

**TFT COLOR LCD MODULE
NL128102BC23-03**

**39 cm (15.4 Inches), 1280 × 1024 Pixels, 16,194,277 Colors,
LVDS Interface, Wide Viewing Angle, High Luminance**

DESCRIPTION

The NL128102BC23-03 is a TFT (thin film transistor) active-matrix color liquid crystal display (LCD) comprising an amorphous silicon TFT attached to each signal electrode, a driving circuit, and a backlight. The NL128102BC23-03 has a built-in backlight. Backlight includes long-life-lamps and the lamps are replaceable with lamp holders.

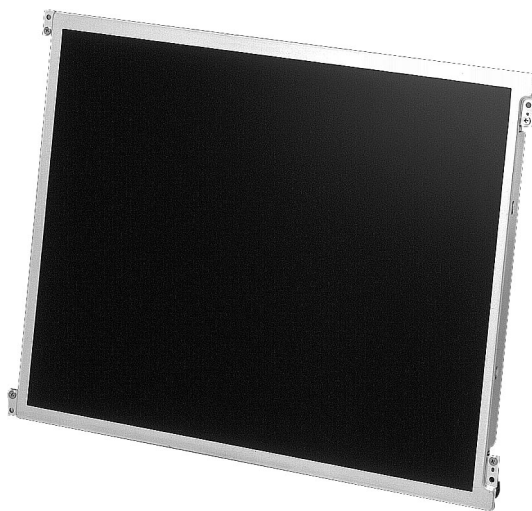
The 39 cm (15.4 inch) diagonal display area contains 1280 × 1024 pixels and can display 16,194,277 colors simultaneously.

FEATURES

- LVDS interface (adapted the THC63LVDF84A, THine Electronics, Inc. as a receiver)
- Wide viewing angle (with Retardation Film)
- High luminance (240 cd/m² at I_L = 6 mAmps/lamp)
- Low reflection
- Incorporated edge-type backlight (four lamps/two holders)
- Replaceable lamp holders (part No. 154LHS04)
- Wide color gamut

APPLICATIONS

- PC, EWS monitors



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. Also, the LCD module is connected to the LSI drivers with a TFT liquid crystal panel structure, and then the backlight assembly is attached to the backside of the panel.

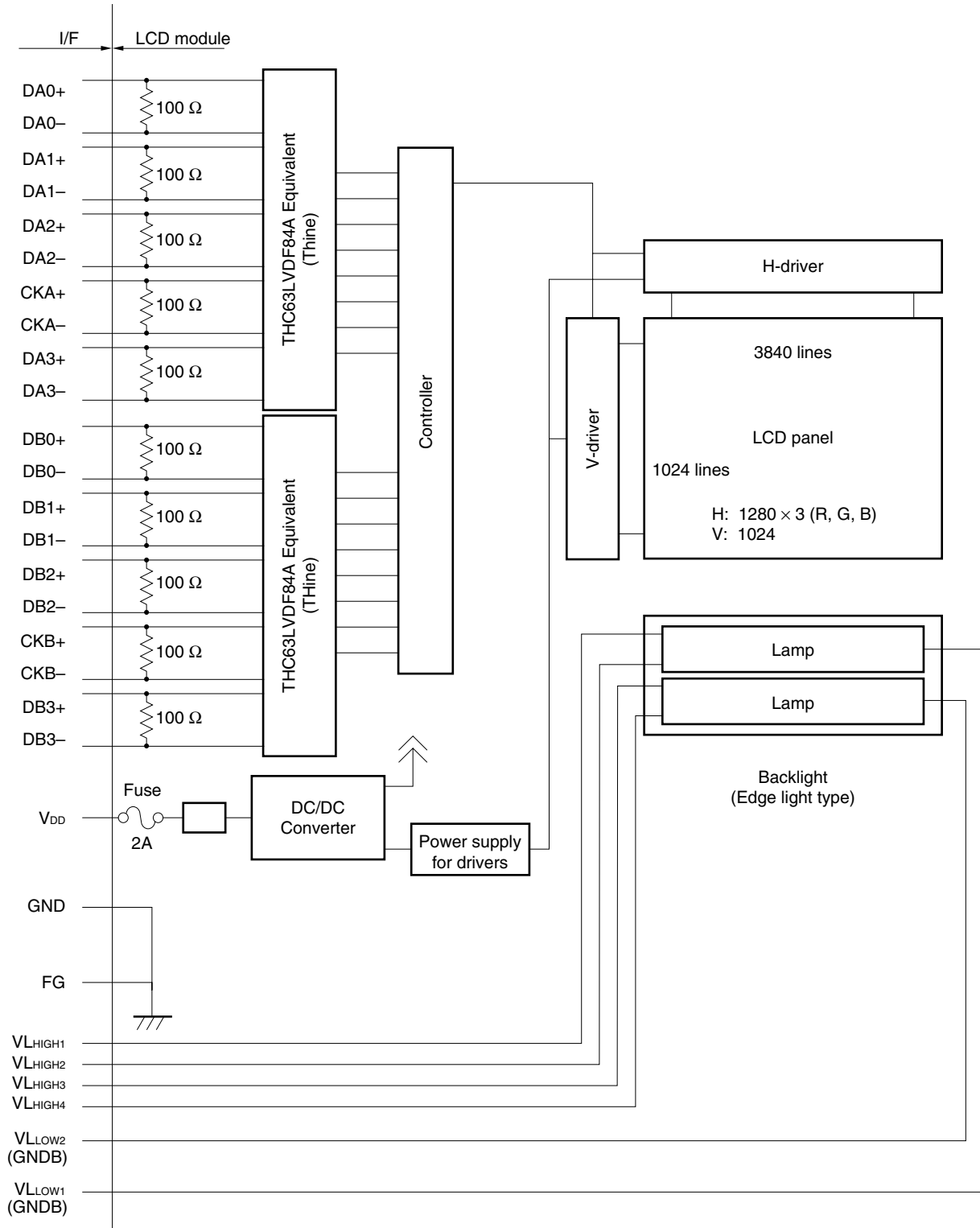
RGB (red, green, blue) data signals from a source system are modulated into a form suitable for active-matrix addressing by the onboard signal processor and sent to the driver LSIs, which in turn address the individual TFT cells.

