

NEC

TFT COLOR LCD MODULE

NL10276BC26-01, 02

**34 cm (13.3 TYPE), 1024 × 768 PIXELS, 262144 COLORS,
INCORPORATED ONE LAMP/EDGE-LIGHT TYPE BACKLIGHT**

DESCRIPTION

NL10276BC26-01, 02 is a TFT (thin film transistor) active matrix color liquid crystal display (LCD) module comprising amorphous silicon TFT attached to each signal electrode, a driving circuit and a backlight.

The 34 cm diagonal display area contains 1024 × 768 pixels and can display 262144 colors simultaneously.

By utilizing one lamp/edge-light type backlight, a very thin profile and low power consumption have been achieved.

FEATURES

Item	NL10276BC26-01	NL10276BC26-02
LVDS interface (adapted for DS90CF562, National Semiconductor Co., Ltd.) LVDS: Low Voltage Differential Signal	○	○
High contrast, Low reflection	○	○
Thin, Light weight, Low power consumption	○	○
Incorporated edge light type backlight (One lamp, Inverter-less)	○	○
Data enable function	○	○
Mounting holes	Four points	Three points
Module size	297 (H) × 218 (V) × 8.5 (D)	289.5 (H) × 222.5 (V) × 9.9 (D)
Power consumption	4.3 W (typ.)	4.5 W (typ.)
CLK frequency	30 to 38 MHz	30 to 35 MHz

APPLICATIONS

- Engineering workstation (EWS)
- Personal computer (PC)
- Monitor



NL10276BC26-01, 02

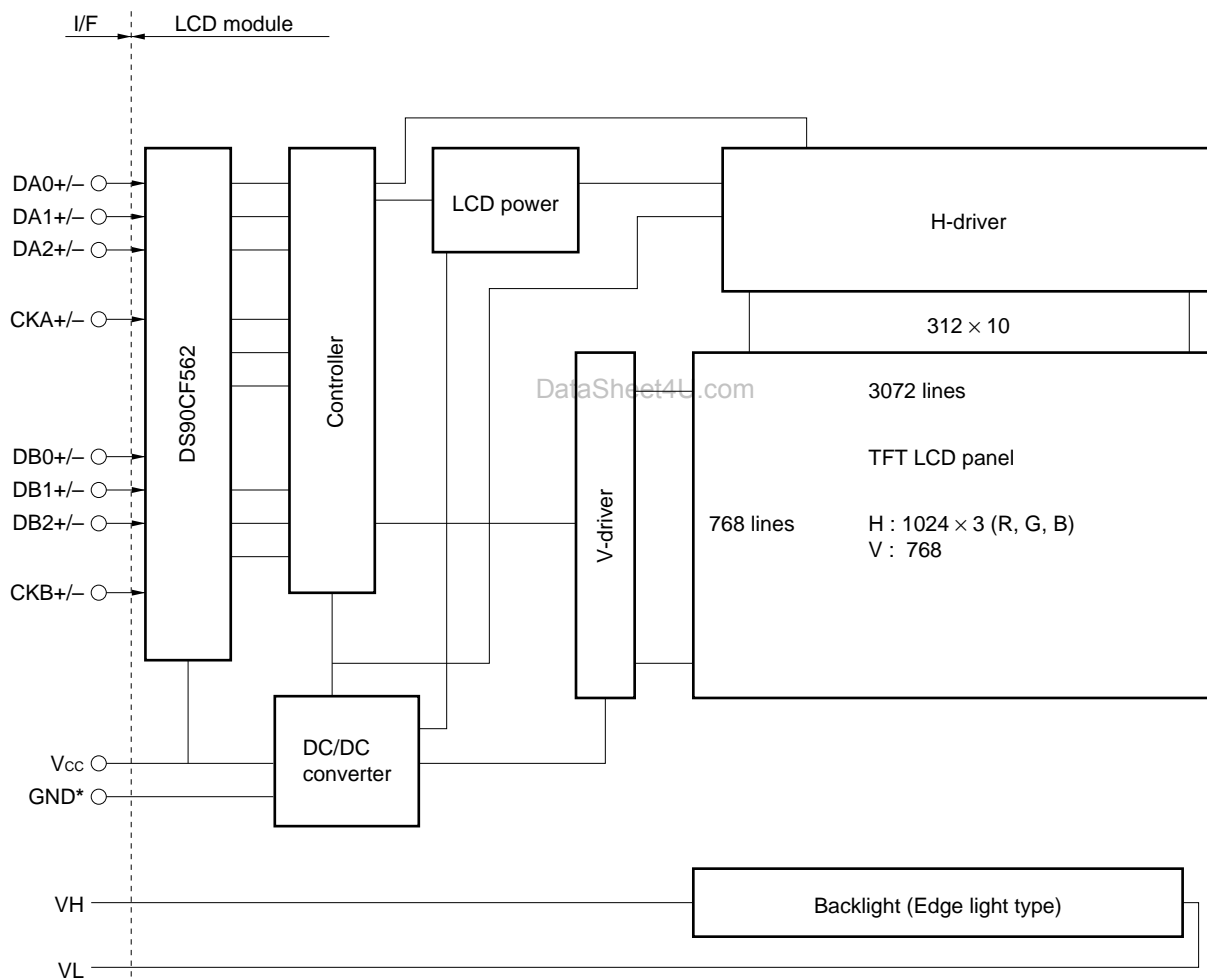
STRUCTURE AND FUNCTIONS

A color TFT (thin film transistor) LCD module is comprised of a TFT liquid crystal panel structure, LSIs for driving the TFT array, and a backlight assembly. The TFT panel structure is created by sandwiching liquid crystal material in the narrow gap between a TFT array glass substrate and a color filter glass substrate. After the driver LSIs are connected to the panel, the backlight assembly is attached to the backside of the panel.

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

Acting as an electro-optical switch, each TFT cell regulates light transmission from the backlight assembly when activated by the data source. By regulating the amount of light passing through the array of red, green, and blue dots, color images are created with clarity.

BLOCK DIAGRAM



* GND is not connected to the module frame.

OUTLINE OF CHARACTERISTICS (at room temperature)

Display area	270.34 (H) × 202.75 (V) mm
Drive system	a-Si TFT active matrix
Display colors	262,144
Number of pixels	1024 × 768
Pixel arrangement	RGB vertical stripe
Pixel pitch	0.264 (H) × 0.264 (V) mm
Module size	NL10276BC26-01: 297.0 (H) × 218.0 (V) × 8.5 (D) mm NL10276BC26-02: 289.5 (H) × 222.5 (V) × 9.9 (D) mm
Weight	635 g (typ.)
Contrast ratio	120:1 (typ.)
Viewing angle (more than the contrast ratio of 10:1)	<ul style="list-style-type: none"> • Horizontal : 45° (typ., left side, right side) • Vertical : 25° (typ., up side), 35° (typ., down side)
Designed viewing direction	<ul style="list-style-type: none"> • Optimum grayscale ($\gamma = 2.2$): perpendicular
Color gamut	40 % (min. At center, To NTSC)
Response time	40 ms (max.), "white" to "black"
Luminance	100 cd/m ² (typ.)
Signal system (*)	6 bit digital RGB signals, Synchronous signals (Hsync, Vsync), Dot clock (CLK) Data enable signal
Supply voltage	5.0 V (typ.)
Backlight	Edge light type: One fluorescent lamps (cold cathode type)
Power consumption	NL10276BC26-01: 4.3 W (typ.) NL10276BC26-02: 4.5 W (typ.)

