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NEC

TFT COLOR LCD MODULE

NL8060BC26-17

26 cm (10.4 inches), 800 × 600 pixels, 262,144 colors high luminance, wide viewing angle

DESCRIPTION

The NL8060BC26-17 is a TFT (thin film transistor) active-matrix color liquid crystal display (LCD) module comprising an amorphous silicon TFT attached to each signal electrode, a driving circuit, and a backlight.

The NL8060BC26-17 has a built-in backlight. The backlight includes long-life lamps, which are replaceable, and a holder.

The 26 cm diagonal display area contains 800 × 600 pixels and can display 262,144 colors simultaneously.

The NL8060BC26-17 is suitable for industrial application use because the viewing angle is wide and the luminance is high. The viewing direction is selectable for either the upper or the lower side by changing the scan direction.

FEATURES

- High luminance (280 cd/m^2, typ.)
- Wide viewing angle (with retardation film)
- Low reflection
- Reversible scan direction
- 6-bit digital RGB signals
- Data enable (DE) function
- Edge-type backlight with two long-filetime lamps (one lamp holder)
- Replaceable lamp holder
- Recommendation inverter for a backlight: Part No. 104PWBR1

APPLICATIONS

- Display terminals for control systems
- Monitors for process controllers



The information in this document is subject to change without notice.
Please confirm the delivery specification before starting to design your system.

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NEC Corporation 2000

STRUCTURE AND FUNCTION

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 back side of the panel.

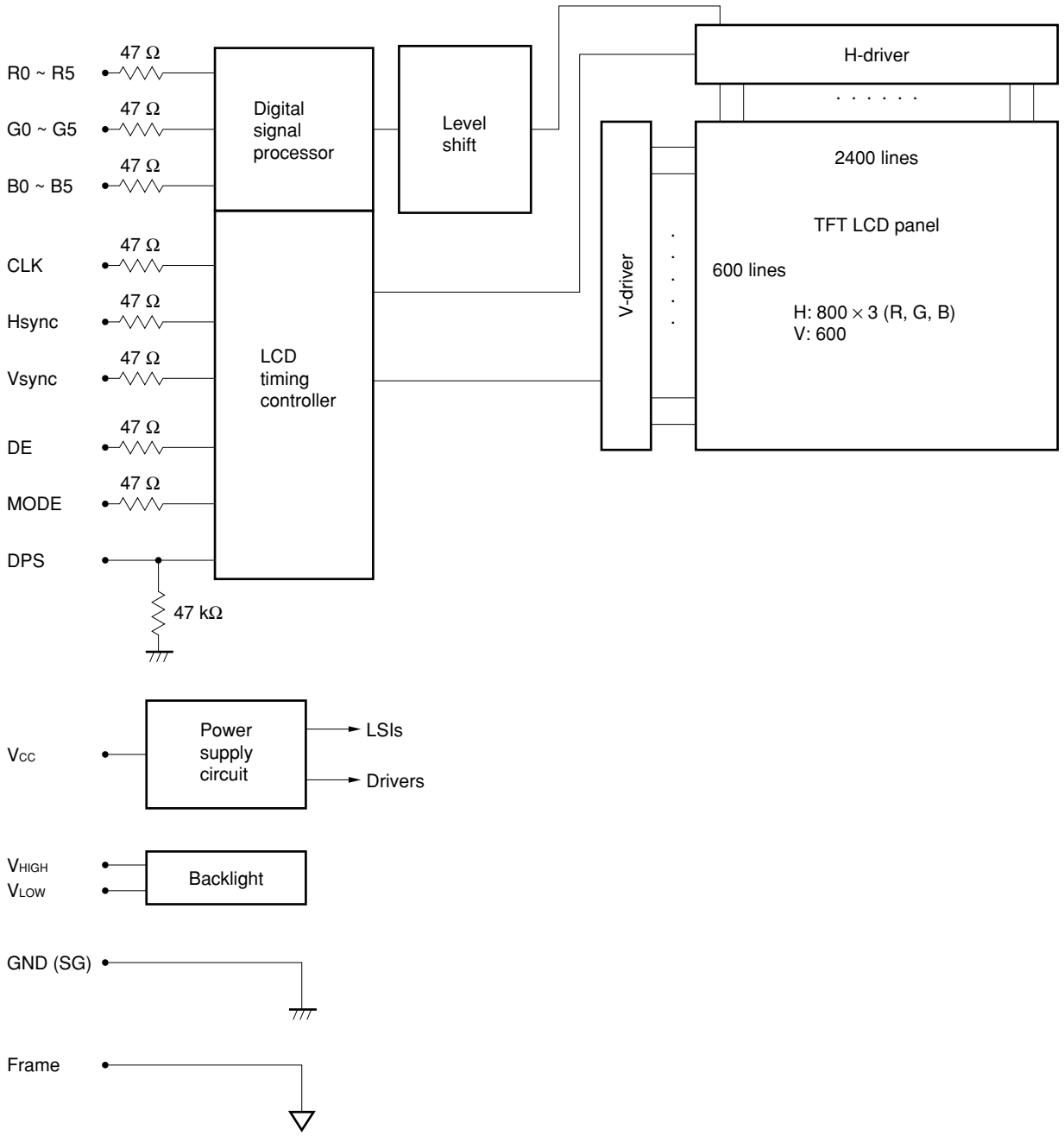
RGB (red, green, blue) data signals from a source system are modulated into a form suitable for active-matrix addressing by the onboard signal processor and sent to the driver LSIs, which in turn address the individual TFT cells.

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.

CHARACTERISTICS (at room temperature)

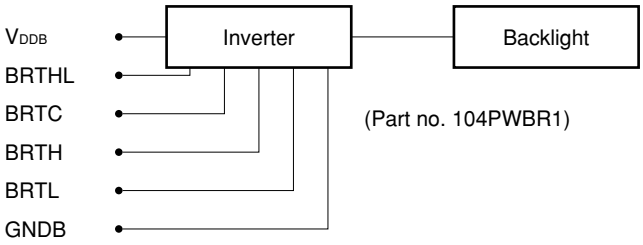
Display area	211.2 (H) × 158.4 (V) mm
Drive system	a-Si TFT active matrix
Display colors	262,144 colors
Number of pixels	800 × 600 pixels
Pixel arrangement	RGB vertical stripe
Pixel pitch	0.264 (H) × 0.264 (V) mm
Module size	243.0 (H) × 185.1 (V) × 11.5 max. (D) mm
Weight	520 (typ.)
Contrast ratio	300:1 (typ.)
Viewing angle (more than the contrast ratio of 10:1)	
	Horizontal: 50° (typ. left side, right side)
	Vertical: 35° (typ. up side), 45° (typ. down side)
Designed viewing direction	• Wider viewing angle with contrast ratio: down side (6 o'clock, normal scan) up side (12 o'clock, reverse scan)
	• Wider viewing angle without image reversal: up side (12 o'clock, normal scan) down side (6 o'clock, reverse scan)
	• Optimum gray-scale (γ = 2.2): perpendicular
Color gamut	43% (typ. center, to NTSC)
Response time	15 ms (max.), "white 100%" to "black 10%"
Luminance	280 cd/m^2 (typ.) (lamp current: I_L = 5 mA rms per lamp)
Signal system	6-bit digital signals for each of the RGB primary colors, synchronous signals (Hsync, Vsync), dot clock (CLK)
Supply voltage	3.3 V [5.0 V] (logic, LCD driving)
Backlight	Edge light type, two cold cathode fluorescent lamps in a holder, attached inverter • Lamp holder set: Part no.104LHS31 • Recommended inverter: Part no. 104PWBR1
Power consumption	7.0 W (typ. at 3.3 V, with recommended inverter)

BLOCK DIAGRAM



Note: Frame is not connected with GND (SG).

