

The logo features a stylized graphic of three slanted bars in red, green, and blue. 

# Microtips

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## T E C H N O L O G Y

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## Record of Revision

Date	Revision No.	Summary
2015-11-04	1.0	Rev 1.0 was issued
2016-02-24	1.1	Update "7.2 LED Backlight"
2016-07-22	1.2	Revise the PIN definition sheet

### 1. Scope

This data sheet is to introduce the specification of **MTD0400KZG** active matrix TFT module. It is composed of a color TFT-LCD panel, driver ICs, FPC and a backlight unit. The 4.0" display area contains 640 (RGB) x 1136 pixels.

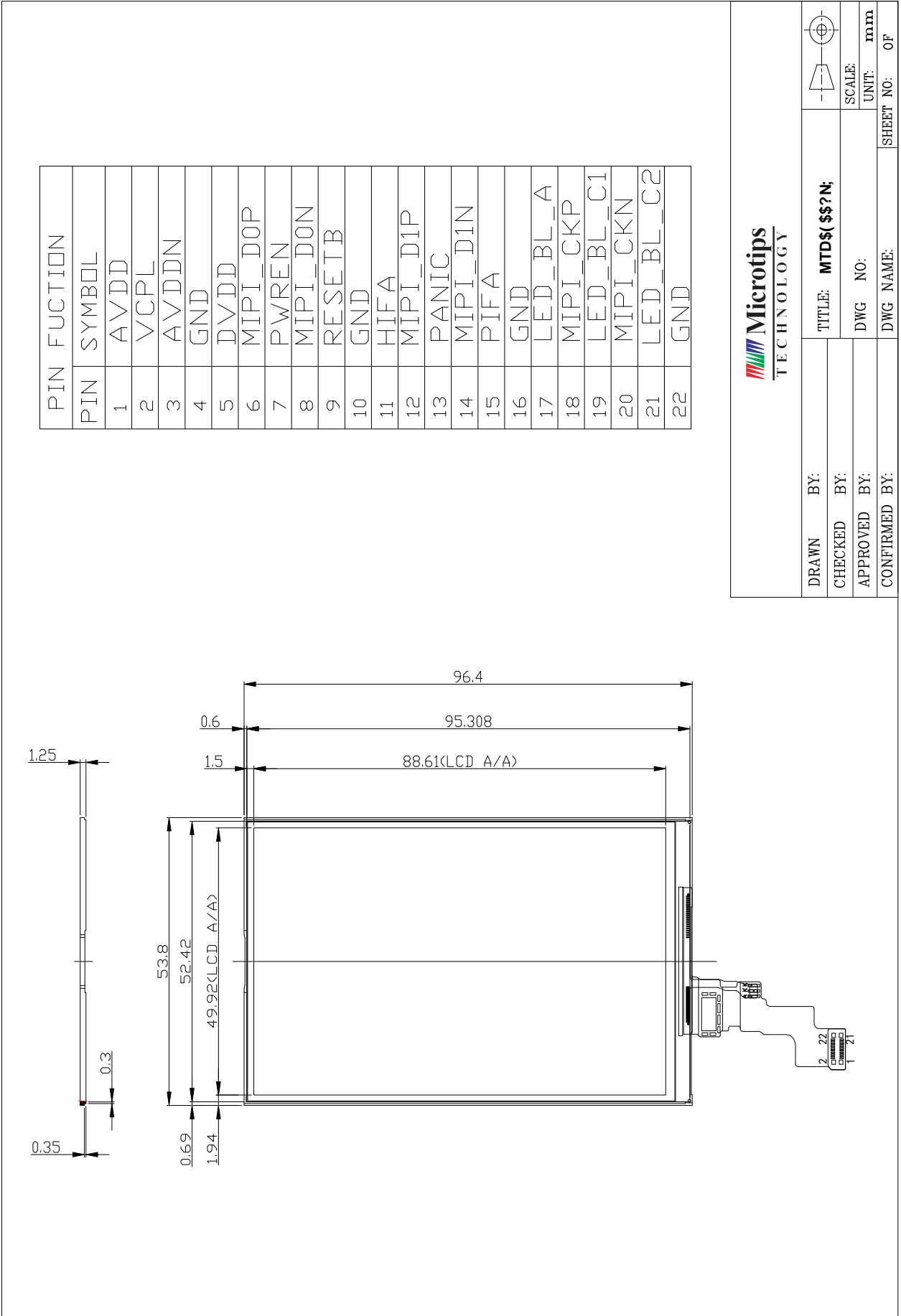
### 2. Application

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

### 3. General Information

Item	Contents	Unit
Size	4.0	inch
Resolution	640 (RGB) x 1136	/
Interface	MIPI	/
Technology type	a-Si TFT	/
Pixel pitch	0.078 x 0.078	mm
Pixel Configuration	RGB stripes	
Outline Dimension (W x H x D)	53.80 x 96.40 x 1.45	mm
Active Area	49.92 x 88.61	mm
Backlight Type	LED	/
Weight	TBD	g

