DATA SHEET

NEC

TFT COLOR LCD MODULE
NL6448BC20-08

17 cm (6.5 type), 640 × 480 pixels 262144 colors, high luminance, wide viewing angle

DESCRIPTION

NL6448BC20-08 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. NL6448BC20-08 has a built-in backlight. Backlight includes long-life lamps and the lamps are replaceable.

The 17 cm diagonal display area contains 640 × 480 pixels and can display 262144 colors simultaneously.

NL6448BC20-08 is suitable for industrial application use, because the luminance is high, and the viewing direction is selectable with display scan select.

FEATURES

- High luminance (300 cd/m^2, typ.)
- Low reflection
- Wide viewing angle with retardation film (Antiglare treatment)
- Display reverse scan function
- 6-bit digital RGB signals
- Edge type backlight with long-life-lamps (Two lamp holders, inverter-less)
- Variable luminance control
- Recommended inverter (Part No. 65PWB31)
- Compatible to the mounting holes position of NL6448AC20-06 except for inverter.

APPLICATIONS

- Measuring instruments
- Display terminals for control system
- Monitors for process controller

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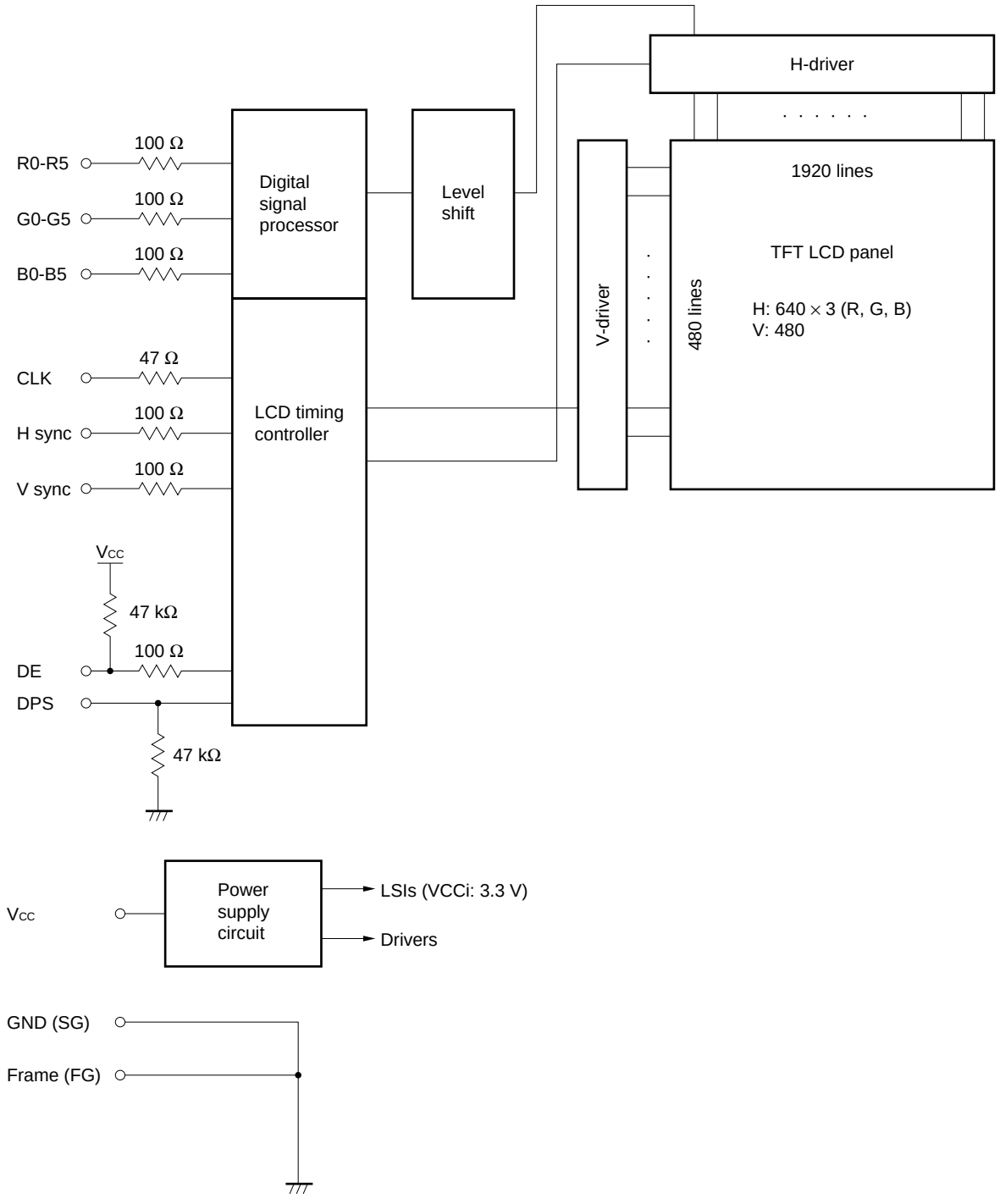
STRUCTURE AND FUNCTIONS

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.

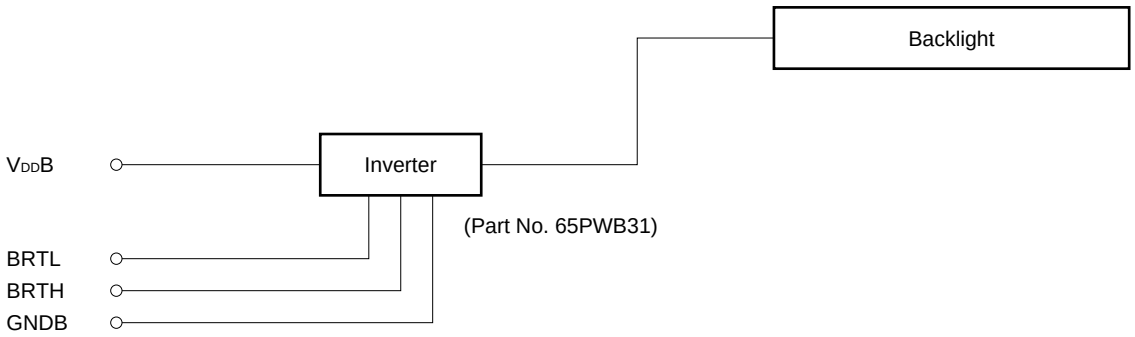
RGB (red, green, blue) data signals from a source system is modulated into a form suitable for active matrix addressing by the onboard signal processor and sent to the driver LSIs which in turn addresses the individual TFT cells.

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.

