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**TITLE : HV121X02-100
Product Specification**

Rev. O

BOE HYDIS TECHNOLOGY

SPEC. NUMBER S864-1266	PRODUCT GROUP TFT-LCD PRODUCT	REV. O	ISSUE DATE 2006.01.25	PAGE 1 OF 22
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		PRODUCT GROUP	REV.	ISSUE DATE
		TFT-LCD PRODUCT	O	2006.01.25
REVISION HISTORY				
REV.	ECN NO.	DESCRIPTION OF CHANGES	DATE	PREPARED
O	-	Initial Release	06.01.25	J.K.Han
SPEC. NUMBER S864-1266		SPEC. TITLE HV121X02-100 Product Specification		PAGE 2 OF 22

**PRODUCT GROUP**

REV.

ISSUE DATE

TFT-LCD PRODUCT

O

2006.01.25

Contents

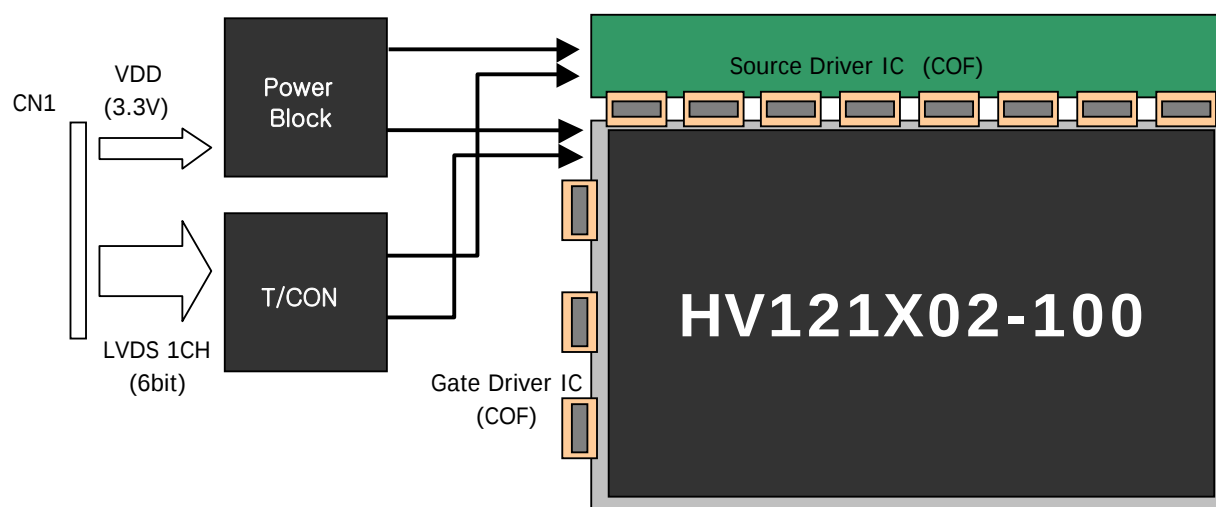
No	Item	Page
1.0	General Description	4
2.0	Environmental absolute maximum ratings	5
3.0	Optical specifications	6
4.0	Electrical specifications	7
5.0	Interface connection	8
6.0	Signal timing specifications	9
7.0	Signal timing waveforms of interface signal	11
8.0	Input signals, basic display colors & gray scale of colors	12
9.0	Power sequence	13
10.0	Reliability test	14
11.0	Handling & cautions	16
12.0	Appendix	17

SPEC. NUMBER
S864-1266SPEC. TITLE
HV121X02-100 Product SpecificationPAGE
3 OF 22

1.0 GENERAL DESCRIPTION

1.1 Introduction

HV121X02-100 is a color active matrix TFT LCD module using amorphous silicon TFT's (Thin Film Transistors) as active switching devices. This module has a 12.1 inch diagonally measured active area with XGA resolutions (1024 horizontal by 768 vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe. This module consists of TFT-LCD panel, which Tabs bonded data D-IC and gate D-IC and PCB are attached.



1.2 Features

- Product Scope: HV121X02 Panel (High Reliable LC and AR pol.) with Driver IC and Driving Circuit Board (PCB) without BLU
*BLU will be assembled by Customer.
- LVDS Interface with 1pixel / clock
- High-speed response at high temperature
- High contrast ratio and wide viewing angle
- High-temperature operations enable
- 6-bit color depth, Display 262,144 colors
- DE (Data Enable) mode only
- RoHS

1.3 Applications

- ATM / Car / Avionics

**PRODUCT GROUP**

REV.

ISSUE DATE

TFT-LCD PRODUCT

O

2006.01.25

1.4 General Specifications

The followings are general specifications at the model HV121X02-100.

Parameter	Specification	Unit	Remark
Active area	245.76 (H) × 184.32 (V)	mm	
Number of pixels	1024(H) × 768(V)	pixels	
Pixel pitch	0.24(H) × 0.24(V)	mm	
Pixel arrangement	RGB Vertical stripe	-	
Display mode	Normally Black (FFS)	-	
Surface treatment	Anti-Reflective (No Haze)	-	
Liquid Crystal clearing temperature	≥ 103	℃	
Color filter Chromaticity	x=0.312, y=0.342		
CF Color Gamut	40	%	
Panel Transmittance	5.91 (excluding the gain of the rear-polarizer)	%	Note. 1

Note 1) The Panel Transmittance as described above, will be obtained after electronics and back-light driving circuit are optimized to a panel.

