

NEC

TFT COLOR LCD MODULE

NL6448CC33-30W

26.4cm (10.4 Type)

VGA

DATA SHEET

(3rd edition)

All information is subject to change without notice.

INTRODUCTION

No part of this document shall be copied in any form or by any means without the prior written consent of NEC Corporation.

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

While NEC Corporation has been making continuous effort to enhance the reliability of its products, the possibility of failures cannot be eliminated entirely. To minimize risks of damage to property or injury to person arising from a failure in an NEC product, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment and anti-failure features.

NEC products are classified into the following three quality grades:

"Standard", "Special", "Specific"

The ***"Specific"*** quality grade applies only to applications developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a product depend on its quality grade, as indicated below. Customers must check the quality grade of each application 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: Military systems, aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems (medical equipment, etc.) and any other equipment

The quality grade of this product is ***"Standard"*** unless otherwise specified in this document. If customers intend to use this product for applications other than those specified for ***"Standard"*** quality grade, they should contact NEC Corporation sales representative in advance.

Anti-radioactive design is not implemented in this product.

CONTENTS

INTRODUCTION..... 2

1. OUTLINE 5

 1.1 STRUCTURE AND PRINCIPLE 5

 1.2 APPLICATIONS 5

 1.3 FEATURES 5

2. GENERAL SPECIFICATIONS..... 6

3. BLOCK DIAGRAM 7

4. DETAILED SPECIFICATIONS..... 8

 4.1 MECHANICAL SPECIFICATIONS 8

 4.2 ABSOLUTE MAXIMUM RATINGS 8

 4.3 ELECTRICAL CHARACTERISTICS 9

 4.3.1 Driving for LCD panel signal processing board 9

 4.3.2 Power supply voltage ripple 9

 4.3.3 Fuse 9

 4.4 POWER SUPPLY VOLTAGE SEQUENCE..... 10

 4.4.1 Sequence for LCD panel signal processing board..... 10

 4.4.2 Sequence for backlight inverter (Commercial item) 10

 4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS 11

 4.5.1 Terminal on LCD panel signal processing board 11

 4.5.2 Positions of sockets 12

 4.6 DISPLAY COLORS AND INPUT DATA SIGNALS 13

 4.7 DISPLAY POSITIONS 14

 4.8 SCANNING DIRECTIONS 14

 4.9 INPUT SIGNAL TIMINGS FOR LCD PANEL SIGNAL PROCESSING BOARD 15

 4.9.1 Outline of input signal timings 15

 4.9.2 Detailed input signal timing chart for fixed mode 16

 4.9.3 Detailed input signal timing chart for DE mode 17

 4.9.4 Timing characteristics 18

 4.10 OPTICS 19

 4.10.1 Optical characteristics 19

 4.10.2 Definition of contrast ratio 20

 4.10.3 Definition of transmittance uniformity 20

 4.10.4 Definition of response times 20

 4.10.5 Definition of viewing angles 20

 4.10.6 Gamma curves 21

 4.10.7 Photoabsorbed axis of polarizer 21

CONTENTS

5. RELIABILITY TESTS	22
6. PRECAUTIONS	23
6.1 MEANING OF CAUTION SIGNS	23
6.2 CAUTIONS	23
6.3 ATTENTIONS.....	23
6.3.1 Handling of the product.....	23
6.3.2 Environment.....	23
6.3.3 Characteristics	24
6.3.4 Other.....	24
7. OUTLINE DRAWINGS	25
7.1 FRONT VIEW	25
7.2 REAR VIEW	26

1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

NL6448CC33-30W module is composed of the amorphous silicon thin film transistor liquid crystal display (a-Si TFT LCD) panel structure with driver LSIs for driving the TFT (Thin Film Transistor) array and a backlight unit.

The a-Si TFT LCD panel structure is injected liquid crystal material into a narrow gap between the TFT array glass substrate and a color-filter glass substrate.

Color (Red, Green, Blue) data signals from a host system (e.g. PC, signal generator, etc.) are modulated into best form for active matrix system by a signal processing board, and sent to the driver LSIs which drive the individual TFT arrays.

The TFT array as an electro-optical switch regulates the amount of transmitted light from the backlight assembly, when it is controlled by data signals. Color images are created by regulating the amount of transmitted light through the TFT array of red, green and blue dots.

1.2 APPLICATIONS

- Industrial PC
- Display terminal for control system

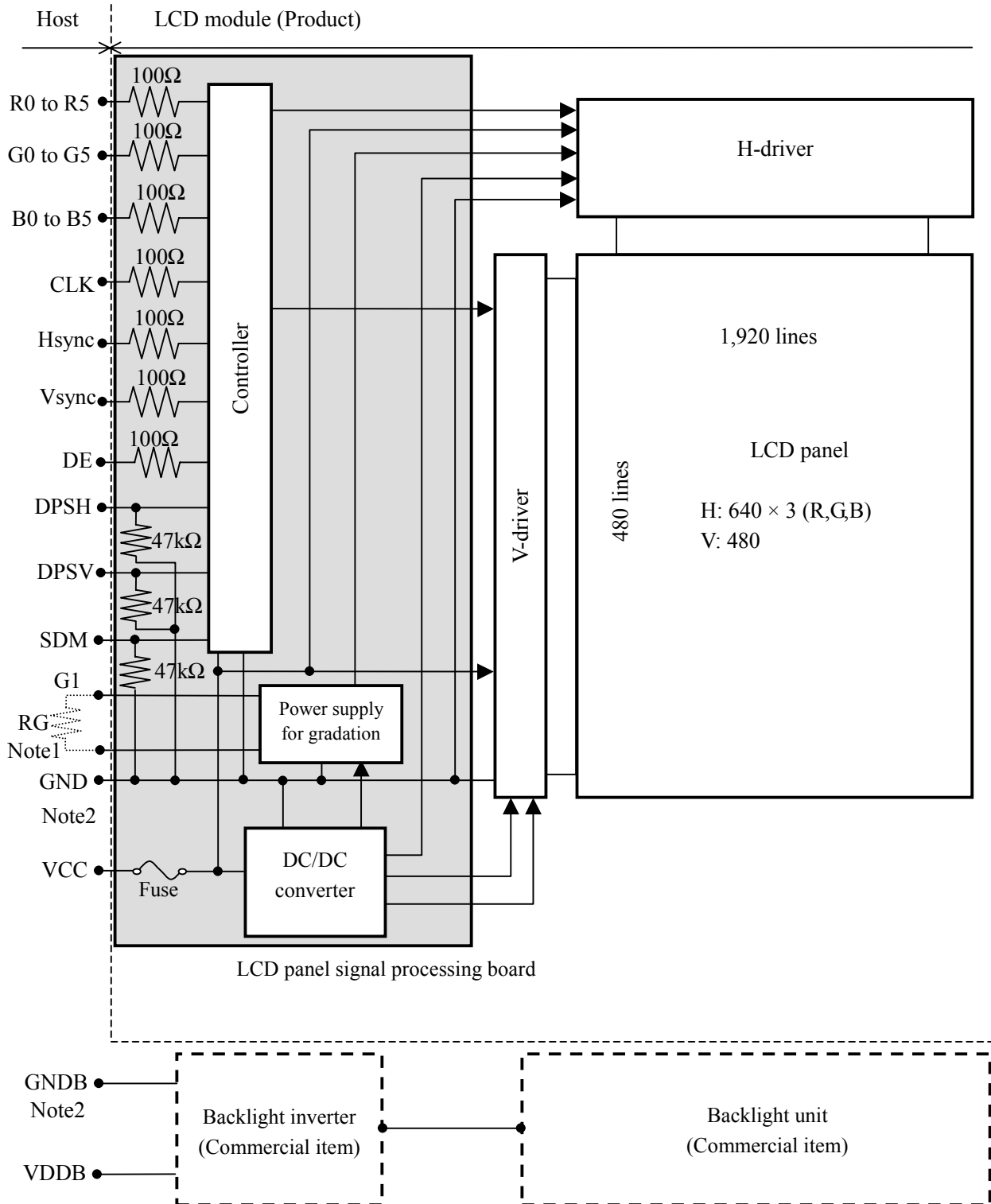
1.3 FEATURES

- Wide viewing angle
- 6-bit digital RGB signals
- Reversible-scan direction
- Gamma correction
- Backlight unit less