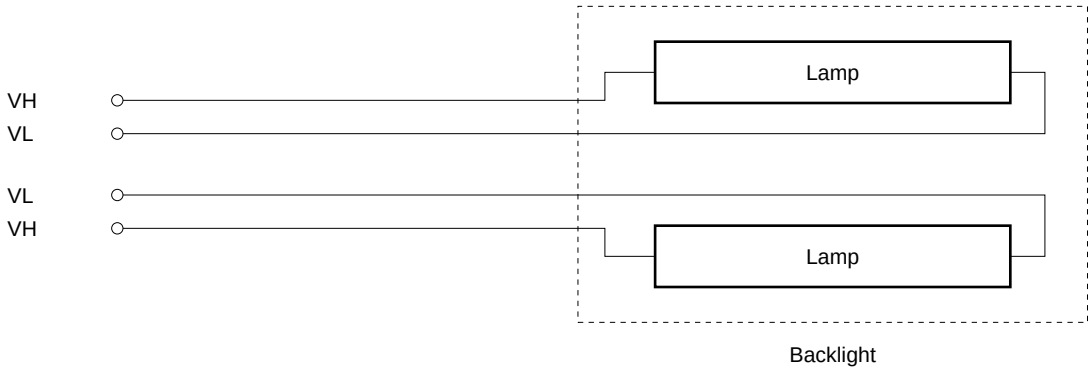
BLOCK DIAGRAM



(1) In case of use NEC recommended inverter



(2) In case of use the inverter of customers



OUTLINE OF CHARACTERISTICS (at room temperature)

Display area	132.48 (H) × 99.36 (V) mm
Drive system	a-Si TFT active matrix
Display colors	262144
Number of pixels	640 × 480
Pixel arrangement	RGB vertical stripe
Pixel pitch	0.207 (H) × 0.207 (V) mm
Module size	178.8 (H) × 126.8 (V) × 11.0 typ. (D) mm
Weight	240 g (typ.)
Contrast ratio	250:1 (typ.)

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

- Horizontal : 50° (typ. left side, right side)
- Vertical : 35° (typ. up side), 45° (typ. down side)

Designed viewing direction

- wider viewing angle with contrast ratio : up side (12 o'clock, reverse scan)
  : down side (6 o'clock, normal scan)
- wider viewing angle without image reversal : up side (12 o'clock, normal scan)
  : down side (6 o'clock, reverse scan)

Palarizer pencil-hardness	2H (min. at JIS K5400)
Color gamut	42% (typ. center to NTSC)
Response time	16 ms (typ.) "white" to "black"
Luminance	300 cd/m^2 (typ.)
Signal system	6-bit digital signals for each of RGB primary colors, Synchronous signals (Hsync, Vsyc), Dot clock (CLK)
Supply voltage	5.0 V (3.3 V) (Logic, LCD driving)
Backlight	Edge light type: two fluorescent lamps (cold cathode type)
Power consumption	5.0 W (typ., at 300 cd/m^2, not include inverter less)

GENERAL SPECIFICATIONS

Item	Specifications	Unit
Module size	178.8 ± 0.5 (H) × 126.8 ± 0.5 (V) × 11.5 max. (D)	mm
Display area	132.48 (H) × 99.36 (V)	mm
Number of pixels	640 (H) × 480 (V)	pixel
Dot pitch	0.069 (H) × 0.207 (V)	mm
Pixel pitch	0.207 (H) × 0.207 (V)	mm
Pixel arrangement	RGB (Red, Green, Blue) vertical stripe	–
Display colors	262144	color
Weight	260 (max.)	g

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit	Remarks
Supply voltage	V_{CC}	–0.3 to 6.5	V	Ta = 25°C $V_I - V_{CC} < 3.0$
	V_{DD}	–0.3 to 6.5	V	
Input voltage	V_I	–0.3 to V_{CC} + 0.3	V	
Lamp voltage	V_L	1600	V_{rms}	–
Storage temp.	T_{ST}	–25 to 70	°C	–
Operating remp.	T_{OP}	0 to 60	°C	module surface **Note**
Humidity (no condensation)	RH	≤ 95% relative humidity		Ta ≤ 40°C
		≤ 85% relative humidity		40 < Ta ≤ 50°C
		Absolute humidity shall not exceed Ta = 50°C, 85% relative humidity level.		Ta > 50°C

Note measured at the display area

ELECTRICAL CHARACTERISTICS

(1) Logic, LCD driving

Ta = 25°C

Parameters	Symbols	Min.	Typ.	Max.	Unit.	Remarks
Supply voltage	V_{CC}	4.75 (3.0)	5.0 (3.3)	5.25 (3.6)	V	–
Logic input “L” voltage	V_{IL}	0	–	$V_{CCi} \times 0.3$	V	CMOS level **Note 2**
Logic input “H” voltage	V_{IH}	$V_{CCi} \times 0.7$	–	V_{CC}	V	
Supply current	I_{CC}	–	200[Note 1] (320)	450 (600)	mA	V_{CC} = 5.0 V (V_{CC} = 3.3 V)

Notes 1. Checker flag pattern (in EIAJ ED-2522)

2. V_{CCi} = 3.3 V : V_{CCi} is given by DC/DC converter in the LCD module.

(2) Backlight

Ta = 25°C

Parameters	Symbols	Min.	Typ.	Max.	Unit.	Remarks
Lamp current	I_L	2.0	5.0	6.0	mArms	with one lamp
Lamp voltage	V_L	–	400	–	Vrms	–
Lamp turn on voltage	V_S	–	–	720	Vrms	Ta = 0°C
		–	–	590		Ta = 25°C
Oscillator frequency	F_t	50	54	58	kHz	**Note**

Note Recommended value of "F_t"

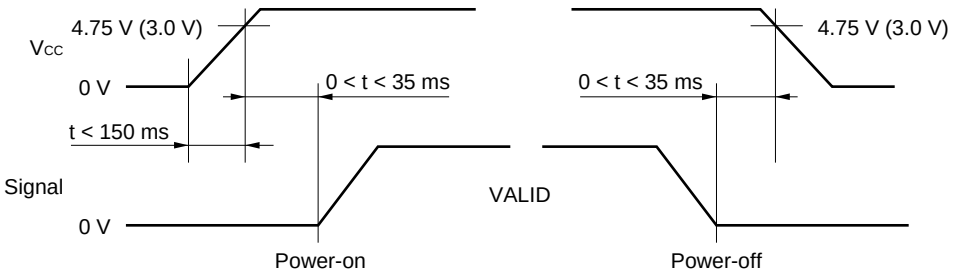
- F_t is within the specification.

and

- $F_t = \frac{1}{4th} \times (2n - 1)$ th: Hsync period
  n : a natural number (1, 2, 3, ····)

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

SUPPLY VOLTAGE SEQUENCE



***1** The supply voltage for input signals should be the same as V_{CC}.

***2** Apply $V_{DD}B$ within the LCD operation period. When the backlight turns on before LCD operation or the LCD operation turns off before the backlight turn off, the display may momentarily become white.

***3** When the power is off, please keep whole signals (Hsync, Vsync, CLK, DE, and DATA) low level or high impedance.

INTERFACE PIN CONNECTION

Module side connector
CN31 ····· IL-310-T31PB-VF (No. 1 to 31)
Supplier: Japan Aviation Electronics Industry Limited (JAE)

Mating connector
IL-310-T31S-VF
or
DF9-31S-1V or DF9M-31S-1R
Supplier: HIROSE ELECTRIC CO., LTD

(1) 6-bit interface signals, power supply

Pin No.	Symbols	Function
1	GND	Ground
2	CLK	Dot clock
3	Hsync	Horizontal synchronous
4	Vsync	Vertical synchronous
5	GND	Ground
6	R0	Red data (LSB)
7	R1	Red data
8	R2	Red data
9	R3	Red data
10	R4	Red data
11	R5	Red data (MSB)
12	GND	Ground
13	G0	Green data (LSB)
14	G1	Green data
15	G2	Green data
16	G3	Green data

Pin No.	Symbols	Function
17	G4	Green data
18	G5	Green data (MSB)
19	GND	Ground
20	B0	Blue data (LSB)
21	B1	Blue data
22	B2	Blue data
23	B3	Blue data
24	B4	Blue data
25	B5	Blue data (MSB)
26	GND	Ground
27	DE	Data enable
28	V_{CC}	Power supply
29	V_{CC}	Power supply
30	N.C.	Non-connection (Open)
31	DPS	Scan Direction select

LSB : Least Significant Bit
MSB: Most Significant Bit

Notes 1. V_{CC} : All V_{CC} terminals should be connected to V_{CC}.
2. DPS: Normal scan is “L” or “Open”. And reverse scan is “H”.
3. During the operation, do not change the operation mode: e.g. scan direction.