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)

Item	Description
Display area	305.28 (H) × 244.224 (V) mm
Drive system	a-Si TFT active matrix
Display colors	16,194,277 colors
Number of pixels	1280 (H) × 1024 (V) pixels
Pixel arrangement	RGB vertical stripe
Pixel pitch	0.2385 (H) × 0.2385 (V) mm
Module size	340.0 (H) × 269.0 (V) × 17.9 (D) mm typ.
Weight	1400 g (typ.)
Contrast ratio	250:1 (typ.)
Viewing angle (more than the contrast ratio of 10:1)	<ul style="list-style-type: none"> • Horizontal: 70° (typ., left side, right side) • Vertical: 50° (typ., up side, down side)
Designed viewing direction	<ul style="list-style-type: none"> • Optimum gray-scale (r = 2.2): perpendicular
Polarizer pencil-hardness	3H (min., at JIS K5400)
Color gamut	60% (typ., at center, to NTSC)
Response time	6 ms (typ.), "white 100%" to "black 10%"
Luminance	240 cd/m ² (typ., at I _L = 6 mA rms/lamp)
Signal system	LVDS interface (receiver: THC63LVDF84A, Thine Electronics, Inc or equivalent.) RGB 6-bit signals, synchronous signals (Hsync, Vsync), dot clock (CLK) encoded with the THC63LVDF84A (Thine Electronics, Inc.) are preferable.
Supply voltage	12 V (logic, LCD driving)
Backlight	Edge light type: Four cold cathode fluorescent lamps in two holders, Inverter-less Lamp holder: Part no. 154LHS04
Power consumption	19 W (typ., Checker flag pattern, at I _L = 6 mA rms/lamp)

BLOCK DIAGRAM



Note GND (Signal Ground) is connected to FG (Frame Ground) in the LCD module. Neither GND nor FG is connected to GNDB (Backlight Ground). These grounds should be connected to system ground in customer equipment.

GENERAL SPECIFICATIONS

Items	Description	Unit
Module size	340.0 ± 1.0 (H) × 269.0 ± 1.0 (V) × 17.9 + 0.1/−0.2 (D) Note 1	mm
Display area	305.28 (H) × 244.224 (V) [Diagonal display area: 39 cm (15.4 inches)]	mm
Number of pixels	1280 (H) × 1024 (V)	pixel
Dot pitch	0.0795 (H) × 0.2385 (V)	mm
Pixel pitch	0.2385 (H) × 0.2385 (V)	mm
Pixel arrangement	RGB (red, green, blue) vertical stripe	–
Display colors	16,194,277 (RGB, 8 bits)	color
Weight	1400 (typ.), 1520 (max.)	g

Note 1: Wrinkless and beding of a transparency sheet are excepted.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit	Remarks
Supply voltage	V _{DD}	−0.3 to +14.0	V	T _a = 25°C
Logic input voltage	V _i	−0.3 to 3.6	V	T _a = 25°C V _{DD} = 12 V
Lamp voltage	V _L	2000	V _{rms}	T _a = 25°C
Storage temp.	T _{ST}	−20 to +60	°C	–
Operating temp.	T _{OP1}	0 to +50	°C	Module surface Note 1
	T _{OP2}	0 to +60	°C	Module rear surface Note 2
Relative humidity (RH)	Note 3	≤ 95	%	T _a ≤ 40°C
		≤ 85	%	40 < T _a ≤ 50°C
Absolute humidity	Note 3	≤ 78 Note 4	g/m ³	T _a > 50°C

- Notes 1:** Measured at the panel surface (including self-heat)
- 2:** Measured at the rear shield (including self-heat)
- 3:** No condensation
- 4:** T_a = 50°C, RH = 85%

ELECTRICAL CHARACTERISTICS

(1) Logic, LCD Driving

T_a = 25°C

Parameters	Symbols	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	V _{DD}	11.4	12.0	12.6	V	–
Ripple voltage	V _{RP}	–	–	+100	mV	for V _{DD}
Differential input “L” threshold voltage	V _{TL}	–100	–	–	mV	V _{CM} = 1.2 V Note 1
Differential input “H” threshold voltage	V _{TH}	–	–	+100	mV	
Differential input voltage	V _I	0	–	2.4	V	–
Terminating resistor	R _T	–	100	–	Ω	–
Supply current	I _{DD}	–	270 Note 2	450 Note 3	mA	V _{DD} = 12.0 V

- Notes**
- 1:** Common mode voltage; LVDS driver
 - 2:** Checker flag pattern (in EIAJ ED-2522)
 - 3:** Pattern for the maximum current

(2) Backlight

T_a = 25°C

Parameters	Symbols	Min.	Typ.	Max.	Unit	Remarks
Lamp current	I _L	3.0	6.0	7.0	mA rms	at a lamp, I _L = 6.0 mA rms: 240 cd/m ² , Note 1
Lamp voltage	V _L	–	650	–	V rms	–
Lamp turn-on voltage	V _s	1050	–	–	V rms	T _a = 25°C Note 1
		1450	–	–	V rms	T _a = 0°C Note 1
Oscillator frequency	F ₀	50	–	60	kHz	Note 2

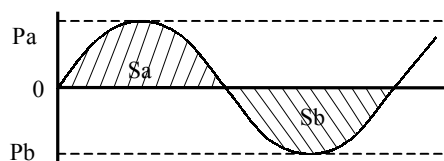
Notes 1: When I_L and V_s are less than the minimum value, lamps might not turn on.

2: Recommended value of “F₀.”

- F₀ is within the specification.
- $F_0 = \frac{1}{4} th \times (2n - 1)$ th: Hsync period
 n: a natural number (1, 2, 3 …)

If F₀ is out of the recommended value, interference between F₀ frequency and Hsync frequency may cause beat on the display.

3: The asymmetric ratio of working waveform for lamps (Power supply voltage peak ratio, power supply current peak ratio and waveform space ratio) should be less than 5% (See the following figure.). If the waveform is asymmetric, DC (Direct current) element apply into the lamp. In this case, a lamp lifetime may be shortened, because a distribution of a lamp enclosure substance inclines toward one side between low voltage terminal (Cold terminal) and high voltage terminal (Hot terminal).

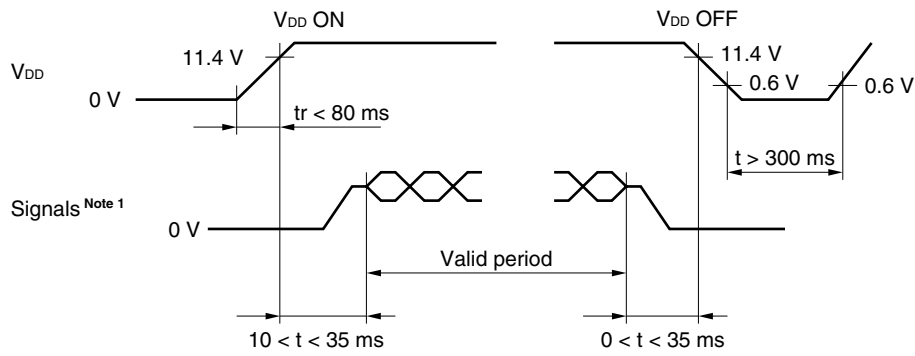


$$\frac{|Pa - Pb|}{Pb} \times 100 \leq 5 \%$$

$$\frac{|Sa - Sb|}{Sb} \times 100 \leq 5 \%$$

Pa: Supply voltage/current peak for positive, Pb: Supply voltage/current peak for negative
Sa: Waveform space for positive part, Sb: Waveform space for negative part

SUPPLY VOLTAGE SEQUENCE



Note 1: Terminations of the signal lines are resistance 100 Ω.