2. GENERAL SPECIFICATIONS

Display area	211.2 (W) × 158.4 (H) mm (typ.)
Diagonal size of display	26.4 cm (10.4 inches)
Drive system	a-Si TFT active matrix
Display color	262,144 colors
Pixel	640 (H) × 480 (V) pixels
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe
Dot pitch	0.1100 (W) × 0.3300 (H) mm
Pixel pitch	0.3300 (W) × 0.3300 (H) mm
Module size	264.0 (W) × 187.8 (H) × 8.8 (D) mm (typ.)
Weight	300 g (typ.)
Contrast ratio	150:1 (typ.)
Viewing angle	At the contrast ratio 10:1 <ul style="list-style-type: none"> • Horizontal: Left side 55° (typ.), Right side 55° (typ.) • Vertical: Up side 30° (typ.), Down side 50° (typ.)
Designed viewing direction	At DPSH: normal scan and DPSV: normal scan <ul style="list-style-type: none"> • Viewing direction without image reversal: up side (12 o'clock) • Viewing direction with contrast peak: down side 5° to 10° (6 o'clock) • Viewing angle with optimum grayscale ($\gamma=2.2$): normal axis
Polarizer surface	Non matt treatment
Polarizer pencil-hardness	2H (min.) [by JIS K5400]
Color gamut	At use of backlight unit (1,500 cd/m ² , Wx: 0.320, Wy: 0.325) 42 % (typ.) [against NTSC color space]
Response time	15 ms (typ.)
Transmittance	At use of backlight unit (1,500 cd/m ² , Wx: 0.320, Wy: 0.325) 6.0 % (typ.)
Signal system	6-bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE), Horizontal synchronous signal (Hsync), Vertical synchronous signal (Vsync)
Power supply voltage	LCD panel signal processing board: 3.3V or 5.0V
Power consumption	At checkered flag pattern 1.0 W (typ.)

3. BLOCK DIAGRAM



Note1: Attach RG (Resistance) between G1 and G2. Do not use an "Open" condition!

Note2: GND and GNDDB (Backlight inverter ground) should be connected together in customer equipment.

4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification	Unit
Module size	264.0 ± 0.5 (W) × 187.8 ± 0.5 (H) × 8.8 ± 0.5 (D) Note1	mm
Display area	211.2 ± 0.5 (W) × 158.4 ± 0.5 (H) Note1	mm
Weight	300 (typ.), 330 (max.)	g

Note1: See "7. OUTLINE DRAWINGS".

4.2 ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Rating	Unit	Remarks	
Power supply voltage	LCD panel signal board	VCC	-0.3 to +6.5	V	Ta = 25°C	
Input voltage for signals	Display signals Note1	VD	-0.3 to VCC+0.3	V		
	Function signals Note2	VF	-0.3 to VCC+0.3	V		
Gamma correction resistance		RG	3,000	Ω	-	
Absolute light resistance illuminance		LRIL	20,000	lx	Front view side	
Absolute light resistance intensity		LRIN	20,000	cd/m ²	Rear view side	
Storage temperature		Tst	-30 to +85	°C	-	
Operating temperature	Front surface	Character recognition	TopF1	-10 to +70		°C
		Nondestructive for circuit system	TopF2	-25 to +85		°C
	Rear surface	Character recognition	TopR1	-10 to +70		°C
		Nondestructive for circuit system	TopR2	-25 to +85		°C
Relative humidity Note3		RH	≤ 95	%	Ta ≤ 40°C	
			≤ 85	%	40 < Ta ≤ 50°C	
			≤ 70	%	50 < Ta ≤ 55°C	
			≤ 60	%	55 < Ta ≤ 60°C	
			≤ 50	%	60 < Ta ≤ 65°C	
			≤ 42	%	65 < Ta ≤ 70°C	
Absolute humidity Note3		AH	≤ 78 Note4	g/m ³	Ta > 70°C	

Note1: Display signals are CLK, Hsync, Vsync, DE and DATA (R0 to R5, G0 to G5, B0 to B5).

Note2: Function signals are DPSH, DPSV and SDM.

Note3: No condensation

Note4: Ta = 70°C, RH = 42%

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 Driving for LCD panel signal processing board

(Ta = 25°C)

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remarks
Power supply voltage		VCC	3.0	3.3	3.6	V	for 3V system
			4.7	5.0	5.3	V	for 5V system
Power supply current		ICC	-	280 Note1	400	mA	VCC = 3.3V Note2
			-	200 Note1	280	mA	VCC = 5.0V Note2
Logic input voltage for display signals	Low	VDLL	0	-	0.3Vcc	V	CMOS level
	High	VDLH	0.7Vcc	-	Vcc	V	
Input voltage for DPSH and DPSV signals	Low	VFDL	0	-	0.3Vcc	V	
	High	VFDH	0.7Vcc	-	Vcc	V	
Input voltage for SDM signal	Low	VFDL	0	-	0.3Vcc	V	
	High	VFDH	0.7Vcc	-	Vcc	V	

Note1: Checkered flag pattern [by EIAJ ED-2522]

Note2: RG = 820Ω (See "4.5.1 Terminal on LCD panel signal processing board".)

4.3.2 Power supply voltage ripple

This product works, even if the ripple voltage levels are beyond the permissible values as following the table, but there might be noise on the display image.

Parameter	Power supply voltage	Ripple voltage Note1 (Measure at input terminal of power supply)	Unit
VCC	3.3 V	≤ 100	mVp-p
	5.0 V	≤ 100	mVp-p

Note1: The permissible ripple voltage includes spike noise.

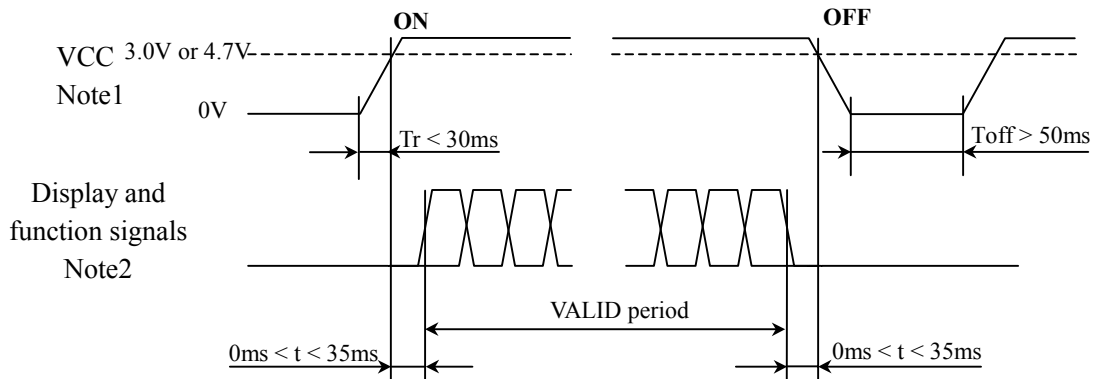
4.3.3 Fuse

Fusing line	Fuse		Rating	Fusing current Note1
	Type	Supplier		
VCC	TF20N1.25TE	KOA Corporation	1.25 A	2.5 A
			32 V	

Note1: The power supply capacity should be more than the fusing current. If the power supply capacity is less than the fusing current, the fuse may not blow for a short time, and then nasty smell, smoking and so on may occur.

4.4 POWER SUPPLY VOLTAGE SEQUENCE

4.4.1 Sequence for LCD panel signal processing board

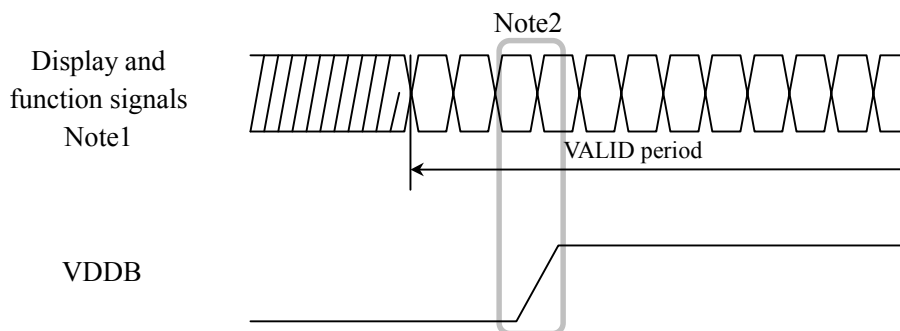


Note1: In terms of voltage variation (voltage drop) while VCC rising edge is below 3.0V in "VCC = 3.3V" or 4.7V in "VCC = 5.0V", a protection circuit may work, and then this product may not work.

