Vertex LCD Inc.

TENTATIVE PRODUCT INFORMATION

(All information in this technical data sheet is tentative and subject to change without notice.)

Updated: 10/17/2001

10.4" XGA TFT-LCD

LVM104XSB

COLOR LIQUID CRYSTAL DISPLAY

CONTENTS

1. General Description

LVM104XSB is 10.4" Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Fluorescent Lamp (CCFL) backlight system. The matrix employs Poly-Silicon Thin Film Transistor as the active element. It is a transmissive type display operating in the normally white mode. This TFT-LCD has a 10.4 inch diagonally measured active display area with XGA resolution (768 horizontal by 1024 vertical pixel array). Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 8-bit gray scale signal for each dot, thus presenting a palette of more than 16,777,216 colors.

The LVM104XSB is intended to support applications where high brightness, broad viewing angle, high resolution are critical factors. In combination with the vertical arrangement of the sub-pixels, the LVM104XSB characteristics provide an excellent flat panel display for office or industrial automation products or daylight applications.

General Specification

General specifications are summarized in the following table:

ITEM	SPECIFICATION
Active screen size	10.4 inches(26cm) diagonal 210.432(H) X 157.824(V) mm
Outline dimensions	237(H) × 184(V) × 8.1(D) mm
Pixel pitch	0.2055(H) mm × 0.2055(V) mm
Pixel format	1024(H) X 768(V) pixels
Color Pixel Arrangement	RGB stripe arrangement
Color depth	8-bit, 16,777,216 colors
Brightness	1,300 cd/m^2
Power Consumption	Total 17.5 Watt,typ (1.2Watt @Vcc, 16.2 Watt @Lamp)
Weight	600 g (typ)
Display operating mode	Transmissive mode, normally white
Surface treatments	hard coating(3H), anti-glare treatment anti-reflective (optional)
Backlight Unit	CCFL, 4 tubes

2. Absolute Maximum Rating

Parameter	symbol	Values		Units	Notes
		Min.	Max.		
Power Input Voltage	V_{CC}	-0.3	+4.5	Vdc	at 25°C
Operating Temperature	T_{OP}	0	+50	°C	1
Storage Temperature	T_{ST}	-20	+60	°C	1

Note: Humidity ≦ 85% RH. No condensation.

3. Electrical Characteristics

The LVM104XSB requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input which powers the CCFL, is typically generated by an inverter. The inverter is an external unit to the LCD.

Parameter	Symbol	Values			Units	Notes
		Min.	Typ.	Max.		
MODULE:						
Power Supply Input Voltage	V_{CC}	3.0	3.3	3.6	Vdc	Vcc = 3.3 V
Power Supply Input Current	I_{CC}	-	0.360	0.400	A	1 Vcc = 3.3 V
Power Consumption	P_C	-	1.2	1.5	Watts	
LAMP						
Operating Voltage	V_{BL}	540	580	665	V_{RMS}	3
Operating Current	I_{BL}	4.0	7.0	8.0	mA	
Established Starting Voltage						4
at 25°C				875	V_{RMS}	
at 0°C		-	-	1300	V_{RMS}	
Operating Frequency	f_{BL}	30	55	60	kHz	
Power Consumption	P_{BL}	8.7	16.3	21.3	Watts	5
Life Time		35,000	40,000		Hrs	6

Notes: 1. The current draw and power consumption specified is for 3.3 Vdc at 25°C and fv at 60Hz.(at Black pattern displayed)
3. The variance of the voltage is ± 10%.
4. The output voltage at the transformer in the inverter must be high considering to the loss of the ballast capacitor in the inverter.
5. The lamp power consumption shown above does not include loss of external inverter.
6. The life time is determined as the time at which brightness of lamp is 50% compare to that of initial value at the typical lamp current.

4. Interface Connections

A. CN 1(interface signal): LVM104XSB uses 14 pin connector for module electronics.
Connector: 55176-1491/Molex Japan Co., LTD. Mating Connector: 51146-1400 (housing)/Molex Japan Co., LTD.

Pin	Symbol	Description
1	Vcc	Power Supply: +3.3 V
2	Vcc	Power Supply: +3.3 V
3	GND	
4	GND	
5	CLK+	Sampling Clock +
6	CLK-	Sampling Clock –
7	IN2+	Transmission Data of Pixel 2 +
8	IN2-	Transmission Data of Pixel 2 –
9	IN1+	Transmission Data of Pixel 1 +
10	IN1-	Transmission Data of Pixel 1 –
11	IN0+	Transmission Data of Pixel 0 +
12	IN0-	Transmission Data of Pixel 0 –
13	GND	
14	GND	

Notes : 1. All GND(ground) pins should be connected together and the LCD's metal frame.
2. All Vcc (power input) pins should be connected together to 3.3 V.

B. CN 2(backlight): LVM104XSB employs 2 JST connectors for the backlight power. The part number is BHR-03VS-1, manufactured by JST. The mating connector part number is SM02(8.0)B-BHS-1-TB or equivalent.

