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FINAL PRODUCT INFORMATION

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Updated: Dec 07, 2015

4.3" SXGA+ TFT-LCD

LC043SX1

MONO-COLOR LIQUID CRYSTAL DISPLAY CELL

CONTENTS

Revision History

<table>
<tr><th>Rev</th><th>ECN No.</th><th>Description of changes</th><th>Date</th><th>Prepared</th></tr>
<tr><td>P0</td><td></td><td>Initial release</td><td>05/30/12</td><td>Brian Yi</td></tr>
<tr><td>P1</td><td></td><td>Added outline drawing and dimensions
Added Electrical Max Rating, Electrical Characteristics, Interface Connection, Block Diagram, Data Mapping, Input Signal and Timing</td><td>11/08/12</td><td>Danny Yip</td></tr>
<tr><td>P2</td><td></td><td>Input signal reference has changed
Previous:
<table>
<tr><td>Display Color</td><td colspan="3">Data signals(0: Low level; 1: High level)</td><td></td></tr>
<tr><td></td><td>R7,R6,R5,R4,R3,R2,R1,R0</td><td>G7,G6,G5,G4,G3,G2,G1,G0</td><td>B7,B6,B5,B4,B3,B2,B1,B0</td><td></td></tr>
<tr><td>Black</td><td>1,1,1,1,1,1,1,1</td><td>1,1,1,1,1,1,1,1</td><td>1,1,1,1,1,1,1,1</td><td></td></tr>
<tr><td>White</td><td>0,0,0,0,0,0,0,0</td><td>0,0,0,0,0,0,0,0</td><td>0,0,0,0,0,0,0,0</td><td></td></tr>
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Now:
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</table></td><td>11/09/12</td><td>Danny Yip</td></tr>
<tr><td>P3</td><td></td><td>Interface Connector was changed:
From XF2M-2615-1A (OMRON)
From LSHM-120-01-L-RH-A-S-K-TR (SAMTEC)

Interface Pin Assignment was changed.
Block Diagram was modified.</td><td>05/05/14</td><td>Johnson Hui</td></tr>
<tr><td>P4</td><td></td><td>Data Mapping was updated
Input Signal and Timing was updated
Reliability table is updated</td><td>11/17/14</td><td>Johnson Hui</td></tr>
<tr><td>P5</td><td></td><td>Changed response time and added note 5 at optical specifications
Updated polarizer type
Updated mechanical drawings
Updated reliability table
Updated packing form information
Added appendix E (polarizer datasheet)</td><td>12/7/15</td><td>Eunice Lee</td></tr>
</table>

1. General Description

LC043SX1 is a mono active matrix liquid crystal display cell. The matrix employs amorphous silicon thin film transistor as the active element, and operates in normally white mode. This TFT-LCD has a 4.3 inch diagonally measured active display area with SXGA+ resolution (1400 horizontal by 1050 vertical pixel arrays). Gray scale or the brightness of the pixel brightness is determined with an 8-bit gray scale signal for each dot.

General Specification

ITEM	SPECIFICATION
Active area	87.50(H) x 65.63(V) mm
Number of pixels	1400(H) x 1050(V)
Pixel pitch	0.0625(H) x 0.0625(V) mm
Panel outline dimension	96.80(H) x 75.00(V) mm
Color depth	8-bit Mono 256 gray scale (no dithering)
Display mode	Normally White
LCD clearing temperature	≥103°C
Transparency	Minimum 8%.
Electronic components reference	Gate: Novatek NT52003 (1050) Source: Novatek NT51013 (2x864) Timing control: Novatek NT71391

2. Absolute Maximum Rating

2.1 Environmental Maximum Rating

Parameter	Symbol	Values		Units	Notes
		Min.	Max.		
Operating Temperature	T_{OP}	-40	+95	°C	1
Storage Temperature	T_{ST}	-54	+90	°C	1

Note: 1. Humidity ≦ 90% RH. No condensation.

2.2 Electrical Maximum Rating

Symbol	Description	Ratings		Unit
		Min.	Max.	
Vdd	DC Supply Voltage	-0.3	4	V
Vin	DC Input/Output Voltage	-0.3	Vdd+0.3	V
T_Operating	Operating Temperature	-20	+85	℃
T_Storage	Storage Temperature	-40	+90	℃

Stresses above what is listed under "Absolute Maximum Rating" may cause permanent damage to the device. These are stress ratings only. Functional operation of this device at these or any other conditions above what is indicated in the operational sections of this specification is not implied and exposure to absolute maximum rating conditions for extended periods may affect device reliability.

