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**TITLE: HT12X13-100
Product Specification**

Rev. B

BOE HYDIS TECHNOLOGY CO., LTD.

SPEC. NUMBER	PRODUCT GROUP	REV.	ISSUE DATE	PAGE
S864-1189	TFT-LCD PRODUCT	B	2004.08.31	1 OF 21



PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.08.31

REVISION HISTORY

REV.	ECN NO.	DESCRIPTION OF CHANGES	DATE	PREPARED
O		Initial Release	04.05.31	S.M.Lee
A	E407-F009	Lamp Start Voltage Change. (7 Page) -. Typ. Data (860, 1080) Delete. -. Max. Data -> Min. Data Change. -. Note 4 Add.	04.07.09	H.R.Park
B	E408-F020	Power Supply Current Change. (7 Page) -. Typ. Current : 233 -> 255 -. Max. Current : 430 -> 455	04.08.31	I.H.JUN

SPEC. NUMBER
S864-1189

SPEC. TITLE
HT12X13-100 Product Specification

PAGE
2 OF 21

**PRODUCT GROUP****REV.****ISSUE DATE**

TFT-LCD PRODUCT

B

2004.08.31

Contents

No	Item	Page
1.0	General Description	4
2.0	Absolute Maximum Ratings	5
3.0	Electrical Specifications	6
4.0	Optical Specifications	7
5.0	Interface Connection	9
6.0	Signal Timing Specifications	11
7.0	Signal Timing Waveforms of interface signal (DE mode)	13
8.0	Input Signals, Display Colors & Gray Scale of Colors	14
9.0	Power Sequence	15
10.0	Mechanical Characteristics	16
11.0	Reliability Test	17
12.0	Handling & Cautions	18
13.0	Appendix	19

SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

3 OF 23



PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

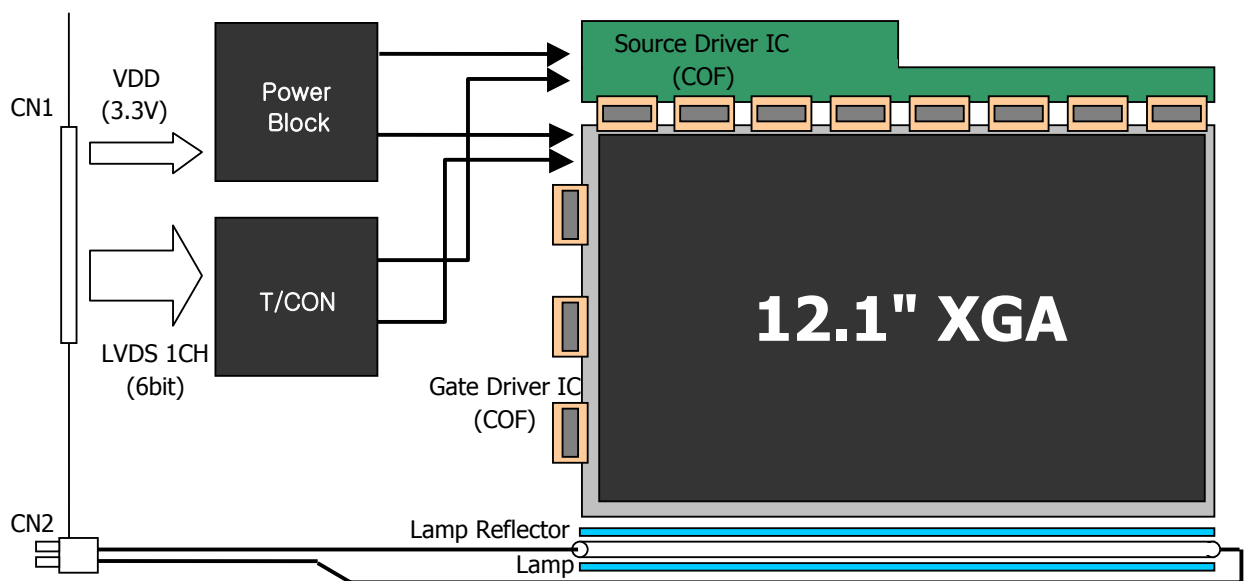
B

2004.08.31

1.0 GENERAL DESCRIPTION

1.1 Introduction

HT12X13-100 is a color active matrix TFT LCD module using amorphous silicon TFT's (Thin Film Transistors) as an 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 and this module can display 262,144 colors. The TFT-LCD panel used for this module is a low reflection and higher color type.