- Remark:**
1. Logic signals (synchronous signals and control signals) must be “0” voltage (V), when V_{DD} is not input. If input voltage to signal lines is higher than 0.3 V, the internal circuit will be damaged.
 2. When turn on the LCD module, if V_{DD} voltage falls down during the rising period up to 11.4 V, the LCD module may not start work because of the protection circuit.
 3. Turn on the backlight within the LCD operation period. 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.
 4. When the power is off, keep whole signals at low level or high impedance.
 5. This LCD module uses a fuse as follows.

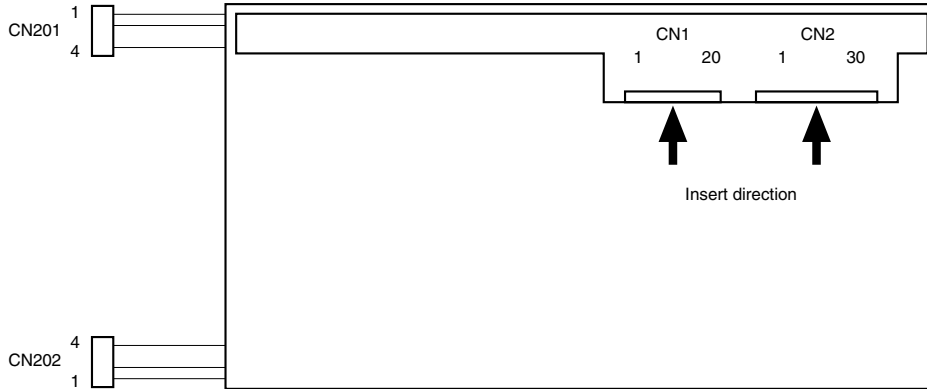
Fuse

Item	Fuse		Rating	Unit	Remark
	Type	Supplier			
V _{DD}	CCF16202AD	KAMAYA ELECTRIC Co., LTD	4	A	Fusing current ^{Note 1}
			32	V	—

Note 1: The power capacity should be more than the fusing current rating.

If the power capacity is less than the criteria value, the fuse may not blow, and then nasty smell, smoking and so on may occur.

INTERFACE PIN CONNECTIONS AND FUNCTIONS

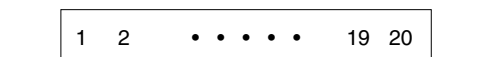


(1) Interface connector for signal and power

CN1 socket: 53780-2090
 Adaptable plug: 51146-2000
 Supplier: Molex Incorporated.

Pin No.	Symbol	Function	Description
1	N.C.	Non-connection	Keep the terminal open
2	N.C.		
3	GND	Ground	Connect to system ground Note 1
4	GND		
5	DA0-	Odd pixel data0	LVDS differential signal Note 2
6	DA0+		
7	GND	Ground	Connect to system ground Note 1
8	DA1-	Odd pixel Data1	LVDS differential signal Note 2
9	DA1+		
10	GND	Ground	Connect to system ground Note 1
11	DA2-	Odd pixel Data2	LVDS differential signal Note 2
12	DA2+		
13	GND	Ground	Connect to system ground Note 1
14	CKA-	Odd pixel Clock	LVDS differential signal Note 2
15	CKA+		
16	GND	Ground	Connect to system ground Note 1
17	DA3-	Odd pixel Data3	LVDS differential signal Note 2
18	DA3+		
19	GND	Ground	Connect to system ground Note 1
20	N.C.	Non-connection	Keep the terminal open

CN1: Figure of socket

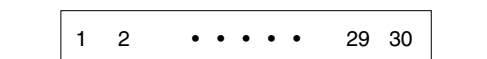


- Notes 1:** GND is signal ground for Controller. GND is connected to FG (Frame Ground) in the LCD module. Neither GND nor FG is connected to GNDB (Backlight Ground). These grounds should be connected to system ground in customer equipment.
- 2:** Use 100Ω twist pair wires for the cable.
- 3:** Do not keep pins free (except 1, 2 and 20) to avoid noise problem.

CN2 socket: 53780-3090
 Adaptable plug: 51146-3000
 Supplier: Molex Incorporated.

Pin No.	Symbol	Function	Description
1	N.C.	Non-connection	Keep the terminal open
2	N.C.		
3	GND	Ground	Connect to system ground Note 1
4	GND		
5	DB0-	Even Pixel Data0	LVDS differential signal Note 2
6	DB0+		
7	GND	Ground	Connect to system ground Note 1
8	DB1-	Even Pixel Data1	LVDS differential signal Note 2
9	DB1+		
10	GND	Ground	Connect to system ground Note 1
11	DB2-	Even Pixel Data2	LVDS differential signal Note 2
12	DB2+		
13	GND	Ground	Connect to system ground Note 1
14	CKB-	Even Pixel Clock	LVDS differential signal Note 2
15	CKB+		
16	GND	Ground	Connect to system ground Note 1
17	DB3-	Even Pixel Data3	LVDS differential signal Note 2
18	DB3+		
19	GND	Ground	Connect to system ground Note 1
20	Reserved	Reserved	Keep the terminal open
21	Reserved		
22	Reserved		
23	Reserved		
24	GND	Ground	Connect to system ground Note 1
25	GND		
26	GND		
27	N.C.	Non-connection	Keep the terminal open
28	VDD	+12 V Power supply	12 V±5%
29	VDD		
30	VDD		

CN2: Figure of socket



- Notes 1:** GND is signal ground for Controller. GND is connected to FG (Frame Ground) in the LCD module. Neither GND nor FG is connected to GNDB (Backlight Ground). These grounds should be connected to system ground in customer equipment.
- 2:** Use 100Ω twist pair wires for the cable.
- 3:** Do not keep pins free (except 1, 2, 20-23 and 27) to avoid noise problem.

(2) Connector for backlight lamp

CN201 plug: BHR-04VS-1

Adaptable socket: SM03(7-D1)B-BHS-1

Supplier: J.S.T. TRADING COMPANY, LTD.

Pin No.	Symbol	Function	Description
1	VL _{HIGH1}	Upper side lamp, High voltage terminal	The cable color is pink Note 1
2	VL _{HIGH2}	Upper side lamp, High voltage terminal	The cable color is pink
3	N.C.	Non-connection	Keep the terminal open.
4	VL _{LOW1} (GNDB)	Up side lamp, Low voltage terminal	The cable color is gray

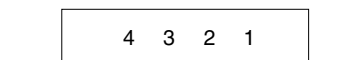
CN202 plug: BHR-04VS-1

Adaptable socket: SM03(7-D1)B-BHS-1

Supplier: J.S.T. TRADING COMPANY, LTD.