4. Outline Drawing



## 5. Interface signals

Interface Connector: HRS BM15AP-0.8-22DS-0.35V

Pin No.	Symbol	I/O	Function	Remark
1	AVDDH	I	Negative 5.7V Analog Supply	
2	VCPL	I	Negative gate voltage for TFT , Connect with negative 5.7V	
3	AVDDN	I	Positive 5.7V Analog Supply	
4	GND	-	System ground	
5	DVDD	I	Digital Supply	
6	MIPI_D0P	I/O	MIPI Data Lane	
7	PWREN	O	Control signal out of Nugget to enable PMU, (should NC)	
8	MIPI_D0N	I/O	MIPI Data Lane	
9	RESETB	I	Reset PIN	
10	GND	-	System ground	
11	HIFA	O	Touch Enable (should NC)	
12	MIPI_D1P	I/O	MIPI Data Lane	
13	PANIC	I	MIPI Data Lane (should NC)	
14	MIPI_D1N	I/O	MIPI Data Lane	
15	PIFA	O	Host interface signal (should NC)	
16	GND	-	System ground	
17	LED_BL_A	I	LED anode voltage	
18	MIPI_CKP	I	MIPI HS clock	
19	LED_BL_C1	I	LED cathode 1 voltage	
20	MIPI_CKN	I	MIPI HS clock	
21	LED_BL_C2	I	LED cathode 2 voltage	
22	GND	-	System ground	

6. Absolute maximum Ratings

6.1. Electrical Absolute max. ratings

Parameter	Symbol	MIN	MAX	Unit	Remark
Power Voltage	AVDDH – AGND	-0.3	6.5	V	Note 2
	AGND – AVDDN	-0.3	6.5	V	Note 3
	DVDD – GND	-0.3	4.6	V	Note 3
	VGH – AGND	-0.3	15.9	V	Note 4
	VGH – AVDDH	-0.3	7.0	V	Note 5
	AGND – VGL	-0.3	13.6	V	Note 4
	AVDDN – VGL	-0.3	6.5	V	Note 5
	VGH – VGL	-0.3	29.5	V	Note 6
Input Voltage	Vt	-0.3	DVDD+0.3	V	Note 1
Analog Positive Supply Current	I_AVDDH	-	150	mA	Note 7
Analog Negative Supply Current	I_AVDDN	-	70	mA	Note 7

Note 1: If used exceed the absolute ratings, the Drive IC may be destroyed. It is strongly recommended to use the Drive IC within the limits of the electrical characteristics during normal operation.

Note 2: DVDD(High) > GND (Low)

Note 3: AVDDH(High) > AGND(Low), AGND(High) > AVDDN(Low)

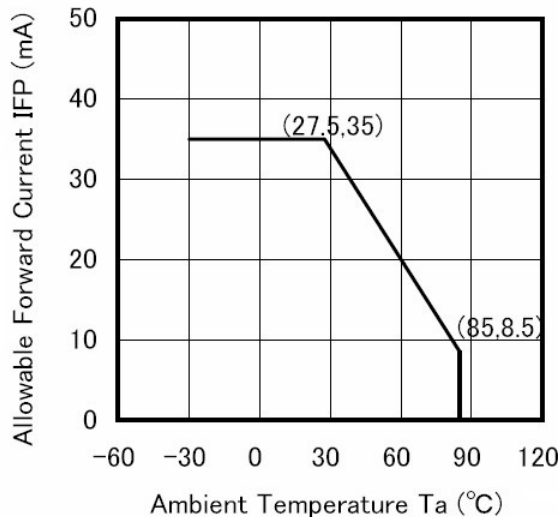
Note 4: VGH(High) > AGND(Low), AGND(High) > VGL(Low)

Note 5: VGH(High) > AVDDH(Low), AVDDN(High) > VGL(Low)

Note 6: VGH(High) > VGL(Low)

Note 7: Inrush current maximum, not operating

Ambient Temperature vs.  
Allowable Forward Current



6.2. Environment Conditions

Item	Symbol	MIN	MAX	Unit	Remark
Operating Temperature	TOPR	-20	70	°C	
Storage Temperature	TSTG	-30	80	°C	

## 7. Electrical Specifications

### 7.1 Electrical characteristics

GND=0V, Ta=25°C

Item	Symbol	MIN	TYP	MAX	Unit	Remark
LCD 5.7V Negative	AVDDH	-5.529	-5.7	-5.871	V	
AVDDH Ripple Requirement	AVDDH_RIPPLE	-	-	50	mV	
LCD 5.7V Positive	AVDDN	+5.871	+5.7	+5.529	V	
AVDDN Ripple Requirement	AVDDN_RIPPLE	-	-	50	mV	
AVDDH Peak AC Current	I <sub>AVDDH/AVDDN-peak</sub>	-	-	200/150	mA/150us	
Digital I/O Voltage	DVDD	1.71	1.8	1.89	V	
DVDD Peak Ripple Requirement	DVDD_Ripple	-	-	72	mVpp	
DVDD Current	I <sub>DVDD</sub>	4.5	12	14	mA	

