DLC Display Co., Limited

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MODEL No: DLC1560CBG-1

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Record of Revision

Date	Revision No.	Summary
2014 09 11	1.0	Rev 1.0 was issued

1. Scope

This data sheet is to introduce the specification of DLC1560CBG-1 active matrix TFT module. It is composed of a color TFT-LCD panel, driver ICs, FPC and a backlight unit. The 15.6'' display area contains 1920(RGB) x 1080 pixels.

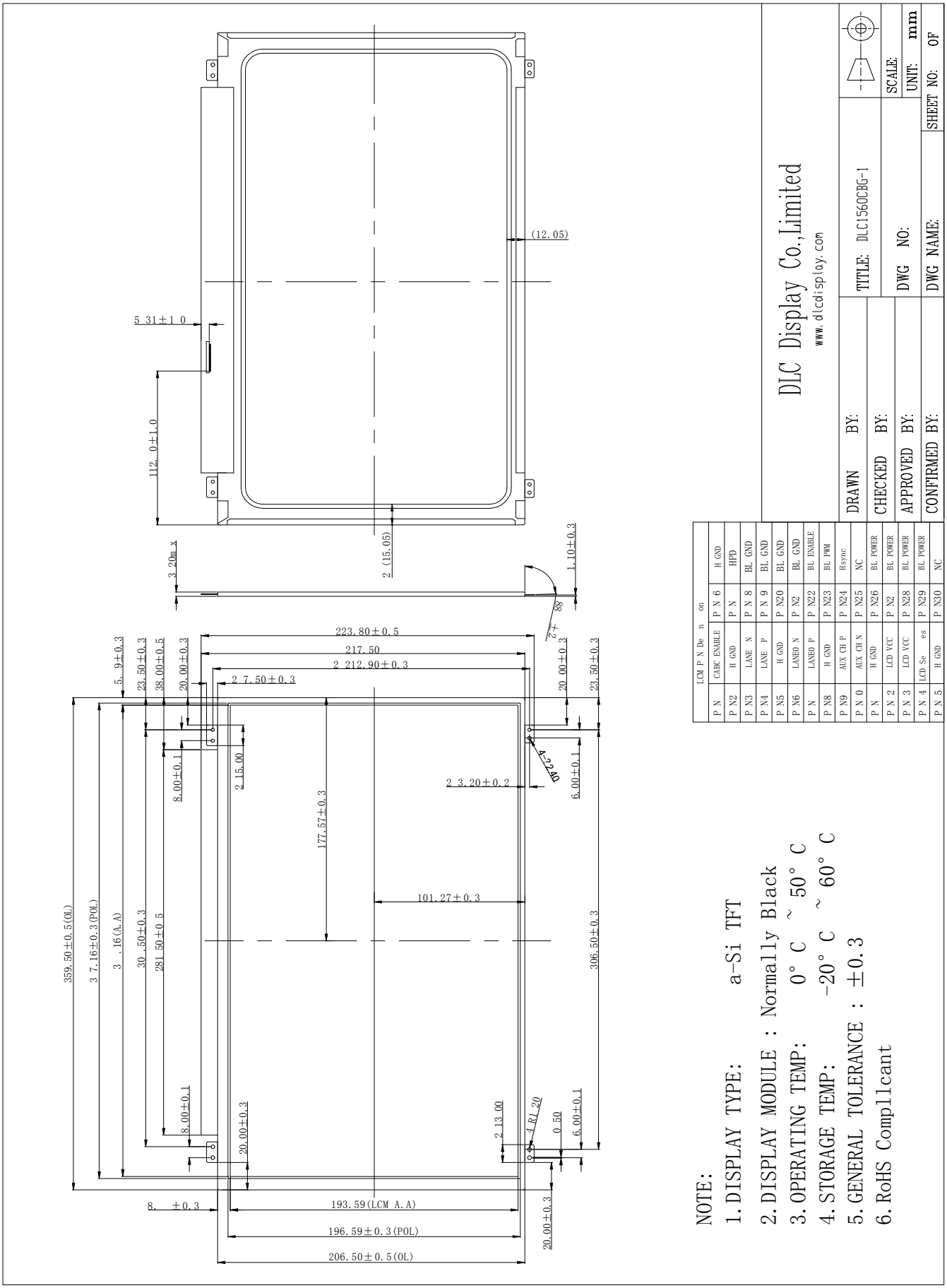
2. Application

Digital equipments which need color display, monitor and laptop.

