PRELIMINARY DATA SHEET

NEC

TFT COLOR LCD MODULE

NL6448CC33-30

26 cm (10.4 inches), 640 480 pixels, 262,144 colors, Backlight-less Wide temperature range

DESCRIPTION

NL6448CC33-30 is a TFT(Thin Film Transistor) active matrix color liquid crystal display (LCD) comprising amorphous silicon TFT attached to each signal electrode and a driving circuit.

The 26 cm (10.4 inches) diagonal display area contains 640 480 pixels and can display 262,144 colors simultaneously.

NL6448CC33-30 is a backlight-less model. Therefore, it is easy for customers to make own backlight and to get necessary brightness.

FEATURES

- Backlight-less
- High contrast, wide viewing angle and wide color gamut
- Smooth polarizer surface
- 6-bit digital RGB interface
- Data enable (DE) function
- Variable gamma control
- Reverse scan capability
- Wide temperature range

APPLICATIONS

- Display terminals for control system
- Monitors for process controller
- Industrial PC

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

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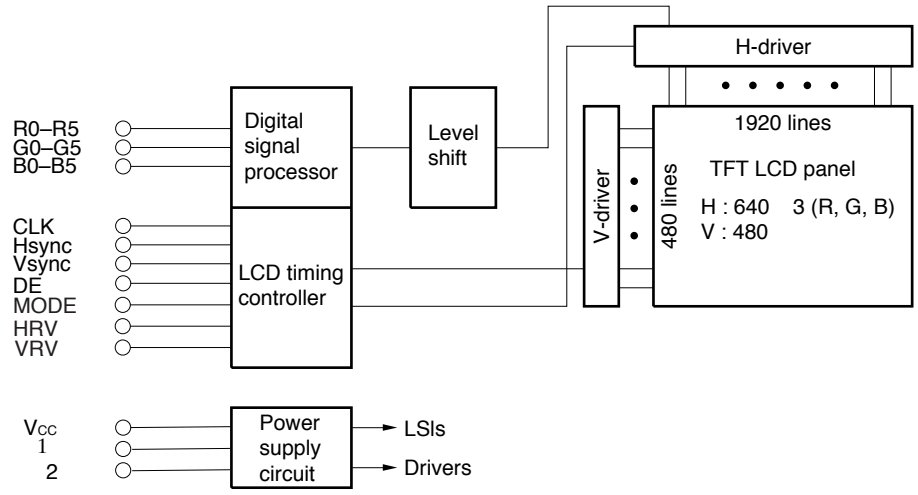
STRUCTURE AND FUNCTIONS

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.

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 a 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



OUTLINE OF CHARACTERISTICS (at room temperature)

Display area	211.2 (H) 158.4 (V) mm
Drive system	a-Si TFT active matrix
Display colors	262,144 colors
Number of pixels	640 480 pixels
Pixel arrangement	RGB vertical stripe
Pixel pitch	0.33 (H) 0.33 (V) mm
Module size	264.0 (H) 187.8 (V) 8.8 TYP. (D) mm
Weight	300 g (TYP.)
Contrast ratio	150 : 1 (TYP.)
Color gamut	43% (TYP., center, to NTSC)
Response time	15 ms (TYP.), white to black
Transmittance	6.3% (TYP.) **Note**
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]
Backlight	Backlight-less
Power consumption	1.0 W (TYP. at 3.3V)

Note: Measuring light conditions

Lamp	Cold Cathode Fluorescent Lamp
Chromaticity coordinates	x=0.320, y=0.325 typical
Luminance	1500cd/m^2

GENERAL SPECIFICATIONS

Item	Specification	Unit
Module size	264.0 ± 0.5 (H) 187.8 ± 0.5 (V) 8.8 (D)TYP.	mm
Display area	211.2 (H) 158.4 (V)	mm
Number of dots	640 3 (H) 480 (V)	dot
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	262,144	color
Weight	Module: 330 (MAX.)	g

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit	Remarks
Supply voltage	V_{CC}	–0.3 to 6.5	V	Ta= 25°C $V_I - V_{CC} < 3.0$
Input voltage	V_I	–0.3 to 6.5	V	
Storage temp.	T_{ST}	–30 to 85	°C	**Note 4**
Operating temp.	T_{OP1}	-25 to 85	°C	Non-destructive **Note 4**
	T_{op2}	-10 to 70	°C	Screen image should be recognized. **Note 2**
Humidity	RH	95% relative humidity	–	Ta 40°C
		85% relative humidity	–	40 < Ta 50°C
		(T_a = 50°C, 85% relative humidity) Absolute humidity.	–	Ta> 50°C
Incident light intensity	II	< 20,000	cd/m^2	at CF side, Ta= 25°C **Notes 1, 4**
Environment light intensity	–	< 20,000	lx	at TFT side, Ta= 25°C **Notes 1, 5, 6**
Gamma resistor	R	3 k Max		Should not be used by "Open"

Notes 1. Measured at the center of display area (Front side)

2. Guarantee the optical characteristics at 25 degree C only.

3. No condensation

4. In case of that the module is exposed at high temperature in operation or storage, the polarizer film may peel off from the panel in the edge of the display area.
It is recommended not to use the module under such environment continuously. It is estimated that the polarizer may peel off after the operation at 85 degree C with 120 hours in accumulation.

5. Incident light (Backlight) should be located from CF(Color Filter) side only.

6. Avoid to use the module in the environment which the strong light exposes the module surface directly.

ELECTRICAL CHARACTERISTICS

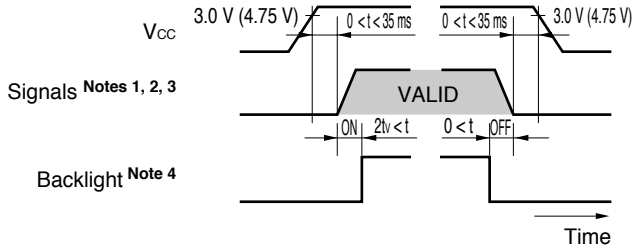
(1) Logic, LCD driving

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 Low voltage	V_{IL}	0	–	V_{CC} 0.3	V	
Logic input High voltage	V_{IH}	V_{CC} 0.7	–	V_{CC}	V	
Supply current	I_{CC}	– –	325 **Note** (250)	400 (300)	mA	V_{CC} = 3.3 V (V_{CC} = 5.0 V)

Note Checkered flag pattern (in EIAJ ED-2522)

SUPPLY VOLTAGE SEQUENCE



Notes 1. Signals: CLK, Hsync, Vsync, DE, DATA (R0-R5, G0-G5, B0-B5)

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

3. 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 turns off, the display may momentarily become white.