Note2: Display (CLK, Hsync, Vsync, DE, R0 to R5, G0 to G5, B0 to B5) and function (DPSH, DPSV, SDM) signals must be Low or High-impedance, exclude the VALID period (See above sequence diagram), in order to avoid that internal circuits is damaged.

If some of display and function signals of this product are cut while this product is working, even if the signal input to it once again, it might not work normally. If customer stops the display and function signals, they should be cut VCC.

4.4.2 Sequence for backlight inverter (Commercial item)



Note1: These are display and function signals for LCD panel signal processing board.

Note2: The backlight inverter voltage (VDDB) should be inputted within the valid period of display and function signals, in order to avoid unstable data display.

4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

4.5.1 Terminal on LCD panel signal processing board

CN1 socket (LCD module side): IL-Z-10PL1-SMTY (Japan Aviation Electronics Industry Limited)
 Adaptable plug: IL-Z-10S-S125C3 (Japan Aviation Electronics Industry Limited)

Pin No.	Symbol	Signal	Remarks
1	GND	Ground	
2	CLK	Dot clock	
3	Hsync	Horizontal synchronous	
4	Vsync	Vertical synchronous	
5	GND	Ground	
6	R0	Red data (LSB)	Least significant bit
7	R1	Red data	
8	R2	Red data	
9	R3	Red data	
10	R4	Red data	

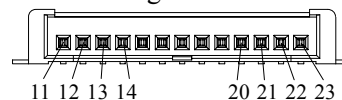
CN1: Figure of socket



CN2 socket (LCD module side): IL-Z-13PL1-SMTY (Japan Aviation Electronics Industry Limited)
 Adaptable plug: IL-Z-13S-S125C3 (Japan Aviation Electronics Industry Limited)

Pin No.	Symbol	Signal	Remarks
11	R5	Red data (MSB)	Most significant bit
12	GND	Ground	-
13	G0	Green data (LSB)	Least significant bit
14	G1	Green data	
15	G2	Green data	
16	G3	Green data	
17	G4	Green data	
18	G5	Green data (MSB)	Most significant bit
19	GND	Ground	-
20	B0	Blue data (LSB)	Least significant bit
21	B1	Blue data	
22	B2	Blue data	
23	B3	Blue data	

CN2: Figure of socket

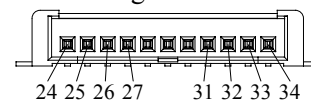


CN3 socket (LCD module side): IL-Z-11PL1-SMTY (Japan Aviation Electronics Industry Limited)
 Adaptable plug: IL-Z-11S-S125C3 (Japan Aviation Electronics Industry Limited)

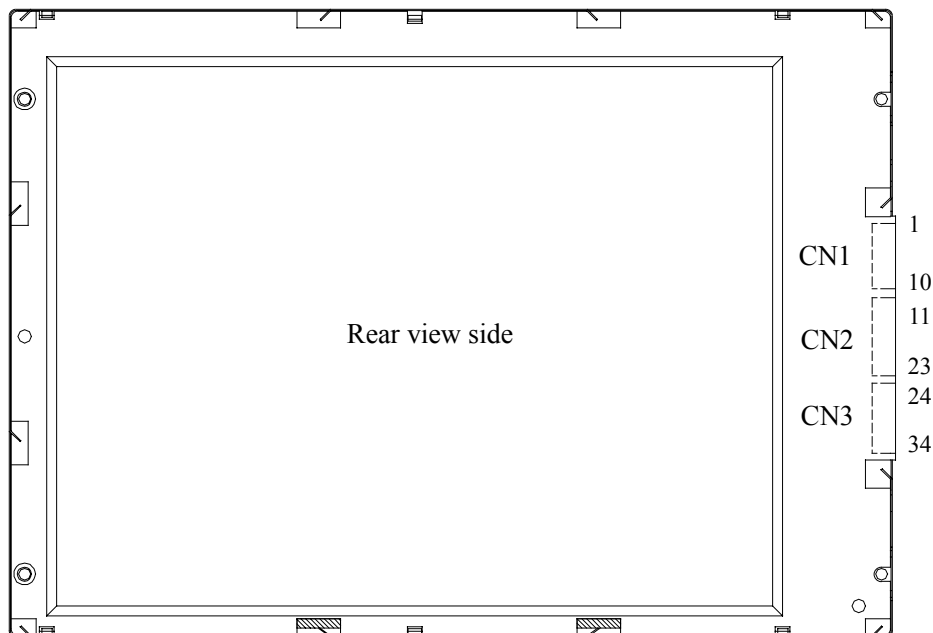
Pin No.	Symbol	Signal	Remarks
24	B4	Blue data	-
25	B5	Blue data (MSB)	Most significant bit
26	GND	Ground	-
27	DE	Data enable	
28	VCC	Power supply	
29	VCC	Power supply	
30	SDM	Select of display mode	DE mode: Low or Open, Fixed mode: High
31	DPSH	Select of scan direction (Horizontal)	Normal scan: Low or Open, Reverse scan: High Note1
32	DPSV	Select of scan direction (Vertical)	
33	G1	Gamma correction	Recommended variable resistance: $2.2k\Omega \pm 5\%$ Do not use "Open" condition!
34	G2	Gamma correction	

Note1: See "4.8 SCANNING DIRECTIONS".

CN3: Figure of socket



4.5.2 Positions of sockets



4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display in equivalent to 262,144 colors in 64 scale. Also the relation between display colors and input data signals is as the following table.

Display colors		Data signal (0: Low level, 1: High level)																	
		R 5	R 4	R 3	R 2	R 1	R 0	G 5	G 4	G 3	G 2	G 1	G 0	B 5	B 4	B 3	B 2	B 1	B 0
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	1	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	1	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 scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	dark	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑				:														
	↓				:														
	bright	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
Green scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	↑				:														
	↓				:														
	bright	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	
	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	
Blue scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
	↑				:														
	↓				:														
	bright	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	1
	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	1	1	1	1	1	1	1	

4.7 DISPLAY POSITIONS

The following table is the coordinates per pixel (See figure of "4.8 SCANNING DIRECTIONS".).

C(0, 0)	C(1, 0)	...	C(X, 0)	...	C(638, 0)	C(639, 0)
C(0, 1)	C(1, 1)	...	C(X, 1)	...	C(638, 1)	C(639, 1)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
C(0, Y)	C(1, Y)	...	C(X, Y)	...	C(638, Y)	C(639, Y)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
C(0,478)	C(1,478)	...	C(X,478)	...	C(638,478)	C(639,478)
C(0,479)	C(1,479)	...	C(X,479)	...	C(638,479)	C(639,479)

4.8 SCANNING DIRECTIONS

The following figures are seen from a front view. Also the arrow shows the direction of scan.

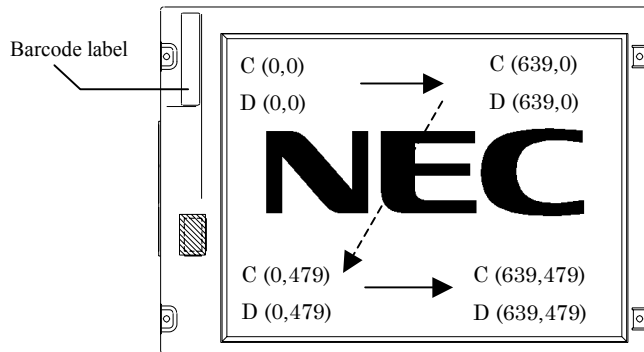


Figure 1. DPSH: Normal scan, DPSV: Normal scan

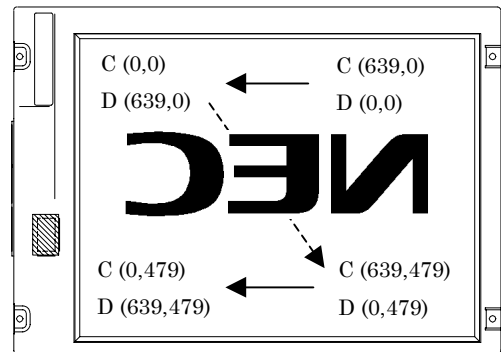


Figure 2. DPSH: Reverse scan, DPSV: Normal scan

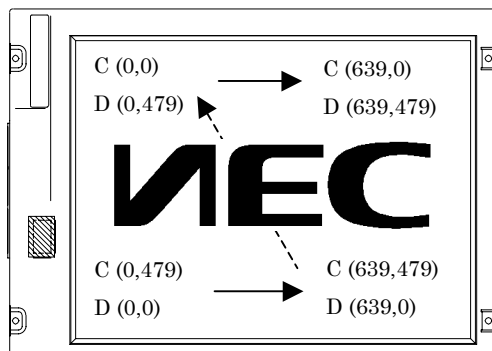


Figure 3. DPSH: Normal scan, DPSV: Reverse scan

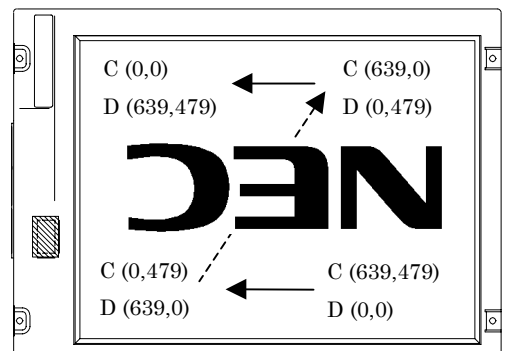


Figure 4. DPSH: Reverse scan, DPSV: Reverse scan

Note1: Meaning of C (X, Y) and D (X, Y)

C (X, Y): The coordinates of the display position (See "4.7 DISPLAY POSITIONS".)