2.0 ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit.

Parameter	Symbol	Min	Max	Unit	Remark
Operating Temperature	T _{OP}	-20	+85	℃	Note. 1

Note. 1) As compromised with Customer, T-CON, D-IC, Polarizer are excluded within the range of guarantee for Operating Temperature.

T-CON : 0 ~ 75℃, D-IC : -10 ~ 75℃, Polarizer : -20 ~ 80℃

SPEC. NUMBER
S864-1266

SPEC. TITLE
HV121X02-100 Product Specification

PAGE
5 OF 22



PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

O

2006.01.25

3.0 OPTICAL SPECIFICATIONS

3.1 Overview

The test of Optical specifications shall be measured in a dark room (ambient luminance ≤ 1 lux and temperature = $25 \pm 2^\circ\text{C}$) with the equipment of Luminance meter system (Goniometer system and TOPCON BM-5) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of θ and ϕ equal to 0° . We refer to $\theta_{\phi=0}$ ($=\theta_3$) as the 3 o'clock direction (the "right"), $\theta_{\phi=90}$ ($=\theta_{12}$) as the 12 o'clock direction ("upward"), $\theta_{\phi=180}$ ($=\theta_9$) as the 9 o'clock direction ("left") and $\theta_{\phi=270}$ ($=\theta_6$) as the 6 o'clock direction ("bottom"). While scanning θ and/or ϕ , the center of the measuring spot on the display surface shall stay fixed. The test setup, geometry, and measurement location are shown in FIGURE 1, and FIGURE 2. (shown in Appendix)

3.2 Optical Specifications

The measurement shall be executed after 30 minutes warm-up period.

[VDD=3.3V, Frame rate=60Hz, Clock=65MHz, Ta = $25 \pm 2^\circ\text{C}$]

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Remark
Viewing Angle	Horizontal	Θ_3	CR > 10		89	90	Deg	Note 1
		Θ_9			89	90	Deg	
	Vertical	Θ_{12}			89	90	Deg	
		Θ_6			89	90	Deg	
Luminance contrast ratio		CR	$\Theta = 0^\circ$	-	450	-		Note 2
Color Reproduction			(Center)	40	45	-	%	
Response time (at 45 °C)	Ttotal (Tr + Td)	Ttotal	Normal Viewing Angle	-	-	32	msec	Note 3
Cross talk		CT		-	-	2.0	%	Note 4

Note:

1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface (see FIGURE 1 shown in Appendix).
2. Contrast measurements shall be made at viewing angle of $\Theta = 0^\circ$ and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state. (See FIGURE 1 shown in Appendix) Luminance Contrast Ratio (CR) is defined mathematically.

SPEC. NUMBER
S864-1266

SPEC. TITLE
HV121X02-100 Product Specification

PAGE
6 OF 22



PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

O

2006.01.25

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3. The electro-optical response time measurements shall be made as FIGURE 2 shown in Appendix by switching the “data” input signal ON and OFF. The times needed for the luminance to change from 10% to 90% is Tr, and 90% to 10% is Td.

4. Cross-Talk of one area of the LCD surface by another shall be measured by comparing the luminance (Y_A) of a 25mm diameter area, with all display pixels set to a gray level, to the luminance (Y_B) of that same area when any adjacent area is driven dark. (See FIGURE 3 shown in Appendix).

4.0 ELECTRICAL SPECIFICATIONS

[Ta = 25±2℃]

Parameter		Min	Typ	Max	Unit	Remark
Power Supply Voltage	V _{DD}	3.0	3.3	3.6	V	
Power Supply Current	I _{DD}	-	220		mA	Note1
Power Consumption	P _D		0.7	1.1	W	
Permissible Input Ripple Voltage	V _{RF}	-	-	100	mV	V _{DD} = 3.3V
High Level Differential Input Threshold Voltage	V _{IH}	-	-	+100	mV	V _{cm} = 1.2V typ.
Low Level Differential Input Threshold Voltage	V _{IL}	-100	-	-	mV	

Notes:

- The supply voltage is measured and specified at the interface connector of LCM.
The current draw and power consumption specified is for VDD = 3.3V, Frame rate = 60 Hz and Clock frequency = 65MHz.
Test Pattern of power supply current
a) Typ: Vertical color bar pattern
b) Max : Gray 28 @ Vertical 2 Skip line pattern

SPEC. NUMBER
S864-1266

SPEC. TITLE
HV121X02-100 Product Specification

PAGE
7 OF 22



PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

O

2006.01.25

5.0 INTERFACE CONNECTION

5.1 Electrical Interface

CN1 Interface connector : DF19L-20P-1H (HIROSE) or equivalent
 User side connector : DF19G-20S-1C (HIROSE) or equivalent

