

DLC Display Co., Limited

德爾西顯示器有限公司



MODEL No:DLC0350AMG

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Record of Revision

Date	Revision No.	Summary
2009-08-20	1.0	Preliminary release
2010-03-03	1.1	Update the Characteristics Data
2010-04-16	1.2	Update the temperature range
2013-06-25	2.0	Change the controller

1. Scope

This data sheet is to introduce the specification of DLC0350AMG active matrix TFT module. It is composed of a color TFT-LCD panel, driver ICs, FPC and a backlight unit. The 3.5" display area contains 320(RGB) x 240 pixels.

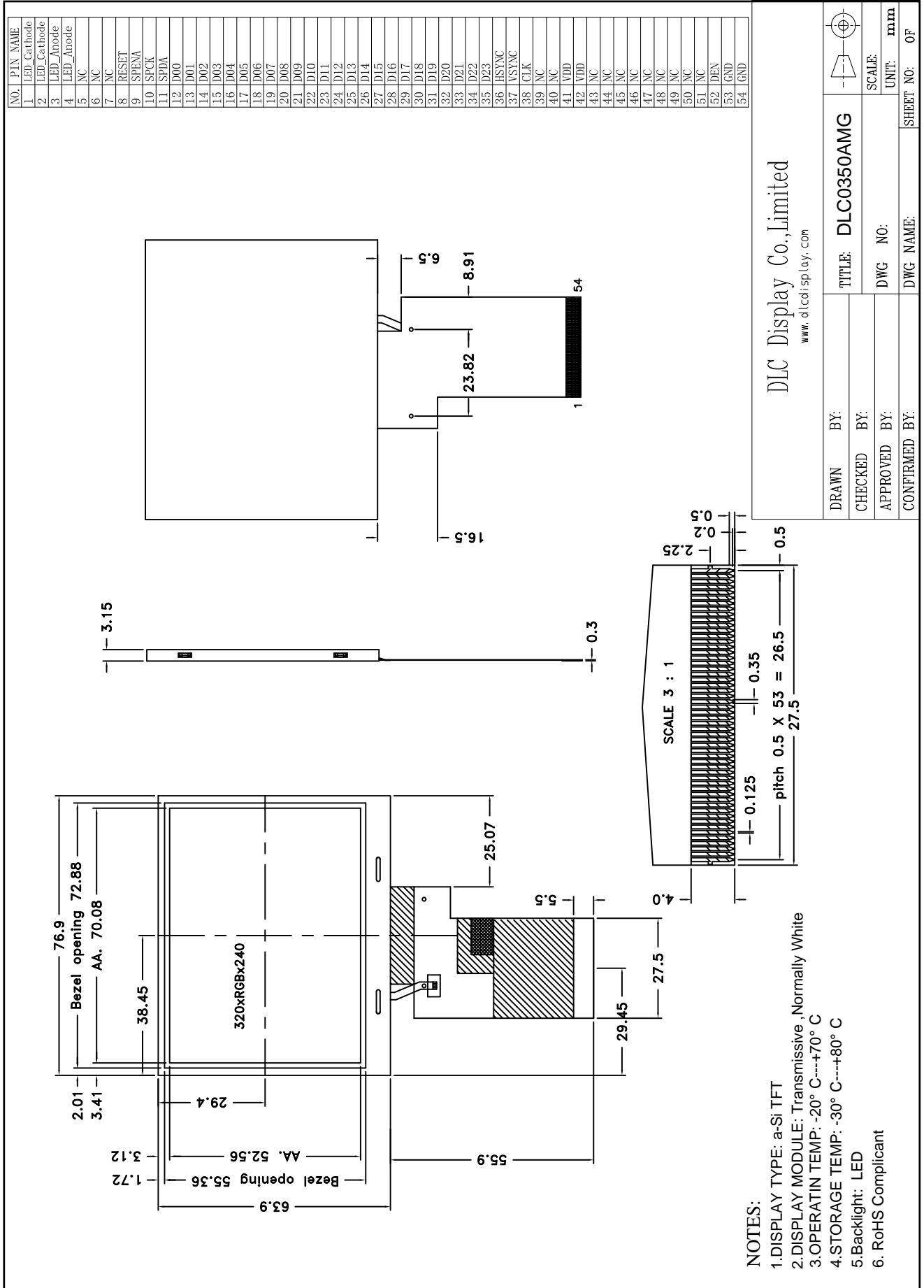
2. Application

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

3. General Information

Item	Contents	Unit
Size	3.5	inch
Resolution	320(RGB) x 240	/
Interface	RGB	/
Technology type	a-si TFT	/
Pixel pitch	0.219x0.219	mm
Pixel Configuration	R.G.B. Vertical Stripe	
Outline Dimension (W x H x D)	76.9x 63.9x3.15	mm
Active Area	70.08 x 52.56	mm
Display Mode	Transmissive, Normally white	/
Driver IC	NV3035C	
Viewing Direction	12 O'clock	/
Backlight Type	LED	/

4. Outline Drawing



5. Interface signals

No	Symbol	Description	Remarks
1	LED_Cathode	LED_Cathode	
2	LED_Cathode	LED_Cathode	
3	LED_Anode	LED_Anode	
4	LED_Anode	LED_Anode	
5	NC	No Connect	
6	NC	No Connect	
7	NC	No Connect	
8	RESET	Reset	
9	SPENA	Serial port data enable signal	
10	SPCK	SPI Serial Clock	
11	SPDA	SPI Serial Data Input/output	
12	D00	Data 00	
13	D01	Data 01	
14	D02	Data 02	
15	D03	Data 03	
16	D04	Data 04	
17	D05	Data 05	
18	D06	Data 06	
19	D07	Data 07	
20	D08	Data 08	
21	D09	Data 09	
22	D10	Data 10	
23	D11	Data 11	
24	D12	Data 12	
25	D13	Data 13	
26	D14	Data 14	
27	D15	Data 15	
28	D16	Data 16	
29	D17	Data 17	
30	D18	Data 18	
31	D19	Data 19	
32	D20	Data 20	
33	D21	Data 21	
34	D22	Data 22	
35	D23	Data 23	
36	HSYNC	Horizontal Synchronous Signal	
37	VSYNC	Vertical Synchronous Signal	
38	CLK	Data Clock	
39	NC	No Connect	