* See Page 7. **METHOD OF CONNECTION FOR DS90CF561.**

GENERAL SPECIFICATIONS

Item	Specification	Unit
Module size	297.0 ± 0.5 (H) × 218.0 ± 0.5 (V) × 9.5 (MAX.) (D) ^{*1} 289.5 ± 0.5 (H) × 222.5 ± 0.5 (V) × 10.4 (MAX.) (D) ^{*2}	mm
Display area	270.34 (H) × 202.75 (V)	mm
Number of pixels	1024 (H) × 768 (V)	Pixel
Pixel pitch	0.088 (H) × 0.264 (V)	mm
Dot pitch	0.264 (H) × 0.264 (V)	mm
Pixel arrangement	RGB (Red, Green, Blue) vertical stripe	—
Display colors	262,144	color
Weight	650 (MAX.)	g

*1 NL10276BC26-01

*2 NL10276BC26-02

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit	Remarks
Supply voltage	V _{CC}	-0.3 to +6.0	V	Ta = 25 °C
Logic input voltage	V _I	-0.3 to V _{CC} + 0.3	V	
Storage temp.	T _{st}	-20 to +60	°C	—
Operating temp.	T _{op}	-0 to +50	°C	Module surface*
Humidity (No condensation)	RH	≤ 95 % relative humidity		Ta ≤ 40 °C
		≤ 85 % relative humidity		40 < Ta ≤ 50 °C
		Absolute humidity shall not exceed Ta = 50 °C, 85 % relative humidity level.		Ta > 50 °C

* Measured at the display area

ELECTRICAL CHARACTERISTICS

(1) Logic/LCD driving

(Ta = 25 °C)

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Remarks
Supply voltage	V _{CC}	4.75	5.0	5.25	V	V _{CCi} = 3.3 V
LVDS signal input "L" voltage	V _{IL}	-100	—	—	mV	V _{CM} = 1.2 V ^{*1}
LVDS signal input "H" voltage	V _{IH}	—	—	+100	mV	
Supply current	I _{CC}	—	300 ^{*2}	700 ^{*3}	mA	V _{CC} = 5.0 V

*1 V_{CM}: Common mode voltage in LVDS driver

*2 Checker flag pattern (in EIAJ ED-2522)

*3 Theoretical maximum current pattern

(2) Backlight

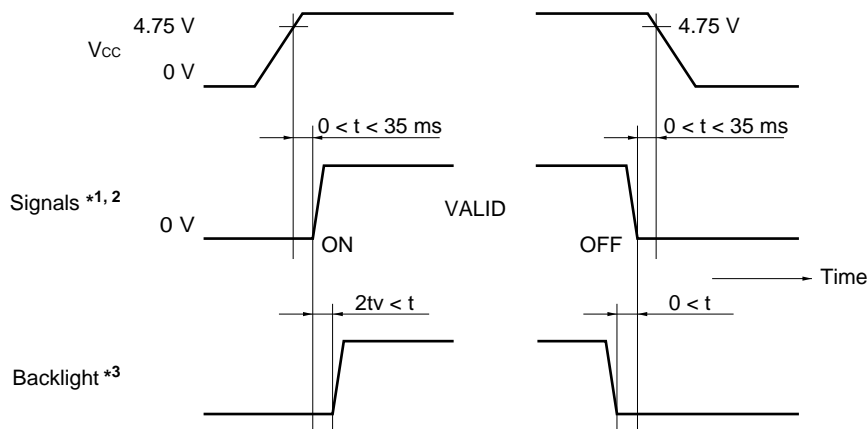
(Ta = 25 °C)

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Remarks
Lamp current	I _L	2.0	4.5	5.5	mArms	100 cd/m ² : 4.5 mArms 60 cd/m ² : 3.0 mArms
Lamp voltage	V _{IL}	—	620	—	V _{rms}	—
		—	670	—	V _{rms}	
Lamp turn on voltage	V _s	1600	—	2000	V _{rms}	Ta = 0 °C
		1100	1550	2000	V _{rms}	Ta = 25 °C NL10276BC26-01
		1400	1700	2000	V _{rms}	Ta = 25 °C NL10276BC26-02
Oscillator frequency	F _t	50	60	95	kHz	Note

Note When the frequency of Hsync (Horizontal synchronous signal) is f_H, recommended value of "f_t" is as follows.

$$f_t = \frac{1}{4} (2n - 1) \times f_H \quad (n: \text{An integral number})$$

When f_t is integral number times of $\frac{f_H}{2}$, it may cause beat on the display.

SUPPLY VOLTAGE SEQUENCE

Signals: CLK, Hsync, Vsync, MODE, DE, DATA

2tv : 2Vsync period

- *1 The supply voltage for input signals should be the same as VCC.
- *2 Apply VH 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.
- *3 When the power is off, please keep whole signals low level or high impedance.

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INTERFACE PIN CONNECTION

(1) Interface connector for signal and power

Part No. : LZ-20P-SL-SMT
 Adaptable socket : LZ-20P-SC3
 Supplier : Japan Aviation Electronics Industry Limited (JAE)

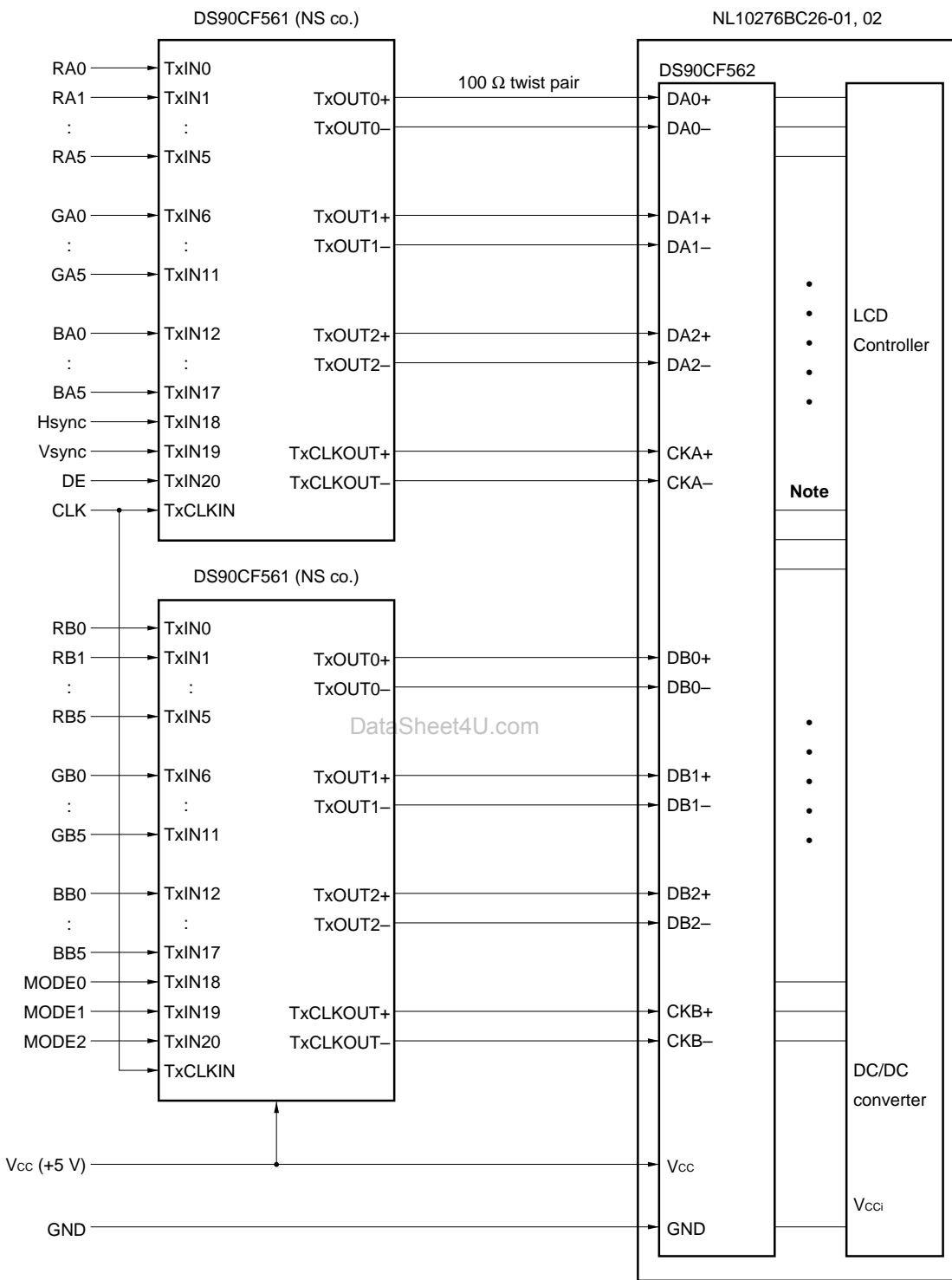
Pin No.	Symbol	Signal type	Function
1	CKB+	An odd number pixel clock	CLK for an odd number pixel f = 32.5 MHz (typ.) (LVDS level)
2	CKB-		
3	DB2+	An odd number pixel data	D1, D3, D5 ... D1023 pixels data (LVDS level)
4	DB2-		
5	DB1+		
6	DB1-		
7	DB0+		
8	DB0-		
9	CKA+	An even number pixel clock	CLK for an even number pixel f = 32.5 MHz (typ.) (LVDS level)
10	CKA-		
11	DA2+	An even number pixel data	D0, D2, D4 ... D1022 pixels data (LVDS level)
12	DA2-		
13	DA1+		
14	DA1-		
15	DA0+		
16	DA0-		
17	GND	Ground	Connect system ground
18	GND		
19	VCC	+5.0 V power supply	Supply +5 V \pm 5 %
20	VCC		

