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DLC Display Co., Limited

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Record of Revision

Date	Revision No.	Summary
2010 08 07	1.0	Rev 1.0 was issued

1. Scope

This data sheet is to introduce the specification of DLC0650AIG-T-1, active matrix TFT module. It is composed of a color TFT-LCD panel, driver ICs, FPC , CTP and a backlight unit. The 6.5" display area contains 800 (RGB) x 480 pixels.

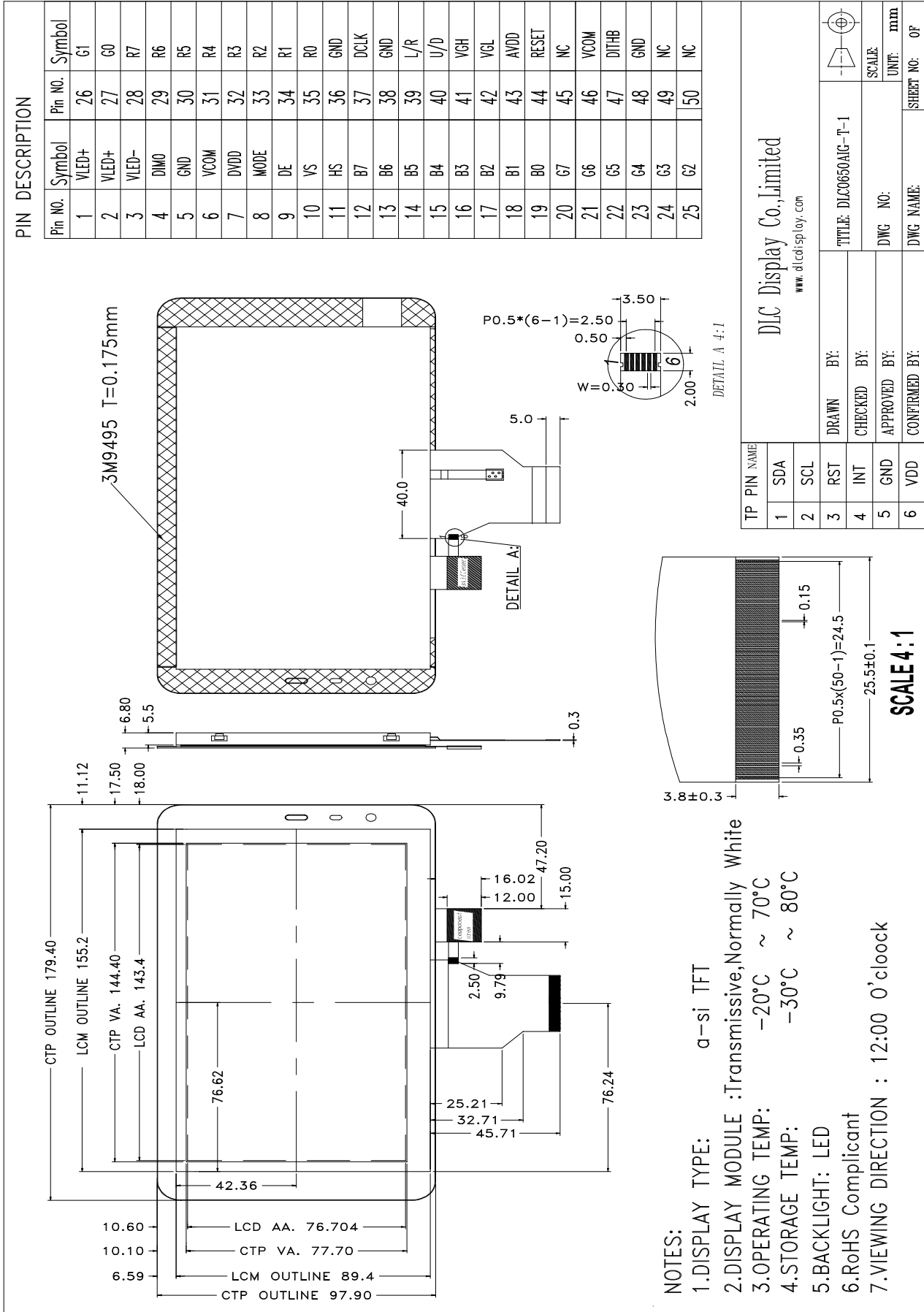
2. Application

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

3. General Information

Item	Contents	Unit
Size	6.5	inch
Resolution	800 (RGB) x 480	/
Technology type	a-si TFT active matrix	/
Interface	TTL	
Pixel pitch	0.05975x0.1598	mm
Pixel Configuration	R.G.B. Vertical Stripe	
Outline Dimension (W x H x D)	179.4x 97.9x6.8	mm
Active Area	143.400x76.704	mm
Display Mode	Transmissive, Normally white	/
Viewing Direction	12 O'clock	/
Backlight Type	LED	/