40	NC	No Connect	
41	VDD	power supply (3.3V)	
42	VDD	power supply (3.3V)	
43	NC	No Connect	
44	NC	No Connect	
45	NC	No Connect	
46	NC	No Connect	
47	NC	No Connect	
48	NC	No Connect	
49	NC	No Connect	
50	NC	No Connect	
51	NC	No Connect	
52	DEN	Data enabling signal	
53	GND	Ground	
54	GND	Ground	

The recommended connector: Kyocera elco:6240 serials

Note1:

Mode	D(23:16)	D(15:08)	D(07:00)	HSYNC	VSYNC
ITU-R BT 656	D(23:16)	GND	GND	NC	NC
ITU-R BT 601	D(23:16)	GND	GND	HSYNC	VSYNC
8 Bit RGB	D(23:16)	GND	GND	HSYNC	VSYNC
24 Bit RGB	R(7:0)	G(7:0)	B(7:0)	HSYNC	VSYNC

6. Absolute maximum Ratings

6.1. Electrical Absolute max. ratings

Parameter	Symbol	MIN	MAX	Unit	Remark
Supply Voltage	VDD	-0.3	5.0	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 Absolute max. ratings

Item	Symbol	MIN	MAX	Unit	Remark
LED Forward Current	ILED	--	25	mA	

7. Electrical Specifications

7.1 Electrical characteristics

GND=0V, Ta=25°C

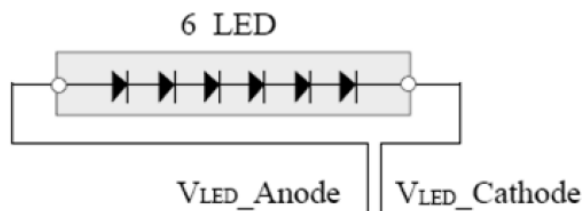
Item	Symbol	MIN	TYP	MAX	Unit	Remark
Supply Voltage	VDD	3.0	3.3	3.6	V	
Input Signal Voltage	VIL	0	--	0.3*VDD	V	
	VIH	0.7*VDD	--	VDD	V	
Power Consumption IDD	Black Mode(60Hz)	-	35	-	mW	
	Sleeping Mode	-	TBD	-	mW	

7.2 LED Backlight

Ta=25°C

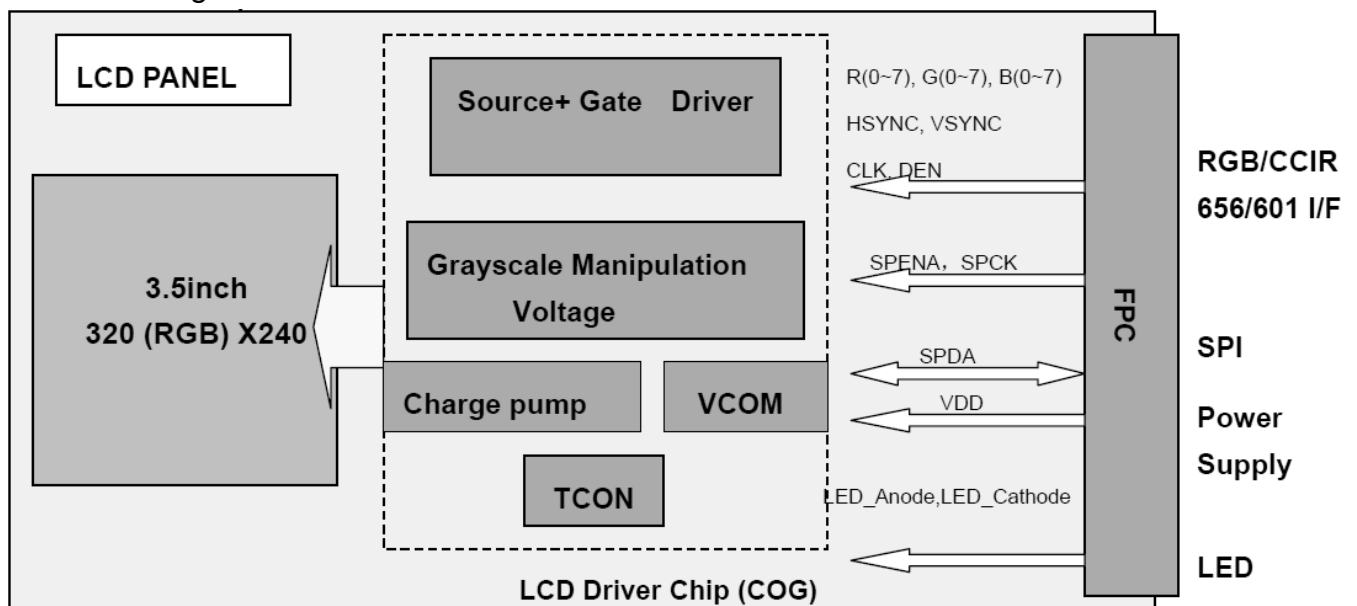
Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	IF	--	20	-	mA	
Forward Voltage	VF	18	19.2	20.4	V	
LED life time	-	-	30,000	-	Hrs	Note 2

Note 1: The figure below shows the connection of backlight LED.