3. Electrical Characteristics

3.1 LVDS Receiver Differential Input (DC Characteristics)

Symbol	Description	Min.	Typ.	Max.	Unit	Condition
RxVTH	Differential input high threshold voltage	-	-	+100	mV	R xVCM =1.2 V
RxVTL	Differential input low threshold voltage	-100	-	-	mV	
RxVIN	Input voltage range (singled-end)	0	-	2.4	V	V DDL = 3.3 V
		0	-	VDD-0.4		V DDL = 2.5 V
RxVCM	Input common mode voltage	| VID | /2	-	2.4- | VID | /2	V	V DDL = 3.3 V
		| VID | /2	-	VDD-0.4- | VID | /2		V DDL = 2.5 V
| VID |	Differential input voltage	100	-	600	mV	-
RVxLIK	Differential input leakage current	-10	-	+10	uA	-
RxFCLK	Clock frequency	25	-	120MHz	MHz	-

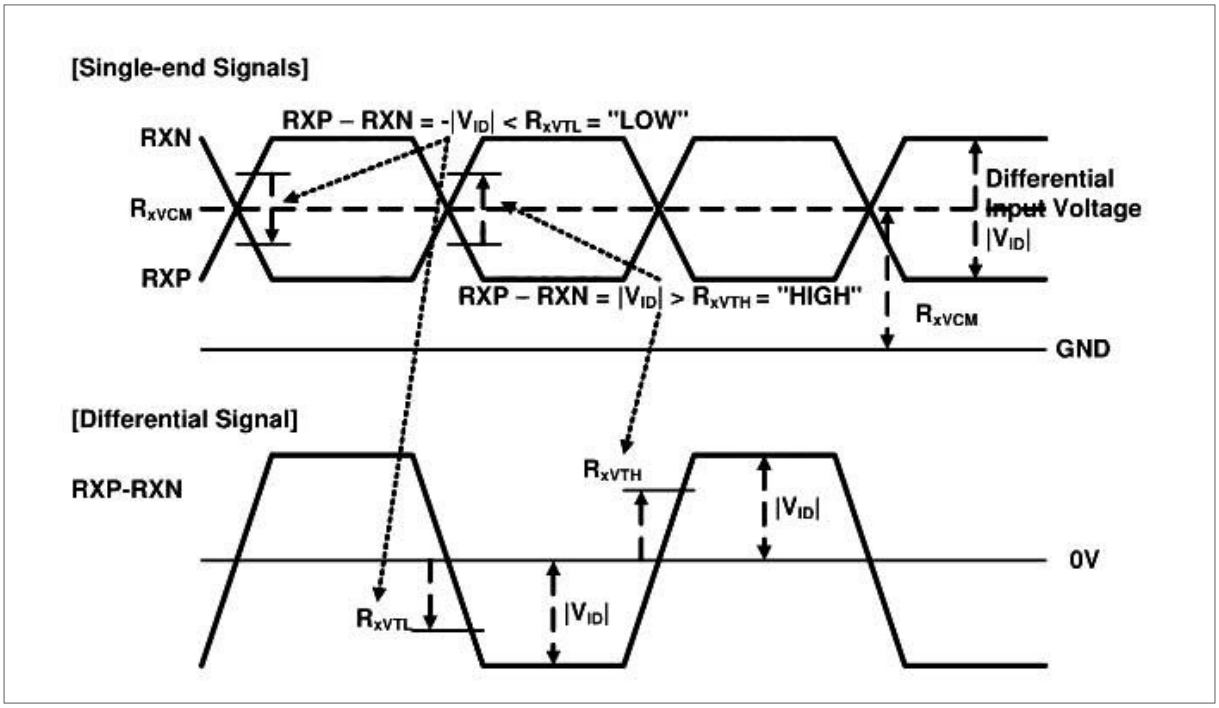


Figure 1: Definition of Input Threshold Voltage (R_{xVTH}/R_{xVTL}), Common Mode Voltage (R_{xVCM}), and Input Voltage Swing ($|V_{ID}|$)

3.2 LVDS Receiver Differential Input (AC Characteristics)

Symbol	Description	Min.	Typ.	Max.	Unit	Condition
T_RSKM	Input data skew margin	-350	-	+350	ps	R xCLK = 100 MHz |R xVTH - R xVTL | = 400 mV R xVCM = 1.2 V R x ΔVCM = 0 mV
T_CK-CK	Inter-clock skew of each port (clock to clock skew margin between EVEN and ODD port)	-1/7	-	+1/7	T	
SS_R	Input spread spectrum ratio	-	-	±3		
F_M	Input modulation frequency	-	-	300K	Hz	

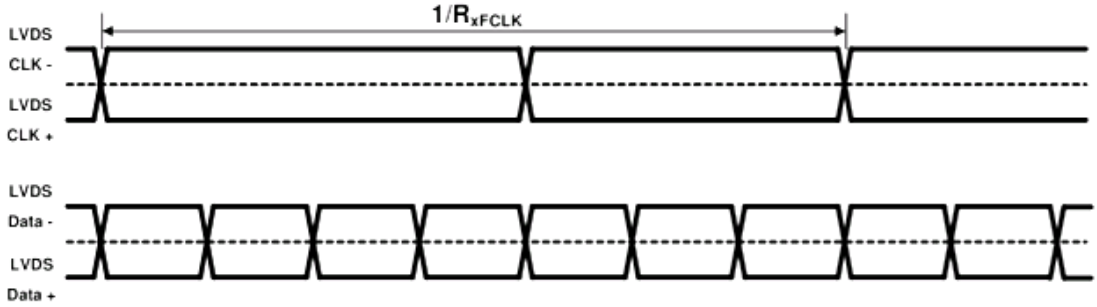


Figure 2: Definition of Clock Frequency (R_{xFCLK})

