

ASI-T-22013A1GT/D

Item	Contents	Unit
Size	2.2	inch
Resolution	320(RGB)X320	/
Interface	RGB16 bits	/
ColorDepth	262Kdithering	/
Technologytype	a-siTFT	/
Pixelpitch	0.123x0.123	mm
PixelConfiguration	R.G.B\VerticalStripe	
OutlineDimension(W x H x D)	47.40x51.85x3.50	mm
ActiveArea	39.36 x39.36	mm
DisplayMode	TransflectiveNormalblack	/
ViewingDirection	6 ~7o'clock	/
BacklightType	LED	/
DriverIC	LG4545	/
Weight	18(TYP)	g

Record of Revision

Date	Revision No.	Summary
2015-07-13	1.0	Rev 1.0 was issued

1. Scope

This data sheet is to introduce the specification of ASI-T-22013A1GT/D active matrix 262k color TFT module. It is composed of a color TFT-LCD panel, driver ICs, FPC, resistive touch panel and a backlight unit. The 2.2" display area contains 320 (RGB) x 320 pixels.

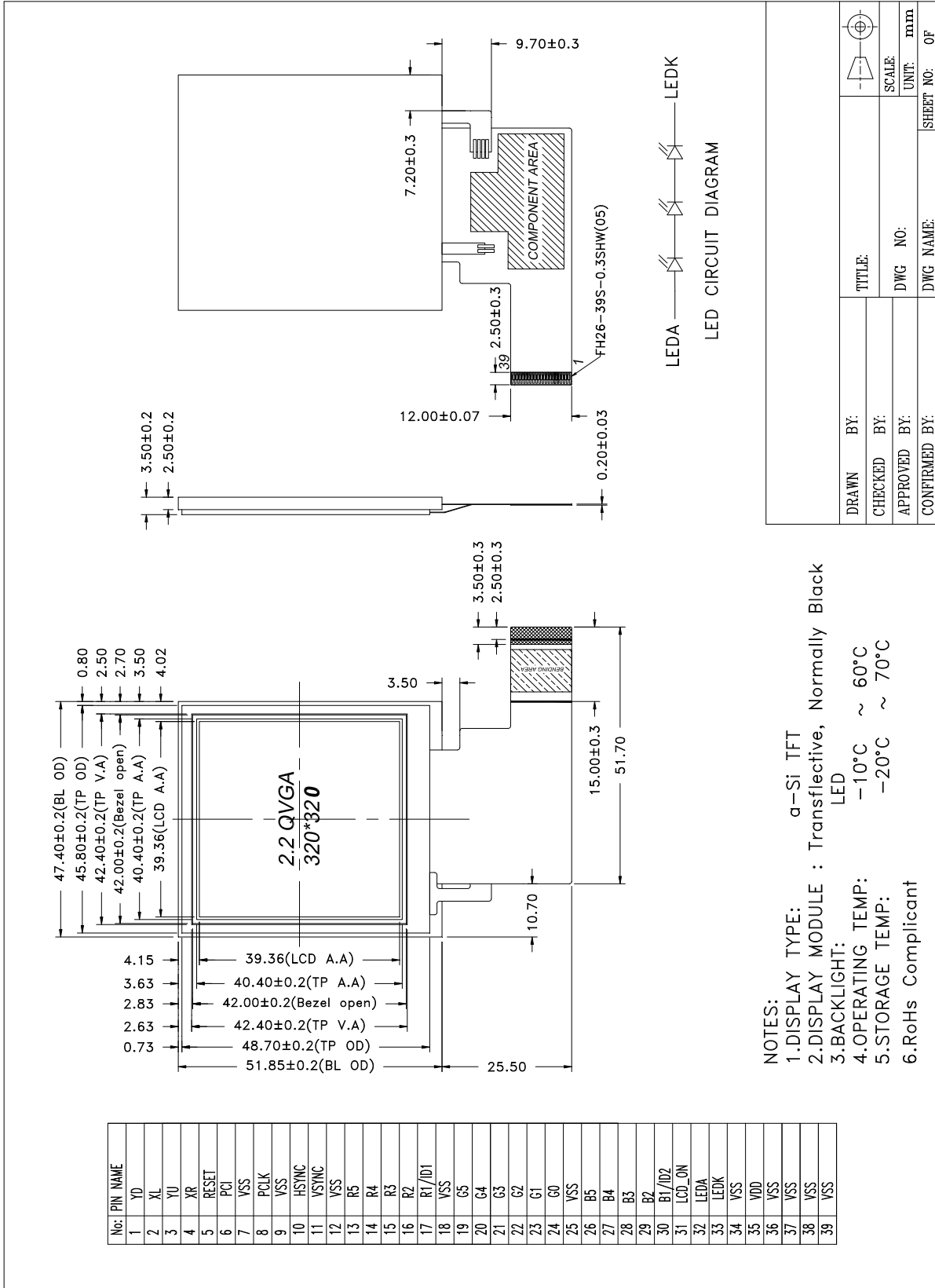
2. Application

Digital equipments which need color display outdoor, mobile navigator/video systems.

