>
		$\theta_L$	$\theta_U = 0^\circ$ , $\theta_D = 0^\circ$	50	60	–	deg.	
	Vertical	$\theta_U$	CR > 10, White/Black	30	40	–	deg.	
		$\theta_D$	$\theta_R = 0^\circ$ , $\theta_L = 0^\circ$	35	50	–	deg.	
Response time	Ton	White (100%) to black (10%)	–	15	40	ms	<b>Note 6</b>	
	Toff	Black (0%) to white (90%)	–	40	80			
Luminance control range	–	Maximum luminance: 100%	–	30 to 100	–	%	–	

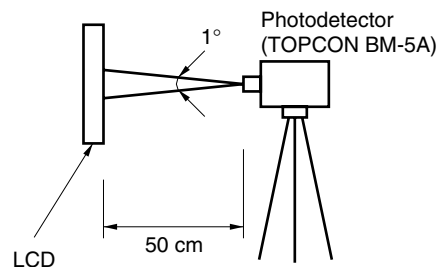
**Notes:** 1. Viewing angle:  $\theta_R = 0^\circ$ ,  $\theta_L = 0^\circ$ ,  $\theta_U = 0^\circ$ ,  $\theta_D = 0^\circ$ , at center

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

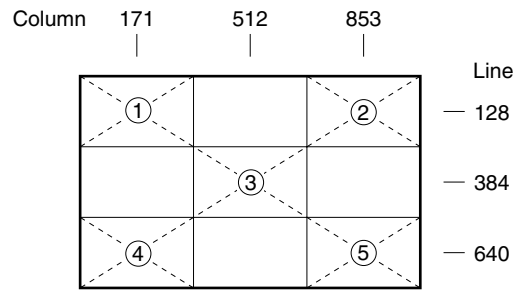
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance with all pixels in white}}{\text{Luminance with all pixels in black}}$$

The luminance is measured in a darkroom.

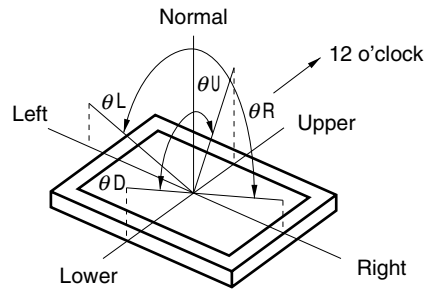
3. The luminance is measured after the module has been working for 20 minutes, with all pixels in white. Typical value is measured after luminance saturation.



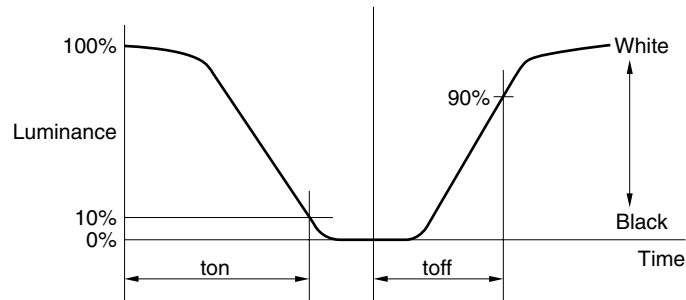
4. The luminance uniformity is calculated by using the formula in the table.  
The luminance is measured at or near the five points shown below.



5. Definitions of viewing angles are as follows.



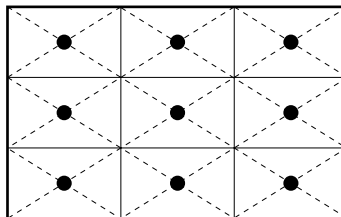
6. Definition of response time is as follows.



RELIABILITY TEST SPECIFICATIONS


Test Item	Test Condition	Notes
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 (nonoperation)	<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 (nonoperation)	<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 (nonoperation)	<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 the LCD module outgoing inspection.
  2. Physical damage.
  3. Discharge points ● are shown in the figure below.




**GENERAL CAUTIONS**

The figures and statements below are very important. Please be sure you understand their contents completely.

	<b>CAUTION</b>	This mark indicates that you will get hurt and/or the module will be damaged if you make a mistake in operation.
---	----------------	--

	This mark indicates that you will get an electric shock if you make a mistake in operation.	
	This mark indicates that you will get hurt if you make a mistake in operation.	


 **CAUTION**

	Do not touch an inverter on which a caution label has been placed while the LCD module is in operation, because of dangerous high voltage.
---	--

**(1) Caution when taking out the module**

- a) Pickup the pouch only, when removing the module from a carrier box.

**(2) Cautions for handling the module**

- a) As 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, impact and pressure to the LCD module should be avoided.
- c) As the surface of the 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 the CLK, Hsync, or Vsync signal. If any one or more of these signals is lost, the panel will be damaged.
- h) The torque on mounting screws should never exceed 0.392 N·m (4 kgf·cm).
- i) Don't push or rub the surface of the module. If you do, scratches or rubbing marks may be left on the module surface.

