DLC Display Co., Limited

德爾西顯示器有限公司

MODEL No: DLC1560BQQ00EF-1

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Record of Revision

Date	Revision No.	Summary
2019-12-22	1.0	Rev 1.0 was issued

1. Scope

This data sheet is to introduce the specification of DLC1560BQQ00EF-1, active matrix TFT module. It is composed of a color TFT-LCD panel, driver IC, FPC and a backlight unit. The 15.6″ display area contains 1920(RGB) x 1080 pixels.

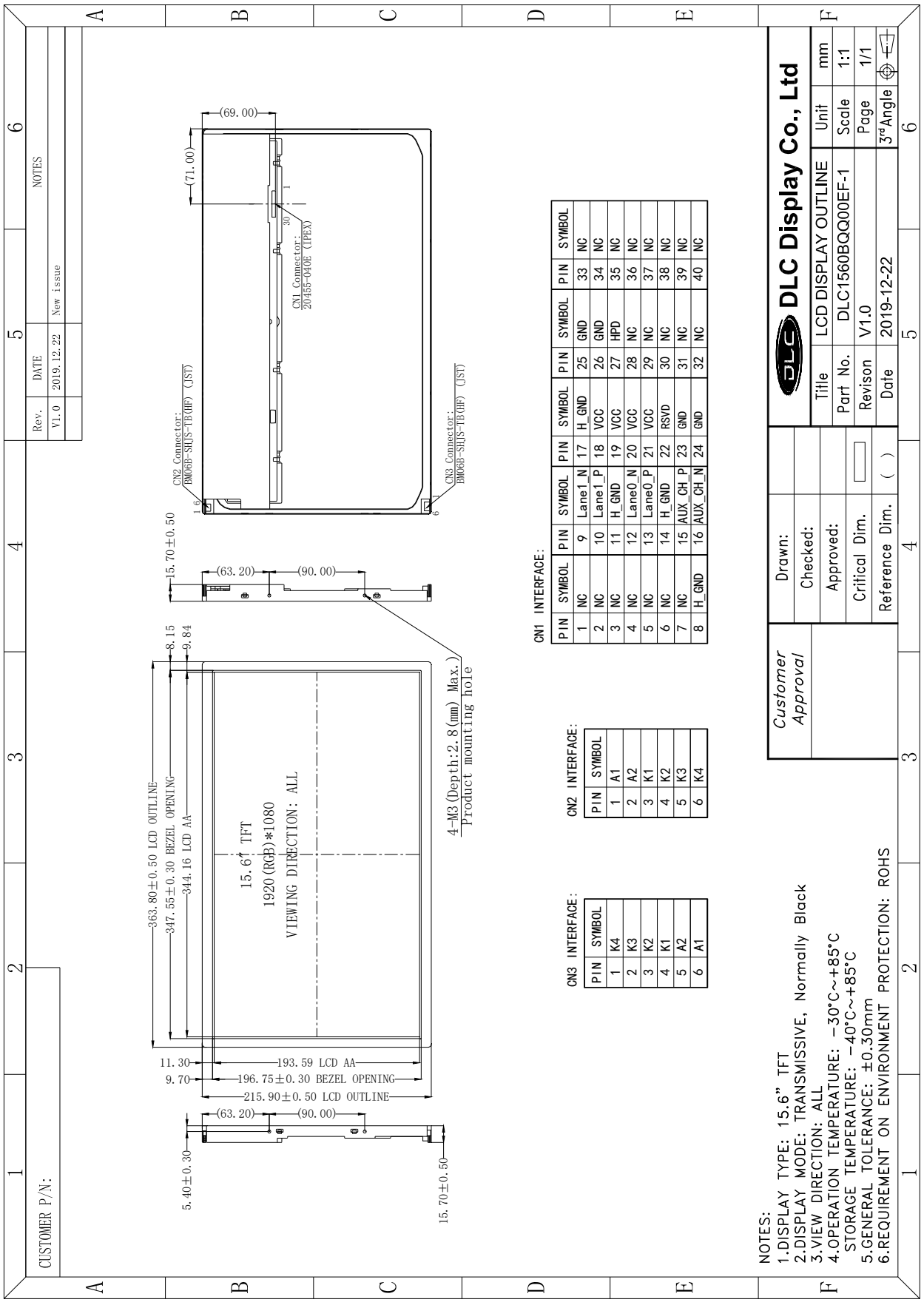
2. Application

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

3. General Information

Item	Contents	Unit
Size	15.6	inch
Resolution	1920(RGB) x 1080	/
Interface	eDP	/
Technology type	a-Si TFT	/
Pixel pitch	0.17925 x 0.17925	mm
Pixel Configuration	R.G.B. Stripe	
Outline Dimension (W x H x D)	363.80 x 215.90 x 15.70	mm
Active Area	344.16 x 193.59	mm
Display Mode	Transmissive, Normally Black	/
Polarizer Surface	Antiglare	/
Viewing Direction	ALL	/
Backlight Type	LED	/
Weight	1050	g

4. Outline Drawing



PIN	SYMBOL	PIN	SYMBOL	PIN	SYMBOL	PIN	SYMBOL
1	NC	9	Lane1_N	17	H_GND	25	GND
2	NC	10	Lane1_P	18	VCC	26	GND
3	NC	11	H_GND	19	VCC	27	HPD
4	NC	12	LaneO_N	20	VCC	28	NC
5	NC	13	LaneO_P	21	VCC	29	NC
6	NC	14	H_GND	22	RSVD	30	NC
7	NC	15	AUX_CH_P	23	GND	31	NC
8	H_GND	16	AUX_CH_N	24	GND	32	NC

PIN	SYMBOL	PIN	SYMBOL
33	NC	1	A1
34	NC	2	A2
35	NC	3	K1
36	NC	4	K2
37	NC	5	K3
38	NC	6	K4
39	NC		
40	NC		

PIN	SYMBOL
1	K4
2	K3
3	K2
4	K1
5	A2
6	A1

5. Interface signals

5.1 LCD Interface Signal (CN1):

CN1 socket (LCD module side): 20455-040E (IPEX)
Adaptable plug: 20453-240T-11 (IPEX, Plug Set)
20454-240T (IPEX, HOUSING) or equivalent.

No	Symbol	Description	Remark
1~7	NC	Keep this pin open.	
8	H_GND	High speed ground	Note 1
9	Lane1_N	Complement signal Link Lane 1	
10	Lane1_P	True signal Link Lane 1	
11	H_GND	High speed ground	Note 1
12	Lane0_N	Complement signal Link Lane 0	
13	Lane0_P	True signal Link Lane 0	
14	H_GND	High speed ground	Note 1
15	AUX_CH_P	True signal Auxiliary channel	
16	AUX_CH_N	Complement signal Auxiliary channel	
17	H_GND	High speed ground	Note 1
18~21	VCC	Power supply for LCD panel signal processing board	Note 1
22	RSVD	Keep this pin open.	
23~26	GND	Ground	Note 1
27	HPD	HPD signal pin	
28~40	NC	Keep this pin open.	