Pin	Symbol	Description	Notes
1	HV	Lamp power input	PINK (or Grey)
2	HV	Lamp power input	PINK (or Grey)
3	LV	Ground	WHITE

Notes : 1. The input power terminal is colored pink (or grey). Ground pin color is white.
2. The lamp ground should be common with GND.

C. Recommended Transmitter to LVM104XSB

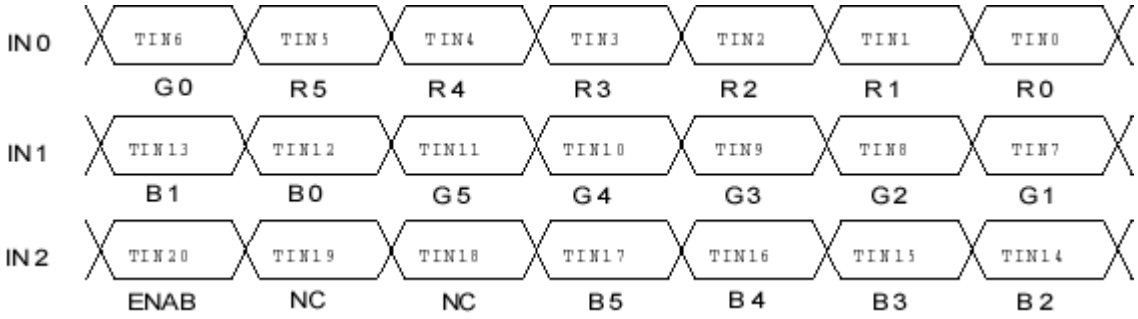
1. 6 Bit Transmitter (DS90CF363)

DS90CF363					LVM104XD	
Input Terminal No.		Input Signal (Graphic controller output signal)		Output Signal Symbol	Interface (CN1)	
Symbo	DS90CF363	Symbol	Function		Terminal	Symbol
TIN0	44	R0	Red Pixels Display Data (LSB)			
TIN1	45	R1	Red Pixels Display Data			
TIN2	47	R2	Red Pixels Display Data			
TIN3	48	R3	Red Pixels Display Data	TOUT0 -	No. 12	IN0 –
TIN4	1	R4	Red Pixels Display Data	TOUT0+	No. 11	IN0 +
TIN5	3	R5	Red Pixels Display Data (MSB)			
TIN6	4	G0	Green Pixels Display Data (LSB)			
TIN7	6	G1	Green Pixels Display Data			
TIN8	7	G2	Green Pixels Display Data			
TIN9	9	G3	Green Pixels Display Data			
TIN10	10	G4	Green Pixels Display Data	TOUT1 –	No. 10	IN1 –
TIN11	12	G5	Green Pixels Display Data (MSB)	TOUT1 +	No. 9	IN1 +
TIN12	13	B0	Blue Pixels Display Data (LSB)			
TIN13	15	B1	Blue Pixels Display Data			
TIN14	16	B2	Blue Pixels Display Data			
TIN15	18	B3	Blue Pixels Display Data			
TIN16	19	B4	Blue Pixels Display Data			
TIN17	20	B5	Blue Pixels Display Data (MSB)	TOUT2 –	No. 8	IN2 –
TIN18	22	NC	Non Connection (open)	TOUT2 +	No. 7	IN2 +
TIN19	23	NC	Non Connection (open)			
TIN20	25	ENAB	Compound Synchronization Signal			
CLK IN	26	NCLK	Data Sampling Clock	TCLK OUT –	No. 6	CLK IN –
				TCLK OUT +	No. 5	CLK IN +

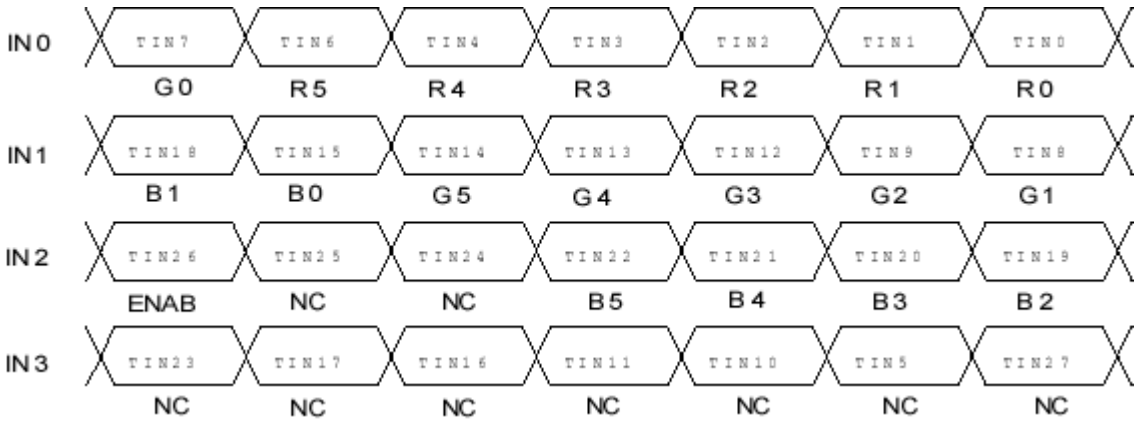
2. 8 Bit Transmitter (DS90CF383)