If connecting the NEC-recommended inverter



GENERAL SPECIFICATIONS

Item	Specification	Unit
Module size	243.0 ± 0.5 (H) × 185.1 ± 0.5 (V) × 11.5 max. (D)	mm
Display area	211.2 (H) × 158.4 (V)	mm
Number of pixels	800 (H) × 600 (V)	pixel
Dot pitch	0.088 (H) × 0.264 (V)	mm
Pixel pitch	0.264 (H) × 0.264 (V)	mm
Pixel arrangement	RGB (red, green, blue) vertical stripe	
Display colors	262,144	color
Weight	520 (typ.) 550 (max.)	g

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit	Remarks
Supply voltage	V_{CC}	–0.3 to 6.5	V	$V_I - V_{CC} < 3.0$
Input voltage	V_I	–0.3 to 6.5	V	T_a = 25 °C
Lamp voltage	V_L	2000	V_{rms}	T_a = 25 °C
Storage temp.	T_{ST}	–20 to 60	°C	
Operating temp.	T_{OP}	0 to 50	°C	Module surface[Note]
Relative humidity (RH)		≦ 95	%	T_a ≦ 40 °C
		≦ 85	%	40 < T_a ≦ 50 °C
Absolute humidity		Absolute humidity shall not exceed T_a = 50 °C, RH = 85 %	g/m^3	T_a > 50 °C

Note: Measured at the panel surface (including self-heat)

ELECTRICAL CHARACTERISTICS

(1) Logic, LCD Driving

T_a = 25 °C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	V_{CC}	3.0 (4.75)	3.3 (5.0)	3.6 (5.25)	V	V_{CC} = 3.3 V (V_{CC} = 5.0 V)
Logic input “L” voltage	V_{IL}	0	–	V_{CC} × 0.3	V	CMOS level
Logic input “H” voltage	V_{IH}	V_{CC} × 0.7	–	V_{CC}	V	
Supply current	I_{CC}	– –	360 (270)[Note]	550 (500)	mA	V_{CC} = 3.3 V (V_{CC} = 5.0 V)

Note: Checker flag pattern (in EIAJ ED-2522)

(2) Backlight

T_a = 25 °C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Lamp current	I_L	2.0	5.0	5.5	mA rms	with one lamp
Lamp voltage	V_L	–	510	–	V rms	–
Lamp turn-on voltage	V_S	840	–	–	V rms	Ta = 25 °C *2
		1265	–	–		Ta = 0 °C *2
Oscillator frequency	Ft	50	54	58	kHz	*1

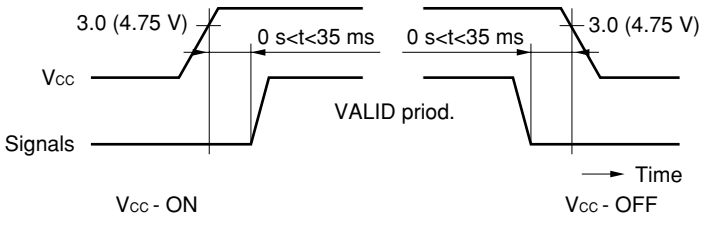
Notes: 1. Recommended value of Ft.

- Ft is within the specification.
  and
- Ft = 1/4Th × (2n –1) Th: Hsync period
  n: a natural number (1, 2, 3…)

If Ft is out of the recommended value, interference between the Ft frequency and Hsync frequency may cause a beat on the display.

2. When Vs is less than the minimum value, the lamp might be not turned on.
3. Recommended inverter: Part no. 104PWBR1

SUPPLY VOLTAGE SEQUENCE



Signals: CLK, Hsync, Vsync, DE, R0 ~ R5, G0 ~ G5, B0 ~ B5

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

2. Turn on the backlight 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 (Hsync, Vsync, CLK, DE, R0 ~ R5, G0 ~ G5, B0 ~ B5) at low level or high impedance.
4. The wrong power sequence may damage the module.
5. The signal should not be down during operation. Even if the signal could recover, the LCD module cannot be operated correctly and the display may be non-uniform. If the signal is down, V_{CC} should be turned off, and then V_{CC} and the signal should be turned on as in the sequence above.

INTERFACE AND CONNECTOR PIN ASSIGNMENT

(1) Interface Signals, Power Supply

Module side connector
CN1 DF9-41P-1V (No. 1 to 41)
Supplier: Hirose Electric Co., Ltd.

Mating connector
DF9-41S-1V

Pin No.	Symbol	Function
1	GND	Ground
2	CLK	Dot clock
3	GND	Ground
4	Hsync	Horizontal sync.
5	Vsync	Vertical sync.
6	GND	Ground
7	GND	Ground
8	GND	Ground
9	R0	Red data (LSB)
10	R1	Red data
11	R2	Red data
12	GND	Ground
13	R3	Red data
14	R4	Red data
15	R5	Red data (MSB)
16	GND	Ground
17	GND	Ground
18	GND	Ground
19	G0	Green data (LSB)
20	G1	Green data
21	G2	Green data

Pin No.	Symbol	Function	
22	GND	Ground	
23	G3	Green data	
24	G4	Green data	
25	G5	Green data (MSB)	
26	GND	Ground	
27	GND	Ground	
28	GND	Ground	
29	B0	Blue data (LSB)	
30	B1	Blue data	
31	B2	Blue data	
32	GND	Ground	
33	B3	Blue data	
34	B4	Blue data	
35	B5	Blue data (MSB)	
36	GND	Ground	
37	DE	Data enable signal	
38	DPS	Scan direction select	**Note 3**
39	V_{CC}	Power supply	**Note 1**
40	V_{CC}	Power supply	**Note 1**
41	MODE	Mode select	**Note 2**

LSB: Least-Significant Bit
MSB: Most-Significant Bit

Notes: 1. V_{CC}: All V_{CC} terminals should be connected to 3.3 V [5.0 V].

2. MODE: { H = Fixed mode
   L or open = DE mode

3. DPS can change scan direction (normal scan and reverse scan).
   DPS: Vcc = normal scan
   GND or open = reverse scan

See page 16, **DISPLAY POSITION**, for an altemate reversible scan.

(2) Lamp Connector

Lamp side connector Mating connector
CN2 ··· BHR-03VS-1 SM02 (4.0) B-BHS-TB
Supplier: J.S.T. Trading Company, Ltd.