3. General Information

Item	Contents	Unit
Size	15.60	inch
Resolution	1920(RGB) x 1080	/
Interface	2 lane eDP	/
Technology type	a-Si TFT	/
Pixel pitch	0.17925x0.17925	mm
Pixel Configuration	RGB vertical stripe	
Outline Dimension (W x H x D)	359.5x223.8x3.2	mm
Active Area	344.16 x 193.59	mm
Display Mode	Normally Black	/
Backlight Type	LED	/
Weight	380(max)	g

4. Outline Drawing



5. Interface signals

Connector P/N: UJU IS050-L30B-C10 or Compatible,
Mating housing: I-PEX 20454-030T or Compatible

Terminal	Symbol	Functions
Pin No.	Symbol	Description
1	CABC_ENABLE	Test enable
2	H_GND	Ground
3	LANE1_N	eDP RX channel 1 negative
4	LANE1_P	eDP RX channel 1 positive
5	H_GND	Ground
6	LANE0_N	eDP RX channel 0 negative
7	LANE0_P	eDP RX channel 0 positive
8	H_GND	Ground
9	AUX_CH_P	eDP AUX CH positive
10	AUX_CH_N	eDP AUX CH negative
11	H_GND	Ground
12	LCD_VCC	Power Supply, 3.3V (typ.)
13	LCD_VCC	Power Supply, 3.3V (typ.)
14	LCD_Self_Test	Panel self test enable
15	H_GND	Ground
16	H_GND	Ground
17	HPD	Hot plug detect output
18	BL_GND	LED Ground
19	BL_GND	LED Ground
20	BL_GND	LED Ground
21	BL_GND	LED Ground
22	BL_ENABLE	LED enable pin(+3.3V Input)
23	BL_PWM	System PWM Signal Input
24	Hsync	No Connection,for reserve
25	NC	No Connection
26	BL_POWER	LED Power Supply 5V-21V
27	BL_POWER	LED Power Supply 5V-21V
28	BL_POWER	LED Power Supply 5V-21V
29	BL_POWER	LED Power Supply 5V-21V
30	NC	No Connection

6. Absolute maximum Ratings

6.1. Electrical Absolute max. ratings

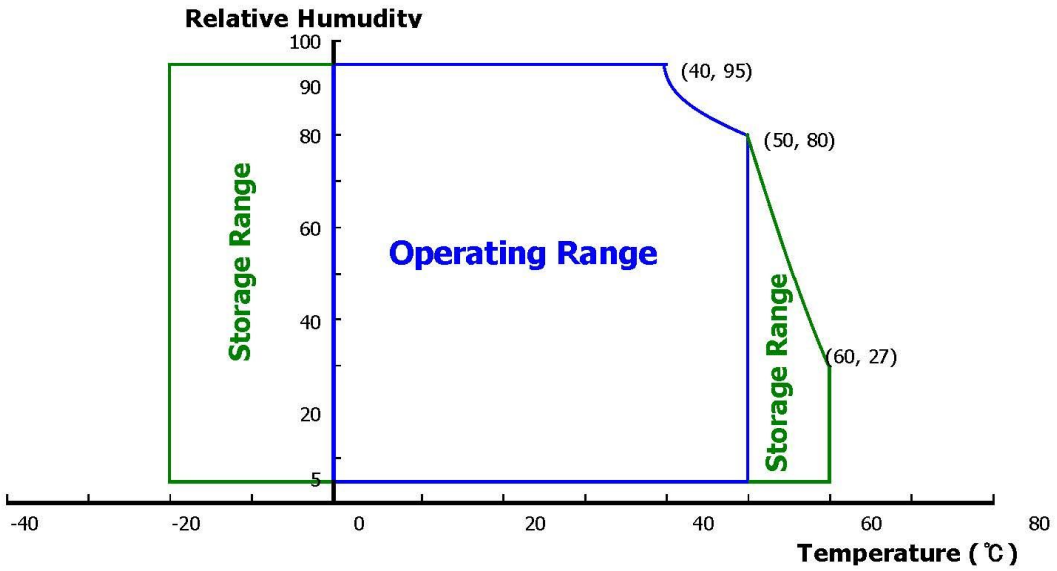
Parameter	Symbol	MIN	MAX	Unit	Remark
Power Supply Voltage	VDD	-0.3	+4.0	V	
Logic Input Voltage	VIN	-0.3	VDD+0.3	V	

Notes : Permanent damage to the device may occur if maximum values are exceeded functional operation should be restricted to the condition described under normal operating conditions.

6.2. Environment Conditions

Item	Symbol	MIN	MAX	Unit	Remark
Operating Temperature	TOPR	0	+50	℃	
Storage Temperature	TSTG	-20	+60	℃	

Note :Temperature and relative humidity range are shown in the figure below.
95 % RH Max. (40 ℃ ≥ Ta)
Maximum wet -bulb temperature at 39 ℃ or less. (Ta > 40 ℃) No condensation.