4. Interface Connection

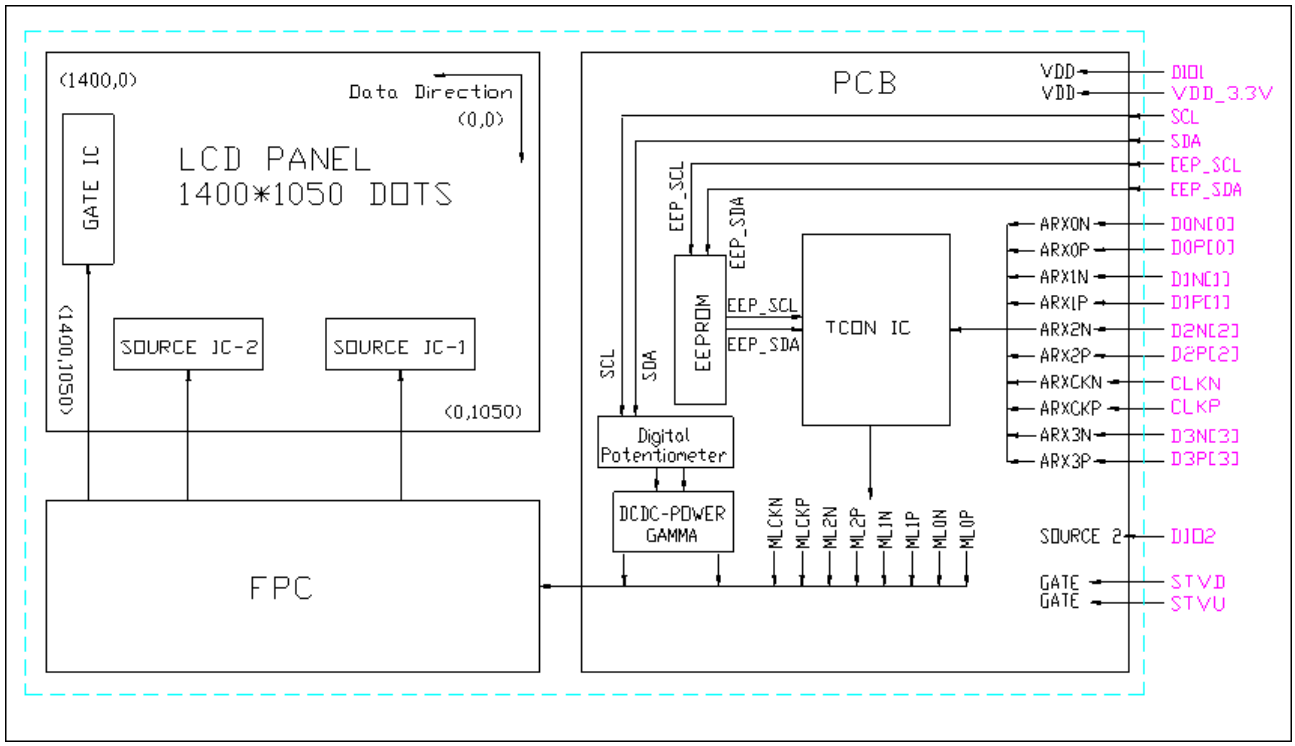
TFT-LCD panel Driving Section (Pin assignment)

Connector Used: LSHM-120-01-L-RH-A-S-K-TR (SAMTEC)