DS90CF363					LVM104XD Interface (CN1)	
Input Terminal No.		Input Signal (Graphic controller output signal)		Output Signal Symbol		
Symbo	DS90CF363	Symbol	Function		Terminal	Symbol
TIN0	51	R0	Red Pixels Display Data (LSB)			
TIN1	52	R1	Red Pixels Display Data			
TIN2	54	R2	Red Pixels Display Data	TOUT0 –	No. 12	IN0 –
TIN3	55	R3	Red Pixels Display Data	TOUT0 +	No. 11	IN0 +
TIN4	56	R4	Red Pixels Display Data			
TIN6	3	R5	Red Pixels Display Data (MSB)			
TIN7	4	G0	Green Pixels Display Data (LSB)			
TIN8	6	G1	Green Pixels Display Data			
TIN9	7	G2	Green Pixels Display Data			
TIN12	11	G3	Green Pixels Display Data	TOUT1 –	No. 10	IN1 –
TIN13	12	G4	Green Pixels Display Data	TOUT1 +	No. 9	IN1 +
TIN14	14	G5	Green Pixels Display Data (MSB)			
TIN15	15	B0	Blue Pixels Display Data (LSB)			
TIN18	19	B1	Blue Pixels Display Data			
TIN19	20	B2	Blue Pixels Display Data			
TIN20	22	B3	Blue Pixels Display Data			
TIN21	23	B4	Blue Pixels Display Data	TOUT2 –	No. 8	IN2 –
TIN22	24	B5	Blue Pixels Display Data (MSB)	TOUT2 +	No. 7	IN2 +
TIN24	27	NC	Non Connection (open)			
TIN25	28	NC	Non Connection (open)			
TIN26	30	ENAB	Compound Synchronization Signal			
TIN27	50	NC	Non Connection (open)			
TIN5	2	NC	Non Connection (open)		_____	_____
TIN10	8	NC	Non Connection (open)	TOUT3 –		
TIN11	10	NC	Non Connection (open)	TOUT3 +		
TIN16	16	NC	Non Connection (open)			
TIN17	18	NC	Non Connection (open)			
TIN23	25	NC	Non Connection (open)			
CLK IN	31	NCLK	Data Sampling Clock	TCLK OUT –	No. 6	CLK IN –
				TCLK OUT +	No. 5	CLK IN +

6 bit Transmitter



8 bit Transmitter



5. Color Input Data Reference

The brightness of each primary color(red, green and blue) is based on the 6-bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

Color		Input Color Data (0: low level, 1: high level)																	
		Red						Green						Blue					
		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	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	0	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	Red(00) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(01)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(02)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(63) Bright	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Green	Green(00)Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(01)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Green(02)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green(63)Bright	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Blue	Blue(00) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(01)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(02)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue(63) Bright	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Wht & Black	Black(00) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	(01)	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1
	(02)	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	(61)	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	0	1
	(62)	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	0
	White(63) Bright	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

6. Signal Timing Specification

Item	Symbol	Min.	Typ.	Max.	Unit
Frame Period	t1	778 x t3	806 x t3	860 x t3	-
Vertical	t2	768 x t3	768 x t3	768 x t3	
One Line Scanning	t3	1319 x t5	1344 x t5	1462 x t5	-
Horizontal Display	t4	1024 x t5	1024 x t5	1024 x t5	
Clock Period	t5	15.0	15.38	-	ns
Clock “L” Time	t6	2.5	-	-	ns
Clock “H” Time	t7	5.0	-	-	ns
Set Up Time	t8	1.5	-	-	ns
Hold Time	t9	2.0	-	-	ns