(2) Inverter

<2-1> In case of use NEC recommended inverter

- Inverter side connector 1 Mating connector 1
  CN1 ··· IL-Z-6PL-SMTY IL-Z-6S-S125C3
  Supplier: Japan Aviation Electronics Industry Limited (JAE)

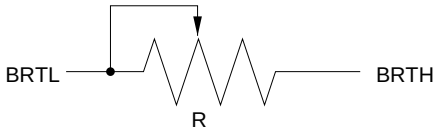
Pin No.	Symbols	Function
1	GNDB	Backlight ground
2	GNDB	Backlight ground
3	V_{DD}B	Power supply

Pin No.	Symbols	Function
4	V_{DD}B	Power supply
5	BRTL	Luminance control input
6	BRTH	Luminance control input

- Inverter side connector 2 Mating connector 2 (Lamp side)
  CN2 and CN3 ··· SM02 (8.0) B-BHS-TB BHR-03VS-1
  Supplier: J.S.T TRADING COMPANY, LTD.

Pin No.	Symbols	Function
1	VH	High voltage terminal
2	N.C.	Non-connection
3	GNDB	Backlight ground

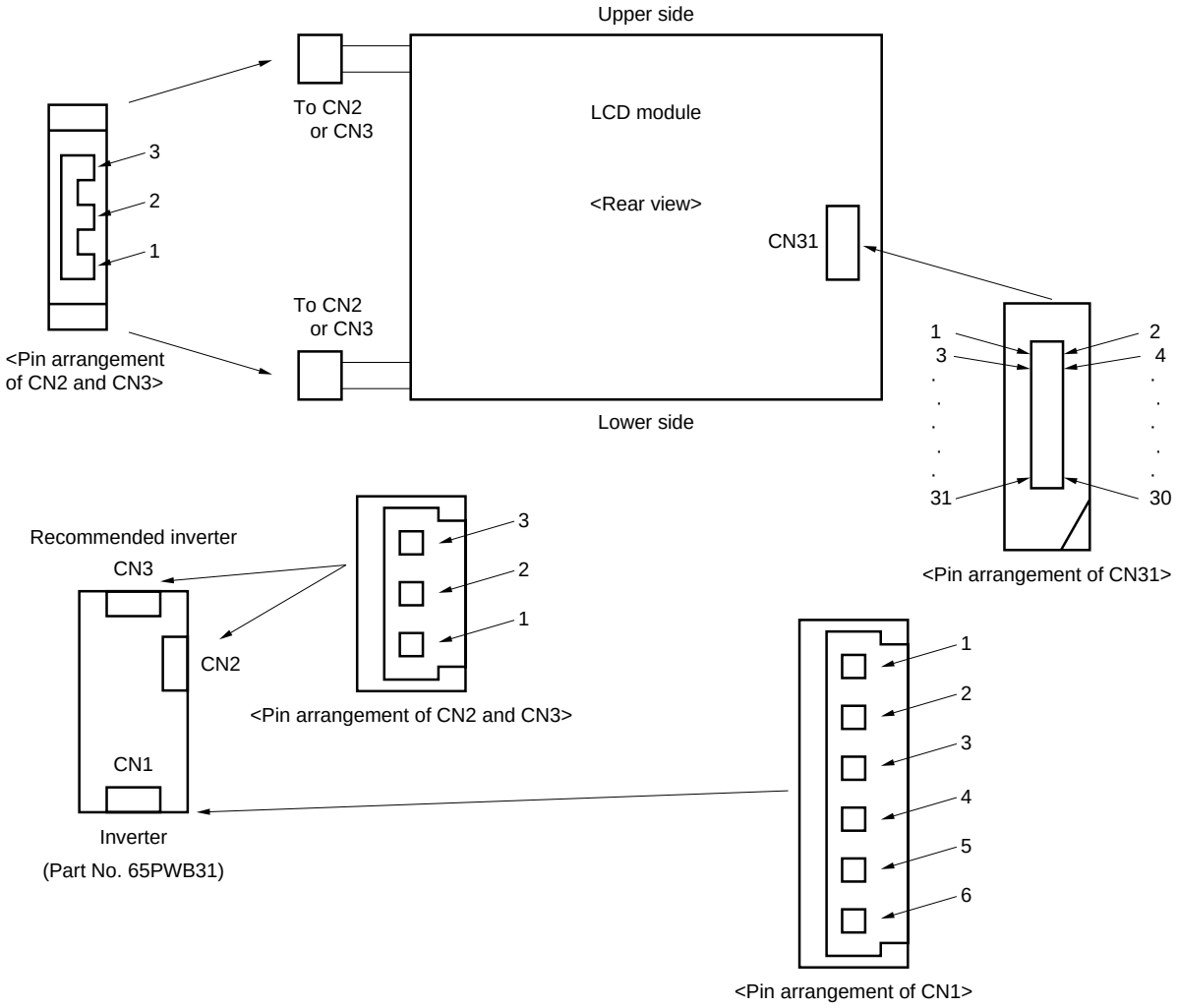
Notes 1. A way of luminance control by a variable resistor



Mating variable resistor : 10 kΩ ±5%
Minimum luminance (50%) : R = 0 Ω
Maximum luminance (100%) : R = 10 kΩ

2. A way of luminance control by a voltage
The range of input voltage between BRTH and GNDB is as follows.
Minimum luminance (50%) : 1.5 V
Maximum luminance (100%) : 1.9 V

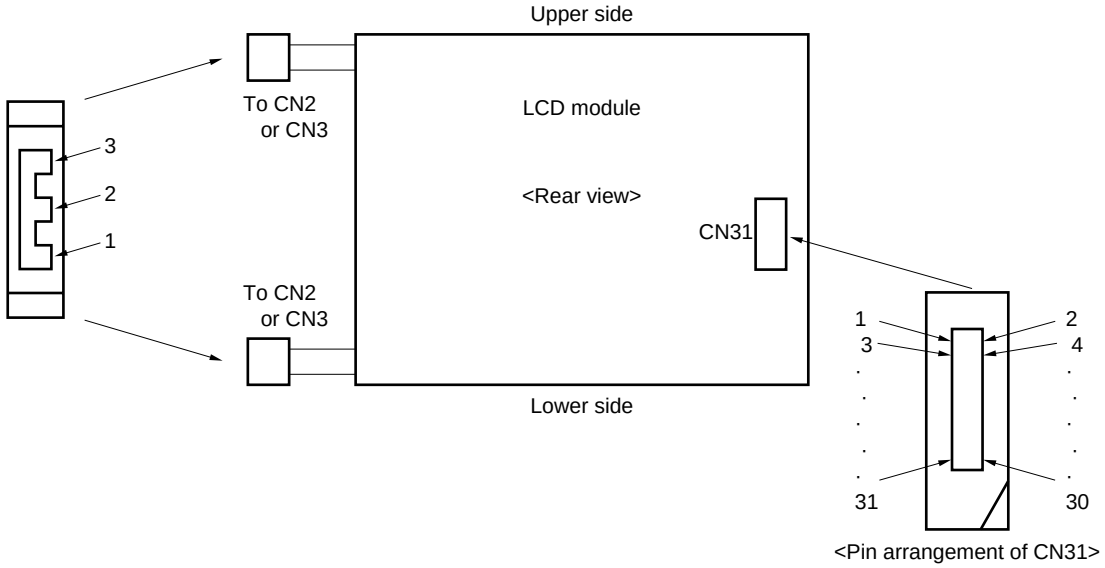
3. Connector location



<2-2> In case of use the inverter of customers

- Module side connector — Mating connector
  CN2 and CN3: BHR-03VS-1 — CN2 and CN3: SM03 (4.0) B-BHS-1-TB
  Supplier: J.S.T TRADING COMPANY. LTD. — Supplier: J.S.T TRADING COMPANY.LTD.