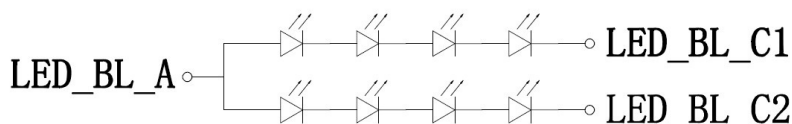
#### Notes:

- (1) The specified current and power consumption are under the conditions at AVDDH = VDD = 5.7V, DVDD = VEE = 1.8V, T = 25° C, and fv = 60 Hz.
- (2) Input mode of RESETB, PIFA, HIFA, PWREN, STSTB.
- (3) LED Backlight assumptions: 3Vf, 20 mA, 8 LED's
- (4) DVDD present only, display off, reset asserted.
- (5) Time from AVDDH and DVDD applied until driver power supplies are stable.

### 7.2 LED Backlight

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	IF	-	40	-	mA	
Forward Voltage	VF	-	3.0	3.3	V	For each LED
LED lifetime		-	25000	-	Hr	IF ≤ 40mA

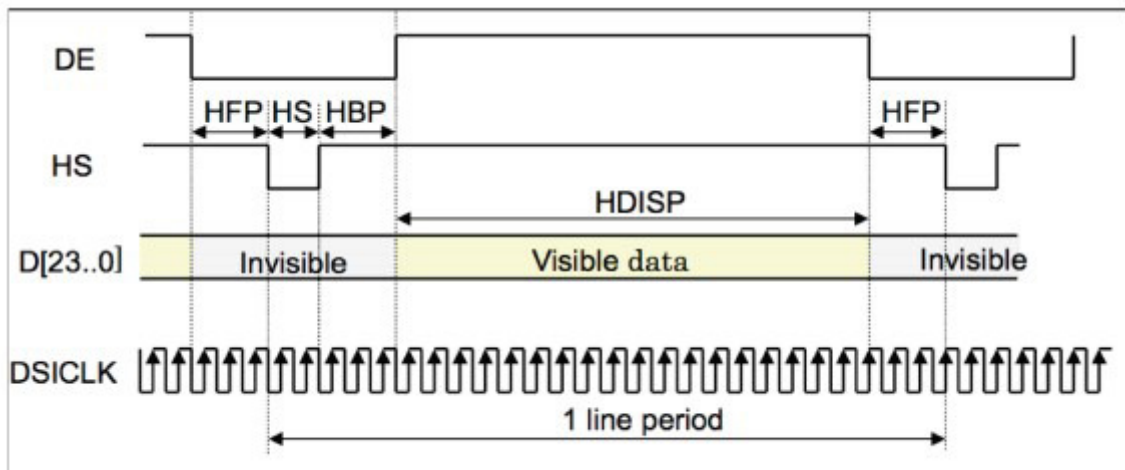
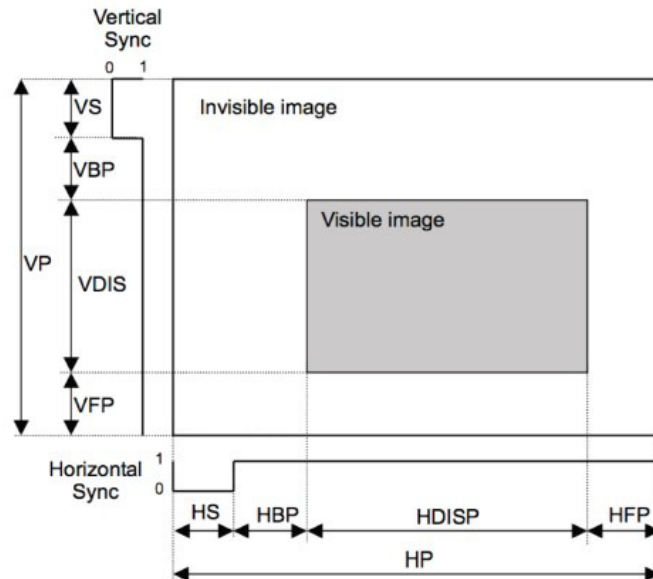
Note : The LED Supply Voltage is defined by the number of LED at Ta=25°C and IF=40mA.