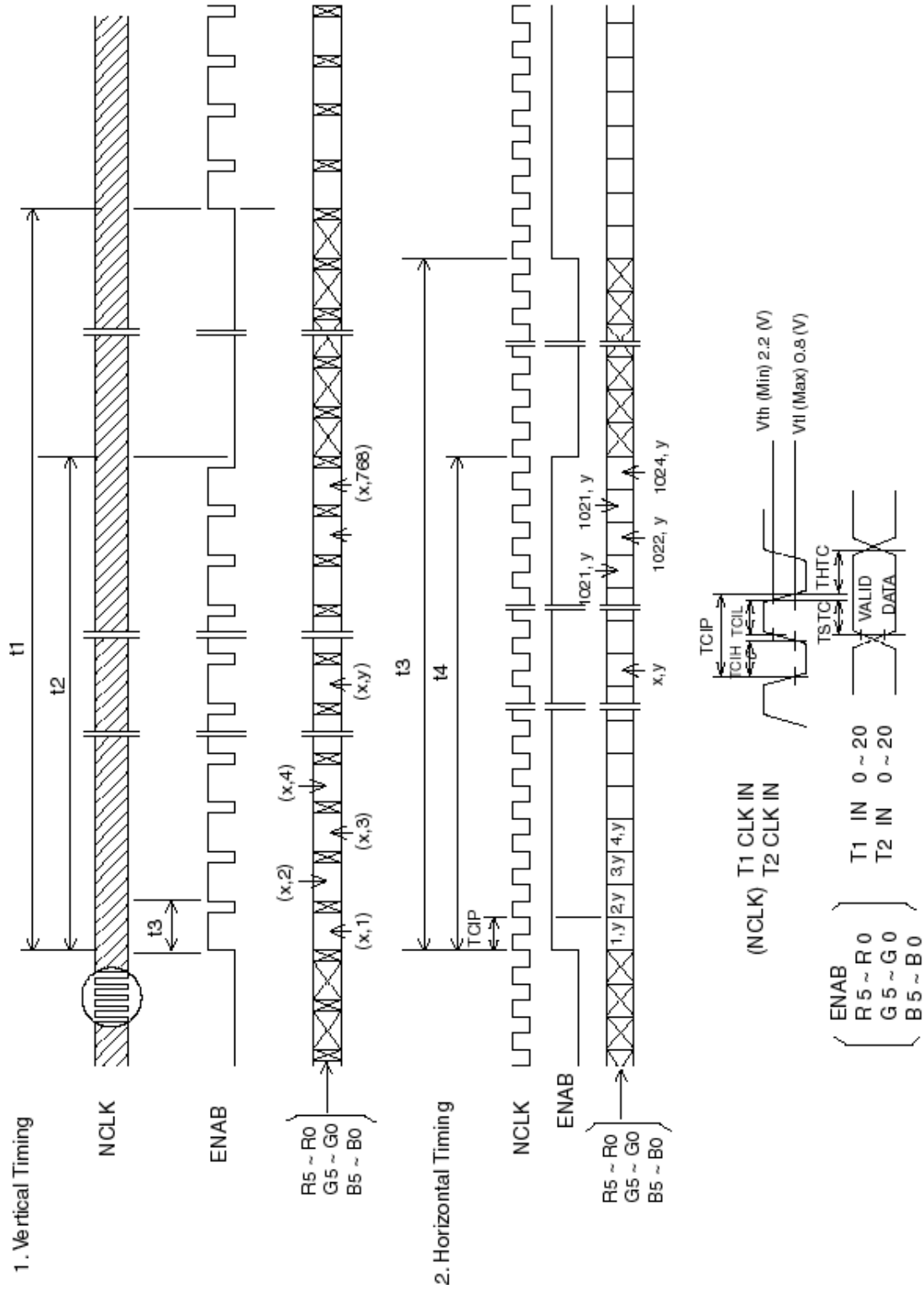
Note 1. Refer to “Signal Timing Wave Form” on page 6.

Note 2. If ENAB is fixed to “H” or “L” level for certain period while NCLK is supplied, the panel displays black with some flicker.

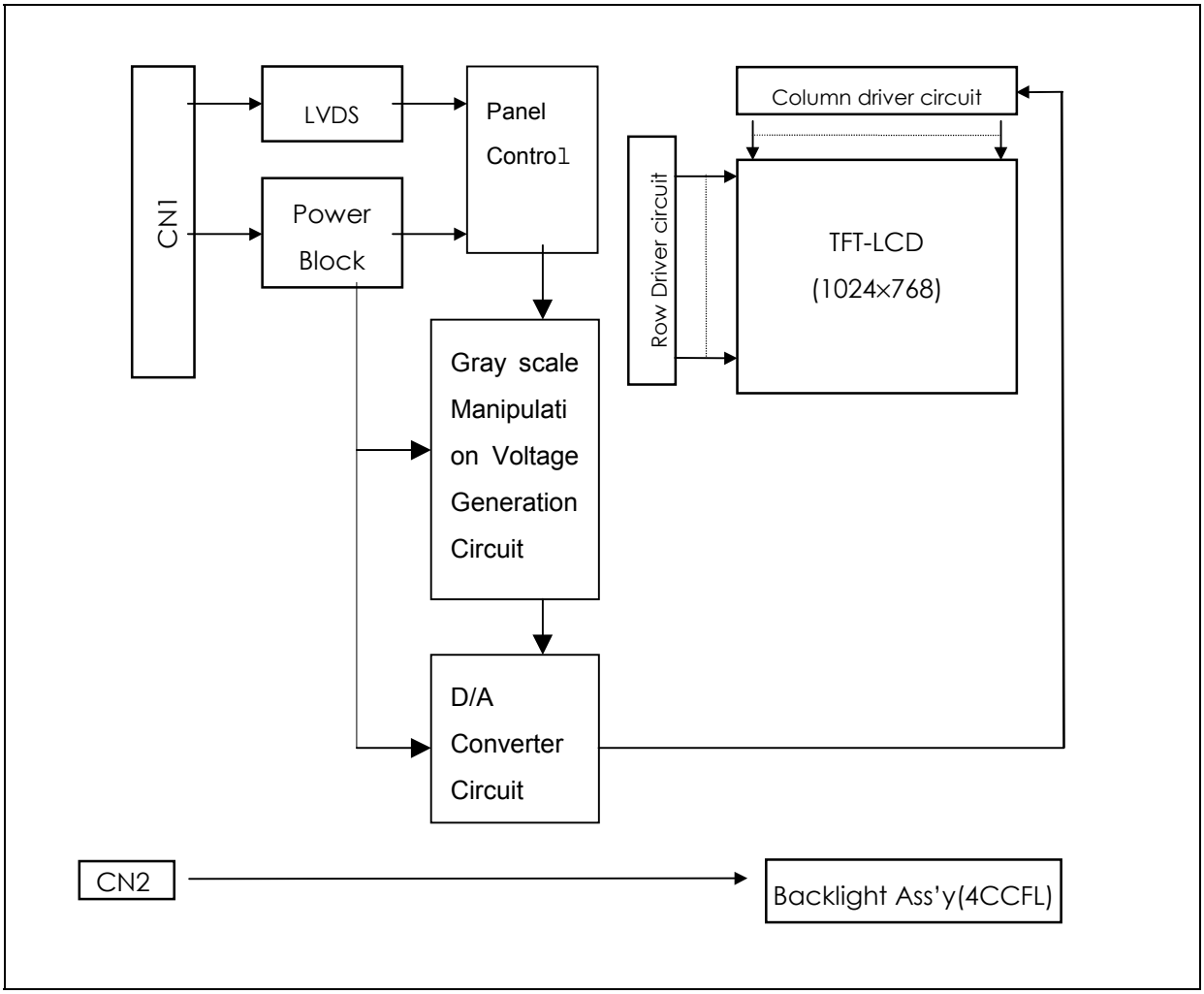
Note 3. Don’t fix NCLK to “H” or “L” level while the Vcc is supplied.
If NCLK is fixed to “H” or “L” level for certain period while ENAB is supplied, the panel may be damaged.