Pin No.	Symbols	Function
1	VH	High voltage terminal (The cable color is white.)
2	N.C.	non-connection
3	VL	Low voltage terminal (The cable color is gray.)



<Pin arrangement of CN31>

PIN DESCRIPTIONS

Symbols	Functions	Logic	Descriptions
Vsync	Vertical sync.	Negative	Vertical synchronous signal
Hsync	Horizontal sync.	Negative	Horizontal synchronous signal
CLK	Dot clock	Negative	Timing signal for display data. The video signal is sampled at the falling edge of DOTCLK.
R0 to R5 G0 to G5 B0 to B5	Display data	Positive	6 bits digital signals for each of RGB primary colors.
DE	Data enable signal	Positive	Data enable signal Back-porch (thb and tvb) can be changed when DE is high. Don't fix "DE = Low", if not, the display will have un-uniformity.
DPS	Scan direction select	–	**Note**
V_{CC}	Power supply	–	+5.0 V (+3.3 V)
GND	Ground	–	Logic ground for V_{CC}

Note DPS: DPS changes display scan direction.
GND or Open = Normal scan
V_{CC} = Reverse scan
See 7-8. DISPLAY POSITION about another way for reversible scan.

DISPLAY COLORS vs. INPUT DATA SIGNALS

(1) 6-bit interface signals

Display colors		Data signals (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
		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 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	1	0	0	0	0	0	0
	Dark	0	0	0	0	0	0	0	0	0	0	1	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 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
		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 signal (64 steps in grayscale) of each primary red, green, and blue color.

This process can result in up to 262144 ($64 \times 64 \times 64$) colors.

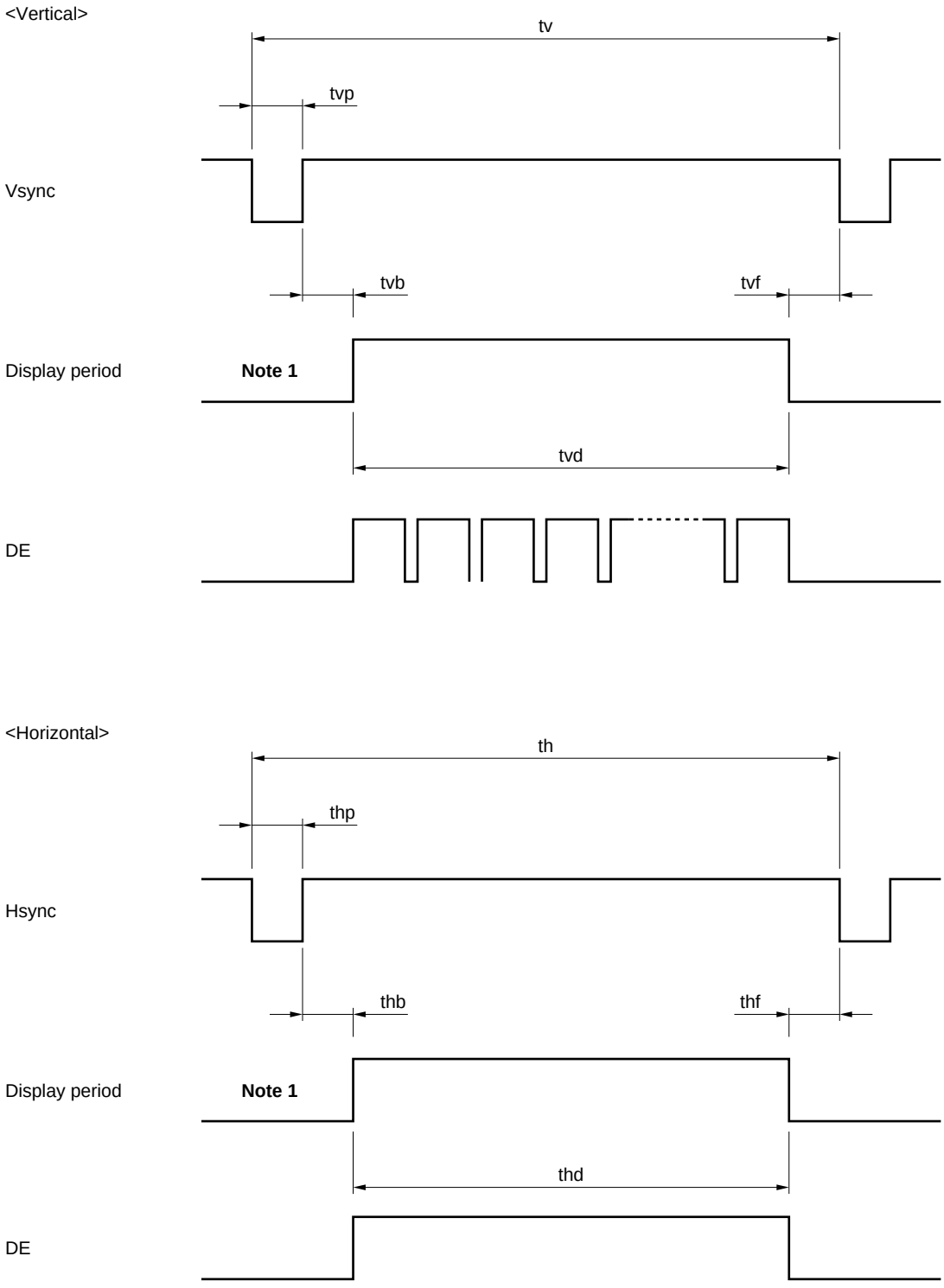
INPUT SIGNAL TIMING

(1) Input signal specifications

Parameters		Symbols	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency	1/tc	21.0	25.175	29.0	MHz	39.722 ns (typ.)
	Duty	tch/tc	0.4	0.5	0.6	–	–
	Rise, fall	tcrf	–	–	10	ns	–
Hsync	Period	th	30.0	31.778	33.6	μs	31.468 kHz (typ.)
			–	800	–	CLK	
	Display period	thd	– –	25.422 640	– –	μs CLK	–
	Front-porch	thf	– 0	0.636 16	– –	μs CLK	–
	Pulse width	thp	– 10	3.813 96	– –	μs CLK	–
	Back-porch	thb	– 5	1.907 48	– –	μs CLK	–
	*) thp + thb		64	144	–	CLK	–
	CLK-Hsync timing	thch	12	–	–	ns	–
	Hsync-CLK timing	thcs	8	–	–	ns	–
	Hsync-Vsync timing	tvh	15	–	–	ns	–
	Vsync-Hsync timing	tvs	15	–	–	ns	–
	Rise, fall	thrf	–	–	10	ns	–
Vsync	Period	tv	16.1	16.683	17.2	ms	59.94 Hz (typ.)
			–	525	–	H	
	Display period	tvd	– –	15.253 480	– –	ms H	–
	Front-porch	tvf	– 1	0.381 12	– –	ms H	–
	Pulse width	tvp	– 2	0.063 2	– –	ms H	–
	Back-porch	tvb	– 4	0.985 31	– –	ms H	–
	*) tvp + tvb		6	33	–	H	–
	Rise, fall		–	–	10	ns	–
DATA R0 to R5 G0 to G5 B0 to B5	CLK-DATA timing	tds	8	–	–	ns	–
	DATA-CLK timing	tdh	12	–	–	ns	–
	Rise, fall	tdrf	–	–	10	ns	–
DE	DE-CLK timing	tes	8	–	–	ns	–
	CLK-DE timing	teh	12	–	–	ns	
	Rise, fall	terf	–	–	10	ns	