4. When the power is off, please keep whole signals low level or high impedance.

INTERFACE AND PIN CONNECTION

(1) Interface signals, power supply

Module side connector	Mating connector
CN1 ··· IL-Z-10PL1-SMTY	IL-Z-10S-S125C3
CN2 ··· IL-Z-13PL1-SMTY	IL-Z-103-S125C3
CN3 ··· IL-Z-11PL1-SMTY	IL-Z-11S-S125C3

Supplier: Japan Aviation Electronics Industry Limited (JAE)

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	MODE	Input signal mode Note 1
31	HRV	Horizontal scanning direction
32	VRV	Vertical scanning direction
33	1	Gamma setting
34	2	Gamma setting

LSB : Least Significant Bit

MSB : Most Significant Bit

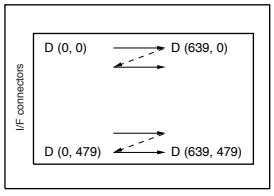
Notes 1. MODE setting
L or Open = DE mode, H = Fixed timing mode

2. HRV setting
L or Open = Normal horizontal scanning (Pull down resistor 47 k ohm), H = Reversed horizontal scanning

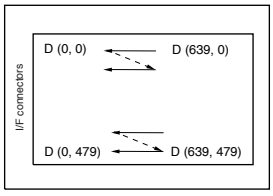
3. VRV setting
L or Open = Normal vertical scanning (Pull down resistor 47 k ohm), H = Reversed vertical scanning

<View from TFT panel side>

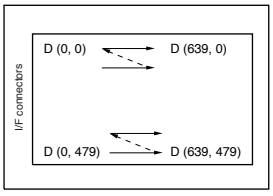
HRV = L, VRV = L



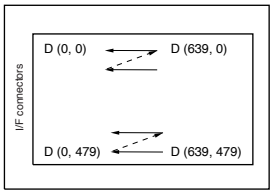
HRV = H, VRV = L



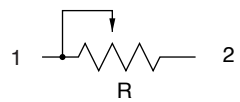
HRV = L, VRV = H



HRV = H, VRV = H



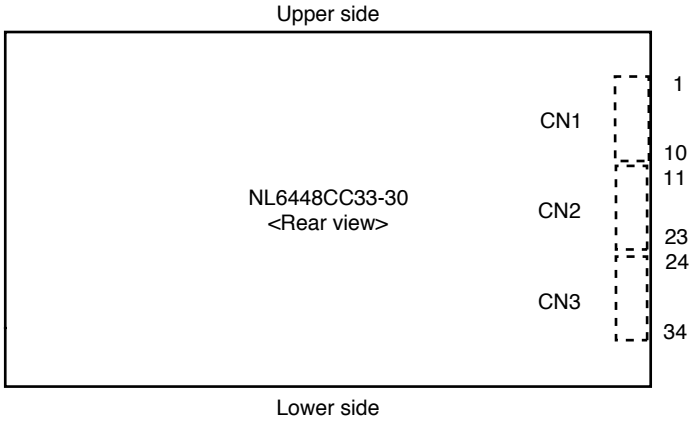
4. Gamma correction



Mating variable resistor : 2.2 k ±5%

5. GND is connected to the frame of LCD module.

<Connector location>



(2) Pin function

Symbol	In/Out	Logic	Description
R0-R5 G0-G5 B0-B5	In	Positive	Data for Red, Green and Blue
Vsync	In	Negative	Vertical synchronous signal
Hsync	In	Negative	Horizontal synchronous signal
CLK	In	Negative	Dot clock input Data is valid at the negative edge of CLK signal.
Mode	–	–	DE mode = High, Fixed mode = Low or Open
DE	In	Positive	Data enable During DE is "High", Data is valid.
1, 2	–	–	Connect 2.2 k ohm valiable resistor for changing the optimum gamma compensation curve viewing angle.
HRV VRV	–	–	Signals for selecting scan direction HRV = Horizontal scan direction VRV = Vertical scan direction
V_{CC}	In	–	Power supply for logic and LCD drivers
GND	–	–	Ground for logic

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

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

INPUT SIGNAL TIMING

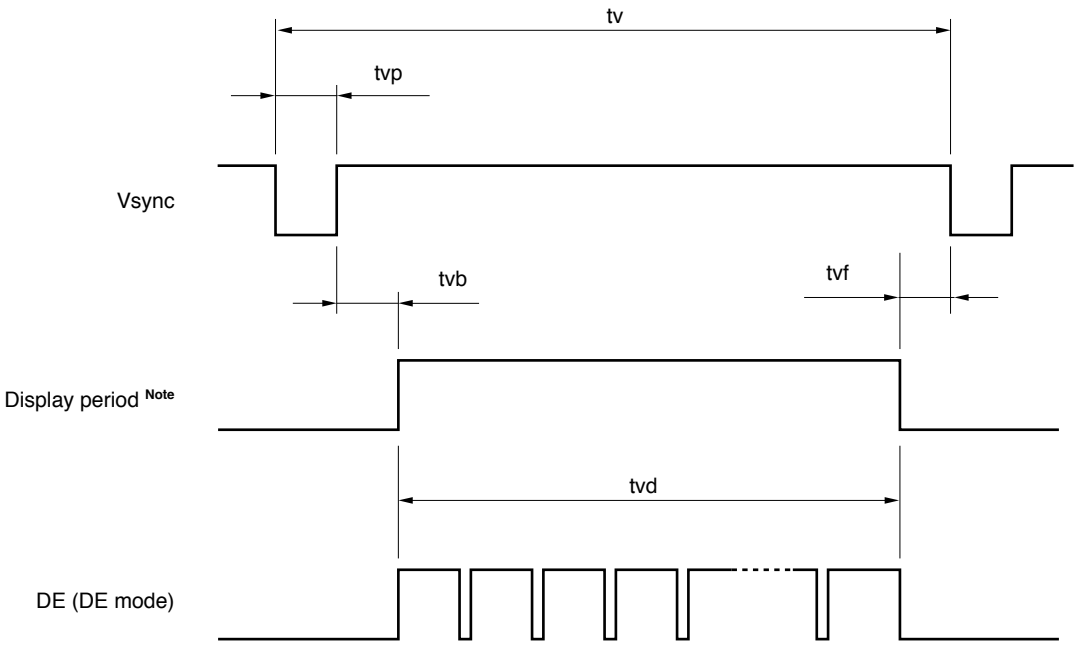
(1) Input signal specifications (DE mode is default.)