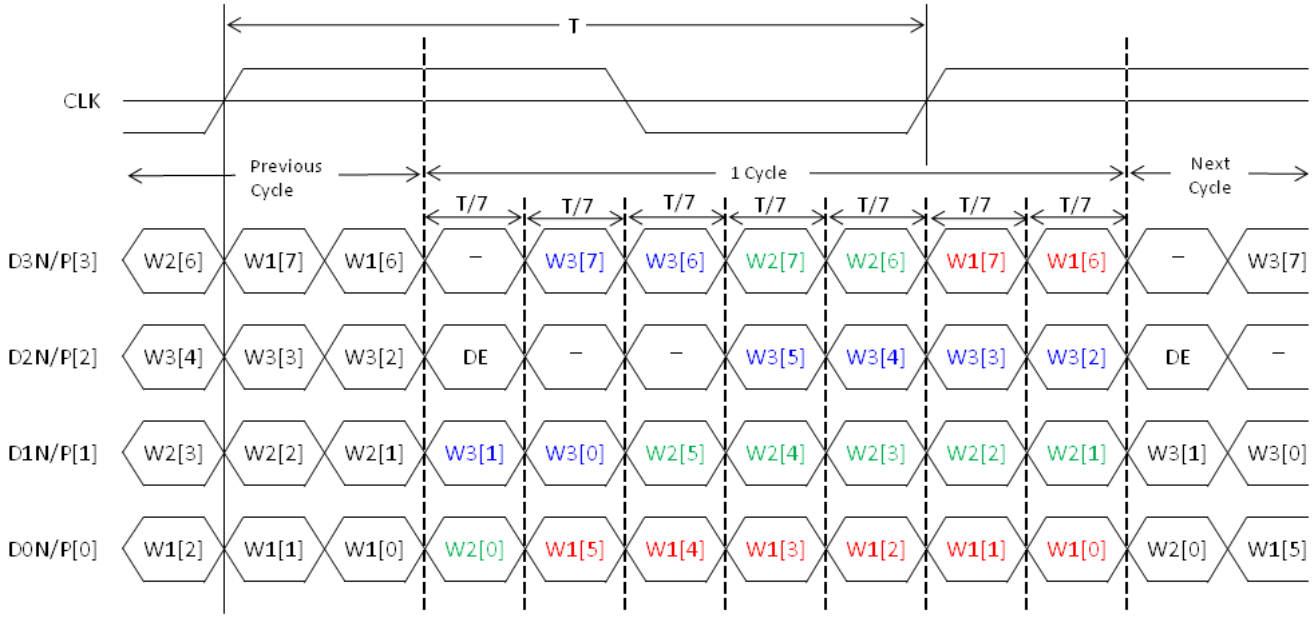
Pin	Name	I/O	Description
1	NC		
2	NC		
3	NC		
4	NC		
5	NC		
6	NC		
7	EEP_SCL	I/O	SCL for TCON configuration EEPROM
8	EEP_SDA	I/O	SDA for TCON configuration EEPROM
9	DIO1	O	Customer monitor pin. Source signal.
10	DIO2	O	Customer monitor pin. Source signal.
11	STVU	O	Customer monitor pin. Gate signal.
12	STVD	O	Customer monitor pin. Gate signal.
13	GND	I	Ground
14	GND	I	Ground
15	VDD 3.3V	I	3.3V input
16	VDD 3.3V	I	3.3V input
17	SCL	I	SCL for digital potentiometer
18	SDA	I/O	SDA for digital potentiometer
19	GND	I	Ground
20	D0N[0]	I	LVDS Differential Data Input -
21	NC		
22	D0P[0]	I	LVDS Differential Data Input +
23	GND	I	Ground
24	D1N[1]	I	LVDS Differential Data Input -
25	NC		
26	D1P[1]	I	LVDS Differential Data Input +
27	GND	I	Ground
28	D2N[2]	I	LVDS Differential Data Input -
29	NC		
30	D2P[2]	I	LVDS Differential Data Input +
31	GND	I	Ground
32	CLKN	I	LVDS Differential Clock Input -
33	NC		
34	CLKP	I	LVDS Differential Clock Input +
35	GND	I	Ground
36	D3N[3]	I	LVDS Differential Data Input -
37	NC		
38	D3P[3]	I	LVDS Differential Data Input +
39	GND	I	Ground
40	NC		

5. Block Diagrams

5.1 Interface Block Diagram



5.2 Data Mapping



8-bit LVDS Data Mapping ("NS" Data Format)