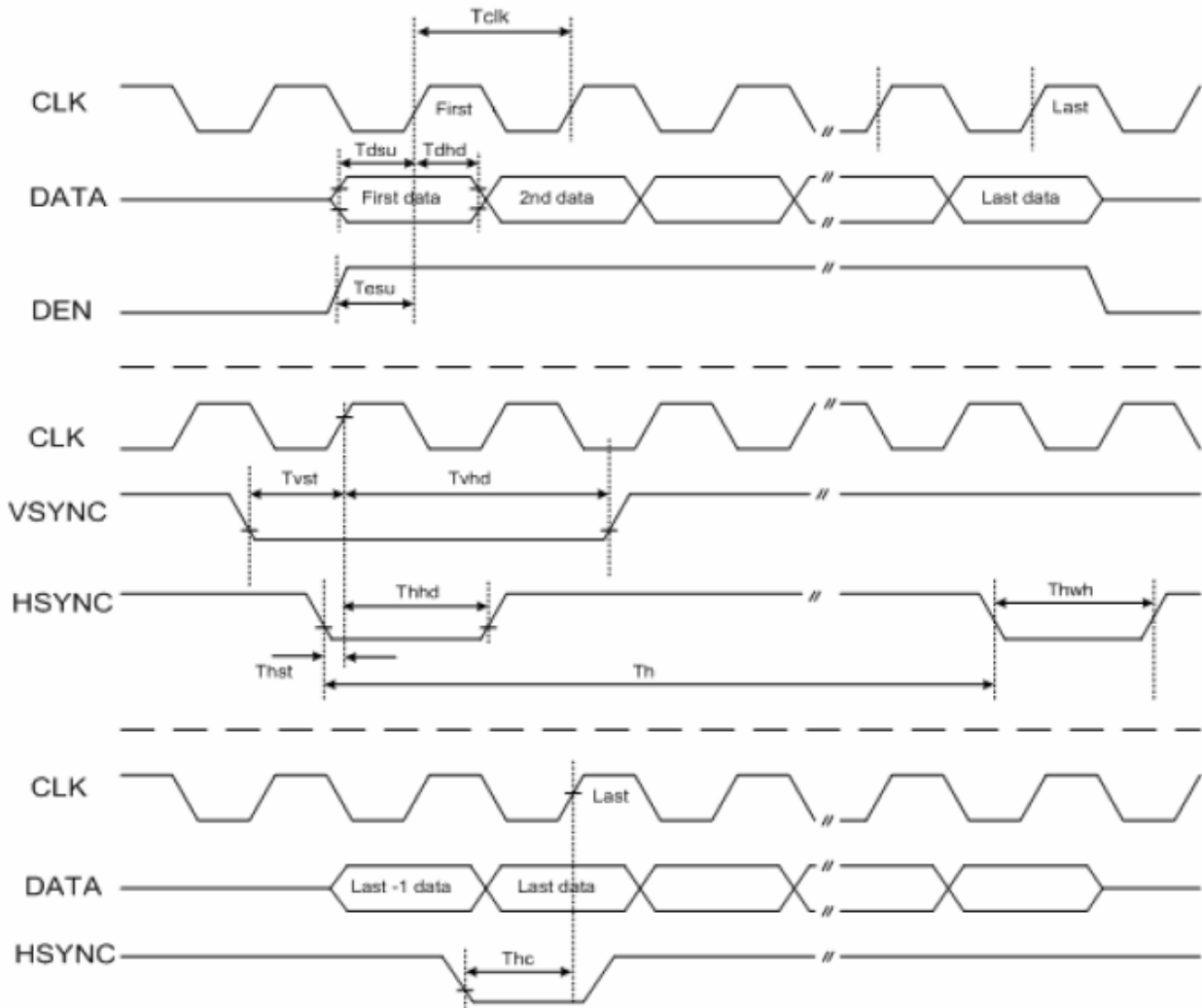
Note 2: The "LED life time" is defined as the module brightness decrease to 50% original brightness at Ta=25°C and IL=20mA. The LED lifetime could be decreased if operating IL is large than 20mA.

