NEC

TFT COLOR LCD MODULE

NL6448AC33-18A

26 cm (10.4 inches), 640 × 480 pixels, 262144 colors, Luminance adjustable, Non anti-glare panel

DESCRIPTION

NL6448AC33-18A 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. NL6448AC33-18A has a built-in backlight. Backlight includes long life lamps, which are replaceable.

The 26 cm diagonal display area contains 640 × 480 pixels and can display 262144 colors simultaneously.

NL6448AC33-18A is suitable for factory automation use, because luminance is higher, and viewing direction is selectable by switching display scan direction.

FEATURES

- Reverse function (user set up)
- 6-bit digital RGB signals
- 3.3 V operation (5.0 V available)
- Data enable function (DE/Fixed mode select: user set up)
- Smooth polarizer surface (No antiglare treatment)
- Incorporated edge type backlight (Two lamps, with inverter, bright/dark selectable)
- Backlight tube replaceable (refer to the tube replace manual for NL6448AC33-18A)

APPLICATIONS

- Industrial PC
- Display terminals for control system
- Monitors 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.

Document No. EN0497EJ1V0DS00
Date Published February 2000 P
Printed in Japan

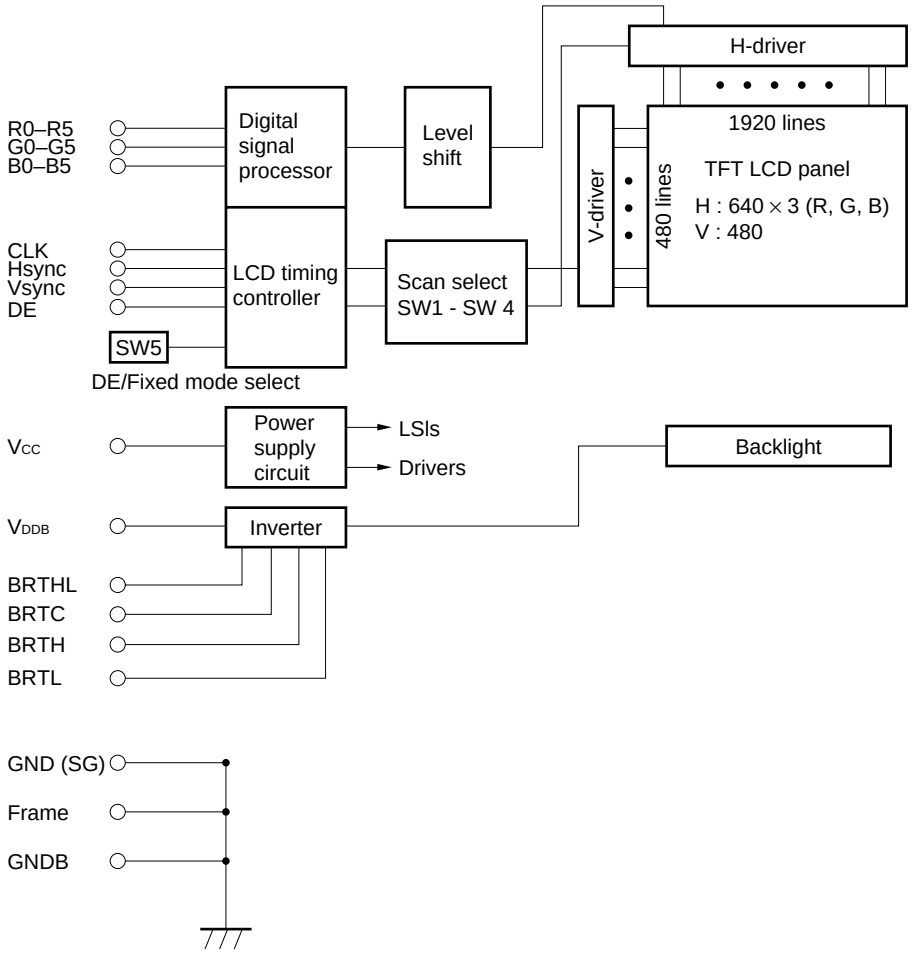
STRUCTURE AND FUNCTIONS

A TFT color LCD module comprises a TFT LCD panel, LSIs for driving liquid crystal, and the backlight. The TFT LCD panel is composed of a TFT array glass substrate superimposed on a color filter glass substrate with liquid crystal filled in the narrow gap between two substrates. The backlight apparatus is located on the backside of the LCD 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



Note 1. Frame and GNDB (Backlight ground) are contacted at the lamp holder.

OUTLINE OF CHARACTERISTICS (at room temperature)

Display area	211.2 (H) × 158.4 (V) mm
Drive system	a-Si TFT active matrix
Display colors	262144 colors
Number of pixels	640 × 480 pixels
Pixel arrangement	RGB vertical stripe
Pixel pitch	0.33 (H) × 0.33 (V) mm
Module size	243.0 (H) × 185.1 (V) × 10.5 typ. (D) mm
Inverter size	25.0 (H) × 105.0 (V) × 10.2 max. (D) mm
Weight	470 g (typ.) + 15 g (typ., inverter)
Contrast ratio	150:1 (typ.)
Viewing angle (more than the contrast ratio of 10:1)	
	Horizontal : 45° (typ. left side, right side)
	Vertical : 30° (typ. up side), 20° (typ. down side)
Designed viewing direction	• Wider viewing angle with contrast ratio
	: up side (12 o'clock, normal scan)
	: down side (6 o'clock, reverse scan)
	• Wider viewing angle without image reversal
	: down side (6 o'clock, normal scan)
	: up side (12 o'clock, reverse scan)
	• Optimum grayscale (γ = 2.2): perpendicular
Color gamut	56 % (typ. center, to NTSC)
Response time	40 ms (max.), "white 100%" to "black 10%"
Luminance	200 cd/m^2 (typ.)
Signal system	6-bit digital signals for each of RGB primary colors, synchronous signals (Hsync, Vsync), dot clock (CLK)
Supply voltages	3.3 V [5.0 V] (Logic, LCD driving), 12 V (Backlight)
Backlight	Edge light type: two cold cathode fluorescent lamp (cold cathode type)
Power consumption	6.8 W (typ. at 3.3 V, 12.0 V)

GENERAL SPECIFICATIONS

Item	Specification	Unit
Module size	243.0 ± 0.5 (H) × 185.1 ± 0.5 (V) × 11.0 max. (D)	mm
Invertor size	25.0 ± 0.5 (H) × $100^{+0.7}_{-0.3}$ (V) × 10.2 max. (D)	mm
Display area	211.2 (H) × 158.4 (V)	mm
Number of pixels	640 (H) × 480 (V)	pixel
Dot pitch	0.11 (H) × 0.33 (V)	mm
Pixel pitch	0.33 (H) × 0.33 (V)	mm
Pixel arrangement	RGB (Red, Green, Blue) vertical stripe	
Display colors	262144	color
Weight	Module: 480 (max.) + Inverter: 20 (max.)	g

