NEC

TFT COLOR LCD MODULE

NL4823HC37-03

18cm (7.0 Type)
WQVGA

DATA SHEET

(1st edition)

All information is subject to change without notice.
Please confirm the delivery specification before starting to design your system.

Document Number: DOD-M-1291 (1st edition)
Published date: December. 2002 CP(N)

INTRODUCTION

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

1. OUTLINE

1.1 STRUCTURE AND PRINCIPLE

NL4823HC37-03 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.

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

- Entertainment equipment for automobile
- Display terminal for control system

1.3 FEATURES

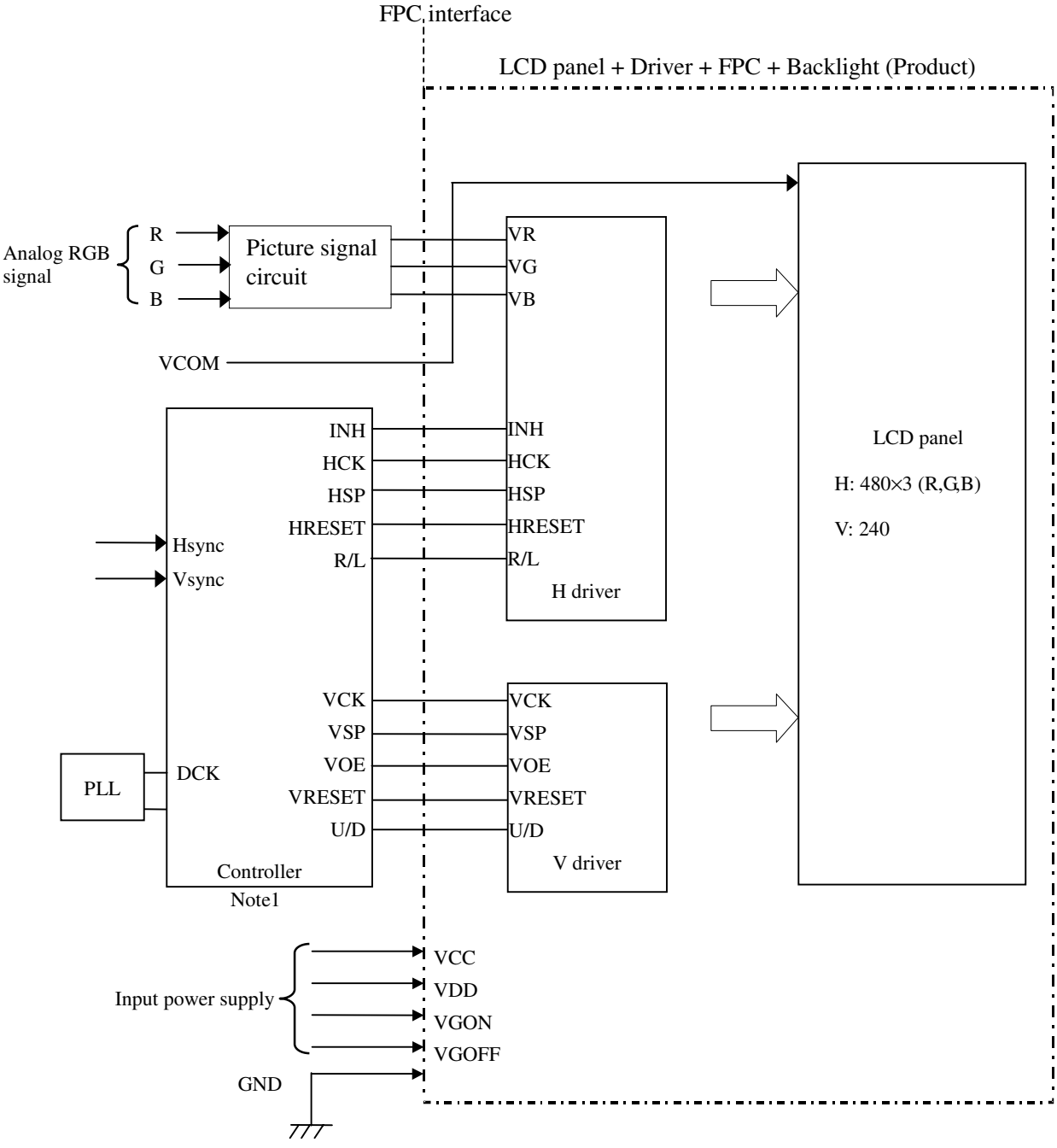
- High luminance
- Wide viewing angle
- High contrast
- Wide temperature range
- Analog RGB interface (Driver interface)
- Edge light type backlight (Inverter less) **Note1**

Note1: Backlight is not replaceable by customers.

2. GENERAL SPECIFICATIONS

Display area	154.08 (W) × 87.05 (H) mm (typ.)
Diagonal size of display	18.0 cm (7.0 inches)
Drive system	a-Si TFT active matrix
Display color	Full color
Display type	Normally black
Pixel	480 (H) × 234 (V) pixels
Pixel arrangement	RGB (Red dot, Green dot, Blue dot) vertical stripe
Dot pitch	0.107 (W) × 0.372 (H) mm
Pixel pitch	0.372 (W) × 0.372 (H) mm
Module size	170.0 (W) × 104.0 (H) × 8.0 (D) mm (typ.)
Weight	180 g (typ.)
Contrast ratio	300:1 (typ.)
Viewing angle	*At the contrast ratio 10:1* • Horizontal: Right side 85° (typ.), Left side 85° (typ.) • Vertical: Up side 85° (typ.), Down side 85° (typ.)
Designed viewing direction	Viewing angle with optimum grayscale (γ=2.2): normal axis
Polarizer surface	Low reflection
Polarizer pencil-hardness	3H (min.) [by JIS K5400]
Color gamut	*At LCD panel center* 40 % (typ.) [against NTSC color space]
Response time	*Ton (black 10% to white 90%)* 38 ms (typ.) *Toff (white 90% to black 10%)* 27 ms (typ.)
Luminance	*At IBL=4.0mArms / lamp* 450 cd/m^2 (typ.)
Signal system	Driver interface Analog RGB signals (VR,VG,VB) Common electrode voltage (VCOM) Horizontal –driver (H-driver) clock (HCK) Horizontal -driver (H-driver) start pulse (HSP) Horizontal -driver (H-driver) reset signal (HRESET) Inhibit signal (INH) Data inversion signal for vertical (D/U) Vertical-driver (V-driver) clock (VCK) Vertical-driver (V-driver) start pulse (VSP) Vertical-driver (V-driver) reset signal (VRESET) Vertical driver (V-driver) output enable signal (VOE) Data inversion signal for horizontal (R/L)
Power supply voltage	VCC= 5.0V (Logic) VDD= 5.4V (LCD driver) VGON= +15V(LCD panel driving) VGOFF= -14V(LCD panel driving)
Backlight	Edge light type ("U" character form): 1 cold cathode fluorescent lamp
Power consumption	*At IBL=4.0mArms / lamp and checkered flag pattern* 5.3W (typ.)

3. BLOCK DIAGRAM



Note1: Recommendation controller "70IC01 A"
Refer to the controller specifications for input signal timings.

Note2: GND (Signal ground) is not connected to FG (Frame ground). These grounds should be connected together in customer equipment.