4. Outline Drawing



5. Interface signals

5.1 TFT LCD Panel Driving Section

No	Symbol	I/O	Description	Remarks
1	VLED+	P	Power for LED backlight (Anode)	
2	VLED+	P	Power for LED backlight (Anode)	
3	VLED-	P	Power for LED backlight (Cathode)	
4	VLED-	P	Power for LED backlight (Cathode)	
5	GND	P	Power ground	
6	VCOM	I	Common voltage	
7	DVDD	P	Power for Digital Circuit	
8	MODE	I	DE/SYNC mode select	Note 1
9	DE	I	Data Input Enable	
10	VS	I	Vertical Sync Input	
11	HS	I	Horizontal Sync Input	
12	B7	I	Blue data(MSB)	
13	B6	I	Blue data	
14	B5	I	Blue data	
15	B4	I	Blue data	
16	B3	I	Blue data	
17	B2	I	Blue data	
18	B1	I	Blue data	Note 2
19	B0	I	Blue data(LSB)	Note2
20	G7	I	Green data(MSB)	
21	G6	I	Green data	
22	G5	I	Green data	
23	G4	I	Green data	
24	G3	I	Green data	
25	G2	I	Green data	
26	G1	I	Green data	
27	G0	I	Green data(LSB)	
28	R7	I	Red data	
29	R6	I	Red data	
30	R5	I	Red data	
31	R4	I	Red data	
32	R3	I	Red data	
33	R2	I	Red data	
34	R1	I	Red data	
35	R0	I	Red data(LSB)	
36	GND	P	Power ground	
37	DCLK	I	Sample clock	Note 3

38	GND	P	Power ground	
39	L/R	I	Left / right selection	Note4, 5
40	U/D	I	Up/down selection	Note 4,5
41	VGH	P	Gate ON Voltage	
42	VGL	P	Gate OFF Voltage	
43	AVDD	P	Power for Analog Circuit	
44	RESET	I	Global reset pin	Note 6
45	NC	-	No connection	
46	VCOM	I	Common Voltage	
47	DITHB	I	Dithering function	Note 7
48	GND	P	Power Ground	
49	NC	-	No connection	
50	NC	-	No connection	

Note 1: DE/SYNC mode select. Normally pull high.

When select DE mode, MODE="1", VS and HS must pull high.

When select SYNC mode, MODE="0", DE must be grounded.

Note 2: When input 18 bits RGB data, the two low bits of R,G and B data must be grounded.

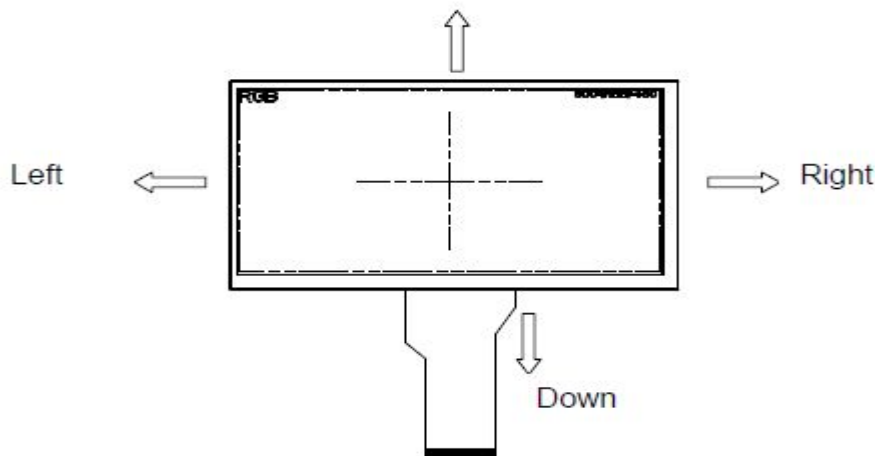
Note 3: Data shall be latched at the falling edge of DCLK.