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit	Remarks	
Supply voltage	V_{CC}	–0.3 to 6.5	V		T_a = 25 °C
Input voltage	V_I	–0.3 to 6.5	V	$V_I - V_{CC} < 3.0$	
Storage temp.	T_{ST}	–20 to 60	°C		
Operating temp.	T_{OP}	0 to 50	°C	Module surface	**Note 1**
Humidity	RH	≤ 95 % relative humidity		$T_a \leq 40$ °C	No condensation
		≤ 85 % relative humidity		$40 < T_a \leq 50$ °C	
		Absolute humidity shall not exceed T_a = 50 °C, 85 % relative humidity level.		$T_a > 50$ °C	

Note 1. Measured at the display area

ELECTRICAL CHARACTERISTICS

(1) Logic, LCD driving

T_a = 25 °C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	V_{CC}	3.0 (4.75)	3.3 (5.0)	3.6 (5.25)	V	V_{CC} = 3.3 V (V_{CC} = 5.0 V)
Logic input “L” voltage	V_{IL}	0	–	$V_{CC} \times 0.3$	V	CMOS level
Logic input “H” voltage	V_{IH}	$V_{CC} \times 0.7$	–	V_{CC}	V	
Supply current	I_{CC}	– –	***1** 300 (200)	400 (300)	mA mA	V_{CC} = 3.3 V (V_{CC} = 5.0 V)

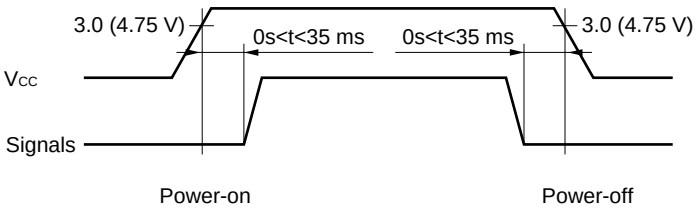
***1.** Checker flag pattern (in EIAJ ED-2522)

(2) Backlight

T_a = 25 °C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	V_{DDB}	11.4	12.0	12.6	V	–
Supply current	I_{DDB}	–	480	550	mA	200cd/m^2 (typ.)

SUPPLY VOLTAGE SEQUENCE



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

Note 2. Apply V_{DDB} 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.

Note 3. When the power is off, please keep whole signals (Hsync, Vsync, CLK, data) low level or high impedance.

INTERFACE PIN CONNECTION

(1) Interface signals, power supply

Module side connector — Mating connector

CN1 ··· DF9C-31P-1V (No. 1 to 31) — DF9-31S-1V or DF9M-31S-1R

Supplier: HIROSE ELECTRIC CO., LTD.

Pin No.	Symbol	Function
1	GND	Ground
2	CLK	Dot clock
3	Hsync	Horizontal sync.
4	Vsync	Vertical sync.
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
17	G4	Green data
18	G5	Green data (MSB)

Pin No.	Symbol	Function
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
31	N. C.	Non-connection

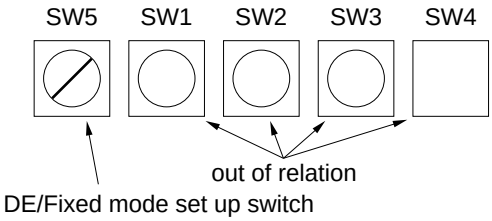
LSB : Least Significant Bit

MSB : Most Significant Bit

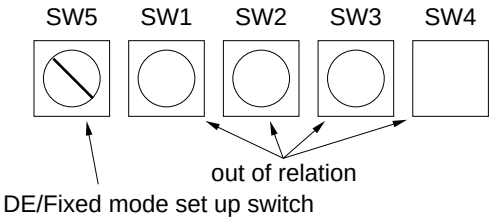
Note 1. V_{CC}: All V_{CC} terminals should be connected to 3.3 V or 5.0 V.

Note 2. DE/Fixed mode select is set by SW5 on the rear side.

• DE mode (factory set)



• Fixed mode



Note 3. GND is connected to the frame of the LCD module.

(2) Backlight

- Inverter side connector 1 — Mating connector 1
  CN2 ··· LZ-5P-SL-SMT — LZ-5S-SC3
  Supplier: Japan Aviation Electronics Industry Limited (JAE)

Pin No.	Symbol	Function
1	V_{DDB}	Backlight power supply
2	V_{DDB}	Backlight power supply
3	GNDB	Backlight ground
4	GNDB	Backlight ground
5	BRTHL	Backlight luminance select **Note 1**

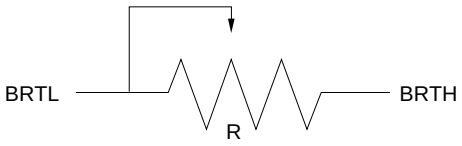
Note 1. High luminance (100 %) ... BRTHL = +5 V or OPEN
Low luminance (60 %) ... BRTHL = GND

- Inverter side connector 2 — Mating connector 2
  CN3 ··· IL-Z-3PL-SMTY — IL-Z-3S-S125C3
  Supplier: Japan Aviation Electronics Industry Limited (JAE)

Pin No.	Symbol	Function
1	BRTC	Backlight ON/OFF signal **Note 1**
2	BRTH	Luminance control input **Note 2**
3	BRTL	Luminance control input **Note 2**

Note 1. TTL level
Backlight ON ... BRTC = H or Open
Backlight OFF ... BRTC = L

Note 2. <1> A way of luminance control by a variable resistor
This way works when BRTHL (No. 5 pin) of CN3 is opened.



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
This way works when BRTHL and BRTL are opend. The range of input voltage between BRTH and GNDB is as follows.
Minimum luminance (50 %) : 2.5 V
Maximum luminance (100 %) : ≤ 1.2 V