## 8. Command/AC Timing

### 8.1 Signal Timing Specifications

Item	Symbol	Timing	Unit	Remarks
Vertical cycle	VP	1500	Line	
Vertical low pulse width	VS	3	Line	
Vertical front porch	VFP	348	Line	
Vertical back porch	VBP	13	Line	
Vertical display area	VDISP	1136	Line	
Horizontal cycle	HP	760	clk	
Horizontal low pulse width	HS	40	clk	
Horizontal front porch	HFP	40	clk	
Horizontal back porch	HBP	40	clk	
Horizontal display area	HDISP	640	clk	



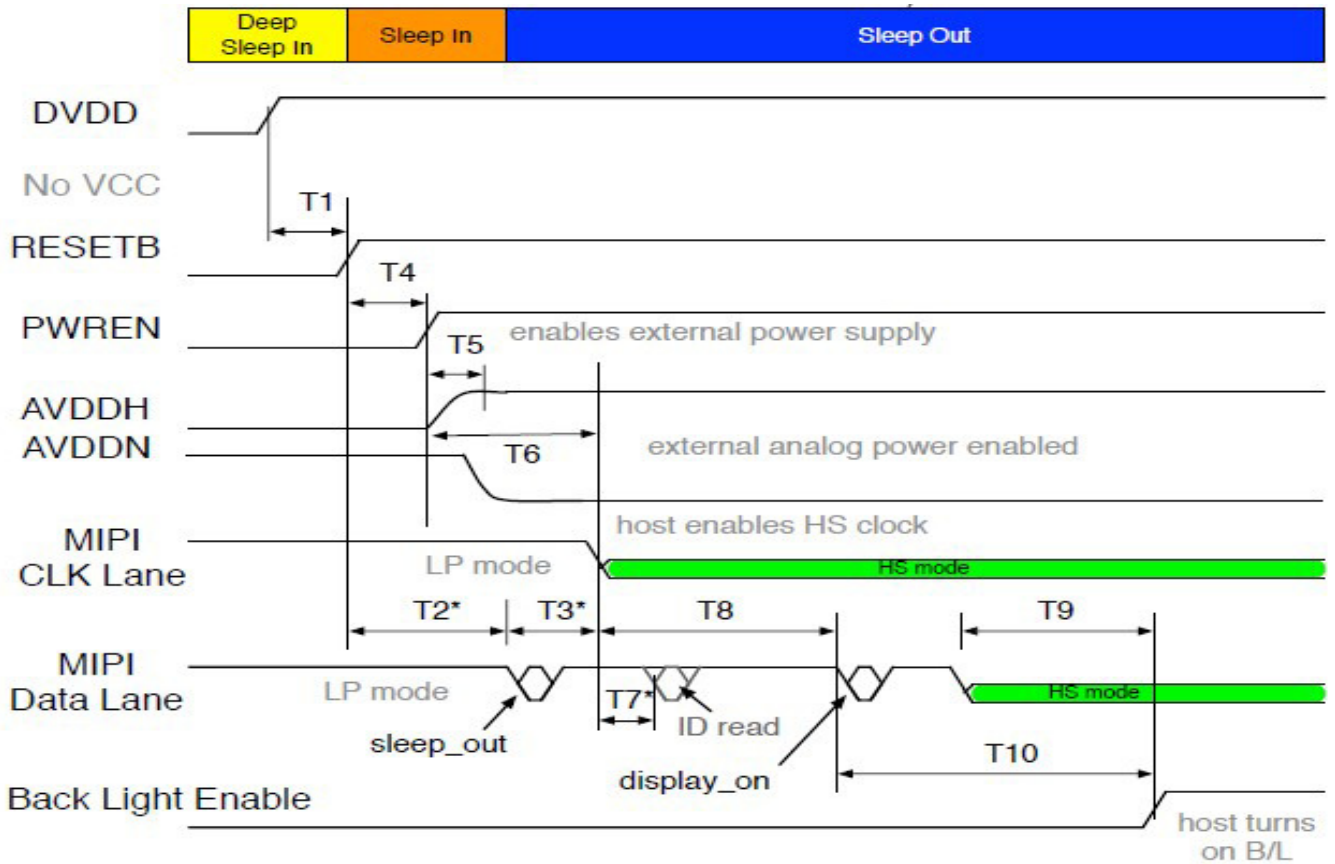


8.2 Color Input data reference

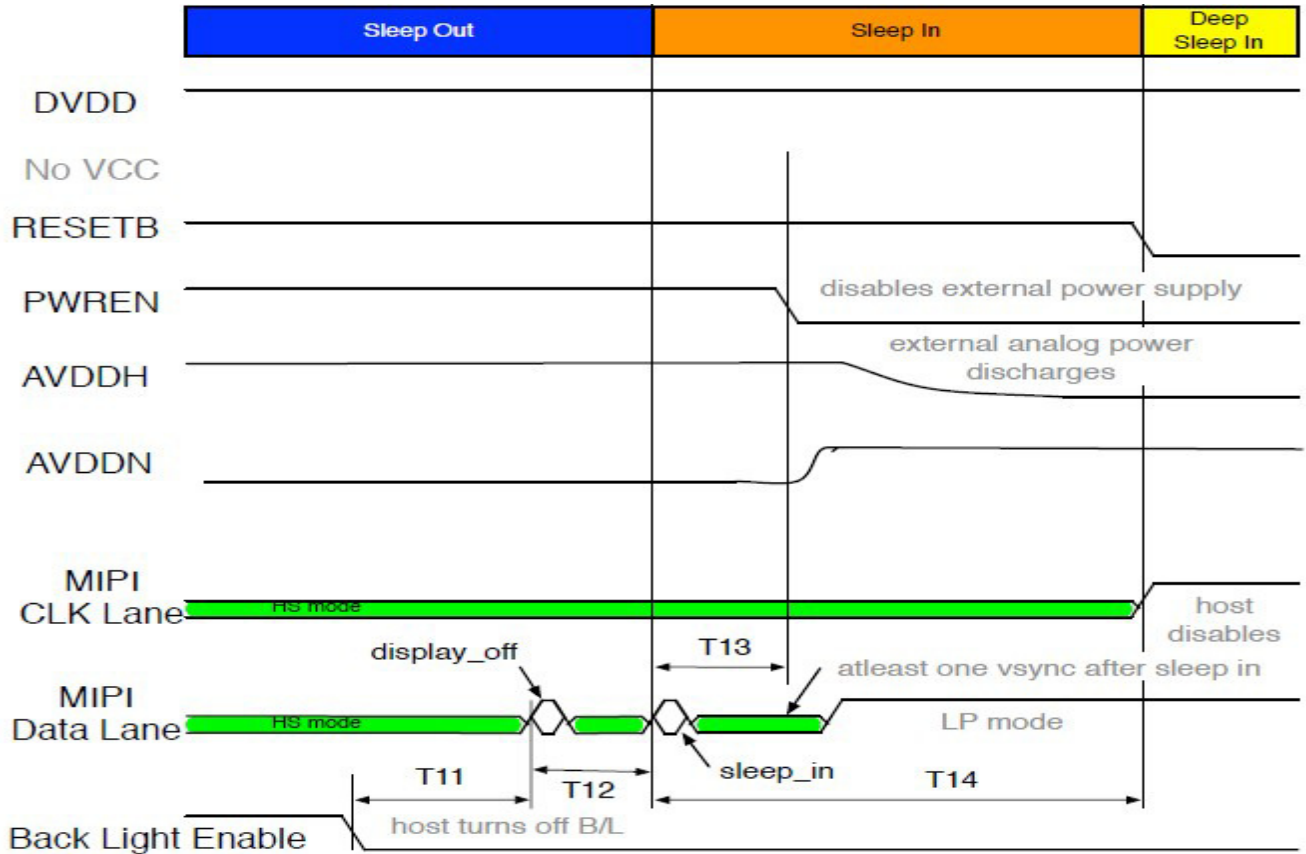
Colors & Gray Scale	Gray Scale Level	Data Signal																											
		R 0	R 1	R 2	R 3	R 4	R 5	R 6	R 7	G 0	G 1	G 2	G 3	G 4	G 5	G 6	G 7	B 0	B 1	B 2	B 3	B 4	B 5	B 6	B 7				
Black	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Blue	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	
Green	-	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	
Cyan	-	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Red	-	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Magenta	-	1	1	1	1	1	1	1	1	0	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	1	1	1	1	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	1	1	1	
Black	G50	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	
	G51	1	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	
↑ Darker ↑ ↓ Brighter ↓	G52	0	1	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	
	↓	↓																											
	G5253	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	G5254	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Red	G5255	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Black	G50	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	
	G51	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
↑ Darker ↑ ↓ Brighter ↓	G52	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	↓	↓																											
	G5253	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	
	G5254	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	
Green	G5255	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	
Black	G50	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	
	G51	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	
↑ Darker ↑ ↓ Brighter ↓	G52	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	
	↓	↓																											
	G5253	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1	
	G5254	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	
Blue	G5255	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	