1.2 Features

- Thin and light weight
- 3.3 V power supply
- Low driving voltage and low power consumption
- 1 Channel LVDS Interface
- Single CCFL (Bottom side/Horizontal Direction)
- 262,144 colors
- Data enable signal mode
- Side Mounting Frame

SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

4 OF 23

**PRODUCT GROUP****REV.****ISSUE DATE**

TFT-LCD PRODUCT

B

2004.08.31

1.3 Applications

- Notebook PC

1.4 General Specifications

Parameter	Specification	Unit	Remarks
Active area	245.76 (H) × 184.32 (V)	mm	
Number of pixels	1024 (H) × 768 (V)	pixels	
Pixel pitch	0.240 (H) × 0.240 (V)	mm	
Pixel arrangement	RGB Vertical stripe		
Display colors	262,144	colors	
Display mode	Normally white		
Dimensional outline	261.0±0.5(W) × 199.0±0.5(V) × 4.7(D) Typ./5.0(D)Max	mm	
Weight	290 (Typ.) / 300 (Max.)	g	
Back-light	CCFL, Horizontal-lamp type		Note 1

Note 1: CCFL (Cold Cathode Fluorescent Lamp)

SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

5 OF 23



PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.08.31

2.0 ABSOLUTE MAXIMUM RATINGS

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

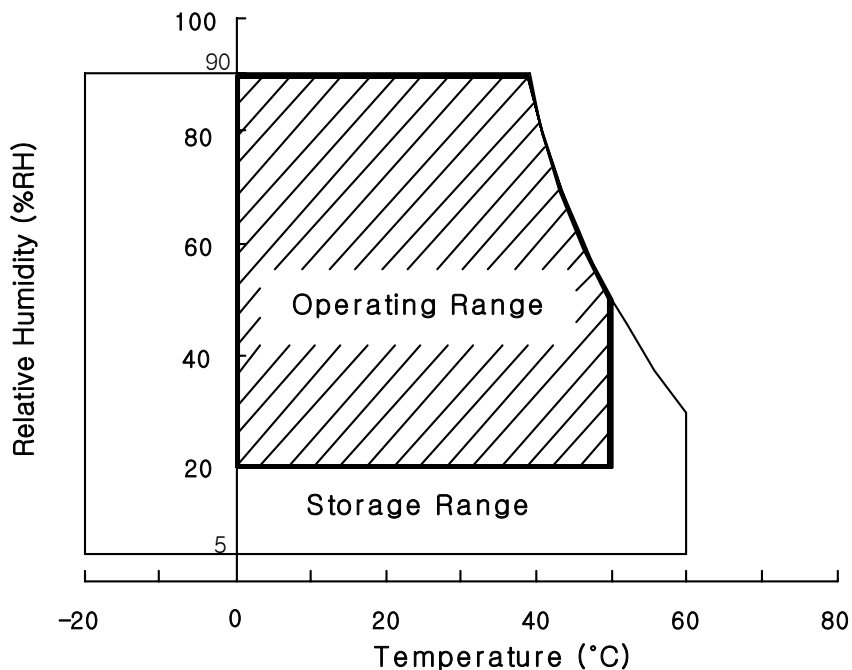
< Table 2. Absolute Maximum Ratings >

Parameter	Symbol	Min.	Max.	Unit	Remarks
Logic Power Supply	V _{DD}	VSS-0.3	4.0	V	Ta = 25 ± 2 °C
Logic Input Voltage	V _{IN}	VSS-0.3	V _{DD} +0.3	V	
Back-light Lamp Current	IBL	2.0	6.0	mA	
Back-light Frequency	FBL	45	80	KHz	
Operating Temperature	T _{OP}	0	+50	°C	Note 1
Storage Temperature	T _{SP}	-20	+60	°C	

Note 1. Temperature and relative humidity range are shown in the figure below.

* 90 [%] RH Max. (40°C ≥ Ta)

* Maximum wet-bulb temperature at 39 °C or less.(Ta > 40°C) No condensation



SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

6 OF 23



PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.08.31

3.0 ELECTRICAL SPECIFICATIONS

[Ta = 25±2 °C]

Parameter		Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	V _{DD}	3.0	3.3	3.6	V	Note1
Power Supply Current	I _{DD}		255	455	mA	Note1
High Level Differential Input Signal Voltage	V _{IH}		-	+100	mV	
Low Level Differential Input Signal Voltage	V _{IL}	-100	-		mV	
Back-light Lamp Voltage	V _{BL}	690	600	570	V _{rms}	Note2
Back-light Lamp Current	I _{BL}	2.0	5.0	6.0	mA	
Back-light Lamp operating Frequency	F _L	45		80	KHz	One Lamp, Note3
Lamp Start Voltage		1,080			V _{rms}	At Ta=25°C, Note4
		1,350			V _{rms}	At Ta=0°C, Note4
Lamp Life		10,000	15,000		Hrs	I _{BL} = 6mA, Note5
Power Consumption	P _D		0.8	1.5	W	Typ.@8color bar
	P _{BL}		3.0	3.3	W	I _{BL} =5mA, Note6
	P _{total}		3.8	4.8	W	

Notes : 1. The supply voltage is measured and specified at the interface connector of LCM.

The current draw and power consumption specified is for 3.3V at 25°C.

a) Typ: 8 color bar Pattern b) Max: V2 Skip Pattern

2. Reference value, which is measured with Samsung Electric SIC-180 Inverter.
(V_{BL} Min is value at I_{BL} Min and V_{BL} Max is value at I_{BL} Max)

3. The lamp frequency should be selected as different as possible from the horizontal synchronous frequency and its harmonics to avoid interference which may cause line flow on the display.

4. For starting the backlight unit, the output voltage of DC/AC's transformer should be larger than the minimum lamp starting voltage.(1,080 V_{rms} at 25 °C & 1,350 V_{rms} at 0 °C)

If an inverter has shutdown function it should keep its output for more than 1 second even if the lamp connector open. Otherwise the lamps may not to be turned on.