4. DETAILED SPECIFICATIONS

4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification	Unit
Module size	170.0 ± 0.5 (W) × 104.0 ± 0.5 (H) × 8.0 ± 0.5 (D) Note1 13.2 ± 0.5 (D) Note2	mm
Display area	154.08 (W) × 87.05 (H) Note1	mm
Weight	180 (typ.) 190 (max.)	g

Note1: See "**7. OUTLINE DRAWINGS**".
Note2: Pole for product mounting is included.

4.2 ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Rating	Unit	Remarks
Power supply (1)	For H-driver	VDD	-0.5 to +6.0	V	Ta = 25°C
Power supply (2)	For logic	VCC	-0.5 to +6.0	V	
Power supply (3)	V-driver ON voltage	VGON	-0.3 to +30	V	
Power supply (4)	V-driver OFF voltage	VGOFF	+0.3 to -20	V	
Power supply (3)-Power supply (4)	V-driver ON-OFF voltage	-	+15 to +40	V	
Common electrode voltage		VCOM	-5 to +12	V	
Analog RGB input voltage		VR,VG,VB	-0.5 to VDD+0.5	V	
Control signals		VI	-0.5 to VCC+0.5	V	Ta = 25°C Note1
Lamp voltage		VBLH	2,300	Vrms	Ta = 25°C
Storage temperature		Tst	-20 to +80	°C	-
Operating temperature	Front surface	TopF	-10 to +70	°C	Note2, Note4
	Rear surface	TopR	-10 to +80	°C	Note3, Note4
Relative humidity Note5		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 Note5		AH	≤ 411 Note6	g/m^3	Ta > 60°C

Note1: Control signals are HCK, HSP1, HSP2, HRESET, INH, D/U, VCK, VSP1, VSP2, VRESET, VOE and R/L.
Note2: Measured at center of LCD panel surface (including self-heat)
Note3: Measured at center of LCD module's rear shield surface (including self-heat)
Note4: It is the temperature which guarantees operation without the remarkable abnormalities in a display, and judges at Ta=25 °C about contrast ratio, response time, and other characteristics.
Note5: No condensation
Note6: Ta = 60°C, RH = 90%

4.3 ELECTRICAL CHARACTERISTICS

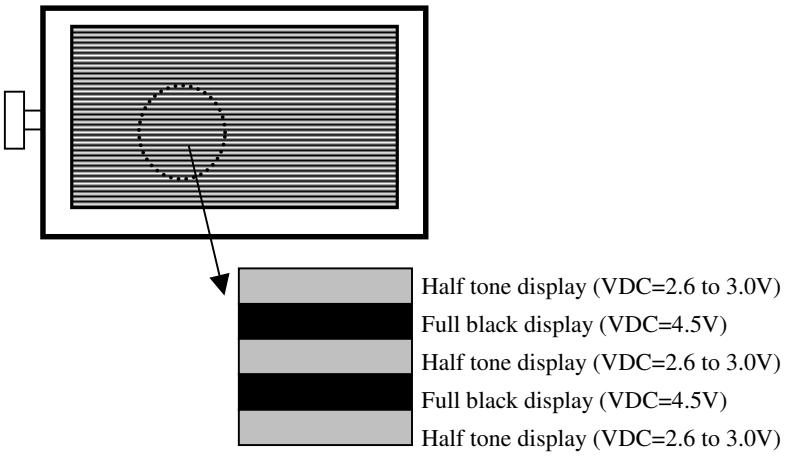
4.3.1 Driving for LCD panel

(Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Power supply (1)	VDD	5.3	5.4	5.5	V	Note1
	IDD	-	25	60	mA	at VDD=5.4V Note2
Power supply (2)	VCC	4.5	5.0	5.5	V	-
	ICC	-	2.5	5.0	mA	at VCC=5.0V Note2
Power supply (3)	VGON	14.5	15.0	15.5	V	-
	IGON	-	0.3	1.0	mA	at VGON=15.0V Note2
Power supply (4)	VGOFF	-14.5	-14.0	-13.5	V	-
	IGOFF	-	1.0	2.0	mA	at VGOFF=-14.0V Note2
Analog RGB signals	VR,VG,VB	GND+0.15	-	VDD-0.15	V	-
Amplitude of Analog RGB signals	VDp-p	(3.9)	4.0	(4.1)	V	See 4.8.2
Difference voltage between VCOM and VR,VG,VB	VDC	(0.5)	-	(4.5)	V	See 4.8.3
Control signals	VIL	0	-	0.3 VCC	V	Note3
	VIH	0.7 VCC	-	VCC		
Common electrode voltage amplitude	VCOMp-p	(4.9)	5.0	(5.1)	V	See 4.8.2
Common electrode offset voltage	Vc	0	-	2.9	V	Note4, Note5

Note1: If the power supply ripple voltage is large, there might be noise on the display image. Evaluate the display image sufficiently, when the power supply is designed.
Note2: Checkered flag pattern [by EIAJ ED-2522]
Note3: Control signals are HCK, HSP1, HSP2, HRESET, INH, D/U, VCK, VSP1, VSP2, VRESET, VOE and R/L.
Note4: Vc is voltage value to offset the difference between VCOMp-p center and VDp-p center.
Note5: Adjusting of Vc (See "**4.8.3 Relation between relative luminance and VDC**".)
Looking at the display, adjust Vc to become a minimum point of the flicker on the display.
Optimal value of Vc is different with each product.

Recommendation adjustment display



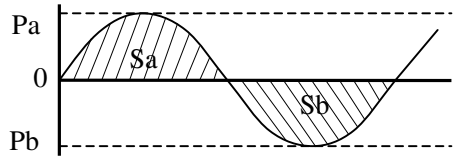
4.3.2 Working for backlight lamp

(Ta=25°C Note1)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Lamp current	IBL	2.0	4.0	6.0	mArms	at IBL=4.0mArms: 450cd/m^2 Note3, Note4
Lamp voltage	VBLH	-	880	-	Vrms	at IBL=4.0mArms Note2, Note3
Lamp starting voltage	VS	1410	-	-	Vrms	Ta = 25°C Note2, Note3
		1800	-	-	Vrms	Ta = -30°C Note2, Note3
Oscillation frequency	FO	40	-	60	kHz	Note5

Note1: The lamp voltage cycle between lamps should be kept on a same phase. "VS" and "VBLH" are the voltage value between low voltage side (Cold) and high voltage side (Hot).

Note2: The asymmetric ratio of working waveform for lamps (Lamp voltage peak ratio, Lamp current peak ratio and waveform space ratio) should be less than 5 % (See the following figure.). If the waveform is asymmetric, DC (Direct current) element apply into the lamp. In this case, a lamp lifetime may be shortened, because a distribution of a lamp enclosure substance inclines toward one side between low voltage terminal (Cold terminal) and high voltage terminal (Hot terminal).



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

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

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

Note3: In case "FO" is not the recommended value, beat noise may display on the screen, because of interference between "FO" and "FHCK". Recommended value of "FO" is as following.