7.3 Block Diagram



8. Command/AC Timing

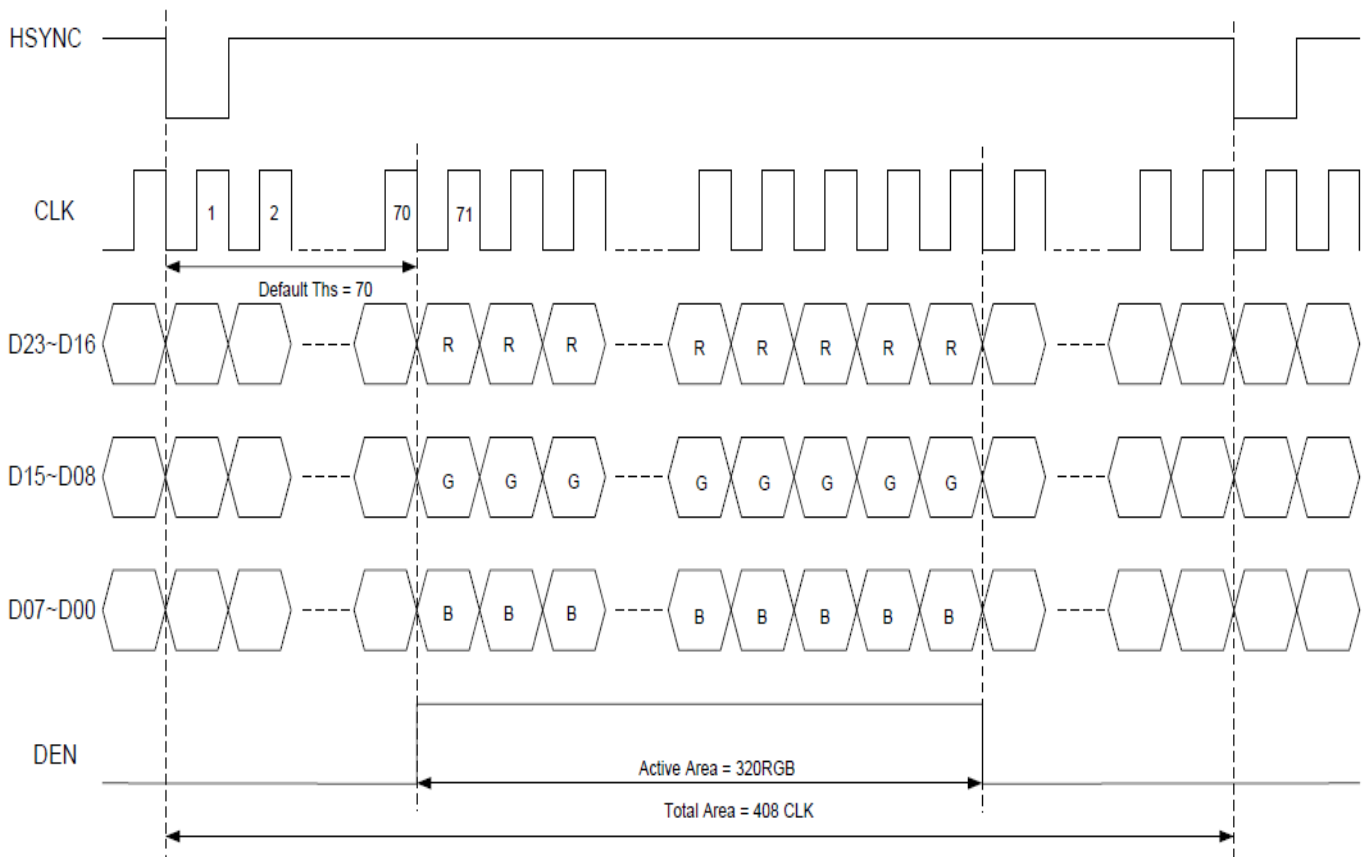
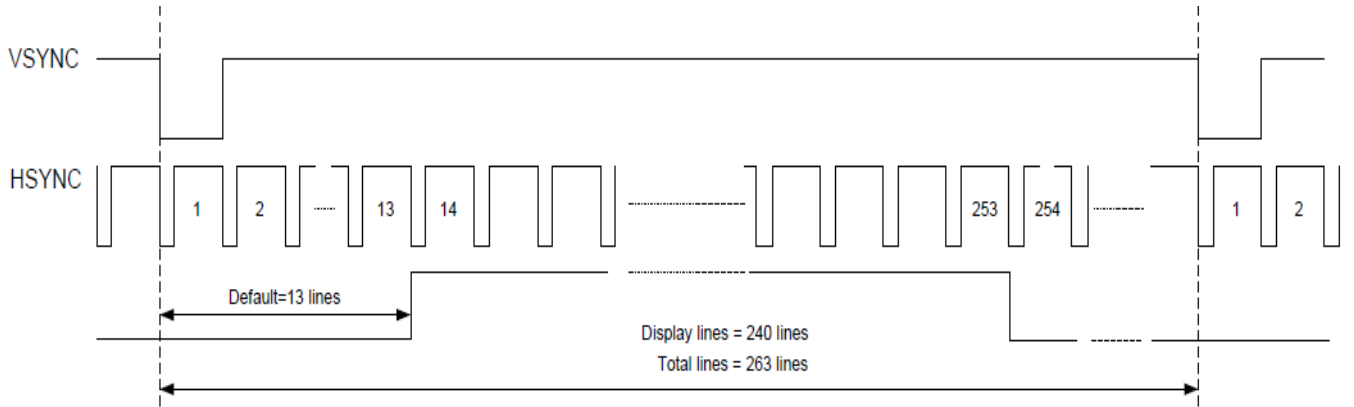
8.1 AC Electrical Characteristics (VDD=3.3V, GND= 0V, Ta=25°C)



Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLK clock time	Tclk	-	-	35.7	ns	CLK=28MHz
CLK pulse duty	Tchw	40	50	60	%	Tclk
HSYNC to CLK	Thc	-	-	1	CLK	
HSYNC width	Thwh	1	-	-	CLK	
VSYNC width	Tvwh	1	-	-	Th	
HSYNC period time	Th	60	63.56	67	us	
VSYNC setup time	Tvst	12	-	-	ns	
VSYNC hold time	Tvhd	12	-	-	ns	
HSYNC setup time	Thst	12	-	-	ns	
HSYNC hold time	Thhd	12	-	-	ns	
Data set-up time	Tdsu	12	-	-	ns	D[23:00] to CLK
Data hold time	Tdhd	12	-	-	ns	D[23:00] to CLK
DEN setup time	Tesd	12	-	-	ns	DEN to CLK