5. End of Life shall be determined by the time when any of the following is satisfied under continuous lighting at 25°C and I_{BL} = 6.0[mA].

- Intensity drops to 50% of the Initial Value.

6. Calculated value for reference (V_{BL} × I_{BL})

SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

7 OF 23



PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.08.31

4.0 OPTICAL SPECIFICATIONS

4.1 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 TOPCONE 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 $\Theta_{\Theta=0}$ ($=\Theta_3$) as the 3 o'clock direction (the "right"), $\Theta_{\Theta=90}$ ($=\Theta_{12}$) as the 12 o'clock direction ("upward"), $\Theta_{\Theta=180}$ ($=\Theta_9$) as the 9 o'clock direction ("left") and $\Theta_{\Theta=270}$ ($=\Theta_6$) 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 backlight should be operating for 30 minutes prior to measurement... VDD shall be $3.3 \pm 0.3\text{V}$ at 25°C . Optimum viewing angle direction is 6 o'clock.

4.2 Optical Specifications

<Table 4. Optical Specifications>

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle range	Horizontal	Θ_3	CR > 10	40	45		Deg.	Note 1
		Θ_9		40	45		Deg.	
	Vertical	Θ_{12}		15	20		Deg.	
		Θ_6		45	50		Deg.	
Luminance Contrast ratio		CR	$\Theta = 0^\circ$		300			Note 2
Luminance of White	5 Points	Y_w	$\Theta = 0^\circ$ $I_{BL} = 5\text{mA}$	130	150		cd/m^2	Note 3
White Luminance uniformity	5 Points	ΔY_5		80	85		%	Note 4
	13 Points	ΔY_{13}		65	75			
White Chromaticity		x_w	$\Theta = 0^\circ$	0.285	0.315	0.345		Note 5
		y_w		0.302	0.332	0.362		
Reproduction of color	Red	x_R	$\Theta = 0^\circ$	0.551	0.581	0.611		
		y_R		0.307	0.337	0.367		
	Green	x_G		0.279	0.309	0.339		
		y_G		0.514	0.544	0.574		
	Blue	x_B		0.120	0.150	0.180		
		y_B		0.113	0.143	0.173		
Response Time	Rise	T_r	$T_a = 25^\circ\text{C}$ $\Theta = 0^\circ$		10	20	ms	Note 6
	Decay	T_d			20	40	ms	
Cross Talk		CT	$\Theta = 0^\circ$			2.0	%	Note 7

SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

8 OF 23

**PRODUCT GROUP****REV.****ISSUE DATE**

TFT-LCD PRODUCT

B

2004.08.31

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.

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

3. Average Luminance of white is defined as arithmetic mean of five measurement points across the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in FIGURE 2 for a total of the measurements per display.

4. The White luminance uniformity on LCD surface is then expressed as : $\Delta Y = \text{Maximum Luminance of 5(or 13) points} / \text{Minimum Luminance of 5(or 13) points}$ (see FIGURE 2 shown in Appendix).

5. The color chromaticity coordinates specified in Table 4 shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

6. The electro-optical response time measurements shall be made as FIGURE 3 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 T_r , and 90% to 10% is T_d .

7. 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 4 shown in Appendix).

SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

9 OF 23



PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.08.31

5.0 INTERFACE CONNECTION

5.1 Electrical Interface

CN1 Interface connector : Hirose/DF19KR-20P-1H or equivalent
 User side connector : Hirose/DF19G-20S-1C 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 (-)	Tx pin # 48
6	RIN0+	LVDS Positive data signal (+)	Tx pin # 47
7	VSS	Ground	
8	RIN1-	LVDS Negative data signal (-)	Tx pin # 46
9	RIN1+	LVDS Positive data signal (+)	Tx pin # 45
10	VSS	Ground	
11	RIN2-	LVDS Negative data signal (-)	Tx pin # 42
12	RIN2+	LVDS Positive data signal (+)	Tx pin # 41
13	VSS	Ground	
14	RCLKIN-	LVDS Negative clock signal (-)	Tx pin # 40
15	RCLKIN+	LVDS Positive clock signal (+)	Tx pin # 39
16	VSS	Ground	
17	Vdd_EDID	No Connection	
18	NC	No Connection	
19	Clk_EDID	No Connection	
20	Clk_Data	No Connection	

SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

10 OF 23



PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.08.31

5.2 Back-light Interface

CN2	Interface Connector	: BHSR-02VS-1 (JST) or equivalent
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Pin No	INPUT	Function	Remarks
1	HOT	High voltage	Pink
2	COLD	Ground	Black

5.3 LVDS Interface

LVDS Transmitter: THC63LVDM83A or equivalent.

Input signal	Transmitter		Interface		DF19KR-20P-1H	Remark
	Pin No	Pin No	System (Tx)	TFT-LCD (Rx)	Pin No.	
R0	51	48 47	OUT0- OUT0+	IN0- IN0+	5	
R1	52					
R2	54					
R3	55				6	
R4	56					
R5	3					
G0	4	46 45	OUT1- OUT1+	IN1- IN1+	8	
G1	6					
G2	7					
G3	11					
G4	12				9	
G5	14					
B0	15	42 41	OUT2- OUT2+	IN2- IN2+	11	
B1	19					
B2	20					
B3	22					
B4	23				12	
B5	24					
HSYNC	27	40 39	CLKOUT- CLKOUT+	CLKIN- CLKIN+	14	
VSYNC	28					
DE	30				15	
MCLK	31					

SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

11 OF 23



PRODUCT GROUP

REV.