7. Electrical Specifications

7.1 Electrical characteristics

Parameter	Symbol	Value			Unit	Remark
		Min.	Typ.	Max.		
Power Supply Voltage	VDD	3.0	3.3	3.6	V	Note 1
Permissible Input Ripple Voltage	VRF	-	-	100	mV	VDD=3.3V
Power Supply Current	IDD	-	TBD	-	A	Note 1
Differential Input Voltage	VID	200	-	600	mV	
Power Consumption	PD	-	1.0	1.6	W	Note 1
	PBL	-	-	4.2	W	Note 2
	Ptotal	-	-	5.8	W	

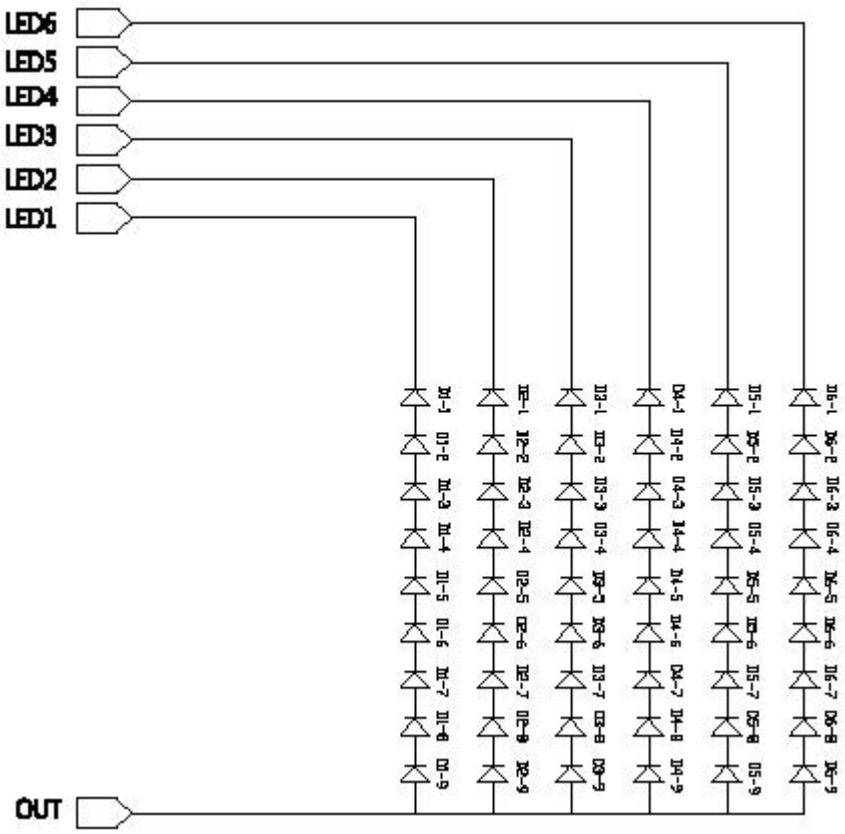
Notes :

1. The supply voltage is measured and specified at the interface connector of LCM.
   The current draw and power consumption specified is for 3.3V at 25℃.
   a) Typ: Mosaic Pattern
   b) Max : Skip sub pixel255
2. Calculated value for reference ($V_{LED} \times I_{LED}$)

