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Document No.	AP3R-150MX41-AC1	Revision	1.0

TO :

Date : Jan. 05, 2000

HannStar Product Information

Customer Acceptance Specification

MODEL : HSD150MX41

-A

Accepted by:		
Signature	Date	
_____	_____	
Proposed by: HannStar Display Corporation		
Product Development Div.	Product Engineering Dep.	Q. R. A. Div.
_____	_____	_____

- Note:1. Please contact HannStar Display Corp. before designing your product based on this module specification.
2. The information contained herein is presented merely to indicate the characteristics and performance of our products. No responsibility is assumed by HannStar for any intellectual property claims or other problems that may result from application based on the module described herein.

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1. RECORD OF REVISIONS

ECN. No.	Date	Description of change
01	Jan. 05, 2000	Specification for HSD150MX41-A was first issued.

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2. GENERAL DESCRIPTION

HannStar Display model HSD150MX41-A is a color active matrix thin film transistor(TFT) liquid crystal display(LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT LCD panel, a driving circuit and a backlight system. This TFT LCD has a 15 inch diagonally measured active display area with XGA resolution(768 vertical by 1024 horizontal pixel array) and can display up to 262,144 colors.

FEATURES:

- High brightness with low power consumption
- Wide viewing angle
- Compact and light weight design
- 2 CCFLs(Cold Cathode Fluorescent Lamp)
- DE mode only
- CMOS interface with 6bit color data

APPLICATIONS:

- Desktop monitors
- moniputers
- Display terminals for AV applications
- Monitors for industrial applications

GENERAL INFORMATION:

Item	Specification	Unit
Display area	304.1 (H)*228.1(V)	mm
Number of pixel	1024(H)*768(V)	pixels
Pixel pitch	0.297(H)*0.297(V)	mm
Pixel arrangement	RGB Vertical stripe	
Display color	262,144	
Display mode	Normally white	
Surface treatment	Antiglare, Hard-Coating (3H)	
Weight	1100	g
Back-light	Bottom edge side 2-CCFL	
Input signal	CMOS interface with 6bit color data	
Power consumption	10.5	W
Optimum viewing direction	6 o'clock	

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MECHANICAL INFORMATION

Item		Min.	Typ.	Max.	Unit
Module Size	Horizontal(H)	335.5	336	336.5	mm
	Vertical(V)	248.5	249	249.5	mm
	Depth(D)	—	—	13.5	mm
Weight (without inverter)		—	1070	1100	g

3. ABSOLUTE MAXIMUM RATINGS

3.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T_{STG}	-20	65	°C	
Operating temperature	T_{OPR}	0	50	°C	
Vibration(non-operating)	V_{nop}	—	1.5	G	(1)
Shock(non-operating)	S_{nop}	—	50	G	(2)
Storage humidity	H_{STG}	10	90	%RH	(3)

Note(1)10-200-10Hz sweep/cycle, X,Y,Z each directions, 0.5hr each

(2)20ms, $\pm X, \pm Y, \pm Z$ direction, one time each. For this shock test, it is necessary to fill the silicon rubber between the shock jig as buffer.

(3)Max wet bulb temp =39°C

3.2 ELECTRICAL ABSOLUTE RATINGS

(1) TFT LCD MODULE

Item	Symbol	Min.	Max.	Unit	Note
Power supply voltage	V_{DD}	-0.3	4.0	V	(1)
Logic input voltage	V_{in}	-0.3	$V_{DD} + 0.3$	V	(1)

(2) BACK-LIGHT UNIT

Item	Symbol	Min.	Max.	Unit	Note
Lamp voltage	V_L	0	2000	V(rms)	(1)
Lamp current	I_L	—	7.0	mA	(1)
Lamp frequency	f_L	0	100	KHz	(1)

Note: (1) Permanent damage may occur to the LCD module if beyond this specification.

Functional operation should be restricted to the conditions described under Normal Operating Conditions.

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4. OPTICAL CHARACTERISTICS

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Contrast		CR	$\Theta=0$ $\Phi=0$ Normal Viewing Angle	—	250	—		(1)(2)	
Response time	Rising	T_R		—	10	—	msec	(1)(3)	
	Falling	T_F		—	40	—			
White luminance (center of screen)		Y_L			—	200	—	cd/m ²	(1)(4)
Color chromaticity (CIE1931)	Red	R_x		0.57	0.62	0.67			
		R_y		0.28	0.33	0.38			
	Green	G_x		0.23	0.28	0.33			
		G_y		0.54	0.59	0.64			
	Blue	B_x		0.09	0.14	0.19			
		B_y		0.06	0.11	0.16			
White	W_x	0.25	0.30	0.35					
	W_y	0.28	0.33	0.38					
Viewing angle	Hor.	Θ_L	CR>10	—	60	—			
		Θ_R		—	60	—			
	Ver.	Φ_H		—	40	—			
		Φ_L		—	45	—			
Brightness uniformity		B_{UNI}		60	—	—	%	(5)	

Measuring condition :

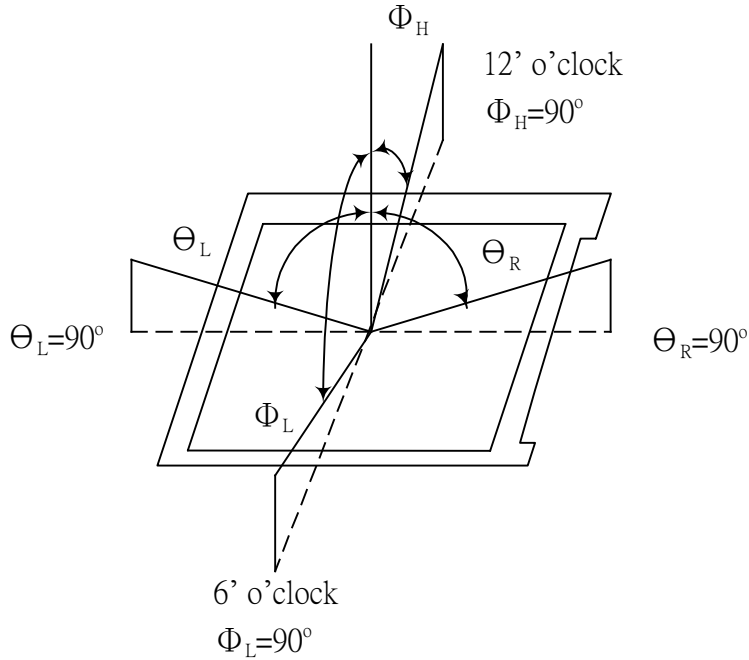
- Measuring surrounding : dark room
- Lamp current $I_L:6\pm0.1mA$
- $V_{DD}=3.3V$, $f_V=60Hz$, $f_{DCLK}=32.5MHz$
- Surrounding temperature : $25\pm2^\circ C$
- 30 min. warm-up time

Measuring equipment :

- BM-7

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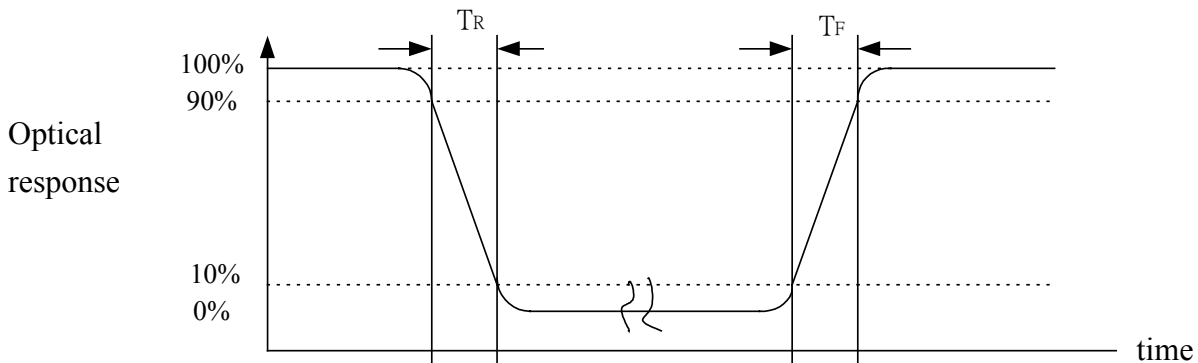
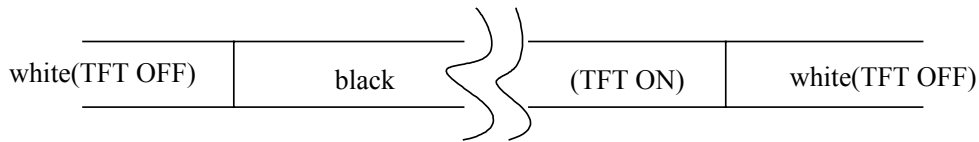
Note (1) Definition of Viewing Angle :