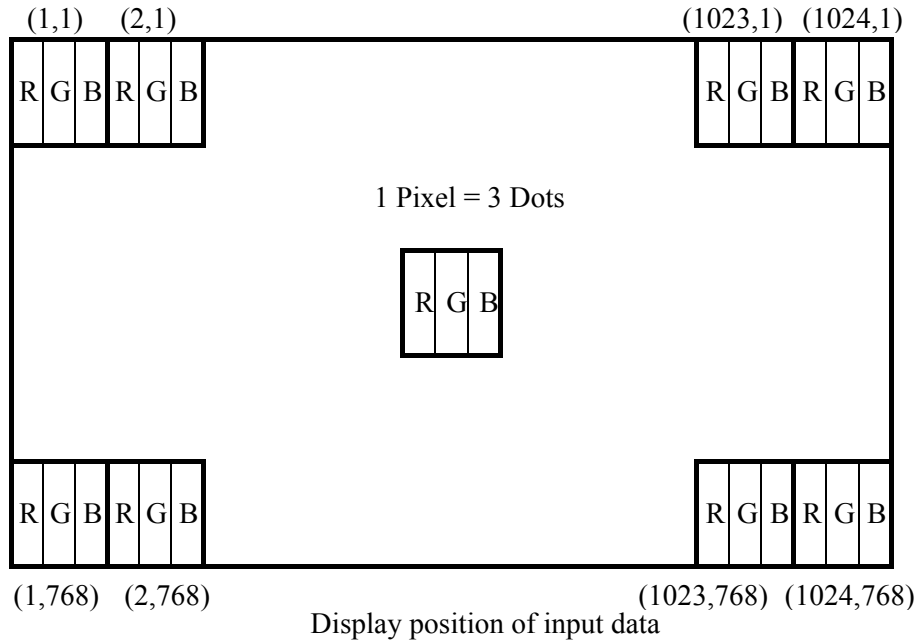
ISSUE DATE

TFT-LCD PRODUCT

B

2004.08.31

5.4 Data Input Format



6.0 SIGNAL TIMING SPECIFICATIONS

6.1 The 12.1"XGA LCM 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

SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

12 OF 23



PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

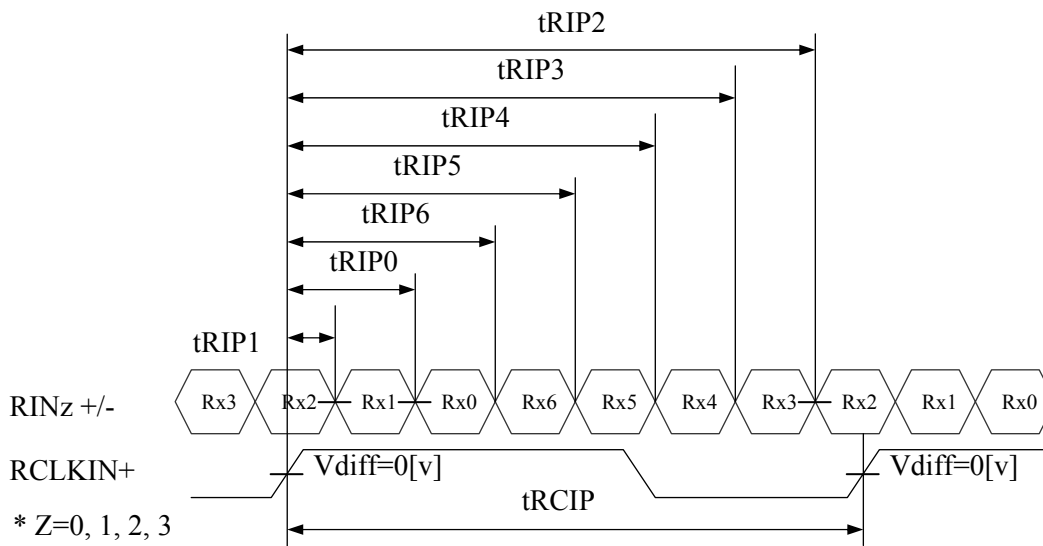
2004.08.31

6.2 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	



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

SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

13 OF 23



PRODUCT GROUP

REV.