Note 4: U/D and L/R control Function DVDD=1,GND=0

L/R	U/D	Function
1	0	Up to down, left to right
0	1	Down to up, right to left
0	0	Up to down, right to left
1	1	Down to up, left to right

Note 5: Definition of scanning direction.

Refer to the figure as below:



Note 6: Global reset pin. Active low to enter reset state. Suggest to connect with an RC reset circuit for stability. Normally pull high.

Note 7: Dithering function enable control, normally pull high.

When DITHB="1", Disable internal dithering function,

When DITHB="0", Enable internal dithering function,

5.2 Backlight Unit Section

No	Symbol	I/O	Description	Remarks
1	VLED+	P	Power for LED backlight anode	Pink
2	VLED-	P	Power for LED backlight cathode	White

5.3 TP signal interface

Pin	Symbol	Description
1	SDA(1.8V)	Data input.
2	SCL(1.8V)	Clock for the data input.
3	RST(1.8V)	Reset pin
4	INT(1.8V)	Interrupt output Pin.
5	GND	Power ground.
6	VDD(1.8V)	Power supply

6. Absolute maximum Ratings

6.1. Electrical Absolute max. ratings

Parameter	Symbol	MIN	MAX	Unit	Remark
Power Supply Voltage	DV _{DD}	-0.3	5.0	V	
	AV _{DD}	6.5	13.5	V	
	V _{GH}	-0.3	40.0	V	
	V _{GL}	-20.0	0.3	V	
	V _{GH-VGL}	-	40.0	V	

6.2. Environment Conditions

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

6.3 LED Backlight

Item	Symbol	MIN	MAX	Unit	Remark
LED reverse voltage	V _r	-	1.2	V	One LED
LED forward current	I _f	-	25	mA	

7. Electrical Specifications

7.1 Electrical characteristics

GND=0V, Ta=25°C

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Power Supply voltage	DV _{DD}		3.3		V	
	AV _{DD}		10.4		V	
	V _{GH}		15.0		V	
	V _{GL}		10.0		V	
Input signal voltage	V _{com}		4.0		V	
Input Logic Voltage	V _{IL}	0	--	0.3 *DV _{DD}	V	
	V _{IH}	0.7 *DV _{DD}	--	DV _{DD}	V	

Note 1: VCC setting should match the signals output voltage (refer to Note 2) of customer's system board.

Note 2: DCLK,DE, HS, VS, R0~ R7,G0~ G7,B0~ B7.

7.2 LED Backlight

Ta=25°C

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	IF		160		mA	
Forward Voltage	VF		9.3		V	Note 1
LED life time		20,000			Hr	Note 2

Note 1: The Voltage for LED Backlight is defined at Ta=25°C and IL =160mA.

Note 2: The "LED life time" is defined as the module brightness decrease to 50% original brightness at Ta=25°C and IL =160mA. The LED lifetime could be decreased if operating IL is larger than 160mA

8. Command/AC Timing

8.1 Timing conditions

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Note
HS setup time	Thst	8	-	-	ns	
HS hold time	Thhd	8	-	-	ns	
VS setup time	Tvst	8	-	-	ns	
VS hold time	Tvhd	8	-	-	ns	
Data setup time	Tdsu	8	-	-	ns	
Data hole time	Tdhd	8	-	-	ns	
DE setup time	Tesu	8	-	-	ns	
DE hole time	Tehd	8	-	-	ns	
DVDD Power On Slew rate	TPOR	-	-	20	ms	From 0 to 90% DVDD
RESET pulse width	TRst	1	-	-	ms	
DCLK cycle time	Tcoh	20	-	-	ns	
DCLK pulse duty	Tcwh	40	50	60	%	

8.2 Timing

8.2.1 horizontal timing

Parameter	Symbol	Min	Typ	Max	Unit	Remark
Horizontal Display Area	thd	-	800	-	DCLK	
DCLK Frequency	fclk	26.4	33.3	46.8	MHz	
One Horizontal Line	th	862	1056	1200	DCLK	
HS pulse width	thpw	1	-	40	DCLK	
HS Blanking	thb	46	46	46	DCLK	
HS Front Porch	thfp	16	210	354	DCLK	