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	–		DE mode
	Pulse width	thp	–	96	–	CLK	Fixed mode
			10	96	–		DE mode
	Back-porch	thb	–	48	–	CLK	Fixed mode
			4	48	–		DE mode
	thp + thb		144			CLK	Fixed mode
			14	144	–		DE mode
	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	–		DE mode
	Pulse width	tvp	–	2	–	H	Fixed mode
			1	2	–		DE mode
	Back-porch	tvb	–	31	–	H	Fixed mode
			4	31	–		DE mode
	tvp + tvb		33			H	Fixed mode
			5	33	–		DE mode
	Rise, fall	tvrf	–	–	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	

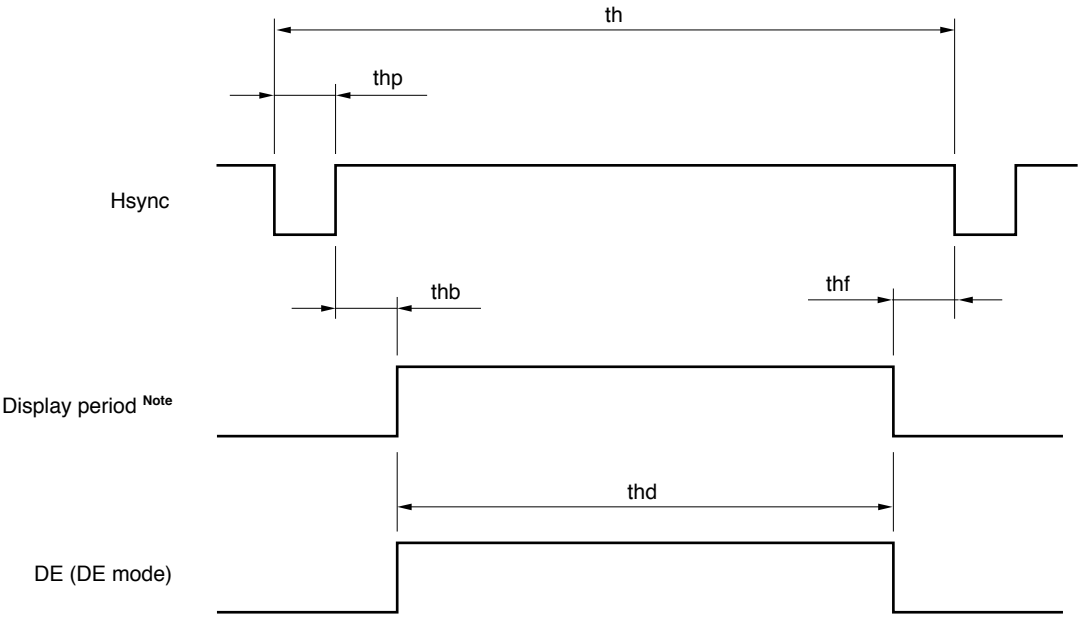
Caution All of parameters should be kept in the specified range.