Pin No.	Symbol	Function
1	V_{LOW}	Low voltage terminal
2	V_{HIGH}	High voltage terminal
3	V_{HIGH}	High voltage terminal

Caution: V_{HIGH} and V_{LOW} must be connected correctly. If they are connected incorrectly, the user may get hurt and the module may break.

a) Connection of recommended inverter: 104PWBR1 (NEC)

Inverter side connector 1 Mating connector 1
CN1 ··· LZ-5P-SL-SMT LZ-5S-SC3
Supplier: Japan Aviation Electronics Industry, Limited (JAE)

Pin No.	Symbol	Function	Pin No.	Symbol	Function
1	V_{DDB}	Power supply (12 V)	4	GNDB	Backlight ground
2	V_{DDB}	Power supply (12 V)	5	BRTHL	Luminance select[Note]
3	GNDB	Backlight ground			

Note: High luminance (100%): BRTHL = High (+5 V) or open
Low luminance (60%): BRTHL = Low (GNDB level)

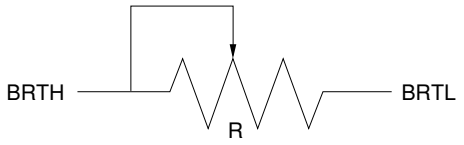
Inverter side connector 2 Mating connector 2
CN3 ··· IL-Z-3PL-SMTY IL-Z-3S-S125C3
Supplier: Japan Aviation Electronics Industry, Limited (JAE)

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

Notes: 1. TTL level
Backlight On: BRTC = High (+5 V) or open
Backlight Off: BRTC = Low (GNDB level)

2. <1> Luminance control by a variable resistor

This way works when BRTHL (the no. 5 pin) of CN3 is opened.



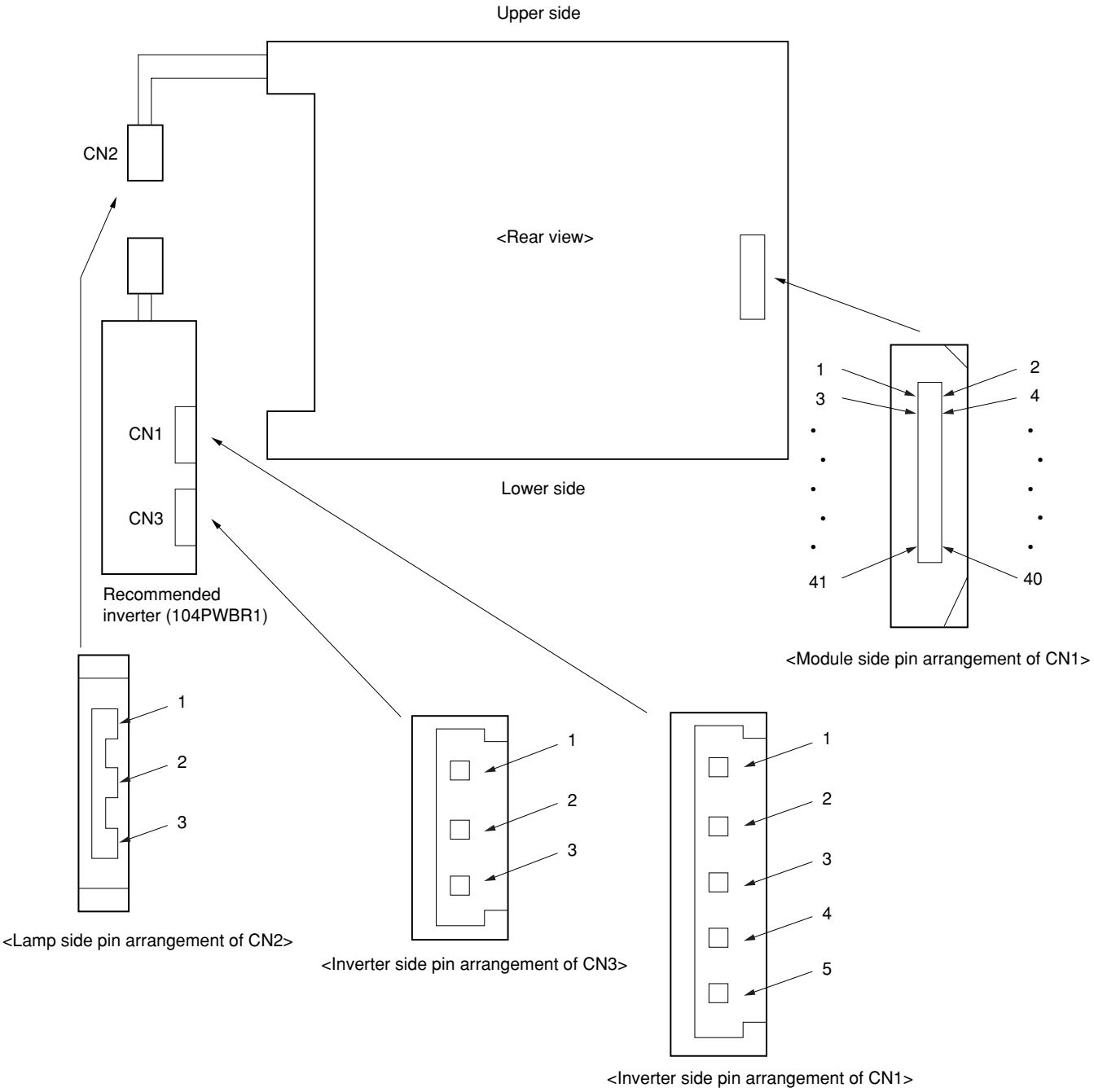
Mating variable resistor: 10 KΩ ±5 %
Minimum luminance (50%): R = 0 Ω
Maximum luminance (100%): R = 10 KΩ

<2> Luminance control by voltage

This way works when BRTL is opened. The range of input voltage between BRTH and GNDB is as follows.

Minimum luminance (50%): 2.5 V
Maximum luminance (100%): ≦ 1.2 V

(3) Connector Location



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 gray-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
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Green gray-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	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 gray-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	0	1
	Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	↑																		
	↓																		
	Bright	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
		0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Note: Colors are developed in combination with 6-bit signals (64 steps in gray-scale) 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