Pin No	Symbol	Function	Remark
1	VDD1	Power Supply: +3.3V	
2	VDD2	Power Supply: +3.3V	
3	VSS	Ground	
4	VSS	Ground	
5	RIN0-	LVDS Negative data signal (-)	R0,R1,R2,R3,R4,R5,G0
6	RIN0+	LVDS Positive data signal (+)	
7	VSS	Ground	
8	RIN1-	LVDS Negative data signal (-)	G1,G2,G3,G4,G5,B0,B1
9	RIN1+	LVDS Positive data signal (+)	
10	VSS	Ground	
11	RIN2-	LVDS Negative data signal (-)	B2,B3,B4,B5, Hsync,Vsync,DE
12	RIN2+	LVDS Positive data signal (+)	
13	VSS	Ground	
14	RCLKIN-	LVDS Negative clock signal (-)	
15	RCLKIN+	LVDS Positive clock signal (+)	
16	VSS	Ground	
17	NC	No Connection	
18	NC	No Connection	
19	VSS	Ground	
20	VSS	Ground	

SPEC. NUMBER
S864-1266

SPEC. TITLE
HV121X02-100 Product Specification

PAGE
8 OF 22

**PRODUCT GROUP**

REV.

ISSUE DATE

TFT-LCD PRODUCT

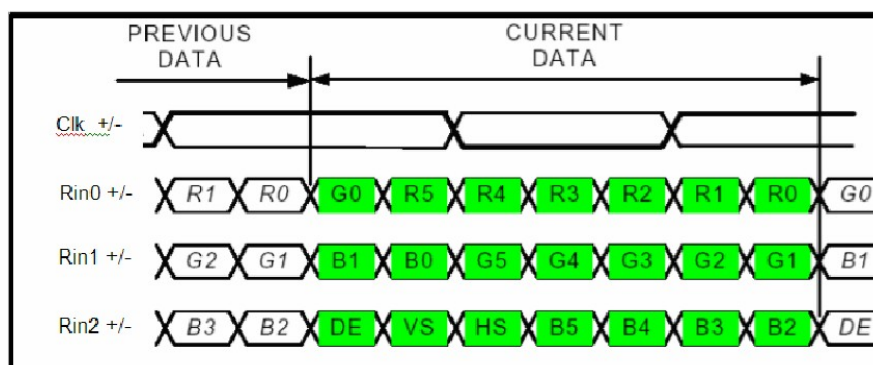
O

2006.01.25

6.0 SIGNAL TIMING SPECIFICATIONS

6.1 The HV121X02-100 is operated by the only DE (Data enable) mode (LVDS Transmitter Input)

Item		Symbols	Min	Typ	Max	Unit
Clock	Frequency	1/Tc	-	65	80	MHz
	High Time	Tch	4.5	-	-	ns
	Low Time	Tcl	4.5	-	-	ns
Data	Setup Time	Tds	2.7	-	-	ns
	Hold Time	Tdh	0	-	-	ns
Data Enable Setup Time		Tes	2.7	-	-	ns
Frame Period		Tv	772	806	1022	lines
Vertical Display Period		Tvd	768	768	768	lines
One Line Scanning Period		Th	1100	1344	2046	clocks
Horizontal Display Period		Thd	1024	1024	1024	clocks