ISSUE DATE

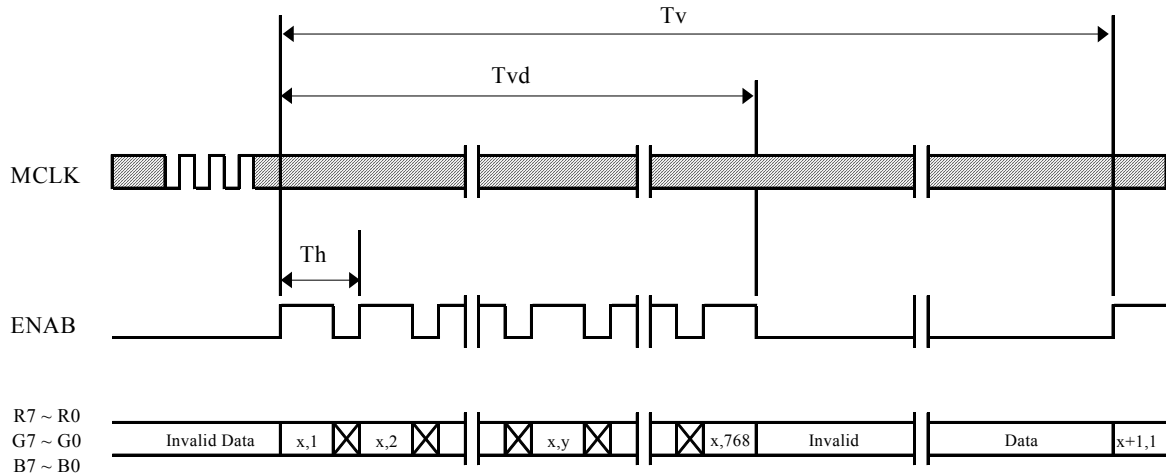
TFT-LCD PRODUCT

B

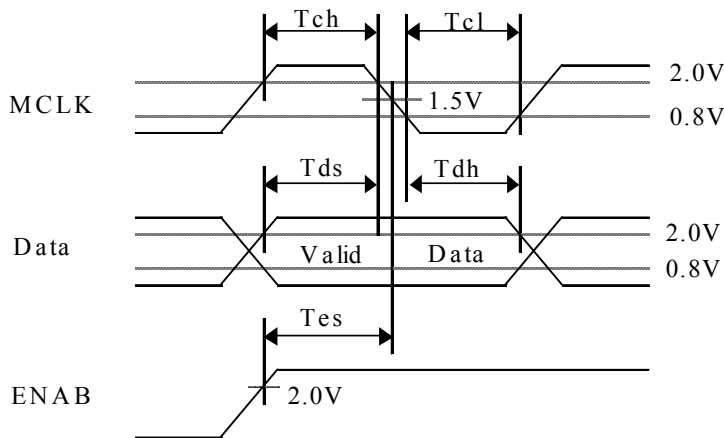
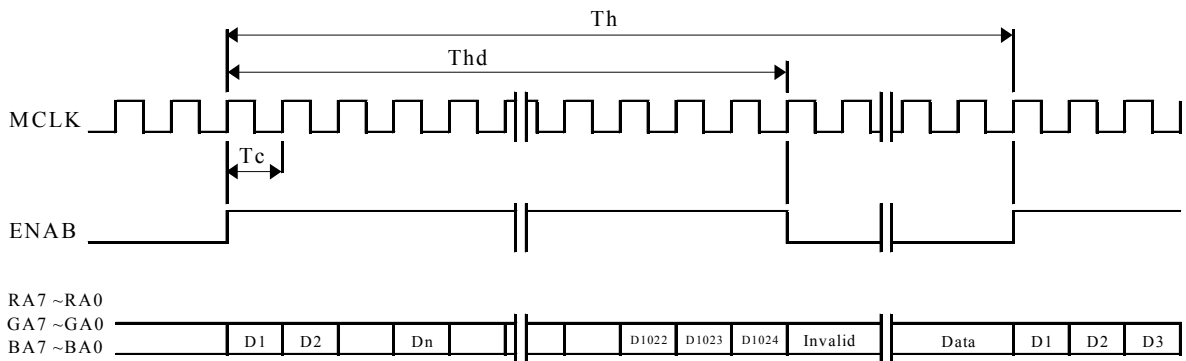
2004.08.31

7.0 SIGNAL TIMING WAVEFORMS OF INTERFACE SIGNAL (DE MODE)

7.1 Vertical Timing Waveforms



7.2 Horizontal Timing Waveforms



SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

14 OF 23



PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.08.31

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
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
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	0	1
	△	↓						↓						↓					
	▽	↓						↓						↓					
	Brighter	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	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
Basic Colors	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

15 OF 23



PRODUCT GROUP

REV.