Figure 8.2.1 : horizontal input timing diagram

8.2.2 Vertical timing

Parameter	Symbol	Min	Typ	Max	Unit	Remark
Vertical Display Area	tv _d	-	480	-	TH	
VS period time	t _v	510	525	650	TH	
VS pulse width	t _{vpw}	1	-	20	TH	
VS Blanking	t _{vb}	23	23	23	TH	
VS Front Porch	t _{vfp}	7	22	147	TH	

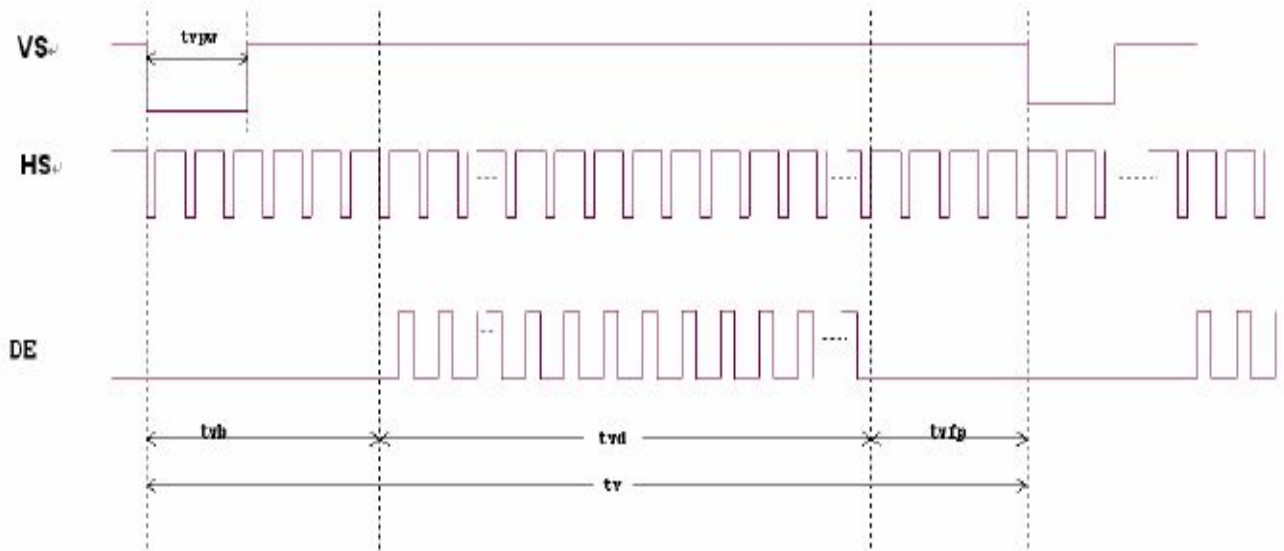
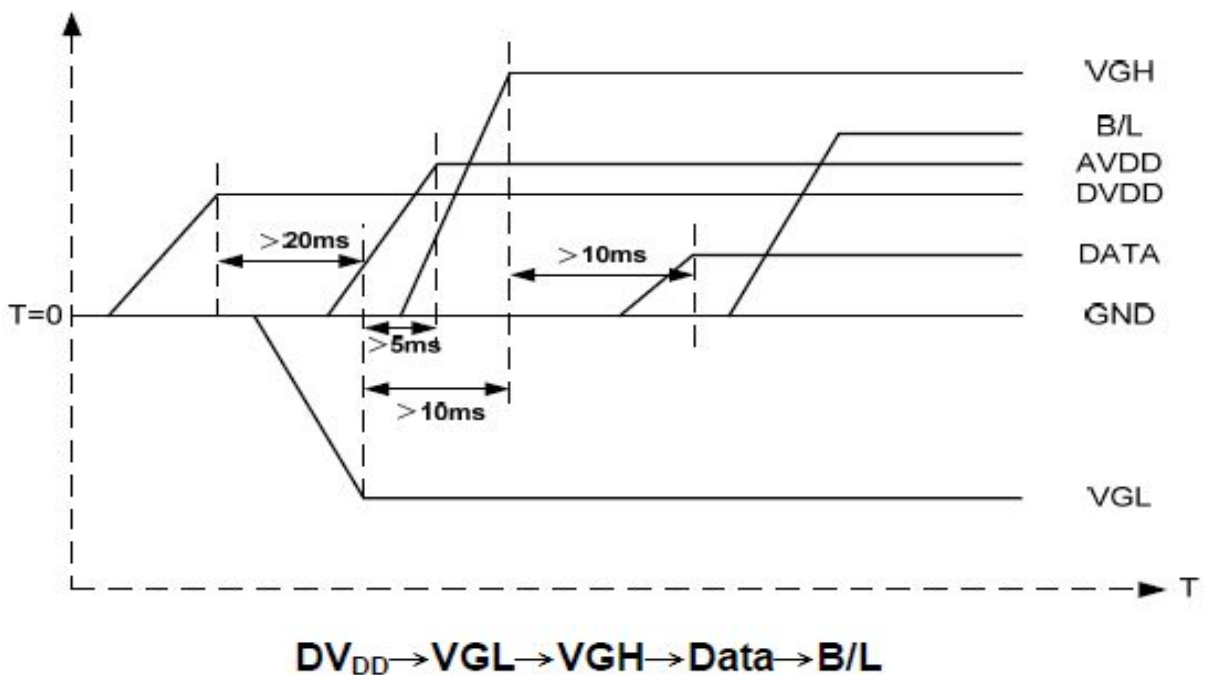