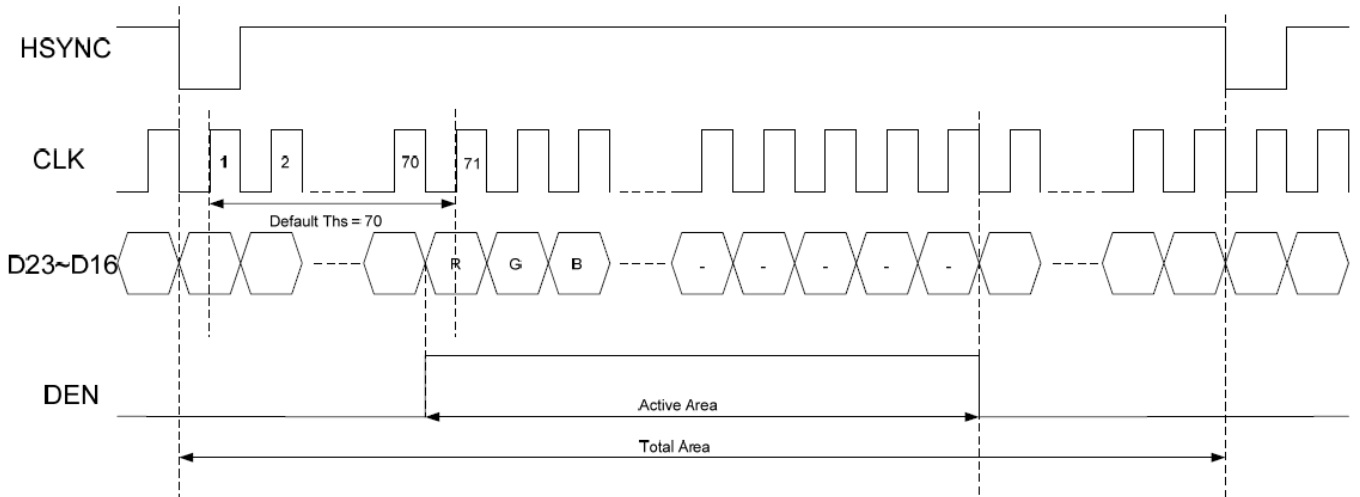
8.2 24 bit RGB mode for 320RGB x 240

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLK frequency	Fclk	-	6.4	-	MHz	VDD=3.0~3.6V
CL CLK cycle time	Tclk	-	156	-	ns	
Time that HSYNC to 1'st data input(NTSC)	Ths	40	70	255	CLK	



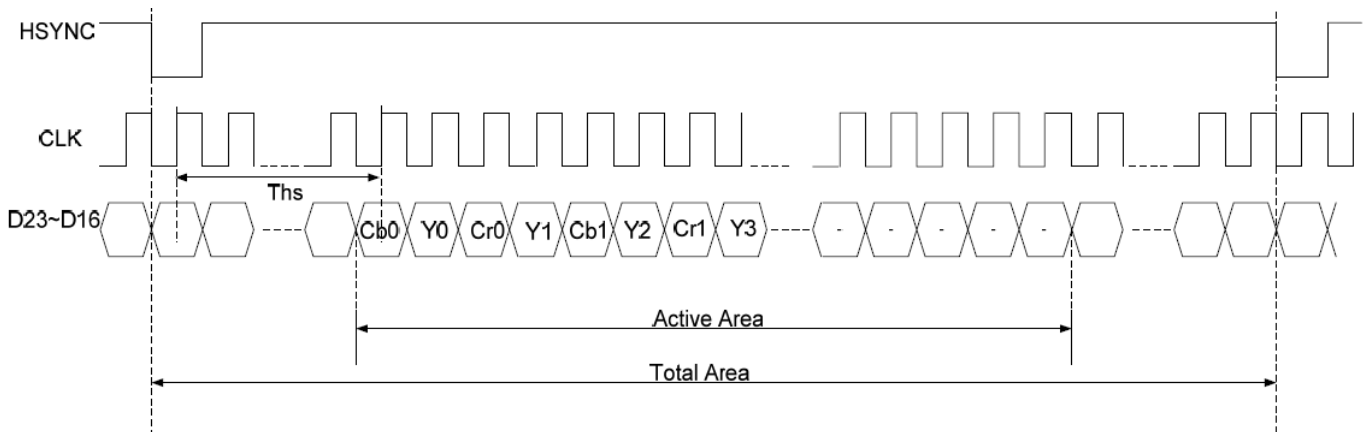
8.3 8 bit RGB mode for 320RGB x 240

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLK frequency	Fclk	-	27	-	MHz	VDD=3.0~3.6V
CLK cycle time	Tclk	-	37	-	ns	
Time that HSYNC to 1'st data input(NTSC)	Ths	35	70	255	CLK	



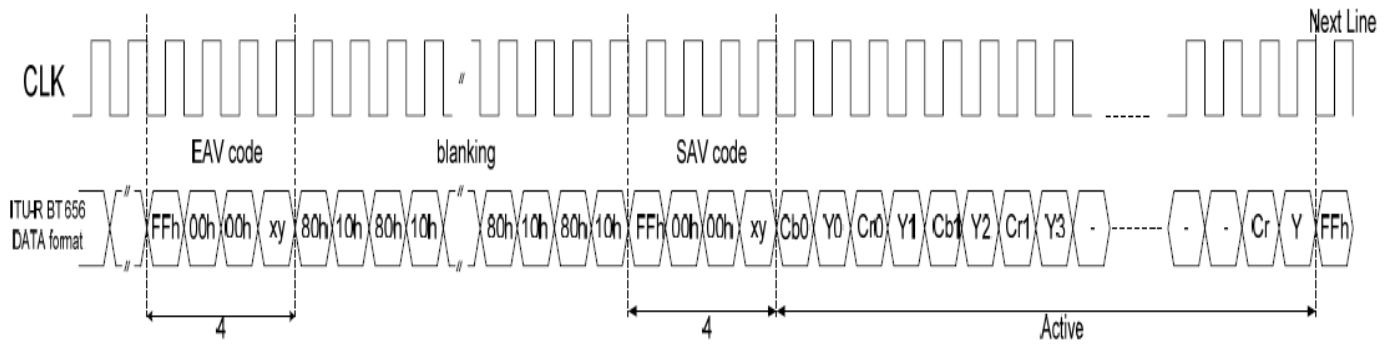
8.4 ITU-R BT 601

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLK frequency	Fclk	-	24.54/27	-	MHz	VDD=3.0~3.6V
CLK cycle time	Tclk	-	40/37	-	ns	
Time that HSYNC to 1'st data input(PAL)	Ths	128	264	-	CLK	
Time that HSYNC to 1'st data input(NTSC)	Ths	128	244	-	CLK	