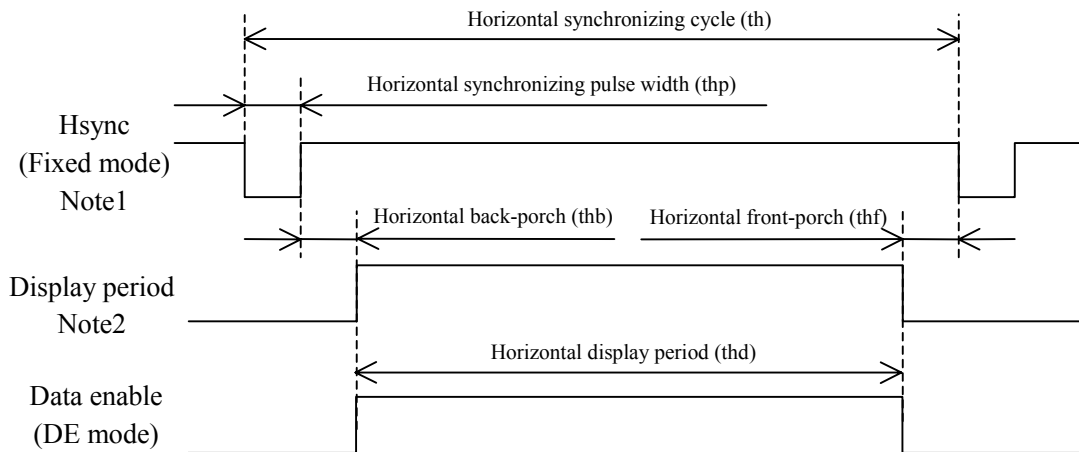
D (X, Y): The data number of input signal for LCD panel signal processing board

Note2: Normal scan: Low or Open, Reverse scan: High

4.9 INPUT SIGNAL TIMINGS FOR LCD PANEL SIGNAL PROCESSING BOARD

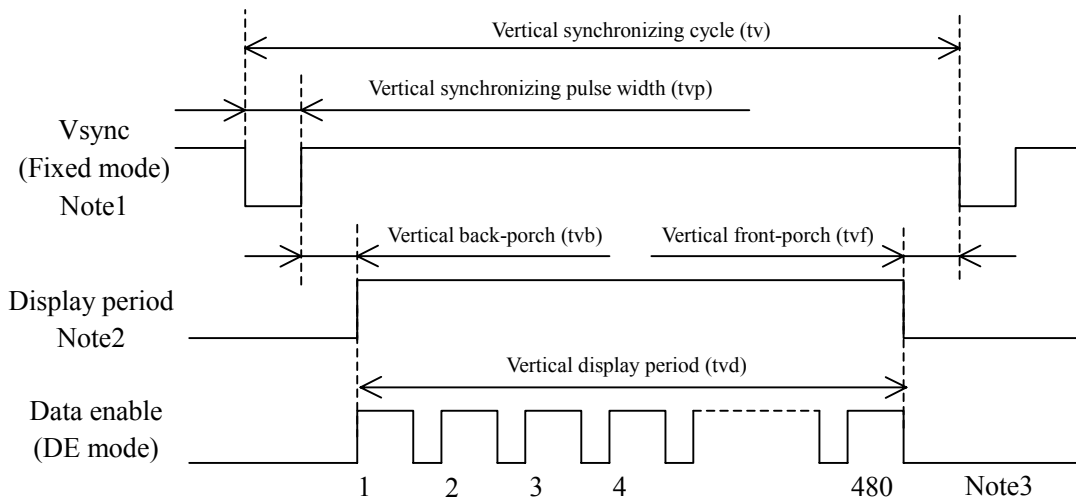
4.9.1 Outline of input signal timings

• Horizontal signal



Note1: Fixed mode cannot be used while working of DE mode.
 Note2: This diagram indicates virtual signal for set up to timing.

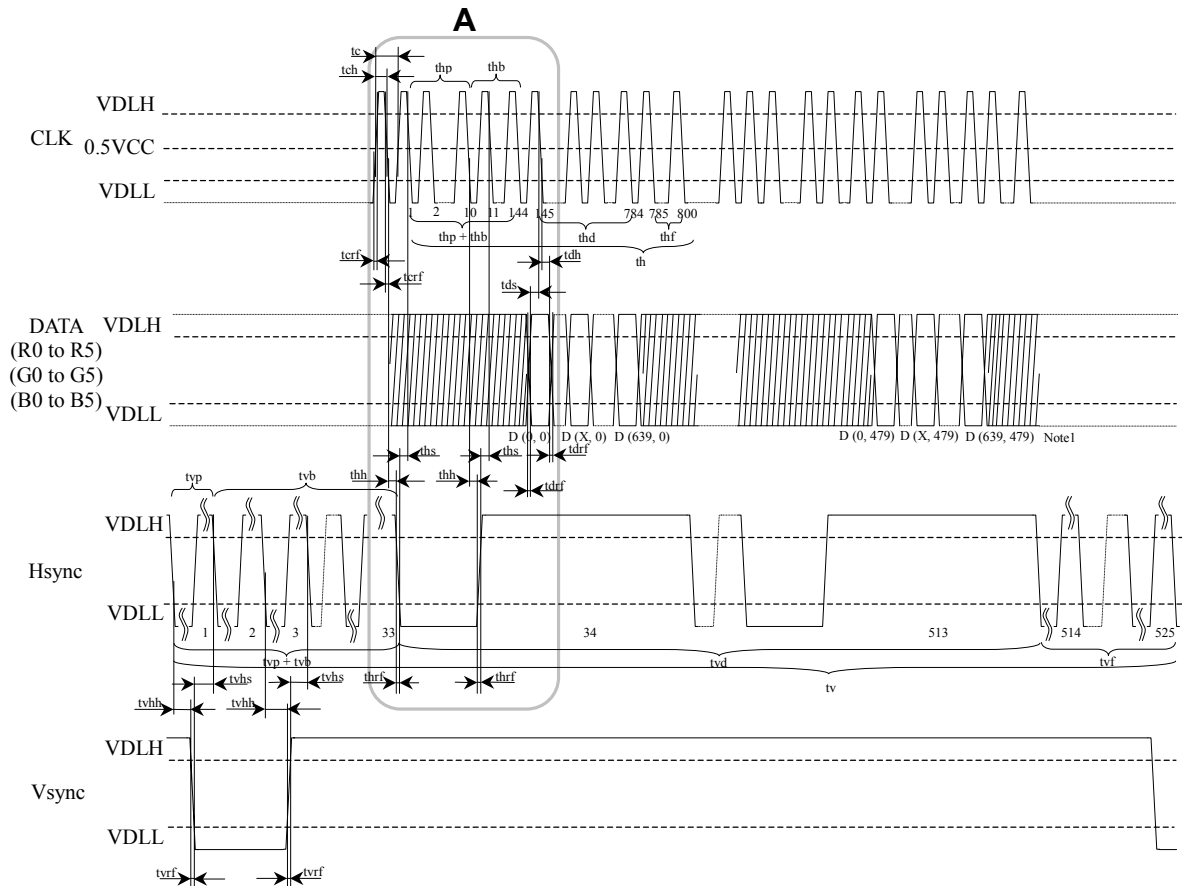
• Vertical signal



Note1: Fixed mode cannot be used while working of DE mode.
 Note2: This diagram indicates virtual signal for set up to timing.
 Note3: See "4.9.2 Detailed input signal timing chart for fixed mode" and "4.9.3 Detailed input signal timing chart for DE mode" for numeration of pulse.