7. Timing Wave Form

Signal Timing Wave



8. Block Diagram



9. Optical Specifications

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25°C. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Ê and θ equal to 0°.
Appendix A presents additional information concerning the measurement equipment and method.

Parameter	Symbol	Values			Units	Notes
		Min.	Typ.	Max.		
Contrast Ratio	CR	-	250	-		1
Surface Luminance, white	L_{WH}	1200	1300	-	cd/m^2	2
Luminance Variation	δ_{WHITE}	-	1.25	1.45		3
Response Time	Tr_R	-	-	50	msec	4
Rise Time	Tr_D	-	-	50		
CIE Color Coordinates						
Red	x_R	tbd	0.598	tbd		
	y_R	tbd	0.344	tbd		
Green	x_G	tbd	0.312	tbd		
	y_G	tbd	0.538	tbd		
Blue	x_B	tbd	0.153	tbd		
	y_B	tbd	0.136	tbd		
White	x_W	tbd	0.320	tbd		
	y_W	tbd	0.340	tbd		
Viewing Angle						
x axis, right (∅=0°)	θ x	+55	-	-	degree	
x axis, left(∅=180°)	θ x	-55	-	-		5
y axis, up(∅=90°)	θ y	+15	-	-		
y axis, down (∅=270°)	θ y	-40	-			

Notes 1. Contrast Ratio (CR) is defined mathematically as :

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

2. Surface luminance is the center point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see Appendix B.
3. The variation in surface Luminance, δ_{WHITE} is determined by measuring L_{ON} at each test position 1 through 5, and then dividing the maximum L_{ON} of 5 points luminance by minimum L_{ON} of 5 points luminance. For more information see Appendix B.
   δ_{WHITE} = Maximum (L_{ON1}, L_{ON2}, ...L_{ON5}) ÷ Minimum (L_{ON1}, L_{ON2}, ...L_{ON5})
4. Response time is the time required for the display to transition from white to black (Rise Time, Tr_R) and from black to white (Decay Time, Tr_D). For additional information see Appendix C.
5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x-axis and the vertical or y-axis with respect to the z-axis which is normal to the LCD surface. For more information see Appendix D.

10. Mechanical Characteristics

The chart below provides general mechanical characteristics for the model LVM104XSB. In addition, the figure below is a detailed mechanical drawing of the LCD. Note that dimension are given for reference purposes only.

Outside dimensions :

Horizontal	237 ± 0.5 mm
Vertical	184 ± 0.5 mm
Depth	8.1 ± 0.5 mm

Active Display area :