Pin No.	Symbol	Function	Description
1	VL _{HIGH3}	Lower side lamp, High voltage terminal	The cable color is pink
2	VL _{HIGH4}	Lower side lamp, High voltage terminal	The cable color is pink
3	N.C.	Non-connection	Keep the terminal open.
4	VL _{LOW2} (GNDB)	Lower side lamp, Low voltage terminal	The cable color is gray

CN201, CN202: Figure of socket



Note 1: GND (signal ground) is connected to FG (frame ground) in the LCD module. Neither GND nor FG is connected to GNDB (backlight ground). These grounds should be connected to system ground in customer equipment.

Attention: VL_{HIGH} and VL_{LOW} must be connected correctly. If customer connects wrongly, customer will be hurt and the module will be broken.

METHOD OF CONNECTION FOR THC63LVDM83A

		TRANSMITTER						I/F CN				RECEIVER				CONTROLLER	
		pin	THC63LVDM83A	pin			pin	CN1	pin	THC63LVDF84A	pin						
Odd pixel data and control signal	RA2	→ 51	TA0				1	N.C.			RA0	27	→	RA2			
	RA3	→ 52	TA1				2	N.C.			RA1	29	→	RA3			
	RA4	→ 54	TA2				3	GND			RA2	30	→	RA4			
	RA5	→ 55	TA3				4	GND			RA3	32	→	RA5			
	RA6	→ 56	TA4	TA-	48	→	5	DA0-	→ 9	RA-	RA4	33	→	RA6			
	RA7	→ 3	TA5	TA+	47	→	6	DA0+	→ 10	RA+	RA5	35	→	RA7			
	GA2	→ 4	TA6				7	GND			RA6	37	→	GA2			
	GA3	→ 6	TB0	TB-	46	→	8	DA1-	→ 11	RB-	RB0	38	→	GA3			
	GA4	→ 7	TB1	TB+	45	→	9	DA1+	→ 12	RB+	RB1	39	→	GA4			
	GA5	→ 11	TB2				10	GND			RB2	43	→	GA5			
	GA6	→ 12	TB3	TC-	42	→	11	DA2-	→ 15	RC-	RB3	45	→	GA6			
	GA7	→ 14	TB4	TC+	41	→	12	DA2+	→ 16	RC+	RB4	46	→	GA7			
	BA2	→ 15	TB5				13	GND			RB5	47	→	BA2			
	BA3	→ 19	TB6	TCLK-	40	→	14	CKA-	→ 17	RCLK-	RB6	51	→	BA3			
	BA4	→ 20	TC0	TCLK+	39	→	15	CKA+	→ 18	RCLK+	RC0	53	→	BA4			
	BA5	→ 22	TC1				16	GND			RC1	54	→	BA5			
	BA6	→ 23	TC2	TD-	38	→	17	DA3-	→ 19	RD-	RC2	55	→	BA6			
	BA7	→ 24	TC3	TD+	37	→	18	DA3+	→ 20	RD+	RC3	1	→	BA7			
	Hsync	→ 27	TC4				19	GND			RC4	3	→	Hsync			
	Vsync	→ 28	TC5				20	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				
Note 1	RSVD	→ 25	TD6							RD6	2	→	RSVD				
	CLK	→ 31	CLKIN							CLKOUT	26	→	CLK				
Even pixel data	RB2	→ 51	TA0				1	N.C.			RA0	27	→	RB2			
	RB3	→ 52	TA1				2	N.C.			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			
	Note 1	RSVD	→ 27	TC4			19	GND			RC4	3	→	RSVD			
	Note 1	RSVD	→ 28	TC5			20	Reserved			RC5	5	→	RSVD			
Note 1	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	N.C.			RD5	50	→	BB1				
Note 1	RSVD	→ 25	TD6			28	V _{DD} : 12 V			RD6	2	→	RSVD				
	CLK	→ 31	CLKIN			29	V _{DD} : 12 V			CLKOUT	26	→	CLK				
						30	V _{DD} : 12 V										

Note 1: RSVD must be low level.

DISPLAY COLORS TO INPUT DATA SIGNALS

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

Note 1: The combination of 8-bit signals (253 steps in grayscale) results in equivalent to 16,194,277 (253 × 253 × 253) colors.

The display data of (11111101), (11111110) and (11111111) become same grayscale.

INPUT SIGNAL TIMINGS

(1) Input signal specifications

	Parameter		Symbol	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency	Vf = 75 Hz	1/tc	65.0	67.5	70.0	MHz	-
				-	14.815	-	ns	
		Vf = 60 Hz		51.5	54.0	56.5	MHz	-
				-	18.52	-	ns	
	Duty		tcl/tc	Note 1			-	-
	Rise, fall		tcrf				ns	-
Hsync	Period	Vf = 75 Hz	th	12.3	12.5043	-	μs	Typ = 80.0 kHz Note 2, 3
				750	844	-	CLK	
		Vf = 60 Hz		12.3	15.630	-	μs	Typ = 64.0 kHz
				750	844	-	CLK	
	Display period		thd	640			CLK	-
	Front-porch		thf	-	-	-	CLK	-
	Pulse width	Vf = 75 Hz	thp*	-	72	-	CLK	-
		Vf = 60 Hz		-	56	-	CLK	
	Back Porch		thb*	-	124	-	CLK	-
	*thp + thb			110	-	-	CLK	-
	CLK-Hsync set-up		ths	Note 1			ns	-
CLK-Hsync hold		thh				ns	-	
Raise, fall		thrf				ns	-	
Vsync	Period	Vf = 75 Hz	tv	-	13.329	17.47	ms	Typ = 75.0 Hz
				1028	1066	-	H	
		Vf = 60 Hz		-	16.661	17.47	ms	Typ = 60.0 Hz
				1028	1066	-	H	
	Display period		tvd	1024			H	-
	Front porch		tvf*	-	1	-	H	-
	Pulse width		tvp*	-	3	-	H	-
	Back porch		tvb*	-	38	-	H	-
	*tpv + tvb + tvf			4	-	-	H	-
	Hsync-Vsync set-up		thvs	1	-	-	CLK	-
	Hsync-Vsync hold		thvh	1	-	-	CLK	-
CLK-Vsync set-up		tvS	Note 1			ns	-	
CLK-Vsync hold		tvh				ns	-	
Raise, fall		tvrf				ns	-	
DE	CLK-DE set-up		tDes	Note 1			ns	-
	CLK-DE hold		tDeh				ns	-
	Raise, fall		tDerf				ns	-
DATA	CLK-DATA set-up		tDs	Note 1			ns	-
	CLK-DATA hold		tDh				ns	-
	Raise, fall		tDrf				ns	-