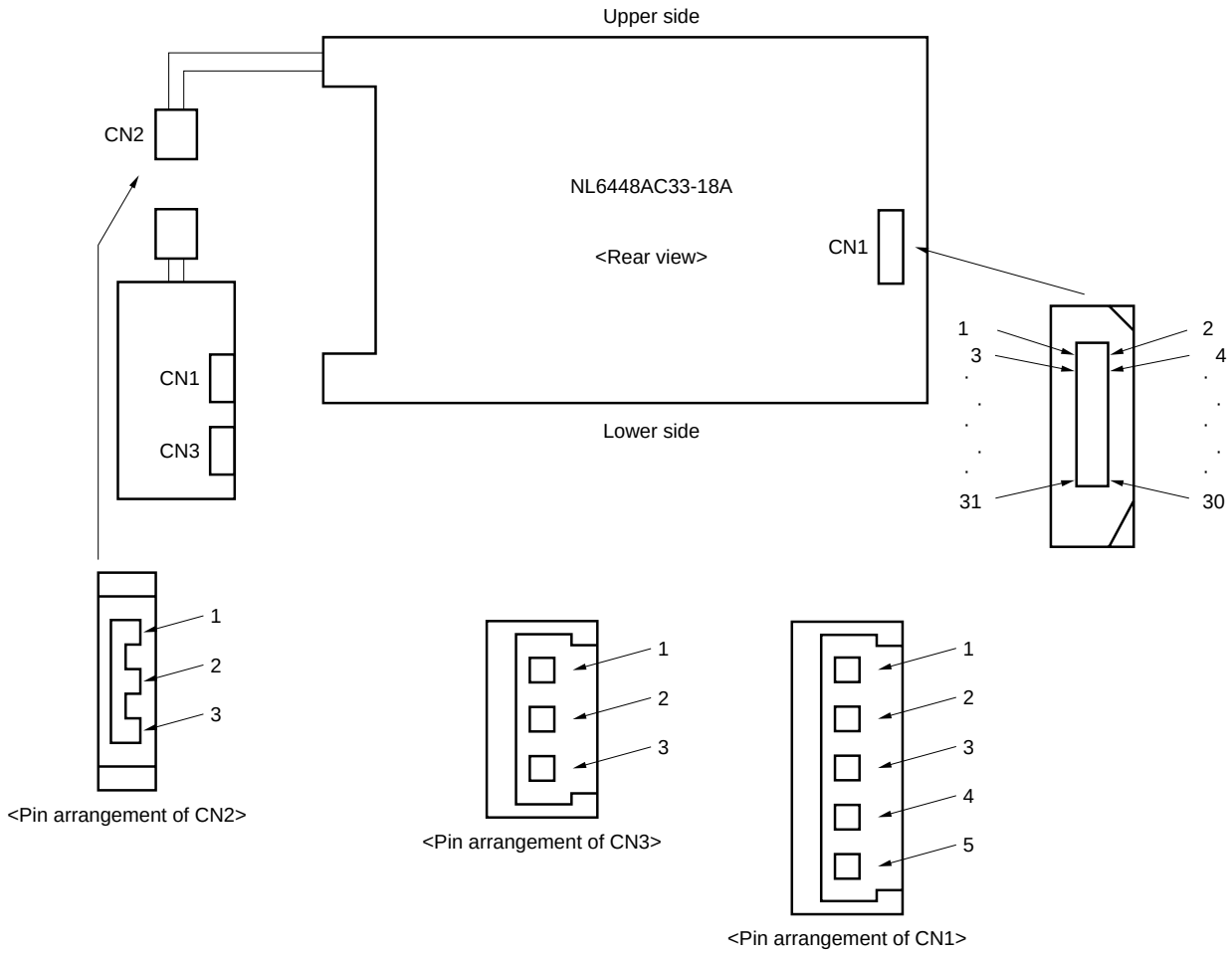
<3> A way of luminace control by a current
This module can not use the luminance control by a current, because GNDB is in contact with the frame.

- Lamp side connector
  CN2 ··· BHR-03VS-1
  Supplier: J. S. T TRADING COMPANY, LTD.

Mating connector
SM02 (8.0) B-BHS-TB

Pin No.	Symbol	Function
1	GNDB	Backlight ground
2	V_H	High voltage terminal
3	V_H	High voltage terminal

<Connector location>



Note 1. CN2 is not connected each other at shipment. It should be connected, when LCD is operated.

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
		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 signals (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

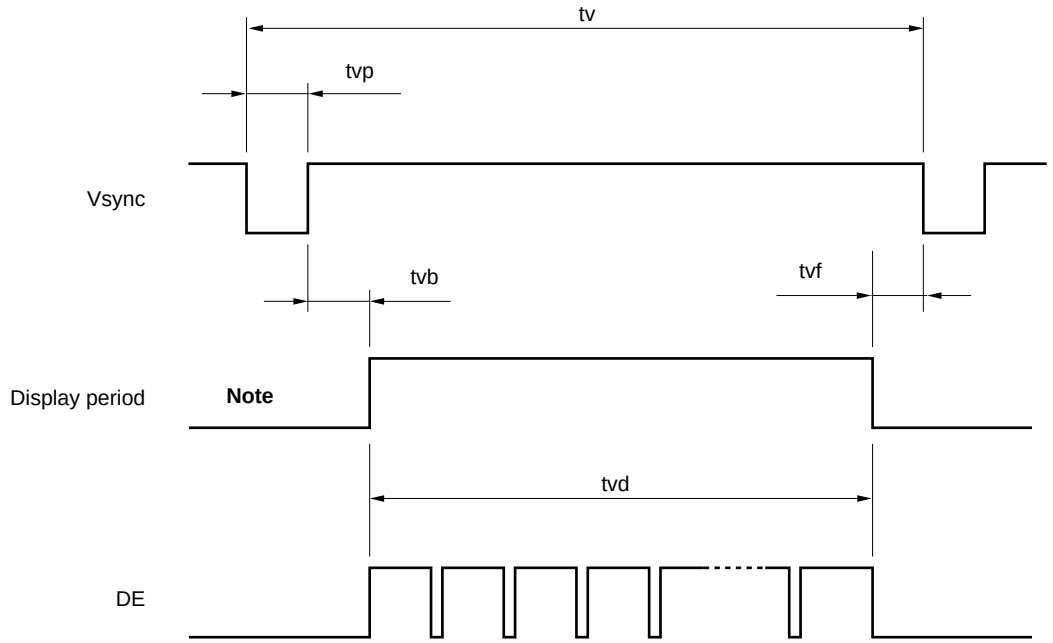
(1) Input signal specifications (DE mode is default)

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency	1/tc	21.0	25.175	29.0	MHz	39.72 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	640			CLK	–
	Front-porch	thf	16			CLK	Fixed mode
			2	16	–	CLK	–
	Pulse width	thp	–	96	–	CLK	Fixed mode
			10	96	–	CLK	–
	Back-porch	thb	–	48	–	CLK	Fixed mode
			4	48	–	CLK	Adjustable range by DE signal
	Note 1) thp + thb		144			CLK	Fixed mode
			14	144	–	CLK	Adjustable range by DE signal
	CLK-Hsync timing	thch	12	–	–	ns	–
	Hsync-CLK timing	thcs	8	–	–	ns	–
	Hsync-Vsync timing	tvh	1	–	–	CLK	–
	Vsync-Hsync timing	tvs	30	–	–	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	480			H	–
	Front-porch	tvf	12			H	Fixed mode
			1	12	–	H	–
	Pulse width	tvp	–	2	–	H	Fixed mode
			1	2	–	H	–
	Back-porch	tvb	–	31	–	H	Fixed mode
			4	31	–	H	Adjustable range by DE signal
	Note 1) tvp + tvb		33			H	Fixed mode
			5	33	–	H	Adjustable range by DE signal
	Rise, fall		–	–	10	ns	–
DATA R0 - R5 G0 - G5 B0 - 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	