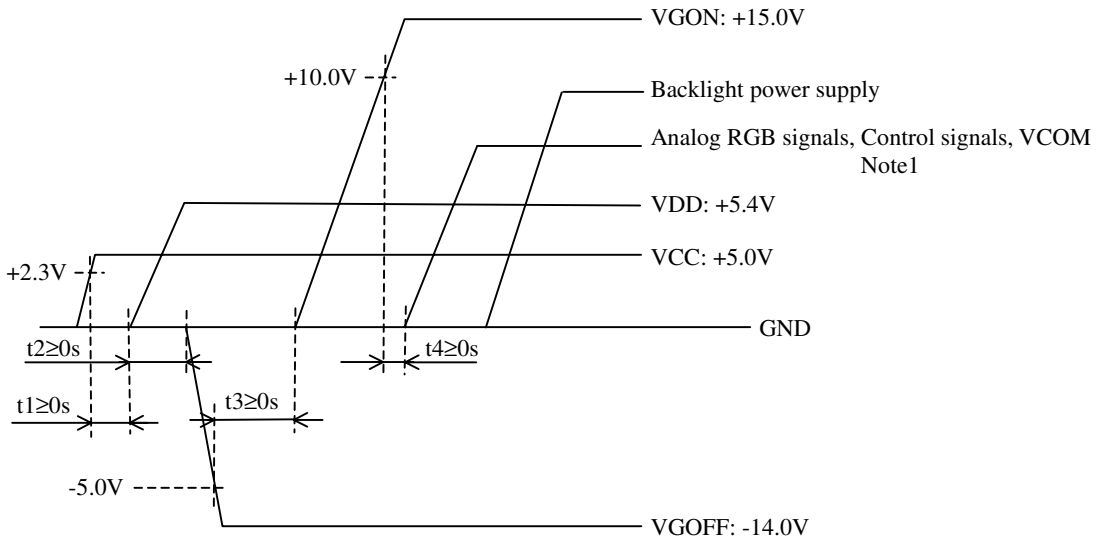
$$FO = \frac{1}{4} \times FHCK \times (2n-1)$$

FHCK: H-driver clock frequency
n: Natural number (1, 2, 3 ·····)

Note4: Method of lamp cable installation may invite fluctuation of lamp current and voltage or asymmetric of lamp working waveform. When design the backlight inverter, evaluate the fluctuation of lamp current and voltage or asymmetric of lamp working waveform sufficiently.

Note5: This product designed only for single transformer type inverter.

4.4 POWER SUPPLY VOLTAGE SEQUENCE



Note1: Control signals are HCK, HSP1, HSP2, HRESET, INH, D/U, VCK, VSP1, VSP2, VRESET, VOE and R/L.

Note2: The power start sequence must be followed above sequence diagram. To shut down, follow above sequence inversely or disconnect all at the same time. Otherwise, internal circuits are damaged.

Note3: VREST must be Low, at the time of inputting VCC, VDD, VGOFF and VGON.
If VRSET is High or floating level at the time of inputting VCC, VDD, VGOFF and VGON, overcurrent may flow. in internal circuits.

Note4: Power supply voltage sequence should be evaluated with connecting the product.

Note5: The backlight power supply should be inputted following above sequence diagram, in order to avoid unstable data display.

Note6: When inputting power supply, do not exceed rating value by overshoot and spike noise. (See "**4.3.1 Driving for LCD panel**".)

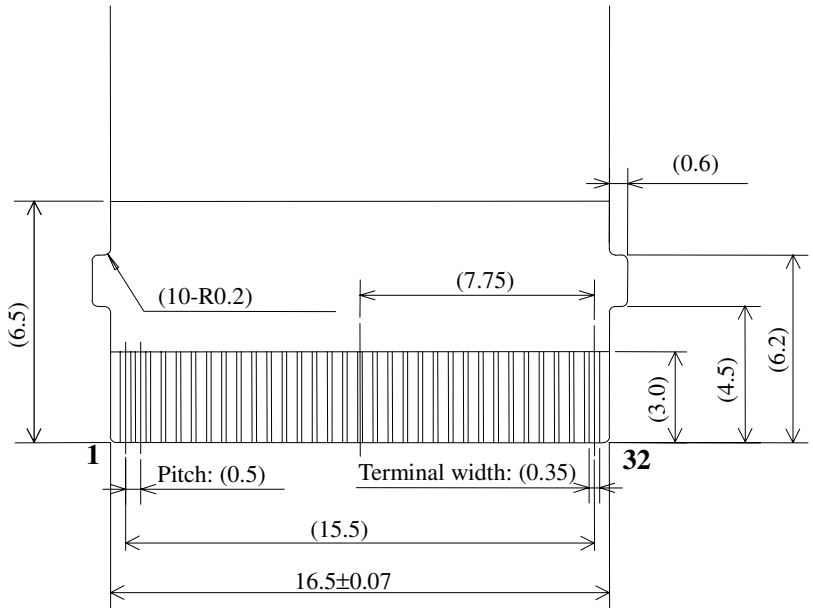
4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

4.5.1 LCD panel driving

CN1 (FPC)
Adaptable plug: IL-FHR-F32S-HF (Japan Aviation Electronics Industry Limited (JAE))

Pin No.	Symbol	I/O	Signal	Remarks
1	VGON	-	V-driver ON voltage	+15V power supply
2	VRESET	I	V-driver reset signal	High: Normal operation Low: Reset data in all shift registers
3	VSP2	I/O	V-driver start pulse 2	At D/U= High: Input terminal of start pulse At D/U= Low: Start pulse is output.
4	N.C.	-	-	-
5	VOE	I	V-driver output enable signal	High: VGOFF level is output. Low: Normal output
6	D/U	I	Data inversion signal for vertical	High: Inversion display for vertical Low: Normal display
7	VSP1	I/O	V-driver start pulse 1	At D/U= High: Start pulse is output. At D/U= Low: Input terminal of start pulse
8	VCK	I	V-driver shift clock	-
9	VCC	-	Power supply for logic	+5V power supply
10	N.C.	-	-	-
11	N.C.			
12	GND	-	-	-
13	N.C.	-	-	-
14	N.C.			
15	VGOFF	-	V-driver OFF voltage	-14V power supply
16	VCOM	-	Common electrode voltage	-
17	GND	-	-	-
18	HCK	I	H-driver shift clock	-
19	HSP2	I/O	H-driver start pulse 2	At R/L= High: Input terminal of start pulse At R/L = Low: Start pulse is output.
20	INH	I	Inhibit signal	-
21	HRESET	I	H-driver reset signal	High: Reset data in all shift registers Low: Normal operation
22	R/L	I	Data inversion signal for horizontal	High: Normal display Low: Inversion display for horizontal
23	HSP1	I/O	H-driver start pulse 1	At R/L= High: Start pulse is output. At R/L = Low: Input terminal of start pulse
24	GND	-	-	-
25	VB	I	Blue data signal	-
26	VG	I	Green data signal	-
27	VR	I	Red data signal	-
28	GND	-	-	-
29	VDD	-	Power supply for H-driver	+5.4V power supply
30	VDD			
31	VCC	-	Power supply for logic	+5V power supply
32	VCC			

FPC detail (Unit: mm)



Note1: The values in parentheses are for reference.
Note2: Thickness of connector insert portion is 0.3±0.05mm.

4.5.2 Backlight lamp

Attention: VBLH and VBLC must be connected correctly. If customer connects wrongly, customer will be hurt and the module will be broken.

CN2 plug (product side): BHR-02(8.0)VS-1N (J.S.T Mfg. Co., Ltd.)
Adaptable socket: SM02(8.0)B-BHS-1 (J.S.T Mfg. Co., Ltd.)
SM02(8.0)B-BHS (J.S.T Mfg. Co., Ltd.)
SM02(8.0)B-BHS-1N (J.S.T Mfg. Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	VBLH	High voltage (Hot)	Cable color: Pink
2	VBLC	Low voltage (Cold)	Cable color: White

4.6 DISPLAY POSITIONS

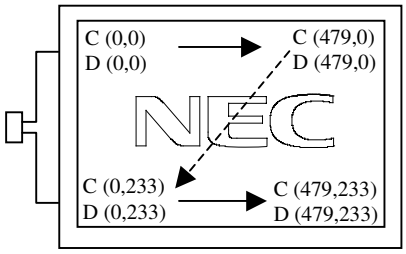
The following table is the coordinates per pixel (See figure of "**4.7 SCANNING DIRECTION**".).