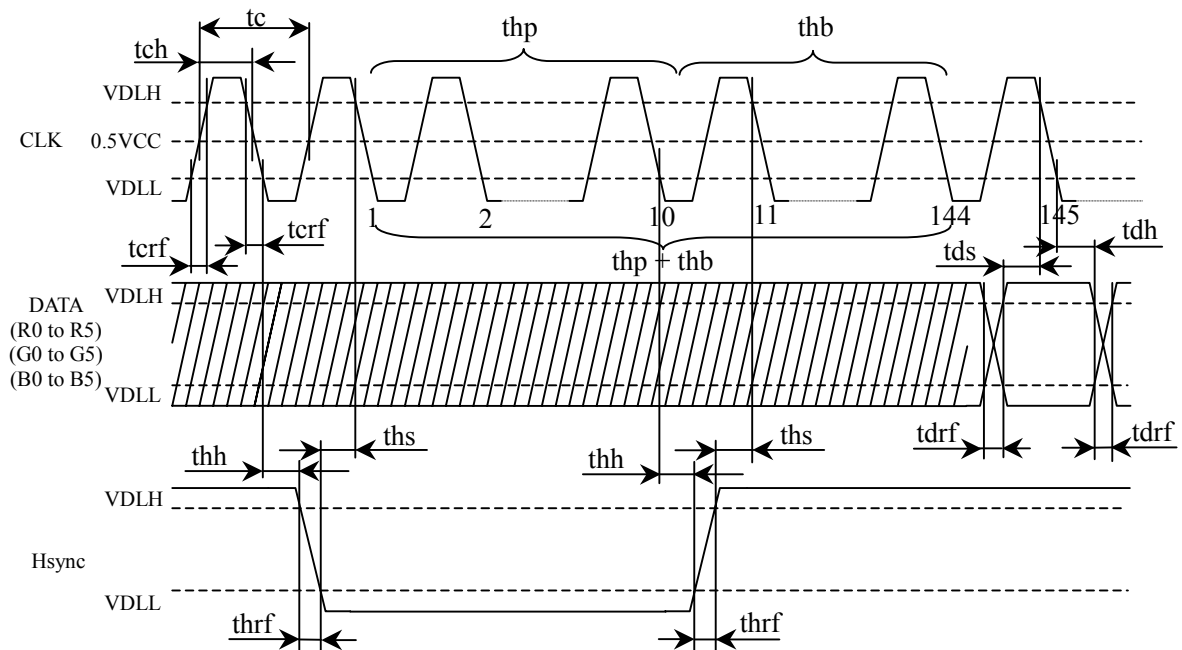
4.9.2 Detailed input signal timing chart for fixed mode

• Outline chart



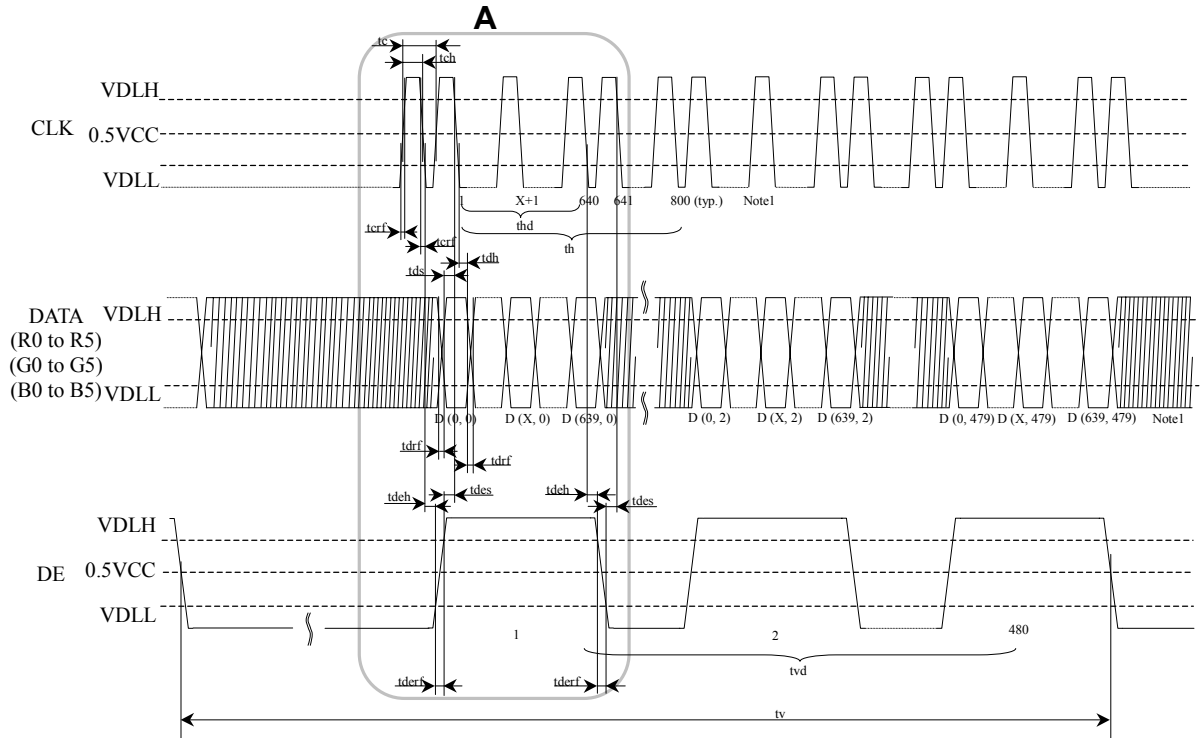
Note1: X is data number from 1 to 638. See "4.8 SCANNING DIRECTIONS".

• Detail of A part



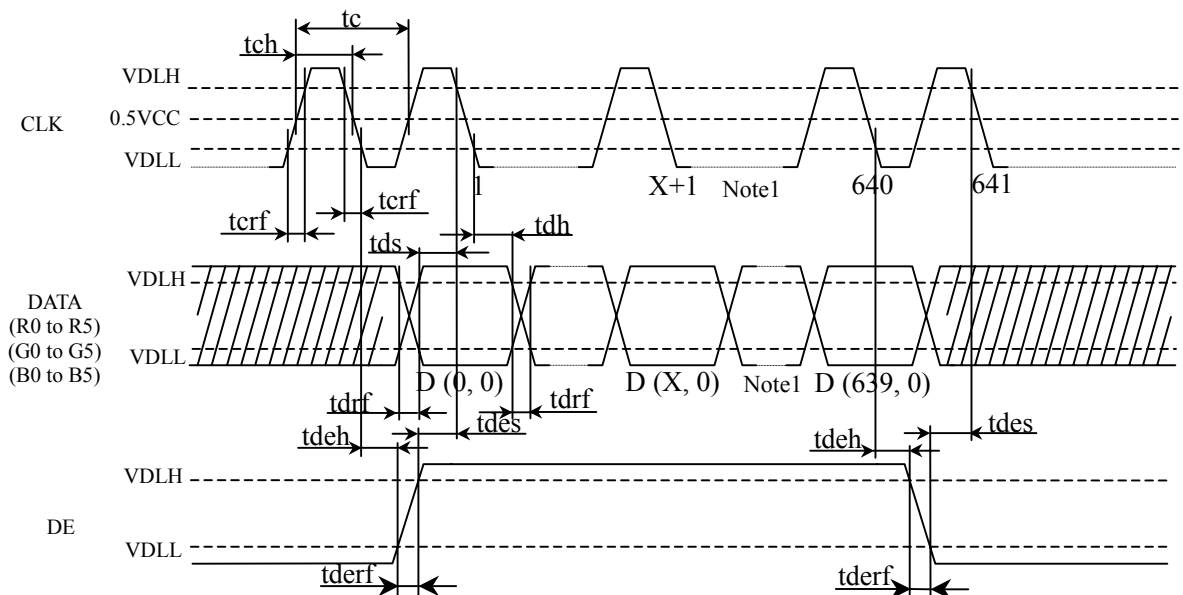
4.9.3 Detailed input signal timing chart for DE mode

- Outline chart



Note1: X is data number from 1 to 638. See "4.8 SCANNING DIRECTIONS".