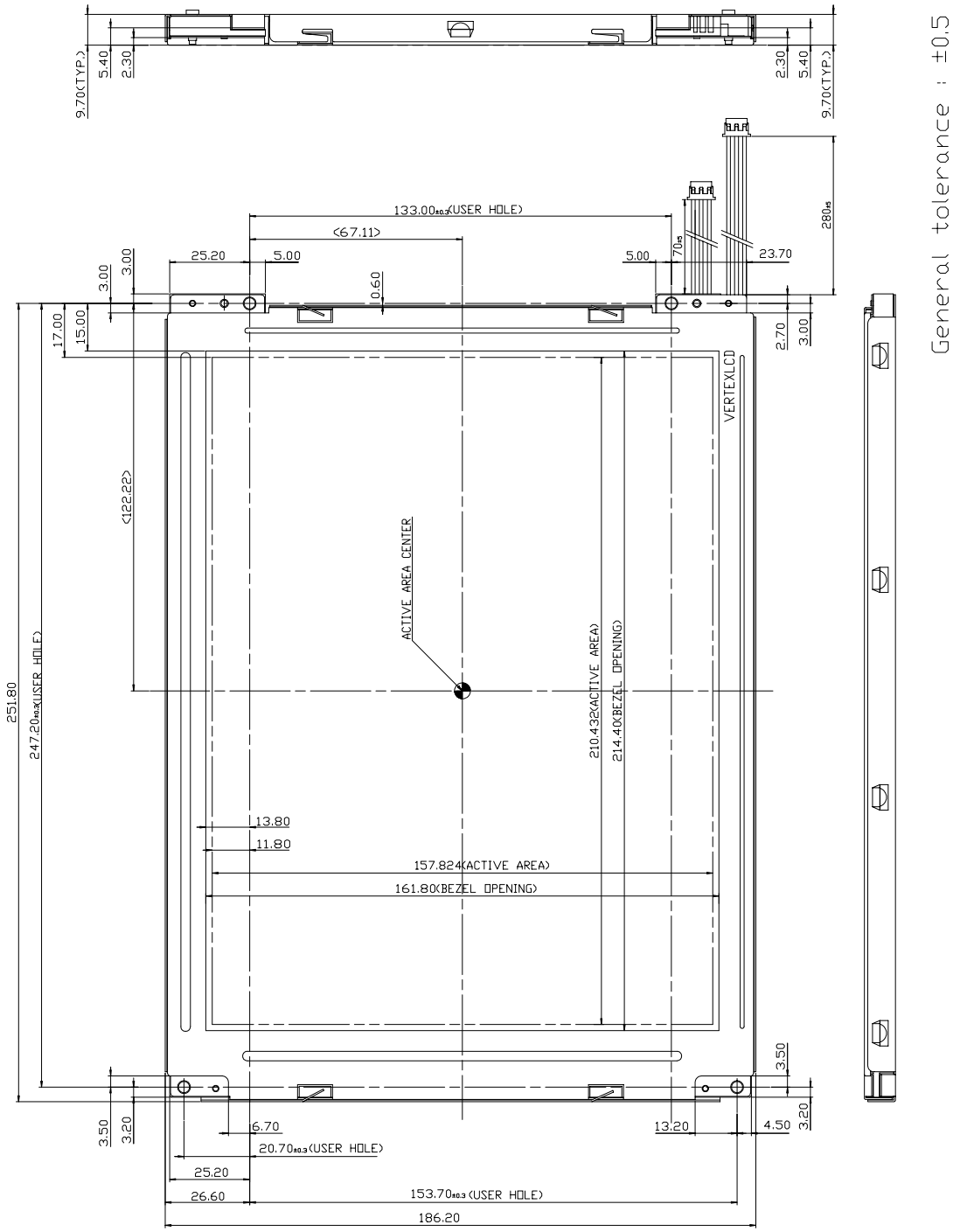
Horizontal	210.432 mm
Vertical	157.824 mm