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

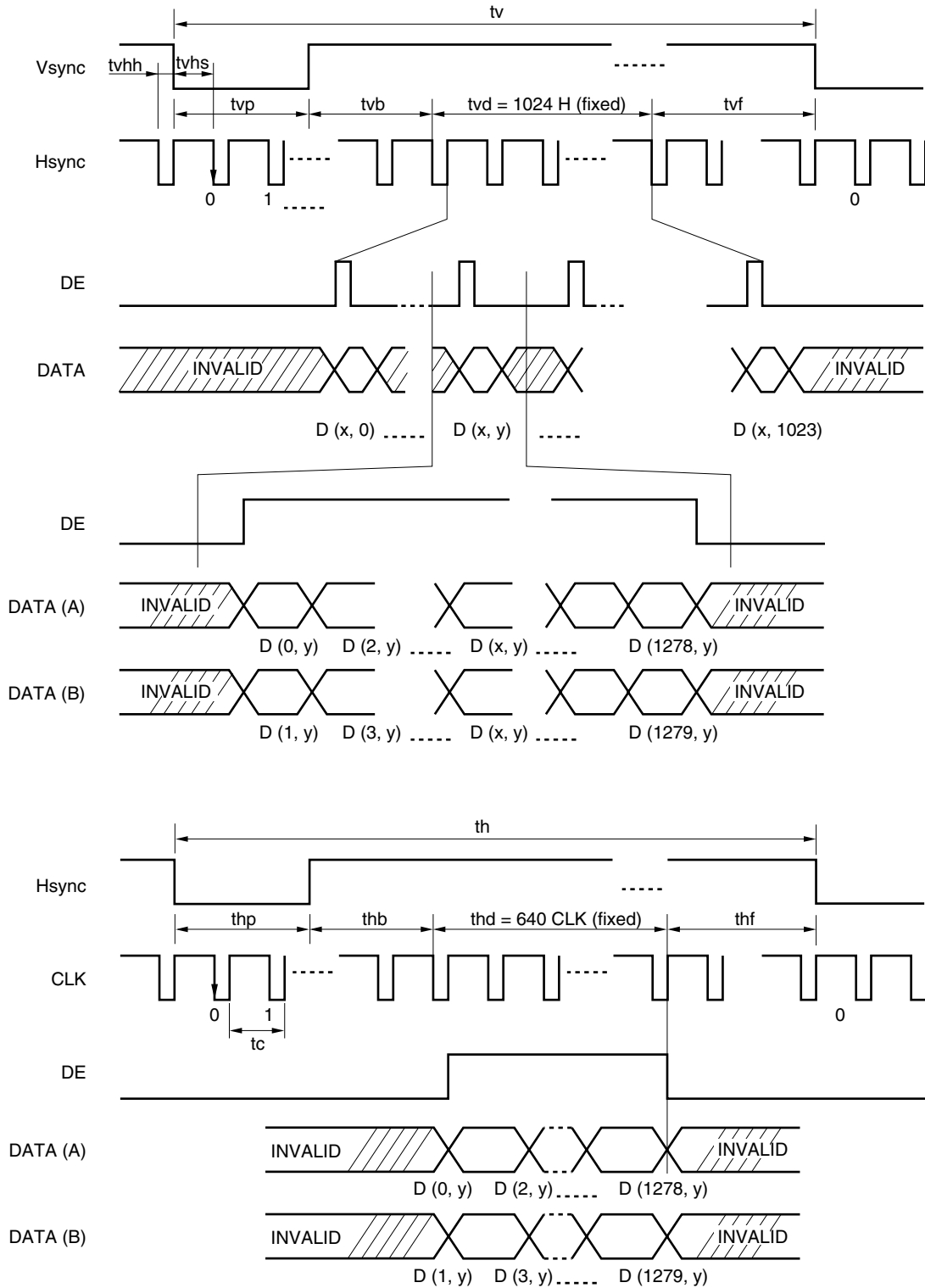
THC63LVDM83A (THine) or equivalent products are recommended for LVDS transmitter.

2: Both of "time" and "CLK number" of the "th" must keep the Minimum value of specification.

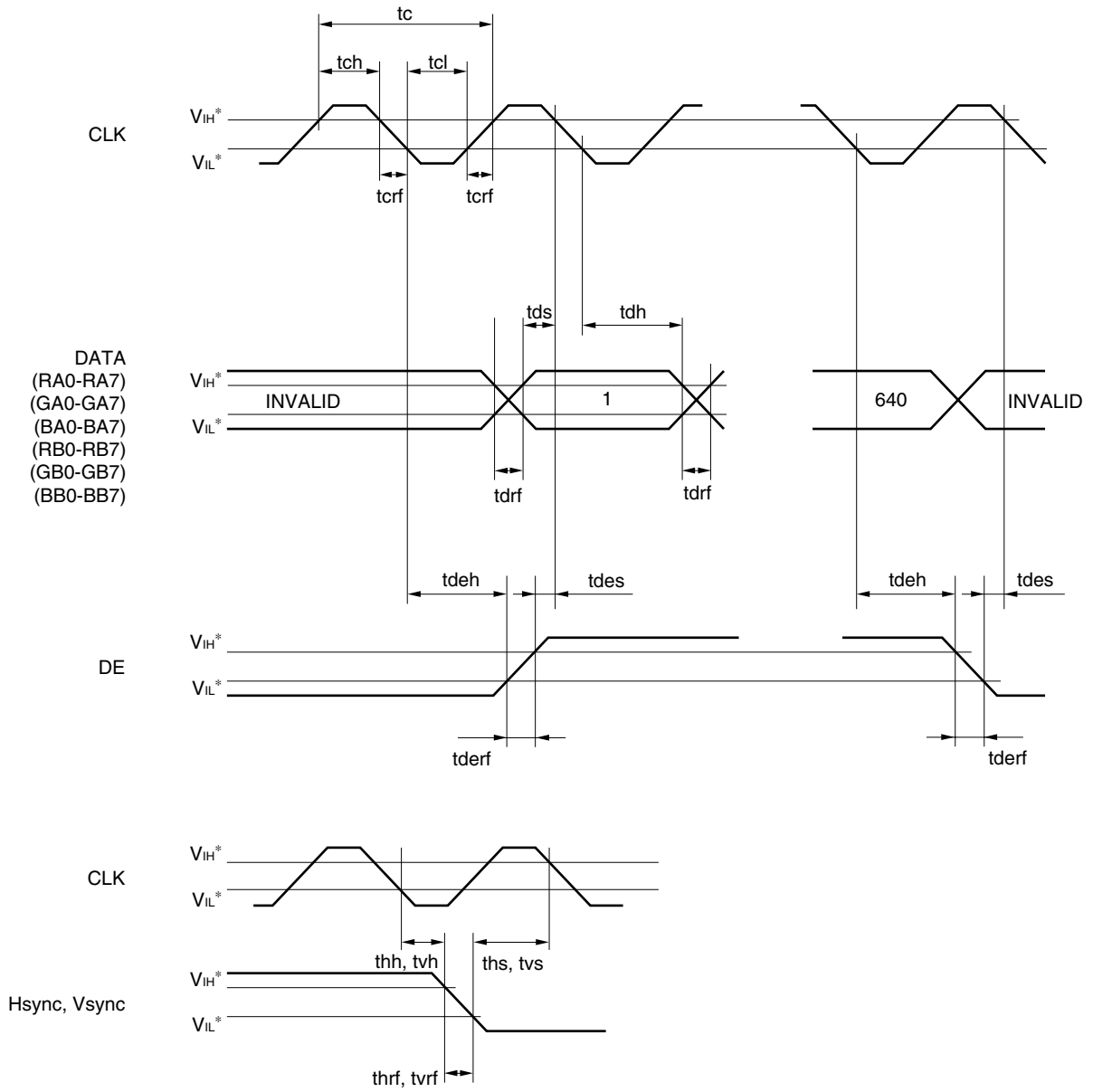
3: During operation, fluctuation of Hsync period must not exceed ±1 CLK. Otherwise function errors will occur in LCD module.