3. General Information

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Weight	18(TYP)	g

4. Outline Drawing



DRAWN BY:	TITLE:	
CHECKED BY:	DWG NO:	SCALE:
APPROVED BY:	DWG NAME:	UNIT: mm
CONFIRMED BY:	SHEET NO:	OF

5. Interface signals

Corresponded connector: FH23-39S-0.3SHW

Pin	SYMBOL	I/O, Power, Analog	Description
1	YD	Analog	Touch Panel Y-Bottom
2	XL	Analog	Touch Panel X-Left
3	YU	Analog	Touch Panel Y-Top
4	XR	Analog	Touch Panel X-Right
5	RESET	I	LCD Reset
6	PCI	I	Power Control In
7	Vss	Power	Ground reference (0V)
8	PCLK	I	Pixel Clock
9	Vss	Power	Ground reference (0V)
10	HSYNC	I	Horizontal Sync Signal
11	VSYNC	I	Vertical Sync Signal
12	Vss	Power	Ground reference (0V)
13	R5	I	Red Data
14	R4	I	Red Data
15	R3	I	Red Data
16	R2	I	Red Data
17	R1/ID1	I/O	Red Data / ID Bit 1
18	Vss	Power	Ground reference (0V)
19	G5	I	Green Data
20	G4	I	Green Data
21	G3	I	Green Data
22	G2	I	Green Data
23	G1	I	Green Data
24	G0	I	Green Data
25	Vss	Power	Ground reference (0V)
26	B5	I	Blue Data
27	B4	I	Blue Data
28	B3	I	Blue Data
29	B2	I	Blue Data
30	B1/ID2	I/O	Blue Data / ID Bit 2
31	LCD_ON	I	Switches LCD on (active low)
32	LED_Anode	I	LED Anode
33	LED_Cathode	I	LED Cathode
34	Vss	Power	Ground reference (0V)
35	VDD	Power	Digital Power Supply (3.0V)
36	Vss	Power	Ground reference (0V)
37	Vss	Power	Ground reference (0V)
38	Vss	Power	Ground reference (0V)
39	Vss	Power	Ground reference (0V)

6. Absolute maximum Ratings

6.1. Electrical Absolute max. ratings

Parameter	Symbol	Values		Units	Notes
		Min.	Max		
Power Supply Input	VDD	-0.3	4.2	V	1
LED Power Consumption	PLED	-	120	mW	2
LED Current	ILED	-	30	mA	2, 3

Notes:

1. Applies to VDD, RESET, PCLK, HSYNC, VSYNC, LCD_ON, PCI, Data.
2. Applies to each LED individually.
3. Allowable forward current is refer to Fig 2.1

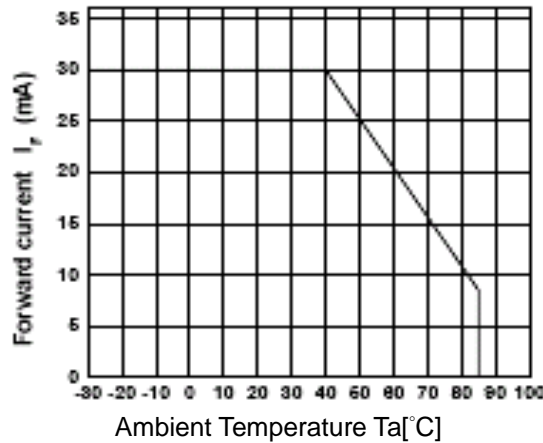


Fig 2.1 Ambient Temperature vs. Allowable Forward Current

6.2. Environment Conditions

Item	Symbol	MIN	MAX	Unit	Remark
Operating Temperature	TOPR	-10	60	°C	
Storage Temperature	TSTG	-20	70	°C	

7. Electrical Specifications

7.1 Electrical characteristics

GND=0V, Ta=25°C

Parameter	Symbol	Values			Units	Notes
		Min	Typ.	Max		
LCD Power Supply Voltage	VDD	2.9	3.0	3.1	V	
“H”Level Input Voltage	VIH	0.8 VDD	-	VDD	V	2
“L”Level Input Voltage	VIL	0	-	0.2VDD	V	2
Current Consumption, Panel	Ivdd		12	19.5	mA	1