C(0, 0)	C(1, 0)	•••	C(X, 0)	•••	C(478, 0)	C(479, 0)
C(0, 1)	C(1, 1)	•••	C(X, 1)	•••	C(478, 1)	C(479, 1)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
C(0, Y)	C(1, Y)	•••	C(X, Y)	•••	C(478, Y)	C(479, Y)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
C(0,232)	C(1,232)	•••	C(X,232)	•••	C(478,232)	C(479,232)
C(0,233)	C(1,233)	•••	C(X,233)	•••	C(478,233)	C(479,233)

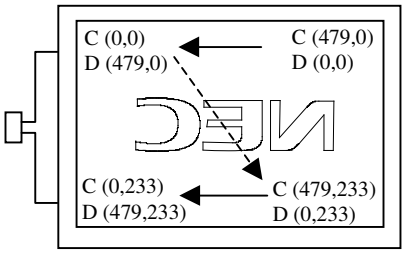
4.7 SCANNING DIRECTIONS

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

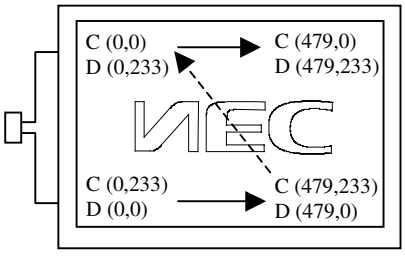
D/U= Low, R/L= High



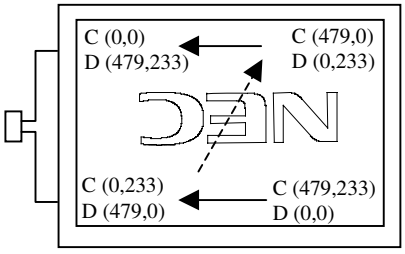
D/U= Low, R/L= Low



D/U= High, R/L= High



D/U= High, R/L= Low



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

C (X, Y): The coordinates of the display position (See "**4.6 DISPLAY POSITIONS**".)

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

4.8 INPUT SIGNAL TIMINGS

4.8.1 Timing characteristics

(Note1)

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remarks
INH	Period	TH	-	63.56	-	μs	1/TH=fH=15.734kHz Typ.
	Pulse width	tINH	5	6	-	HCK	-
HSP	Period	TH	-	63.56	-	μs	-
	Pulse width	TSTH	-	1	-	HCK	-
	Hi pulse width	thss	8	-	-	ns	-
	Low pulse width	shsh	8	-	-	ns	-
HCK	Frequency	FHCK	-	9.566	-	MHz	1/FHCK=104.54ns Typ.
	Hi pulse width	tHCH	33	-	-	ns	-
	Low pulse width	tHCL	33	-	-	ns	-
HRESET	Pulse width	tHRST	66	-	-	ns	-
VSP	Period	TV	-	16.68	-	ms	1/TV=fV=59.94Hz Typ.
	Pulse width	TVSP	-	63.56	-	μs	-
VCK	Frequency	FVCK	-	15.734	-	kHz	1/FVCK=63.56μs Typ.
	Hi pulse width	tVCH	0.9	-	-	ms	-
	Low pulse width	tVCL	0.9	-	-	ms	-

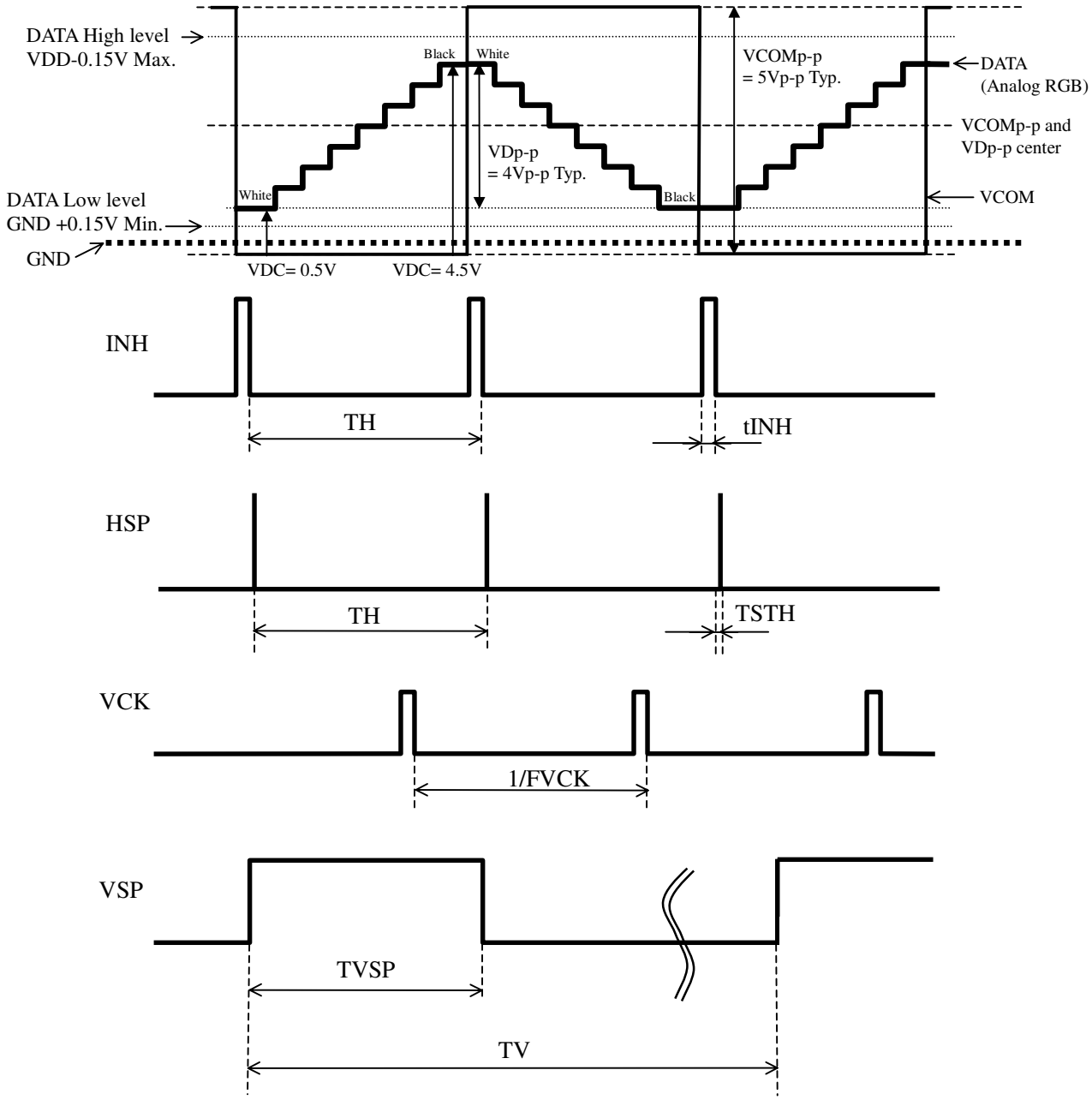
Parameter		Symbol	Min.	Typ.	Max.	Unit	Remarks
VSP-VCK timing	Set up time	tDS	300	-	-	ns	-
	Hold time	tDH	300	-	-	ns	-
HSP-HCK timing	Set up time	thss	8	-	-	ns	-
	Hold time	thsh	8	-	-	ns	-
HCK-INH timing	Set up time	tins1	33	-	-	ns	-
	Hold time	tinh1	33	-	-	ns	-
HRESET-INH set up time		tins2	81	-	-	ns	-

Note1: All parameters should be kept within the specified range.