e.g.: Acceptable fluctuation range is 843-845 CLK, when the Hsync period is 844 CLK.

(2) Input signals timing chart for LCD



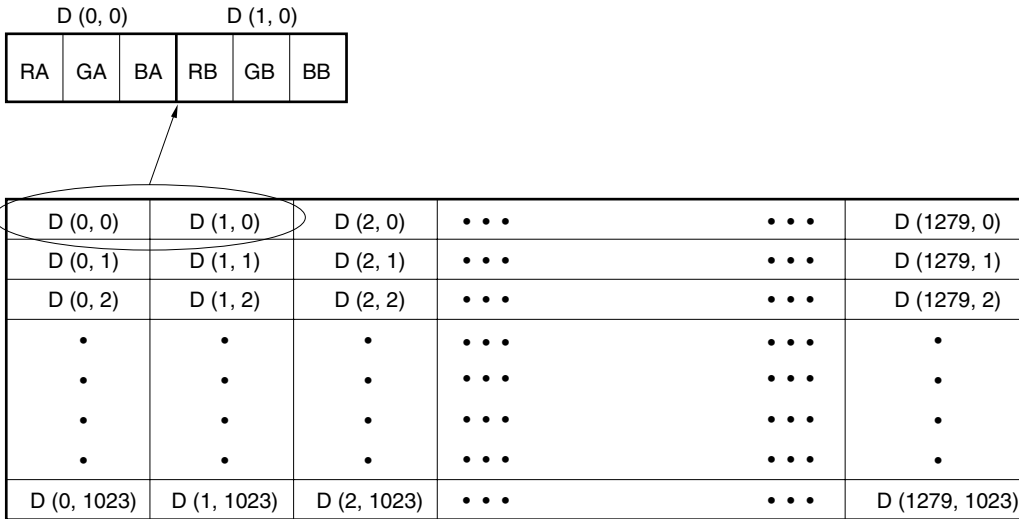
Note DATA (A): RA0-RA7, GA0-GA7, BA0-BA7
 DATA (B): RB0-RB7, GB0-GB7, BB0-BB7



* See the specifications of LVDS manufactures for detailed design.

(3) Display positions of input data

Odd Pixel: RA = R DATA Even Pixel: RB = R DATA
 Odd Pixel: GA = G DATA Even Pixel: GB = G DATA
 Odd Pixel: BA = B DATA Even Pixel: BB = B DATA



OPTICAL CHARACTERISTICS

(T_a = 25°C; Notes 1, 2)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	Remark
Contrast ratio	CR	Note 4	150	250	–	–	Note 3
Luminance	L	"White", Note 4	180	240	–	cd/m ²	Note 2
Luminance uniformity	LU	Maximum/Minimum	–	1.2	1.3	–	Note 7

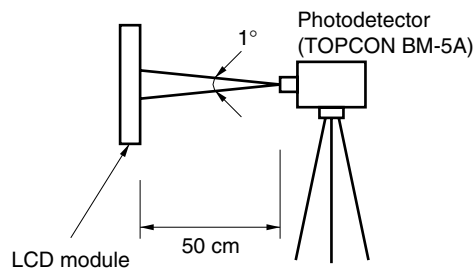
Reference Data

(T_a = 25°C; V_{CC} = 5 V; V_{DDB} = 12 V)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	Remark	
Contrast ratio	CR	Best contrast angle, θ _X = ±0°, θ _Y = –5° to –10° at center	–	300	–	–	Note 3	
Color gamut	C	To NTSC	50	60	–	%	Note 4	
Viewing angle range (CR > 10)	Horizontal	θ _{x+}	CR > 10, θ _y = ±0°	60	70	–	deg.	Note 5
		θ _{x–}		60	70	–	deg.	
	Vertical	θ _{y+}	CR > 10, θ _x = ±0°	35	50	–	deg.	
		θ _{y–}		35	50	–	deg.	
Response time (Product surface temperature = 30°C)	ton	White 100% to black 10%	–	6	12	ms	Note 6	
	toff	Black 0% to white 90%	–	41	60	ms		

Notes 1: V_{CC} = 5 V, I_L = 6.0 mArms

2: Optical characteristics are measured after the module has been working for 20 minutes, with all pixels in "white." Typical values are measured after luminance saturation. The luminance is measured in dark room.



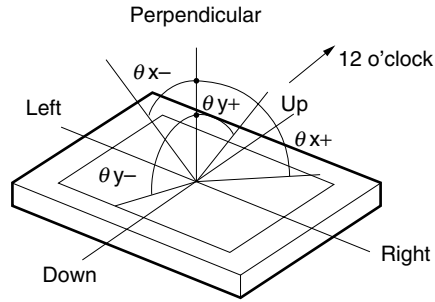
3: The contrast ratio is calculated by using the following formula.

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

The luminance is measured in darkroom.

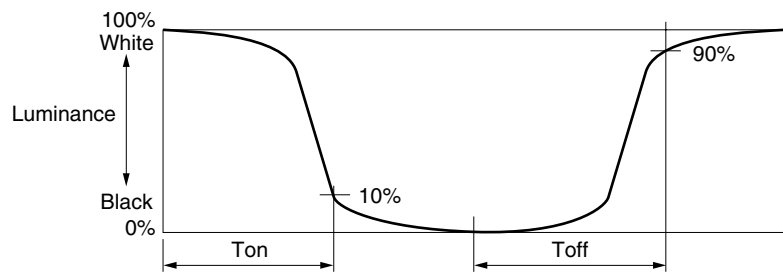
4: Viewing angle is θ_x = ±0°, θ_y = ±0° at center.