(2) Definition of input signal timing

<Vertical>

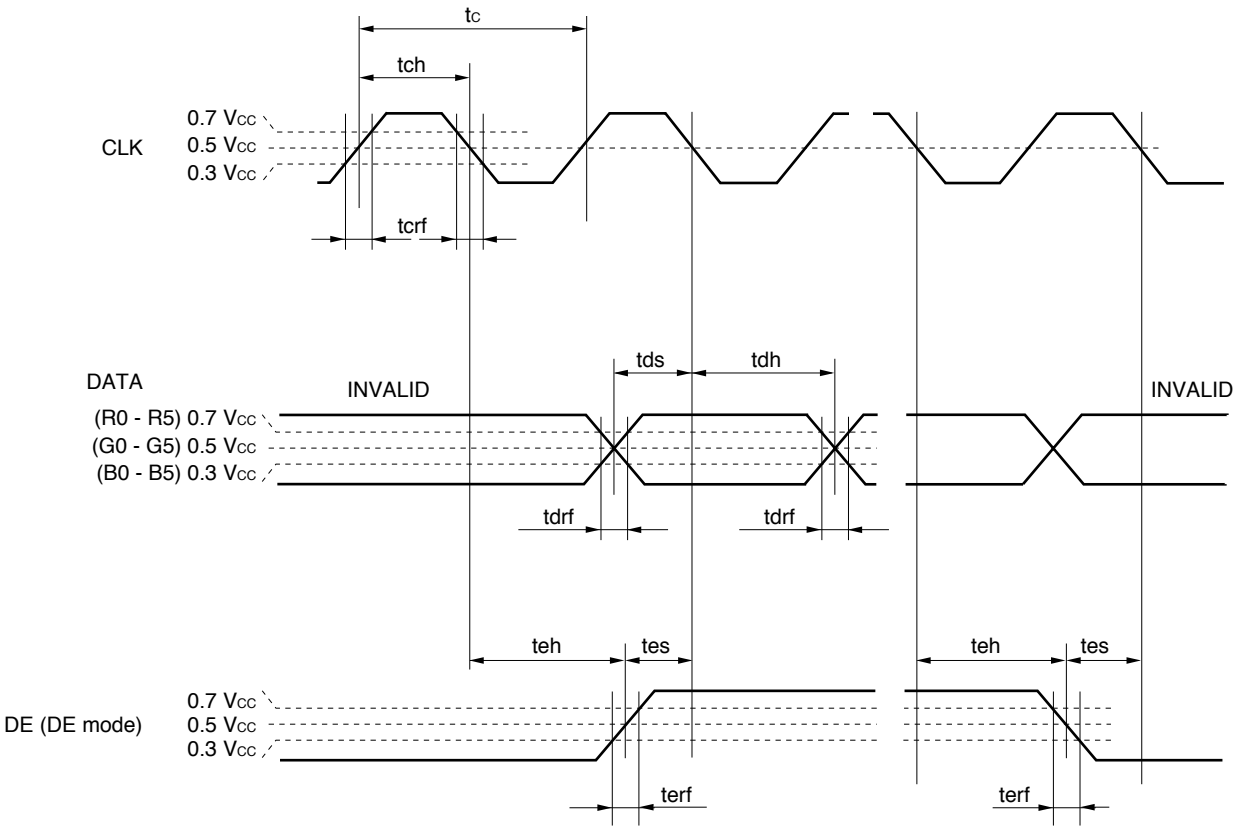


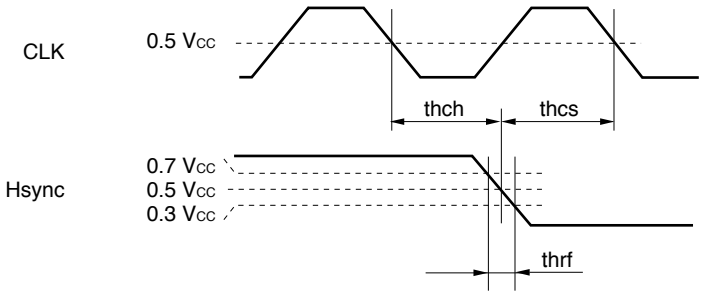
<Horizontal>

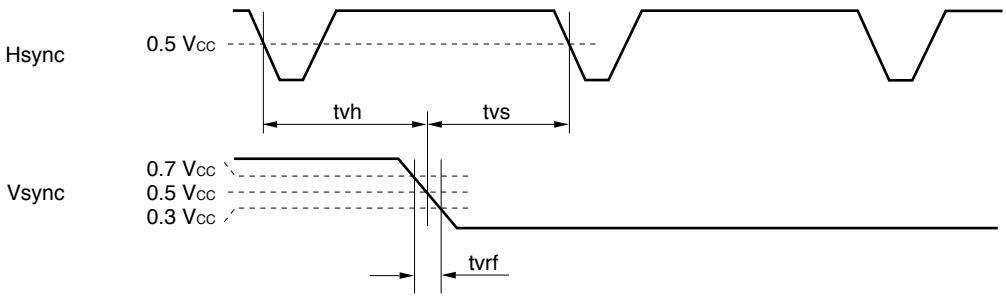


Note These do not exist as signals.

Remark 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.

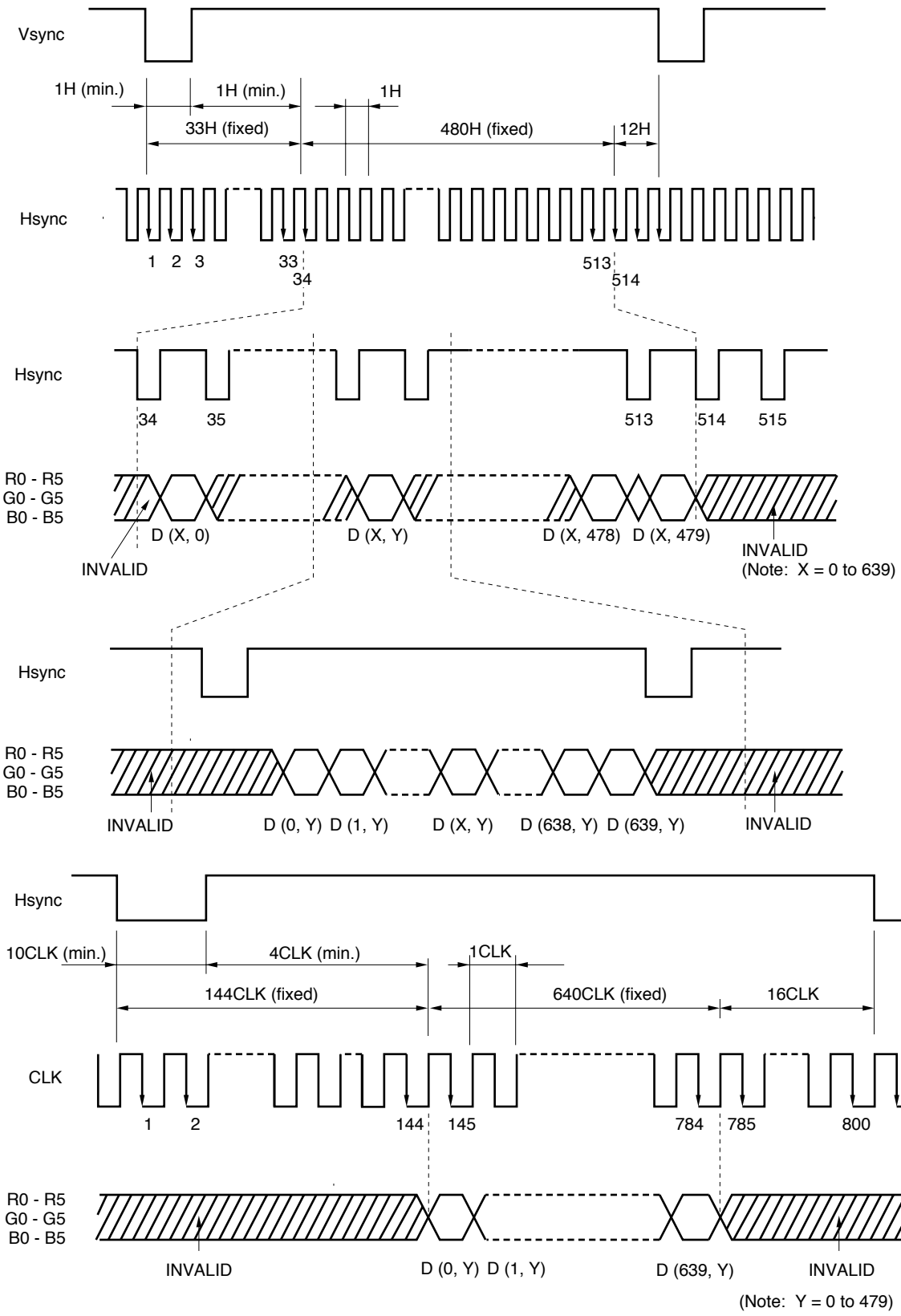

tc
tch
CLK
0.7 Vcc
0.5 Vcc
0.3 Vcc
tcrf
DATA
INVALID
INVALID
tds
tdh
(R0 - R5) 0.7 Vcc
(G0 - G5) 0.5 Vcc
(B0 - B5) 0.3 Vcc
tdrf
tdrf
teh
tes
teh
tes
DE (DE mode)
0.7 Vcc
0.5 Vcc
0.3 Vcc
terf
terf