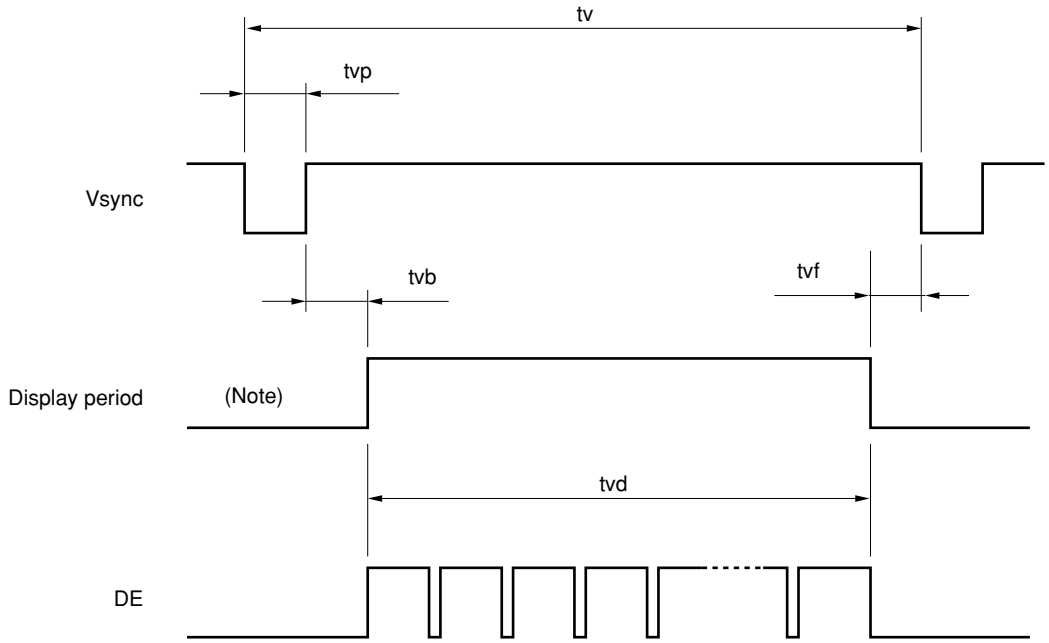
(1) Input Signal Specifications

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency	1/tc	34.0	38.362	40.0	MHz	26.067 ns (typ.)
	Duty	tch/tc	0.4	0.5	0.6	–	–
	Rise, fall	tcrf	–	–	10	ns	–
Hsync	Period	th	24.3	26.693	–	μs	37.468 kHz (typ.)
			–	1024	–	CLK	
	Display period	thd		800		CLK	–
	Front porch	thf	–	24	–	CLK	Fixed mode
			4	24	–	CLK	DE mode
	Pulse width	thp	2	72	127	CLK	Fixed mode
			2	72	–	CLK	DE mode
	Back porch	thb	2	128	198	CLK	Fixed mode
			2	128	–	CLK	DE mode
	thp + thb			200		CLK	Fixed mode
			15	200	–	CLK	DE mode
	CLK-Hsync timing	thch	10	–	–	ns	–
	Hsync-CLK timing	thcs	8	–	–	ns	–
	Hsync-Vsync timing	thv	1	–	–	CLK	–
	Vsync-Hsync timing	tvs	15	–	–	ns	–
	Rise, fall	thrf	–	–	10	ns	–
Vsync	Period	tv	16.1	16.683	17.2	ms	59.94 Hz (typ.)
			–	625	–	H	
	Display period	tvd		600		H	
	Front porch	tvf	–	1	–	H	Fixed mode
			–	1	–	H	DE mode
	Pulse width	tvp	1	2	23	H	Fixed mode
			1	2	–	H	DE mode
	Back porch	tvb	1	22	23	H	Fixed mode
			1	22	–	H	DE mode
	tvp + tvb			24		H	Fixed mode
			2	24	254	H	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	

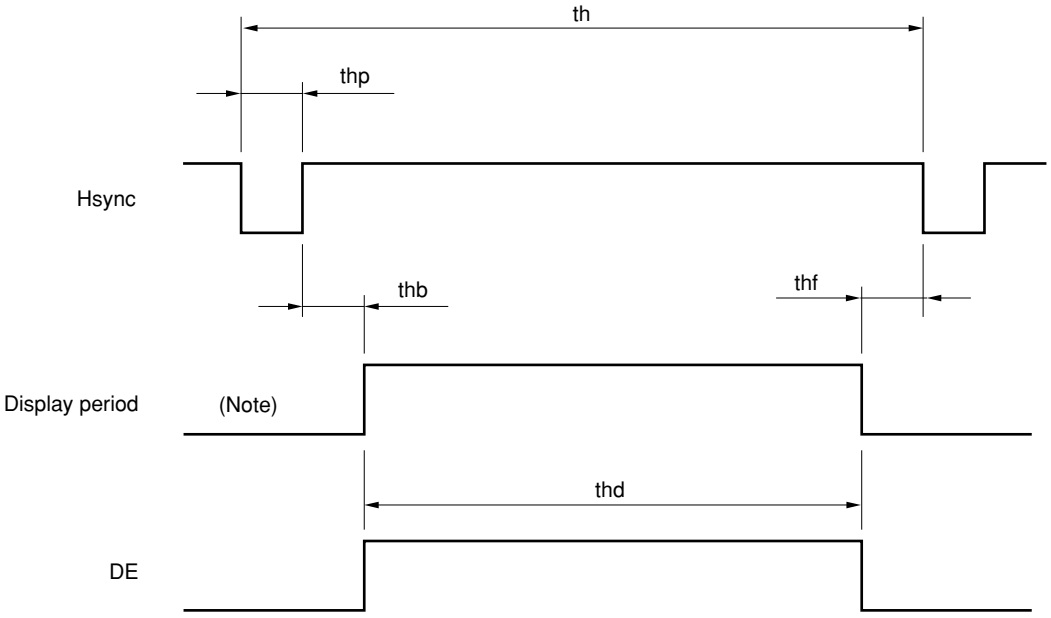
Note: All parameters should be kept in the specified range.