Notes:

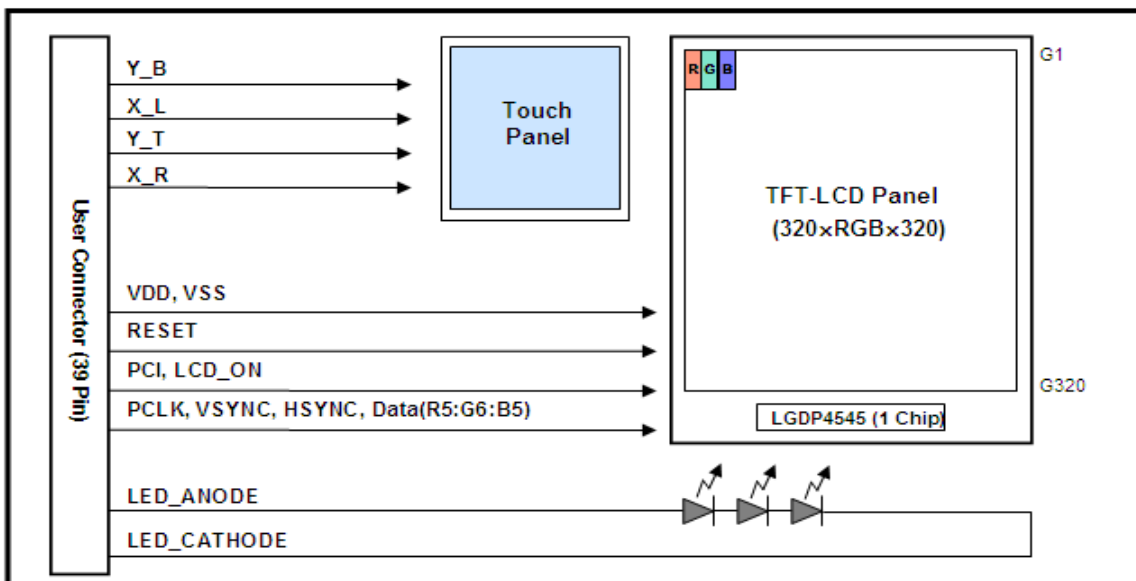
1. The specified current consumption are under the conditions at VDD = 3.0V, Ta=25°C, and fv=54 Hz, 16 gray steps is displayed and fv is the frame frequency.
2. Input mode of Data, PCLK,HSYNC,VSYNC,LCD_ON,PCI,RESET.

7.2 LED Backlight

The edge-lighting type of back light unit consists of 3 LEDs which is connected in serial

Parameter	Symbol	Values			Units	Notes
		Min	Typ.	Max		
LED Current	ILED	-	13	30	mA	
LED Forward Voltage	VLED	-	9.6	10.5	V	
LED Power Consumption	PLED	-	125	137	mW	