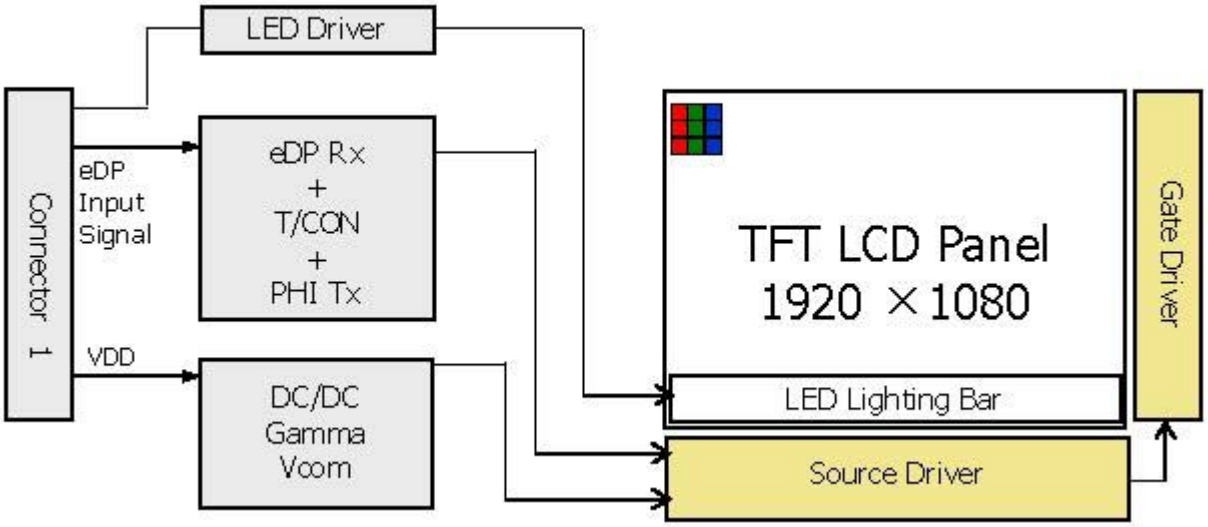
7.2 Black Unit

Parameter			Min.	Typ.	Max.	Unit	Remarks
LED Forward Voltage		V_F	-	-	3.0	V	-
LED Forward Current		I_F	-	22.5	-	mA	-
LED Power Consumption		P_{LED}		-	4.2	W	Note 1
LED Life-Time		N/A	15,000	-	-	Hour	I_F = 20mA
Power supply voltage for LED Driver		V_{LED}	5	12	21	V	
EN Control Level	Backlight on		2.5		5.0	V	
	Backlight off		0		1.0	V	
PWM Control Level	PWM High Level		2.5		5.0	V	
	PWM Low Level		0		0.1	V	
PWM Control Frequency		F_{PWM}	100	-	10,000	Hz	
Duty Ratio		-	1	-	100	%	Note3

Notes : 1. Power supply voltage12Vfor LED Driver
Calculator Value for referenceIF×VF ×54/ efficiency= PLED
2. The LED Life-time define as the estimated time to 50% degradation of initial luminous.
3. 1% duty cycle is achievable with a dimming frequency less than 1KHz.
4. LED structure

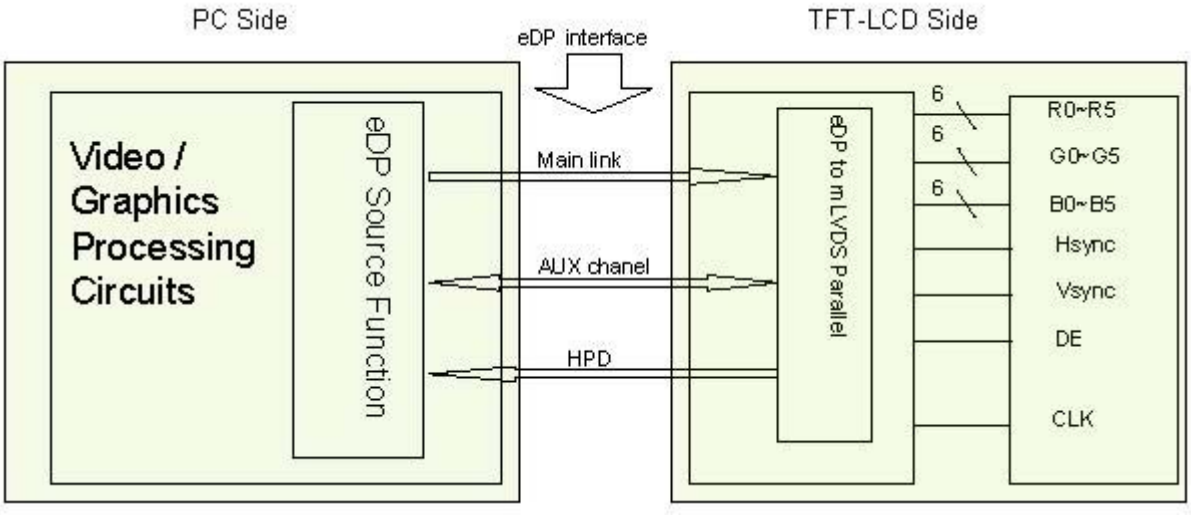


7.3 FUNCTION BLOCK DIAGRAM



8. Command/AC Timing

8.1 eDP Interface



Note. Transmitter : NT71392 or equivalent.

Transmitter is not contained in Module.

8.2 eDP Interface Input singal

Lane 0	
R0-5:0	G0-5:4
G0-3:0	B0-5:2
B0-1:0	R1-5:0
G1-5:0	B1-5:4
B1-3:0	R2-5:2
R2-1:0	G2-5:0
B2-5:0	R3-5:4
R3-3:0	G3-5:2
G3-1:0	B3-5:0