4.8.2 Timing chart 1

This figure is seen from input terminal of the CN1 (FPC).

(Output DATA of H-driver is shifted for 1TH period from input DATA. (See "**4.8.4 Timing chart2**".))



Note1: This product is designed on the premise of driving method of gate line inversion in which polarity of DATA and VCOM is inverted at each HSP period (TH).

Note2: Invert VCOM polarity while INH is High period.

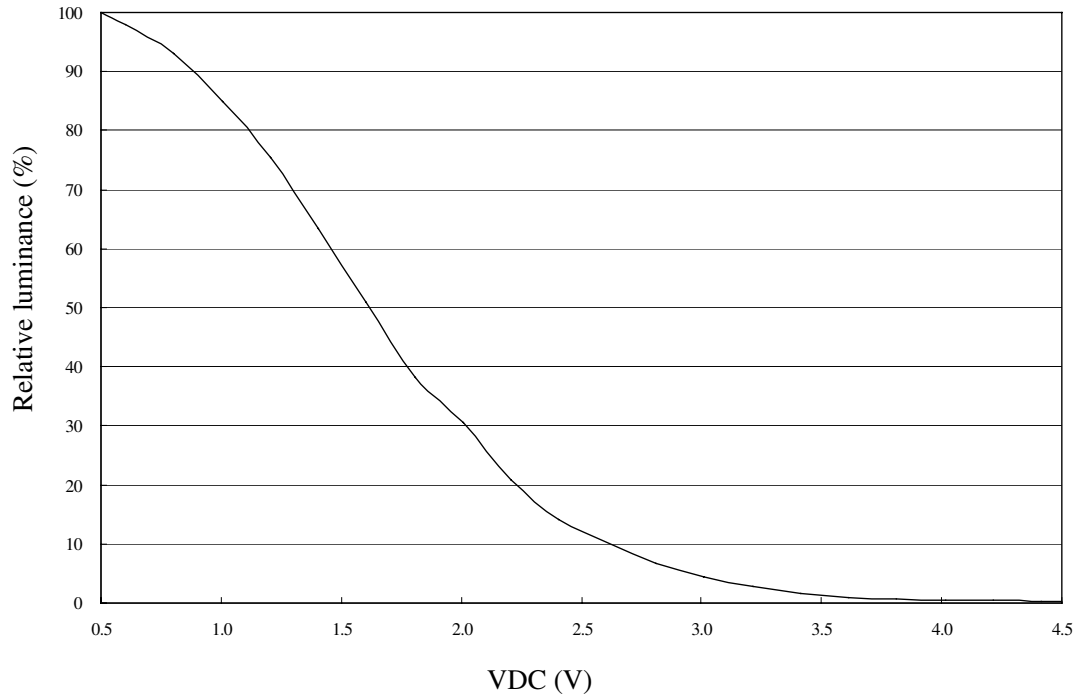
Note3: High period of VSP must be less than 1TH. Otherwise, overcurrent may damage internal circuits.

Note4: VDC is voltage difference between VCOM and DATA.

4.8.3 Relation between relative luminance and VDC (Reference)

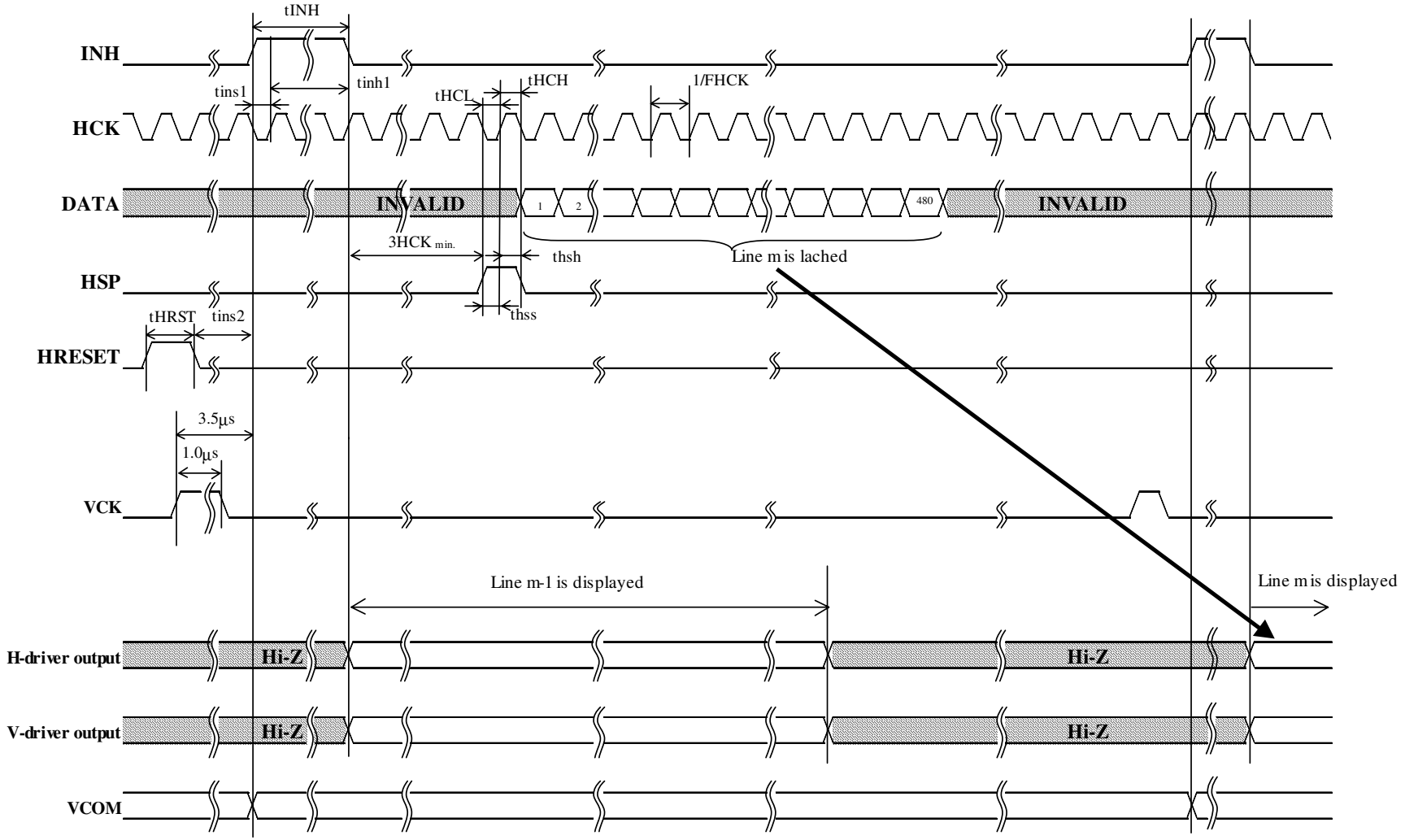
Relation between relative luminance and VDC is as follows. (See "**4.8.2 Timing chart 1**")