Weight (approximate) : 600 g

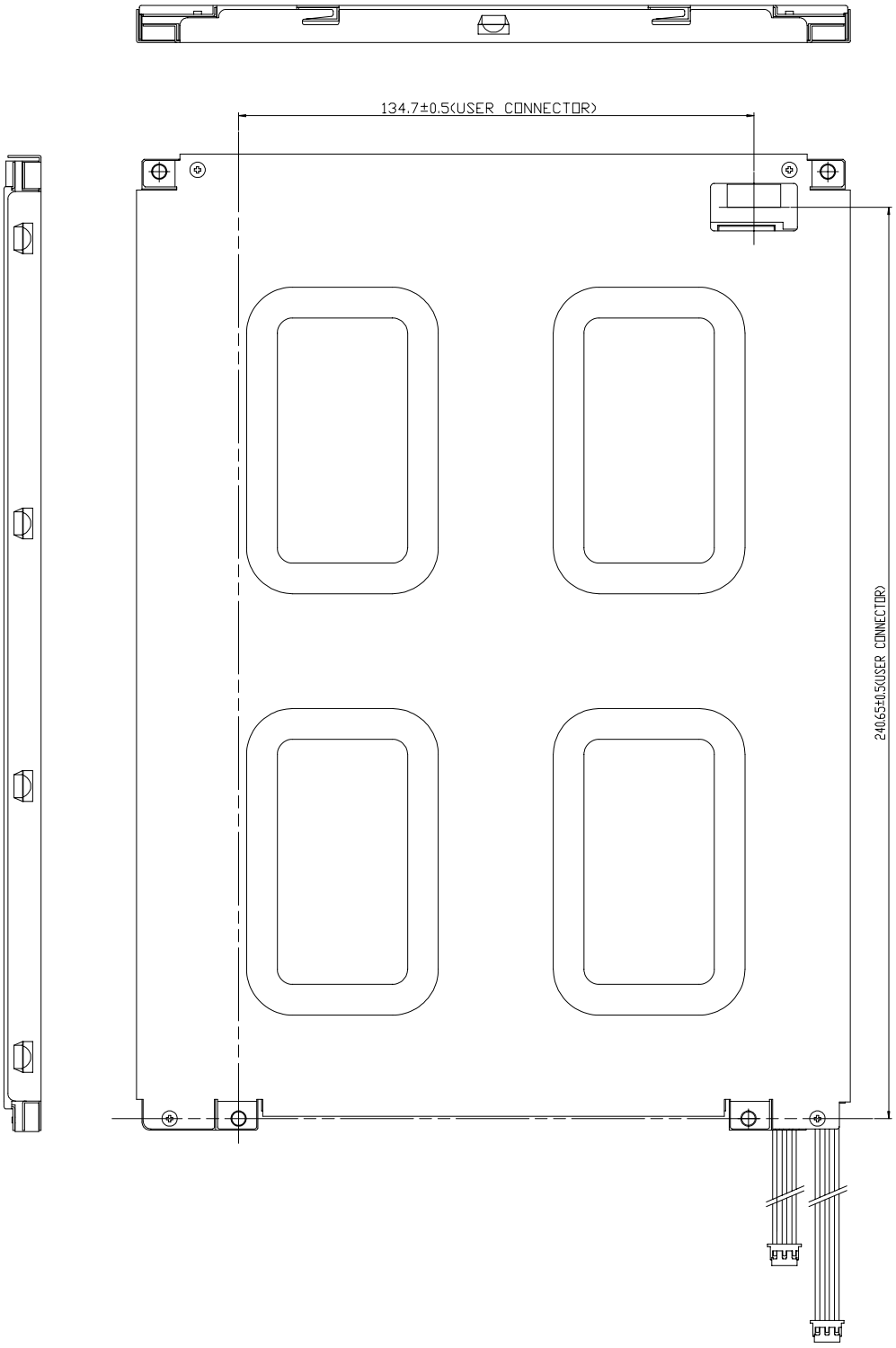
Surface Treatment : Hard coating 3H.
Anti-glare front polarizer. (anti-reflective optional)

11. Mechanical Specification

< FRONT VIEW >



< REAR VIEW >



12. Reliability

- Environment test condition

No.	Test ITEM	Conditions
1	High temperature storage test	Ta = 60 °C 240h
2	Low temperature storage test	Ta = -20 °C 240h
3	High temperature operation test	Ta = 50 °C 50%RH 240h
4	Low temperature operation test	Ta = 0 °C 240h
5	Vibration test (non-operating)	Random : 10~500Hz,0.0046g^2 /Hz, 1Grms, 3axis, 1hour/axis
6	Shock test (non-operating)	half sine wave : 120G, 2ms, one shock of each six faces. (i.e. run 120G 2ms for all six faces.)
7	Altitude storage/shipment	0 - 40,000 feet (12192m)

{Result Evaluation Criteria}

There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

- ON/OFF Cycle
  : The display module will be capable of being operated over 24,000 ON/OFF cycles (Lamp power & Vcc ON/OFF)
- Mean Time between Failure
  : The LCD Panel and interface board assembly (excluding the CCFLs) shall have a mean time between failures of 35,000 hours with a confidence level 90%.

13. Packing Form

a) Package quantity in one box : 10 pcs
b) Box Size : 335 x 297 x 284 (mm)

14. PRECAUTIONS

Please pay attention to the followings when you use this TFT/LCD module.

14.1 MOUNTING PRECAUTIONS

(1) You must mount a module using holes arranged in four corners.
(2) You should consider the mounting structure so that uneven force (ex. twisted stress) is not applied to the module.
And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
(3) Please attach the surface with a transparent protective plate in order to protect the polarizer LC cell.
Transparent protective plate should have sufficient strength in order to resist external force.
(4) You should adopt radiation structure to satisfy the temperature specification.
(5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter cause circuit break by electro-chemical reaction.

(6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And Please do not rub with dust clothes with chemical treatment.
Do not touch the surface df polarizer for bare hand or greasy cloth. (Some cosmetics are detrimental to the polarizer.)
(7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaked with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluen and alcohol because they cause chemical damage to the polarizer.
(8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
(9) Do not open the case because inside circuits do not have sufficient strength.

14.2 OPERATING PRECAUTIONS

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage : V = ± 200mV (Over and under shoot voltage).
(2) Response time depends on the temperature. (In lower temperature, it becomes longer.)
(3) Brightness depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.
(4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
(5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
(6) A module has high frequency circuit. It might be necessary to shield the electromagnetic noise in your integrating system.
(7) When a Backlight unit is operating, it may make sounds. It might be necessary to shield your integrating system to cut down the noise.

14.3 ELECTROSTATIC DISCHARGE CONTROL

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wristband etc . . And don't touch I/F pin directly.

14.4 STORAGE

When storing modules for a long time, the following precautions should be followed.