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

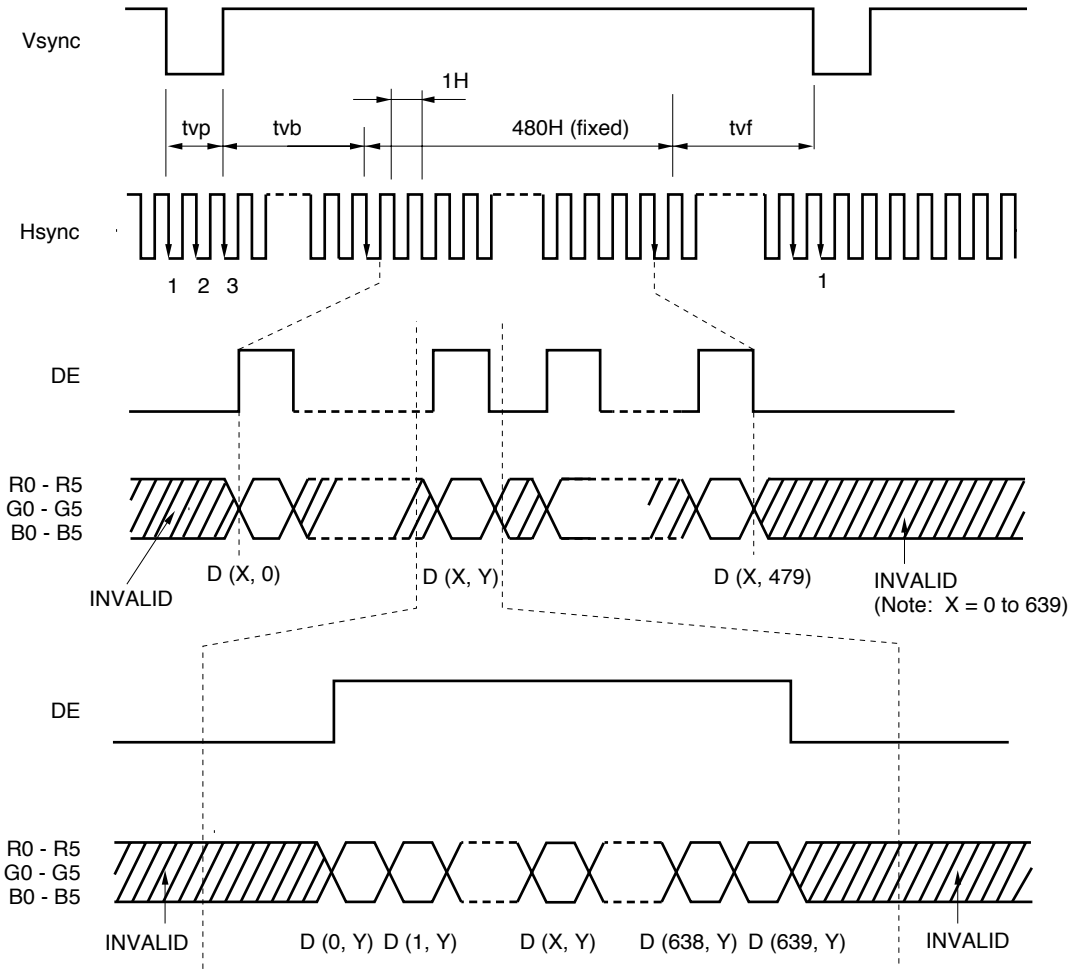

Hsync
0.5 Vcc
tvh
tvs
Vsync
0.7 Vcc
0.5 Vcc
0.3 Vcc
tvrf

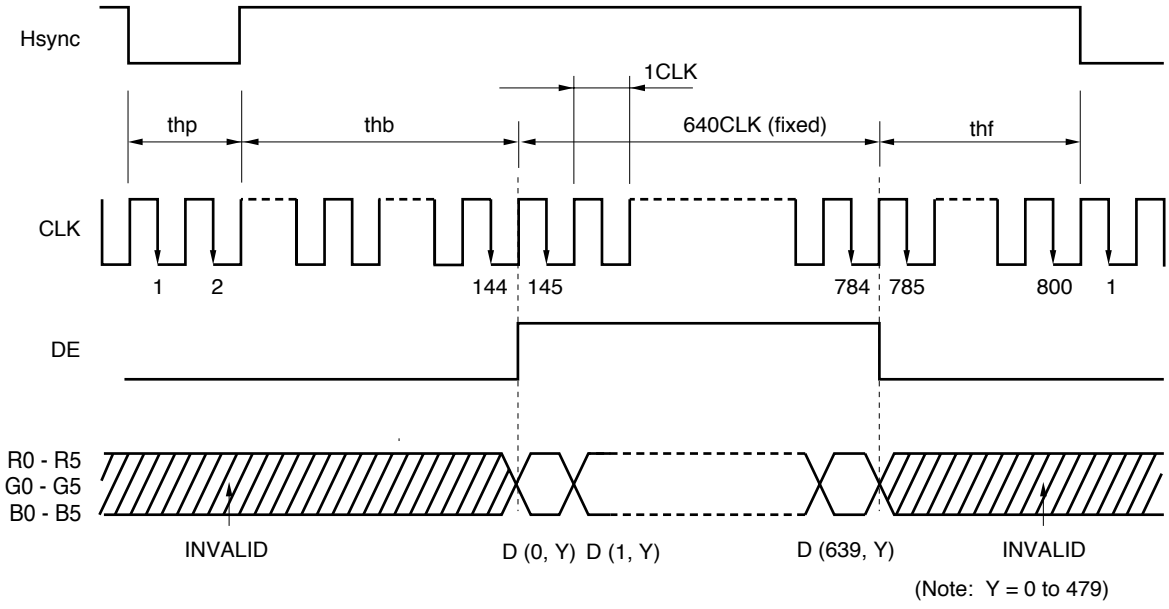
(3) Input signal timing chart

a) Fixed timing 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)