(2) Input Signal Timing

<Vertical>

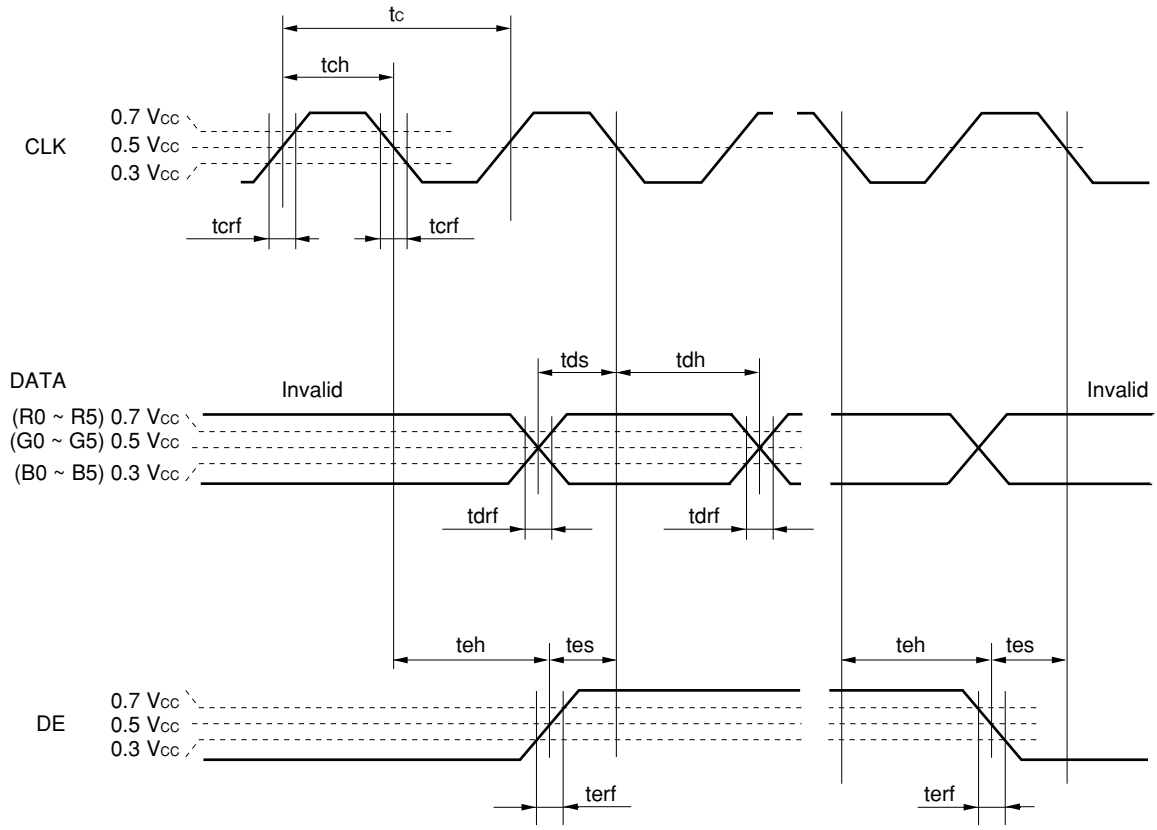


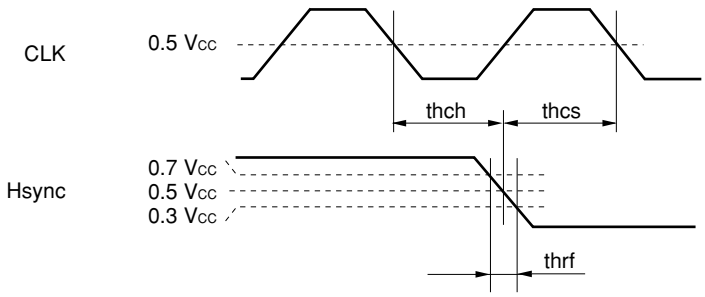
<Horizontal>

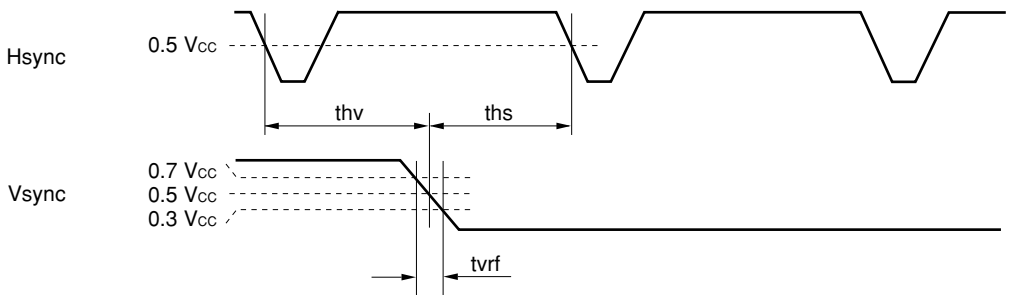


Note: These do not exist as signals.