(2) Connector for backlight unit

Part No. : BHR-03VS-1
 Adaptable socket : SM02(8.0)B-BHS-TB
 Supplier : J.S.T TRADING COMPANY, LTD.

Pin No.	Symbol	Function
1	VH	High voltage terminal
2	N.C.	Non-connection
3	VL	Low voltage terminal

METHOD OF CONNECTION FOR DS90CF561



RAx, GAx, BAx: D0, 2, 4, D1022 pixel data
 RBx, GBx, BBx: D1, 3, 5, D1023 pixel data
 MODE0 : "H"
 MODE1 : Mode select: "L" (DE), "H" (FIX)
 MODE2 : "L"
 V_{cci} = 3.3 V (LCD internal voltage)

Note These timing should be kept in the specified range of Page 9. **INPUT SIGNAL TIMING.**

DISPLAY COLORS vs. INPUT DATA SIGNALS

Display colors		Data signal (0: Low level, 1: High level)																	
		RA5 RA4 RA3 RA2 RA1 RA0	GA5 GA4 GA3 GA2 GA1 GA0	BA5 BA4 BA3 BA2 BA1 BA0															
		RB5 RB4 RB3 RB2 RB1 RB0	GB5 GB4 GB3 GB2 GB1 GB0	BB5 BB4 BB3 BB2 BB1 BB0															
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	
	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	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	0	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 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	
	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 262,144 ($64 \times 64 \times 64$) colors.

INPUT SIGNAL TIMING

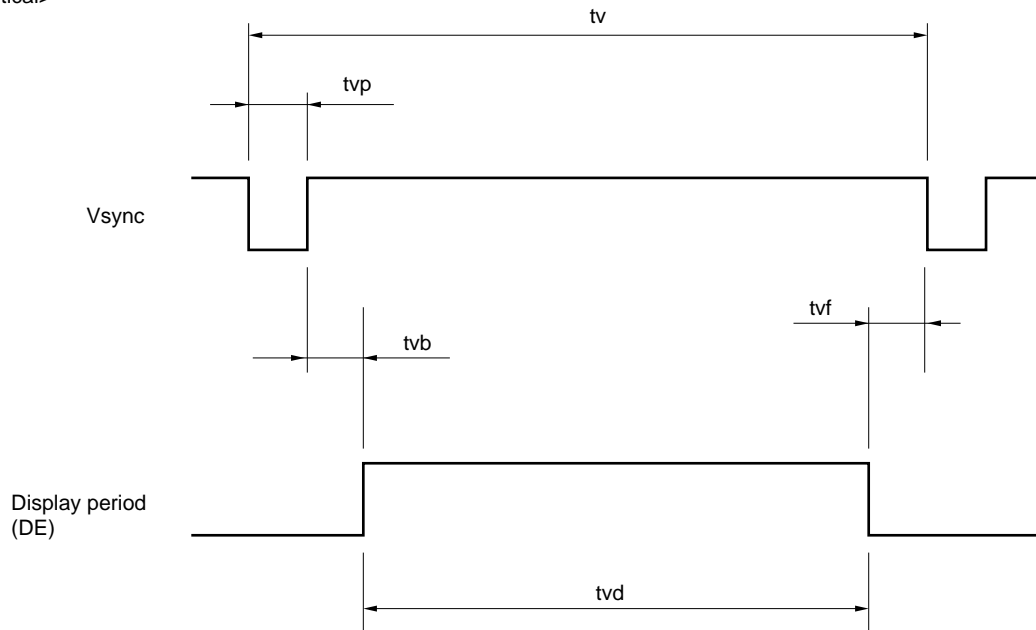
(1) Input signal specification for LCD controller

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency	1/tc	30.0	32.5	38.0	MHz	NL10276BC26-01 30.769 ns (TYP.)
					35.0	MHz	NL10276BC26-02 30.769 ns (TYP.)
	Duty	tch/tc	0.4	0.5	0.6	—	—
	Rise, fall	tcrf	—	—	10	ns	—
Hsync	Period	th	—	20.676	—	μ s	48.363 kHz (TYP.)
			—	672	—	CLK	
	Display period	thd	512			CLK	—
	Front-porch	thf	0	20	—	CLK	—
	Pulse width	thp*	12	—	127	CLK	—
	Back-porch	thb*	2	—	—	CLK	—
	thp + thb*		49	—	160	CLK	DE mode
			—	140	—	CLK	Fixed mode
	Hsync-CLK timing	ths	3	—	—	ns	—
	CLK-Hsync timing	thh	4	—	—	ns	—
	DE-CLK timing	tes	3	—	—	ns	—
	CLK-DE timing	teh	4	—	—	ns	—
	Rise, fall	thrf	—	—	10	ns	(terf)
Vsync	Period	tv	—	16.666	—	ms	60.004 Hz (TYP.)
			—	806	—	H	
	Display period	tvd	768			H	—
	Front-porch	tvf	1	3	—	H	—
	Pulse width	tvp*	1	3	36	H	—
	Back-porch	tvb*	1	—	36	H	—
	tvp + tvb*		4	—	38	H	DE mode
			—	35	—	H	Fixed mode
	Vsync-Hsync timing	tvhs	15	—	—	ns	—
	Hsync-Vsync timing	tvhs	1	—	—	CLK	—
Rise, fall	tvrf	—	—	10	ns	—	
DATA	DATA-CLK (Set up)	tds	3	—	—	ns	—
	CLK-DATA (Hold)	tdh	4	—	—	ns	—