DOT DEFECT SPECIFICATIONS

a) Inspection conditions

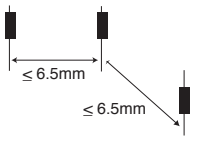
Distance : The distance between the inspector's eye and the LCD panel is 20 cm.
Illumination : The distance between a 20 W fluorescent lamp and the LCD panel is 25 - 30 cm.
Temperature : Room temperature (25+/-5 C)
Viewing angle:
Display specifications : $-20^\circ \leq X \leq +20^\circ$, $0^\circ \leq Y \leq +20^\circ$
Appearance specifications : $-45^\circ \leq X \leq +45^\circ$, $-45^\circ \leq Y \leq +45^\circ$
Measuring light condition: Lamp Cold Cathode Fluorescent Lamp
Chromaticity coordinates (x=0.320, y=0.325 typical)
Luminance 1500cd/m^2

b) Display specifications

Item		Specifications		
Line defect		Not allowed		
Dot defects **Note 1**	Luminous dots **Note 2**	Color	Distance between the same color dots	Quantity
		Red, Green, Blue	–	R + G + B ≤ 6
		Green	–	G ≤ 3
		Red, Green, Blue	≤ 6.5 mm	R, G, B ≤ 0
			Linked two or more dots **Note 4**	R, G, B ≤ 0
	Dark dots **Note 3**	Color	Distance between the same color dots	Quantity
		Black	–	R + G + B ≤ 12 R, G, B ≤ 7
			Linked two dots **Note 4**	≤ 1 pair
			Linked three or more dots **Note 4**	≤ 0
			≤ 6.5 mm **Note 5**	≤ 0
	Luminous dots + Dark dots			≤ 18

Notes 1. Dot defects: Defect area >1/3 dot
2. Luminous dots are measured while the screen is black.
3. Dark dos are measured while the screen is illuminated with Red, Green, or Blue.
4. Linkage means that linked two or more dots.
(▮: Luminous or Dark dot)

5. ≤ 6.5mm is considered with:
(▮: Luminous or Dark dot)



	To be counted	To be uncounted
Luminous dots	Same color	Different color
Dark dots	Same screen	Different screen

c) Appearance specifications

Item	Specifications		
	Measurement criteria		Quantity
Other objects Stains Dusts (Dot shape)	Average diameter ( ) mm		Allowed value
	≤ 0.2		All allowed
	0.2 < < 0.3		≤ 10 points
	0.3 ≤ ≤ 0.5		≤ 3 points
	0.5 <		0 point
	Linked other objects		
Other objects Stains Dusts (Line shape)	Width (W)mm	Length (L)mm	
	W < 0.05	–	All allowed
	0.05 ≤ W ≤ 0.1	L < 0.7	
		0.7 ≤ L ≤ 1.0	4 points
		1.0 < L	0 point
	0.1 < W	–	
Polarizer Bubbles Wrinkles Dent	Average diameter ( ) mm		
	≤ 0.5		≤ 2 points
Panel dent	≤ 0.5		≤ 2 points
Polarizer scratch	Remarkable scratches		0 point
Form	Specified labels and parts should be located		

OPTICAL CHARACTERISTICS

T_a = 25 ± 5°C, V_{CC} = 3.3 V , Nomal scan

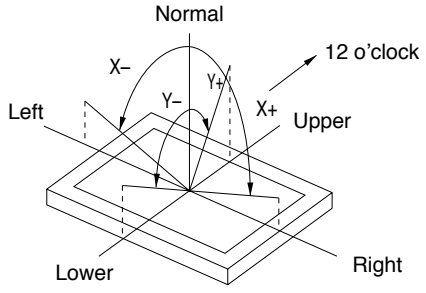
Parameter		Symbol	Condition	MIN.	TYP.	MAX.	Unit
Viewing angle range	Horizontal	X+	CR > 5, Y = ±0°	30	–	–	deg.
		X–	CR > 5, Y = ±0°	30	–	–	deg.
	Vertical	Y+	CR > 5, X = ±0°	20	–	–	deg.
		Y–	CR > 5, X = ±0°	20	–	–	deg.
Contrast ratio		CR	X = ±0°, Y = -5°	80	150	–	–
Color gamut		C	at center, to NTSC	40	43	–	%
Response time		ton	White to black	–	15	–	ms
		toff	Black to white	–	55	–	
Chromaticity	Red	Rx Ry	at display center	–	0.590 0.357	–	–
	Green	Gx Gy	at display center	–	0.319 0.538	–	–
	Blue	Bx By	at display center	–	0.157 0.150	–	–
	White	Wx Wy	at display center	–	0.334 0.367	–	–
Transmittance		T	at display center, with white	5.5	6.3	–	%
Gamma correction			1- 2 : 0	–	0.4	–	–
			1- 2 : 2k	–	4.3	–	

Remarks 1. The contrast ratio is calculated by using the following formula.

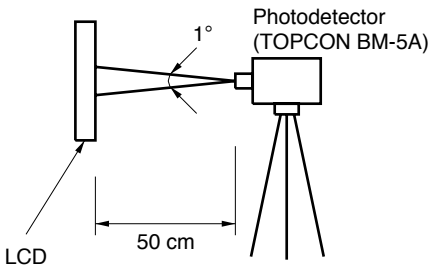
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance with all pixels in white}}{\text{Luminance with all pixels in black}}$$

The Luminance is measured in darkroom.

2. Definitions of viewing angle are as follows.

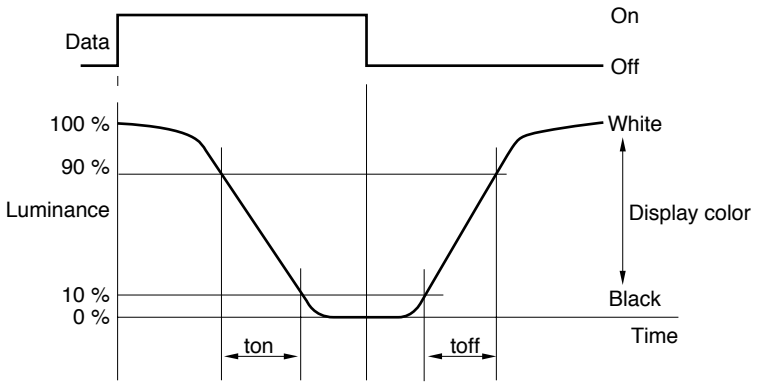


3. The luminance is measured after 20 minutes from the module works, with all pixels in white. Typical value is measured after luminance saturation.