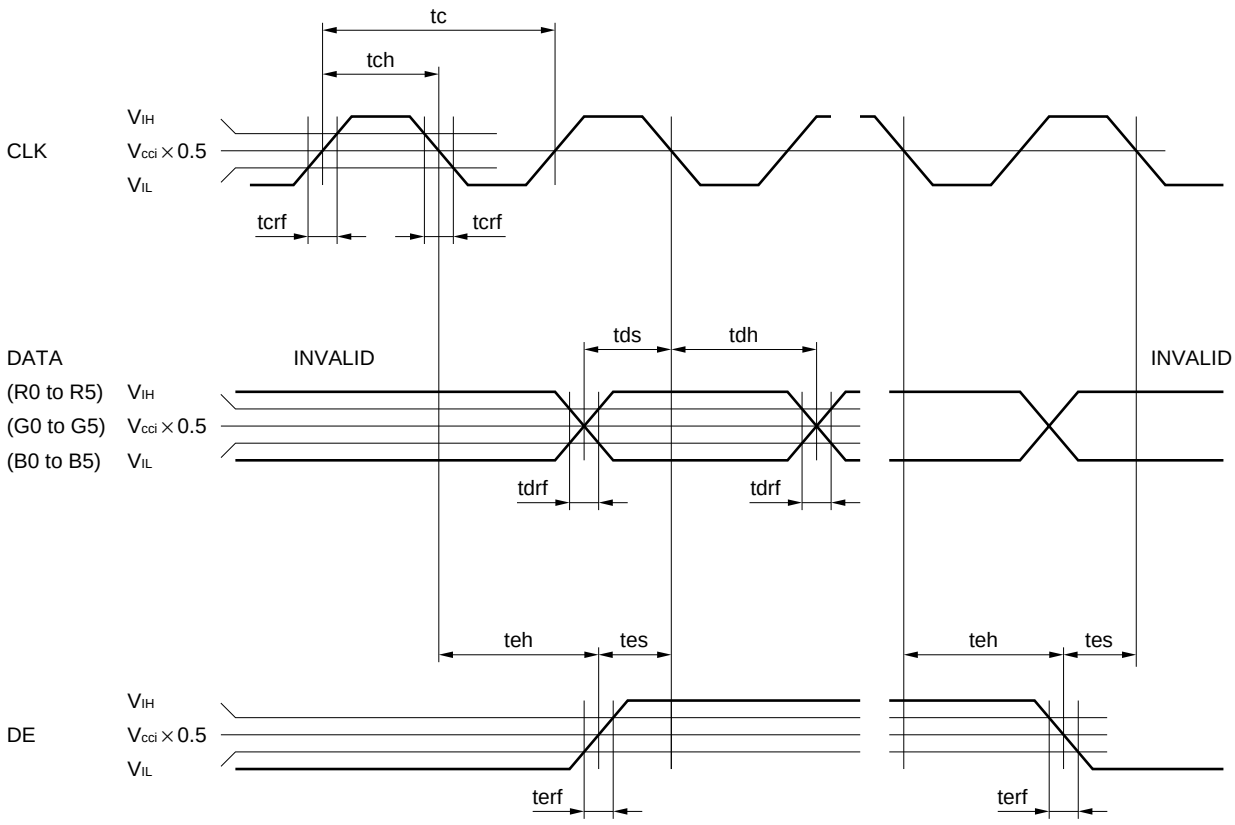
Note All parameters should be kept within the specified range.

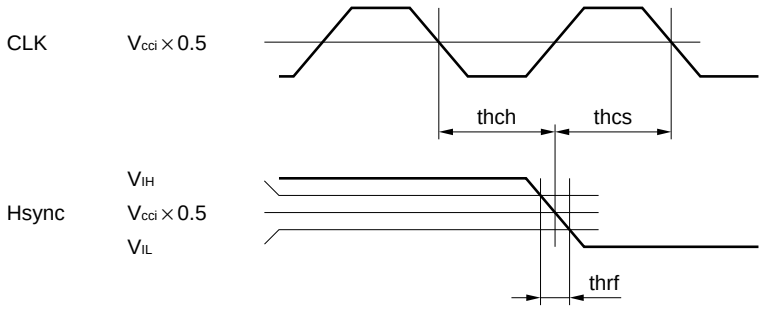
(2) Definition of input signal timing

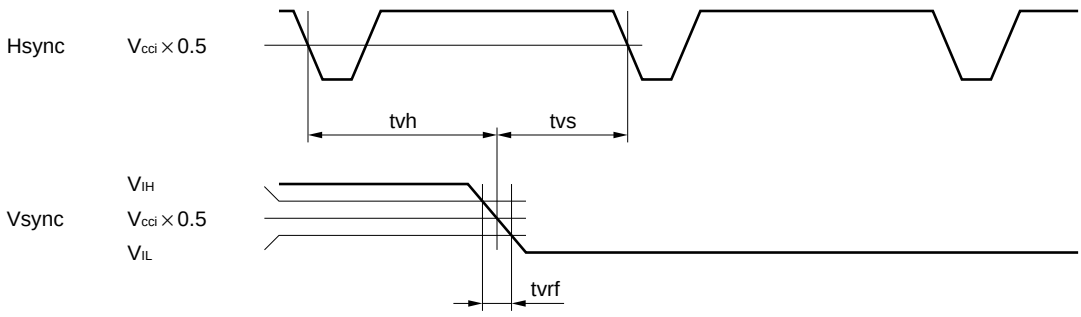


Notes 1. Display period does not exist as signals.

2. Set the total of thp + thb and tvp + tvb as the table of input signal timing, otherwise display position is shifted to right or left side, or to up or down side.