Note 1: All GND and VCC terminals should be used without any non-connected lines.

5.2 Backlight

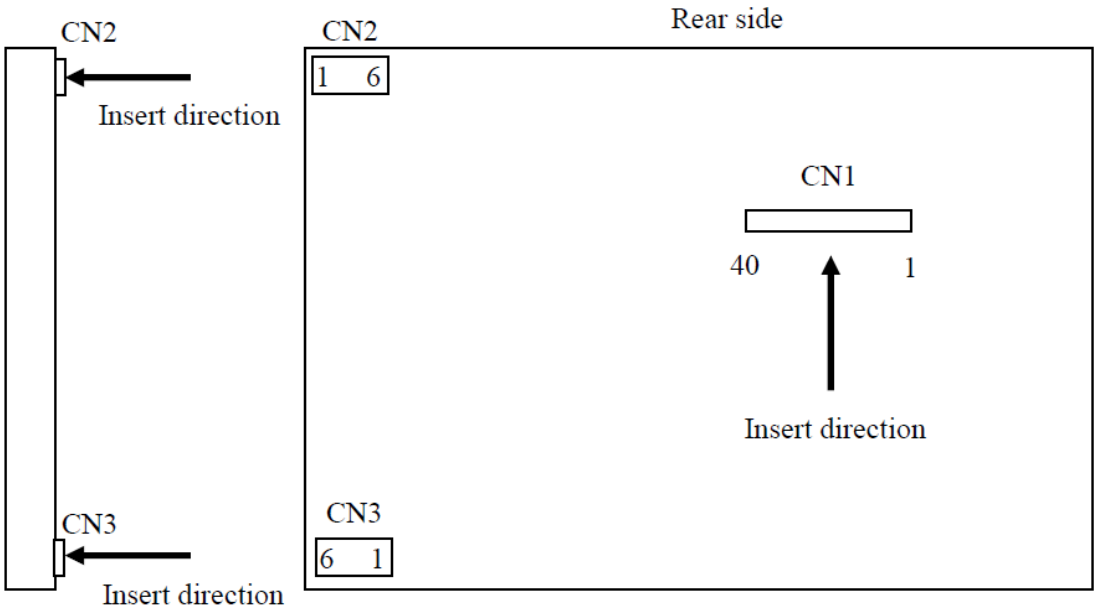
CN2 socket (LCD module side): BM06B-SHJS-TB (HF) (J.S.T. Mfg. Co. Ltd.)
Adaptable plug: SHJP-06V-S (HF) (J.S.T. Mfg. Co., Ltd.)

No	Symbol	Description	Remark
1	A1	Anode 1	
2	A2	Anode 2	
3	K1	Cathode 1	
4	K2	Cathode 2	
5	K3	Cathode 3	
6	K4	Cathode 4	

CN3 socket (LCD module side): BM06B-SHJS-TB (HF) (J.S.T. Mfg. Co. Ltd.)
Adaptable plug: SHJP-06V-S (HF) (J.S.T. Mfg. Co., Ltd.)

No	Symbol	Description	Remark
1	K4	Cathode 4	
2	K3	Cathode 3	
3	K2	Cathode 2	
4	K1	Cathode 1	
5	A2	Anode 2	
6	A1	Anode 1	

5.3 Positions of Socket:



6. Absolute maximum Ratings

6.1. Electrical Absolute max. ratings

Parameter		Symbol	MIN	MAX	Unit	Remark
Power supply voltage	LCD panel signal processing board	VCC	-0.3	+4.0	V	Ta=25℃
Input voltage for signals	Display signals	VD	-0.3	+4.0	V	
Backlight	Forward current	IL	0	75	mA	

Note1: DA0+/-, DA1+/-, DA2+/-, DA3+/-, CLKA+/-, DB0+/-, DB1+/-, DB2+/-, DB3+/-, CLKB+/-.

6.2. Environment Conditions

Item	Symbol	MIN	MAX	Unit	Remark
Operating Temperature	TOPR	-30	+85	℃	
Storage Temperature	TSTG	-40	+85	℃	

7. Electrical Specifications

7.1 LCD panel signal processing board

Parameter	Symbol	MIN	TYP	MAX	Unit	Remarks
Power supply voltage	VCC	3.0	3.3	3.6	V	-
Power supply current	ICC	-	580 Note1	1000 Note2	mA	at VCC=3.3V
Permissible ripple voltage	VRPC	-	-	100	mVp-p	For VCC Note3

Notes:
1. Checkered flag pattern [by IEC 61747-6].
2. Pattern for maximum current.
3. The permissible ripple voltage includes spike noise.

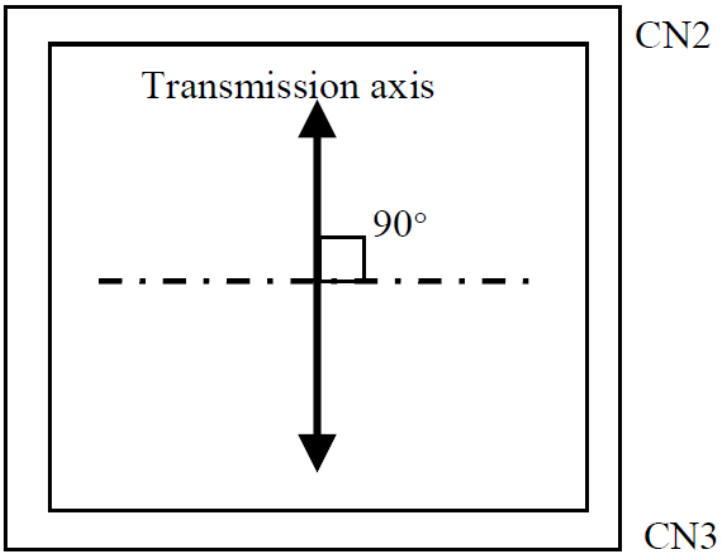
7.2 LED Backlight

Parameter	Symbol	MIN	TYP	MAX	Unit	Remarks
Forward voltage	VL	38.8	43.7	48.6	V	
Forward current	IL	-	65	70	mA	
LED life time		-	50,000	-	Hrs	