4. Definition of response time is as follows.

The output of photodetector is measured when the brightness changes from "white" to "black" and "black" to "white". The response time is defined as 90 to 10 % for turn-on and 10 to 90 % for turn-off.



Reference data at Ta = 0°C

ton = 70ms typical

toff = 160ms typical

5. For the measurements of color gamut, chromaticity and transmittance, the following backlight lamp is used.

Color temperature : 6000 K
Luminance : 1500 cd/m^2
Chromaticity: x=0.320, y=0.325

6. Measuring viewing angle is perpendicular to the center of screen.

X =± 0°, Y =± 0°, at center

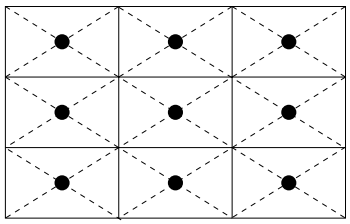
RELIABILITY TEST

Test item	Test condition
High temperature/humidity operation **Note 1**	65 ± 2°C, 85% relative humidity 240 hours Display data is black.
Heat cycle (operation) **Note 1**	<1> -25°C ± 3°C ··· 1 hour 85°C ± 3°C ··· 1 hour <2> 50 cycles, 5 hours/cycle <3> Display data is black.
Thermal shock (non-operation) **Note 1**	<1> –30°C ± 3°C ··· 30 minutes 85°C ± 3°C ··· 30 minutes <2> 16 cycles <3> Temperature transition time within 5 minutes
Vibration (non-operation) **Notes 1, 2**	<1> 5 - 100 Hz, 2G 1 minute/cycle X, Y, Z direction <2> 120 times each direction
Mechanical shock (non-operation) **Notes 1, 2**	<1> 55 G, 11 ms X, Y, Z direction <2> 5 times each direction
ESD (operation) **Notes 1, 3**	150 pF, 150 , ±10 kV 9 places on a panel 10 times each place at one-second intervals

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

a) Pick the pouch only, in taking out module from a carrier box.

(2) Cautions for handling the module

a) As the electrostatic discharges may break the LCD module, handle the LCD module with care against electrostatic discharges.

b)  As the LCD panel is made from fragile glass material, impulse and pressure to the LCD module should be avoided.

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

d) Do not pull the interface connectors in or out while the LCD module is operating.

e) Put the module display side down on a horizontal plane.

f) Handle connectors and cables with care.

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

h) The torque to mounting screw should never exceed 0.294 N·m (3 kgf·cm).

(3) Cautions for the atmosphere

a) Dew drop atmosphere should be avoided.

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

c) Do not operate the LCD module in a high magnetic field.

(4) Caution for the module characteristics

a) Do not apply fixed pattern data signal for a long time to the LCD module. It may cause image sticking. Please use screen savers if the display pattern is fixed more than one hour.

(5) Other cautions

a) Do not disassemble and/or reassemble LCD module.

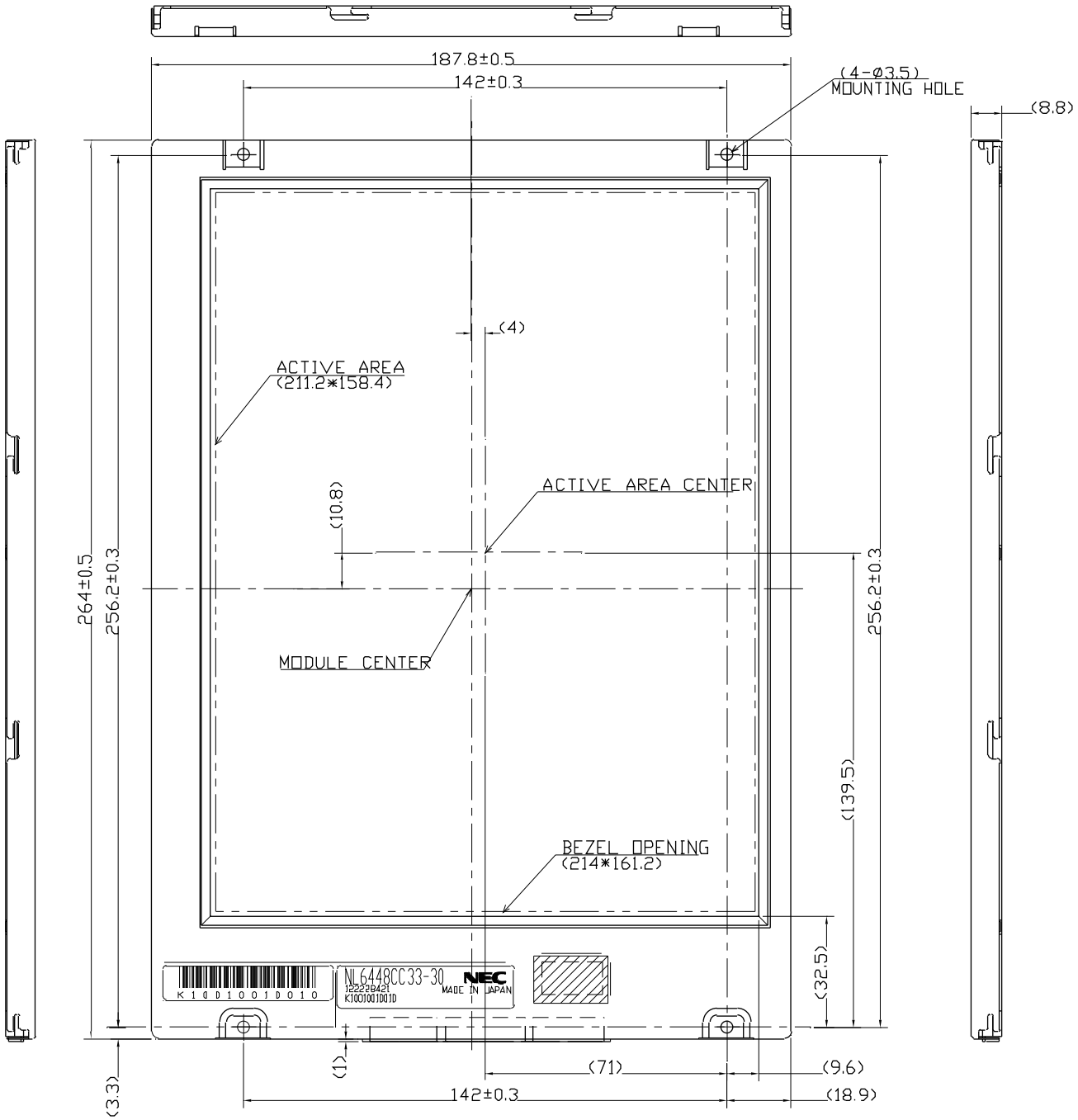
b) Do not readjust variable resistors etc.