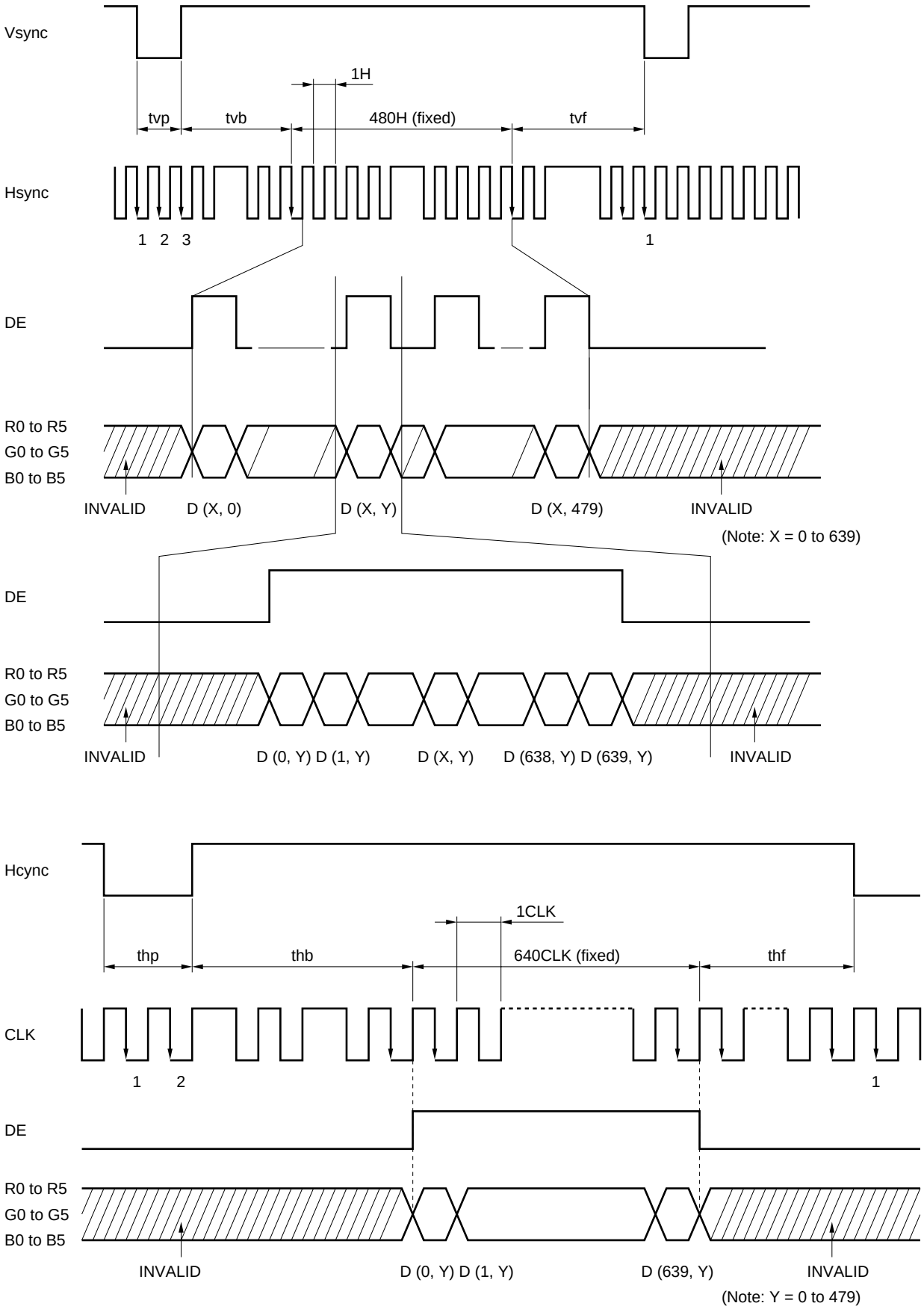


$V_{IH} = V_{CCi} \times 0.7$ (min.)

$V_{IL} = V_{CCi} \times 0.3$ (max.)

V_{CCi} = 3.3 V: V_{CCi} is given by DC/DC converter in the LCD module.

(3) Input signal timing chart



DISPLAY POSITION

Normal scan: DPS = “L” (factory set)

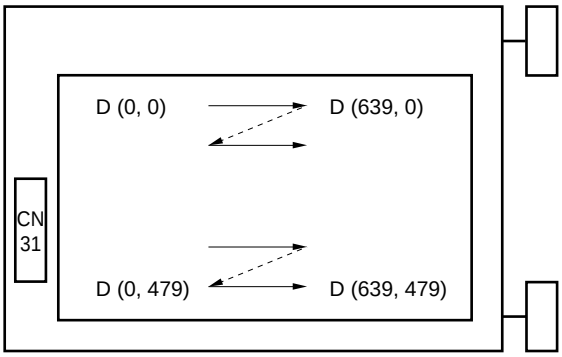
D (0, 0)	D (1, 0)	----	D (X, 0)	----	D (638, 0)	D (639, 0)
D (0, 1)	D (1, 1)	----	D (X, 1)	----	D (638, 1)	D (639, 1)
¦	¦	-¦--	--¦--	-¦--	¦	¦
D (0, Y)	D (1, Y)	----	D (X, Y)	----	D (638, Y)	D (639, Y)
¦	¦	-¦--	--¦--	-¦--	¦	¦
D (0, 478)	D (1, 478)	----	D (X, 478)	----	D (638, 478)	D (639, 478)
D (0, 479)	D (1, 479)	----	D (X, 479)	----	D (638, 479)	D (639, 479)

Reverse scan: DPS = “H”

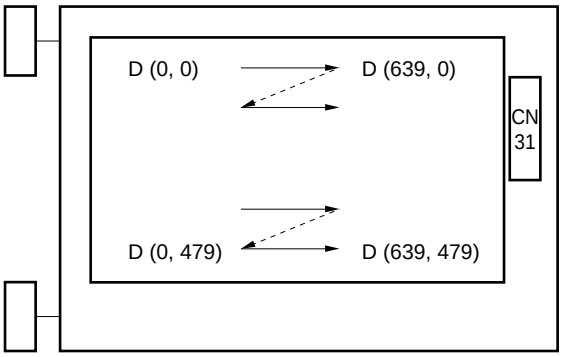
D (639, 479)	D (638, 479)	----	D (X, 479)	----	D (1, 479)	D (0, 479)
D (639, 478)	D (638, 478)	----	D (X, 478)	----	D (1, 478)	D (0, 478)
¦	¦	-¦--	--¦--	-¦--	¦	¦
D (639, Y)	D (638, Y)	----	D (X, Y)	----	D (1, Y)	D (0, Y)
¦	¦	-¦--	--¦--	-¦--	¦	¦
D (639, 1)	D (638, 1)	----	D (X, 1)	----	D (1, 1)	D (0, 1)
D (639, 0)	D (638, 0)	----	D (X, 0)	----	D (1, 0)	D (0, 0)

Note Below drawings show relations between the scan direction and the viewing direction.

Normal scan



Reverse scan



OPTICAL CHARACTERISTICS

Ta = 25°C **Note 1**

Parameters	Symbols	Conditions	Min.	Typ.	Max.	Unit	Remarks
Contrast ratio	CR	**Note 2**	150	250	–	–	**Note 3**
Luminance	Lu	**Note 2**	250	300	–	cd/m^2	**Note 4**
Luminance uniformity	–	max./min.	–	–	1.25	–	**Note 5**

Reference data

Parameters		Symbols	Conditions	Min.	Typ.	Max.	Unit	Remarks
Response time		t on	White to black	–	16	40	ms	**Note 6**
		t off	Black to white	–	55	90	ms	
Color gamut		C	at center, to NTSC	35	42	–	%	–
Viewing angle range	Horizontal	θx+	CR > 10, θy = ±0°	45	50	–	deg.	**Note 7**
		θx–	CR > 10, θy = ±0°	45	50	–	deg.	
	Vertical	θy+	CR > 10, θx = ±0°	30	35	–	deg.	
		θy–	CR > 10, θx = ±0°	40	45	–	deg.	

Notes 1. V_{CC} = 5.0 V, IL = 5.0 mA rms, with NEC recommended inverter (Part No.65PWB31).