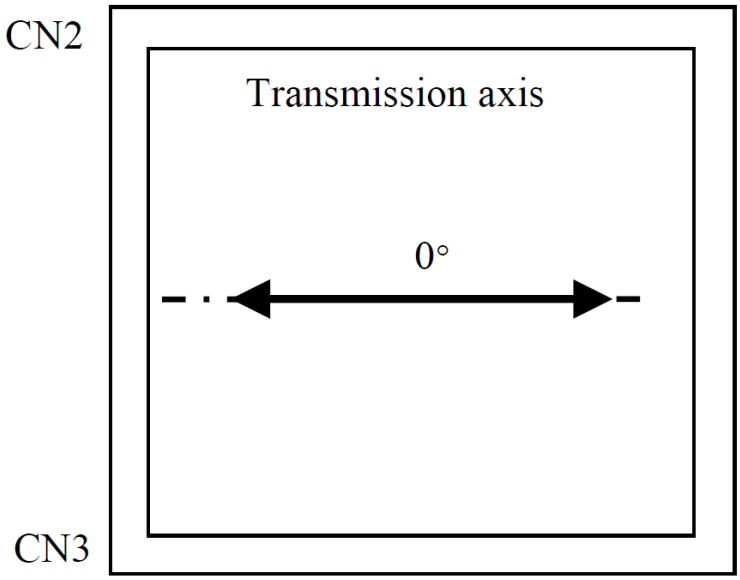
Notes:
1. Please drive the backlight with constant current.
2. The above specifications are for one LED circuit of the backlight.
3. The luminance uniformity may be changed depending on the current variation between 4 circuits. It is recommended that the current value difference among the circuits be less than 5%.

7.3 Polarizer Specifications

CF glass side



TFT glass side



Polarizer film:

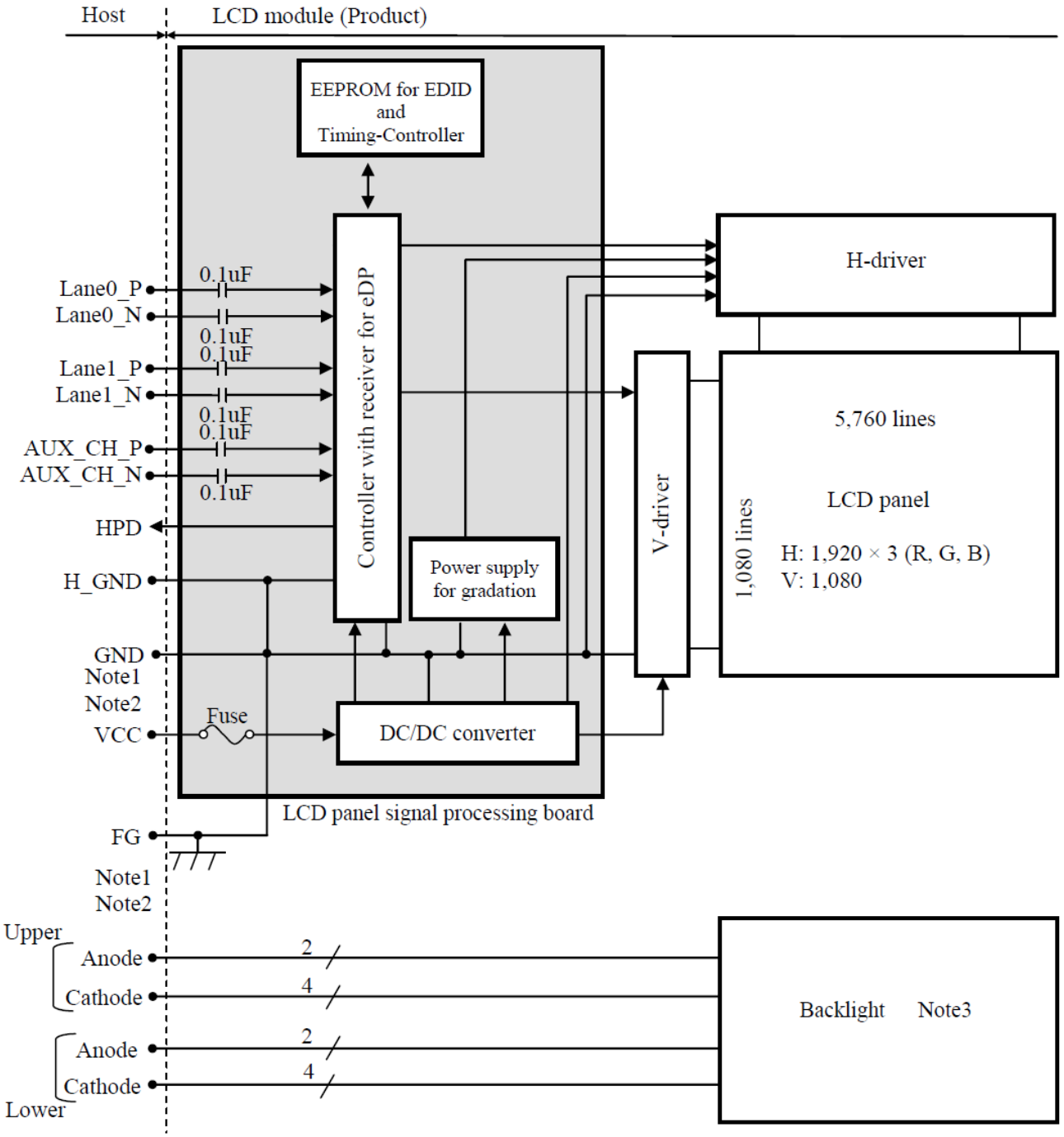
CF-side: ZT-HL23-AT01UAGA1S08 (Sanritz)
TFT-side: ZT-HL23-AT01UHCS08 (Sanritz)

7.3 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VCC	FCC16152AB	KAMAYA ELECTIRC CO., LTD	1.5A 36V	3.0A 5 seconds	Note 1

Note1: The power supply's rated current must be more than the fusing current. If it is less than the fusing current, the fuse may not blow in a short time, and then nasty smell, smoke and so on may occur.