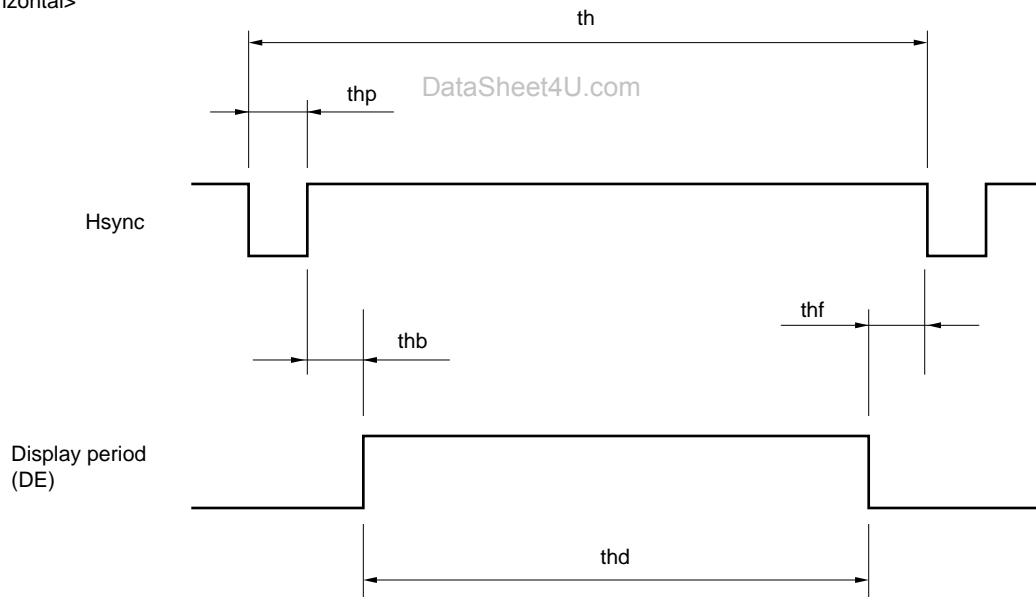
Note These value are in the output of DS90CF562 (See Page 7. **METHOD OF CONNECTION FOR DS90CF561**).

(2) Definition of input signal timing for LCD controller

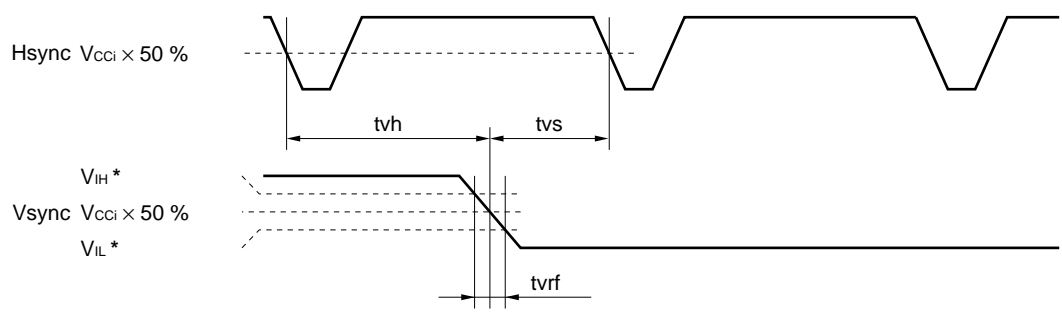
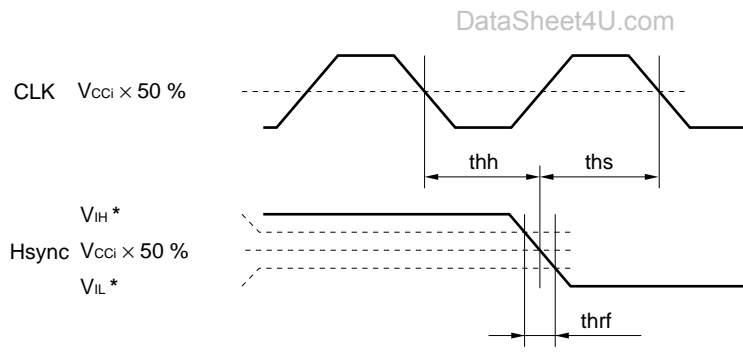
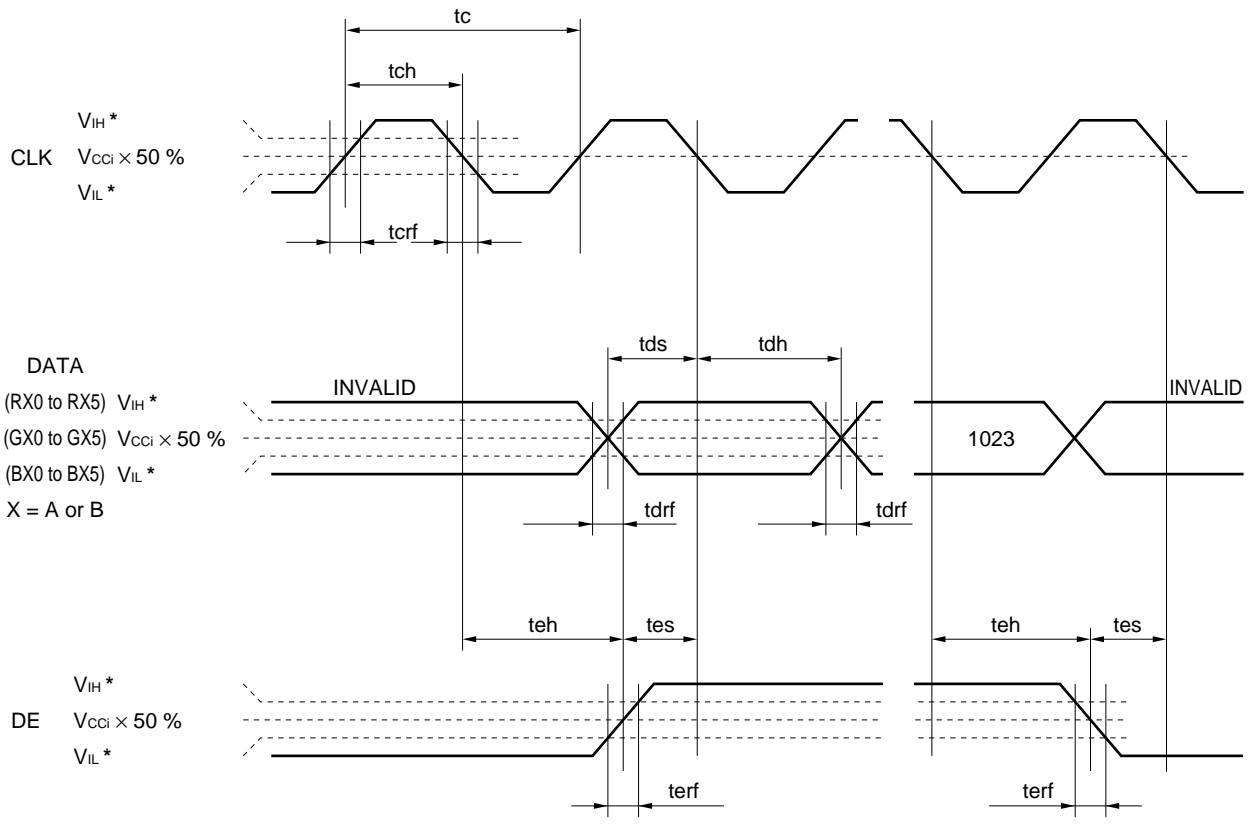
<Vertical>