Note (2) Definition of Contrast Ratio (CR) :
measured at the center point of panel

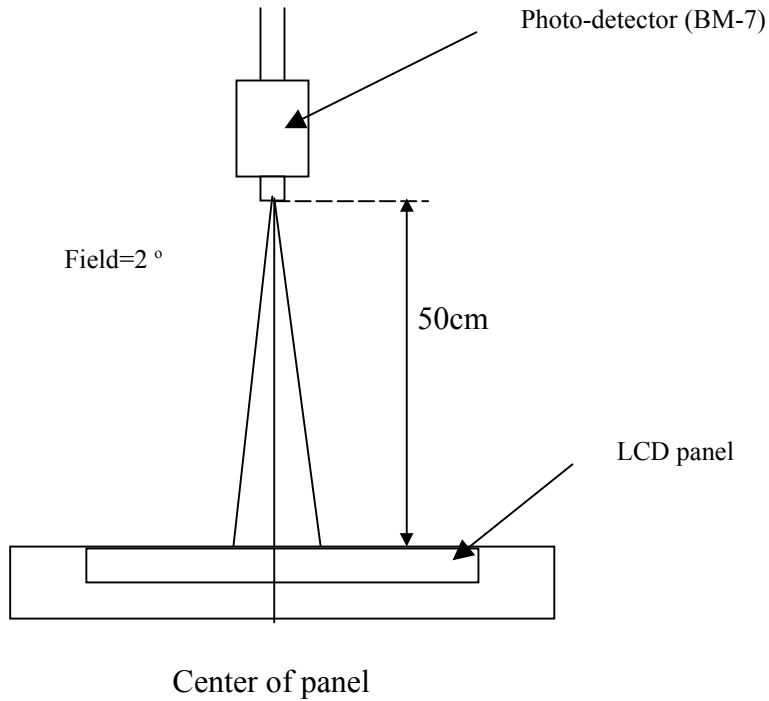
$$CR = \frac{\text{Luminance with all pixels white (L63)}}{\text{Luminance with all pixels black (L0)}}$$

Note (3) Definition of Response Time : Sum of T_R and T_F



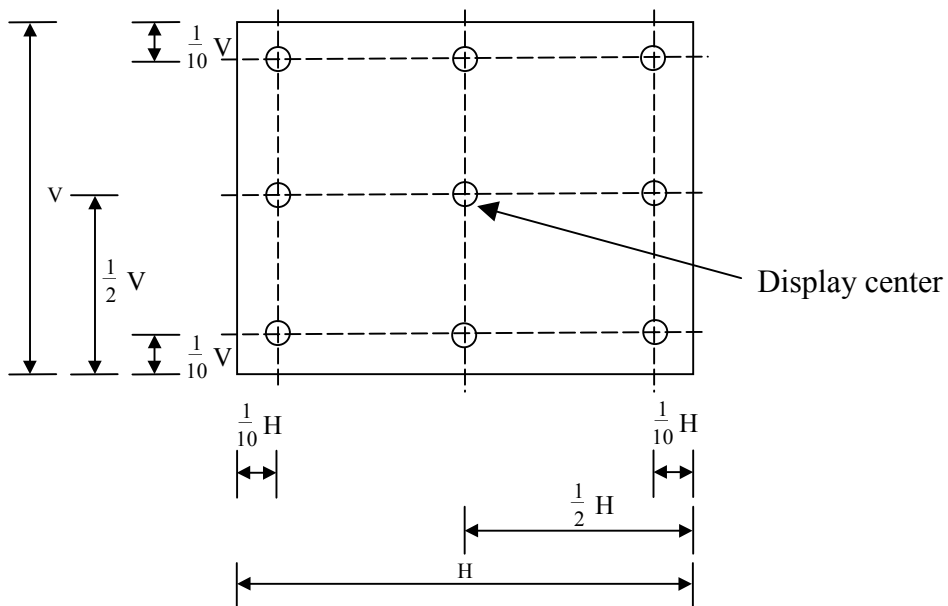
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Note (4) Optical characteristics measurement setup



Note (5) Definition of brightness uniformity

$$\text{Luminance uniformity} = (\text{Min Luminance}) / (\text{Max Luminance}) \times 100\%$$



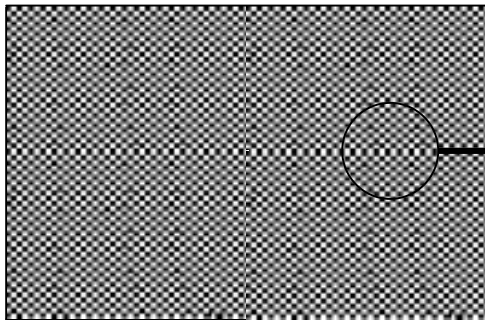
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5. ELECTRICAL CHARACTERISTICS

5.1 TFT LCD MODULE

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of power supply	V_{DD}	3.0	3.3	3.6	V	
Input voltage	High	V_{IH}	2.4	—	3.6	V
	Low	V_{IL}	0	—	0.9	V
Current of power supply	Mosaic	I_{DD}	—	460	—	mA (1)
Vsync frequency	f_V	—	60.00	75.00	Hz	(2)
Hsync frequency	f_H	—	48.35	60.00	kHz	
Main frequency	f_{DCLK}	—	32.50	39.37	MHz	

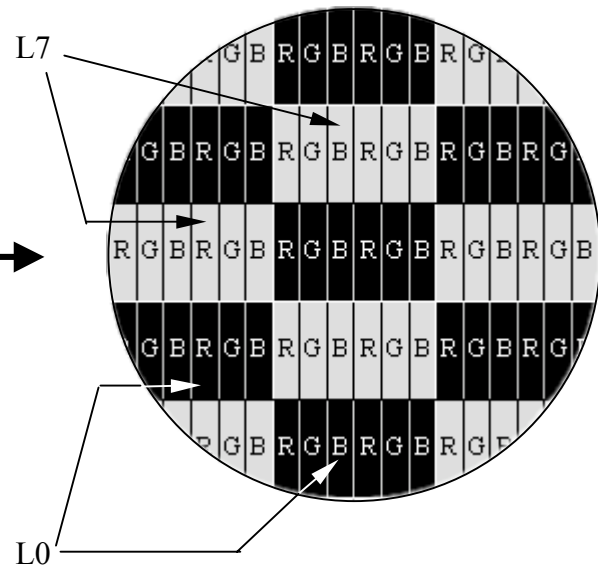
(1)Mosaic: Dot checker image



Grey scale: L0~L63.

L0: Luminance with all pixels black.

L63: Luminance with all pixels white.



(2)When f_V is too low, a flicker may be occurred on the display.