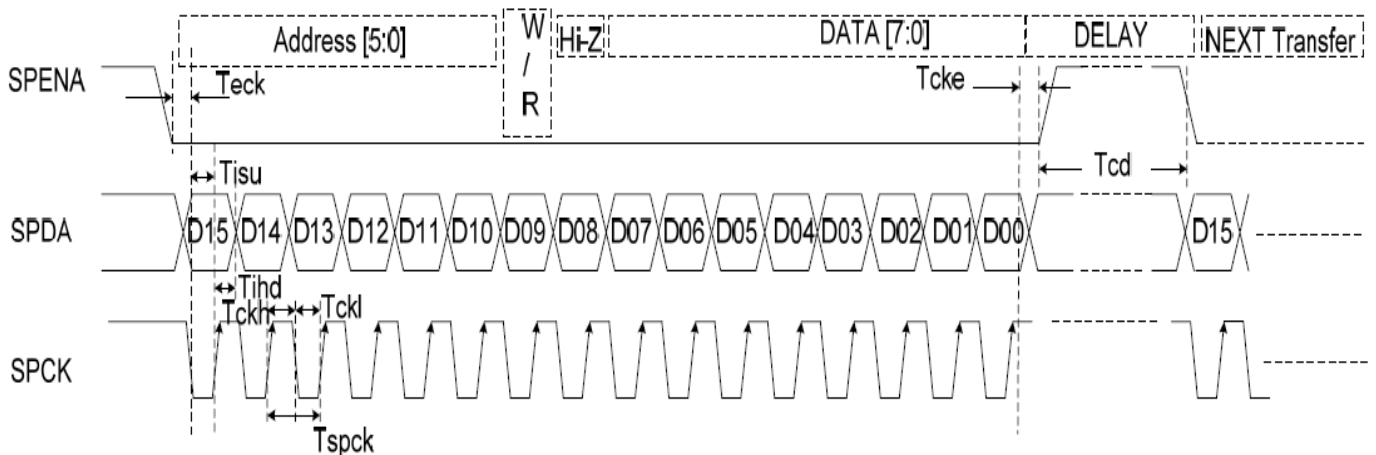
8.5 ITU-R BT 656

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLK frequency	Fclk	-	27	-	MHz	VDD=3.0~3.6V
CLK cycle time	Tclk	-	37	-	ns	
Time that EVA to 1'st data input(PAL)	Ths	128	288	-	CLK	
Time that EVA to 1'st data input(NTSC)	Ths	128	276	-	CLK	



8.6 3-wire serial communication AC timing

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Serial clock	Tspck	320	-	-	ns	
SPCK pulse duty	Tscdut	40	50	60	%	
Serial data setup time	Tisu	120	-	-	ns	
Serial data hold time	Tihd	120	-	-	ns	
Serial clock high/low	Tssw	120	-	-	ns	
Chip select distinguish	Tcd	1	-	-	us	



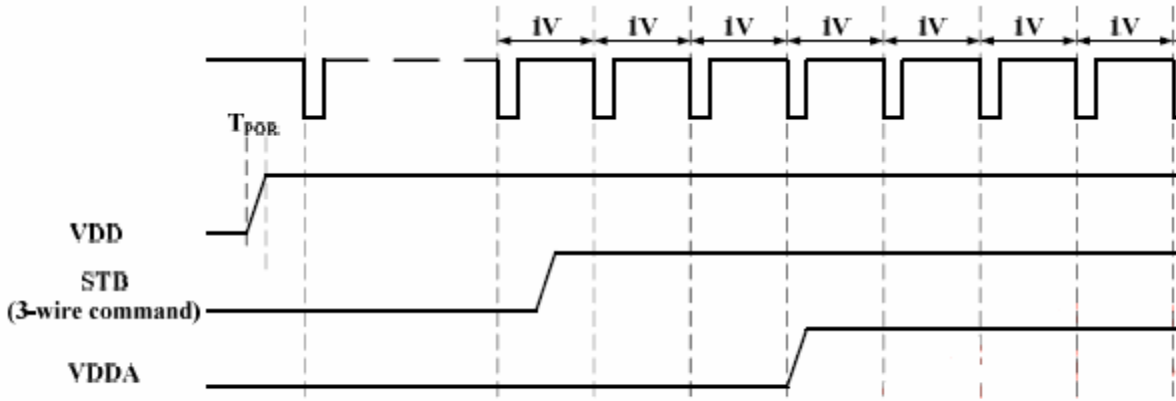
8.7 3-Wire Control Registers List

3-Wire Register		Register Description		
D[15:8]	Name	Init	R/W	Function Description
000000b	R00	07h	R/W	System control register
000001b	R01	00h	R/W	Timing Controller function register
000010b	R02	03h	R/W	Operation control register
000011b	R03	CCh	R/W	Input data Format control register
000100b	R04	46h	R/W	Source Timing delay control register
000101b	R05	0Dh	R/W	Gate Timing delay control register
000110b	R06	00h	R/W	Reserved
000111b	R07	00h	R/W	Internal function control register
001000b	R08	00h	R/W	RGB Contrast control register
001001b	R09	40h	R/W	RGB Brightness control register
001010b	ROA	88h	R/W	Hue / Saturation control register
001011b	ROB	88h	R/W	R / B Sub-Contrast control register
001100b	ROC	20h	R/W	R Sub-Brightness control register
001101b	ROD	20h	R/W	B Sub-Brightness control register
001110b	ROE	68h	R/W	VCOMDC Level Control Register
001111b	ROF	A4h	R/W	VCOMAC Level Control Register
010000b	R10	04h	R/W	VGAM2 level control register
010001b	R11	24h	R/W	VGAM3/4 level control register
010010b	R12	24h	R/W	VGAM5/6 level control register
011110b	R1E	00h	R/W	VCOMDC Trim function control register
100000b	R20	00h	R/W	Wide and narrow display mode control register