6. Input Signal and Timing

6.1 Input Signal for Reference

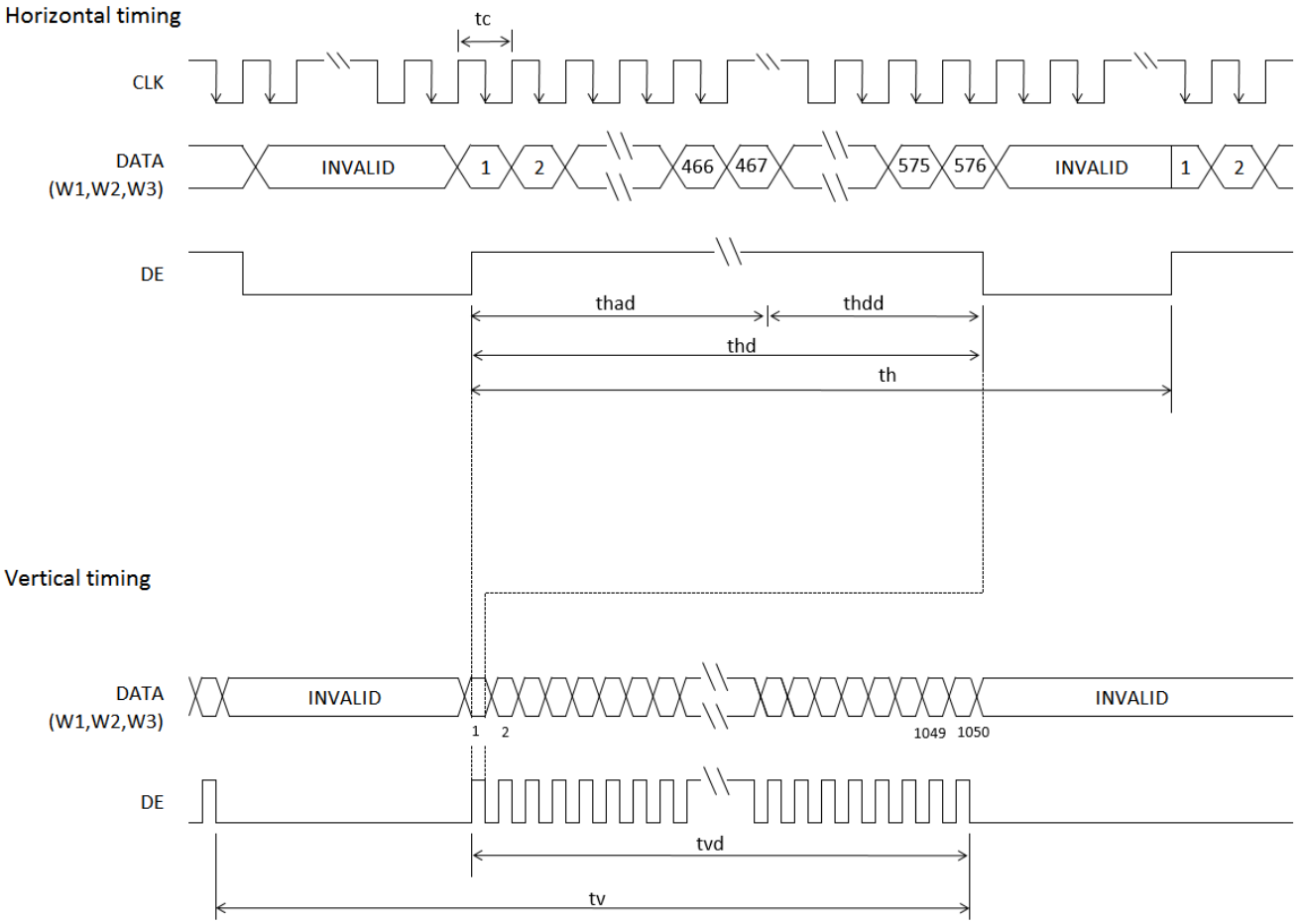
This product is a monochrome display with 8-bit resolution, 256 gray scale

Display Color	Data signals(0: Low level; 1: High level)		
	W1[7:0]	W2[7:0]	W3[7:0]
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
White	1,1,1,1,1,1,1,1	1,1,1,1,1,1,1,1	1,1,1,1,1,1,1,1

6.2 Input Timing for Reference

Timing Name=1400*1050@60Hz	
Hor pixels:1400 //pixels	
Ver Pixel: 1050 //pixels	
Hor Frequency = 63.96 KHz	
Ver Frequency = 60 Hz	
Pixel Clock = 47.07 MHz	For 3 pixels
Hor Sync Polarity = Positive	Tcon doesn't care
Ver Sync Polarity = Negative	Tcon doesn't care
Hor Total time = 736 (WWW)	2208 pixels
Hor Addr time = 576 (WWW)	1728 pixels
Hor Active Display time = 467 (WWW)	1~467 (WWW)
Hor Dummy Display time = 109 (WWW)	468~576 (WWW)
Hor Blank Start = 40	Tcon doesn't care
Hor Blank Time = 80	Tcon doesn't care
Hor Sync Start = 40	Tcon doesn't care
Ver Total Time = 1066	
Ver Addr Time = 1050	
Ver Blank Start = 4	Tcon doesn't care
Ver Blank Time = 8	Tcon doesn't care
Ver Sync Start = 4	Tcon doesn't care

6.3 Timing Graph



7. Optical Specifications

Optical characteristics are determined after the unit has been 'ON' and stable 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 Φ and θ equal to 0°. The Appendix presents additional information concerning the measurement equipment and method.

Parameter		Symbol	Cond.	Min	Typ	Max	Unit	Notes
Viewing Angle Range	x axis, right (=0°)	θx	CR > 10	-	35		Degree	3,5
	x axis, left (=180°)	θx		-	35	-	Degree	
	y axis, up (=90°)	θy		-	30	-	Degree	
	y axis, down (=270°)	θy		-	30	-	Degree	
Contrast Ratio		CR	Θ = 0°	-	500	-		1
Contrast Ratio Uniformity				-	75	-	%	
Color Chromaticity	White	Wx		-		-		
		Wy		-		-		
Response Time		Tr	Ta=25°C, θ = 0°	-	5.3	-	ms	2
Response Time		Td	Ta=25°C, θ = 0°	-	21.4	-	ms	2
Cross Talk		CT	θ = 0°	-	-	2	%	4
Refresh Rate					60		Hz	

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. 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.
3. 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.
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 are when any adjacent area is driven dark. For more information see Appendix.
5. Color inversion may occur at angles >10° @ Yd direction (per Appendix D).