7.4 Block Diagram

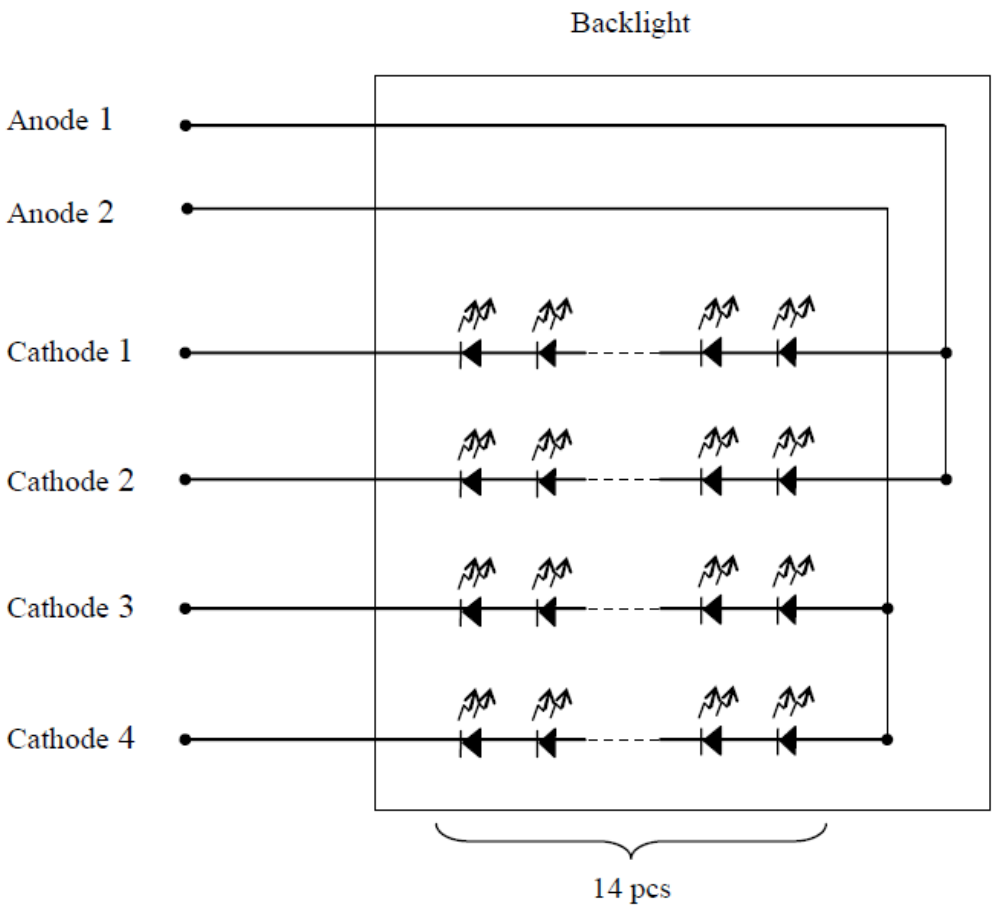


Note1: Relations between H_GND (High Speed Ground), GND (Signal ground) and FG (Frame ground) in the LCD module are as follows.

H_GND-GND	Connected
H_GND-FG	Connected
GND-FG	Connected

Note2: H_GND, GND and FG must be connected to customer equipment's ground, and it is recommended that these grounds to be connected together in customer equipment.

Note3: Backlight in detail



This figure is a common view of both upper and lower.

8. Command/AC Timing

8.1 Timings Characteristics

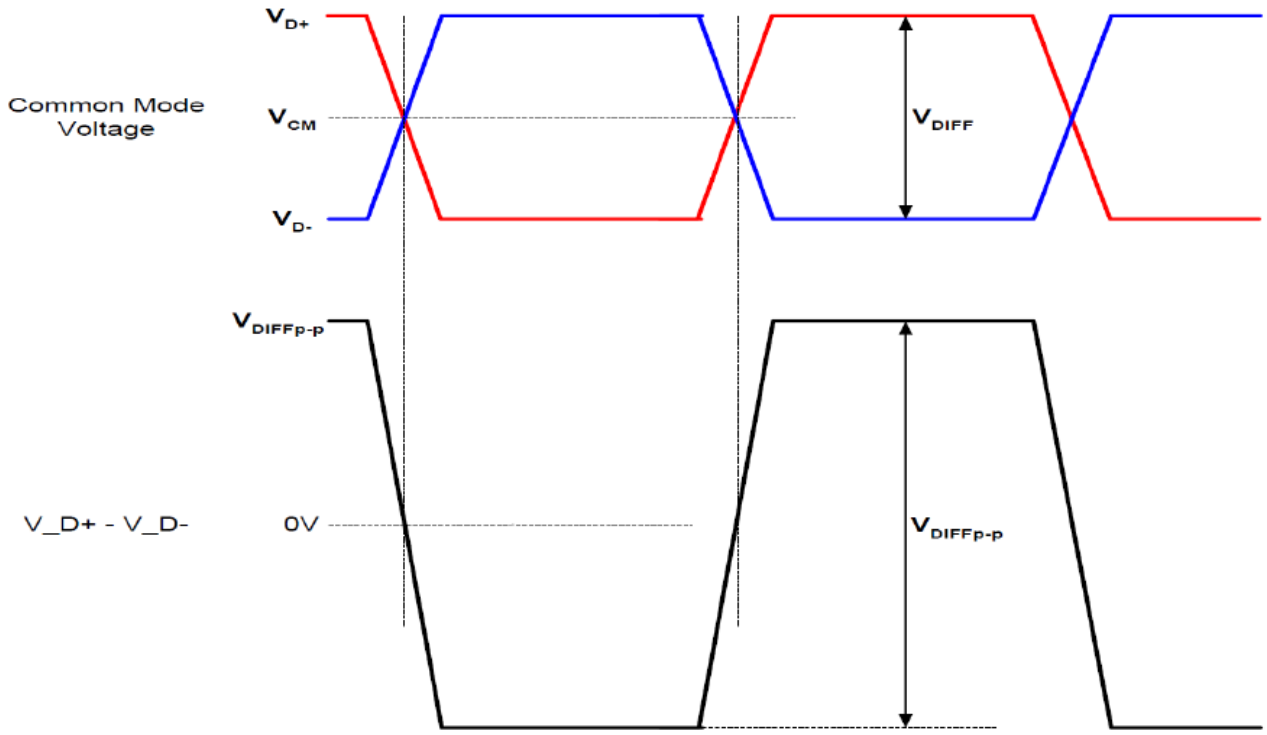
Parameter			Symbol	MIN	TYP	MAX	Unit	Remarks
CLK	Frequency		1/tc	111.0	138.5	166.5	MHz	7.22 ns(typ)
	Duty ratio		-	-				-
	Rise time, Fall time		-				ns	
DE	Horizontal	Cycle	th	-	15.02	-	μs	66.59kHz(typ)
				2040	2080	2280	CLK	
		Display period	thd	1920			CLK	
	Vertical (One frame)	Cycle	tv	-	16.70	-	ms	59.88Hz(typ)
				1111	1112	1212	H	
		Display period	tvd	1080			H	

Note1: Definition of parameters is as follows.

tc= 1CLK, th= 1H

8.2 eDP Signal Timing Specifications

8.2.1 Display Port main link signal



Parameter	Symbol	MIN	TYP	MAX	Unit	Remarks
Differential peak-to-peak Input voltage	VDIFFp-p	100	-	1,320	mV	
Rx input DC common Mode voltage	VCM	-	0	-	V	
Jitter tracking bandwidth	-	10	-	-	MHz	
Link clock down spreading	-	-	0.5	-	%	

8.2.2 Display Port HPD signal

Parameter	Symbol	MIN	TYP	MAX	Unit	Remarks
Hot Plug detect	HPD	2.0	-	2.5	V	I/O type: LVTTL

8.2.3 Display port AUX signal

Description	Symbol	MIN	TYP	MAX	Unit	Remarks
AUX differential peak-to-peak voltage When driving	-	0.4	-	1	V	
AUX differential peak-to-peak voltage When receiving	-	0.25	-	1.36	V	
AUX common-mode voltage When transmitting	-	-	0.15	-	V	
AUX common-mode voltage When receiving	-	-	GND	-	V	

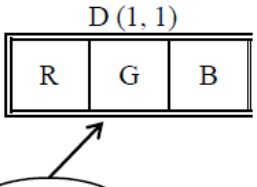
AUX differential termination resistance	-	80	100	120	Ω	
Unit interval	-	0.4	0.5	0.6	μs	
Cycle-to-cycle jitter time	-	-	-	0.04	UI	

8.3 Display Colors and Input Data Signals

This product can display in equivalent to 16,777,216 colors with 256 gray scales. Also the relation between display colors and input data signals is as follows.