ISSUE DATE

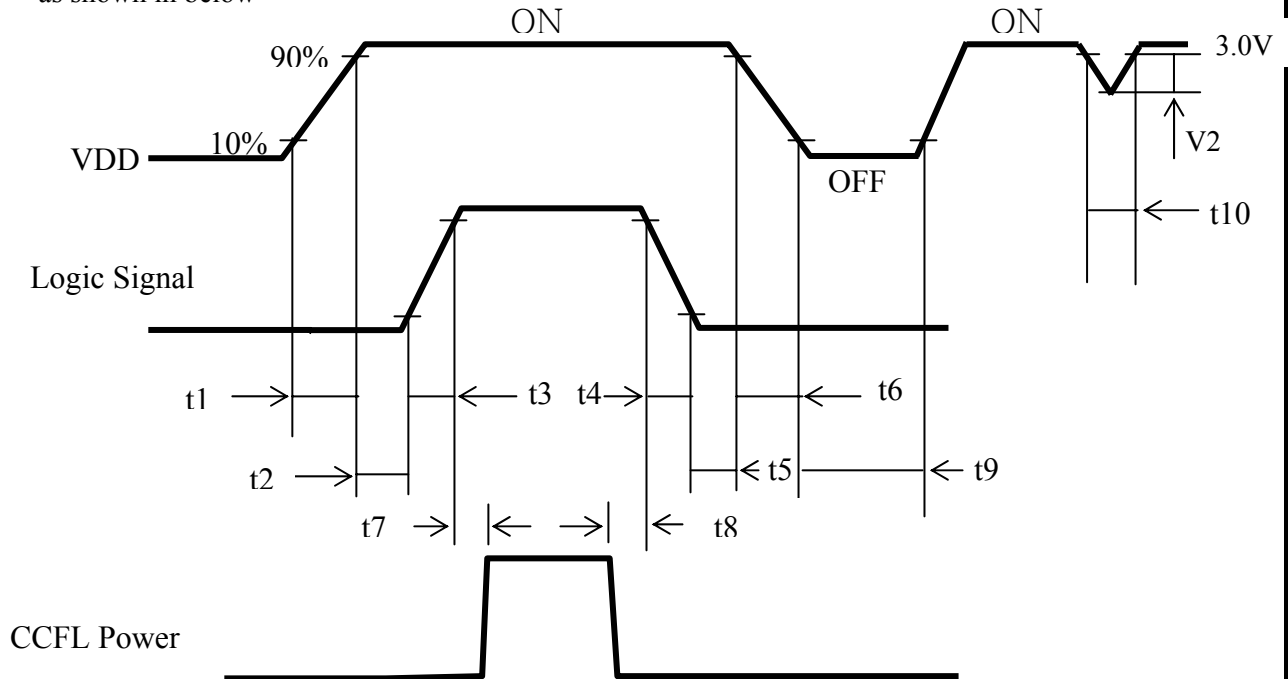
TFT-LCD PRODUCT

B

2004.08.31

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



- | | |
|--------------------------------|--------------------------------|
| $0 < t1 \leq 10 \text{ ms}$ | $0 \leq t4 \leq 50 \text{ ms}$ |
| $0 < t2 \leq 50 \text{ ms}$ | $0 < t5 \leq 50 \text{ ms}$ |
| $0 \leq t3 \leq 50 \text{ ms}$ | $t6 \leq 10 \text{ ms}$ |
| $t7 \geq 100 \text{ ms}$ | $t8 \geq 100 \text{ ms}$ |
| $t9 \geq 200 \text{ ms}$ | $t10 \leq 10 \text{ ms}$ |

$$2.8 \text{ V} \leq V2 \leq 3.0 \text{ V}$$

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.

SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

16 OF 23

**PRODUCT GROUP****REV.****ISSUE DATE**

TFT-LCD PRODUCT

B

2004.08.31

10.0 MECHANICAL CHARACTERISTICS

10.1 Dimensional Requirements

FIGURE 5, 6 shown in appendix shows mechanical outlines for the model.

Parameter	Specification	Unit
Active area	245.76 (H) × 184.32 (V)	mm
Number of pixels	1024(H) × 768(V)	pixels
	(1 pixel = R + G + B dots)	
Pixel pitch	0.240(H) × 0.240(V)	mm
Pixel arrangement	RGB Vertical stripe	
Display colors	262,144	colors
Display mode	Normally white	
Dimensional outline	261.0±0.5(W) × 199.0±0.5(V) × 4.7(D) Typ./5.0(D)Max.	mm
Weight	290 (Typ.) / 300 (Max.)	gram
Back-light	CCFL, Horizontal-lamp type	

10.2 Mounting

See FIGURE 5 shown in appendix

10.3 Anti-Glare and Polarizer Hardness.

The surface of the LCD has an anti-glare coating to minimize reflection and a coating to reduce scratching.

10.4 Light Leakage

There shall not be visible light from the back-lighting system around the edges of the screen as seen from a distance 50 cm from the screen with an overhead light level of 150lux. The manufacture shall furnish limit samples of the panel showing the light leakage acceptable.

SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

17 OF 23



PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.08.31

11.0 RELIABILITY TEST

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 operation Test	Ta = 50 °C, 240 hrs
4	High temperature & high humidity operation test	Ta = 50 °C, 80 %RH, 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 ~ 500 Hz Gravity/AMP : 1.5G Period : X, Y, Z 30 min
8	Shock test (non-operating)	Gravity : 220G Pulse width : 2ms, half sine wave ±X, ±Y, ±Z Once for each direction
9	Electrostatic discharge test	Air : 150 pF, 330Ω , 15KV Contact : 150 pF, 330Ω , 8KV

SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

18 OF 23

**PRODUCT GROUP****REV.****ISSUE DATE**

TFT-LCD PRODUCT

B

2004.08.31

12.0 HANDLING & CAUTIONS

12.1 Cautions when taking out the module

- Pick the pouch only, when taking out module from a shipping package.

12.2 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 and backlight element are 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.
- Do not pull the interface connector in or out while the LCD module is operating.
- Put the module display side down on a flat horizontal plane.
- Handle connectors and cables with care.

12.3 Cautions for the operation

- When the module is operating, do not lose MCLK, DE signals. If any one of these signals were lost, the LCD panel would be damaged.
- Obey the supply voltage sequence. If wrong sequence were applied, the module would be damaged.