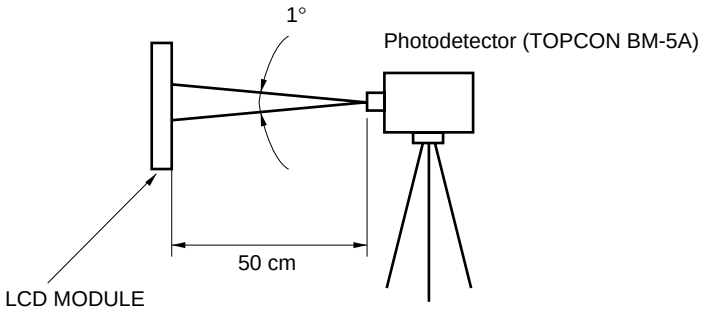
2. Viewing angle: θx = ±0°, θy = ±0°, At center.
Best contrast angle: θx = ±0°, θy = –10°, At center.

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.

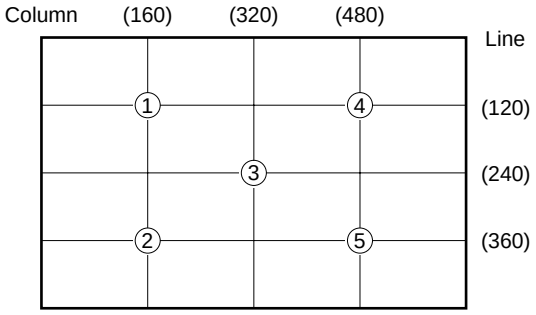
4. The luminance is measured after 20 minutes from the module works, with all pixels in “white”. Typical value is measured after luminance saturation.



5. The luminance uniformity is calculated by using following formula.

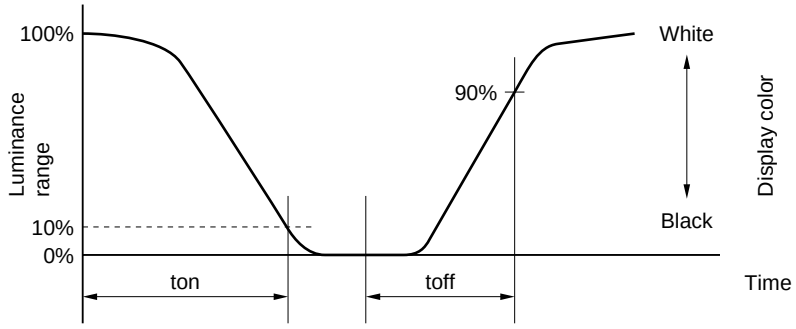
$$\text{Luminance uniformity} = \frac{\text{Maximum luminance}}{\text{Minimum luminance}}$$

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

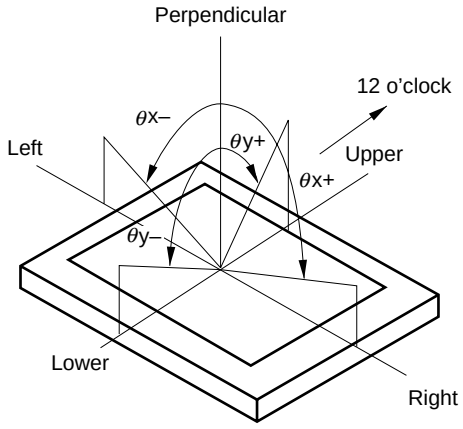


6. Definition of response time is as follows.

Photodetector output signal is measured when the Luminance changes “white” to “black”. Response time is the time between 10% and 100% of the photodetector output amplitude.



7. Definitions of viewing angle are as follows.



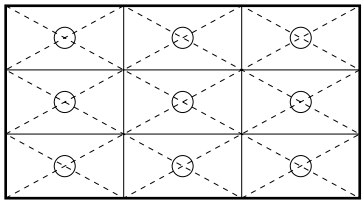
RELIABILITY TEST

No.	Test items	Test conditions	Judgement
1.	High temperature/humidity operation	50 ± 2°C, 85% relative humidity 240 hours Display data is black.	**Note 1**
2.	High temperature (operation)	60 ± 3°C 240 hours Display data is black.	**Note 1**
3.	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**
4.	Thermal shock (non-operation)	<1> –25°C ± 3°C ⋯ 30 minutes 70°C ± 3°C ⋯ 30 minutes <2> 100 cycles <3> Temperature transition time within 5 minutes	**Note 1**
5.	Vibration (non-operation)	<1> 5 - 100 Hz, 2G 1 minute/cycle, X, Y, Z direction <2> 120 times each direction	**Note 1** **Note 2**
6.	Mechanical shock (non-operation)	<1> 55 G, 11 ms X, Y, Z direction <2> 5 times each direction	**Note 1** **Note 2**
7.	ESD (operation)	150 pF, 150 Ω, ±10 kV 9 places on a panel **Note 3** 10 times each place at one-second intervals	**Note 1**
8.	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 these contents as follows.

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

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

CAUTION

(1) Caution when taking out the module

<1> Pick the pouch only, when taking out the module from a carrier box.

(2) Cautions for handling the module

<1> As the electrostatic discharges may break the LCD module, handle the LCD module with care against electrostatic discharges.

<2> As the LCD panel and backlight element are made from fragile glass material, impulse and pressure to the LCD module should be avoided.

<3> As the surface of polarizer is very soft and easily scratched, use a soft dry cloth without chemicals for cleaning.

<4> Do not pull the interface connectors in or out while the LCD module is operating.

<5> Put the module display side down on a flat horizontal plane.

<6> Handle connectors and cables with care.

<7> When the module is operating, do not lose CLK, Hsync, or Vsync signal. If any one or more of these signals is lost, the LCD panel would be damaged.

<8> The torque for mounting screw should never exceed 0.20 N·m (2 kgf·cm).

(3) Cautions for the atmosphere

<1> Dew drop atmosphere must be avoided.

<2> Do not store and/or operate the LCD module in high temperature and/or high humidity atmosphere. Storage in an electro-conductive polymer packing pouch and under relatively low temperature atmosphere is recommended.

<3> This module uses cold cathod fluorescent lamps. Therefore, the life time of lamp becomes short conspicuously at low temperature.

<4> Do not operate the LCD module in high magnetic field.

(4) Caution for the module characteristics

<1> Do not apply any fixed patterns data signal to the LCD module at product aging. Applying fixed pattern for a long time may cause image sticking.

<2> This module has the retardation film which may cause the variation of the color hue in the different viewing angles. The ununiformity may appear on the screen under the high temperature operation.