<Horizontal>



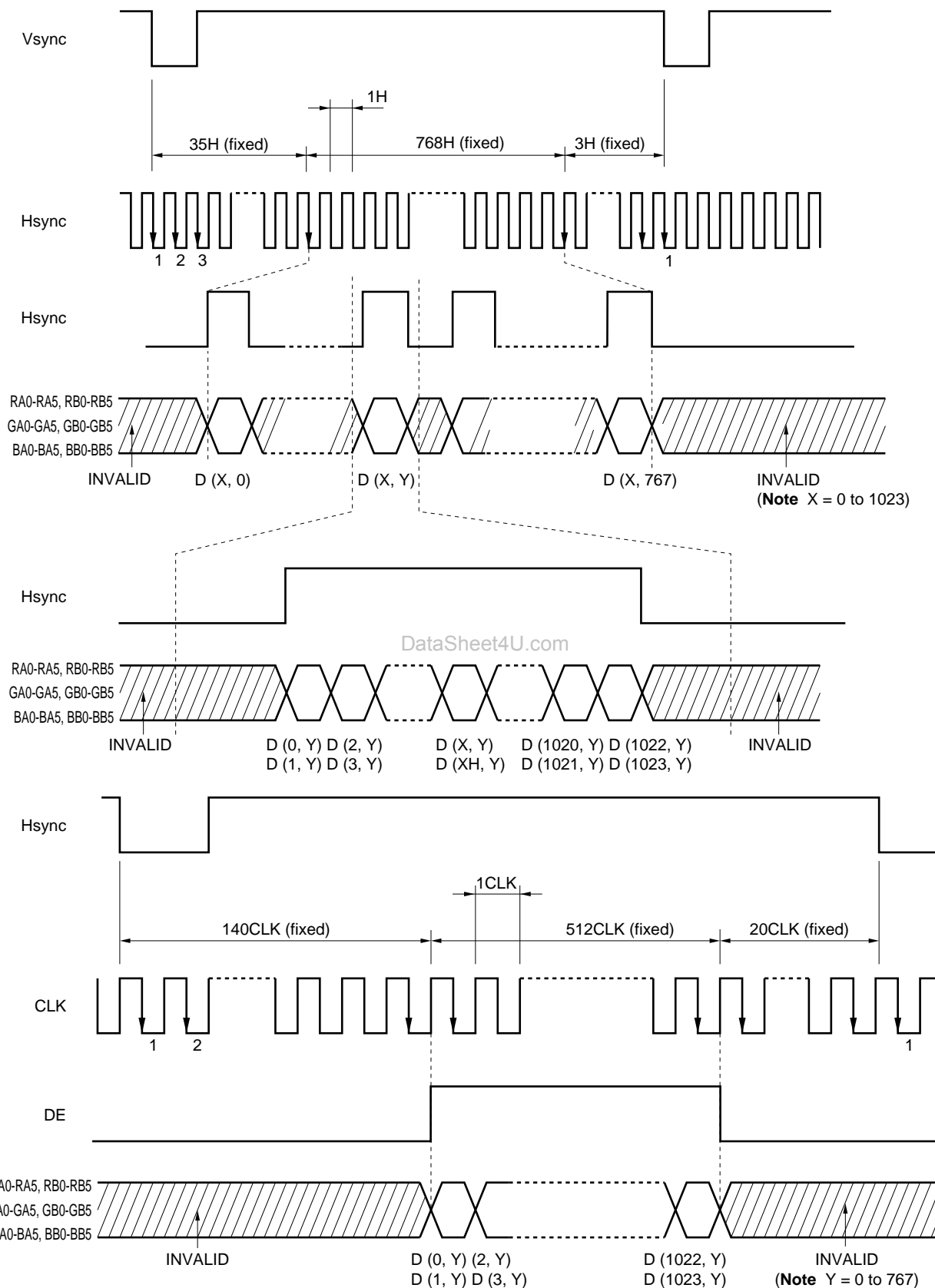
Note Display period does not exist as signals.



* $V_{IH} = V_{CCi} \times 0.7$ (Min.)
 $V_{IL} = V_{CCi} \times 0.3$ (Max.)

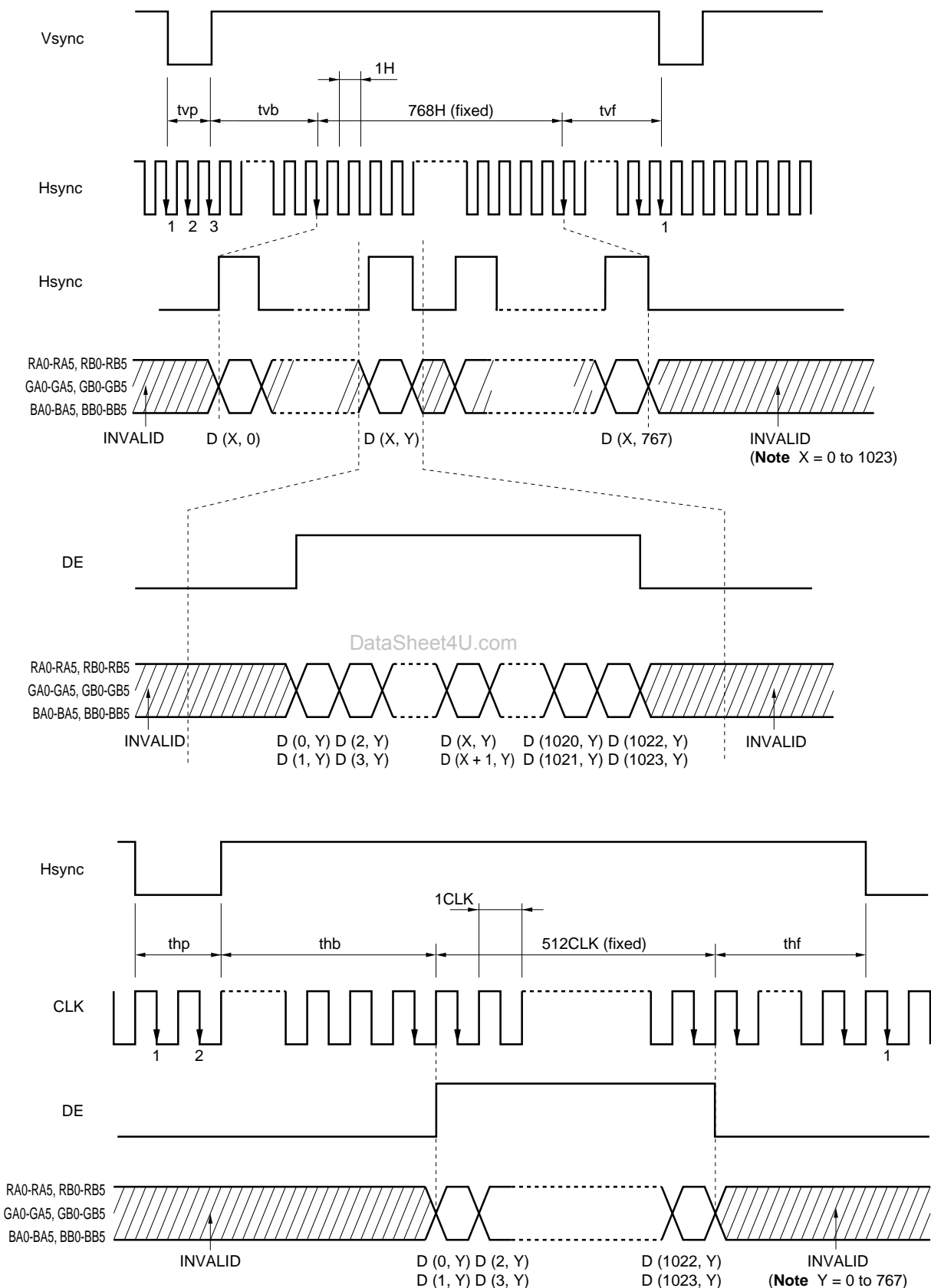
Note $V_{CCi} = 3.3$ V (LCD internal voltage)

(3) Input signal timing chart for LCD controller: Fixed mode



www.DataSheet4U.com **Note** These value are in the output of DS90CF562 (See Page 7. **METHOD OF CONNECTION FOR DS90CF561**). www.DataSheet4U.com

(4) Input signal timing chart for LCD controller: DE mode



Note These value are in the output of DS90CF562 (See Page 7. **METHOD OF CONNECTION FOR DS90CF561**).