**(3) Cautions regarding 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 at room temperature is recommended.
- c) This module uses cold cathoded fluorescent lamps. The lifetime of the lamps is shortened if the module is operated in a low-temperature environment.
- d) Do not operate the module in a high magnetic field.

**(4) Cautions about module characteristics**

- a) Do not apply a 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 retardation film, which may cause variation in the color hue at different viewing angles. Nonuniformity may appear on the screen during high-temperature operation.
- c) A light vertical stripe may be observed, depending on the display pattern. This is not a defect or a malfunction.
- d) Noise from the inverter circuit may be observed in the luminance control mode. This is not a defect or a malfunction.

**(5) Other cautions**

- a) Do not disassemble and/or reassemble the 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 damage. We recommend using the original shipping packages.

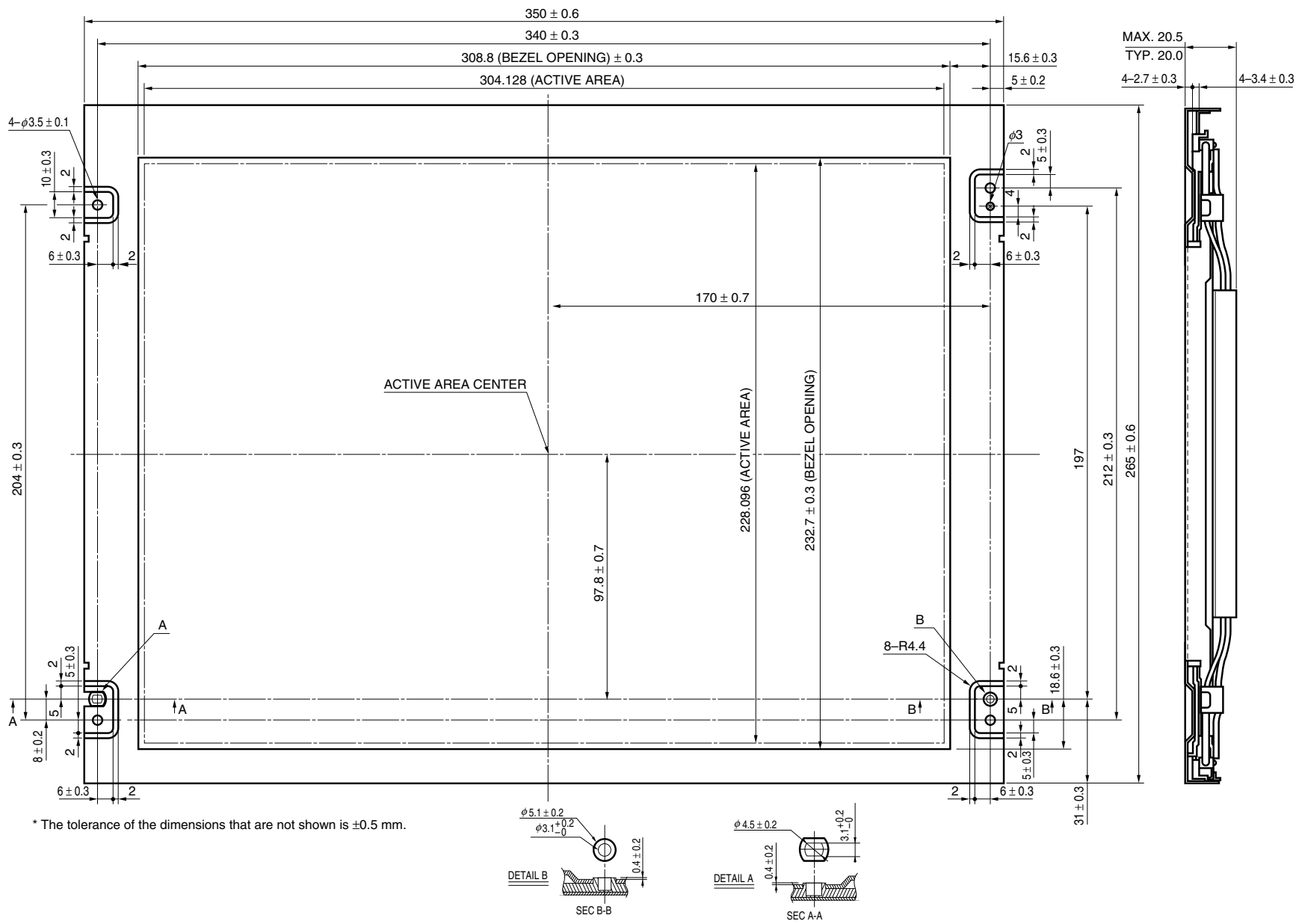
The liquid crystal display has the following specific characteristics. These are not defects or malfunctions.

The optical characteristics of this module may be affected by the ambient temperature. This module has a cold cathode tube for backlight. Optical characteristics, like luminance or uniformity, will change over time.