VDC (V)	Relative luminance (%)	Remarks
4.5	0.32	Recommendation VDC for full black display
4.4	0.33	-
4.2	0.35	-
4.0	0.43	-
3.8	0.61	-
3.6	0.97	-
3.4	1.57	-
3.2	2.77	-
3.0	4.35	-
2.8	6.81	-
2.6	10.3	-
2.4	14.0	-
2.2	20.9	-
2.0	30.7	-
1.8	38.1	-
1.6	50.9	-
1.4	63.4	-
1.2	75.5	-
1.0	85.0	-
0.8	93.1	-
0.6	98.0	-
0.5	100	Recommendation VDC for full white display



4.8.4 Timing chart 2

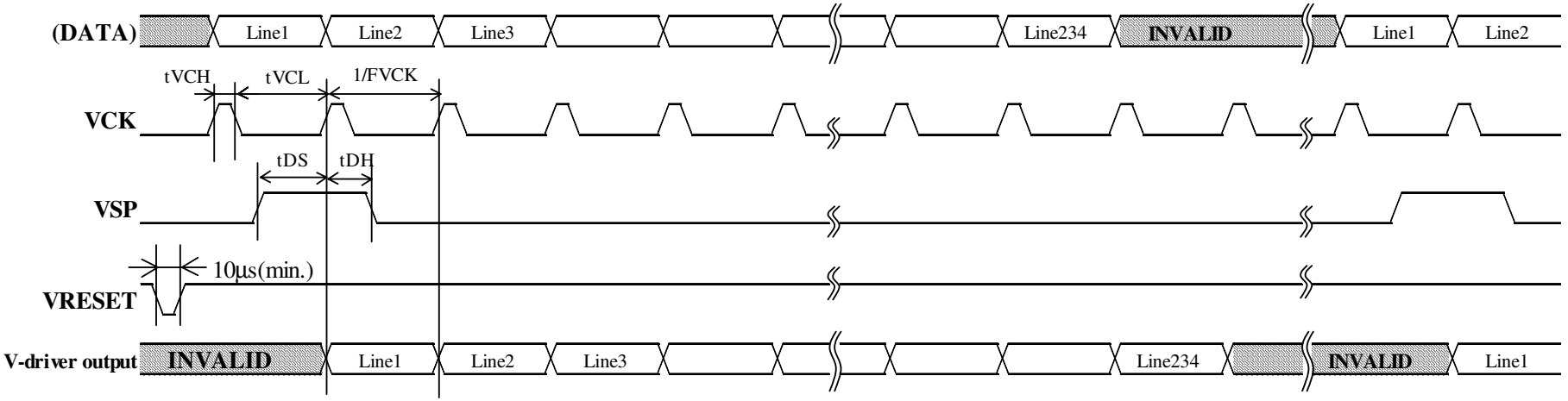
(1) Horizontal timing chart



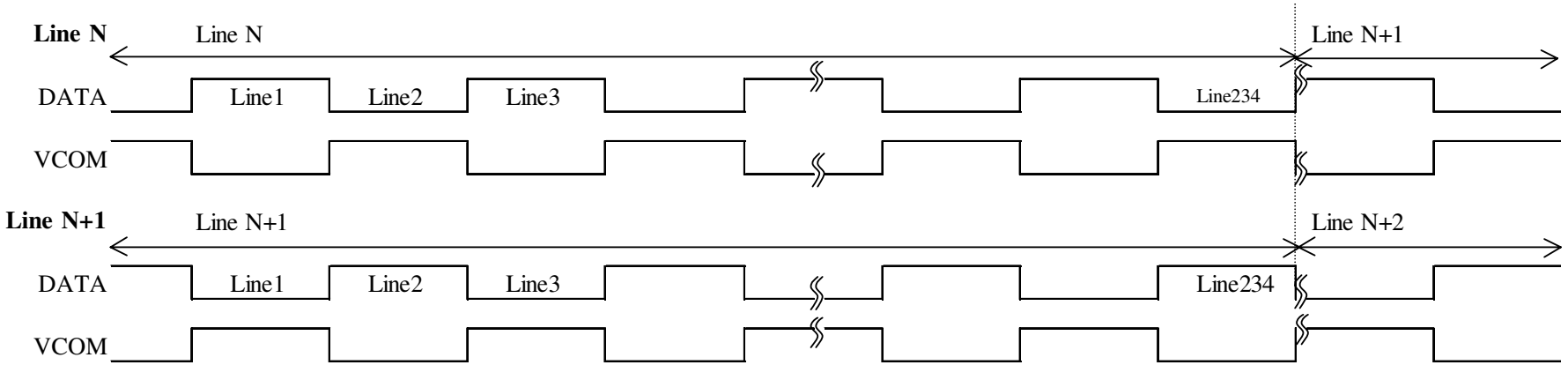
Note1: Do not stop HCK signal while INH is High period.

Note2: The timing between each control signal is prescribed by VCC×0.5.

(2) Vertical timing chart



(3) Relation of polarity inversion



Note1: Invert VCOM polarity while INH is High period. DATA of next line (Line N+1) should be output after VCOM signal is stabilized enough.
Note2: The timing between each control signal is prescribed by VCC×0.5.

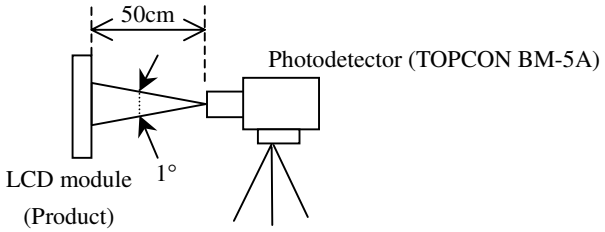
4.9 OPTICS

4.9.1 Optical characteristics

Parameter Note1		Condition	Symbol	Min.	Typ.	Max.	Unit	Remarks
Luminance		White at center θR = 0°, θL = 0°, θU = 0°, θD = 0°	L	330	450	-	cd/m^2	-
Contrast ratio		White/Black at center θR = 0°, θL = 0°, θU = 0°, θD = 0°	CR		300	-	-	Note2
Luminance uniformity		-	LU	-	-	1.40	-	Note3
Chromaticity	White	**x** coordinate	Wx	0.278	0.308	0.338	-	Note4
		y coordinate	Wy	0.288	0.318	0.348	-	
Color gamut		θR = 0°, θL = 0°, θU = 0°, θD = 0° at center, against NTSC color space	C	-	40	-	%	
Response time		White to black	Ton	-	38	50	ms	Note5
		Black to white	Toff	-	27	30	ms	
Viewing angle	Right	θU = 0°, θD = 0°, CR = 10	θR	-	85	-	°	Note6
	Left	θU = 0°, θD = 0°, CR = 10	θL	-	85	-	°	
	Up	θR = 0°, θL = 0°, CR = 10	θU	-	85	-	°	
	Down	θR = 0°, θL = 0°, CR = 10	θD	-	85	-	°	

Note1: Measurement conditions are as follows.
Ta= 25°C, VDD= 5.4V, VCC= 5.0V, VDp-p= 4.0V, VCOMp-p= 5.0V, IBL= 4.0mArms, Display mode: WQVGA, FHCK= 9.566MHz, FVCK= 15.734kHz, D/U= Low, R/L= High

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 "**4.9.2 Definition of contrast ratio**".
Note3: See "**4.9.3 Definition of luminance uniformity**".
Note4: These coordinates are found on CIE 1931 chromaticity diagram.
Note5: See "**4.9.4 Definition of response times**".
Note6: See "**4.9.5 Definition of viewing angles**".