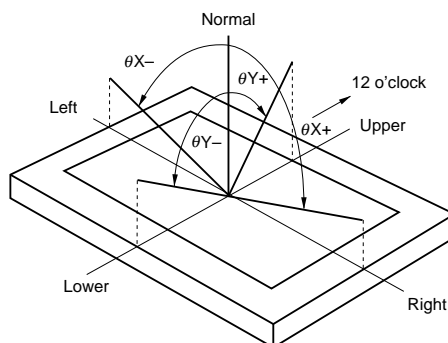
(5) Display position of input data

D(0, 0)	D(1, 0)	...	D(X, 0)	...	D(1023, 0)
D(0, 1)	D(1, 1)	...	D(X, 1)	...	D(1023, 1)
.
.
.
D(0, Y)	D(1, Y)	...	D(X, Y)	...	D(1023, Y)
.
.
.
D(0, 767)	D(1, 767)	...	D(X, 767)	...	D(1023, 767)

OPTICAL CHARACTERISTICS

Ta = 25 °C Note 1

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	
Viewing angle range	Horizontal	θx^+	CR > 10, $\theta y = \pm 0^\circ$	30	45	—	deg.	Note 2
		θx^-	CR > 10, $\theta y = \pm 0^\circ$	30	45	—	deg.	
	Vertical	θy^+	CR > 10, $\theta x = \pm 0^\circ$	10	25	—	deg.	
		θy^-	$\gamma > 10$, $\theta x = \pm 0^\circ$	30	35	—	deg.	
Contrast ratio	CR	$\theta x = \pm 0^\circ$, $\theta y = -5^\circ$ Best contrast angle	—	300	—	—	Note 4	
		Note 3	80	120	—			
Response time	tpd	white to black	—	—	40	ms	Note 5	
Color gamut	C	at center, to NTSC	35	40	—	%	—	
Luminance	Lu	Note 3	—	100	—	cd/m ²	Note 6	
Brightness uniformity	—	max./min.	—	—	1.33	—	Note 7	

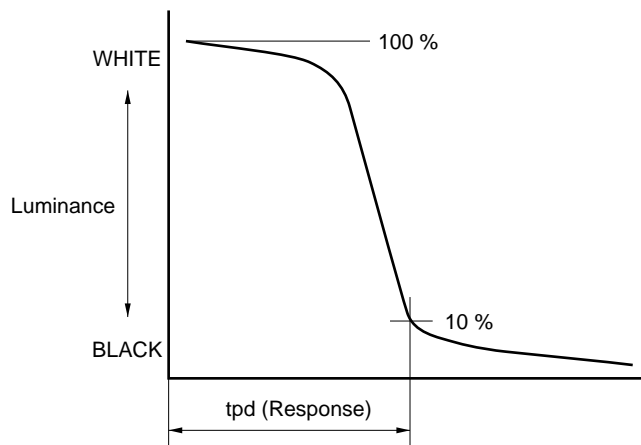
Notes 1. VCC = 5.0 V, IL = 4.5 mArms**2.** Definitions of viewing angle are as follows.**3.** Viewing angle is $\theta x = \pm 0^\circ$, $\theta y = \pm 0^\circ$. At center. $\gamma = 2.2$ viewing angle.**4.** The contrast ratio is calculated by using the following formula.

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

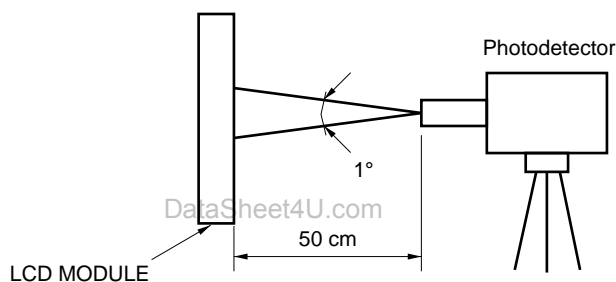
The luminance is measured in darkroom.

Notes 5. Definition of response time is as follows.

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



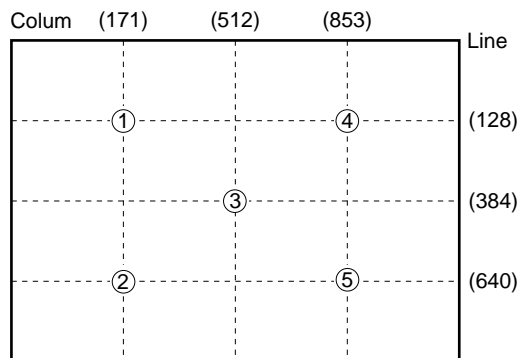
6. The luminance is measured after 20 minutes from the module works, with all pixels in “white”.



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.



GENERAL CAUTION

Next figures and sentence are very important, please understand these contents as follows.



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 hurt when you make a mistake to operate.

**GENERAL CAUTION****(1) Caution when taking out the module**

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

(2) Caution for handling the module

- <1> As the electrostatic discharges may break the LCD module, handle the LCD module with care against electrostatic discharges. Peel protection sheet out from the LCD panel surface as slowly as possible.



- <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 of mounting screw should be 0.294 N·m (3 Kgf·cm) less.

- <9> Input signal timing is regulated by a output part of DS90CF562 (NS) in LCD module. If see the disturbing display, make sure a signal timing of the output part of IC (DS90CF562) showed in OUTLINE Rear View, and set the signal timing in a regulation range. Regarding DS90CF562 specification, get a data-sheet of National Semiconductor corporation and refer to the data-sheet.

(3) Caution for the atmosphere

- <1> Dew drop atmosphere should be avoided.

- <2> 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.

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

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

(4) Caution for the module characteristics

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

(5) Other cautions

- <1> Do not disassemble and/or reassemble LCD module.
- <2> Do not readjust variable resistor or switch etc.
- <3> 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.