8.3 SIGNAL TIMING SPECIFICATION

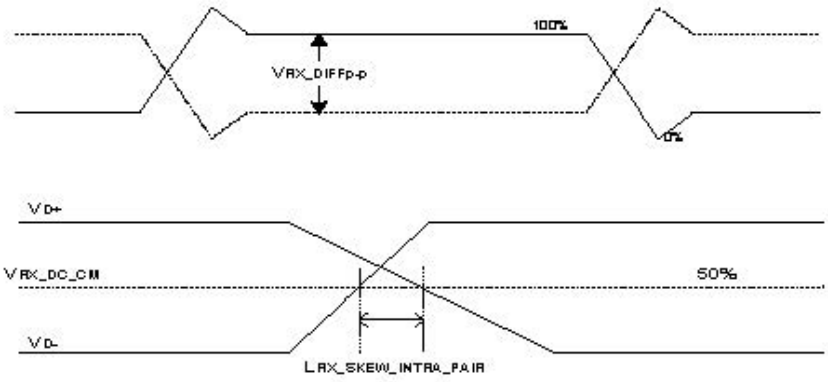
operated by the DE only

Item		Symbols	Min	Typ	Max	Unit
Clock	Frequency	1/Tc	100	141.4	160	MHz
	High Time	Tch	-	4/7	-	Tc
	Low Time	Tcl	-	3/7	-	Tc
Frame Period		Tv	1090	1100	1238	lines
			-	60	-	Hz
			-	16.7	-	ms
Vertical Display Period		Tvd	-	1080	-	lines
One line Scanning Period		Th	2080	2142	2400	clocks
Horizontal Display Period		Thd	-	1920	-	clocks

Note: This Module can support low frame refresh rate 50Hz & 40Hz.

eDP Rx Interface Timing Parameter

Item	Symbol	Min	Typ	Max	Unit	Remark
Spread spectrum clock	ssc		0.5		%	
Differential peak-to-peak input voltage at package pins	VRX-DIFFp-p	100	0	1320	mV	
Rx input DC common mode voltage	VRX_DC_CM	-	GND	-	V	
Differential termination resistance	RRX-DIFF	80	-	100	Ω	
Single-ended termination resistance	RRX-SE	40	-	60	Ω	
Rx short circuit current limit	IRX_SHORT	-	-	20	mA	
Intra-pair skew at Rx package pins (HBR) RX intra-pair skew tolerance at HBR	LRX_SKEW_INTRA_PAIR	-	-	150	ps	