(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
(2) The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

14.5 HANDLING PRECAUTIONS FOR PROTECTION FILM

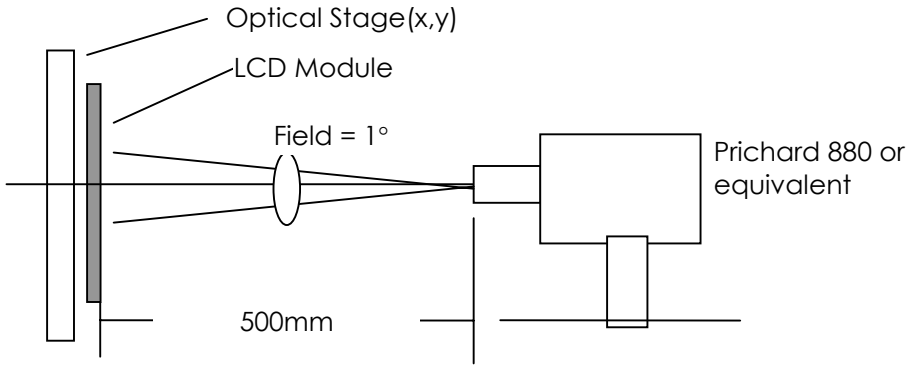
(1) When the protection film is peeled off, static electricity is generated between the film and polarizer.
This should be peeled off slowly and carefully by people who are electrically grounded and with well ion- blown equipment or in such a condition, etc..
(2) The protection film is attached to the polarizer with a small amount of glue. If some

stress is applied to rub the protection film against the polarizer during the time you peel off the film, the glue is apt to remain on the polarizer.
Please carefully peel off the protection film without rubbing it against the polarizer.

(3) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the polarizer after the protection film is peeled off.

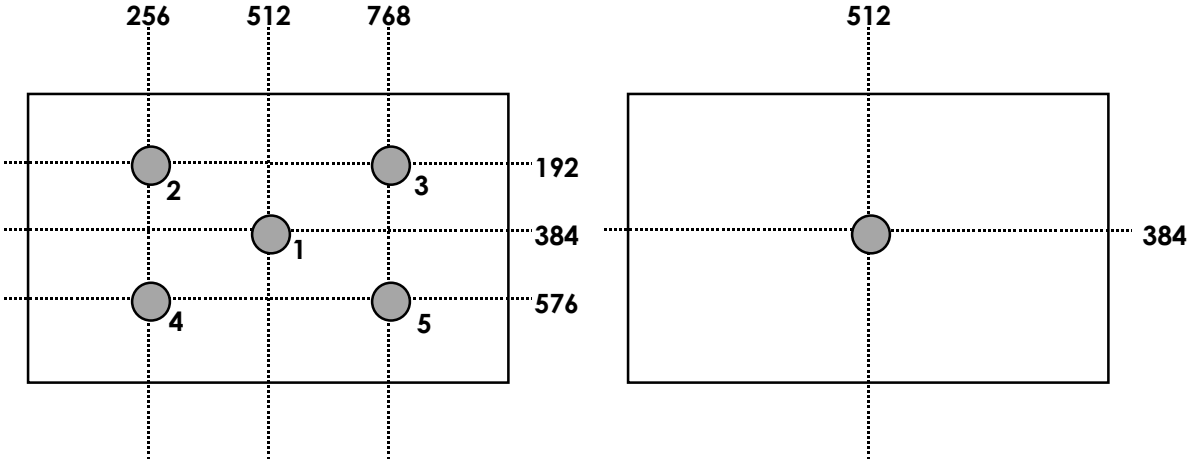
(4) You can remove the glue easily. When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal- hexane.

A. Optical Characteristic Measurement Equipment and Method



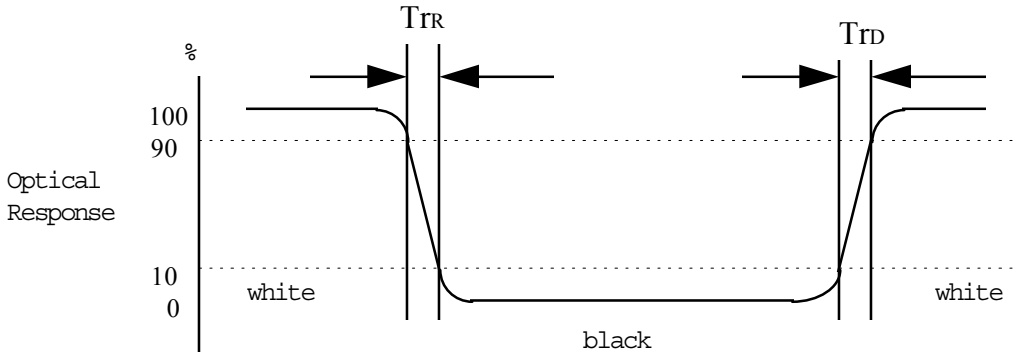
B. Luminance

<measuring point for luminance variation> <measuring point for surface luminance >



C. Response Time

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



D. Viewing angle

<Definition of viewing angle range>