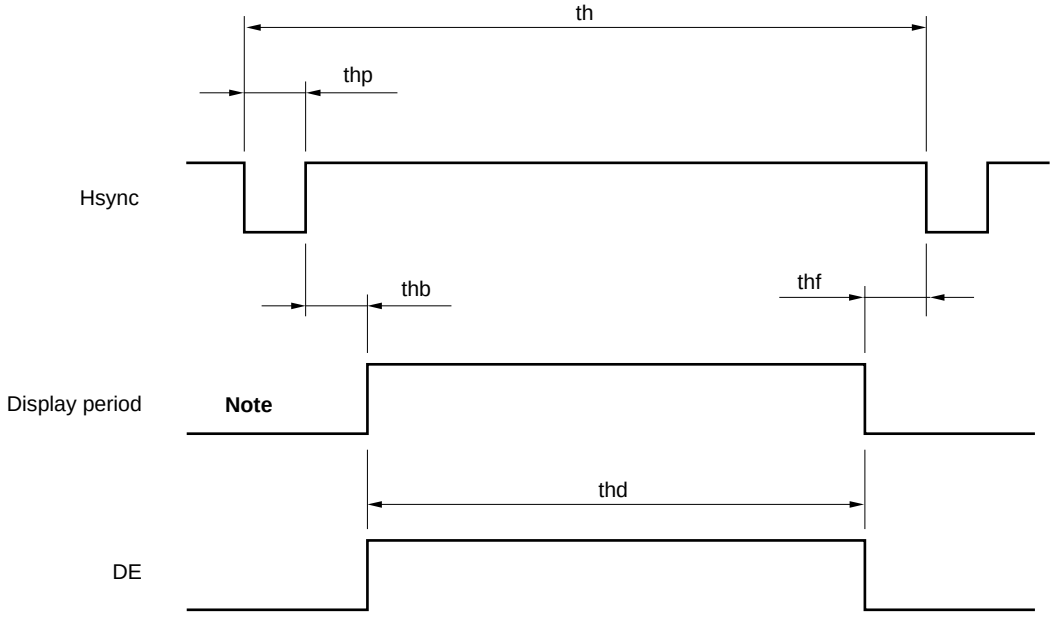
Note 1. All of parameters should be kept in the specified range.

(2) Definition of input signal timing

<Vertical>

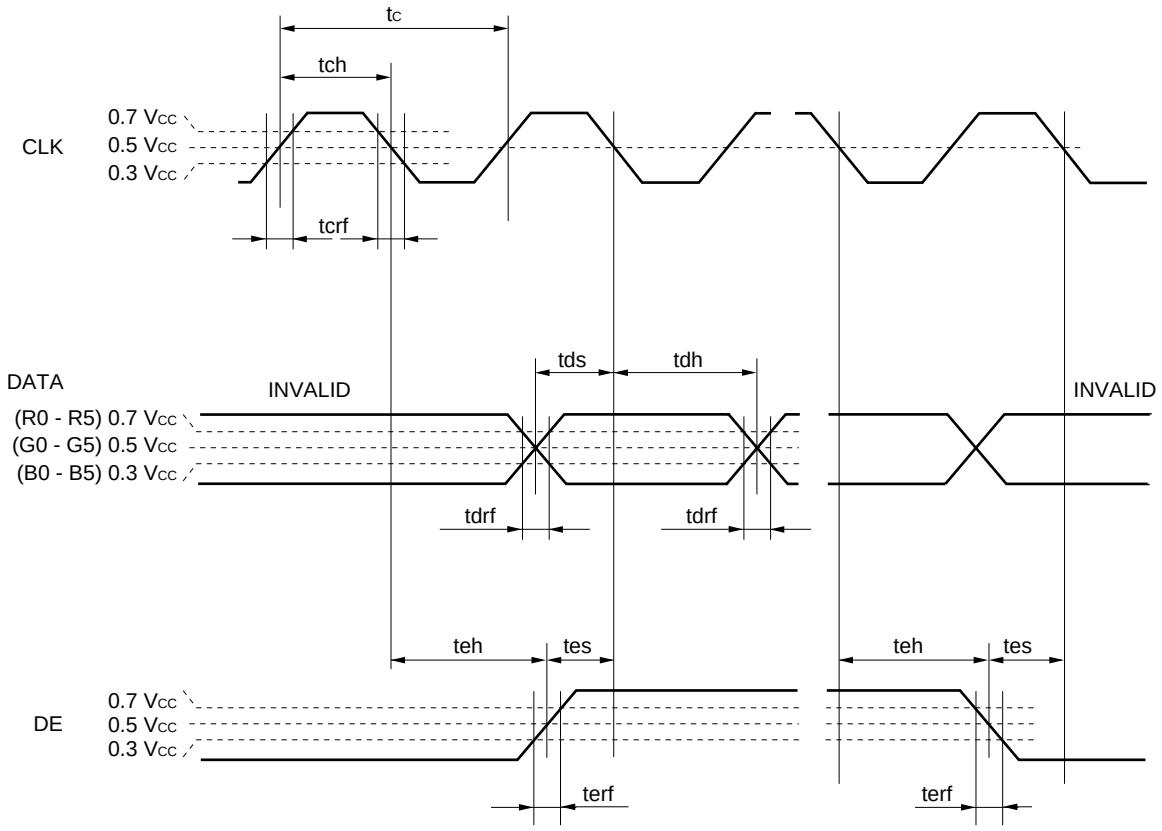


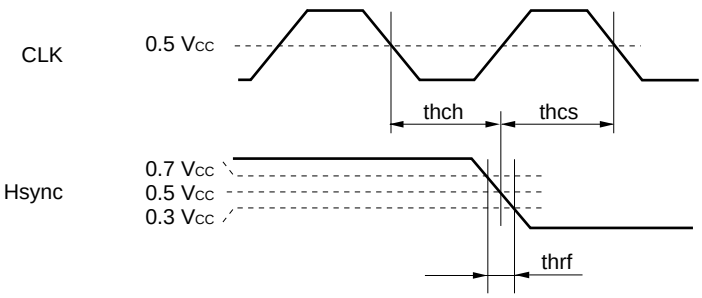
<Horizontal>

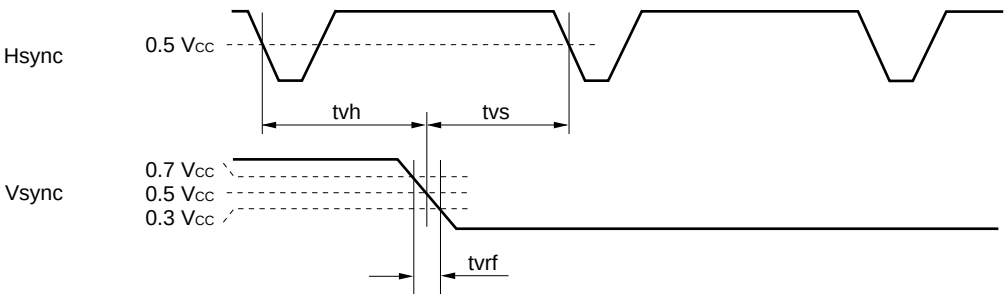


Note 1. These do not exist as actual signals.