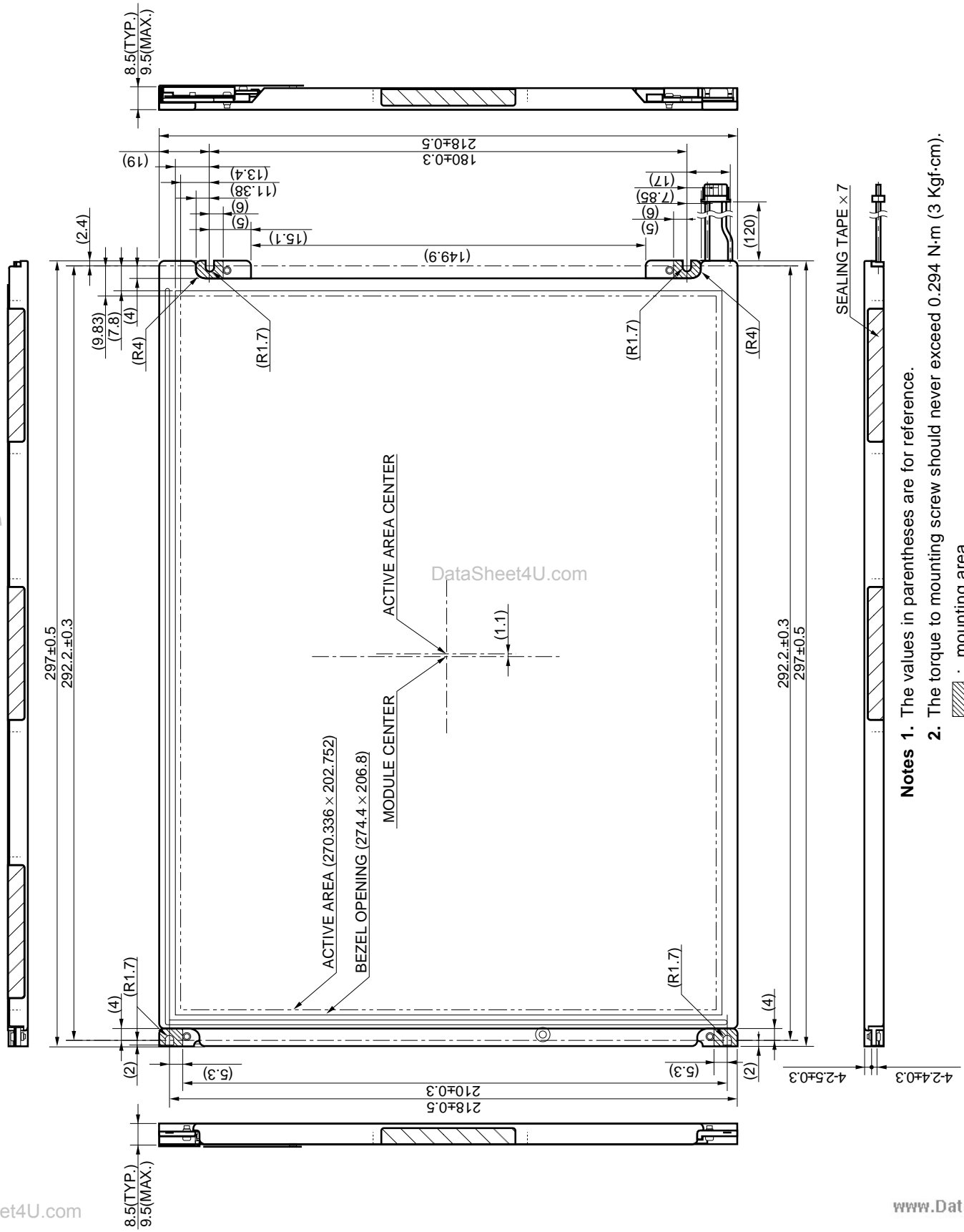
There are not defects or malfunctions.

The display condition of LCD module may be affected by the ambient temperature.

The LCD module uses cold cathode tube for backlighting. Optical characteristics, like luminance or uniformity, will change during time.

Uneven brightness and/or small spots may be noticed depending on different display patterns.

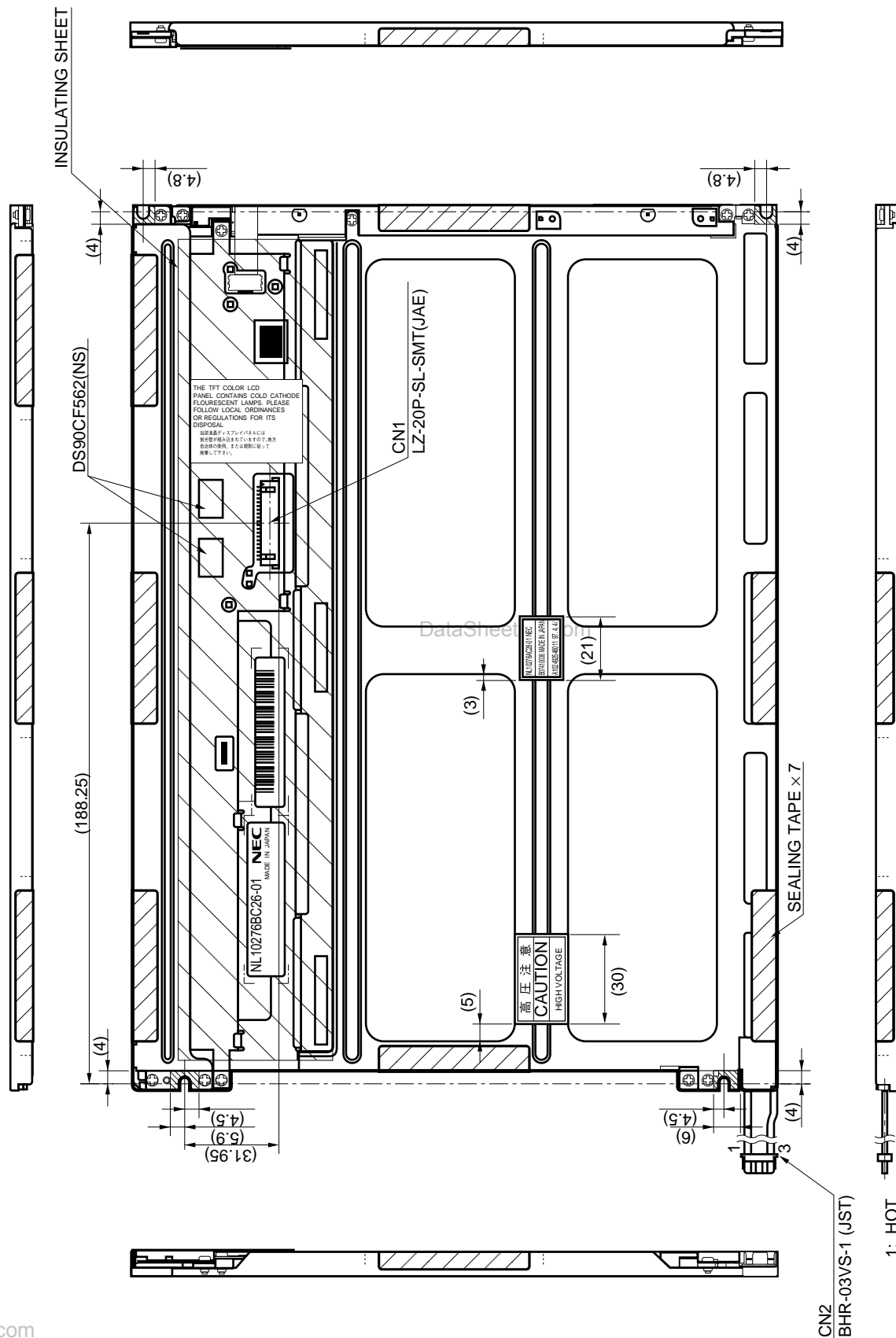
NL10276BC26-01
OUTLINE DRAWING: Front View (Unit in mm)



- Notes**
1. The values in parentheses are for reference.
 2. The torque to mounting screw should never exceed 0.294 N·m (3 Kgf·cm).
- ▨ : mounting area

NL10276BC26-01

OUTLINE DRAWING: Rear View (Unit in mm)