(5) Other cautions

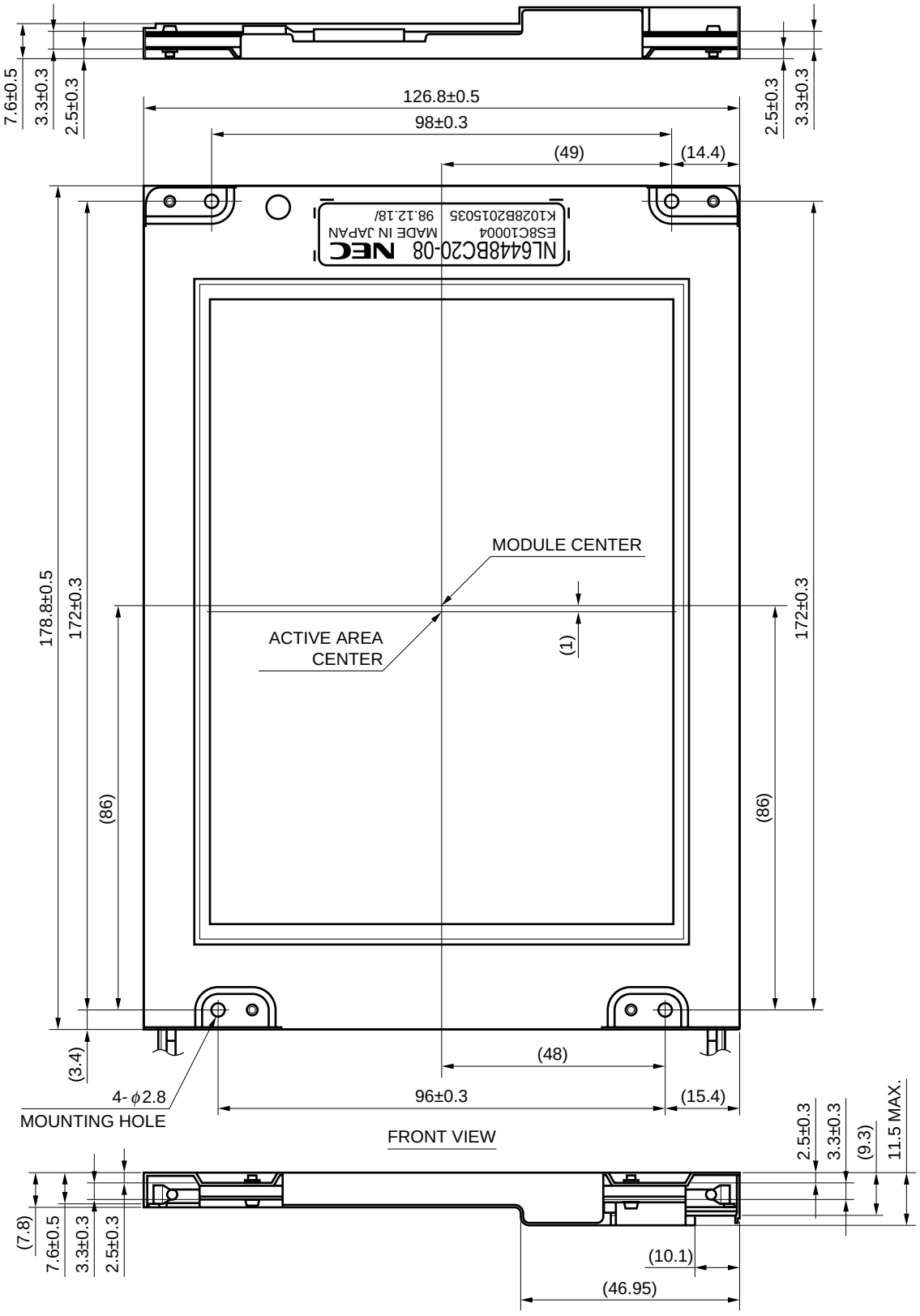
<1> Do not disassemble and/or reassemble LCD module.

<2> Do not readjust variable resistors nor switches etc.

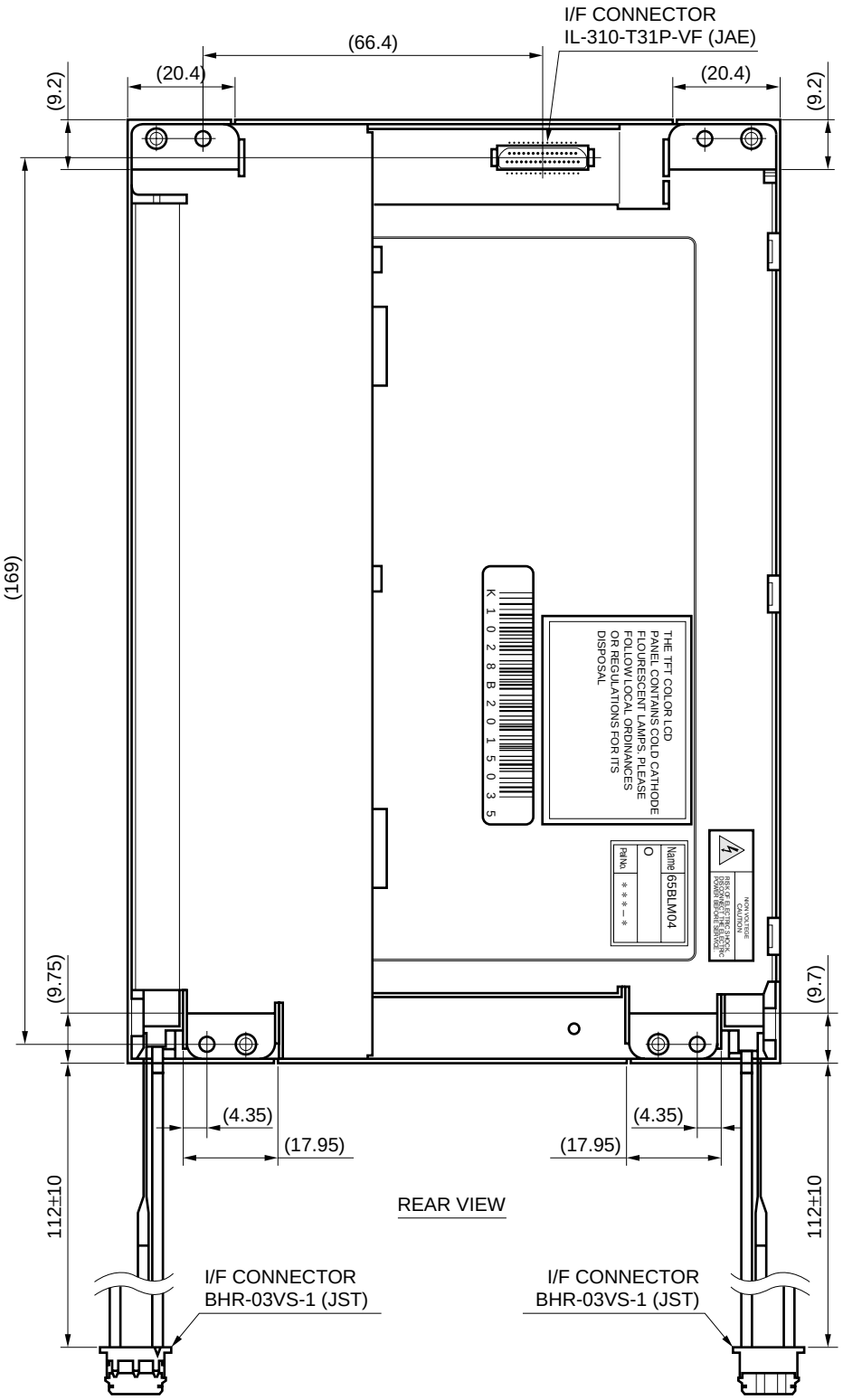
<3> When returning the module for repair or etc, pack the module not to be broken. We recommend the original shipping packages.

Liquid Crystal Display has the following specific characteristics. There are not defects nor malfunctions.
The display condition of the LCD module may be affected by the ambient temperature.
The LCD module uses cold cathode tube for backlighting. Optical characteristics, like luminance or uniformity, will change during time.
Uneven brightness and/or small spots may be noticed depending on different display patterns.

OUTLINE DRAWING/FRONT SIDE (Unit in mm)



OUTLINE DRAWING/REAR SIDE (Unit in mm)



Notes 1. Not shown tolerances of the dimensions are ±0.5 mm.

2. The value in parenthese are for reference.