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.

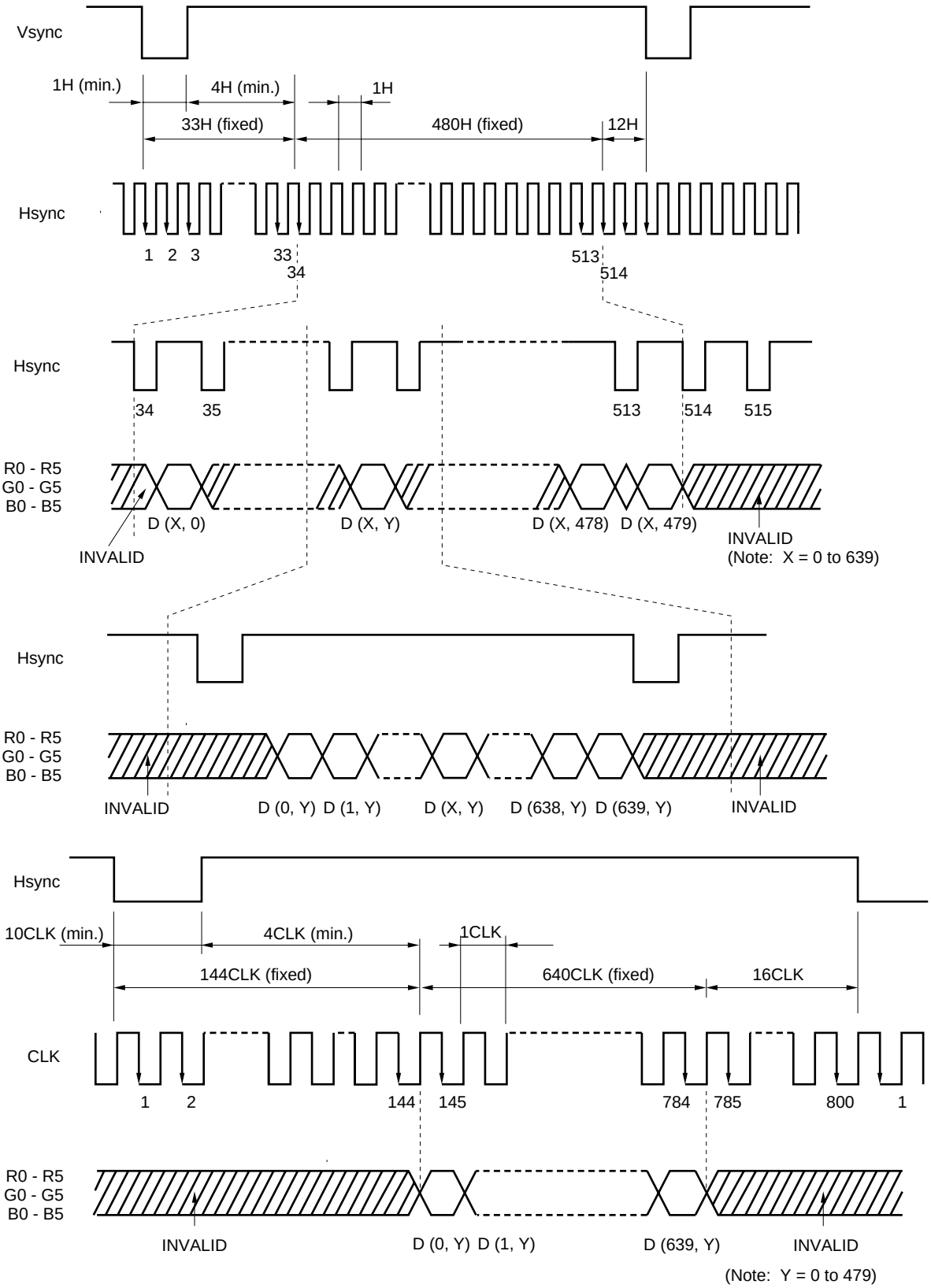

tc
tch
CLK
0.7 Vcc
0.5 Vcc
0.3 Vcc
tcrf
tds
tdh
DATA
INVALID
INVALID
(R0 - R5) 0.7 Vcc
(G0 - G5) 0.5 Vcc
(B0 - B5) 0.3 Vcc
tdrf
tdrf
teh
tes
teh
tes
DE
0.7 Vcc
0.5 Vcc
0.3 Vcc
terf
terf