8. Mechanical Specifications

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

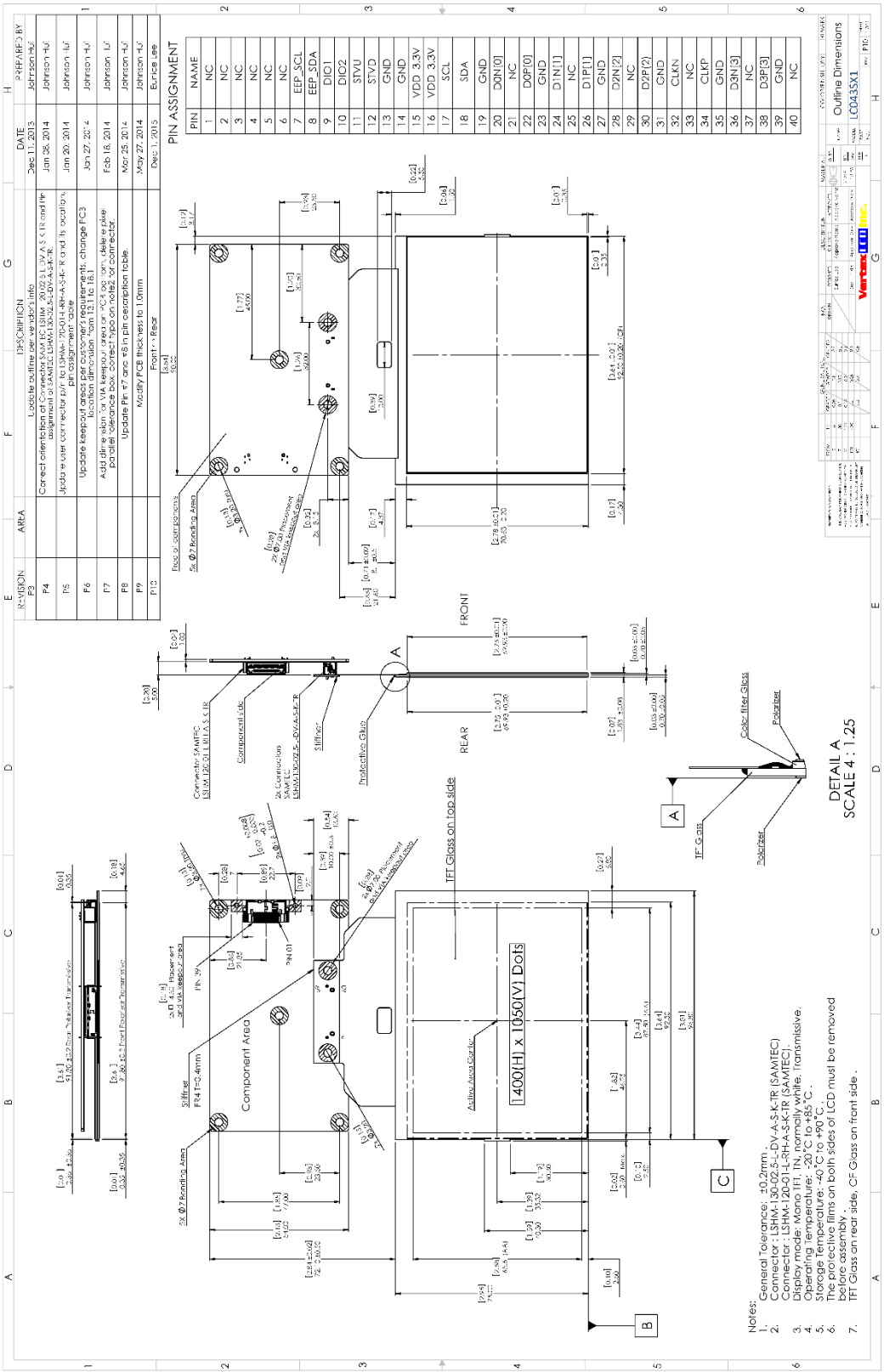
Panel outline dimensions:	96.80 x 75.00 mm
Active area:	87.50 x 65.63 mm
Weight :	46.0 g

Surface Treatment:

Front Polarizer: AR (Glossy)

Rear Polarizer: AG (Matte)

9. Mechanical Drawings



10. Reliability

Environment test conditions

No.	Test Item	Conditions
1	High temperature storage test	90℃ x 240h
2	Low temperature storage test	-40℃ x 240h
3	High temperature & high humidity operation test	60℃ x 90%RH x 240h
4	High temperature operation test	85℃ x 240h
5	Low temperature operation test	-20℃ x 240h
6	Thermal Shock	-20±2℃(30min.) ~25℃(5min.) ~ 85±2℃(30min.) × 20cycles

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.

11. Packing Form

a) Package quantity in one box: 48
b) Box Size: 500 * 390 * 270 mm

12. ELECTROSTATIC DISCHARGE CONTROL

Since the module is composed of electronic circuits, it is at risk to electrostatic discharge. Make certain that the operator(s) is connected to ground through ESD wristband or other ESD protection equipments. The operator should do not touch I/F pin directly.