7.3 Block Diagram



8. Command/AC Timing

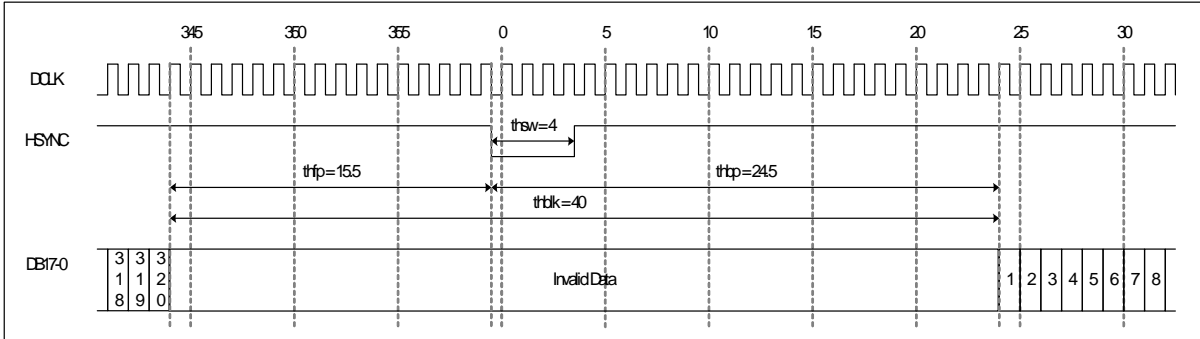
8.1 SIGNAL TIMING SPECIFICATIONS

Item	Symbol	Minimum	Typical	Maximum	Unit	Note
Input clock voltage	VIL	-0.3	0	0.2*VDD	V	
	VIH	0.8*VDD	-	VDD	V	
Vertical frequency	fv	50.5	54.1	57.8	Hz	
Horizontal frequency	fh	17.0	18.1	19.2	KHz	
PCLK frequency	ftch	6.25	6.5	6.75	MHz	
PCLK pulse width	tclk	148	154	160	ns	
PCLK Low/High pulse width	PWDL, PWDH	32	0.5tclk	-	ns	
PCLK cycle time	tCYCD	80	-	-	ns	
Hsync low pulse width	thsw	4	5	8	dots	
Vsync low pulse width	thsw	1	1	4	line	
Hsync setup time	tSYNCS	20	-	-	ns	
Hsync hold time	tSYNCH	20	-	-	ns	
Data setup time	tPDS	20	-	-	ns	
Data hold time	tPDH	20	-	-	ns	
Number of Horizontal		352	360	368	dots	
Horizontal blanking period	thblk	32	40	48	clk	
Hsync falling edge (1st data start	thbp	-	24.5	-	dots	
Hsync front porch	thfp	7.5	15.5	23.5	dots	
Number of vertical		332	334	336	line	
Vertical blanking period	tvblk	12	14	16	line	
Vsync falling edge (1st data start	tvbp	-	8	-	line	
Vsync front porch	tvfp	4	6	8	line	
Vsync falling edge (Hsync falling edge	tvhde	-5	-4	100	clk	
Fast clock rise time	trgbr	-	-	25	ns	1
Fast clock fall time	trgbf	-	-	25	ns	1
Slow clock rise time	trscclk	-	-	100	ns	2
Slow clock fall time	tfscclk	-	-	100	ns	2

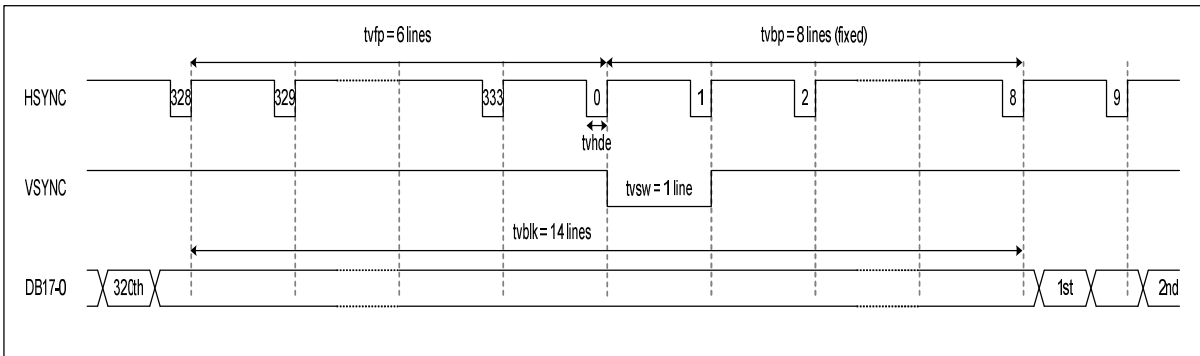
Notes: 1. PCLK, VSYNC, HSYNC
2. LCD_ON, PCI