- Detail of A part



Note1: X is data number from 1 to 638. See "4.8 SCANNING DIRECTIONS".

4.9.4 Timing characteristics

• Common to fixed mode and DE mode

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remarks	
CLK	Frequency	tcf	21.0	25.2	29.0	MHz	39.7 ns (typ.) Note1	
	Duty	tcd	0.4	-	0.6	-	Note1	
	Rise time, Fall time	terf	-	-	10	ns	-	
DATA	CLK-DATA	Setup time	tds	8	-	-		ns
		Hold time	tdh	12	-	-		ns
	Rise time, Fall time	tdrf	-	-	10	ns		

Note1: Definition of parameters is as follows.

$$tcf = 1/tc, tcd = tch/tc = tch \times tcd$$

• Fixed mode

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remarks	
Hsync	Cycle	th	30.0	31.8	33.6	μs	31.4 kHz (typ.)	
			800			CLK	Note1	
	Display period	thd	640			CLK		
	Front-porch	thf	16			CLK		
	Pulse width	thp	10	96	-	CLK		
	Back-porch	thb	-	48	134	CLK		
	Total of pulse width and back-porch	thp + thb	144			CLK		Note1, Note2
	CLK- Hsync	Setup time	ths	8	-	-		ns
Hold time		thh	12	-	-	ns		
	Rise time, Fall time	thrf	-	-	10	ns		
Vsync	Cycle	tv	16.1	16.7	17.2	ms	59.9 Hz (typ.)	
			525			H	Note1	
	Display period	tvd	480			H		
	Front-porch	tvf	12			H		
	Pulse width	tvp	1	-	2	H		
	Back-porch	tvb	31	-	32	H		
	Total of pulse width and back-porch	tvp + tvb	33			H		Note1, Note2
	Vsync-Hsync	Setup time	tvhs	30	-	-		ns
Hold time		tvhh	1	-	-	CLK	-	
	Rise time, Fall time	tvrf	-	-	10	ns		

Note1: Definition of parameters is as follows.

$$tc = 1CLK, th = 1H$$

Note2: Keep tvp + tvb and thp + thb within the table. If it is out of specification, display position will be shifted to right/left side or up/down.

• DE mode

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remarks	
DE	Horizontal	Cycle	th	-	800	-	CLK	Note1
		Display period	thd	640			CLK	
	Vertical (One frame)	Cycle	tv	-	525	-	H	
		Display period	tvd	480			H	
	CLK-DE	Setup time	tdes	8	-	-	ns	-
		Hold time	tdeh	12	-	-	ns	
	Rise time, Fall time	tderf	-	-	10	ns		

Note1: Definition of parameters is as follows.

$$tc = 1CLK, th = 1H$$

4.10 OPTICS

4.10.1 Optical characteristics

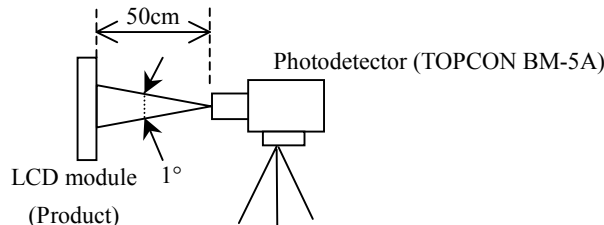
Parameter	Note1	Condition	Symbol	Min.	Typ.	Max.	Unit	Remarks
Contrast ratio		White/Black at center $\theta_R = 0^\circ, \theta_L = 0^\circ, \theta_U = 0^\circ, \theta_D = 0^\circ$	CR	80	150	-	-	Note2
Transmittance		White at center $\theta_R = 0^\circ, \theta_L = 0^\circ, \theta_U = 0^\circ, \theta_D = 0^\circ$	T	5.5	6.0	-	%	-
Transmittance uniformity		-	TU	-	-	1.4	-	Note3
Chromaticity	White	x coordinate	Wx	-	0.321	-	-	Note4
		y coordinate	Wy	-	0.352	-	-	
	Red	x coordinate	Rx	-	0.590	-	-	
		y coordinate	Ry	-	0.356	-	-	
	Green	x coordinate	Gx	-	0.327	-	-	
		y coordinate	Gy	-	0.547	-	-	
Blue	x coordinate	Bx	-	0.164	-	-		
	y coordinate	By	-	0.160	-	-		
Color gamut		$\theta_R = 0^\circ, \theta_L = 0^\circ, \theta_U = 0^\circ, \theta_D = 0^\circ$ at center, against NTSC color space	C	40	42	-	%	
Response time		White to black	Ton	-	15	30	ms	Note5
		Black to white	Toff	-	55	70	ms	Note6
Viewing angle	Right	$\theta_U = 0^\circ, \theta_D = 0^\circ, CR = 10$	θ_R	-	55	-	$^\circ$	Note7
	Left	$\theta_U = 0^\circ, \theta_D = 0^\circ, CR = 10$	θ_L	-	55	-	$^\circ$	
	Up	$\theta_R = 0^\circ, \theta_L = 0^\circ, CR = 10$	θ_U	-	30	-	$^\circ$	
	Down	$\theta_R = 0^\circ, \theta_L = 0^\circ, CR = 10$	θ_D	-	50	-	$^\circ$	
Gamma level		RG = 0Ω	γ_0	-	0.5	-	-	Note8
		RG = 2kΩ	γ_2	-	4.6	-	-	

Note1: Measurement conditions are as follows. However, RG of gamma level is option.

Ta = 25°C, VCC = 5.0V, DPSH = Low, DPSV: Low, RG = 820Ω,

Backlight (Color temperature: 6,000K, Luminance: 1,500cd/m², Wx: 0.320, Wy: 0.325)

Optical characteristics are measured at luminance saturation after 20minutes from working the product, in the dark room. Also measurement method for luminance is as follows.



Note2: See "4.10.2 Definition of contrast ratio".

Note3: See "4.10.3 Definition of transmittance uniformity".

Note4: These coordinates are found on CIE 1931 chromaticity diagram.

Note5: Product surface temperature: TopF = 25°C

Note6: See "4.10.4 Definition of response times".

Note7: See "4.10.5 Definition of viewing angles".

Note8: See "4.10.6 Gamma curves".

4.10.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

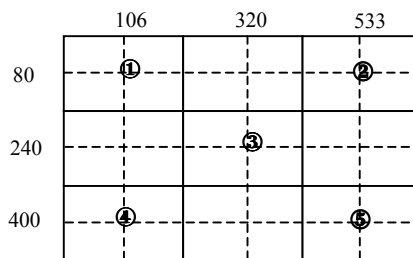
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.10.3 Definition of transmittance uniformity

The transmittance uniformity is calculated by using following formula.

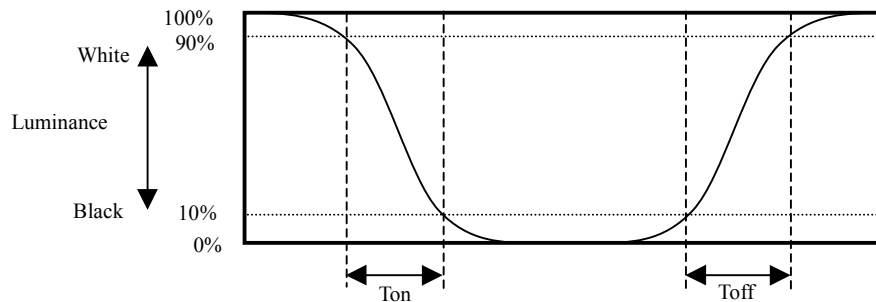
$$\text{Transmittance uniformity (TU)} = \frac{\text{Maximum transmittance from ① to ⑤}}{\text{Minimum transmittance from ① to ⑤}}$$

The transmittance is measured at near the 5 points shown below.