13. STORAGE

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

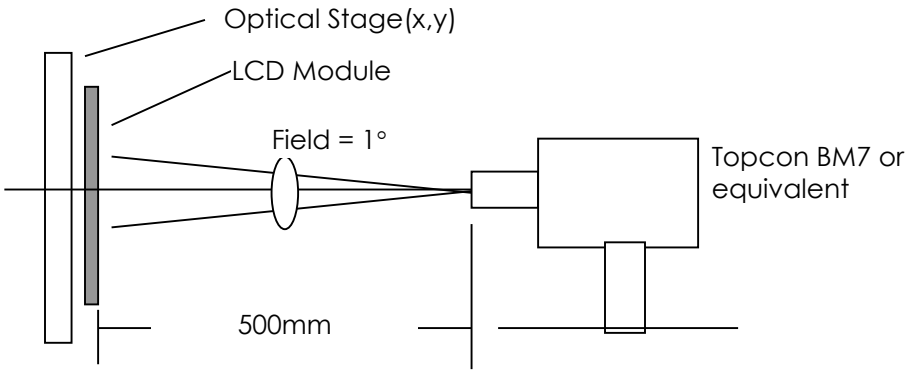
1. Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
2. The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were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

14. 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 ion-blower or similar equipment to neutralize charge.
2. 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.
3. When the glue remains on the polarizer surface or its vestige is recognized, please **very gently wipe** off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