12.4 Cautions for the atmosphere

- Dewdrop atmosphere should be avoided.
- Do not store and/or operate the LCD module in a high temperature and/or humidity atmosphere. Storage in an electro-conductive polymer-packing pouch and under relatively low temperature atmosphere is recommended.

12.5 Cautions for the module characteristics

- 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.

12.6 Other cautions

- Do not disassemble and/or re-assemble LCD module.
- Do not re-adjust variable resistor or switch etc.
- 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

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

19 OF 23



PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.08.31

13.0 Environment & Safety

13.1 Mercury disposal & High voltage caution

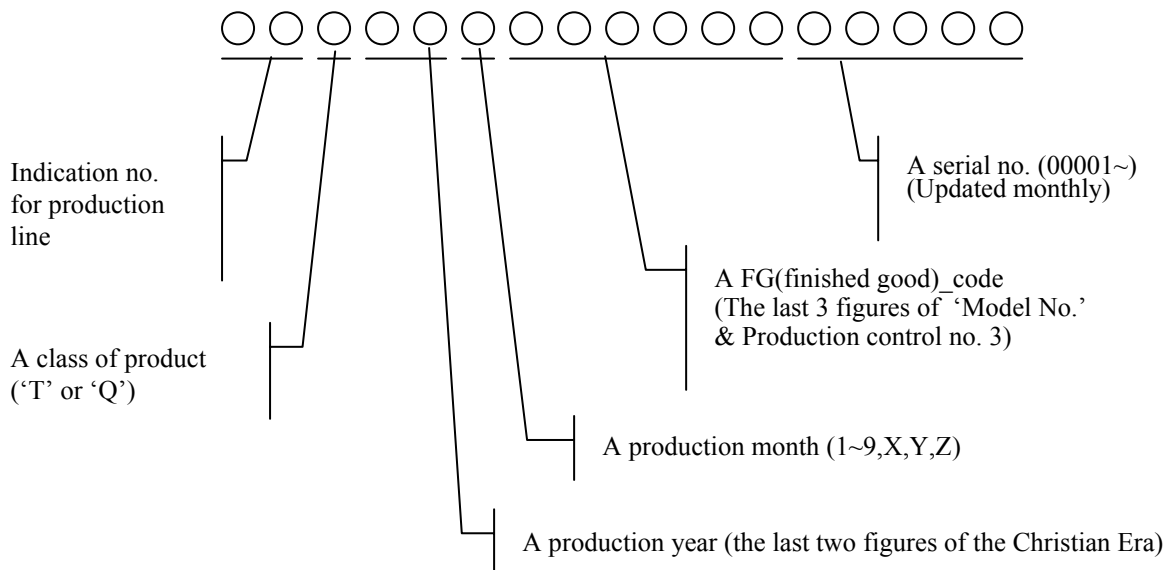
	<p>HIGH VOLTAGE CAUTION</p>	<p>COLD CATHODE FLUORESCENT LAMP IN LCD PANEL CONTAINS A SMALL AMOUNT OF MERCURY. PLEASE FOLLOW LOCAL OR- DINANCES OR REGULATIONS FOR DISPOSAL.</p>
	<p>RISK OF ELECTRIC SHOCK. DISCONNECT THE ELECTRIC POWER BEFORE SERVICING</p>	

13.2 Product Label

HT12X13-100

MADE IN KOREA XXXXXX100XXXXXXX

How to express 'Lot No.'



SPEC. NUMBER S864-1189	SPEC. TITLE HT12X13-100 Product Specification	PAGE 20 OF 23
----------------------------------	---	-------------------------



PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.08.31

14.0 APPENDIX

Figure 1. Measurement Set Up

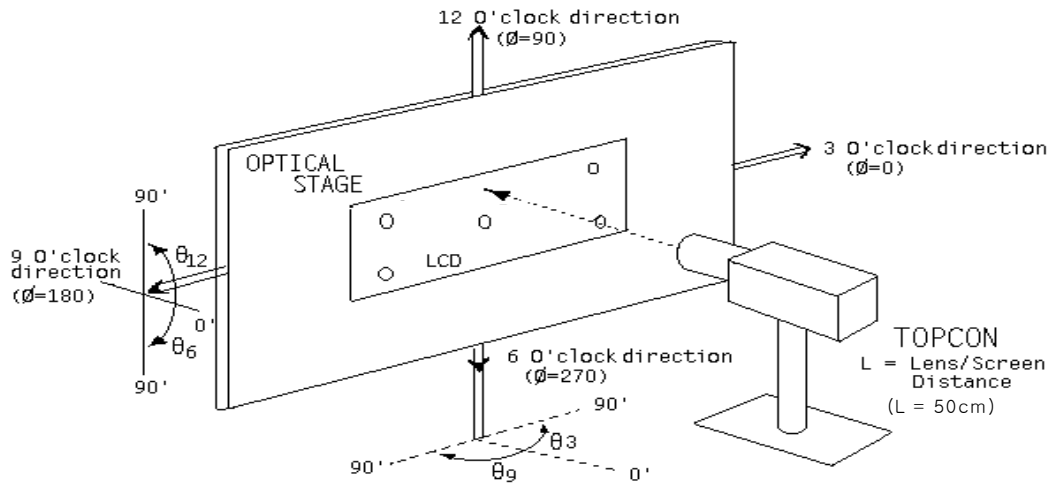
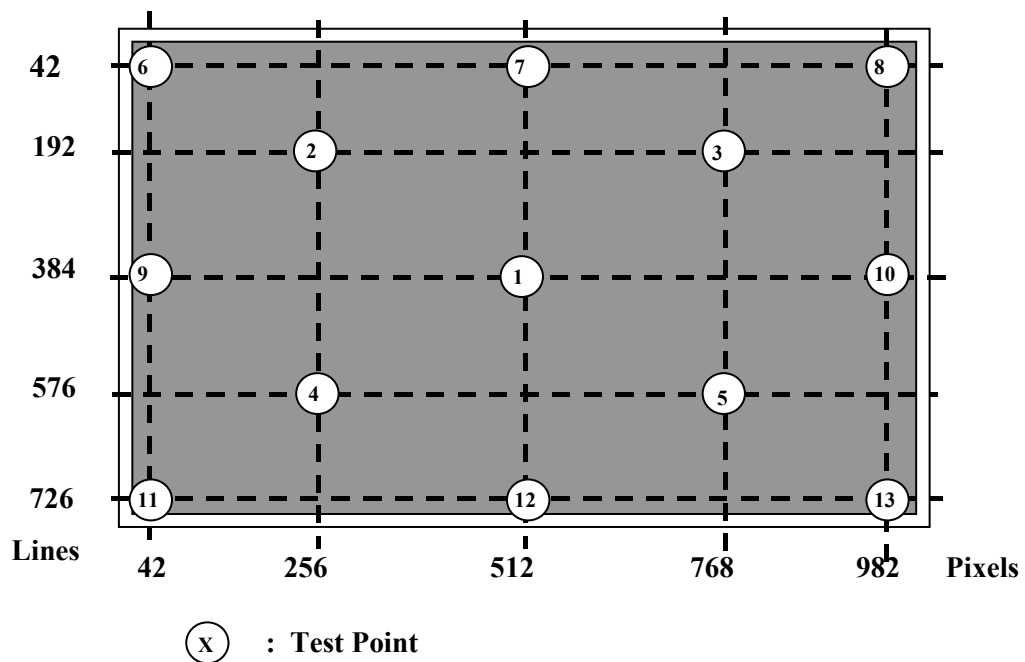


Figure 2. Average Luminance Measurement Locations & Uniformity Measurement Locations



SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

21 OF 23



PRODUCT GROUP

REV.

ISSUE DATE

TFT-LCD PRODUCT

B

2004.08.31

Figure 3. Response Time Testing

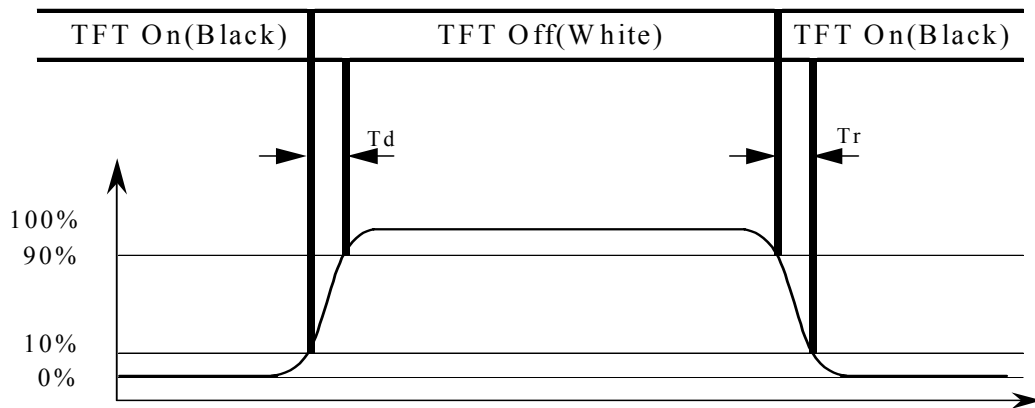
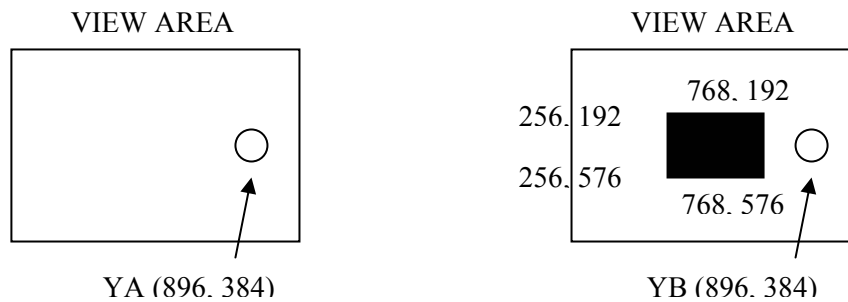


Figure 4. Cross Modulation Test Description



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

Where:

Y_A = Initial luminance of measured area (cd/m²)

Y_B = Subsequent luminance of measured area (cd/m²)

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

SPEC. NUMBER

S864-1189

SPEC. TITLE

HT12X13-100 Product Specification

PAGE

22 OF 23