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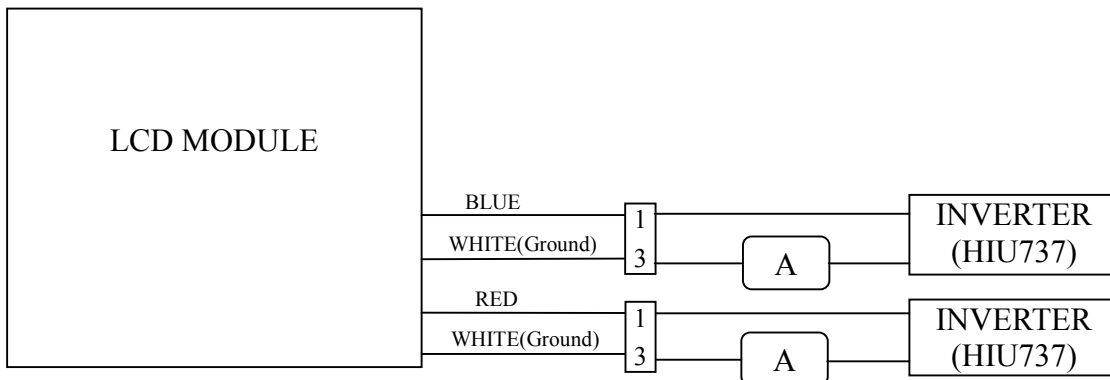
5.2 BACK-LIGHT UNIT

The back-light system is an edge-lighting type with 2 CCFL(Cold Cathod Fluorescent Lamp).

The characteristics of two lamps are shown in the following tables.

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Lamp current	I_L	3.0	6.0	7.0	mA(rms)	(1)
Lamp voltage	V_L	—	640	—	V(rms)	$I_L=6.0mA$
Frequency	f_L	20	30	70	KHz	(2)
Operating life time	Hr	50,000	—	—	Hour	(3)
Startup voltage	V_s	—	—	1220	V(rms)	at 25°C
				1410		at 0°C

Note(1)Lamp current is measured with current meter for high frequency as shown below. Specified values are for a lamp.



(2)Lamp frequency may produce interference with horizontal synchronous frequency and this may cause line flow on the display. Therefore lamp frequency shall be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.

(3) Life time (Hr) can be defined as the time in which it continues to operate under the condition:

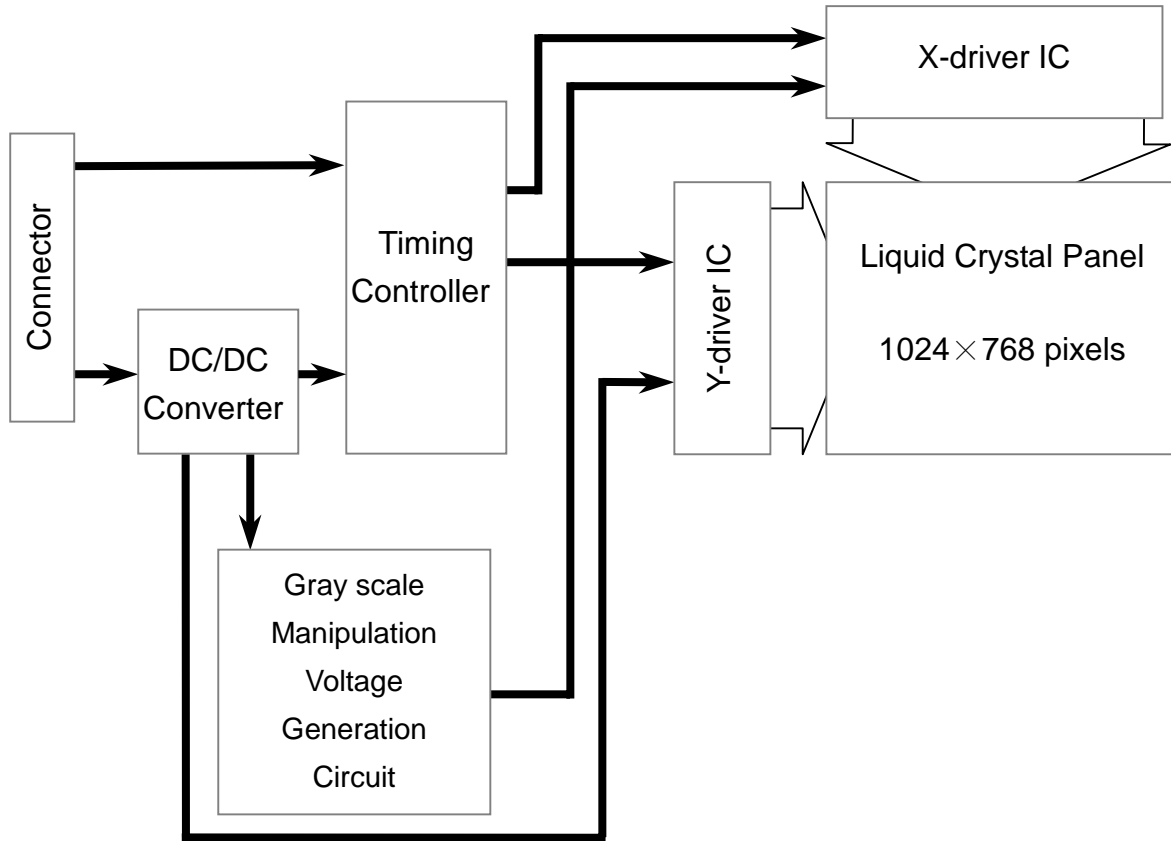
$T_a=25\pm 3^\circ C$, $I_L=6.0mA(rms)$ and $f_L=30$ KHz until one of the following event occurs:

1. When the brightness becomes 50%.
2. When the startup voltage (V_s) at 0°C becomes higher than the maximal value of V_s specified above.

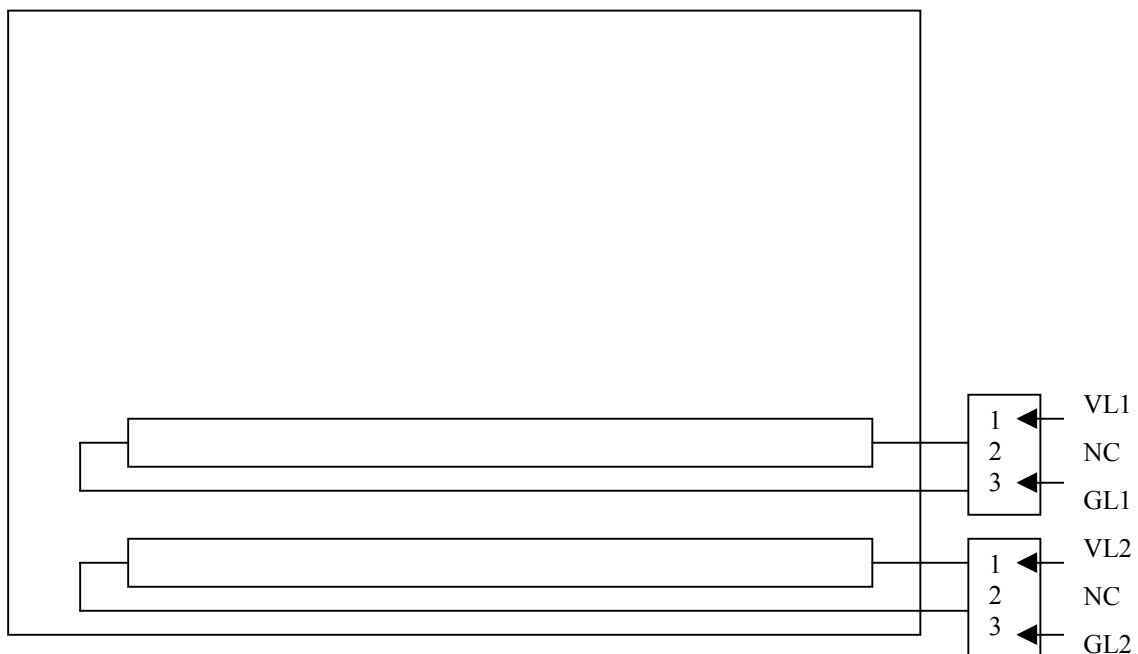
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6. BLOCK DIAGRAM