8.2 SIGNAL TIMING WAVEFORMS

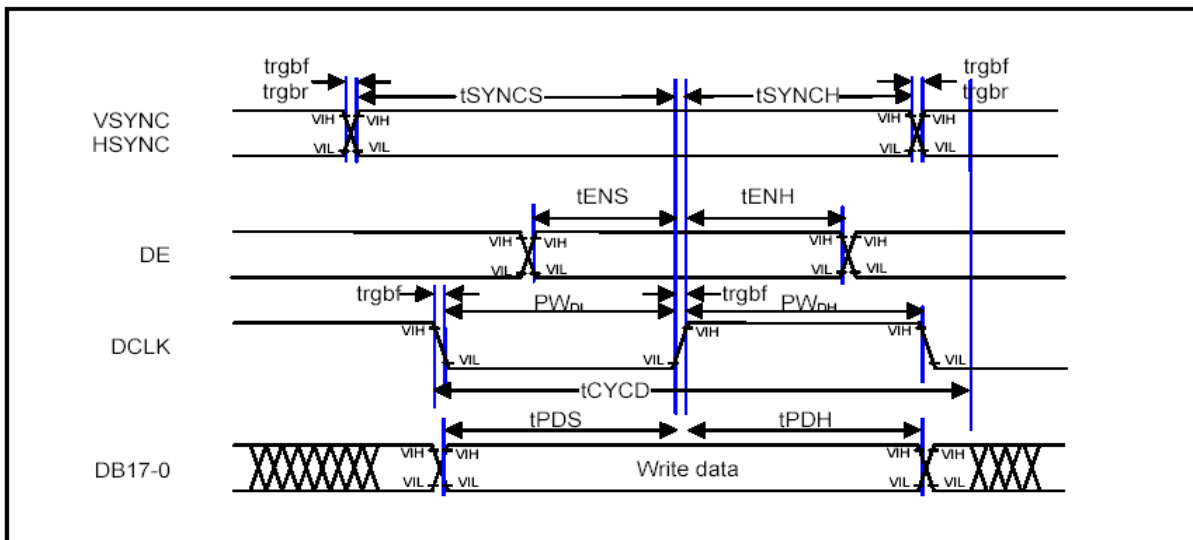
Horizontal Timing chart



Vertical Timing chart



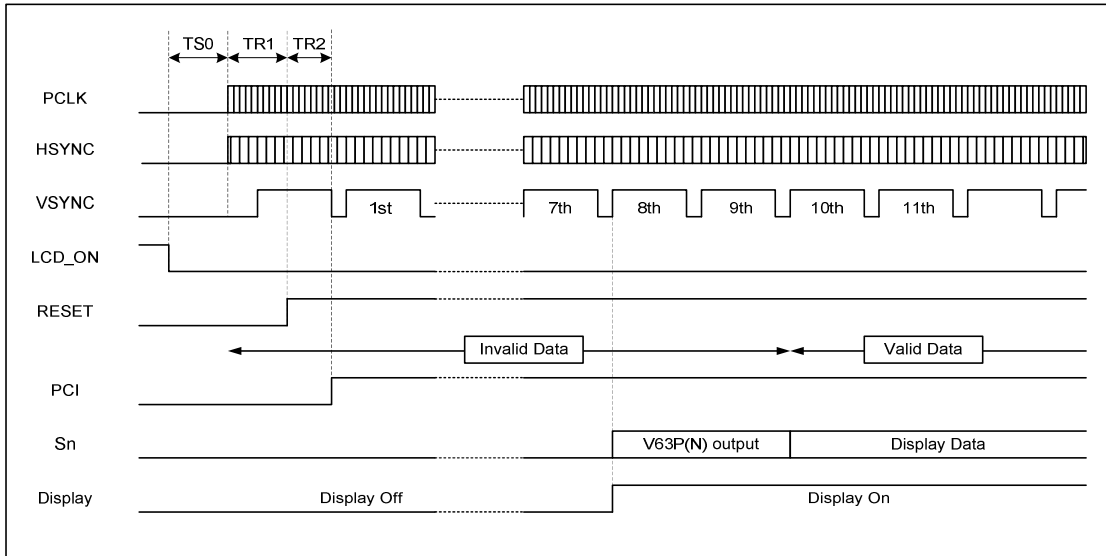
Timing Characteristics



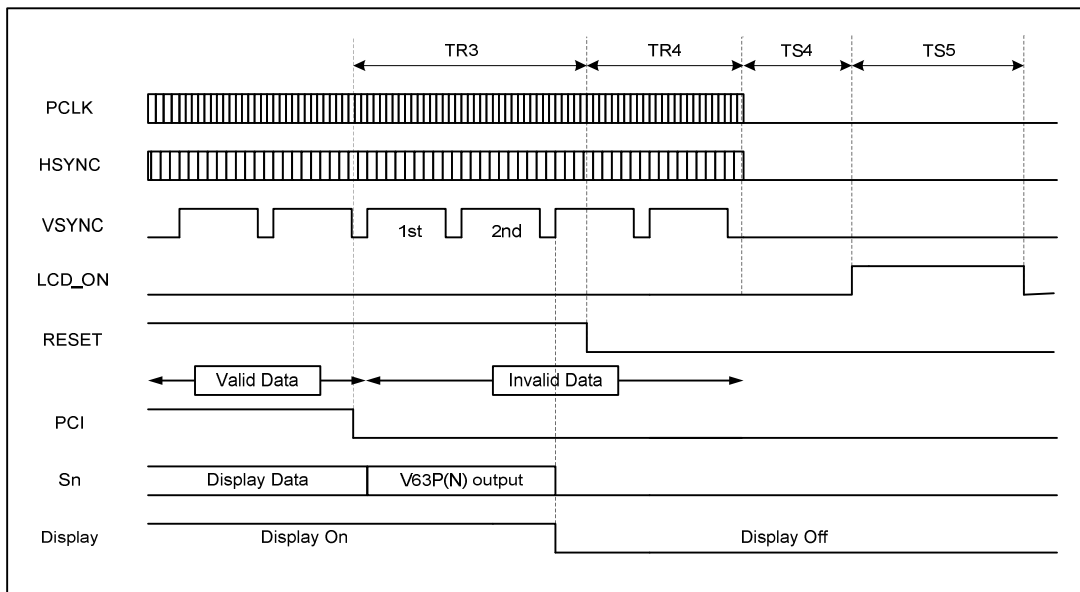
8.3 COLOR INPUT DATA REFERENCE

Display Colors		Data Signal															
		R5	R4	R3	R2	R1	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1
Basic Color	Black	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	1	1	1	1	1
	Green	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0
	Cyan	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red Gray Scale	Black	0	0	0	0	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	0	1	0	0	0	0	0	0	0	0	0	0	0	0
		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Brighter ↓	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Red	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	
Green Gray Scale	Black	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	1	0	0	0	0	0	0
		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Brighter ↓	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0
		0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
Green	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	
Blue Gray Scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker ↑	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	0	0	1	0
		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Brighter ↓	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1