6.2 LVDS data mapping

SPEC. NUMBER
S864-1266

SPEC. TITLE
HV121X02-100 Product Specification

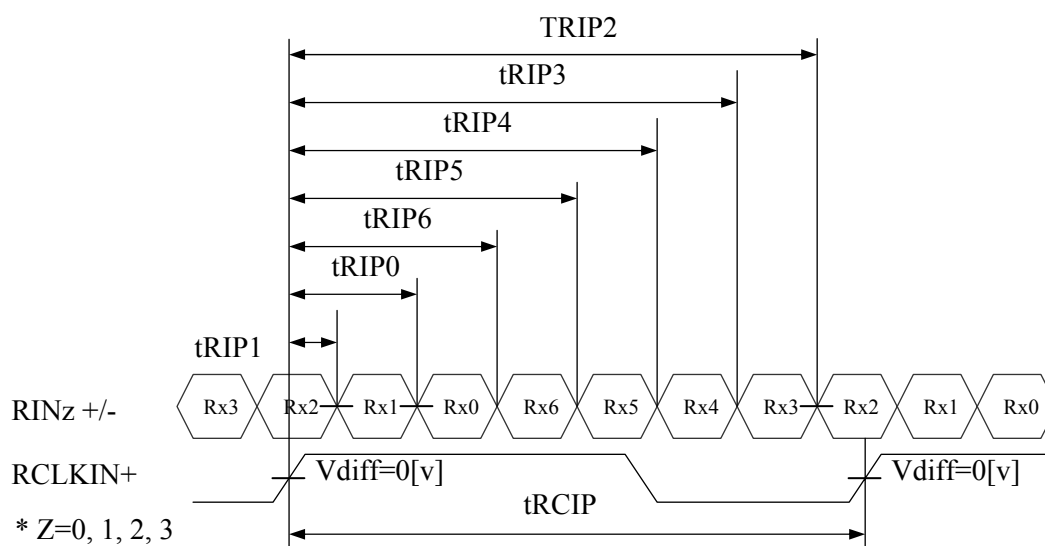
PAGE
9 OF 22

6.3 LVDS Rx interface timing parameter

The specification of the LVDS Rx interface timing parameter

<LVDS Rx Interface Timing Specification>

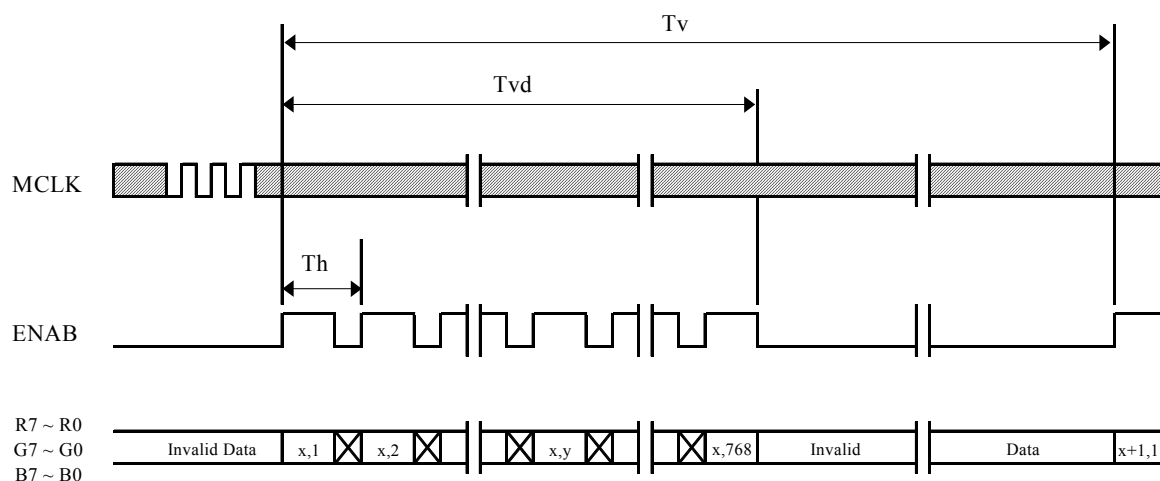
Item	Symbol	Min	Typ	Max	Unit	Remark
CLKIN Period	tRCIP	12.5	15.38	-	nsec	
Input Data 0	tRIP1	-0.4	0.0	+0.4	nsec	
Input Data 1	tRIP0	1*tRCIP/7 -0.4	1*tRCIP/7	1*tRCIP/7 +0.4	nsec	
Input Data 2	tRIP6	2*tRCIP/7 -0.4	2*tRCIP/7	2*tRCIP/7 +0.4	nsec	
Input Data 3	tRIP5	3*tRCIP/7 -0.4	3*tRCIP/7	3*tRCIP/7 +0.4	nsec	
Input Data 4	tRIP4	4*tRCIP/7 -0.4	4*tRCIP/7	4*tRCIP/7 +0.4	nsec	
Input Data 5	tRIP3	5*tRCIP/7 -0.4	5*tRCIP/7	5*tRCIP/7 +0.4	nsec	
Input Data 6	tRIP2	6*tRCIP/7 -0.4	6*tRCIP/7	6*tRCIP/7 +0.4	nsec	



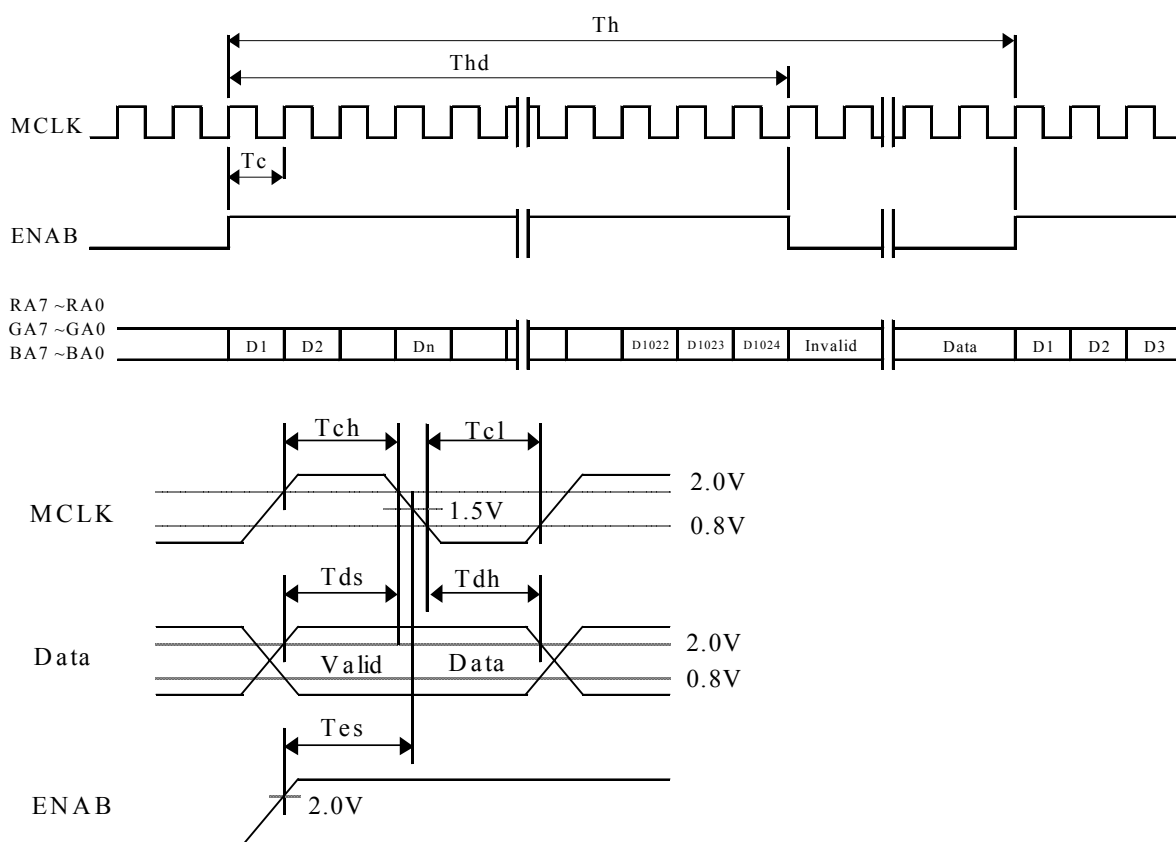
$$* V_{diff} = (RINz+) - (RINz-), (RCLKIN+) - (RCLKIN-)$$