6.1 TFT LCD MODULE



6.2 BACK-LIGHT UNIT



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7. INTERFACE PIN CONNECTION

7.1 TFT LCD MODULE

CN1¹⁾²⁾³⁾ INPUT SIGNAL (FX8-60S-SV/HIROSE ELECTRIC CO., LTD)¹⁾²⁾³⁾

MATING CONNECTOR: FX8-60P-SV/HIROSE ELECTRIC CO., LTD

Terminal no.	Symbol	Function	Terminal no.	Symbol	Function
1	GND	Ground	31	EB5	BLUE DATA B5 (MSB) EVEN
2	GND	Ground	32	EB4	BLUE DATA B4 EVEN
3	ENAB	COMPOUND SYNCHONAIIZATION SIGNAL	33	EB3	BLUE DATA B3 EVEN
4	NC		34	EB2	BLUE DATA B2 EVEN
5	NC		35	EB1	BLUE DATA B1 EVEN
6	GND	Ground	36	EB0	BLUE DATA B0 (LSB) EVEN
7	OB5	BLUE DATA B5 (MSB) ODD	37	GND	Ground
8	OB4	BLUE DATA B4 ODD	38	EG5	GREEN DATA G5 (MSB) EVEN
9	OB3	BLUE DATA B3 ODD	39	EG4	GREEN DATA G4 EVEN
10	OB2	BLUE DATA B2 ODD	40	EG3	GREEN DATA G3 EVEN
11	OB1	BLUE DATA B1 ODD	41	EG2	GREEN DATA G2 EVEN
12	OB0	BLUE DATA B0 (LSB) ODD	42	EG1	GREEN DATA G1 EVEN
13	GND	Ground	43	EG0	GREEN DATA G0 (LSB) EVEN
14	OG5	GREEN DATA G5 (MSB) ODD	44	GND	Ground
15	OG4	GREEN DATA G4 ODD	45	ER5	RED DATA R5 (MSB) EVEN
16	OG3	GREEN DATA G3 ODD	46	ER4	RED DATA R4 EVEN
17	OG2	GREEN DATA G2 ODD	47	ER3	RED DATA R3 EVEN
18	OG1	GREEN DATA G1 ODD	48	ER2	RED DATA R2 EVEN
19	OG0	GREEN DATA G0 (LSB) ODD	49	ER1	RED DATA R1 EVEN
20	GND	Ground	50	ER0	RED DATA R0 (LSB) EVEN
21	OR5	RED DATA R5 (MSB) ODD	51	GND	Ground
22	OR4	RED DATA R4 ODD	52	ENCLK	PIXEL CLOCK EVEN
23	OR3	RED DATA R3 ODD	53	GND	Ground
24	OR2	RED DATA R2 ODD	54	GND	Ground
25	OR1	RED DATA R1 ODD	55	VDD	3.3 V POWER SUPPLY
26	OR0	RED DATA R0 (LSB) ODD	56	VDD	3.3 V POWER SUPPLY
27	GND	Ground	57	VDD	3.3 V POWER SUPPLY
28	ONCLK	PIXEL CLOCK ODD	58	VDD	3.3 V POWER SUPPLY
29	GND	Ground	59	GND	Ground
30	GND	Ground	60	GND	Ground

- 1) Please connect NC pin to nothing. Don't connect it to ground nor to other signal input. (NC pin should be open.)
- 2) Please connect GND pin to ground. Don't use it as no-connect nor connect with high Impedance.
- 3) 262,144 colors are displayed by the combinations of 18 bits data.

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7.2 BACK-LIGHT UNIT

CN2¹⁾ CCFL POWER SOURCE

BHR-03VS-1/JAPAN SOLDERLESS TERMINAL MFG CO., LTD. ¹⁾

Mating Connector : SM02 (8.0) B-BHS/JAPAN SOLDERLESS TERMINAL MFG CO., LTD.

Terminal no.	Symbol	Function
1	VL1	CCFL power supply (high voltage)
2	NC ¹⁾	
3	GL1	CCFL power supply (low voltage)

CN3¹⁾ CCFL POWER SOURCE

BHR-03VS-1/JAPAN SOLDERLESS TERMINAL MFG CO., LTD. ¹⁾

Mating Connector : SM02 (8.0) B-BHS/JAPAN SOLDERLESS TERMINAL MFG CO., LTD.

Terminal no.	Symbol	Function
1	VL2	CCFL power supply (high voltage)
2	NC ¹⁾	
3	GL2	CCFL power supply (low voltage)

Note

- 1) Please connect NC pin to nothing. Don't connect it to ground nor to other signal input. (NC pin should be open.)

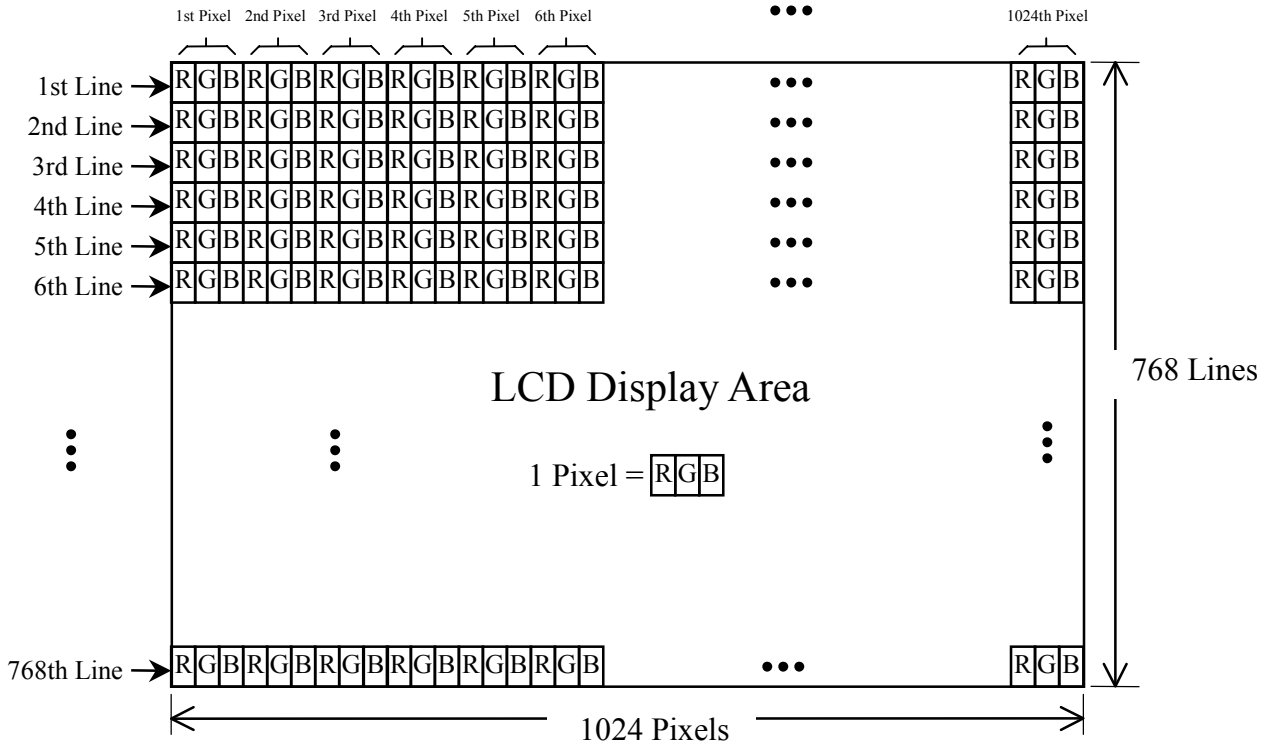
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7.3 RELATIONSHIP BETWEEN DISPLAYED COLOR AND INPUT DATA