Display colors		Input color data																							
		Red								Green								Blue							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	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
	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
	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
	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
	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
	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
	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
	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
Red gray scale	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	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑				:	:							:	:							:	:			
	↓				:	:							:	:							:	:			
	bright	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	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	0	0	0	0	0	0
	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
Green gray scale	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	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	↑				:	:							:	:							:	:			
	↓				:	:							:	:							:	:			
	bright	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	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
	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
Blue gray scale	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	↑				:	:							:	:							:	:			
	↓				:	:							:	:							:	:			
	bright	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	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

8.4 Input Data Signals and Display Positions

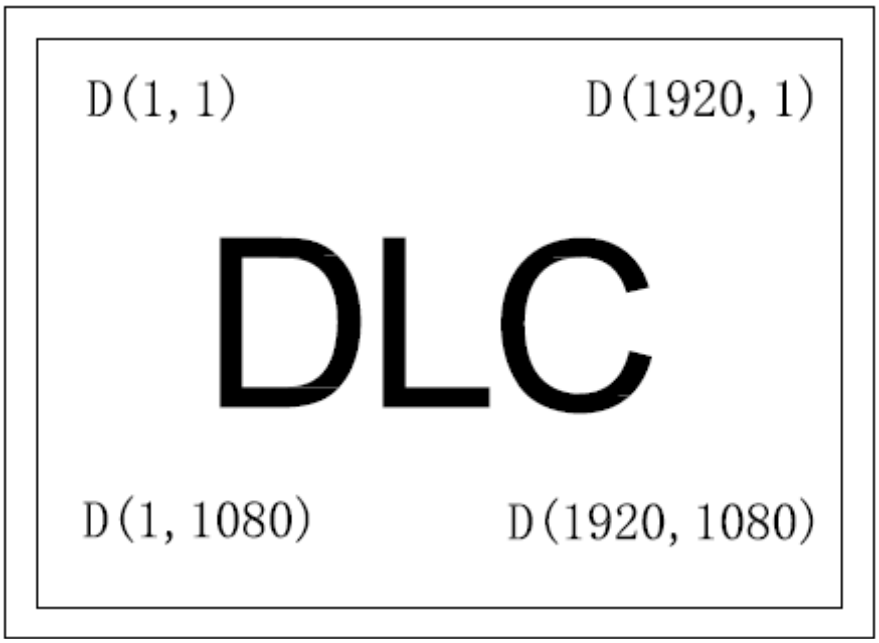


D(1, 1)	D(2, 1)	• • •	D(X, 1)	• • •	D(1919, 1)	D(1920, 1)
D(1, 2)	D(2, 2)	• • •	D(X, 2)	• • •	D(1919, 2)	D(1920, 2)
• • •	• • •	• • • •	• • •	• • • •	• • •	• • •
D(1, Y)	D(2, Y)	• • •	D(X, Y)	• • •	D(1919, Y)	D(1920, Y)
• • •	• • •	• • • •	• • •	• • • •	• • •	• • •
D(1, 1079)	D(2, 1079)	• • •	D(X, 1079)	• • •	D(1919, 1079)	D(1920, 1079)
D(1, 1080)	D(2, 1080)	• • •	D(X, 1080)	• • •	D(1919, 1080)	D(1920, 1080)

8.5 Display Direction

The following figures are seen from a front view.