7.0 SIGNAL TIMING WAVEFORMS OF INTERFACE SIGNAL (DE MODE)

7.1 Vertical Timing Waveforms



7.2 Horizontal Timing Waveforms



**PRODUCT GROUP**

REV.

ISSUE DATE

TFT-LCD PRODUCT

O

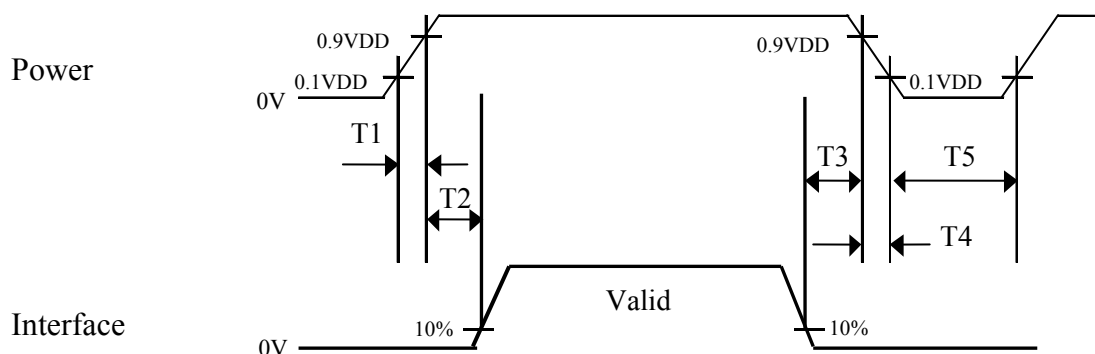
2006.01.25

8.0 INPUT SIGNALS, BASIC DISPLAY COLORS & GRAY SCALE OF COLORS

Colors & Gray Scale		Red Data						Green Data						Blue Data					
		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
	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
	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
	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
Gray Scale Of Red	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
	Darker	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	↓						↓						↓					
	▽																		
	Brighter	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
Gray Scale Of Green	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
	Darker	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	△	↓						↓						↓					
	▽																		
	Brighter	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
Gray Scale Of Blue	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
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	△	↓						↓						↓					
	▽																		
	Brighter	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
Gray Scale Of White & Black	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	1	0	0	0	0	0	1
	Darker	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0
	△	↓						↓						↓					
	▽																		
	Brighter	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	0	1
	▽	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

SPEC. NUMBER
S864-1266SPEC. TITLE
HV121X02-100 Product SpecificationPAGE
12 OF 22

9.0 POWER SEQUENCE



To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as shown in below

- $0 < T1 \leq 10 \text{ ms}$
- $0 < T2 \leq 50 \text{ ms}$
- $0 \text{ ms} \leq T3$
- $0 \leq T4 \leq 10 \text{ ms}$
- $150 \text{ ms} \leq T5$

Notes:

1. When the power supply VDD is 0V, Keep the level of input signals on the low or keep high impedance.
2. Do not keep the interface signal high impedance when power is on.
3. Back Light must be turn on after power for logic and interface signal are valid.

**PRODUCT GROUP**

REV.

ISSUE DATE

TFT-LCD PRODUCT

O

2006.01.25

10.0 RELIABILITY TEST**10.1 BOE HYDIS Test condition**

The following test is performed for the HV121X02-100 module with HT12X21-220 BLU.