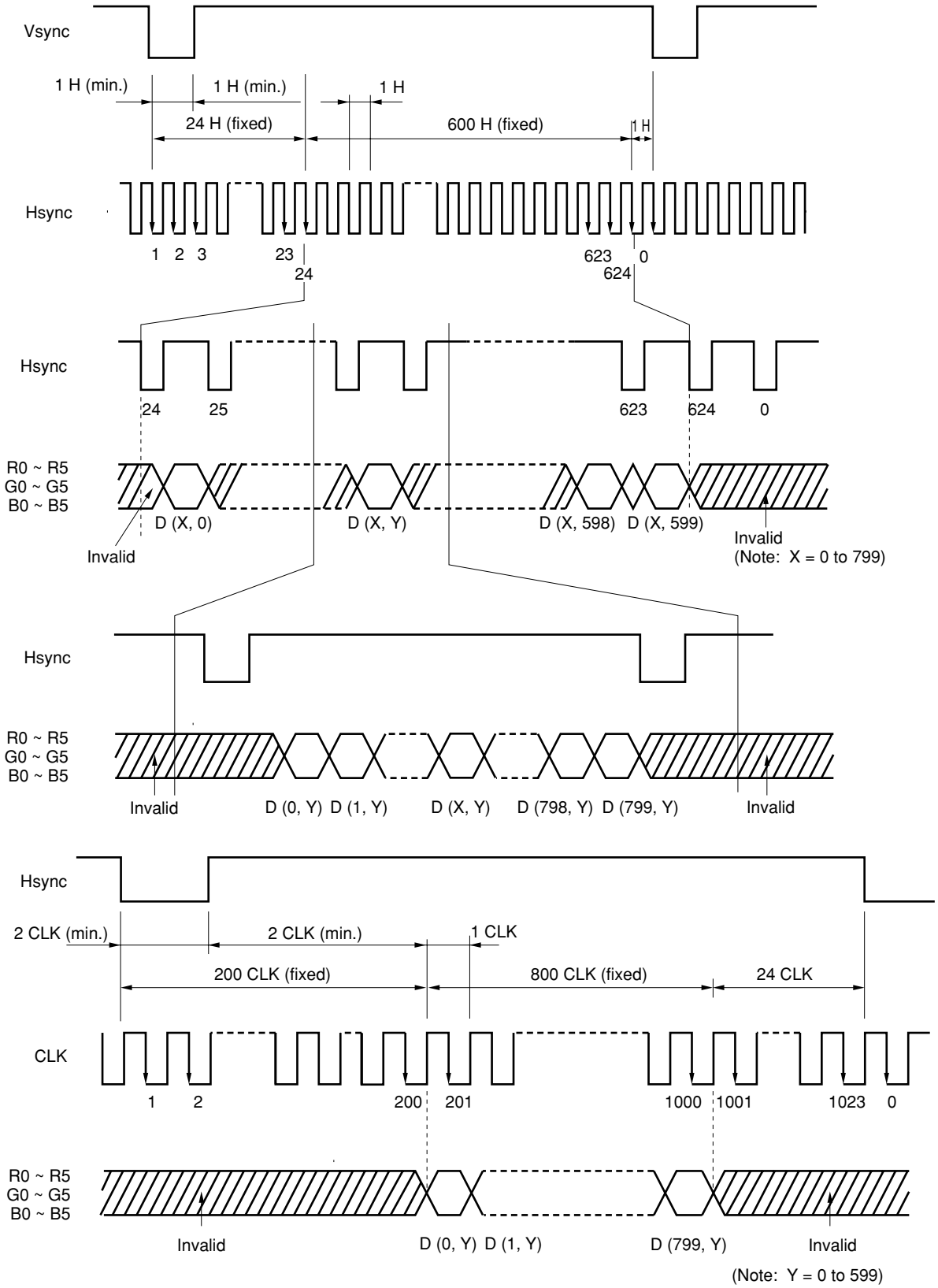
(3) Input Signal Timing Chart



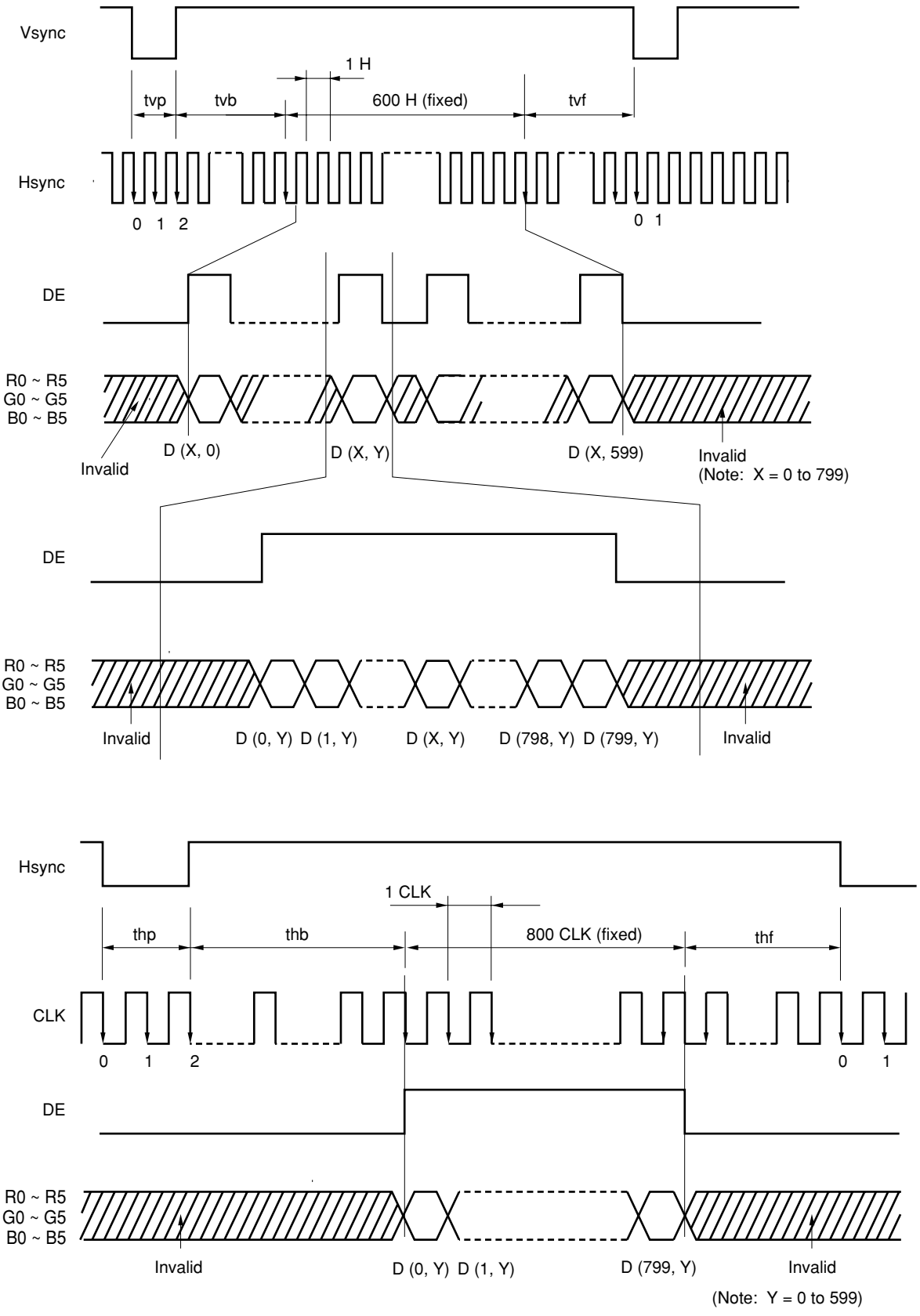




a) Fixed timing mode



b) DE mode


Vsync
1 H
tvp
tvb
600 H (fixed)
tvf
Hsync
0 1 2
0 1
DE
R0 ~ R5
G0 ~ G5
B0 ~ B5
Invalid
D (X, 0)
D (X, Y)
D (X, 599)
Invalid
(Note: X = 0 to 799)
DE
R0 ~ R5
G0 ~ G5
B0 ~ B5
Invalid
D (0, Y) D (1, Y)
D (X, Y)
D (798, Y) D (799, Y)
Invalid
Hsync
1 CLK
thp
thb
800 CLK (fixed)
thf
CLK
0 1 2
0 1
DE
R0 ~ R5
G0 ~ G5
B0 ~ B5
Invalid
D (0, Y) D (1, Y)
D (799, Y)
Invalid
(Note: Y = 0 to 599)

DISPLAY POSITION

Normal scan (DPS = "Vcc")

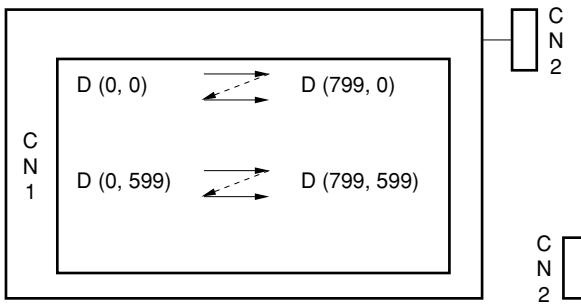
D (0, 1)	D (1, 1)	- - - - - - - - -	D (X, 1)	- - - - - - - - -	D (798, 1)	D (799, 1)
D (0, 1)	D (1, 1)	- - - - - - - - -	D (X, 1)	- - - - - - - - -	D (798, 1)	D (799, 1)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
D (0, Y)	D (1, Y)	- - - - - - - - -	D (X, Y)	- - - - - - - - -	D (798, Y)	D (799, Y)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
D (0, 598)	D (1, 598)	- - - - - - - - -	D (X, 598)	- - - - - - - - -	D (798, 598)	D (799, 598)
D (0, 599)	D (1, 599)	- - - - - - - - -	D (X, 599)	- - - - - - - - -	D (798, 599)	D (799, 599)

Reverse scan (DPS = "GND" or "Open")

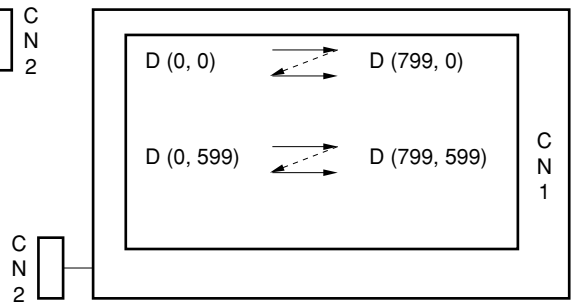
D (799,599)	D (798,599)	- - - - - - - - -	D (X, 599)	- - - - - - - - -	D (1,599)	D (0,599)
D (799,598)	D (798,598)	- - - - - - - - -	D (X, 598)	- - - - - - - - -	D (1,598)	D (0,598)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
D (799, Y)	D (798, Y)	- - - - - - - - -	D (X, Y)	- - - - - - - - -	D (1, Y)	D (0, Y)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
D (799, 1)	D (798, 1)	- - - - - - - - -	D (X, 1)	- - - - - - - - -	D (1, 1)	D (0, 1)
D (799, 0)	D (798, 0)	- - - - - - - - -	D (X, 0)	- - - - - - - - -	D (1, 0)	D (0, 0)

The drawings below show the relationship between the scan direction and the viewing direction.

Normal scan



Reverse scan



OPTICAL CHARACTERISTICS

Ta = 25°C **Note 1**

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Contrast ratio	CR	**Note 2**	150	300	–	–	**Note 3**
Luminance	Lu max	**Note 2**	200	280	–	cd/m^2	**Note 4**
Luminance uniformity	–	max./min.	–	–	1.4	–	**Note 5**

Reference data

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Response time		ton	White to black 100% → 10%	–	15	50	ms	**Note 6**
		toff	Black to white 0% → 90%	–	65	80	ms	
Color gamut		C	at center, to NTSC	–	43	–	%	–
Viewing angle range	Horizontal	$\theta x+$	CR > 10, $\theta y = \pm 0°$	45	50	–	deg.	**Note 7**
		$\theta x-$	CR > 10, $\theta y = \pm 0°$	45	50	–	deg.	
	Vertical	$\theta y+$	CR > 10, $\theta y = \pm 0°$	30	35	–	deg.	
		$\theta y-$	CR > 10, $\theta y = \pm 0°$	40	45	–	deg.	

Notes: 1. V_{CC} = 3.3 V; IL = 5.0 mA rms; DPS = High at normal scan with recommended inverter.

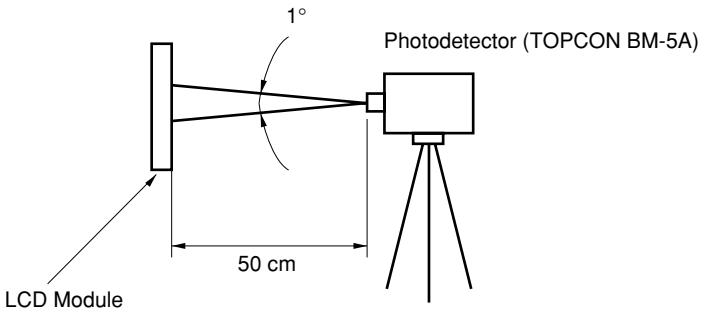
2. Viewing angle: $\theta x = \pm 0°$, $\theta y = \pm 0°$, at center.