CLK
0.5 Vcc
thch
thcs
Hsync
0.7 Vcc
0.5 Vcc
0.3 Vcc
thrf

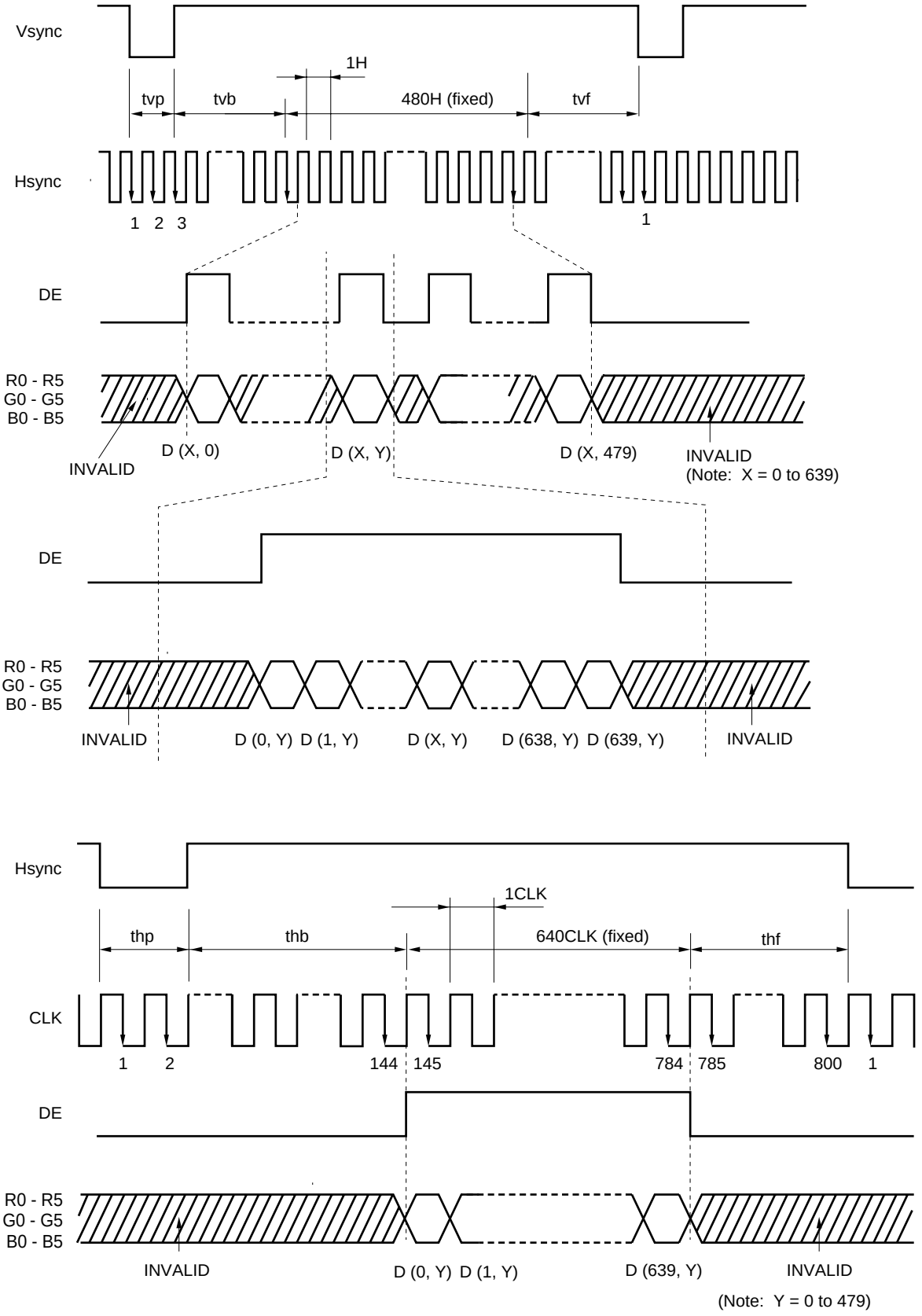

Hsync
0.5 Vcc
tvh
tvs
Vsync
0.7 Vcc
0.5 Vcc
0.3 Vcc
tvrf

(3) Input signal timing chart

a) Fixed mode



b) DE mode


Vsync
1H
tvp
tvb
480H (fixed)
tvf
Hsync
1 2 3
1
DE
R0 - R5
G0 - G5
B0 - B5
INVALID
D (X, 0)
D (X, Y)
D (X, 479)
INVALID
(Note: X = 0 to 639)
DE
R0 - R5
G0 - G5
B0 - B5
INVALID
D (0, Y) D (1, Y)
D (X, Y)
D (638, Y) D (639, Y)
INVALID
Hsync
1CLK
thp
thb
640CLK (fixed)
thf
CLK
1
2
144
145
784
785
800
1
DE
R0 - R5
G0 - G5
B0 - B5
INVALID
D (0, Y) D (1, Y)
D (639, Y)
INVALID
(Note: Y = 0 to 479)

DISPLAY POSITION

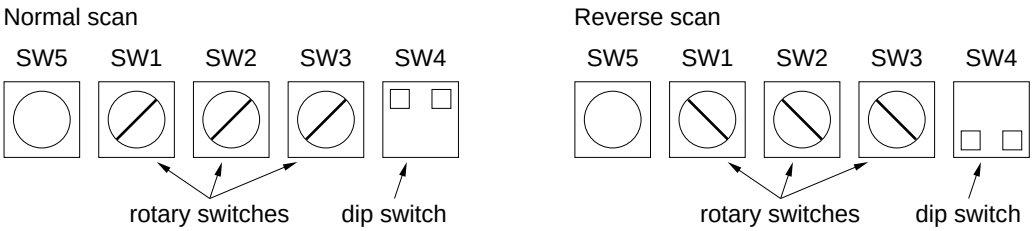
Normal scan (factory set)

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

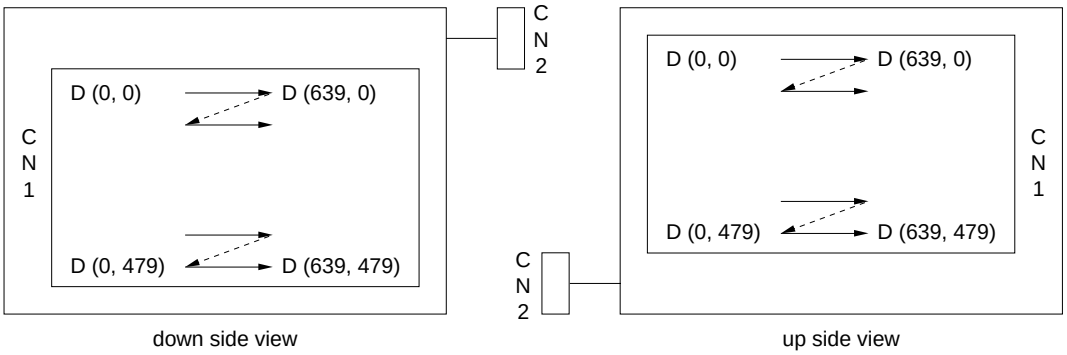
D (639, 479)	D (638, 479)	- - -	D (X, 479)	- - -	D (1, 479)	D (0, 479)
D (639, 478)	D (638, 478)	- - -	D (X, 478)	- - -	D (1, 478)	D (0, 478)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
D (639, Y)	D (638, Y)	- - -	D (X, Y)	- - -	D (1, Y)	D (0, Y)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
D (639, 1)	D (638, 1)	- - -	D (X, 1)	- - -	D (1, 1)	D (0, 1)
D (639, 0)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

Note 1. The scan direction is set up by switches on the rear side.



*SW5 is not related for setting up the scan direction.

Note 2. Below drawings shows relation between the scan direction and viewing direction.