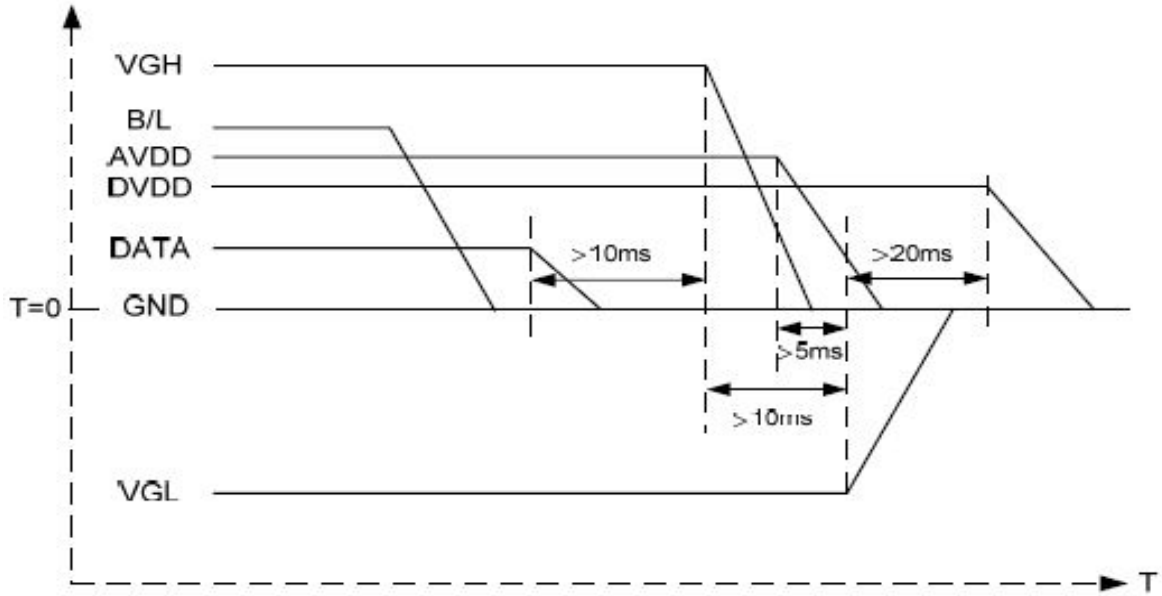
Figure 8.2.2 : Vertical input timing diagram

8.3 power sequence

8.3.1 power on:



8.3.2 power off:



B/L → Data → VGH → VGL → DV_{DD}

Note: Data include DCLK, POL, OEV, CKV, STVU, STVD, STHL, STHR, LD, R0~R5, G0~G5, B0~B5