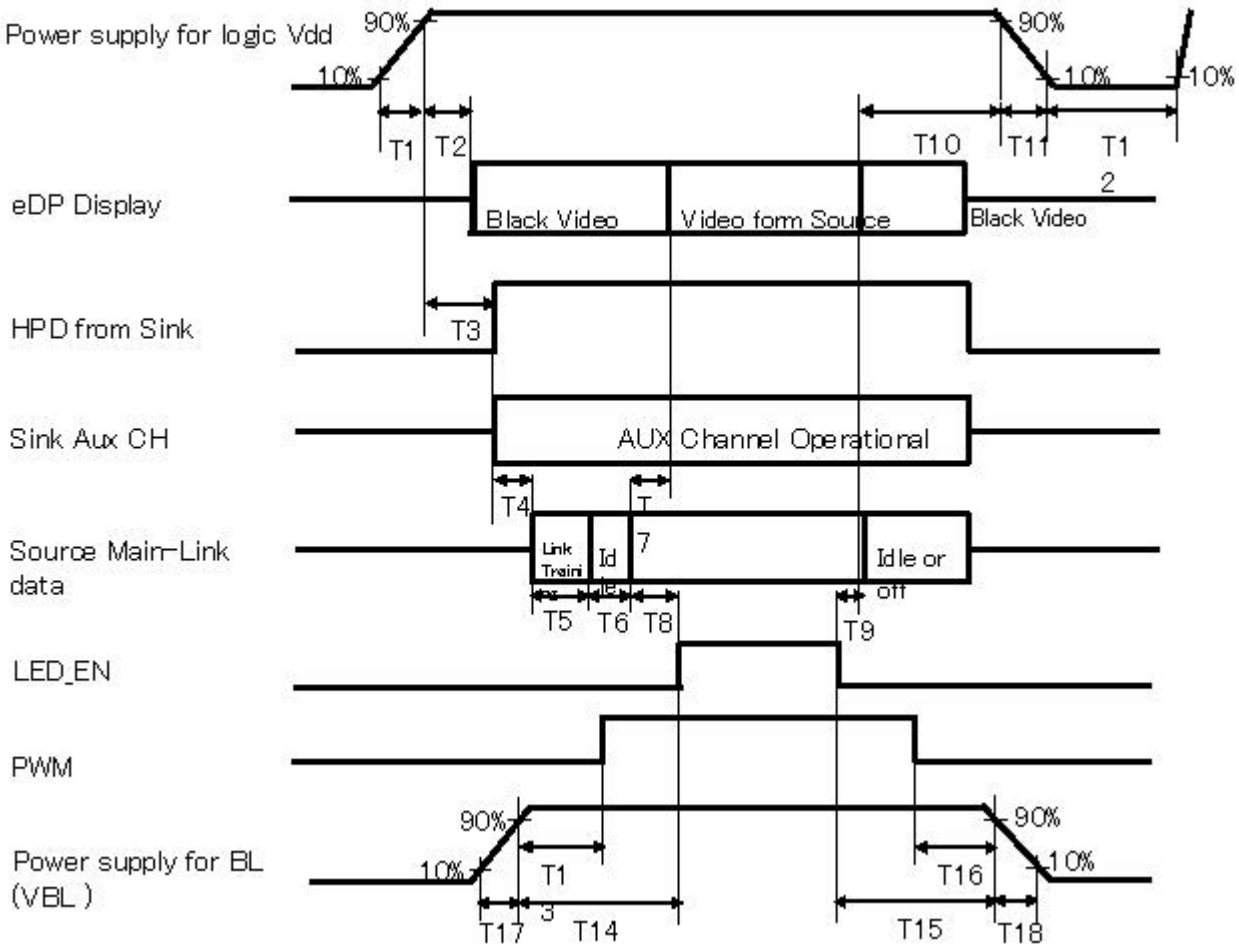


8.4 INPUT SIGNALS, BASIC DISPLAY COLORS & GRAY SCALE OF COLORS

	Colors & Gray scale	Data signal																	
		R0	R1	R2	R3	R4	R5	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	B4	B5
Basic colors	Black	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	1	1	1	1	1	1
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Light Blue	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Purple	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	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
Gray scale of Red	Black	0	0	0	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	0	0	0
	Darker	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	↑						↑						↑					
	▽	↓						↓						↓					
	Brighter	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	▽	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Gray scale of Green	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	1	0	0	0	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	△	↑						↑						↑					
	▽	↓						↓						↓					
	Brighter	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	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	0	1	1	1	1	1	1	0	0	0	0	0	0
Gray scale of Blue	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	0	0	0	1	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	△	↑						↓						↑					
	▽	↓						↓						↓					
	Brighter	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1
	▽	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Gray scale of White & Black	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0
	Darker	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
	△	↑						↑						↑					
	▽	↓						↓						↓					
	Brighter	1	0	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1
	▽	0	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

8.5 POWER SEQUENCE

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence shall be as shown in below



- 0.5ms ≤ T1 ≤ 10 ms
- 0ms ≤ T2 ≤□200 ms
- 0ms ≤ T3 ≤200 ms
- 0ms ≤ T13
- 0ms ≤ T14
- 0ms ≤ T17
- 0ms ≤ T18
- 0ms ≤T7≤ 50ms
- 0ms ≤T10 ≤500 ms
- 0 ms ≤T11 ≤10 ms
- 150ms ≤T12
- 0ms ≤T15
- 0ms ≤ T16

Notes:

1. When the power supply VDD is 0V, keep the level of input signals on the low or keep high impedance.
2. Do not keep the interface signal high impedance when power is on.Back Light must be turn on after power for logic and interface signal are valid.

9. Optical Specification

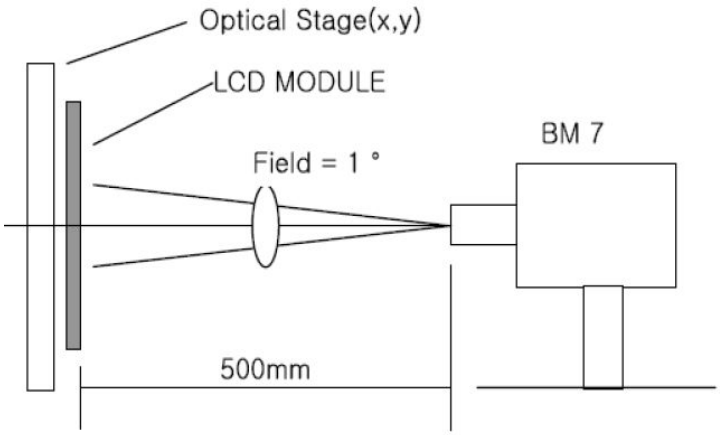
Ta=25℃

Item		Symbol	Condition	Min	Typ.	Max.	Unit	Remark
Contrast Ratio		CR	θ=0°		800			Note1 Note2
Response Time		Tr+Tf	25℃		30	35	ms	Note1 Note3
View Angles		θT	CR≧10		85		Degree	Note 4
		θB			85			
		θL			85			
		θR			85			
Chromaticity	White	x	Brightness is on	TYP 0.03	0.313	TYP+0.03		Note5, Note1
		y			0.329			
	Red	x			0.640			
		y			0.330			
	Green	x			0.300			
		y			0.600			
	Blue	x			0.150			
		y			0.060			
Gumat		S			72		%	
Luminance		L			300		cd/m²	Note1 Note6
Uniformity		U			80		%	Note1 Note7
Cross Talk		CT				2.0	%	Note8

Note 1: Definition of optical measurement system.