4.9.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

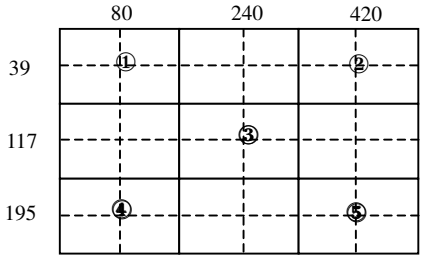
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

4.9.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

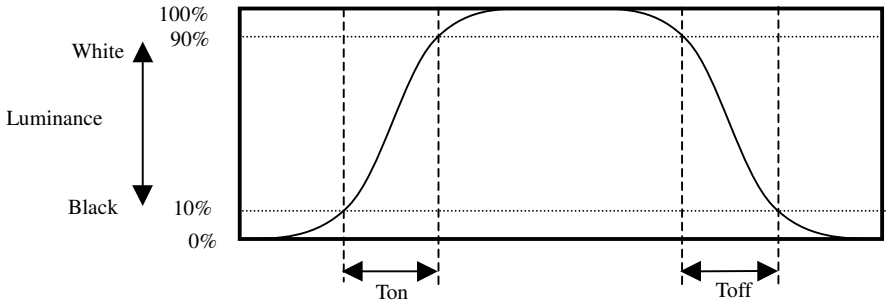
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

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

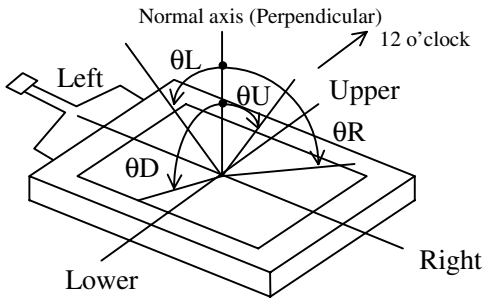


4.9.4 Definition of response times

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



4.9.5 Definition of viewing angles

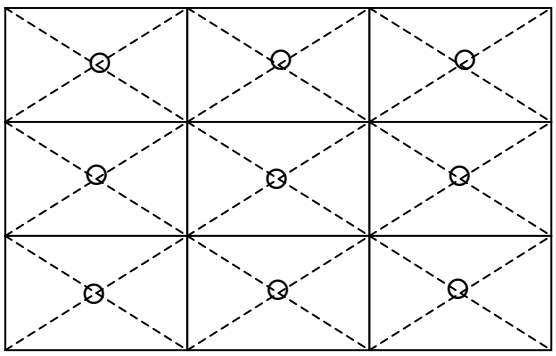


5. RELIABILITY TESTS

Test item	Condition	Judgement
High temperature and humidity (Operation)	① 60 ± 2°C, RH = 90%, 240hours ② Display data is white.	No display malfunctions Note1
Heat cycle (Operation)	① -10 ± 3°C…1hour 70 ± 3°C…1hour ② 50cycles, 4hours/cycle ③ Display data is white.	
High temperature (Operation)	① 70 ± 2°C, 240hours ② Display data is white.	
Low temperature (Non operation)	① -20 ± 3°C, 500hours	
Thermal shock (Non operation)	① -20 ± 3°C…30minutes 80 ± 3°C…30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.	
ESD for terminal of FPC (Non operation)	① 200pF, 0Ω, ±200V ② 3 times at 1 sec interval	
ESD for display area (Operation)	① 150pF, 150Ω, ±15kV ② 9 places on a panel surface Note2 ③ 10 times each places at 1 sec interval	
Dust (Operation)	① Sample dust: No. 15 (by JIS-Z8901) ② 15 seconds stir ③ 8 times repeat at 1 hour interval	
Vibration (Non operation)	① 5 to 12.3Hz, 10mmp-p ② 12.3 to 200Hz, 29.4m/s^2 ③ 10 minute/cycle ④ X, Y, Z direction ⑤ 48 times each directions	No display malfunctions Note1 No physical damages
Mechanical shock (Non operation)	① 980m/ s^2, 11ms ② ±X, ±Y, ±Z direction ③ 3 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" and "6.3 ATTENTIONS", after understanding this contents!**

This sign has the meaning that customer will get an electrical shock, if customer has wrong operations.

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

This sign has the meaning that customer will be injured by himself or the product will sustain a damage, if customer has wrong operations.

6.2 CAUTIONS

∗ Do not touch the working backlight. Customer will be in danger of an electric shock.

∗ Do not touch the working backlight. Customer will be in danger of burn injury.

∗ Do not shock and press the LCD panel and the backlight! There is a danger of breaking, because they are made of glass. (Shock: To be not greater 980m/s^2 and to be not greater 11ms, Pressure: To be not greater 19.6 N)

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 hook cables nor pull connection cables such as lamp cable and so on, for fear of damage.

③ If customer puts down the product temporarily, the product puts on flat subsoil as a display side turns down.

④ 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.

⑤ The torque for mounting screws must never exceed 0.35N·m. Higher torque values might result in distortion of the bezel.

⑥ 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.

⑦ Do not push-pull the FPC and/or lamp connector while the product is working, because wrong power sequence may break down the product.

⑧ Do not bend or unbend the lamp cable at the near part of the lamp holding rubber, to avoid the damage for high voltage side of the lamp. This damage may cause a lamp breaking and abnormal operation of high voltage circuit.
⑨ Do not bend the FPC extremely.
Permissible value of bending: R=0.2mm or more, 10 times or less

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.