	Display	MSB						LSB						Gray scale level						
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0		B5	B4	B3	B2	B1	B0
Basic color	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	-
	Blue	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	-
	Green	L	L	L	L	L	L	H	H	H	H	H	H	L	L	L	L	L	L	-
	Light Blue	L	L	L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	-
	Red	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	-
	Purple	H	H	H	H	H	H	L	L	L	L	L	L	H	H	H	H	H	H	-
	Yellow	H	H	H	H	H	H	H	H	H	H	H	H	L	L	L	L	L	L	-
	White	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	-
Gray scale of Red	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L0
	Dark ↑ ↓ Light	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L1
		L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L2
		⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	L3...L60
		H	H	H	H	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L61
		H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L62
	Red	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	Red L63
	Gray scale of Green	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Dark ↑ ↓ Light		L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L1
		L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L2
		⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	L3...L60
		L	L	L	L	L	L	H	H	H	H	L	H	L	L	L	L	L	L	L61
		L	L	L	L	L	L	H	H	H	H	H	L	L	L	L	L	L	L	L62
Green		L	L	L	L	L	L	H	H	H	H	H	H	L	L	L	L	L	L	Green L63
Gray scale of Blue		Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Dark ↑ ↓ Light	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L1
		L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L2
		⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	L3...L60
		L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	L	H	L61
		L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	L	L62
	Blue	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	Blue L63
	Gray scale of White & Black	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Dark ↑ ↓ Light		L	L	L	L	L	H	L	L	L	L	L	H	L	L	L	L	L	H	L1
		L	L	L	L	H	L	L	L	L	L	H	L	L	L	L	L	H	L	L2
		⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	L3...L60
		H	H	H	H	L	H	H	H	H	H	L	H	H	H	H	H	L	H	L61
		H	H	H	H	H	L	H	H	H	H	H	L	H	H	H	H	H	L	L62
White		H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	White L63

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7.4 PIXEL FORMAT



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8. INTERFACE TIMING ¹⁾²⁾³⁾⁴⁾⁵⁾⁶⁾

8.1 Timing Parameters (DE Mode)

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Frame period	t1	778×t3 —	806×t3 16.67	860×t3 —	— ms	¹⁾⁵⁾
Vertical display term ¹⁾	t2	768×t3 —	768×t3 15.8	768×t3 —	— ms	¹⁾
One line scanning time ¹⁾⁵⁾	t3	590×t5 —	672×t5 20.68	700×t5 —	— μs	¹⁾⁵⁾
Horizontal display term ¹⁾	t4	512×t5 —	512×t5 15.76	512×t5 —	— ns	¹⁾
Clock period ⁵⁾	t5	25.00	30.77	—	ns	
Clock low time	t6	9	—	—	ns	
Clock high time	t7	9	—	—	ns	
Data setup time	t8	2	—	—	ns	
Data hold time	t9	5	—	—	ns	

Note 1) Refer to TIMING CHART at page17 & 18.

Note 2) In case of using the long frame period, the deterioration of display quality, noise etc. may be occurred.

Note 3) When ENAB is fixed to “L” level after NCLK input, the panel is displayed as black. However, a flicker may be occurred on the display. When ENAB is fixed to “H” level after NCLK input, the panel will be damaged.

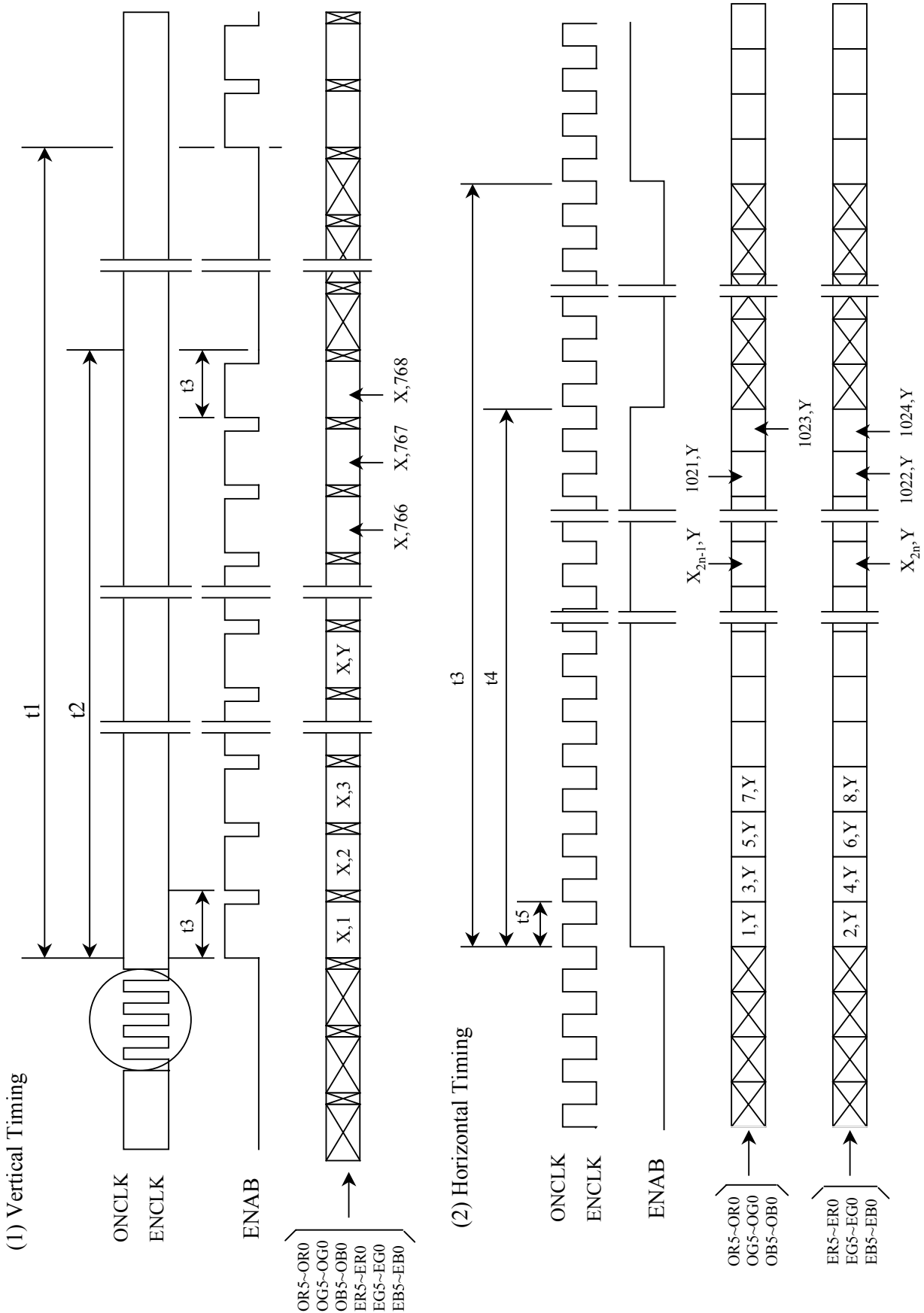
Note 4) Do not fix NCLK to “H” or “L” level while the V_{DD} (+3.3V) is supplied. If NCLK is fixed to “H” level or “L” level for certain period while the V_{DD} (+3.3V) is supplied, the panel may be damaged.

Note 5) Do not change t1 and t3 values in the operation. When t1 or t3 is changed, the panel is displayed as black.