3. 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.

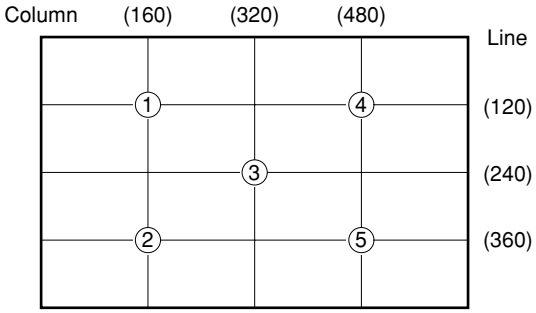
4. The luminance is measured after 20 minutes from the module works, with all pixels in "white". Typical value is measured after luminance saturation. The luminance is measured in darkroom.



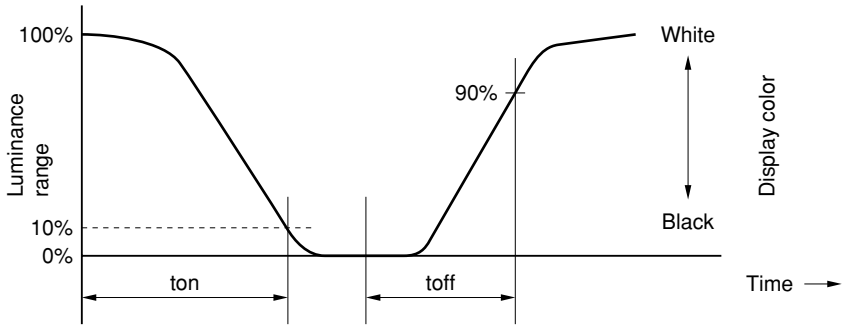
5. The luminance uniformity is calculated by using following formula.

$$\text{Luminance uniformity} = \frac{\text{Maximum luminance}}{\text{Minimum luminance}}$$

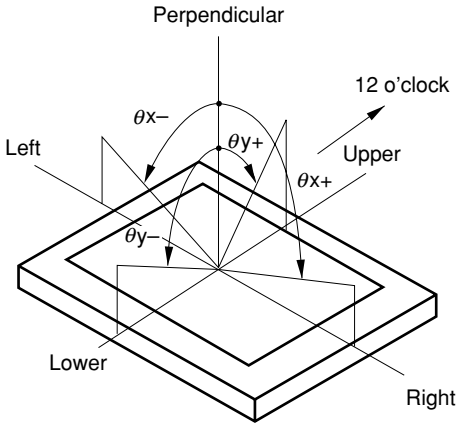
The luminance is measured at or near the five points shown below.



6. Definition of response time is as follows.
The photodetector output signal is measured when the luminance changes from white to black or from black to white.



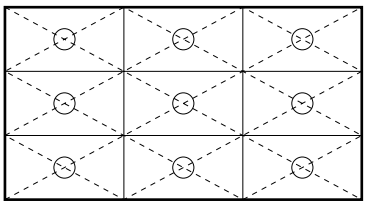
7. Definitions of viewing angles are as follows.



RELIABILITY TEST

Test Items	Test Conditions	Notes
High temperature/humidity operation	50 ± 2°C, 85% relative humidity 240 hours Display data is black.	**Note 1**
Heat cycle (operation)	<1> 0°C ± 3°C … 1 hour 55°C ± 3°C … 1 hour <2> 50 cycles, 4 hours/cycle <3> Display data is black.	**Note 1**
Thermal shock (nonoperation)	<1> –20°C ± 3°C … 30 minutes 60°C ± 3°C … 30 minutes <2> 100 cycles <3> Temperature transition time within 5 minutes	**Note 1**
Vibration (nonoperation)	<1> 5 - 100 Hz, 19.6 m/s^2 (2G) 1 minute/cycle, X, Y, Z direction <2> 120 times each direction	**Note 1** **Note 2**
Mechanical shock (nonoperation)	<1> 539 m/s^2 (55G), 11 ms X, Y, Z direction <2> 5 times each direction	**Note 1** **Note 2**
ESD (operation)	150 pF, 150 Ω, ±10 kV 9 places on a panel 10 times each place at one-second intervals	**Note 1** **Note 3**
Dust (operation)	15 kinds of dust (JIS Z 8901) Hourly 15 seconds stir, 8 times repeat	**Note 1**

Notes: 1. Display function is checked by the same condition as the LCD module outgoing inspection.
2. Physical damage.
3. Discharge points are shown as follows.



GENERAL CAUTIONS

The figures and statements below are very important. Please be sure you understand their contents completely.

CAUTION	This mark indicates that you will get hurt and/or the module will be damaged if you make a mistake in operation.

	This figure indicates that you will get hurt if you make a mistake in operation.

CAUTION

(1) Caution when taking out the module

<1> Pick up the pouch only, when removing the module from a carrier box.

(2) Cautions for handling the module

<1> As electrostatic discharges may break the LCD module, handle the LCD module with care against electrostatic discharges.

<2> As the LCD panel and backlight element are made from fragile glass material, impact and pressure to the LCD module should be avoided.

<3> As the surface of the 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 the CLK, Hsync, or Vsync signal. If any one of these signals is lost, the LCD panel will be damaged.

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

<9> Don't push or rub the surface of the LCD module.
If you do, scratches or rubbing marks may be left on the surface of the module.

<10> Do not give any stress to the interface connector.

(3) Cautions regarding atmosphere

<1> Dew-drop atmosphere must 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 in a relatively low-temperature atmosphere is recommended.

<3> This module uses cold cathode fluorescent lamps. Therefore, the lifetime of the lamp is shortened conspicuously at very low temperatures.

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

(4) Cautions about module characteristics

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

<2> This module has retardation film, which may cause variation of the color hue at different viewing angles. Nonuniformity may appear on the screen during high-temperature operation.

<3> A light vertical stripe may be observed, depending on the display pattern. This is not a defect or a malfunction.

<4> Noise from the inverter circuit may be observed in the luminance control mode. This is not a defect or a malfunction.