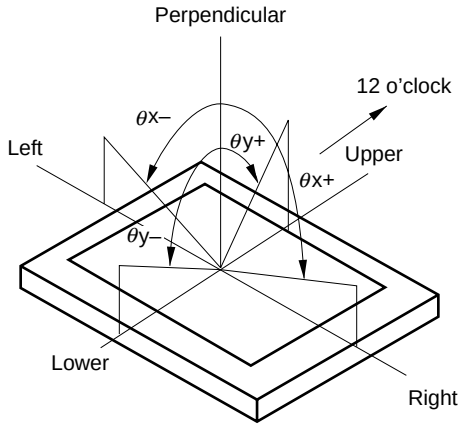
OPTICAL CHARACTERISTICS

Ta = 25°C, at normal scan **Note 1**

Item		Symbols	Conditions	Min.	Typ.	Max.	Unit	Remarks
Viewing angle range	Horizontal	$\theta x+$	CR > 10, $\theta y = \pm 0°$	30	45	–	deg.	**Note 2**
		$\theta x-$	CR > 10, $\theta y = \pm 0°$	30	45	–	deg.	
	Vertical	$\theta y+$	CR > 10, $\theta y = \pm 0°$	20	30	–	deg.	
		$\theta y-$	CR > 10, $\theta y = \pm 0°$	10	20	–	deg.	
Contrast ratio		CR	**Note 3**	80	150	–	–	**Note 4**
Response time		tpd	White → black (100%) (10%)	–	–	40	ms	**Note 5**
Color gamut		C	at center, to NTSC	35	56	–	%	–
Luminance		Lu	**Note 3**	150	200	–	cd/m^2	**Note 6**
Luminance uniformity		–	max./min.	–	–	1.25	–	**Note 7**

Notes 1. V_{CC} = 3.3 V, V_{DDB} = 12 V

2. Definitions of viewing angle are as follows.



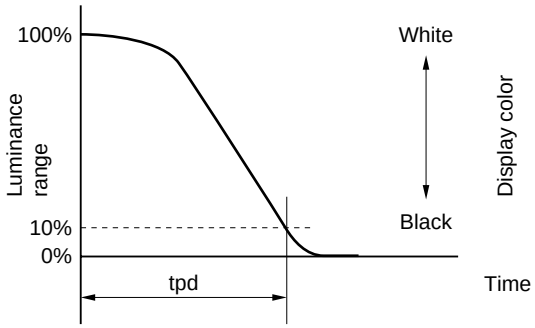
3. Viewing angle: $\theta x = \pm 0°$, $\theta y = \pm 0°$, At center.

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

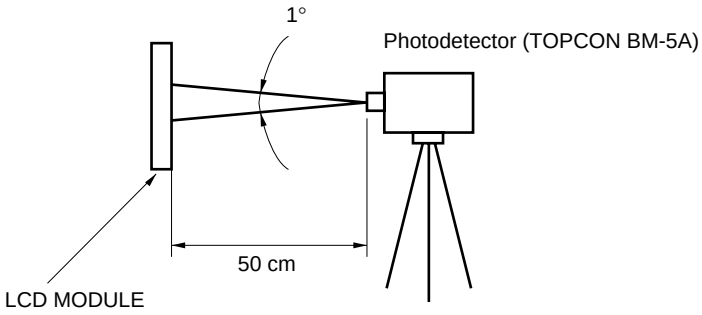
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance with all pixels in "white"}}{\text{Luminance with all pixels in "black"}}$$

The Luminance is measured in darkroom.

5. 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.



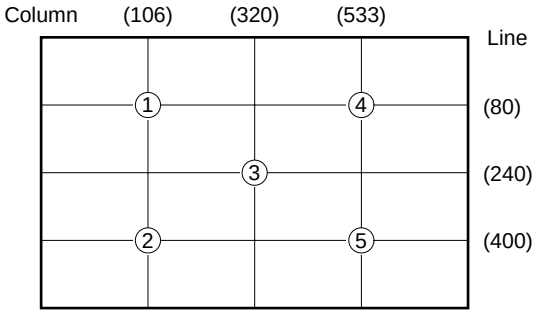
6. The luminance is measured after 20 minutes from the module works, with all pixels in "white". Typical value is measured after luminance saturation.



7. 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.



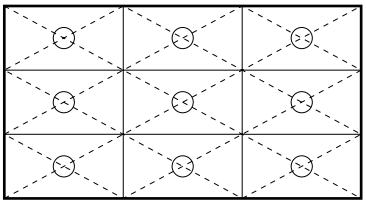
RELIABILITY TEST

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.	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**
3.	Thermal shock (non-operation)	<1> –25°C ± 3°C … 30 minutes 60°C ± 3°C … 30 minutes <2> 100 cycles <3> Temperature transition time within 5 minutes	**Note 1**
4.	Vibration (non-operation)	<1> 5 - 100 Hz, 2G 1 minute/cycle, X, Y, Z direction <2> 120 times each direction	**Note 1** **Note 2**
5.	Mechanical shock (non-operation)	<1> 55 G, 11 ms X, Y, Z direction <2> 5 times each direction	**Note 1** **Note 2**
6.	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**
7.	Dust (operation)	15 kinds of dust (JIS Z 8901) Hourly 15 seconds stir, 8 times repeat	**Note 1**

Notes 1. Display function is checked under 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

Do not touch an inverter ···on which is stuck a caution label··· while the LCD module is under the operation, because of dangerous high voltage.

(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 of these signals is lost, the LCD panel would be damaged.

<8> The torque for mounting screw should never exceed 0.294 N·m (3 kgf·cm).

(3) Cautions for the atmosphere

<1> Dew drop atmosphere should 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 fixed pattern data signal for a long time to the LCD module. It may cause image sticking. Please use screen savers if the display pattern is fixed more than one hour.