No	Test Items	Conditions
1	High temperature storage test	Ta = 60 °C, 240 hrs
2	Low temperature storage test	Ta = -20 °C, 240 hrs
3	High temperature & high humidity operation test	Ta = 50 °C, 80 %RH, 240 hrs
4	High temperature operation test	Ta = 50 °C, 240 hrs
5	Low temperature operation test	Ta = 0 °C, 240 hrs
6	Thermal shock	Ta = -20 °C ↔ 60 °C (30 min), 100 cycle
7	Vibration test (non-operating)	Frequency : 10 ~ 300 Hz Gravity/AMP : 1.5G Period : X, Y, Z 30 min
8	Shock test (non-operating)	Gravity : 150G Pulse width : 6ms, half sine wave ±X, ±Y, ±Z Once for each direction

*As Guarantee Range of Specific part (Pol. / D-IC / LC), BOEHYDIS have responsibility within this Range of these parts.

SPEC. NUMBER
S864-1266

SPEC. TITLE
HV121X02-100 Product Specification

PAGE
14 OF 22

**PRODUCT GROUP**

REV.

ISSUE DATE

TFT-LCD PRODUCT

O

2006.01.25

10.2 Customer Test condition

The following test is performed with the HV121X02-100.

No	Test Items	Conditions	Remark
1	High temperature storage test	Ta = 85 °C, 50%, 240 hrs	
2	Low temperature storage test	Ta = -25 °C, 240 hrs	
3	High temperature & high humidity operation test	Ta = 85 °C, 80 %RH, 240 hrs	
4	Low temperature operation test	Ta = -25 °C, 240 hrs	
5	Shock	Gravity : 120G Pulse Width : 2ms, Half Sine Wave for x, y, z direction	
6	Vibration test (non-operating)	Frequency : 1 ~ 300Hz Gravity / AMP : 1.5G Period X, y, z 30min.	

SPEC. NUMBER
S864-1266SPEC. TITLE
HV121X02-100 Product SpecificationPAGE
15 OF 22

	PRODUCT GROUP	REV.	ISSUE DATE
	TFT-LCD PRODUCT	O	2006.01.25

11.0 HANDLING & CAUTIONS

11.1 Cautions for handling the module

- As the electrostatic discharges may break the LCD module, handle the LCD module with care. Peel a protection sheet off from the LCD panel surface as slowly as possible.
- As the LCD panel is made from fragile glass material, impulse and pressure to the LCD module should be avoided.
- As the surface of the polarizer is very soft and easily scratched, use a soft dry cloth without chemicals for cleaning.
- Put the module display side down on a flat horizontal plane.

11.2 Other cautions

- Do not disassemble and/or re-assemble LCD module.
- When returning the module for repair or etc, please pack the module not to be broken. We recommend using the original shipping packages.

SPEC. NUMBER S864-1266	SPEC. TITLE HV121X02-100 Product Specification	PAGE 16 OF 22
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12.0 APPENDIX