(5) Other cautions

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

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

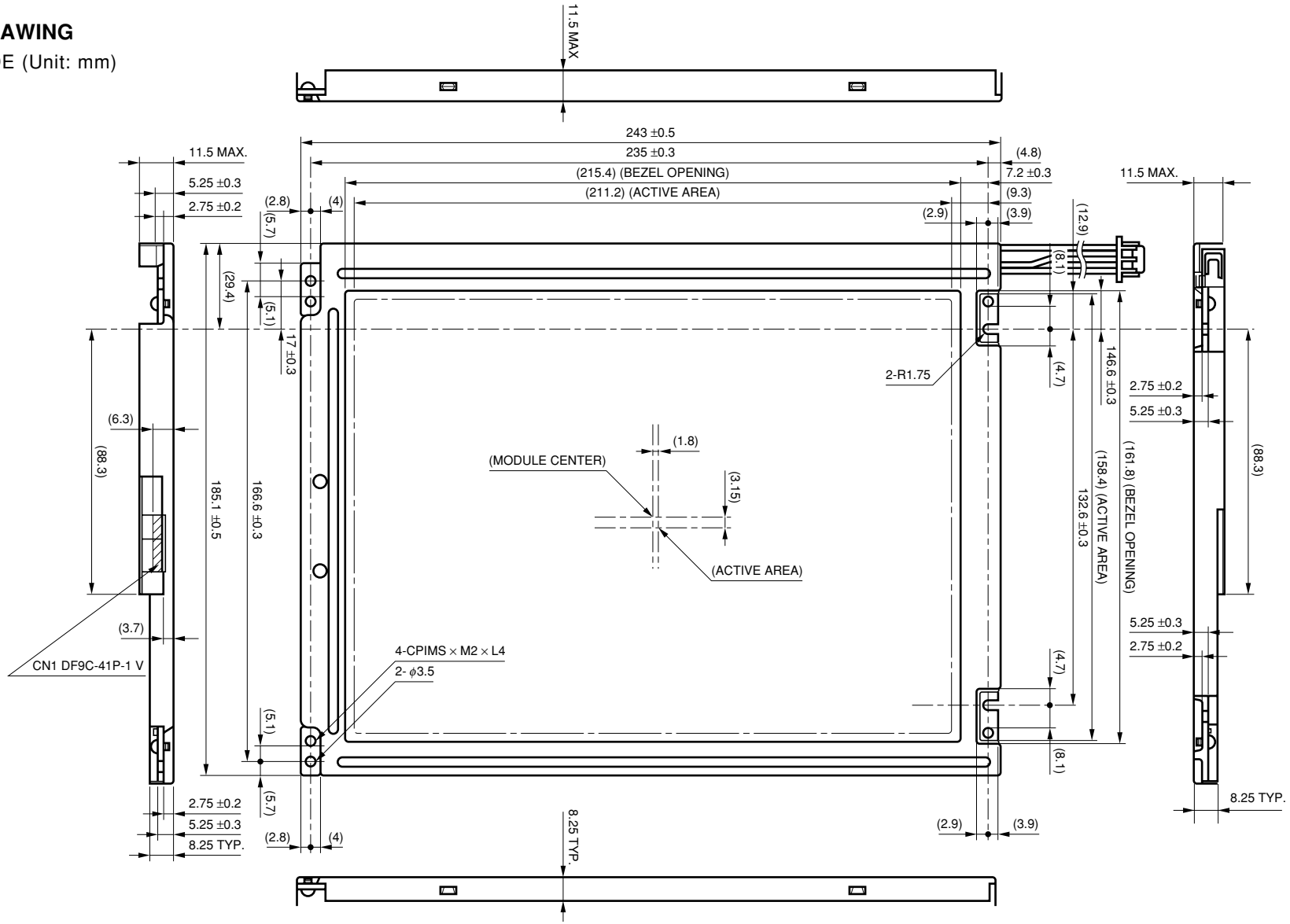
<3> When returning the module for repair, etc., please pack the module properly so as to avoid damages. We recommend using the original shipping packages.

<4> If a scan converter is used to convert the VGA signal to NTSC, it is recommended to use the frame memory type, not the line memory.

The liquid crystal display has the following specific characteristics. These are not defects or malfunctions.
The display condition of the LCD module may be affected by the ambient temperature.
The LCD module uses a cold cathode tube for backlighting. Optical characteristics, like luminance or uniformity, will change over time.
Uneven brightness and/or small spots may be observed, depending on different display patterns.

OUTLINE DRAWING

FRONT SIDE (Unit: mm)

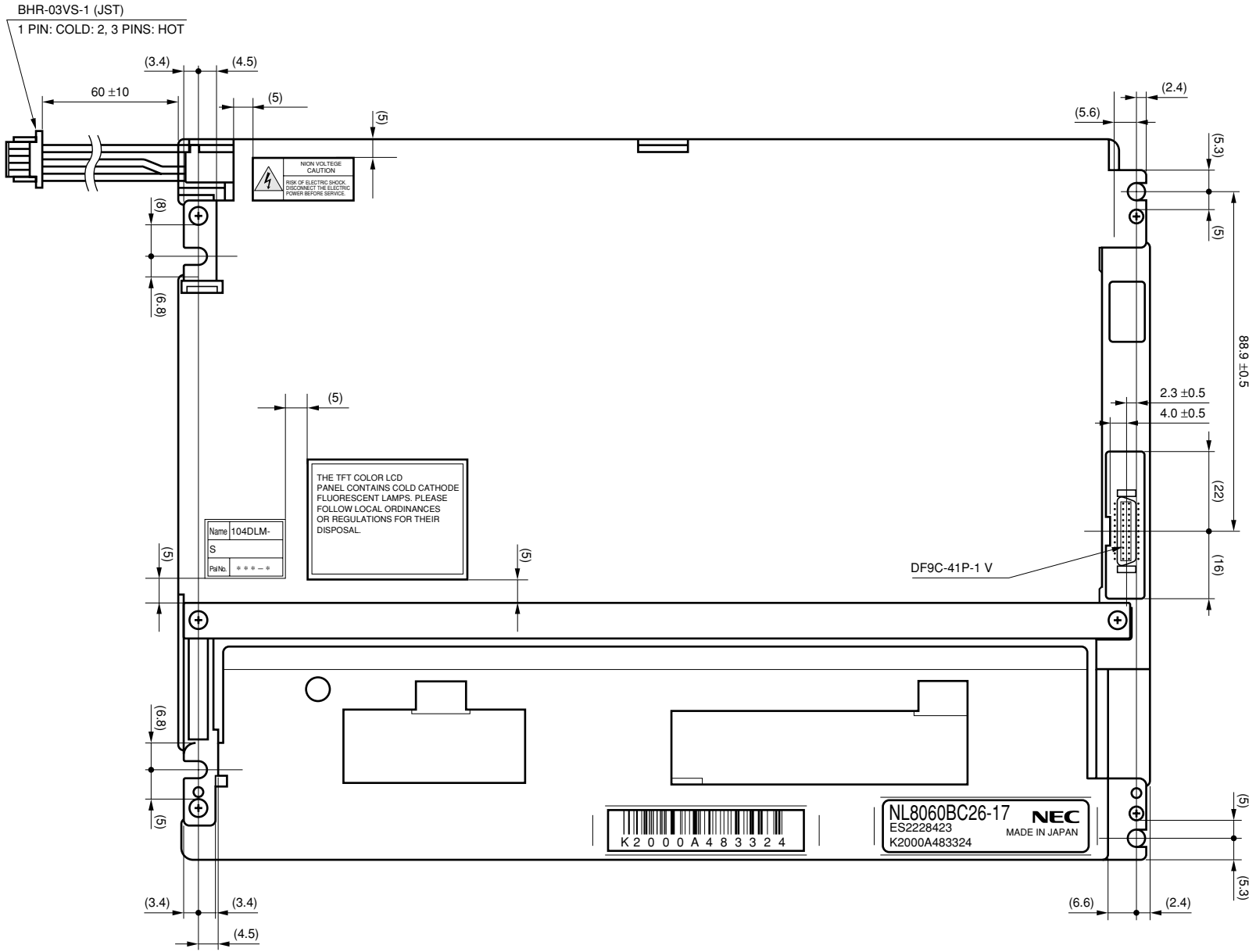


Notes : 1. The torque on mounting screws should never exceed 0.294 N·m (3Kgf·cm).

2. The values in parentheses are for reference.

OUTLINE DRAWING

REAR SIDE (Unit: mm)



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Specific: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

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