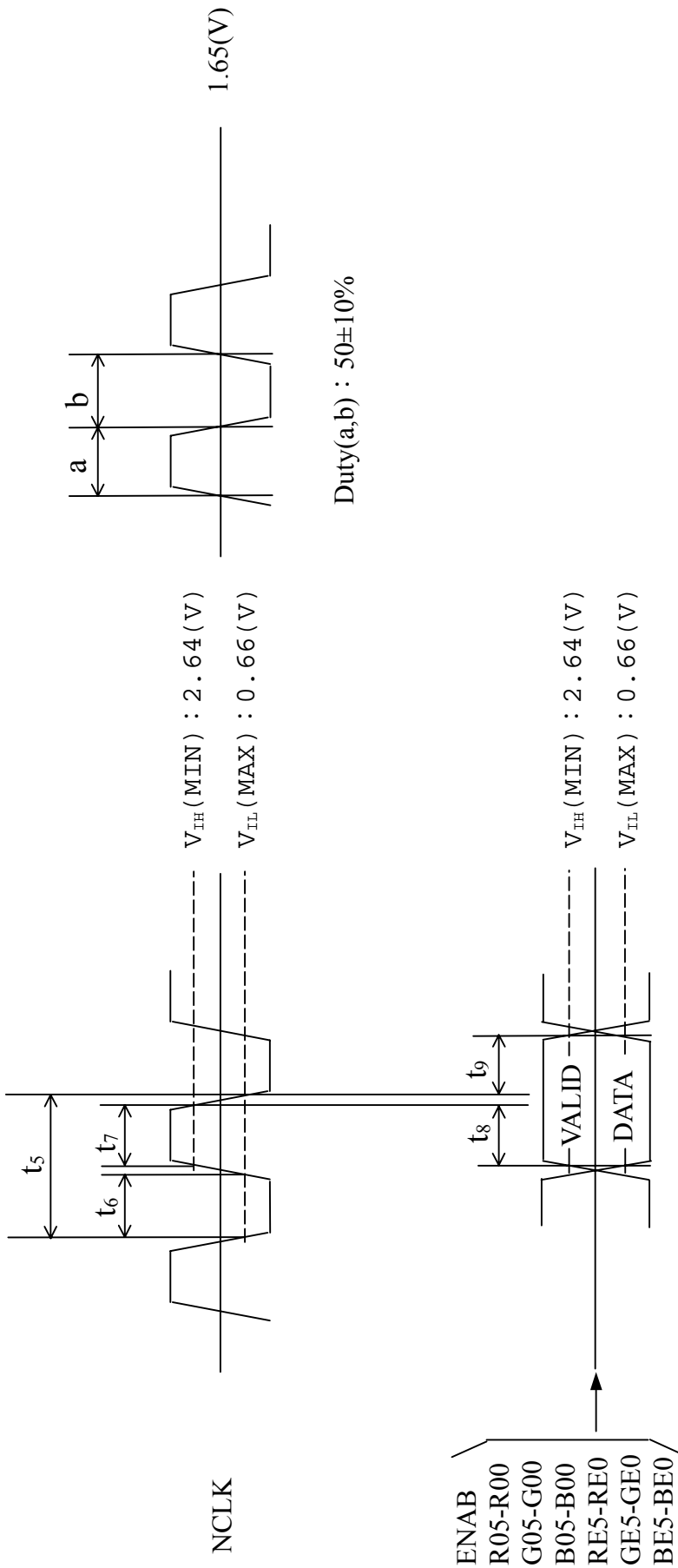
Note 6) Please adjust LCD operating signal timing and FL driving frequency, to optimize the display quality. There is a possibility that flicker is observed by the interference of LCD operating signal timing and FL driving condition (especially driving frequency).

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8.2 Timing Diagram of Interface Signal (DE mode)