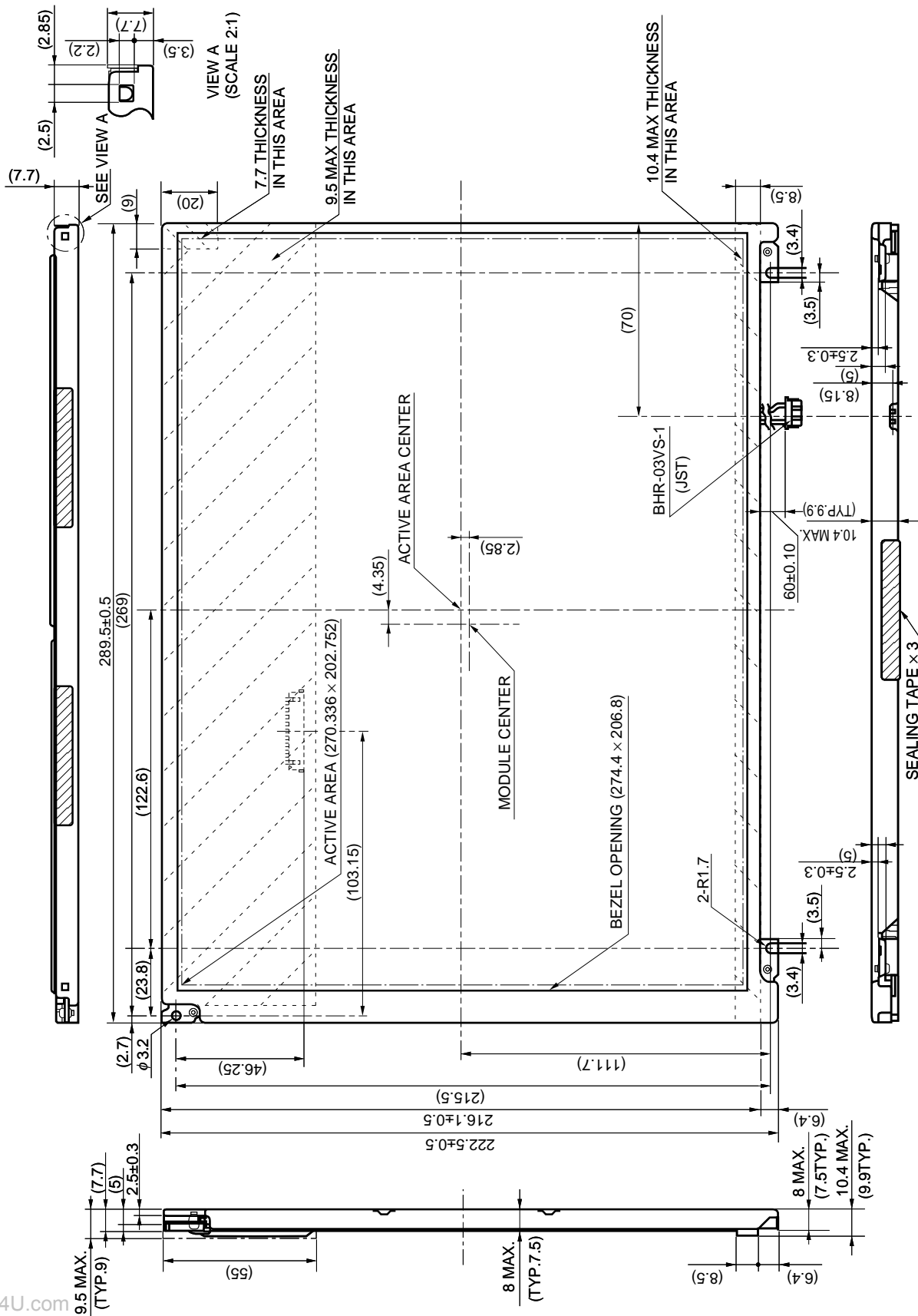


- Notes 1.** The values in parentheses are for reference.
- 2.** The torque to mounting screw should never exceed 0.294 N·m (3 Kgf·cm).
- ▨ : mounting area

- 1: HOT
 2: (NC)
 3: COLD

NL10276BC26-02

OUTLINE DRAWING: Front View (Unit in mm)

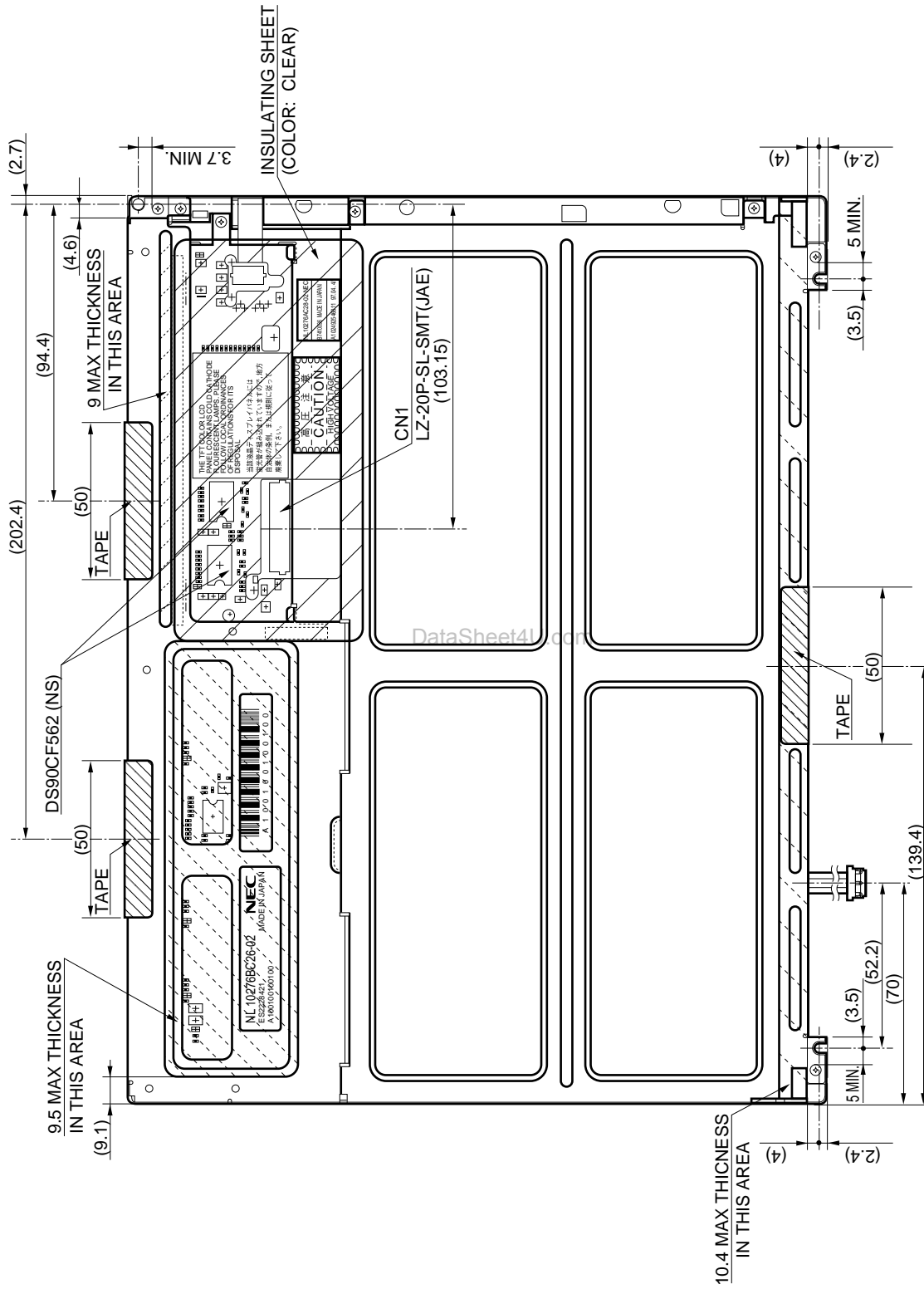


Notes 1. The values in parentheses are for reference.

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

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OUTLINE DRAWING: Rear View (Unit in mm)



- Notes**
1. The values in parentheses are for reference.
 2. The torque to mounting screw should never exceed 0.294 N·m (3 Kgf·cm).

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