9. Optical Specification

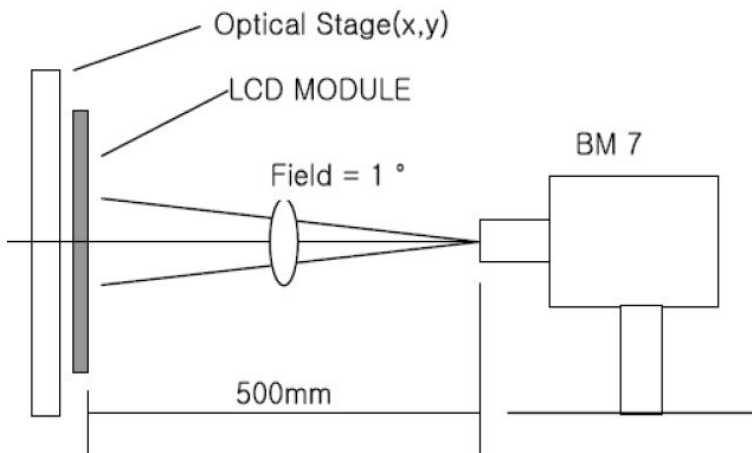
Ta=25°C

Item	Symbol	Condition	Min	Typ.	Max.	Unit	Remark
Contrast Ratio	CR	$\theta=0^\circ$	400	500			Note1 Note2
Response Time	Ton	25°C		10	20	ms	Note1
	Toff			15	30		Note3
View Angles	ΘT	$CR \geq 10$	40	50		Degree	Note 4
	ΘB		60	70			
	ΘL		60	70			
	ΘR		60	70			
Chromaticity	White	x	Typ 0.05	0.31	Typ+0.05		Note5, Note1
		y		0.33			
Luminance	L		280	360		cd/m ²	Note1 Note6
Uniformity	U		70	75		%	Note1 Note7

Note 1: Definition of optical measurement system.

Temperature = 25°C (±3°C)

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

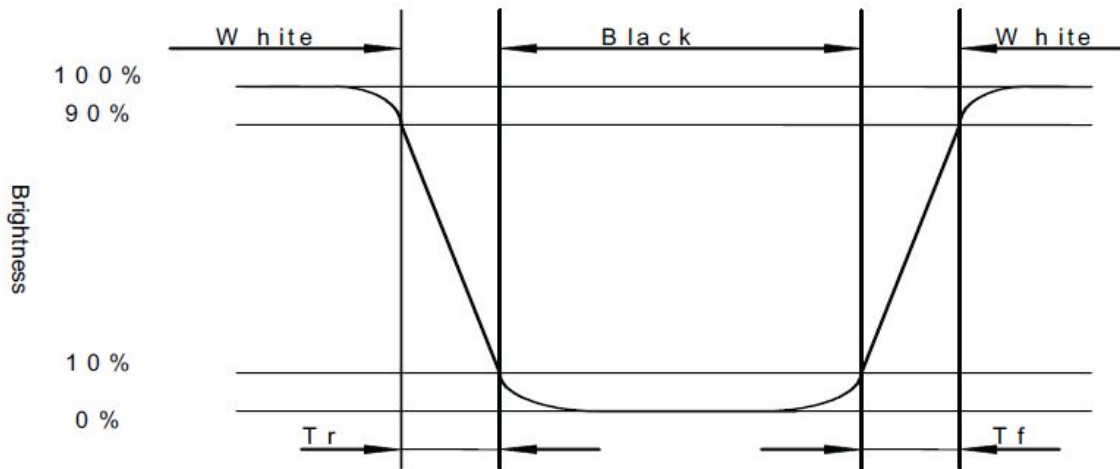


Note 2: Contrast ratio is defined as follow:

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

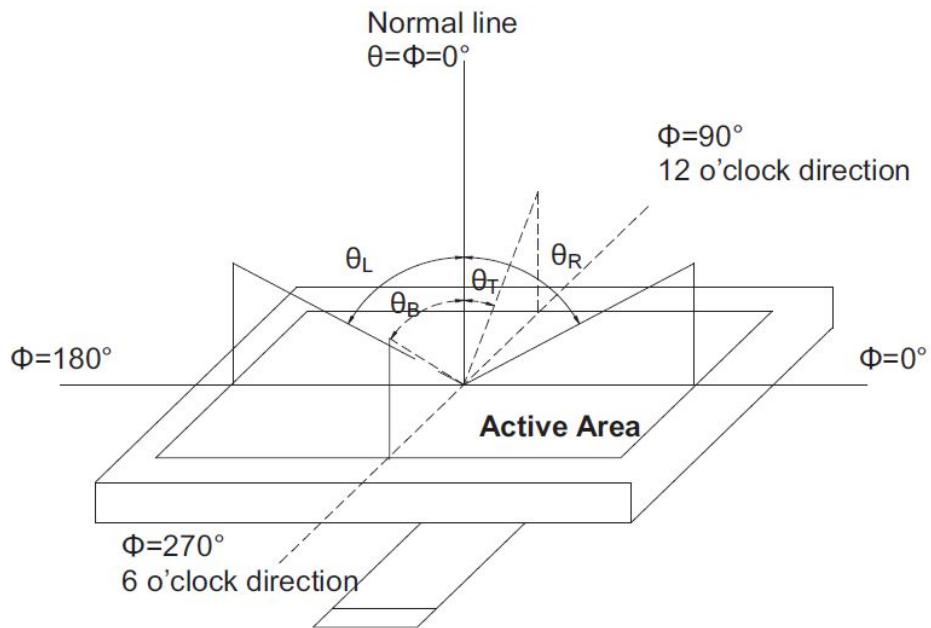
Note 3: Response time is defined as follow:

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).



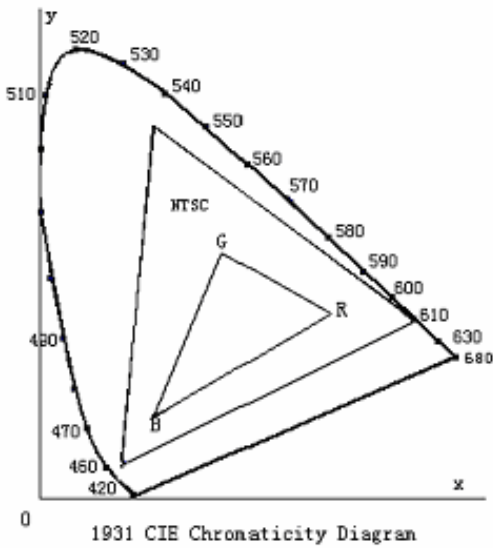
Note 4: Viewing angle range is defined as follow:

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: 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.

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

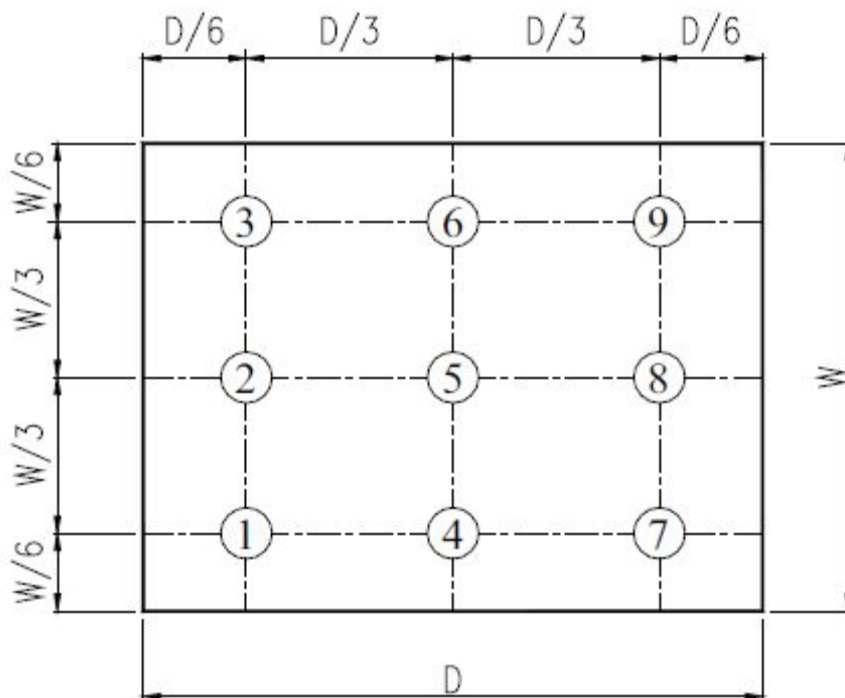


Fig. 2 Definition of uniformity

10. Environmental / Reliability Tests

No	Test Item	Condition	Judgment criteria
1	High Temp Operation	Ts=+70°C, 120hrs	Per table in below
2	Low Temp Operation	Ta= 20°C, 120hrs	Per table in below
3	High Temp Storage	Ta=+80°C, 120hrs	Per table in below
4	Low Temp Storage	Ta= 30°C, 120hrs	Per table in below
5	High Temp & High Humidity Storage	Ta=+40°C, 90% RH 120 hours	Per table in below (polarizer discoloration is excluded)
6	Thermal Shock (Non operation)	30°C 30 min~+80°C 30 min, Change time:5min, 10 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°C \pm 10°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.