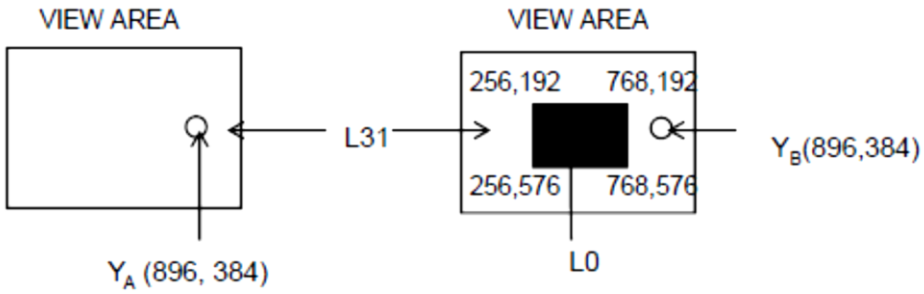
APPENDIX

A. Optical Characteristic Measurement Equipment and Method



B. Cross Talk

Cross Modulation Test Description

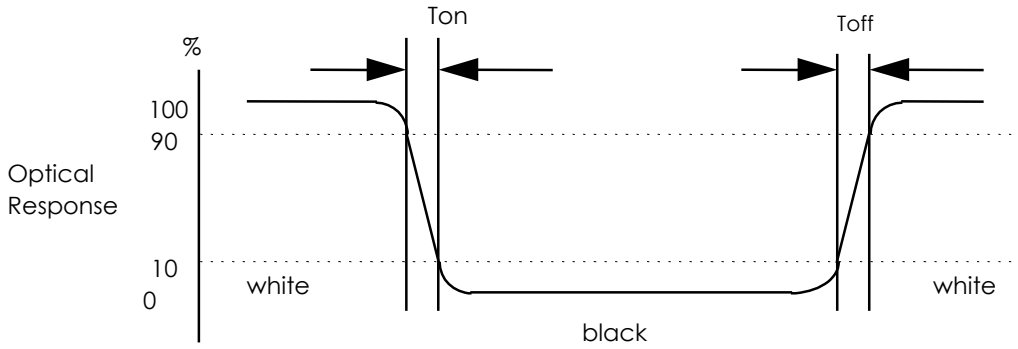


$$\text{Cross-Talk (\%)} = \left| \frac{Y_B - Y_A}{Y_B} \right| \times 100$$

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

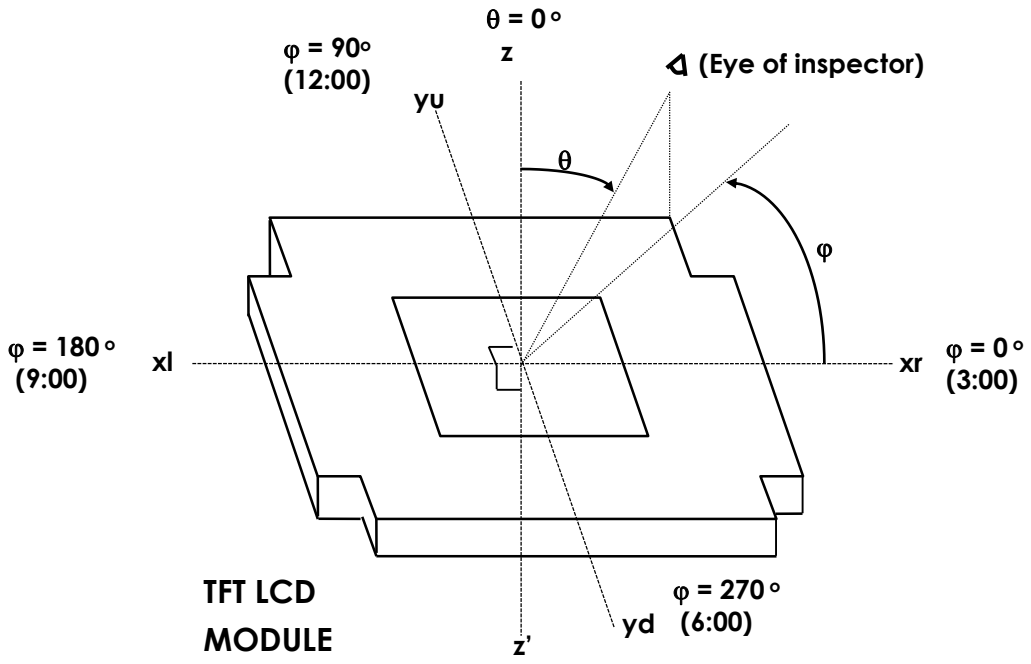
C. Response Time

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>



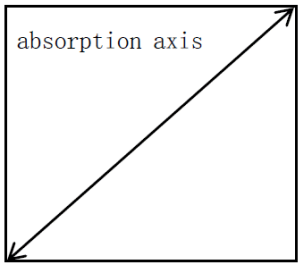
E. Polarizer

IS LCD - Front polarizer specification

Item		Unit			Testing method
Thickness	Total thickness	μm	215±25		Refer to Item 5.2
	Adhesive	μm	21±5		
Peeling strength	Release film	gf/25mm	50 or less		Refer to Item 5.3
	Protective film	gf/25mm	50 or less		
Adhesion to glass plate		gf/25mm	100 or more		Refer to Item 5.4
Optical properties	Single transmittance	%	41.7±1.5		Refer to Item 5.5
	Polarization efficiency	%	99.50 or more		
	380nm transmittance	%	2.0 or less		
Hue	a	NBS	-1.5±1.5		Refer to Item 5.6
	b	NBS	4.0±1.5		
Haze value		%	42.0±7.0		Refer to Item 5.7
Air bubbles		-	No visible air bubbles.		Refer to Item 5.8
Delamination on humidity		-	None		Refer to Item 5.9
Dimension shrinkage rate ★		%	3.0 or less		Refer to Item 5.10
Average inclination angle β ◆		°	16.0±2.0		Refer to Item 5.11
Re value ◆		nm	155±10		
Curl		mm	Long side×±10%		Refer to Item 5.12

Properties	Testing conditions	Change of single transmittance	Appearance and adhesion characteristics
Heat resistance	95°C, 500hrs	Within 5%	Remarkable foaming, disbondment, color change and other appearance change affecting indication are not allowed.
Cold resistance(*)	-30°C, 500hrs	Within 5%	
Humidity resistance(*)	60°C×90%RH, 500hrs	Within 5%	

(*)Dew condensation and water drop have not adhered.



Adhesive layer on bottom

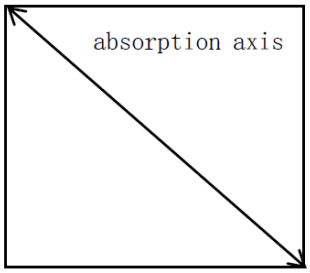
IS LCD - Rear polarizer specification

Item		Unit			Testing method
Thickness	Total thickness	μm	215±25		Refer to Item 5.2
	Adhesive	μm	21±5		
Peeling strength	Release film	gf/25mm	50 or less		Refer to Item 5.3
	Protective film	gf/25mm	50 or less		
Adhesion to glass plate		gf/25mm	100 or more		Refer to Item 5.4
Optical properties	Single transmittance	%	42.0±1.5		Refer to Item 5.5
	Polarization efficiency	%	99.60 or more		
	380nm transmittance	%	2.0 or less		
Hue	a	NBS	-1.5±1.5		Refer to Item 5.6
	b	NBS	4.0±1.5		
Haze value		%	-		Refer to Item 5.7
Air bubbles		-	No visible air bubbles.		Refer to Item 5.8
Delamination on humidity		-	None		Refer to Item 5.9
Dimension shrinkage rate ★		%	3.0 or less		Refer to Item 5.10
Average inclination angle β ◆		°	16.0±2.0		Refer to Item 5.11
Re value ◆		nm	155±10		
Curl		mm	Long side×±10%		Refer to Item 5.12

Properties	Testing conditions	Change of single transmittance	Appearance and adhesion characteristics
Heat resistance	95°C, 500hrs	Within 5%	Remarkable foaming, disbondment, color change and other appearance change affecting indication are not allowed.
Cold resistance(*)	-30°C, 500hrs	Within 5%	
Humidity resistance(*)	60°C×90%RH, 500hrs	Within 5%	

(*)Dew condensation and water drop have not adhered.

rear polarizer



Adhesive layer on top