5: Definitions of viewing angles are as follows.



6: Definition of response time is as follows.

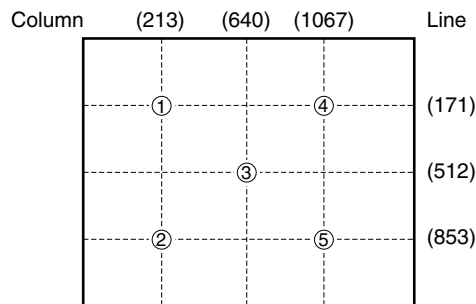
Photo-detector output signal is measured when the luminance changes “white” to “black” or “black” to “white.” Response time is the time between 10% and 100% of the photo-detector output amplitude.



7: Luminance uniformity is calculated by using the following formula.

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

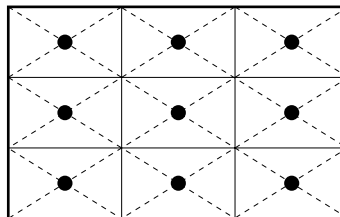
The luminance is measured at the five points shown below.



RELIABILITY TESTS

Test item	Test condition
High temperature/humidity operation Note 1	50 ± 2°C, 85% relative humidity 240 hours Display data is black.
Heat cycle (operation) Note 1	<1> 0°C ± 3°C ... 1 hour 55°C ± 3°C ... 1 hour <2> 50 cycles, 4 hours/cycle <3> Display data is black.
Thermal shock (nonoperation) Note 1	<1> -20°C ± 3°C ... 30 minutes 60°C ± 3°C ... 30 minutes <2> 100 cycles, 1 hour/cycle <3> Temperature transition time within 5 minutes
Vibration (nonoperation) Notes 1, 2	<1> 5 ~ 100 Hz, 19.6 m/s ² (2G) 1 minute/cycle X, Y, Z direction <2> 50 times each direction
Mechanical shock (nonoperation) Notes 1, 2	<1> 294 m/s ² (30 G), 11 ms X, Y, Z direction <2> 3 times each direction
ESD (operation) Notes 1, 3	150 pF, 150 Ω, ±10 kV 9 places on a panel 10 times each place at one-second intervals
Dust (operation) Note 1	Sample dust: No.15 (JIS Z 8901) Hourly 15 seconds stir, 8 times repeat


- Notes 1:** Display function is checked by the same condition as the LCD module outgoing inspection.
2: No Physical damage.
3: Discharge points (●) are shown in the figure.





PRECAUTIONS

MEANING OF CAUTION SIGNS


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


	CAUTION	This sign has a meaning that customer will be injured himself and/or the product will sustain a damage, if customer makes a mistake in operations.
---	----------------	--

		This sign has a meaning that customer will get an electric shock, if customer makes a mistake in operations.
---	--	--

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

CAUTIONS

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

		<ul style="list-style-type: none"> * Pay attention to handling for the working backlight. It may be over 35°C from ambient temperature. * Do not shock and press the LCD panel and the backlight. There will be in danger of breaking, because they are made of glass. (Shock: To be not greater 294 m/s² (30 G) and to be not greater 11 ms, Pressure: To be not greater 19.6 N (2 kgf))
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ATTENTIONS

(1) Handling the product

- <1>When customer pulls out products from carton box, take hold of both ends without touch the circuit board. If customer touches it, products may be broken down and/or out of adjustment, because of stress to mounting parts.
- <2>If customer places products temporarily, turn down the display side and place on a flat table.
- <3>Handle products with care and avoid electrostatic discharge (e.g. Decrease with earth band, ionic shower, etc.), because products (LCD module) may be damaged by electrostatic.
- <4>The torque for mounting screws should never exceed 0.39 N•m (4 kgf•cm). Over torque may cause mechanical damage to the product.
- <5>Do not press or friction, because LCD panel surface is sensitive. If customers will be clean the product surface, NEC Corporation or their supplier will recommend using the cloth with ethanolic liquid.
- <6>Do not push-pull the interface connectors while turn on, because wrong power sequence may break down the product.
- <7>Connection cables such as flexible cable, and so on, are danger of damage. Do not hook cables nor pull them.

(2) Environment

- <1>Do not operate or store in high temperature, high humidity, dewdrop atmosphere or corrosive gases. Keep the product in antistatic pouch in room temperature, because of avoidance for dusts and sunlight, if customer stores the product.
- <2>Do not operate and/or store in high temperature and/or high humidity atmosphere. If customer store the product, keep in antistatic pouch at room temperature, to avoid dust and sunlight.

- <3> Do not operate in high magnetic field. Circuit boards may be broken down by it.
- <4> Use an original protection sheet on product surface (polarizer). Adhesive type protection sheet should be avoided, because it may change color and/or properties of the polarizer.

(3) Specification for products

- <1> Do not display the fixed pattern for a long time because it may cause image sticking. If the fixed pattern is displayed on the screen, use a screen saver.
- <2> The product may be changed of color by viewing angle because of the use of condenser sheet for backlight unit.
- <3> The product may be changed of luminance by voltage variation, even if power source applies recommended voltage to backlight inverter.
- <4> Optical characteristics may be changed by input signal timings.