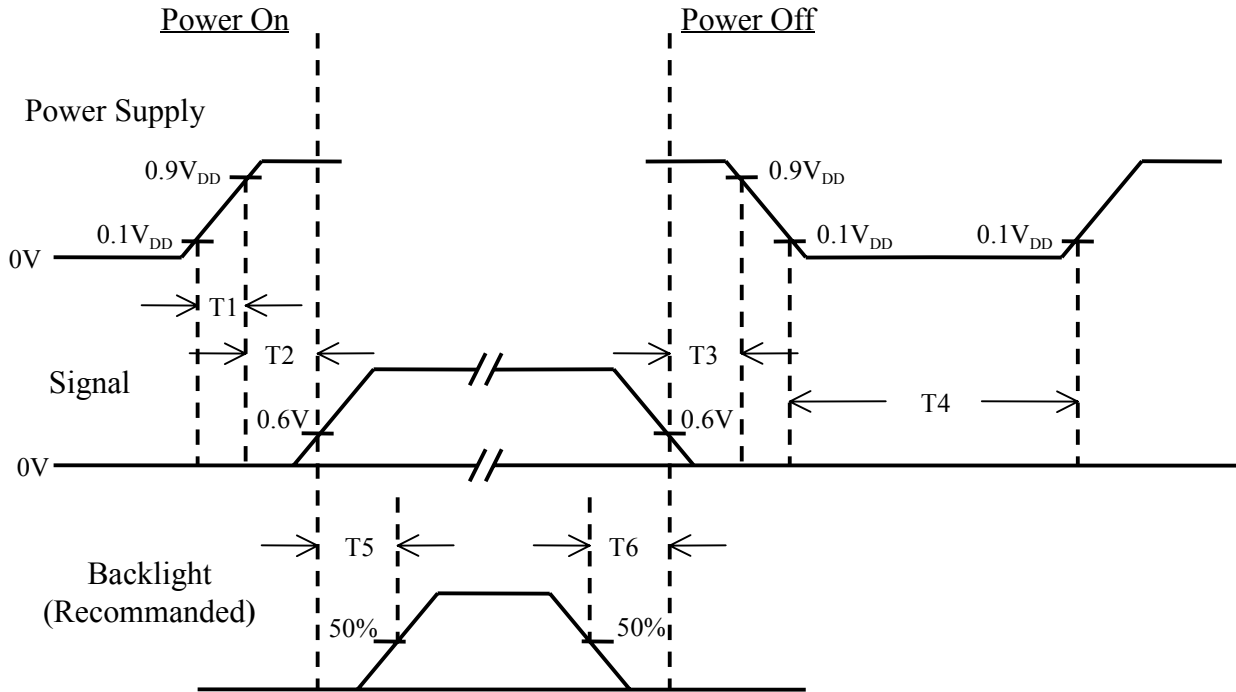


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8.3 Power ON/OFF Sequence



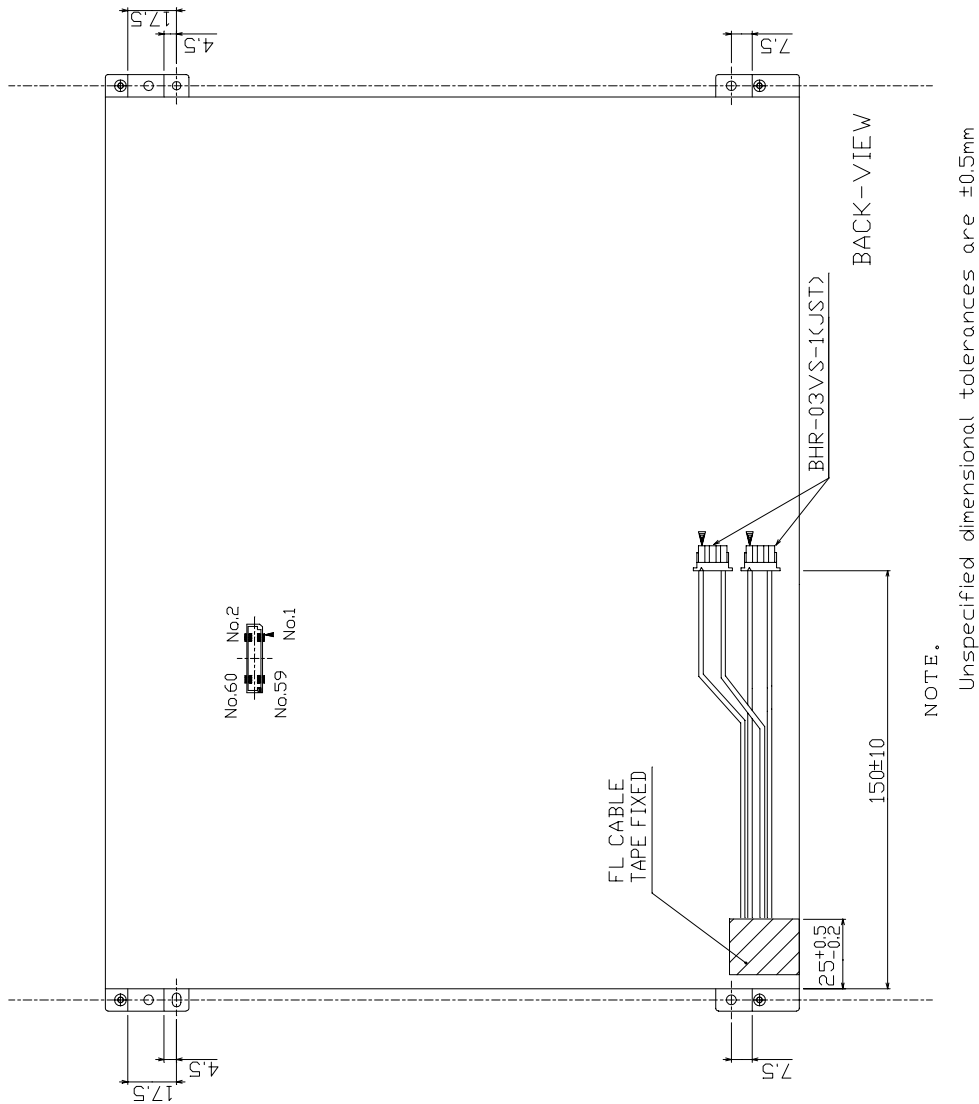
Item	Min.	Typ.	Max.	Unit	Remark
T1	0	—	10	msec	
T2	0	—	50	msec	
T3	0	—	50	msec	
T4	1	—	—	sec	
T5	200	—	—	msec	
T6	200	—	—	msec	

Note

- (1) The supply voltage of the external system for the module input should be the same as the definition of V_{DD} .
- (2) Apply the lamp voltage within the LCD operation range. When the back-light turns on before the LCD operation or the LCD turns off before the back-light turns off, the display may momentarily become white.
- (3) In case of $V_{DD} = \text{off level}$, please keep the level of input signal on the low or keep a high impedance.
- (4) T4 should be measured after the module has been fully discharged between power off and on period.
- (5) Interface signal shall not be kept at high impedance when the power is on.

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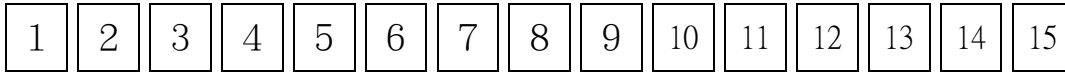
(2)Back view outline dimension



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10. LOT MARK

10.1 lot mark



code 1,2,3,4,5,6: HannStar internal flow control code.

code 7: production location.

code 8: production year.

code 9: production month.

code 10,11,12,13,14,15: serial number.

Note(1) production year

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Mark	9	0	1	2	3	4	5	6	7	8

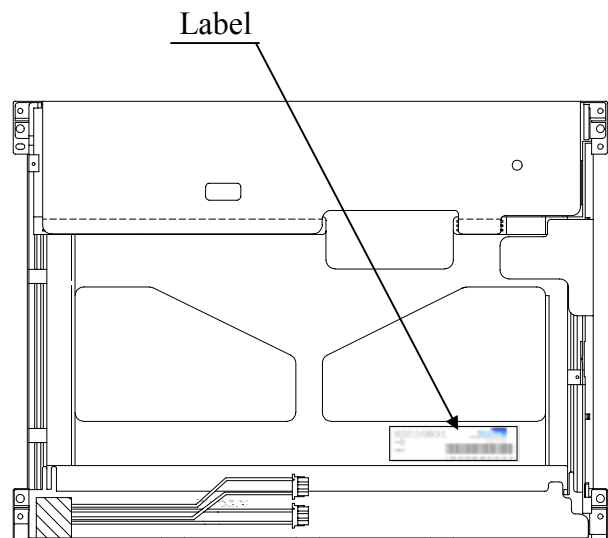
Note(2) production month

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Mark	1	2	3	4	5	6	7	8	9	A	B	C

10.2 location of lot mark

(1) The label is attached to the backside of the LCD module.

(2) This is subject to change without prior notice.



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11. GENERAL PRECAUTION

(1) USE RESTRICTION

This product is not authorized for use in life supporting systems, aircraft navigation control systems, military systems and any other application where performance failure could be life-threatening or otherwise catastrophic.

(2) DISASSEMBLING OR MODIFICATION

Do not disassemble or modify the module. It may damage sensitive parts inside LCD module, and may cause scratches or dust on the display. HannStar does not warrant the module, if customers disassemble or modify the module.

(3) BREAKAGE OF LCD PANEL

(3.1) If LCD panel is broken and liquid crystal spills out, do not ingest or inhale liquid crystal, and do not contact liquid crystal with skin.

(3.2) If liquid crystal contacts mouth or eyes, rinse out with water immediately.

(3.3) If liquid crystal contacts skin or cloths, wash it off immediately with alcohol and rinse thoroughly with water.

(3.4) Handle carefully with chips of glass that may cause injury , when the glass is broken.

(4) ELECTRIC SHOCK

(4.1) Disconnect power supply before handling LCD module.

(4.2) Do not pull or fold the CCFL cable.

(4.3) Do not touch the parts inside LCD modules and the fluorescent lamp's connector or cables in order to prevent electric shock.

(5) ABSOLUTE MAXIMUM RATINGS AND POWER PROTECTION CIRCUIT

(5.1) Do not exceed the absolute maximum rating values, such as the supply voltage variation, input voltage variation, variation in parts' parameters, environmental temperature, etc., otherwise LCD module may be damaged.

(5.2) Please do not leave LCD module in the environment of high humidity and high temperature for a long time.

(5.3) It's recommended to employ protection circuit for power supply.

(6) OPERATION

(6.1) Do not touch, push or rub the polarizer with anything harder than HB pencil lead.

(6.2) Use fingerstalls of soft gloves in order to keep clean display quality, when persons handle the LCD module for incoming inspection or assembly.

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(6.3) When the surface is dusty, please wipe gently with absorbent cotton or other soft material.

(6.4) Wipe off saliva or water drops as soon as possible. If saliva or water drops contact with polarizer for a long time, they may causes deformation or color fading.

(6.5) When cleaning the adhesives, please use absorbent cotton wetted with a little petroleum benzine or other adequate solvent.

(7) Mechanism

Please mount LCD module by using mouting holes arranged in four corners tightly.

(8) STATIC ELECTRICITY

(8.1) Protection film must remove very slowly from the surface of LCD module to prevent from electrostatic occurrence.

(8.2) Because LCD module use CMOS-IC on circuit board and TFT-LCD panel, it is very weak to electrostatic discharge. Please be careful with electrostatic discharge. Persons who handle the module should be grounded through adequate methods.

(9) STRONG LIGHT EXPOSURE

The module shall not be exposed under strong light such as direct sunlight. Otherwise, display characteristics may be changed.

(10) DISPOSAL

When disposing LCD module, obey the local environmental regulations.