8.3 Power On/off Sequence

Power On Sequence



Power Off Sequence



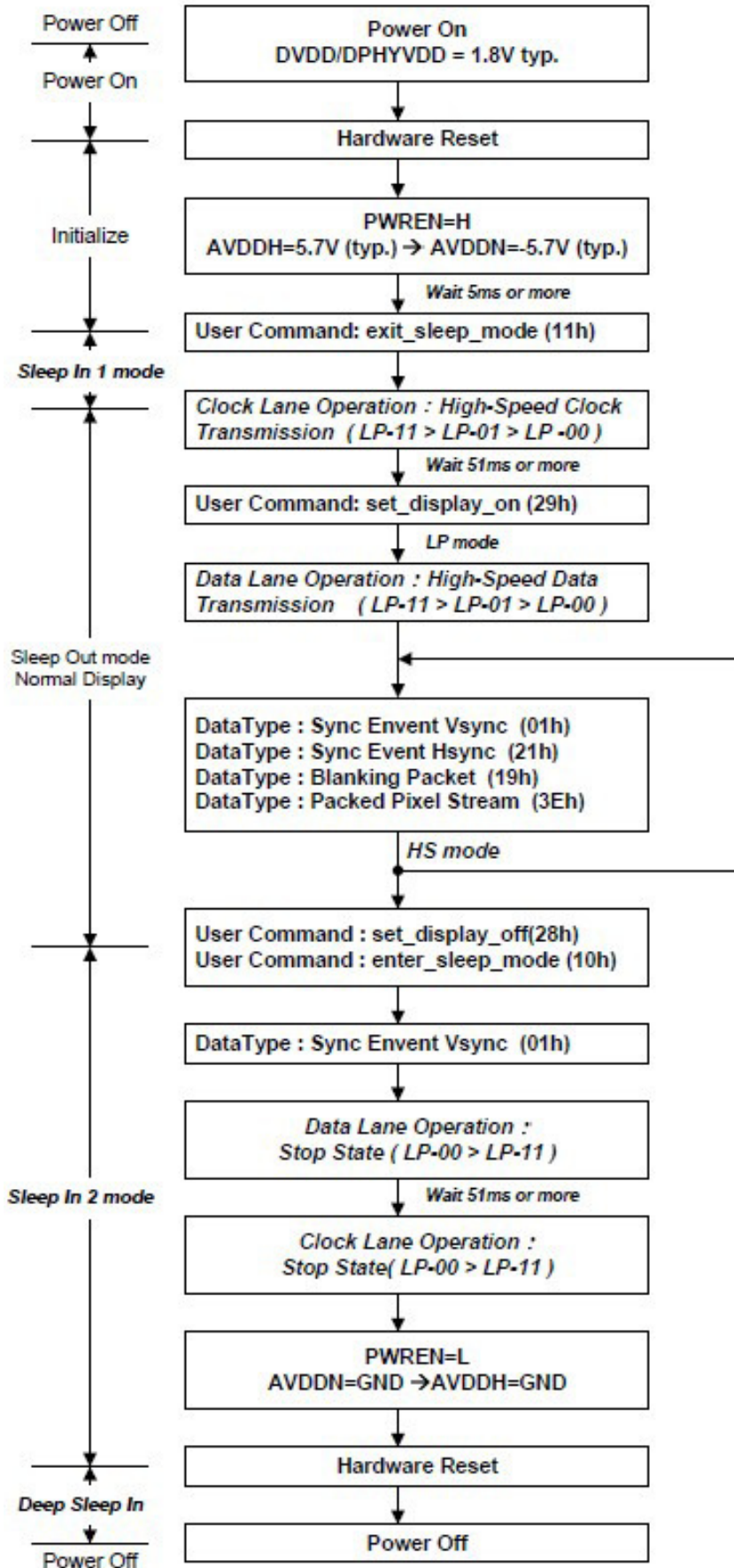
Note: Before power off, insert one black frame, in the power off sequence.

Table Power On/Off Sequence

Parameter	Ref	Timing requirements		
		Min	Typ	Max
DEEP SLEEP IN to RESET deassert	T1	5mS	10mS	-
RESET to first MIPI LP Command	T2	6.5mS	7mS	10mS
LP Command to HS CLK	T3	15uS	-	
RESET to PWREN	T4	-	-	1mS
PWREN to AVDDH Turn on	T5	-	-	3.5mS
PWREN to AVDDN Turn on	T6	-	-	4.0mS
MIPI HS CLK to next LP Command (e.g., panel ID read)	T7	25 mS	-	-

MIPI HS CLK to DISPLAY ON	T8	100mS	-	-
Valid Display Image (CLCD) to BACKLIGHT ON	T9	16.66mS	33.33mS	
DISPLAY ON to BACKLIGHT ON	T10	51mS	-	-
BACKLIGHT OFF until DISPLAY OFF	T11	16.66mS	-	-
DISPLAY OFF to SLEEP IN	T12	16.66mS		
SLEEP IN to PWREN Low Internal Power Off and video data/clock enabled	T13	66.68mS	-	-
SLEEP IN to HS CLK Off & Reset	T14	100mS	-	-

8.4 Display Flow



9. Optical Specification

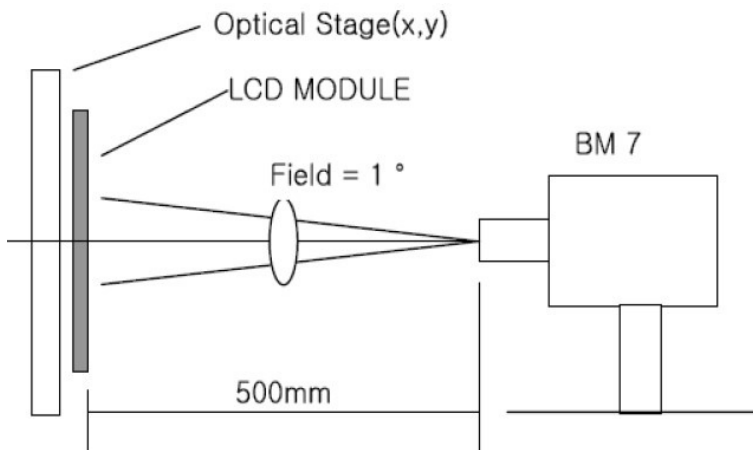
Ta=25°C

Item	Symbol	Condition	Min	Typ.	Max.	Unit	Remark
Contrast Ratio	CR	$\theta=0^\circ$	800	1000	-		Note1 Note2
Response Time	Ton+Toff	25°C	-	20	25	ms	Note1 Note3
View Angles	$\theta T$	$CR \geq 10$	80	-	-	Degree	Note 4
	$\theta B$		80	-	-		
	$\theta L$		80	-	-		
	$\theta R$		80	-	-		
Chromaticity	White	x	Brightness is on	TYP-0.05	0.308	TYP+0.05	Note5, Note1
		y			0.326		
	Red	x			0.640		
		y			0.330		
	Green	x			0.300		
		y			0.600		
	Blue	x			0.150		
		y			0.060		
Luminance	L		480	580		cd/m <sup>2</sup>	Note1 Note6
Uniformity	U		75	80	-	%	Note1 Note7
Color Gamut	NTSC			72		%	

Note 1: Definition of optical measurement system.