Temperature = 25℃(±3℃);

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

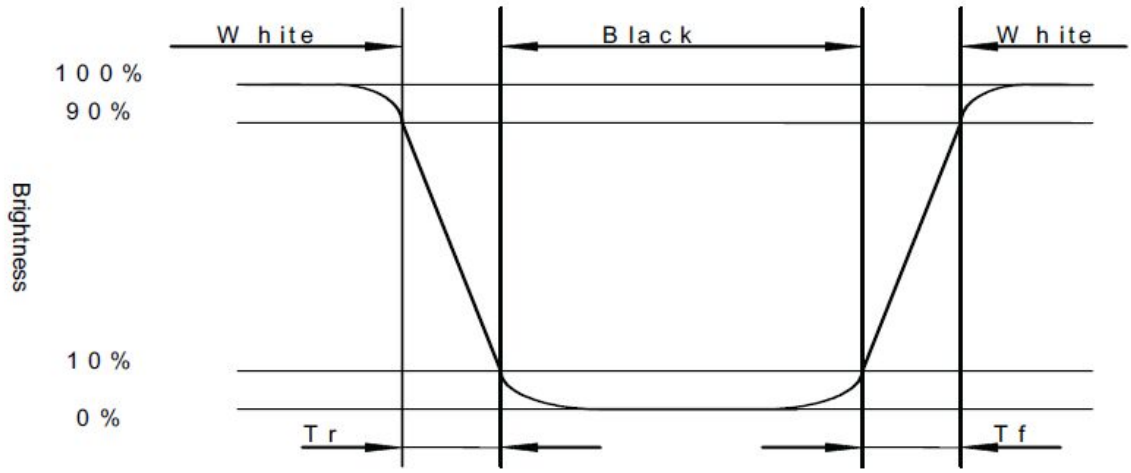


Note 2: Contrast ratio is defined as follow:

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

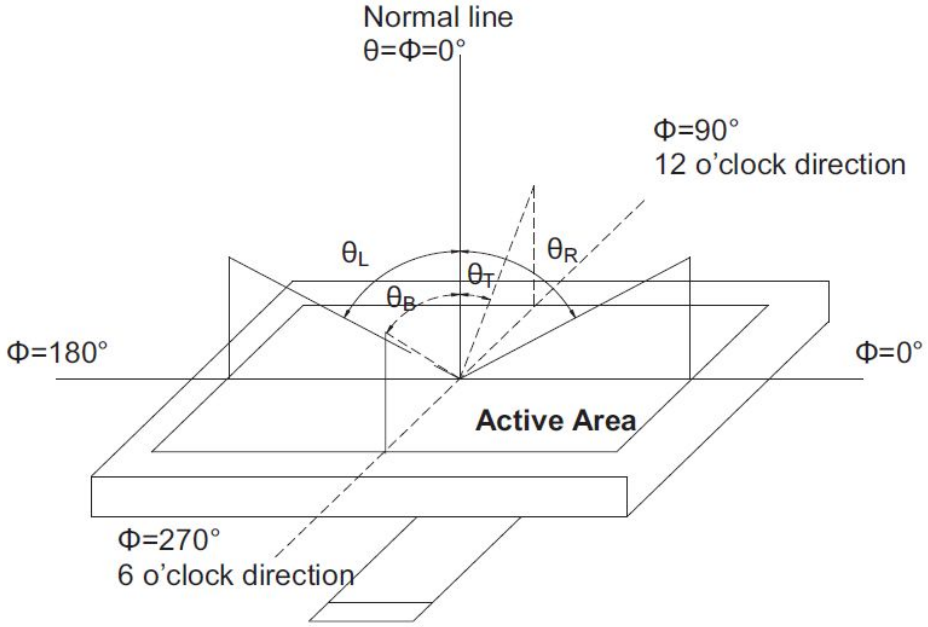
Note 3: Response time is defined as follow:

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



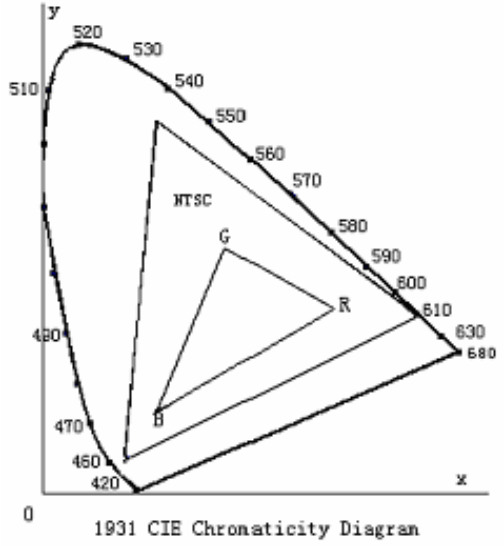
Note 4: Viewing angle range is defined as follow:

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.



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

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.