		0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
Blue	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	

8.4 POWER SUPPLY & Display SEQUENCE



Power-up Sequence



Power-down Sequence

Power-up/down Sequence Timing Condition]

Symbol	Minimum	Typical	Maximum	Unit	Remarks
TS0	4	-	200	ms	
TR1	2	-	5	frame	2-5 frames
TR2	2	-	5	frame	2-5 frames
TR3	2.5	-	5	frame	2.5-5 frames
TR4	2	-	5	frame	2-5 frames
TS4	17.2	-	59.4	ms	
TS5	100	-	-	ms	

9. Optical Specification

9.1 Driving the backlight condition

Item	Symbol	Condition	Min	Typ.	Max.	Unit	Remark
Contrast Ratio	CR	$\theta=0^\circ$	100	120	-		Note1 Note3
Response Time	Ton/ Toff	25°C	-	35	50	ms	Note1 Note4
View Angles	θT	$CR \geq 5$	25	40	-	Degree	Note 2
	θB		35	50	-		
	θL		60	90	-		
	θR				-		
Chromaticity	White	Brightness is on	x	0.240	0.290	0.340	Note5
			y	0.263	0.313	0.363	
	Red		x	0.528	0.578	0.628	
			y	0.289	0.339	0.389	
	Green		x	0.254	0.304	0.354	
			y	0.494	0.544	0.594	
	Blue		x	0.099	0.149	0.199	
			y	0.068	0.118	0.168	
Luminance	L	ILED=13mA	110	160	-	cd/m ²	Note6
Uniformity		ILED=13mA	80	-	-	%	Note8
NTSC			45	-	-	%	

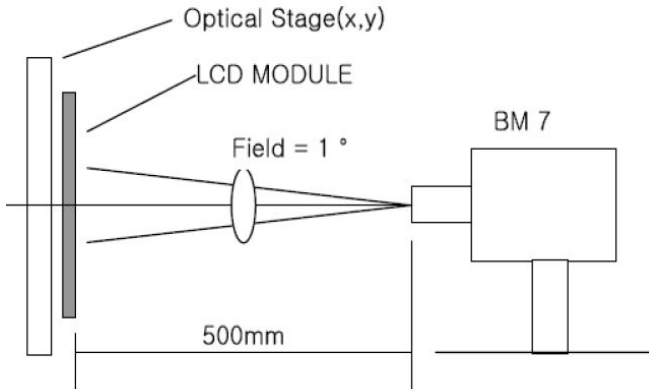
9.2 Not Driving the backlight condition

Item	Symbol	Condition	Min	Typ.	Max.	Unit	Remark
Contrast Ratio	CR	$\theta=0^\circ$	3	5	-		Note1 Note3
Response Time	Ton/ Toff	25°C	-	40	60	ms	Note1 Note4
View Angles	θT	$CR \geq 2$	60	75	-	Degree	Note 2
	θB				-		
	θL		50	65	-		
	θR				-		
Reflectance	R		2.5	3.5	-	%	Note7

Note 1: Definition of optical measurement system.