(5) Other cautions

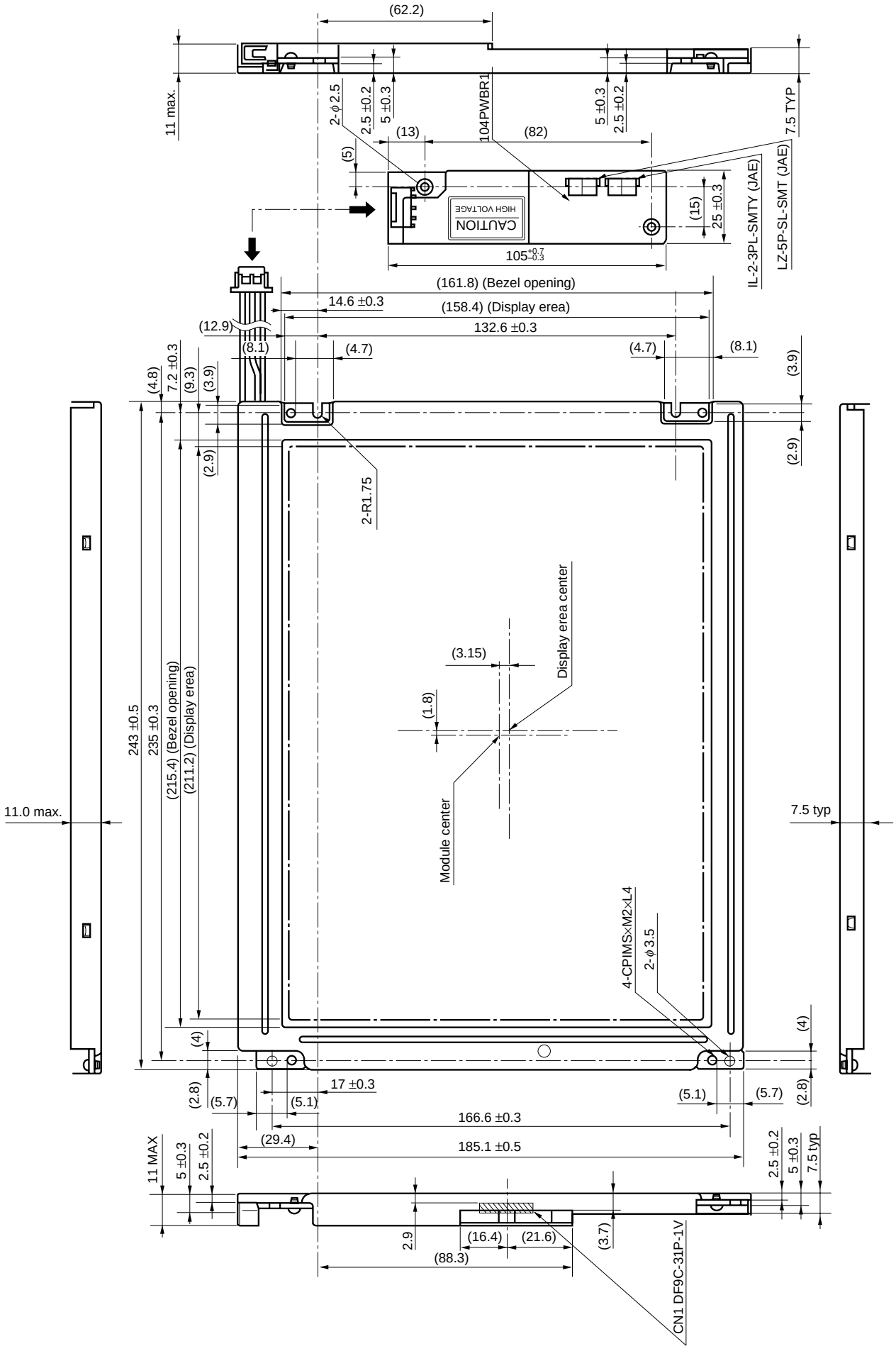
<1> Do not disassemble and/or reassemble LCD module.

<2> Do not readjust variable resistors, switches, etc.

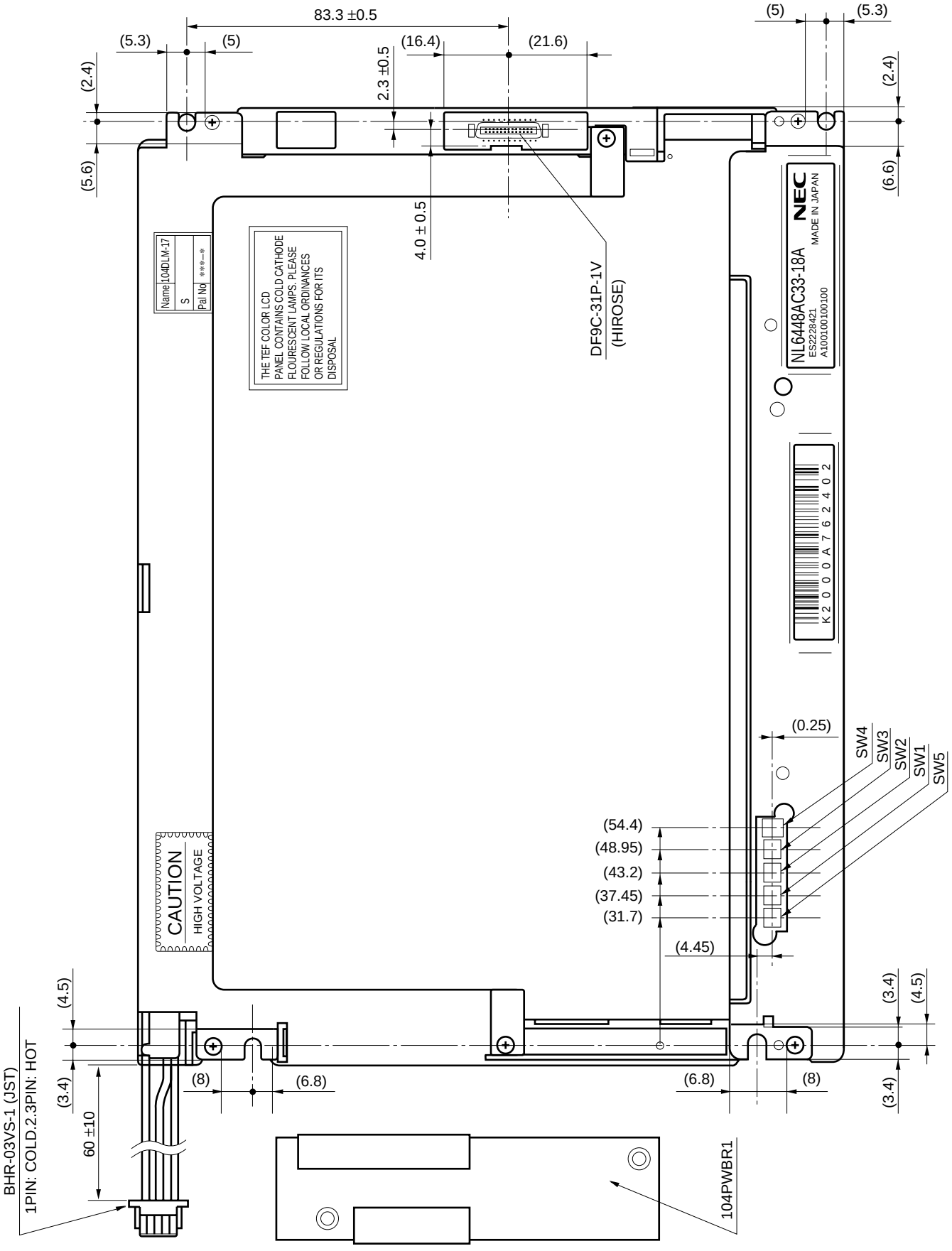
<3> When returning the module for repair, etc. pack the module not to be broken. We recommend the original shipping packages.

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 in the progres of time.
Uneven brightness and/or small spots may be observed depending on different display patterns.

OUTLINE DRAWING: Front View (Unit in mm)



OUTLINE DRAWING: Rear View (Unit in mm)



[MEMO]

[MEMO]