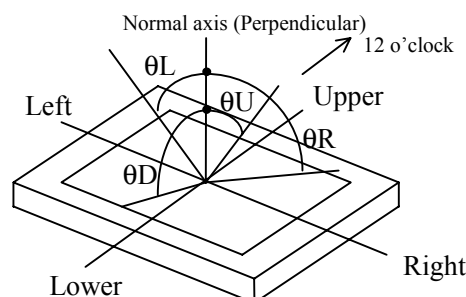


4.10.4 Definition of response times

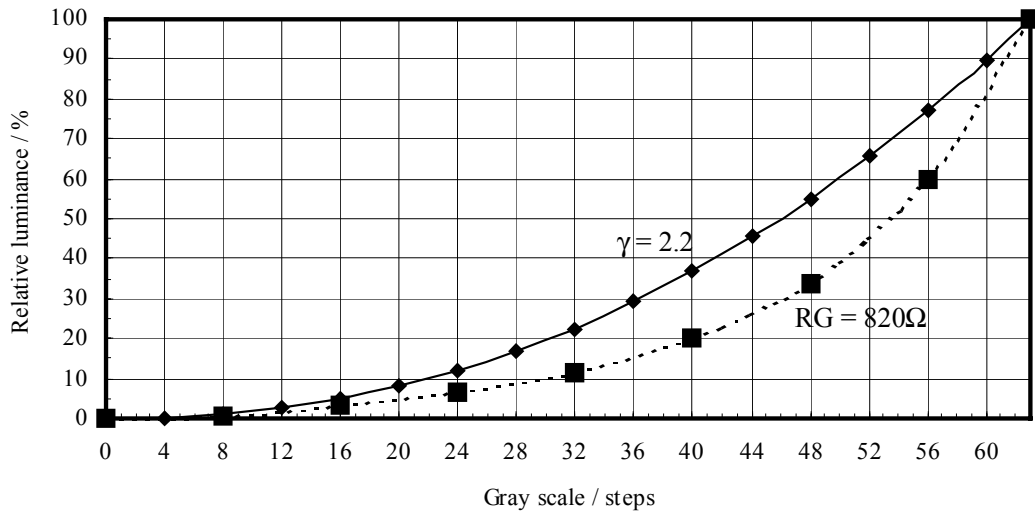
Response time is measured, the luminance changes from "white" to "black", or "black" to "white" on the same screen point, by photo-detector. Ton is the time it takes the luminance change from 90% down to 10%. Also Toff is the time it takes the luminance change from 10% up to 90% (See the following diagram.).



4.10.5 Definition of viewing angles



4.10.6 Gamma curves



4.10.7 Photoabsorbed axis of polarizer

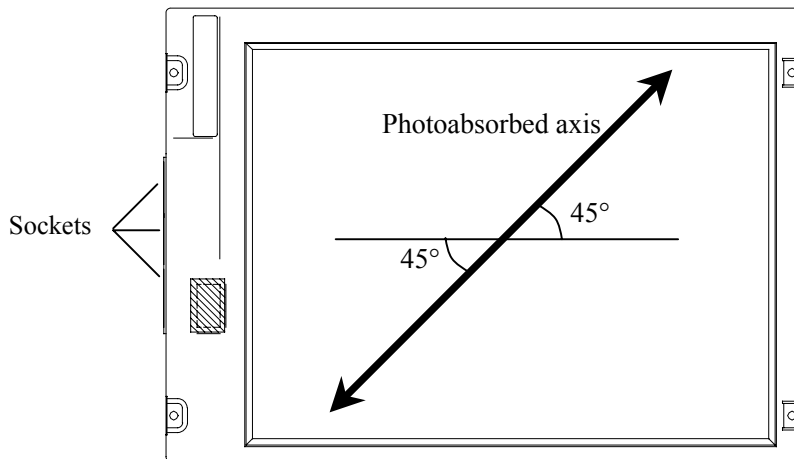


Figure 1. Front view

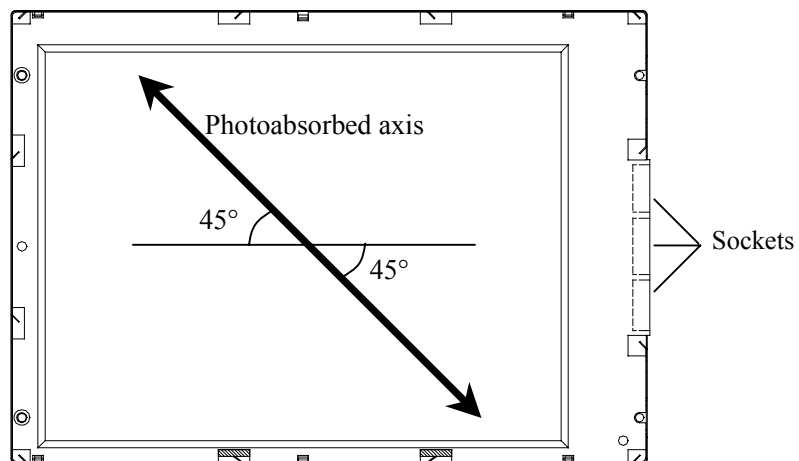


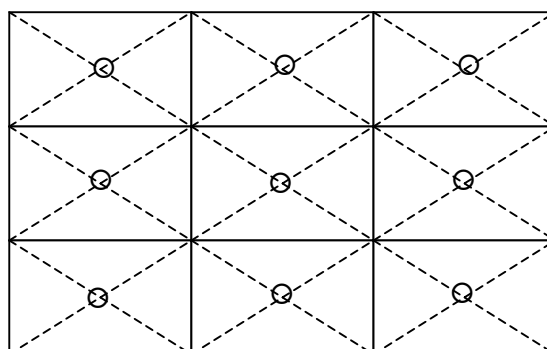
Figure 2. Rear view

5. RELIABILITY TESTS

Test item	Condition	Judgement
High temperature and humidity (Operation)	① $65 \pm 2^{\circ}\text{C}$, RH = 85%, 240hours ② Display data is black.	No display malfunctions Note1
High temperature (Operation)	① $85 \pm 3^{\circ}\text{C}$, 240hours ② Display data is black.	
Heat cycle (Operation)	① $-25 \pm 3^{\circ}\text{C}$...1hour $85 \pm 3^{\circ}\text{C}$...1hour ② 50cycles, 5hours/cycle ③ Display data is black.	
Thermal shock (Non operation)	① $-30 \pm 3^{\circ}\text{C}$...30minutes $85 \pm 3^{\circ}\text{C}$...30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.	
ESD (Operation)	① 150pF, 150Ω, $\pm 10\text{kV}$ ② 9 places on a panel surface Note2 ③ 10 times each places at 1 sec interval	
Vibration (Non operation)	① 5 to 100Hz, 19.6m/s^2 ② 1 minute/cycle ③ X, Y, Z direction ④ 120 times each directions	No display malfunctions Note1 No physical damages
Mechanical shock (Non operation)	① 490m/s^2 , 11ms ② $\pm X, \pm Y, \pm Z$ direction ③ 5 times each directions	

Note1: Display functions are checked under the same conditions as product inspection.

Note2: See the following figure for discharge points.




6. PRECAUTIONS

6.1 MEANING OF CAUTION SIGNS

The following caution signs have very important meaning. **Be sure to read "6.2 CAUTIONS", after understanding this contents!**

	This sign has the meaning that customer will be injured by himself, if customer has wrong operations.
---	---

6.2 CAUTIONS

	<p>Do not shock and press the LCD panel! Danger of breaking, because they are made of glass. (Shock: To be not greater 490m/s² and to be not greater 11ms, Pressure: To be not greater 19.6N)</p>
---	---

6.3 ATTENTIONS

6.3.1 Handling of the product

- ① Take hold of both ends without touch the circuit board when customer pulls out products (LCD modules) from inner packing box. If customer touches it, products may be broken down or out of adjustment, because of stress to mounting parts.
- ② Do not put on too much stress for the interface connectors on the circuit board.
- ③ Do not hook cables nor pull connection cables such as flexible cable and so on, for fear of damage.
- ④ If customer puts down the product temporarily, the product puts on flat subsoil as a display side turns down.
- ⑤ Take the measures of electrostatic discharge such as earth band, ionic shower and so on, when customer deals with the product, because products may be damaged by electrostatic.
- ⑥ The torque for mounting screws must never exceed 0.29N·m. Higher torque values might result in distortion of the bezel.
- ⑦ Do not press or rub on the sensitive display surface. If customer clean on the panel surface, NEC Corporation recommends using the cloth with ethanolic liquid such as screen cleaner for LCD.
- ⑧ Do not push-pull the interface connectors while the product is working, because wrong power sequence may break down the product.

6.3.2 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 in high magnetic field. Circuit boards may be broken down by it.
- ③ Use an original protection sheet on the product surface (polarizer). Adhesive type protection sheet should be avoided, because it may change color or properties of the polarizer.

6.3.3 Characteristics

The following items are neither defects nor failures.