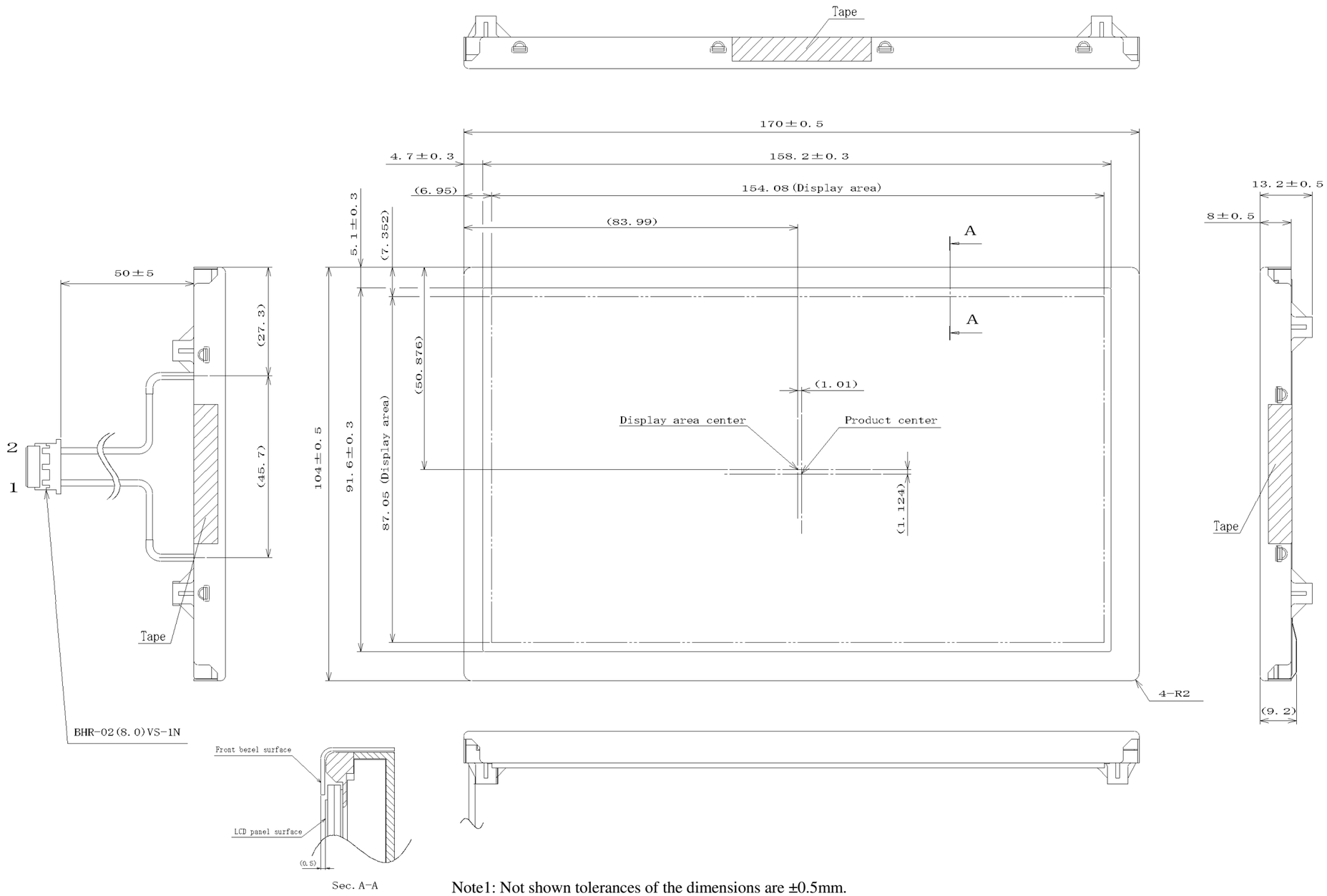
① Response time, luminance and color may be changed by ambient temperature.
② The LCD may be seemed luminance non-uniformity, flicker, vertical seam or small spot by display patterns.
③ Optical characteristics (e.g. luminance, display uniformity, etc.) gradually is going to change depending on operating time, and especially low temperature, because the LCD has cold cathode fluorescent lamps.
④ 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.
⑤ The display color may be changed by viewing angle because of the use of condenser sheet in the backlight unit.
⑥ Optical characteristics may be changed by input signal timings.
⑦ 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.
⑧ Each of color of the polarizer surface at non-operation may differ because of antireflection treatment.

6.3.4 Other

① All GND, backlight inverter ground (GNDB), VCC and backlight inverter power supply voltage (VDDB) terminals should be used without a non-connected line.
② Do not disassemble a product or adjust volume without permission of NEC Corporation.
③ See "REPLACEMENT MANUAL FOR LAMPHOLDER SET", if customer would like to replace backlight lamps.
④ Pay attention not to insert waste materials inside of products, if customer uses screwnails.
⑤ Pack the product with original shipping package, because of avoidance of some damages during transportation, when customer returns it to NEC Corporation for repair and so on.

7. OUTLINE DRAWINGS

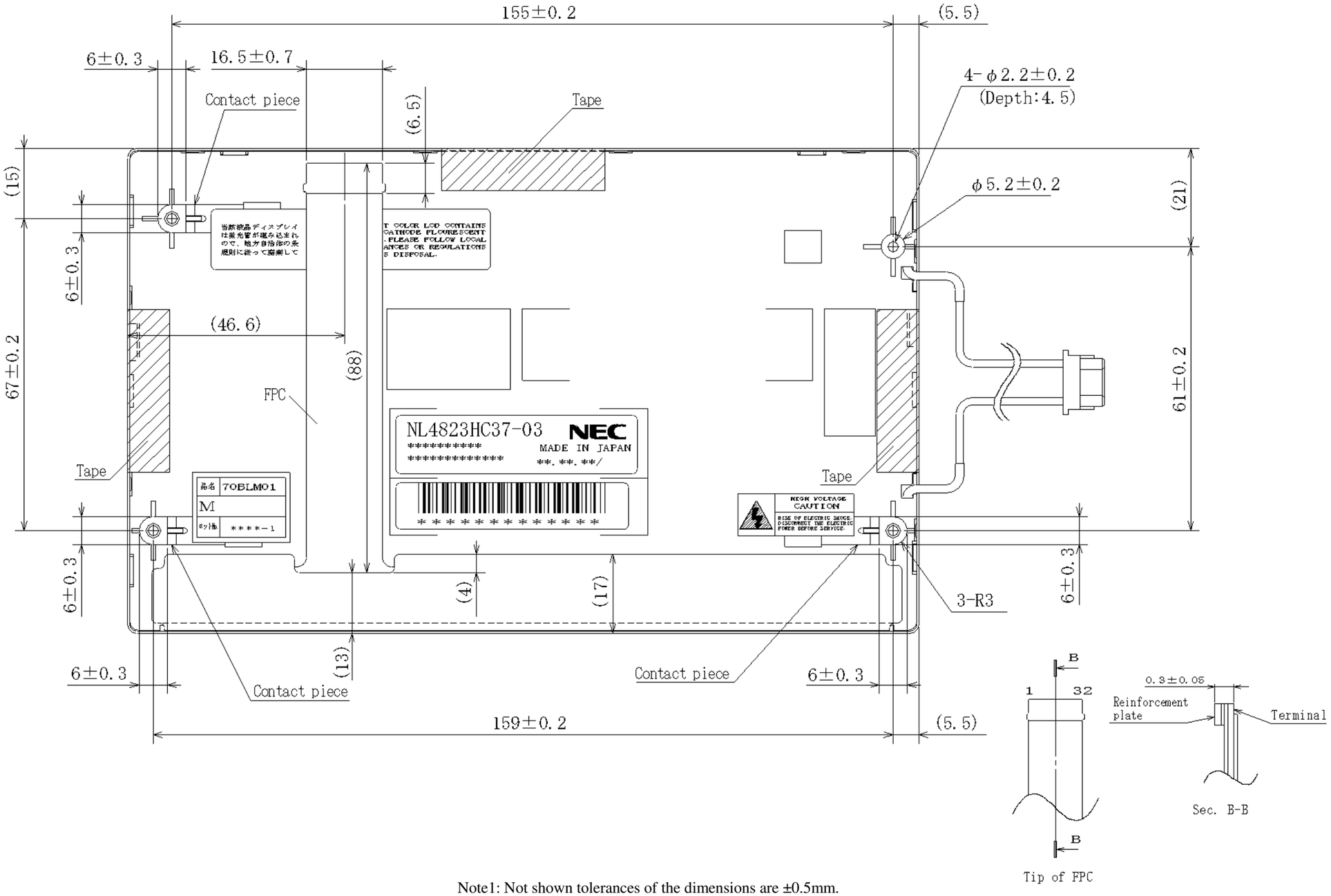
7.1 FRONT VIEW



Note1: Not shown tolerances of the dimensions are ±0.5mm.
Note2: The values in parentheses are for reference.
Note3: The torque for mounting screw should never exceed 0.35N·m.

Unit: mm

7.2 REAR VIEW



Note1: Not shown tolerances of the dimensions are ±0.5mm.
Note2: The values in parentheses are for reference.
Note3: The torque for mounting screw should never exceed 0.35N·m.
Note4: Contact pieces are connected FG inside the product. (Contact pieces are fixed to rear shield by each label.)

Unit: mm