Figure 1. Measurement Set Up

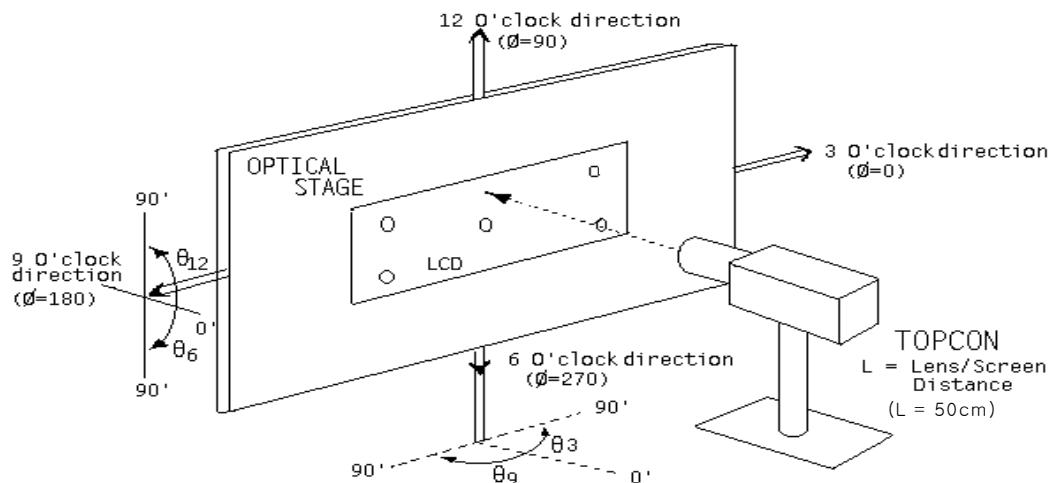


Figure 2. Response Time Testing

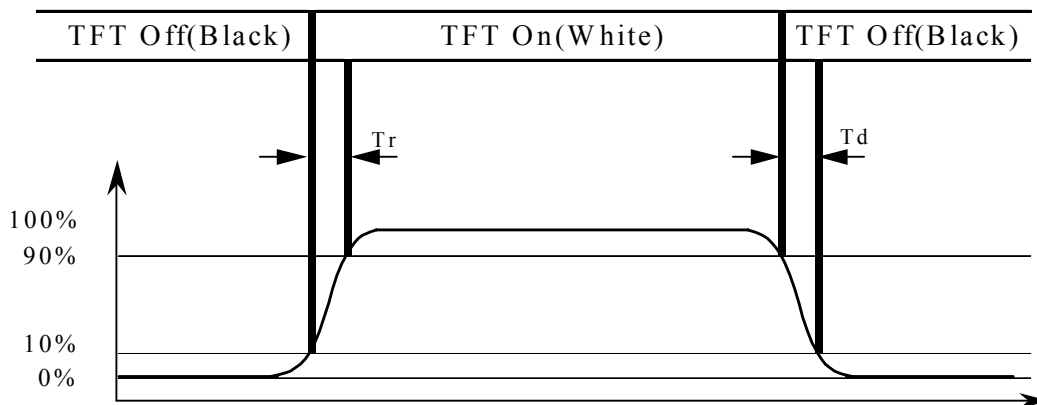
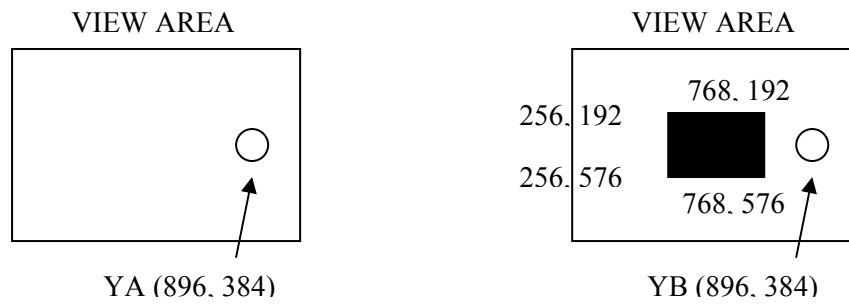


Figure 3. Cross Modulation Test Description



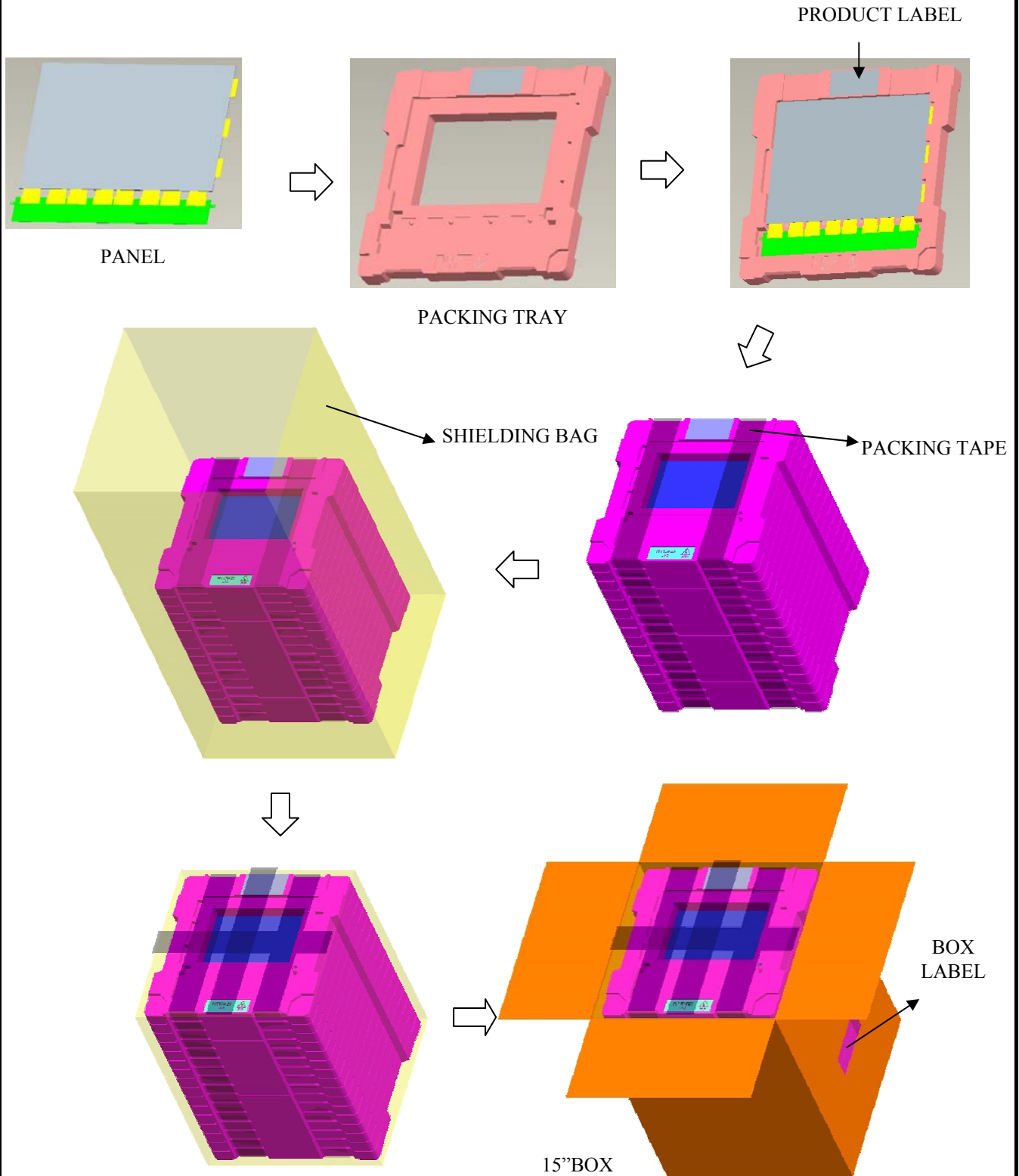
$$\text{Cross-Talk} = \left| \frac{Y_B - Y_A}{Y_A} \right| \times 100$$