Temperature = 25°C(±3°C)

LED back-light: ON, Environment brightness < 150 lx

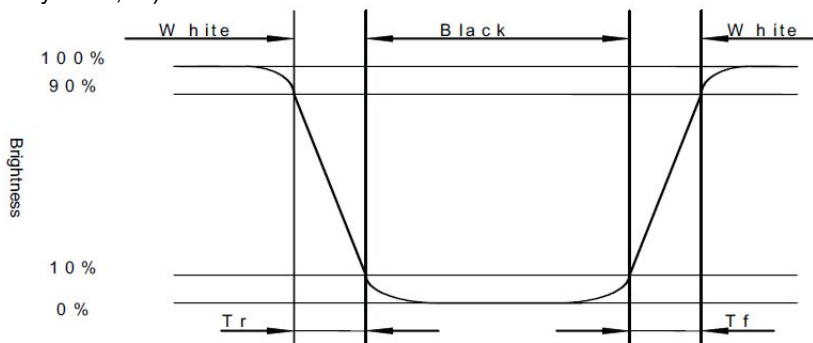


Note 2: Contrast ratio is defined as follow:

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

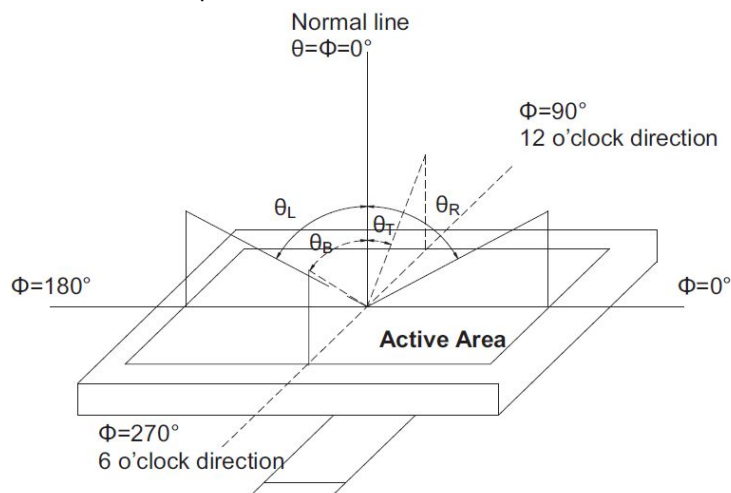
Note 3: Response time is defined as follow:

Response time is the time required for the display to transition from black to white (Rise Time, T_r) and from white to black(Decay Time, T_f).



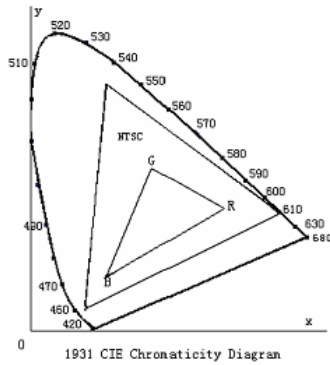
Note 4: Viewing angle range is defined as follow:

Viewing angle is measured at the center point of the LCD.



Note 5: Color chromaticity is defined as follow: (CIE1931)

Color coordinates measured at center point of LCD.

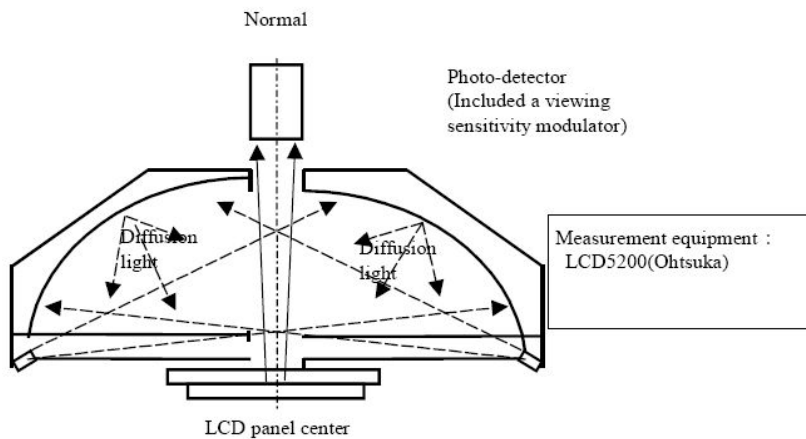


$$S = \frac{\text{area of RGB triangle}}{\text{area of NTSC triangle}} \times 100\%$$

Note 6: Luminance is defined as follow:

Luminance is defined as the brightness of all pixels “White” at the center of display area on optimum contrast.