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12. VISUAL INSPECTION SPECIFICATION

Inspection condition is as followings

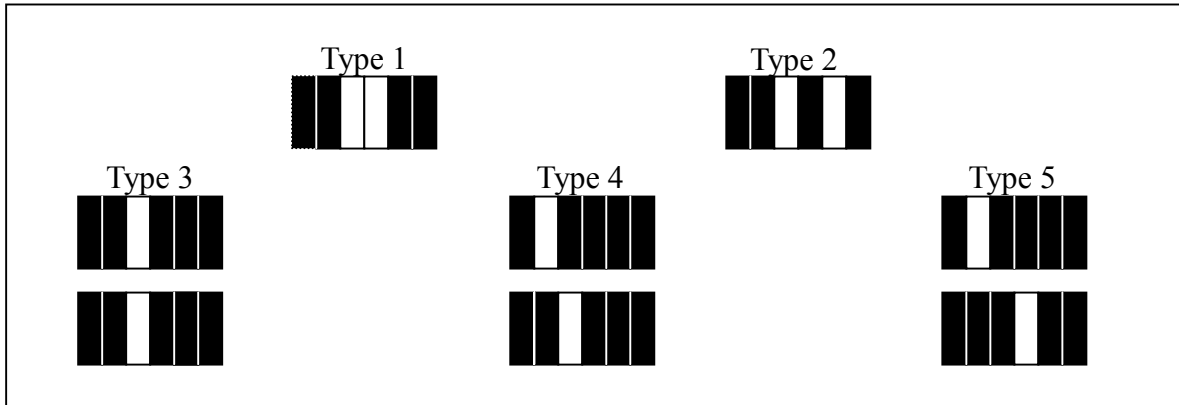
- Viewing distance is approximately 15-50 cm
- Viewing angle is normal to the LCD panel
- Ambient temperature is in the room temperature
- Ambient illumination is 300~500 Lux
- Bright dot is defined as visible through 5% ND filter

	Defect type	Criteria
Visual defect D: diameter N: number W: horizontal width L: vertical high	Dark/ Bright Spot Circular Foreign Material	$0.2 \text{ mm} \leq D \leq 0.5 \text{ mm}$ $N \leq 7$
	Bright or Dark Line Foreign Material	$0.05 \text{ mm} \leq W \leq 0.2 \text{ mm}$ $0.3 \text{ mm} \leq L \leq 3 \text{ mm}, N \leq 5$
	Polarizer/ Linear Scratch	$0.01 \text{ mm} \leq W \leq 0.2 \text{ mm}$ $1.0 \text{ mm} \leq L \leq 10 \text{ mm}, N \leq 5$
	Polarizer- Bubble/ Peeling	Average $D \leq 0.5 \text{ mm}$ $N \leq 6$
	Maximum Allowable Defect Count All Types	$N \leq 7$
Electrical defect N: number	Bright Dot Random	$N \leq 7$
	Bright Dot – Green	$N \leq 4$
	Bright Dot- 2 Adjacent	$N \leq 2$
	Dark Dots- Random	$N \leq 7$
	Dark Dots- 2 Adjacent	$N \leq 3$
	Dark Dots- 3 or More Adjacent	$N = 0$
	Total Bright and Dark Dots	$N \leq 10$
	Minimum Distance Between Bright Dots	15 mm
Minimum Distance Between Dark Dots	5 mm	

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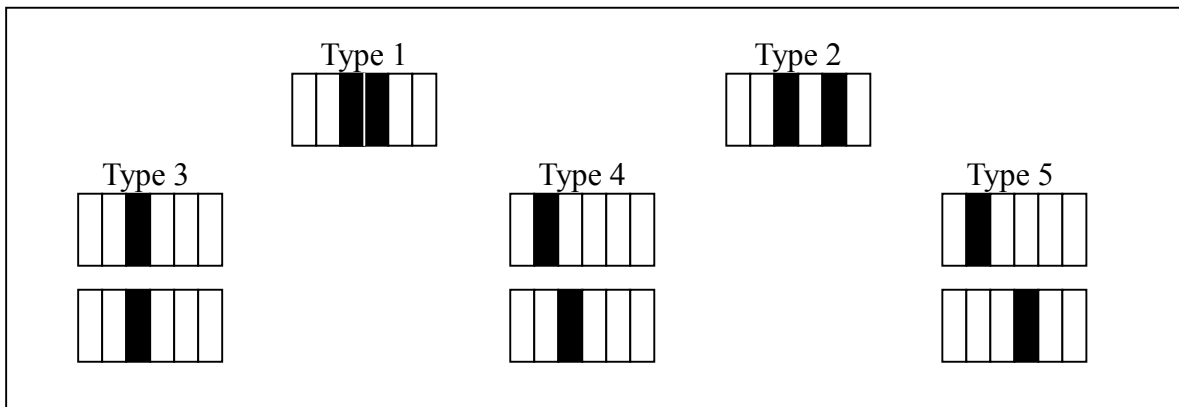
Note(1)Bright dot defect description

-Two adjacent



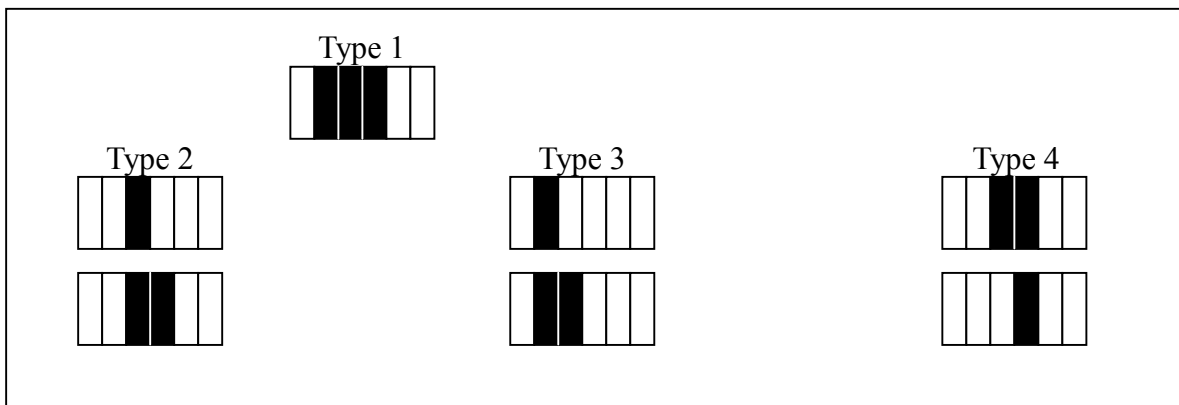
Note(2)Dark dot defect description

-Two adjacent



Note(3)Dark dot defect description

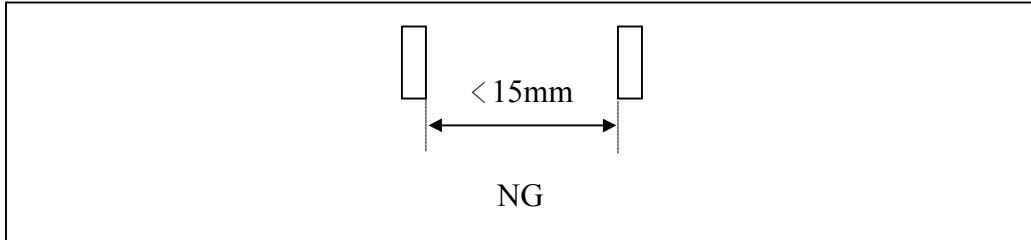
-Three adjacent



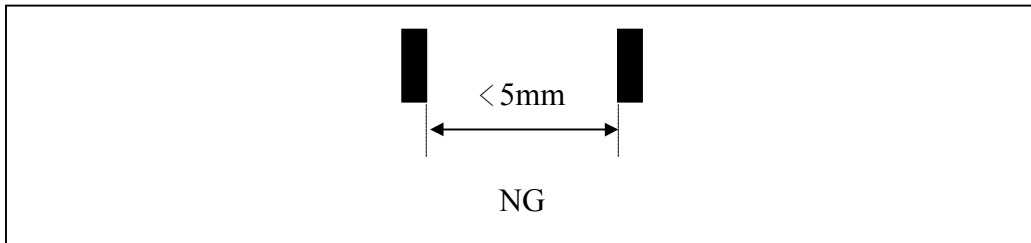
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Note(4) Minimum distance between dot defects

Bright dot to bright dot



Dark dot to dark dot



The defects that are not defined above and considered to be problem shall be reviewed and discussed by both parties.