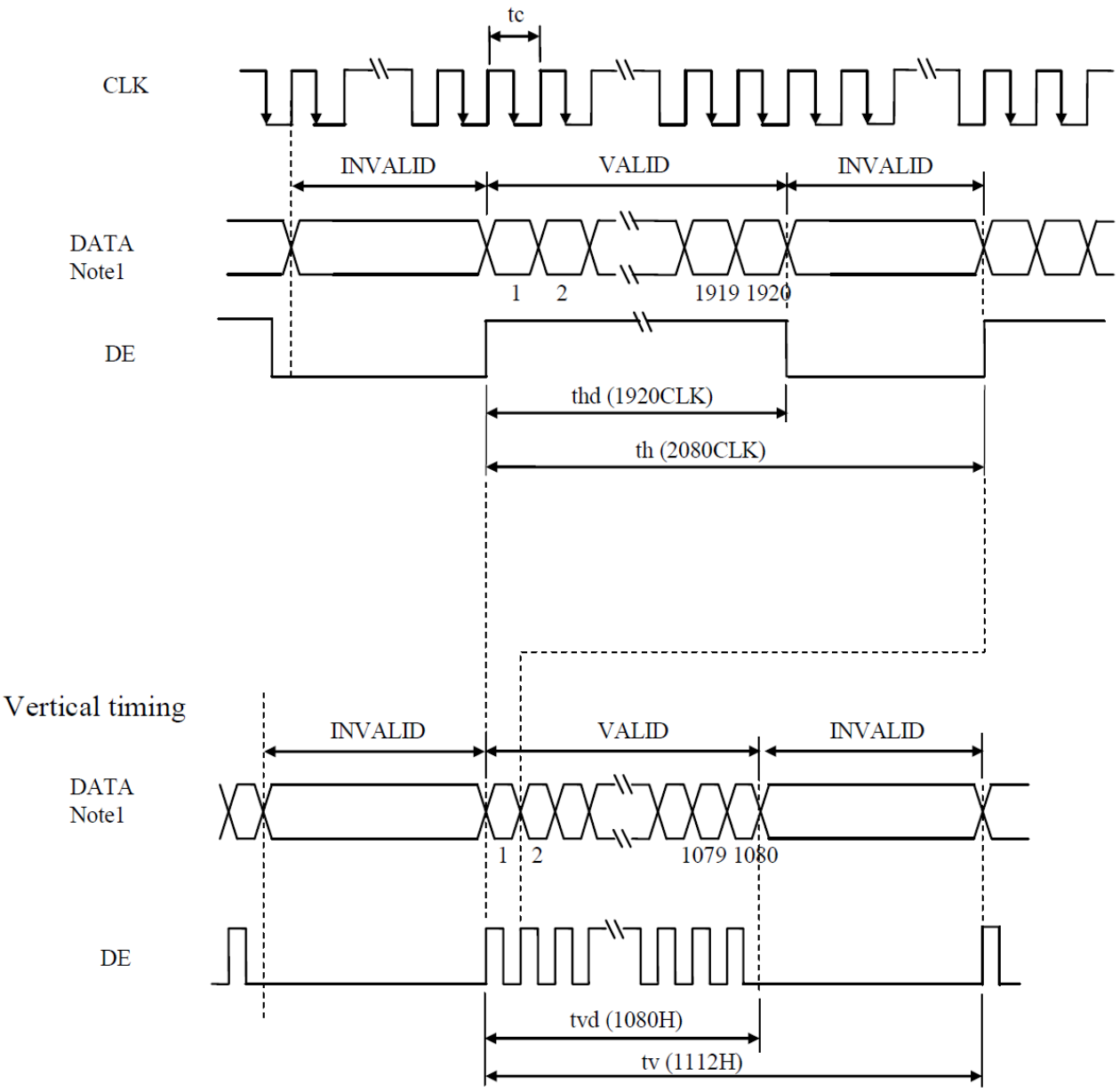
Signal processing board side



Note1: Meaning of D (X, Y)
D (X, Y): Input data signals for LCD panel signal processing board