c) When returning the module for repair or etc, please pack the module not to be broken. We recommend to the original shipping packages.

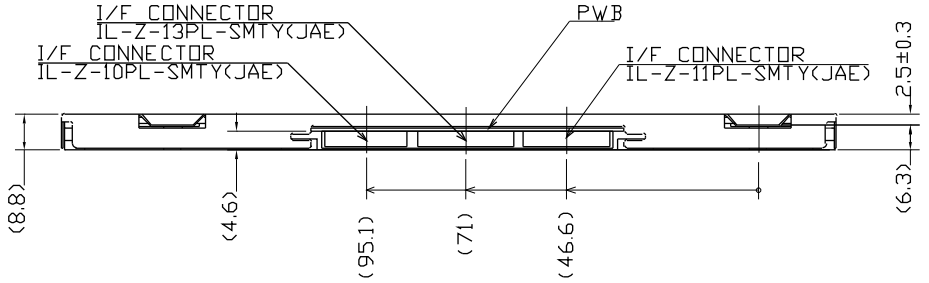
Liquid Crystal Display has the following specific characteristics. There are not defects or malfunctions.

- The display condition of LCD module may be affected by the ambient temperature.
- Uneven brightness and/or small spots may be noticed depending on different display patterns.

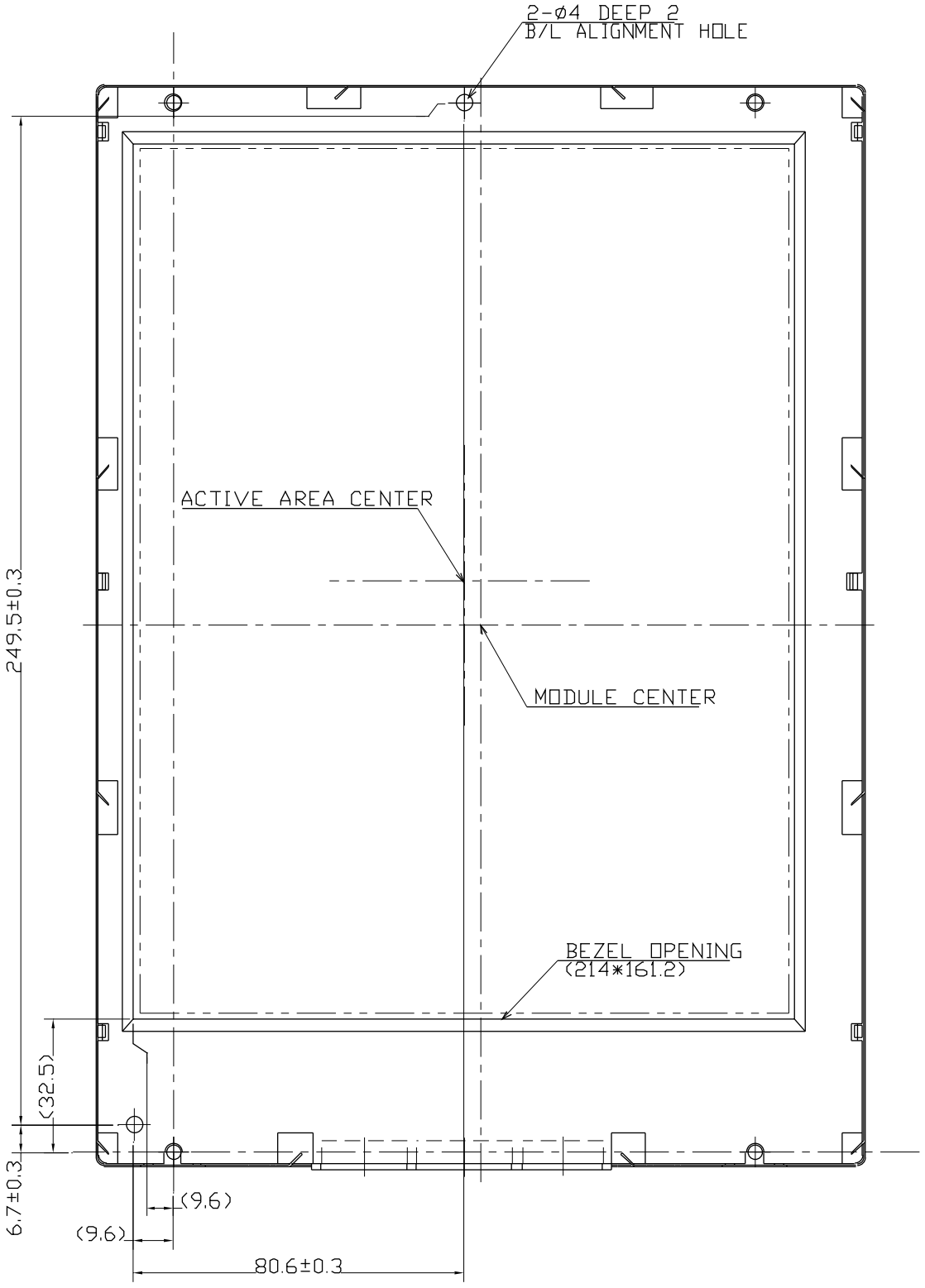
OUTLINE DRAWING: Front view (Unit: mm)



(TFT Side)



OUTLINE DRAWING: Rear View (Unit: mm)



(Color Filter Side)