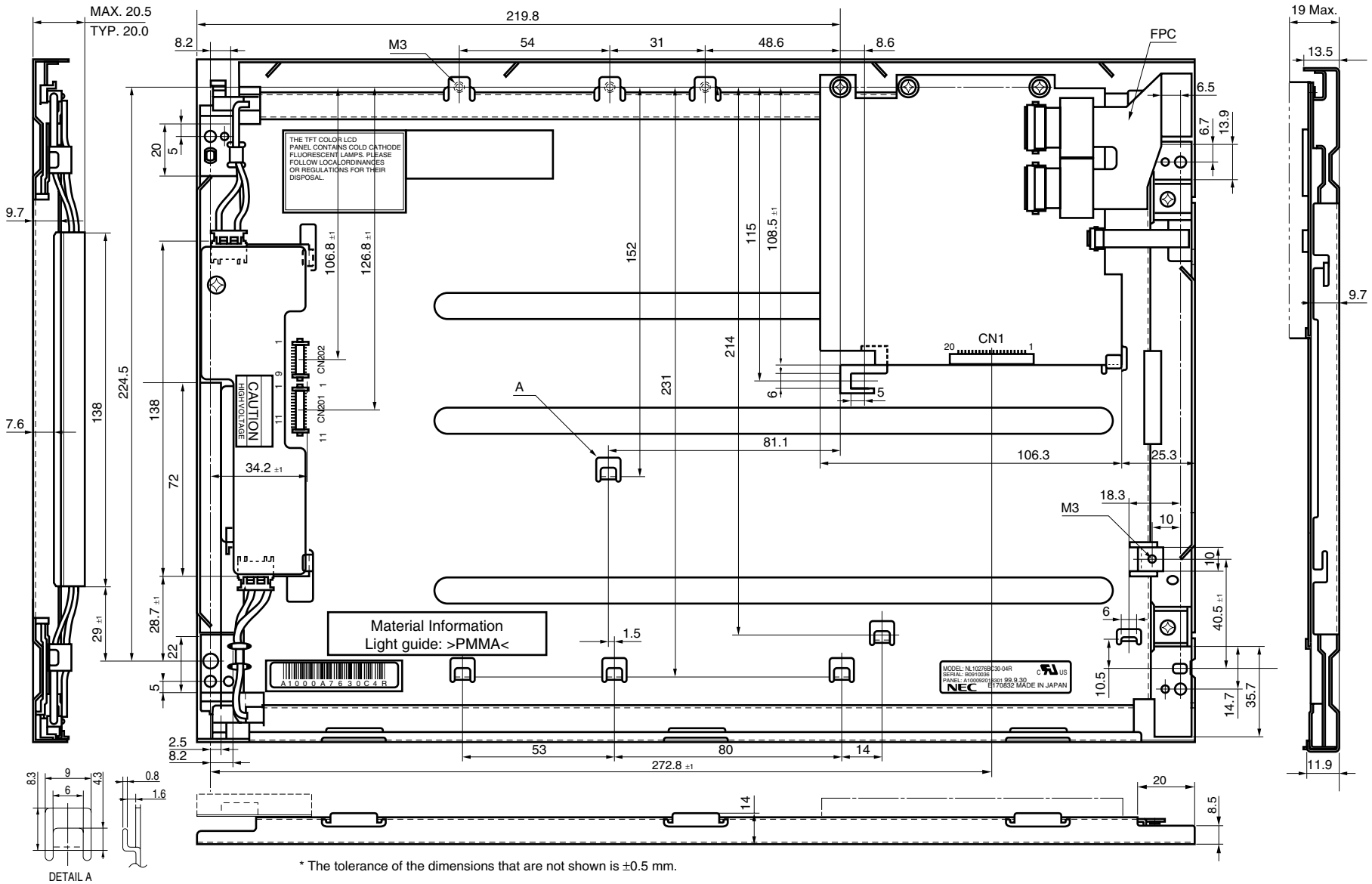
Uneven brightness and/or small spots may be observed, depending on different display patterns.



OUTLINE DRAWING: Front View (Unit: mm)



OUTLINE DRAWING: Rear View (Unit: mm)





No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Corporation. NEC Corporation assumes no responsibility for any errors which may appear in this document.

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

While NEC Corporation has been making continuous effort to enhance the reliability of its electronic components, the possibility of defects cannot be eliminated entirely. To minimize risks of damage or injury to persons or property arising from a defect in an NEC electronic component, customers must incorporate sufficient safety measures in its design, such as redundancy, fire-containment, and anti-failure features. NEC devices are classified into the following three quality grades:

"Standard," "Special," and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device before using it in a particular application.

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

Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

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

The quality grade of NEC devices is "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact an NEC sales representative in advance.

(Note)

(1) "NEC" as used in this statement means NEC Corporation and also includes its majority-owned subsidiaries.

(2) "NEC electronic component products" means any electronic component product developed or manufactured by or for NEC (as defined above).