Note 7: Reflectance measurement system is defined as follow:



Note 8: Luminance Uniformity is defined as follow:

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

$$\text{Uniformity (U)} = \frac{\text{Minimum Luminance(brightness) in 9 points}}{\text{Maximum Luminance(brightness) in 9 points}}$$

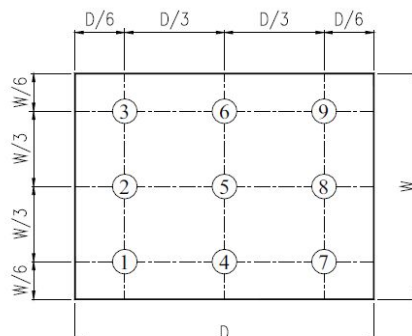


Fig. 2 Definition of uniformity

10. Environmental / Reliability Tests

No	Test Item	Condition	Judgment criteria
1	High Temp Operation	Ts=+60°C, 240hrs	Per table in below
2	Low Temp Operation	Ta=-10°C, 240hrs	Per table in below
3	High Temp Storage	Ta=+70°C, 240hrs	Per table in below
4	Low Temp Storage	Ta=-20°C, 240hrs	Per table in below
5	High Temp & High Humidity Storage	Ta=+40°C, 95% RH 240 hours	Per table in below (polarizer discoloration is excluded)
6	Thermal Shock (Non-operation)	-20°C 30 min~+70°C 30 min, Change time:5min, 10 Cycles	Per table in below
7	ESD (Operation)	C=150pF,R=330 , 5points/panel Air:±8KV, 5times; Contact:±4KV, 5 times;	Per table in below
8	Vibration (Non-operation)	- X, Y, Z : 1hr(axis, sweep) -Acceleration: 10mm/4.4G/2.5G the amplitude is 10mm -Sweep range: 5~15Hz/10mm P-P/ 16~30Hz/4.4G, 30~300Hz/2.5G	Per table in below
9	Shock (Non-operation)	Half sine wave, 180G, 2ms, 1 time shock of X, Y, Z axis	Per table in below
10	Package Drop Test	Height:80 cm, 1 corner, 3 edges, 6 surfaces	Per table in below

INSPECTION	CRITERION(after test)
Appearance	No Crack on the FPC, on the LCD Panel
Alignment of LCD Panel	No Bubbles in the LCD Panel No other Defects of Alignment in Active area
Electrical current	Within device specifications
Function / Display	No Broken Circuit, No Short Circuit or No Black line No Other Defects of Display

11. Precautions for Use of LCD Modules

11.1 Safety

The liquid crystal in the LCD is poisonous. Do not put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.

11.2 Handling

- A. The LCD and touch panel is made of plate glass. Do not subject the panel to mechanical shock or to excessive force on its surface.
- B. Do not handle the product by holding the flexible pattern portion in order to assure the reliability
- C. Transparency is an important factor for the touch panel. Please wear clear finger sacks, gloves and mask to protect the touch panel from finger print or stain and also hold the portion outside the view area when handling the touch panel.
- D. Provide a space so that the panel does not come into contact with other components.
- E. To protect the product from external force, put a covering lens (acrylic board or similar board) and keep an appropriate gap between them.
- F. Transparent electrodes may be disconnected if the panel is used under environmental conditions where dew condensation occurs.
- G. Property of semiconductor devices may be affected when they are exposed to light, possibly resulting in IC malfunctions.
- H. To prevent such IC malfunctions, your design and mounting layout shall be done in the way that the IC is not exposed to light in actual use.

11.3 Static Electricity

- A. Ground soldering iron tips, tools and testers when they are in operation.
- B. Ground your body when handling the products.
- C. Power on the LCD module before applying the voltage to the input terminals.
- D. Do not apply voltage which exceeds the absolute maximum rating.
- E. Store the products in an anti-electrostatic bag or container.

11.4 Storage

- A. Store the products in a dark place at $+25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ with low humidity (40% RH to 60% RH). Don't expose to sunlight or fluorescent light.
- B. Storage in a clean environment, free from dust, active gas, and solvent.

11.5 Cleaning

- A. Do not wipe the touch panel with dry cloth, as it may cause scratch.
- B. Wipe off the stain on the product by using soft cloth moistened with ethanol. Do not allow ethanol to get in between the upper film and the bottom glass. It may cause peeling issue or defective operation. Do not use any organic solvent or detergent other than ethanol.

11.6 Cautions for installing and assembling

Bezel edge must be positioned in the area between the Active area and View area. The bezel may press the touch screen and cause activation if the edge touches the active area. A gap of approximately 0.5mm is needed between the bezel and the top electrode. It may cause unexpected activation if the gap is too narrow. There is a tolerance of 0.2 to 0.3mm for the outside dimensions of the touch panel and tail. A gap must be made to absorb the tolerance in the case and connector.