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

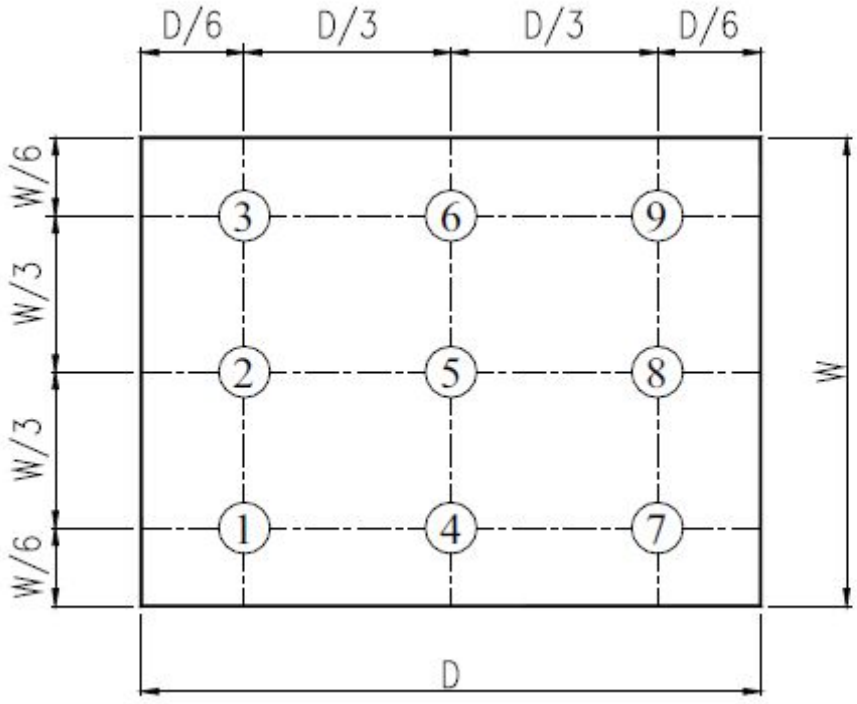
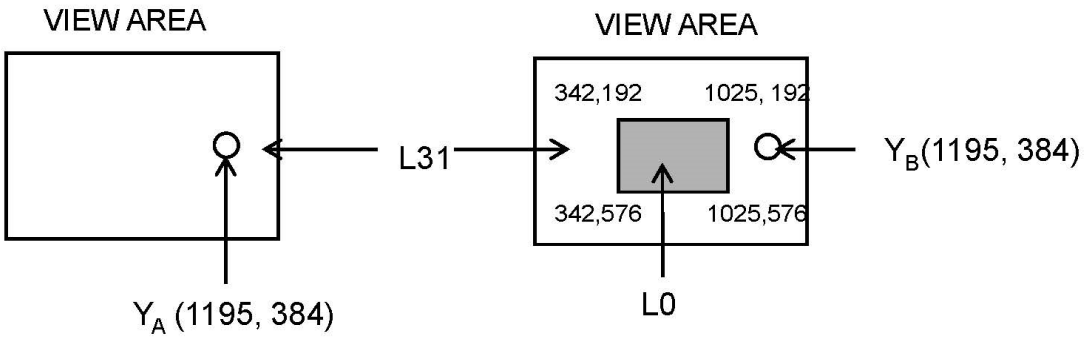


Fig. 2 Definition of uniformity

Note 8: Cross-Talk of one area of the LCD surface by another shall be measured by comparing the luminance (YA) of a 25mm diameter area, with all display pixels set to a gray level, to the luminance (YB) of that same area when any adjacent area is driven dark.

Cross Modulation Test Description



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

Where:
Y_A= Initial luminance of measured area (cd/m2)
Y_B= Subsequent luminance of measured area (cd/m2)
The location measured will be exactly the same in both patterns

Cross-Talk of one area of the LCD surface by another shall be measured by comparing the luminance (YA) of a 25mm diameter area, with all display pixels set to a gray level, to the luminance (YB) of that same area when any adjacent area is driven dark

10. Environmental / Reliability Tests

No	Test Item	Condition	Judgment criteria
1	High Temp Operation	Ts=50℃, 240hrs	Per table in below
2	Low Temp Operation	Ta=0℃, 240hrs	Per table in below
3	High Temp Storage	Ta=+60℃, 240hrs	Per table in below
4	Low Temp Storage	Ta= 20℃, 240hrs	Per table in below
5	High Temp & High Humidity Storage	Ta=+50℃, 80% RH 240 hours	Per table in below (polarizer discoloration is excluded)
6	Thermal Shock (Non operation)	20℃ 30 min~+60℃ 30 min, Change time:5min, 100Cycles	Per table in below
7	ESD (Operation)	C=150pF, R=330Ω，5points/panel Air:±15KV, 5times; Contact:±8KV, 5 times;	Per table in below
8	Vibration (Non operation)	1.5G, 10~500Hz,Half Sine X,Y,Z / Sweep rate : 1 hour	Per table in below
9	Shock (Non operation)	220G, Half Sine Wave 2msec ±X,±Y,±Z Once 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.

11.4Storage

A. Store the products in a dark place at +25℃ 10℃ 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.