Temperature = 25°C(±3°C)

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

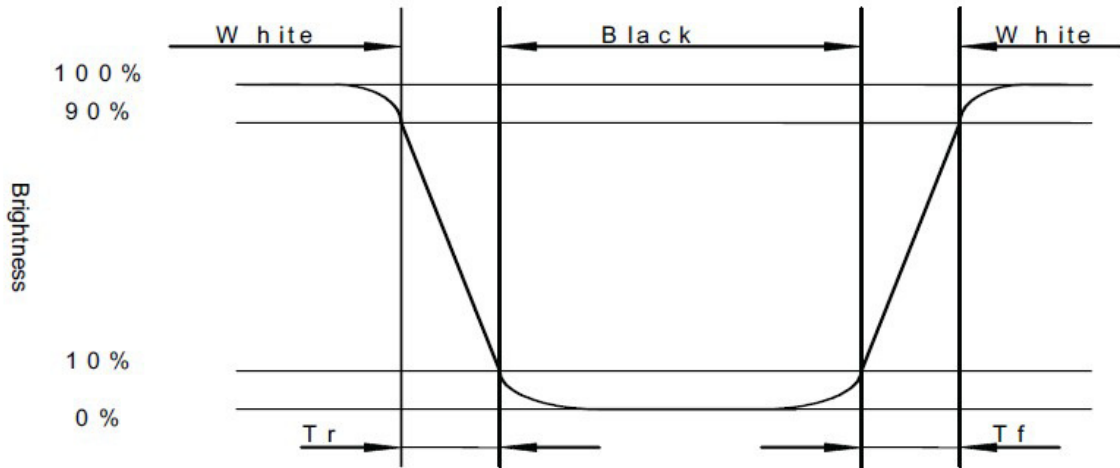


Note 2: Contrast ratio is defined as follow:

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

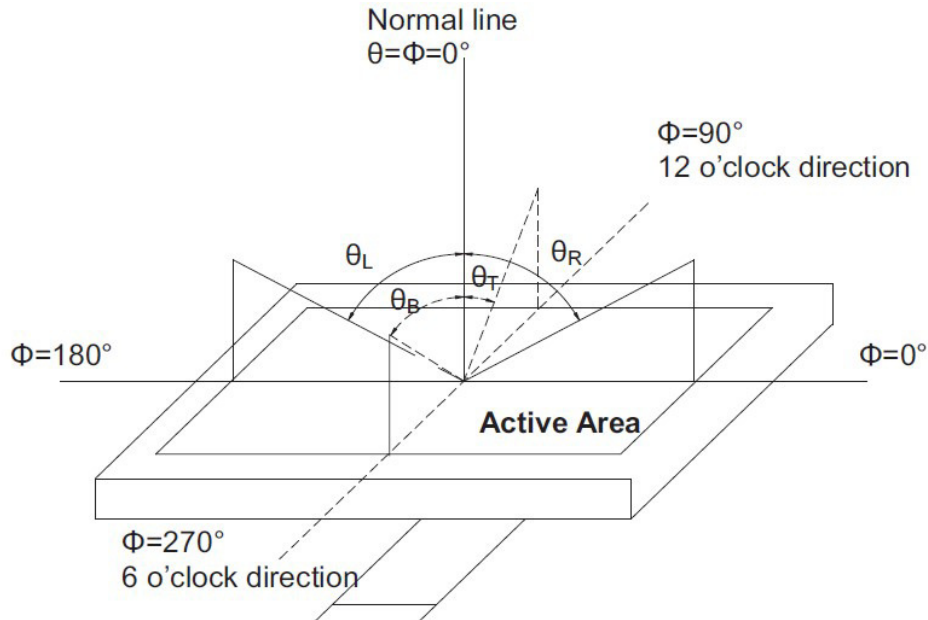
Note 3: Response time is defined as follow:

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,  $T_f$ ).