Where:

Y_A = Initial luminance of measured area (cd/m^2)

Y_B = Subsequent luminance of measured area (cd/m^2)

The location measured will be exactly the same in both patterns.

Figure 4. Packing Sequence of HV121X02-100


	PRODUCT GROUP	REV.	ISSUE DATE
	TFT-LCD PRODUCT	O	2006.01.25

Figure 5. Product Serial Number



1	2	3	4	5	6	7
X X	X	X	X X	X	X X X X	X X X X X X

Type

- No 1. Control
- No 2. Rank
- No 3. Line Classification(BOE HYDIS : H, LCM : L, BOE OT : A/B/C)
- No 4. Year(2001 : 01, 2002 : 02, ...)
- No 5. Month(1, 2, 3, ...,9 X, Y, Z)
- No 6. FG Code
- No 7. Serial No.

SPEC. NUMBER S864-1266	SPEC. TITLE HV121X02-100 Product Specification	PAGE 20 OF 22
---------------------------	---	------------------

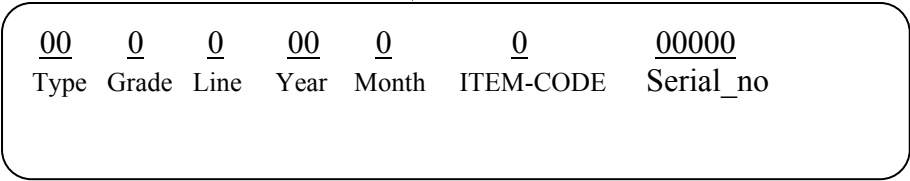
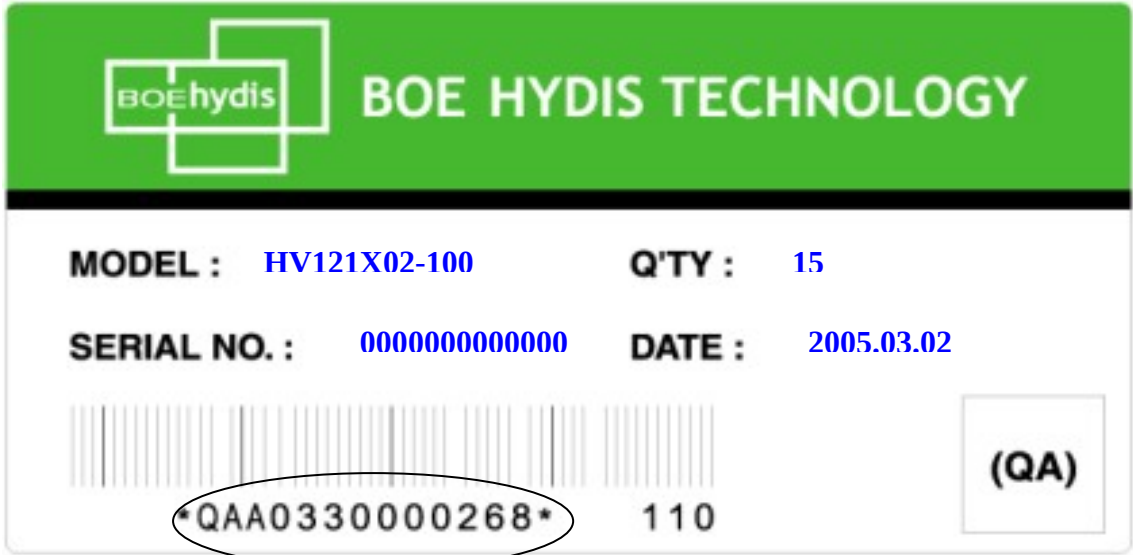
	PRODUCT GROUP	REV.	ISSUE DATE
	TFT-LCD PRODUCT	O	2006.01.25

*. Packing Note

- Box Dimension: 333mm(W)X 333mm(D)X 435(H)
- Package Quantity in one Box: 15pcs

Figure 6. Box Label

- Label Size: 108 mm (L) × 56 mm (W)
- Contents
 - Model: HV121X02-100
 - Q`ty: Module Q`ty in one box
 - Serial No.: Box Serial No. See next page for detail description.
 - Date: Packing Date
 - FG Code: FG Code of Product



FG CODE

SPEC. NUMBER S864-1266	SPEC. TITLE HV121X02-100 Product Specification	PAGE 21 OF 22
---------------------------	---	------------------