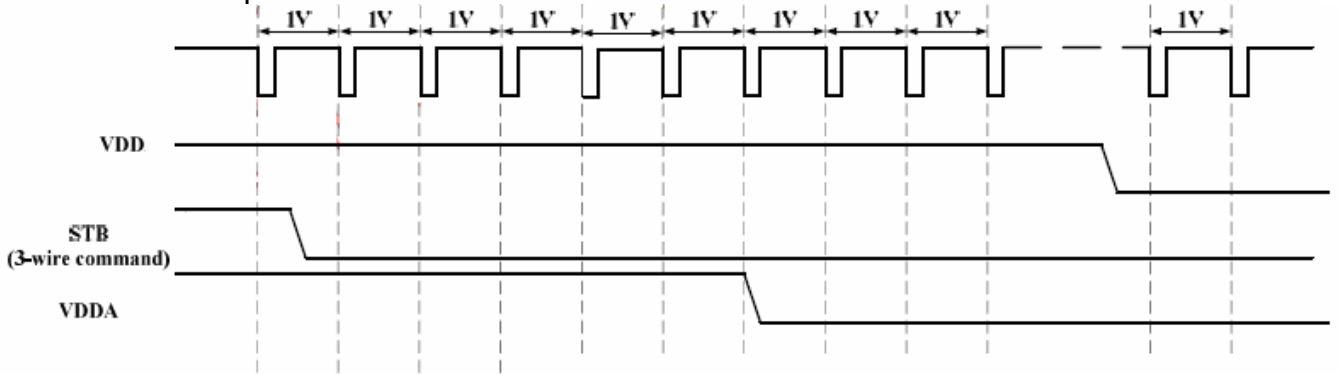
Note :

R03: c4h:ITU-R BT 656 Mode
 c2h:ITU-R BT 601 Mode
 c8h:8 bit RGB Mode(HV Mode)
 c9h:8 bit RGB Mode(DE Mode)
 cch(default):24 bit RGB Mode (HV mode)
 cdh:24 bit RGB Mode (DE mode)

8.8 Power on Sequence



8.9 Power off Sequence



9. Optical Specification

Ta=25°C

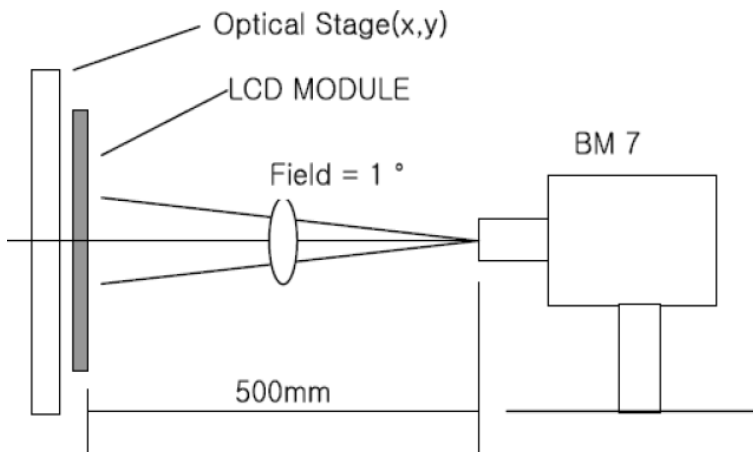
Item	Symbol	Condition	Min	Typ.	Max.	Unit	Remark
Contrast Ratio	CR	$\theta=0^\circ$	200	350	-		Note1 Note2
Response Time	Ton/ Toff	25°C	-	25	40	ms	Note1 Note3
View Angles	θT	$CR \geq 10$	30	40	-	Degree	Note 4
	θB		50	60	-		
	θL		50	60	-		
	θR		50	60	-		
Chromaticity	White	x	Brightness is on	0.260	0.310	0.360	Note5, Note1
		y		0.283	0.333	0.383	
NTSC	S			50		%	Note5
Luminance	L		240	300	-	cd/m ²	Note1 Note6
Uniformity	U		75	80	-	%	Note1 Note7

Test Conditions: VF=3.2V, IF=20mA (LED current), the ambient temperature is 25°C.

Note 1: Definition of optical measurement system.

Temperature = 25°C(±3°C)

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

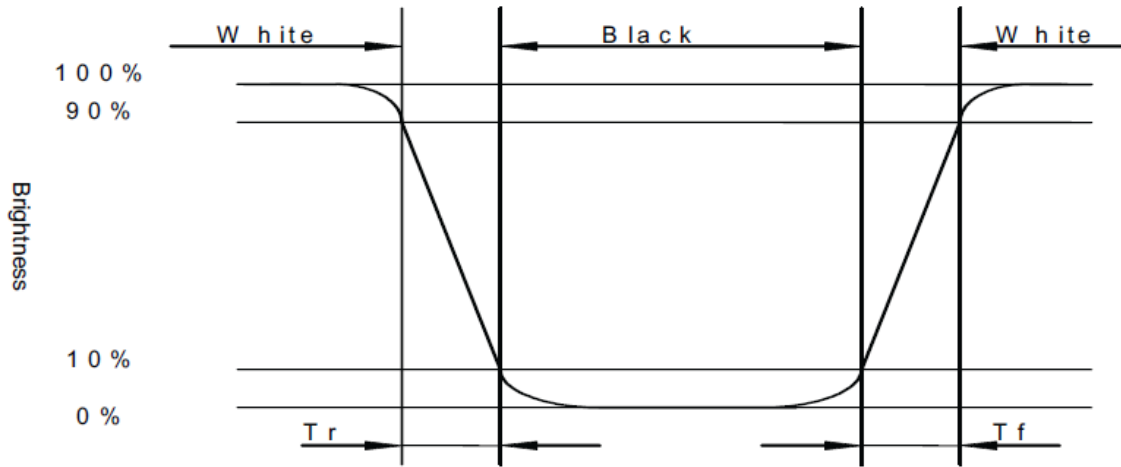


Note 2: Contrast ratio is defined as follow:

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

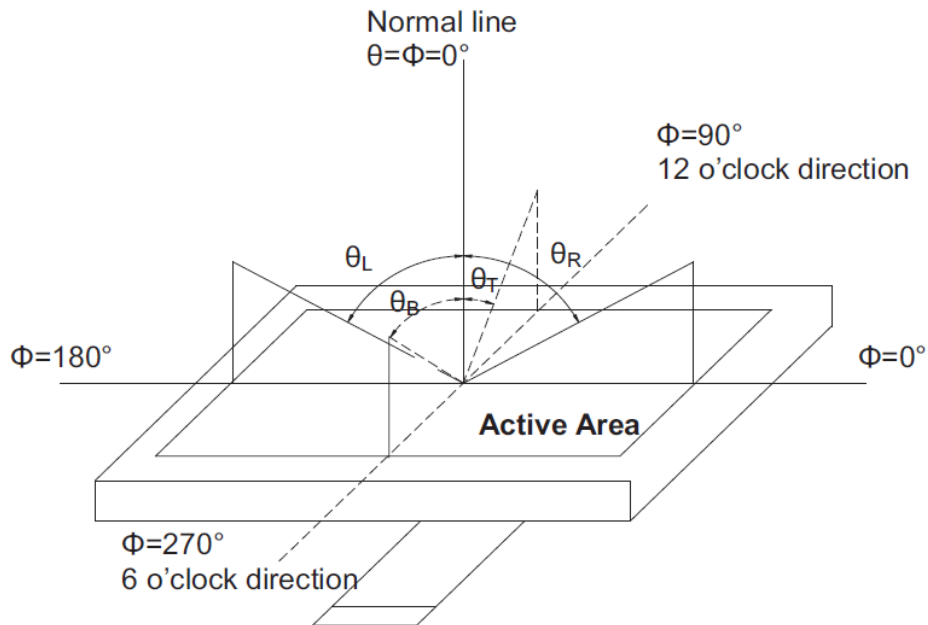
Note 3: Response time is defined as follow:

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).



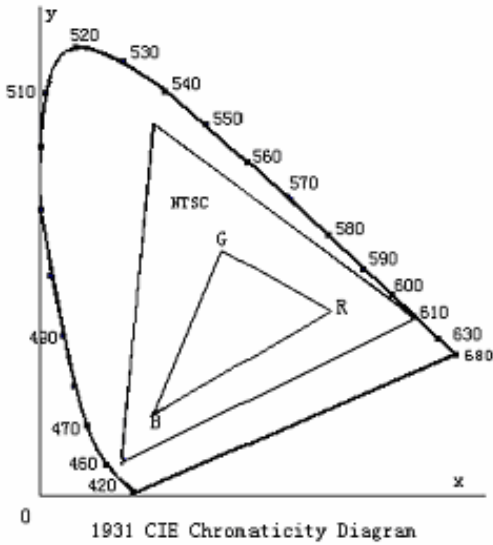
Note 4: Viewing angle range is defined as follow:

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.

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

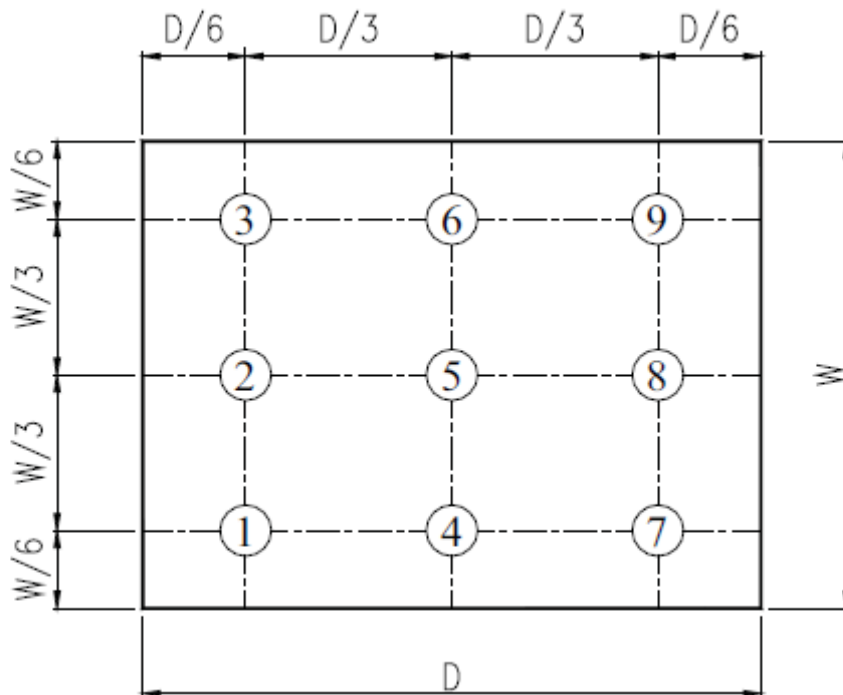


Fig. 2 Definition of uniformity

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=+60°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 $+25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ 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.

In order to make the display assembly stable and firm, DLC recommends to design some supporting at the display backside, especially for the display with tape-attached touch panel, such supporting is important and essential, or else, the display may drop-off from front after some period of time.