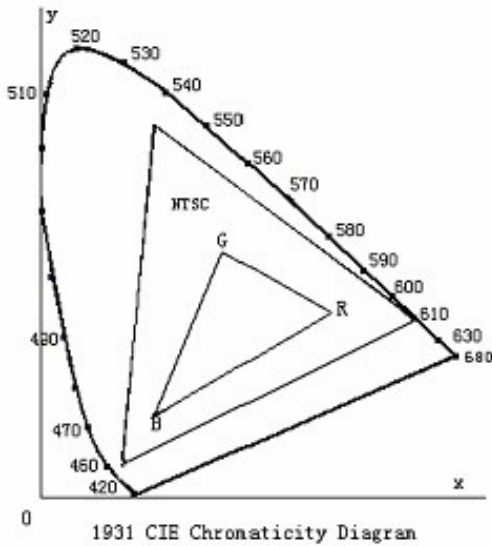
Note 4: Viewing angle range is defined as follow:

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: 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.

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

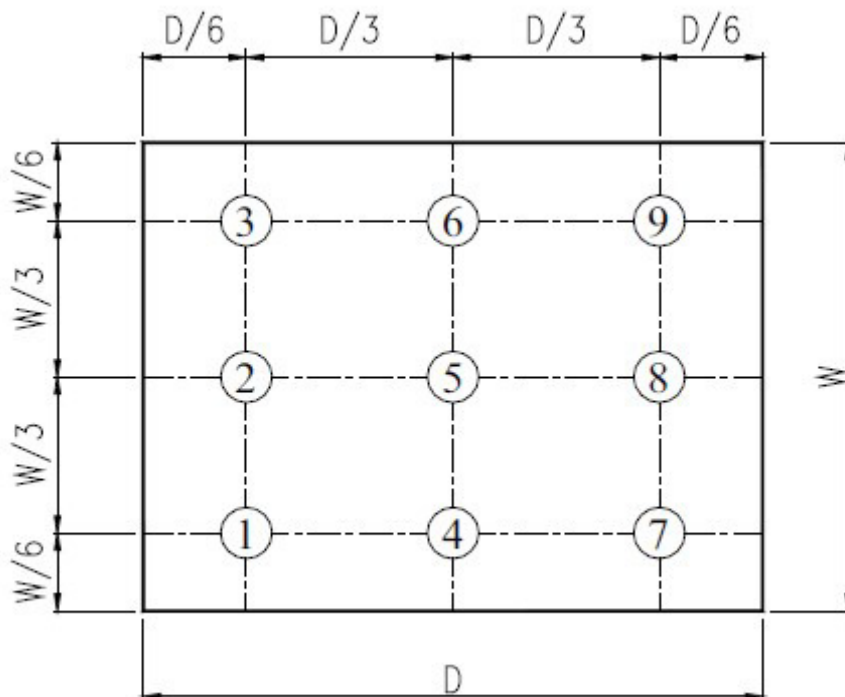


Fig. 2 Definition of uniformity

### 10. Environmental / Reliability Tests

No	Test Item	Condition	Judgment criteria
1	High Temp Operation	Ts=+70°C, 240hrs	Per table in below
2	Low Temp Operation	Ta=-20°C, 240hrs	Per table in below
3	High Temp Storage	Ta=+80°C, 240hrs	Per table in below
4	Low Temp Storage	Ta=-30°C, 240hrs	Per table in below
5	High Temp & High Humidity Storage	Ta=+60°C, 90% 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, 20 Cycles	Per table in below
7	ESD (Operation)	C=150pF, R=330Ω, 5points/panel Air:±8KV, 5times; Contact:±4KV, 5 times;	Per table in below
8	Vibration (Non-operation)	Frequency range:10~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z.	Per table in below
9	Shock (Non-operation)	60G 6ms, ±X,±Y,±Z 3times, for each direction	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

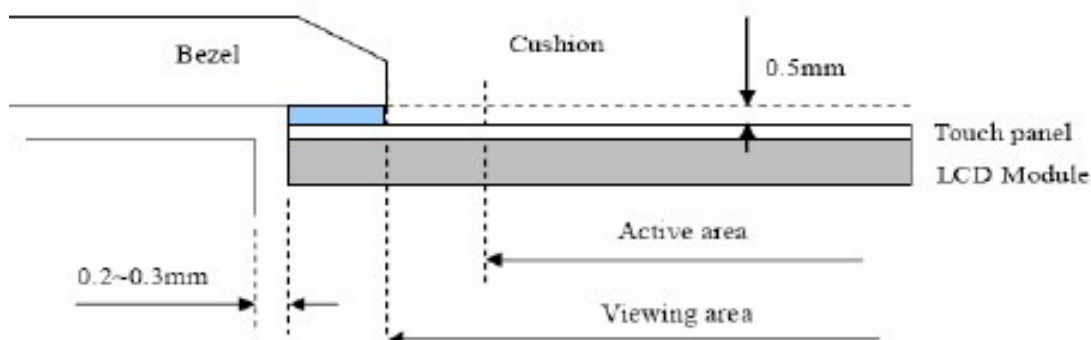
- A. Store the products in a dark place at  $+25^{\circ}\text{C} \pm 10^{\circ}\text{C}$  with low humidity (40% RH to 60% RH). Don't expose to sunlight or fluorescent light.
- B. Storage in a clean environment, free from dust, active gas, and solvent.

### 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.



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