8.6 Input Signal Timing Chart

Horizontal timing

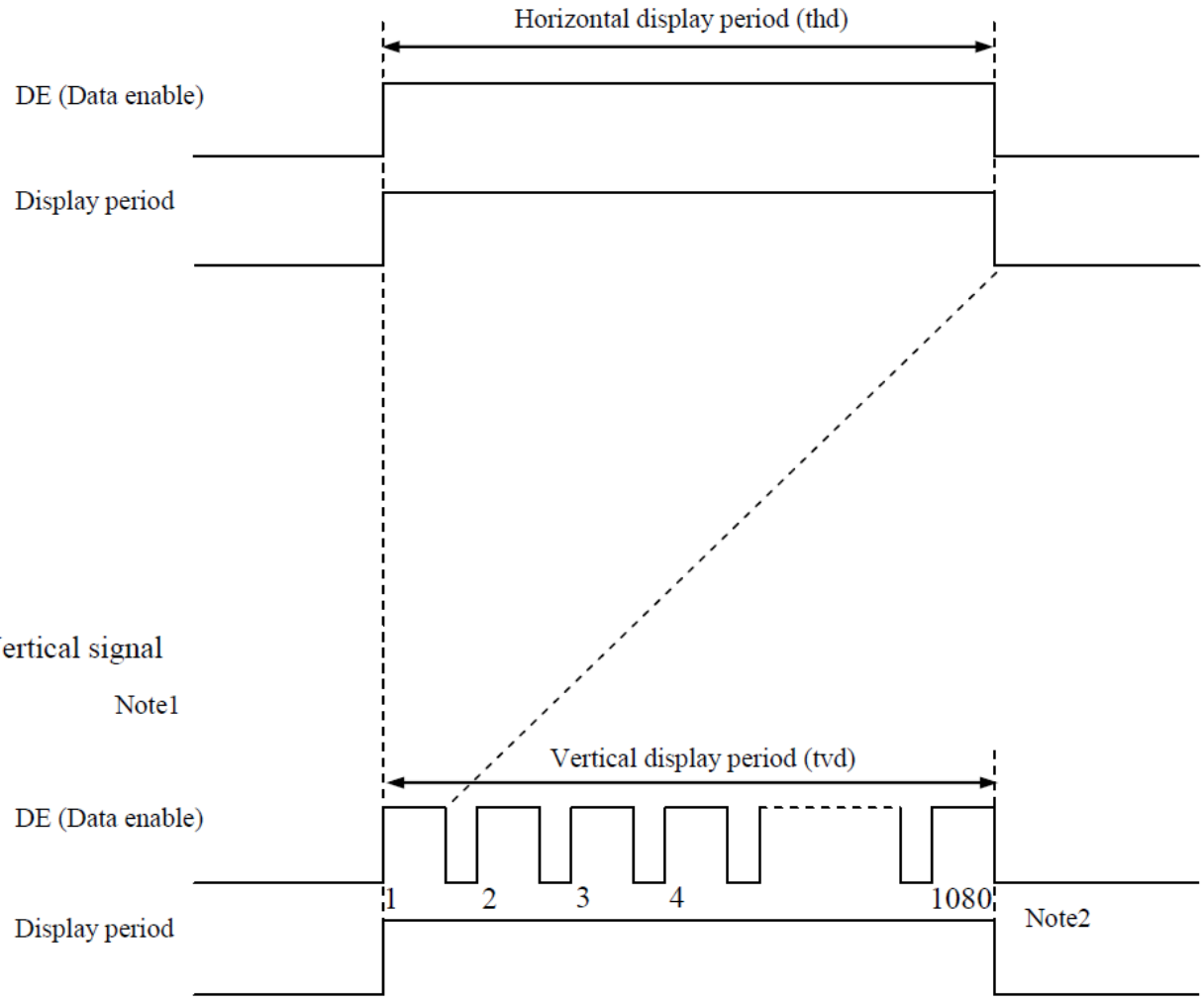


Vertical timing

8.7 Outline of input signal timings

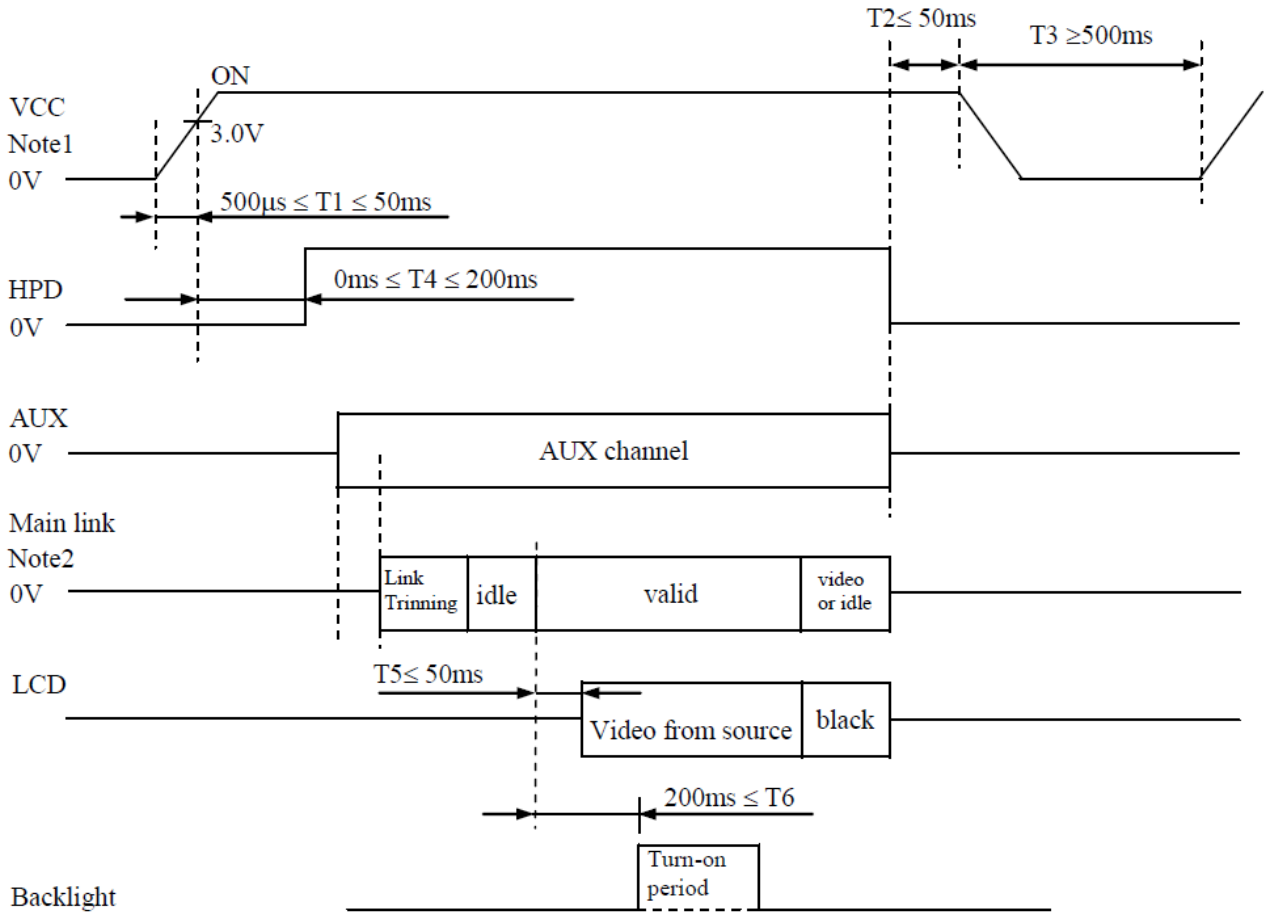
• Horizontal signal

Note1



Notes:
1. This diagram indicates virtual signal for set up to timing.
2. See "8.6" Input signal timing chart" for the pulse number.

8.8 Power Supply Voltage Sequence



*These signals should be measured at the terminal of 100Ω resistance.

Notes:

1. If there is a voltage variation (voltage drop) at the rising edge of VCC below 3.0V, there is a possibility that a product does not work due to a protection circuit.
2. Display signals (Lane0_P/N, Lane1_P/N) must be set to Low or High-impedance, except the VCC ON period (See above sequence diagram), in order to avoid the circuitry damage.

9. Optical Specification

Ta=25℃

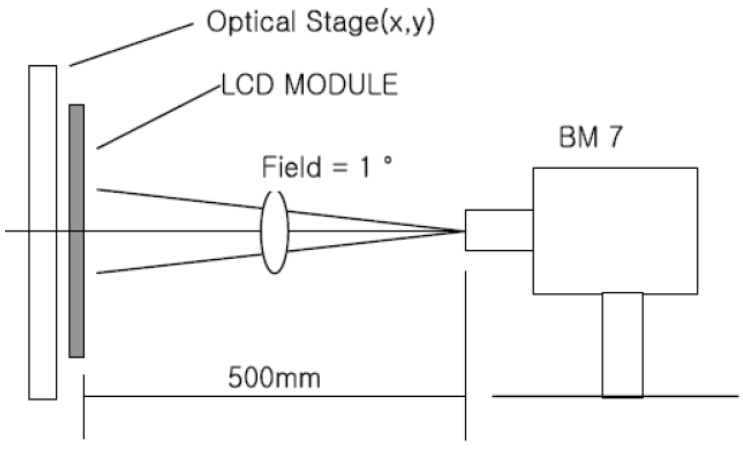
Item		Symbol	Condition	Min	Typ.	Max.	Unit	Remark
Contrast Ratio		CR	θ=0°	500	750	-		Note1 Note2
Response Time		Ton	25℃	-	15	20	ms	Note1 Note3
		Toff		-	15	20		
View Angles		ΘT	CR≧10	70	88	-	Degree	Note 4
		ΘB		70	88	-		
		ΘL		70	88	-		
		ΘR		70	88	-		
Chromaticity	White	x	Brightness is on	0.263	0.313	0.363		Note5, Note1
		y		0.279	0.329	0.379		
	Red	x		0.515	0.565	0.615		
		y		0.295	0.345	0.395		
	Green	x		0.290	0.340	0.390		
		y		0.480	0.530	0.580		
	Blue	x		0.100	0.150	0.200		
		y		0.055	0.105	0.155		
Luminance		L		1200	1500	--	cd/m^2	Note1 Note6
Uniformity		LU		--	1.25	1.4		Note1 Note7

Measurement conditions are as follows: Ta= 25°C, VCC= 3.3V, IL=65mA/One circuit,
Display mode: FHD, Horizontal cycle= 1/66.59kHz, Vertical cycle= 1/59.88Hz.

Note 1: Definition of optical measurement system.

Temperature = 25℃(±3℃) ,

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

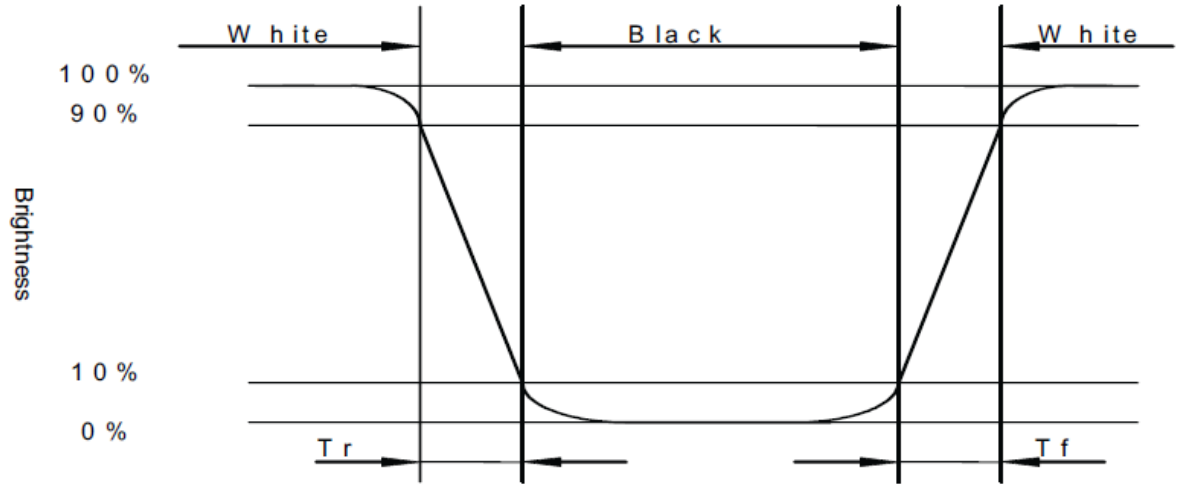


Note 2: Contrast ratio is defined as follow:

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

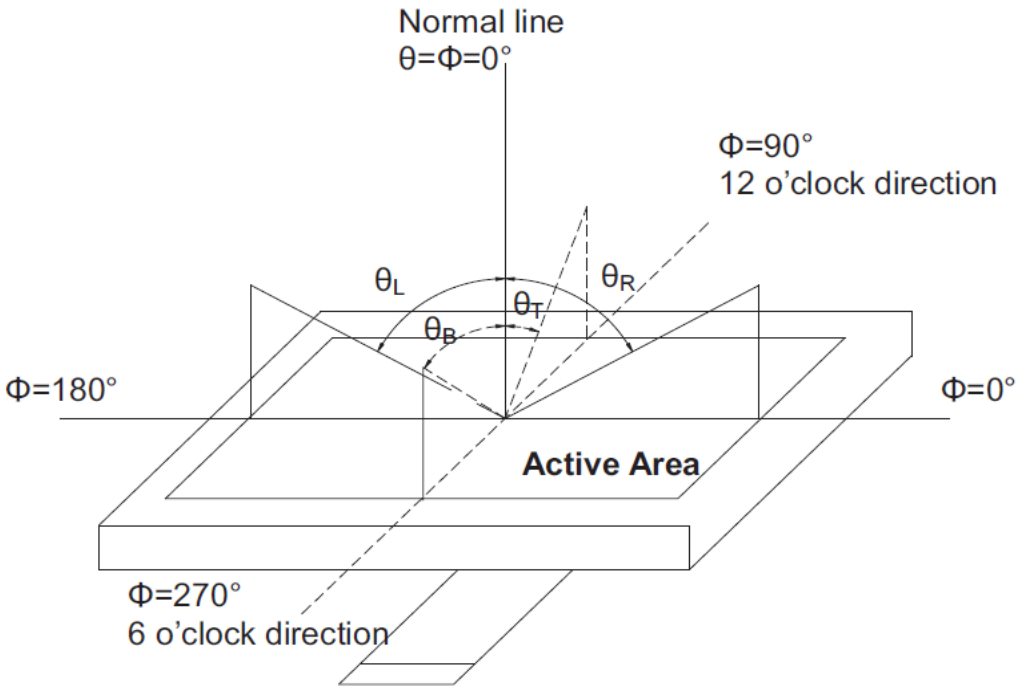
Note 3: Response time is defined as follow:

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).



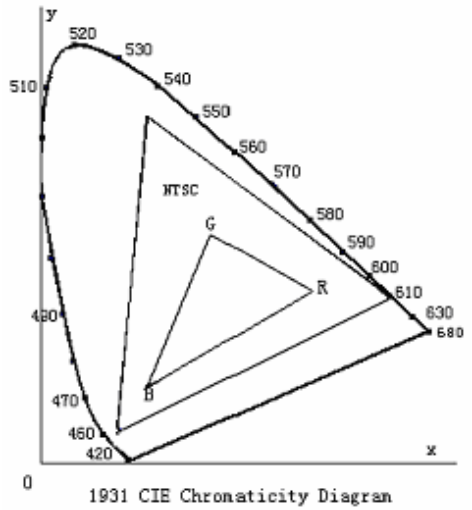
Note 4: Viewing angle range is defined as follow:

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.



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

Note 6: Luminance is defined as follow:

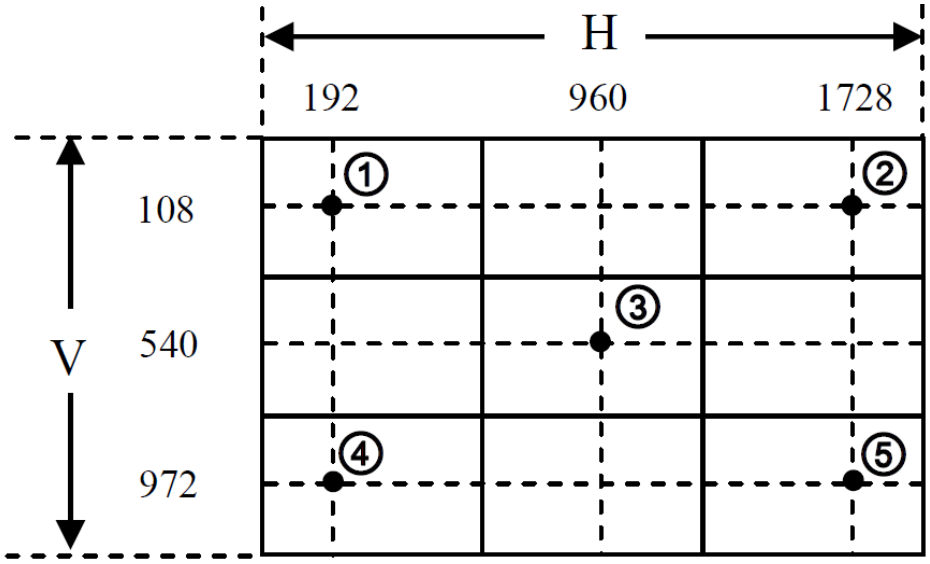
Luminance is defined as the brightness of all pixels "White" at the center of display area on optimum contrast.

Note 7: Luminance Uniformity is defined as follow:

The luminance uniformity is calculated by using following formula.

$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

The luminance is measured at near the 5 points shown below.



10. Environmental / Reliability Tests

No	Test Item	Condition	Judgment criteria
1	High Temp Operation	Ta= +85℃, 240hrs	Per table in below
2	Low Temp Operation	Ta= -30℃, 240hrs	Per table in below
3	High Temp Storage	Ta= +85℃, 240hrs	Per table in below
4	Low Temp Storage	Ta= -40℃, 240hrs	Per table in below
5	High Temp & High Humidity Storage	Ta= +60℃, 90% RH, 240 hours	Per table in below (polarizer discoloration is excluded)
6	Thermal Shock (Non-operation)	1. -40℃ 30 min~+85℃ 30 min, 2. 100cycles, 1hour/cycle, 3. Temperature transition time is within 5 minutes.	Per table in below
7	ESD (Operation)	1. 150pF, 150Ω, ±10kV 2. 9 places on a panel surface 3. 10 times each places at 1 sec interval	Per table in below
8	Vibration (Non-operation)	1. 5 to 100Hz, 11.76m/s^2 2. 1 minute/cycle 3. X, Y, Z directions 4. 50 times each direction	Per table in below
9	Shock (Non-operation)	1. 294m/s2, 11ms 2. ±X, ±Y, ±Z directions 3. 3 times each directions	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

A. 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.
B. 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.
C. Do not display the fixed pattern for a long time because it may develop image sticking due to the LCD structure. If the screen is displayed with fixed pattern, use a screen saver.