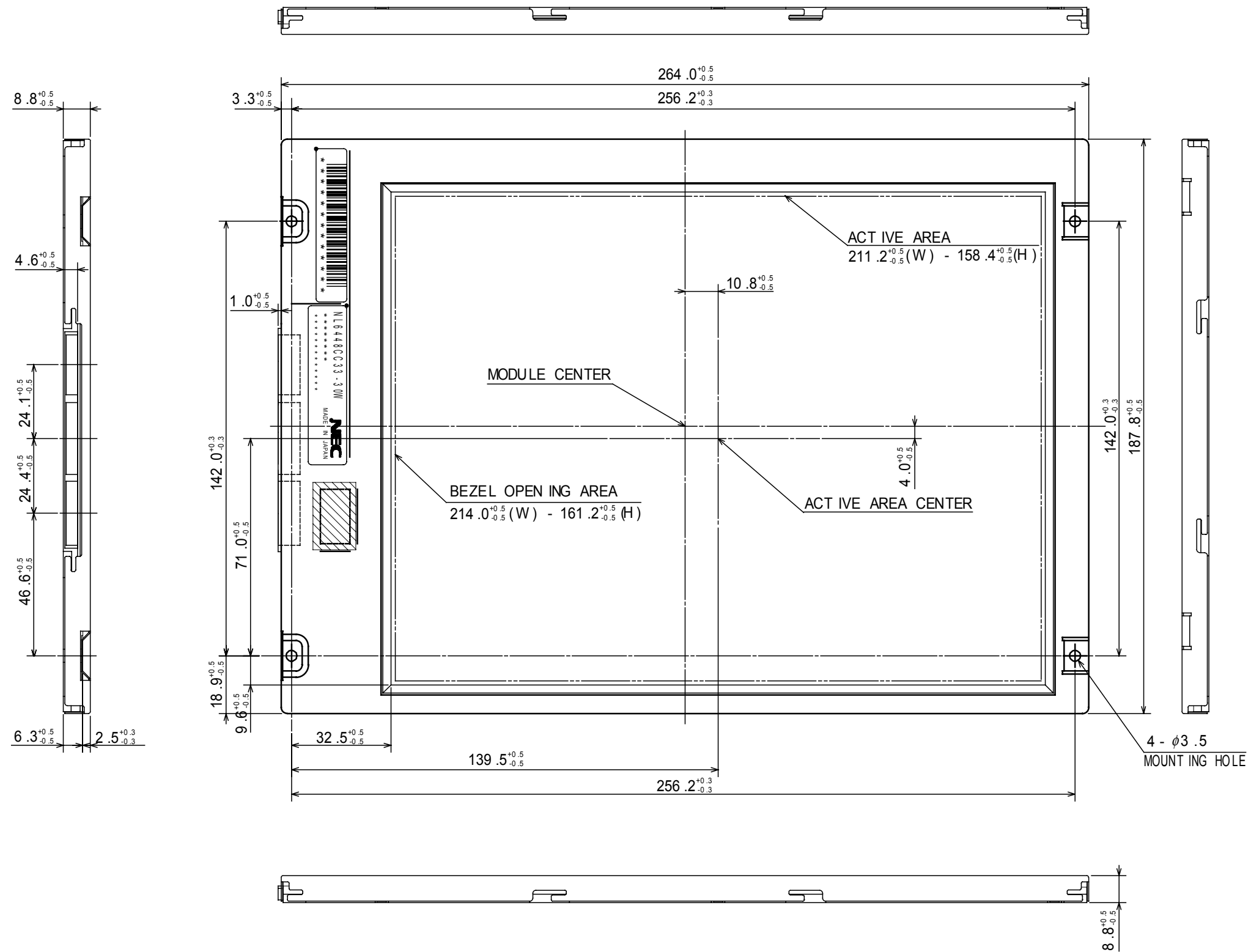
- ① Response time, luminance and color may be changed by ambient temperature.
- ② The LCD may be seemed luminance non-uniformity, flicker, vertical seam or small spot by display patterns.
- ③ Do not display the fixed pattern for a long time because it may cause image sticking. Use a screen saver, if the fixed pattern is displayed on the screen.
- ④ Optical characteristics may be changed by input signal timings.
- ⑤ The interference noise of input signal frequency for this product's signal processing board and luminance control frequency of customer's backlight inverter may appear on a display. Set up luminance control frequency of backlight inverter so that the interference noise does not appear.

6.3.4 Other

- ① All GND, backlight inverter ground (GNDB), VCC and backlight inverter power supply voltage (VDDDB) terminals should be used without a non-connected line.
- ② Do not disassemble a product or adjust volume without permission of NEC Corporation.
- ③ Pay attention not to insert waste materials inside of products, if customer uses screwnails.

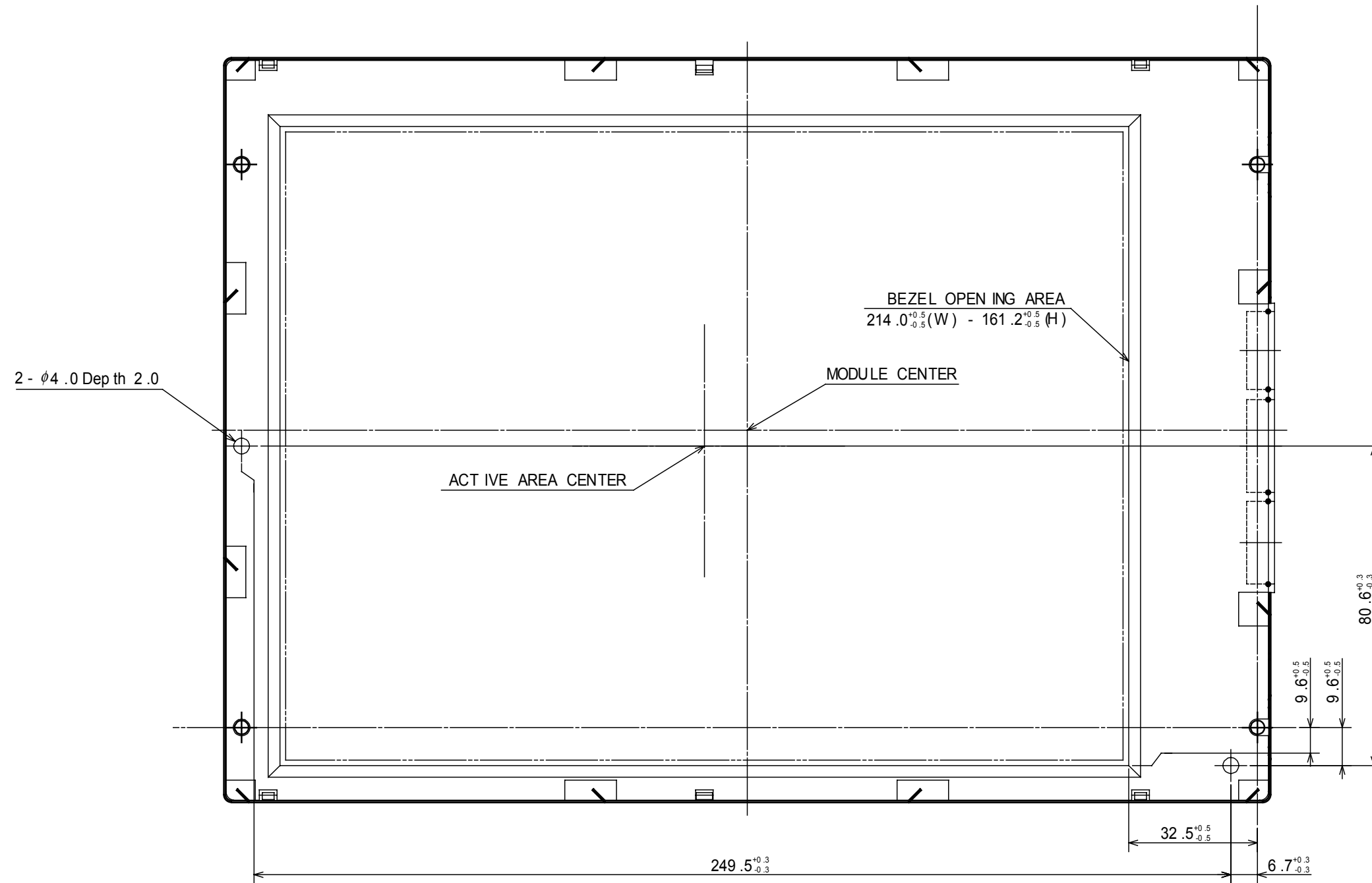
7. OUTLINE DRAWINGS

7.1 FRONT VIEW



Unit: mm

7.2 REAR VIEW



Unit: mm