(4) Other

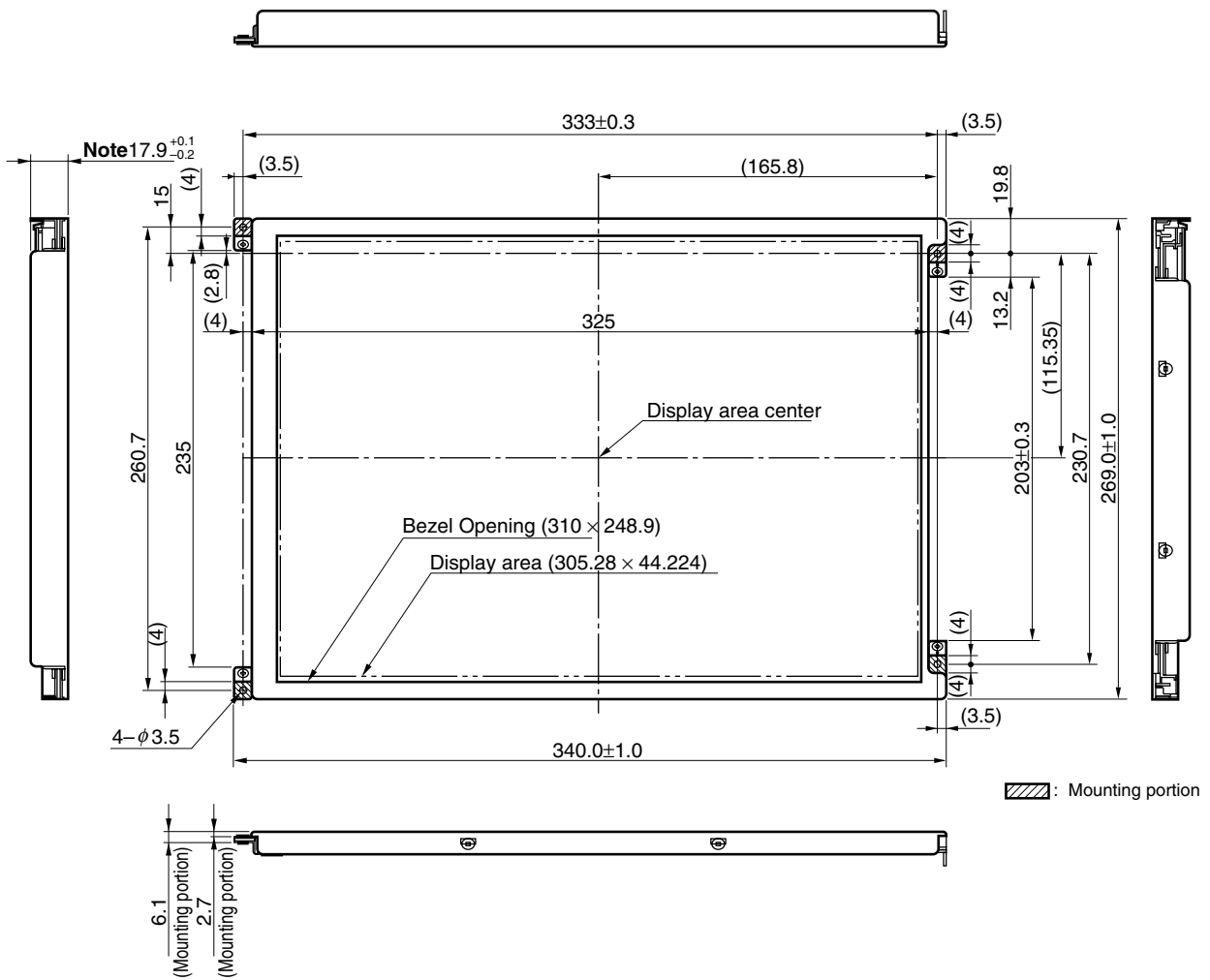
- <1> All GND, GNDB and VDD terminals should be connected without a non-connected signal line.
- <2> Do not disassemble a product and/or adjust volume.
- <3> If customer would like to replace backlight lamps, see 'REPLACEMENT MANUAL FOR BACKLIGHT'.
- <4> If customer uses screwdrivers, pay attention not to insert waste materials in inside of products.
- <5> When customer returns product for repair and so on, pack it with original shipping package because of avoidance of some damages during transportation.
- <6> 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."

General specifications for the LCD

The following items are neither defects nor failures.

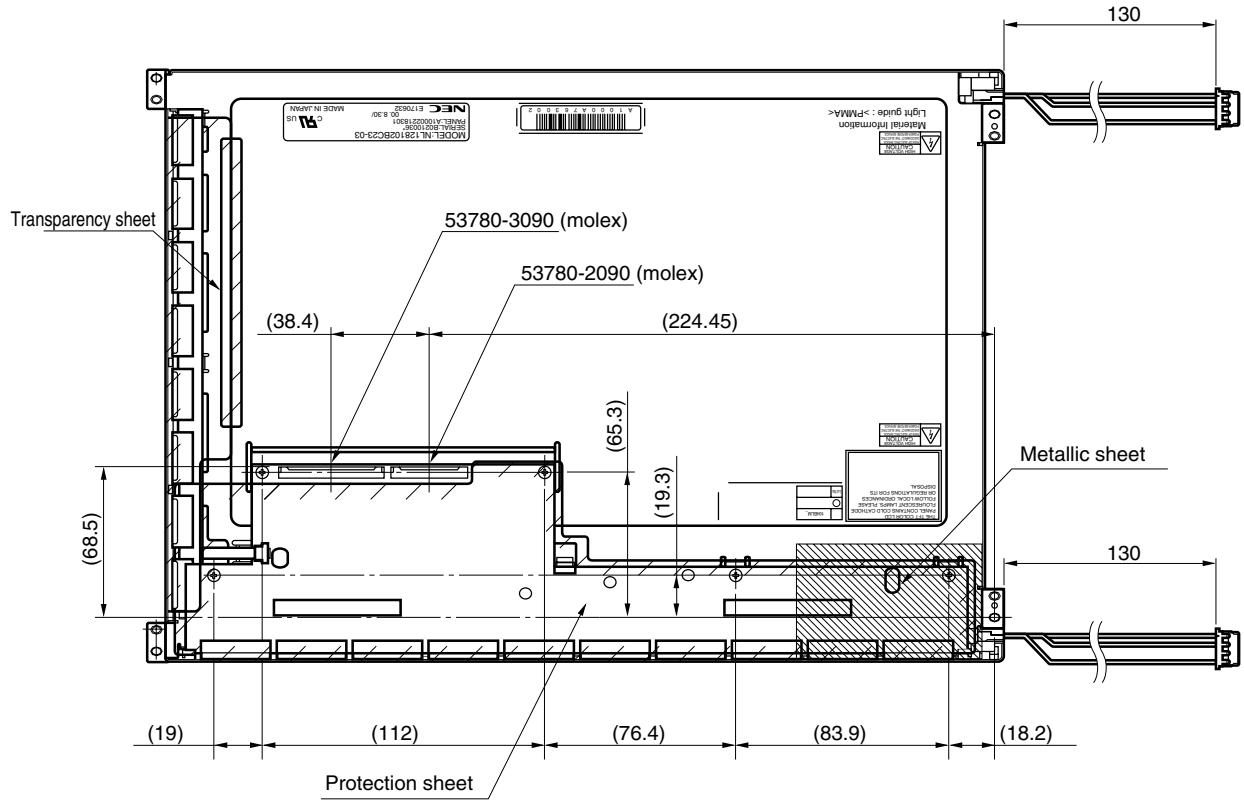
- * Response time, luminance and color gamut may be changed by ambient temperature.
- * The LCD may be seemed luminance uniformity, flicker, vertical seam and/or small spot by display patterns.
- * Optical characteristics (e.g. luminance, display uniformity, etc.) gradually is going to change depending on operating time, and especially low temperature, because the LCD has cold cathode fluorescent lamps.

OUTLINE DRAWING (Unit: mm)
 Front View



Notes 1: The values in parentheses are for reference.
 2: The pressure for mounting should never exceed $0.39 \text{ N} \cdot \text{m}$.

Rear View



- Notes 1:** The values in parentheses are for reference.
2: The pressure for mounting should never exceed 0.39 N•m.

[MEMO]

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"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.

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Anti-radioactive design is not implemented in this product.

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