

DLC Display Co., Limited

德爾西顯示器有限公司



MODEL No:DLC0200CCP04DF-1

TEL: 86-755-86029824

FAX: 86-755-86029827

E-MAIL: sales@dlcdisplay.com

WEB: www.dlcdisplay.com



Record of Revision

Date	Revision No.	Summary
2019-03-05	1.0	Rev 1.0 was issued

1. Scope

This data sheet is to introduce the specification of DLC0200CCP04DF-1 active matrix TFT module. It is composed of a color TFT-LCD panel, driver IC, FPC and a backlight unit. The 2.0" display area contains 480(RGB) x 360 pixels.

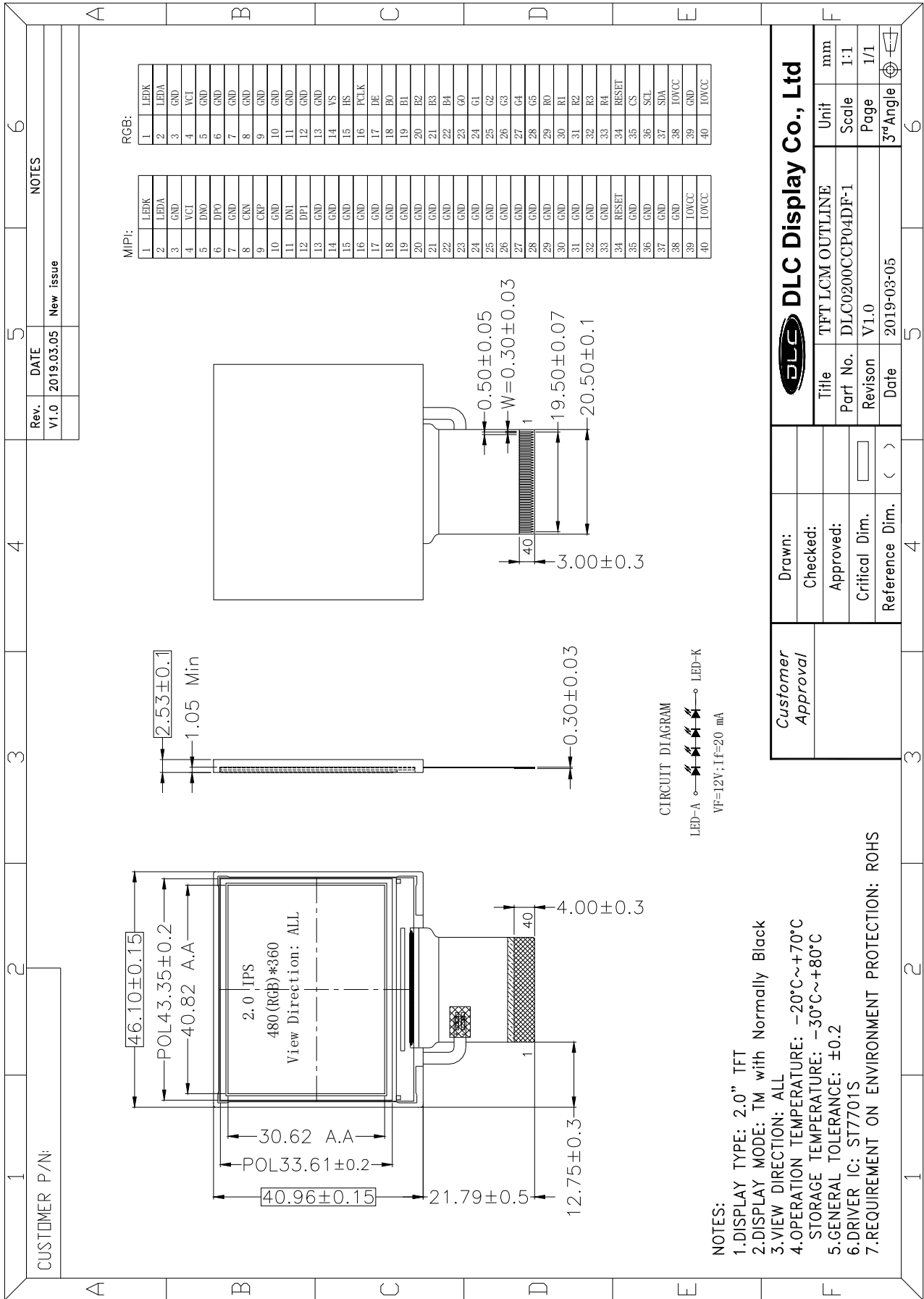
2. Application

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

3. General Information

Item	Contents	Unit
Size	2.0	inch
Resolution	480(RGB) X 360	/
Interface	RGB-16bit or MIPI	/
Technology type	IPS	/
Pixel pitch	0.085 x 0.085	mm
Pixel Configuration	R.G.B. Vertical Stripe	
Outline Dimension (W x H x D)	46.10 x 40.96 x 2.53	mm
Active Area	40.82 x 30.62	mm
Display Mode	Transmissive, Normally black	/
Viewing Direction	ALL	/
Backlight Type	LED	/
Driver IC	ST7701S	/

4. Outline Drawing



5. Interface signals

5.1 16-bit RGB Description

No	Symbol	Description	Remarks
1	LEDK	Power for LED Backlight cathode	
2	LEDA	Power for LED Backlight anode	
3	GND	Power ground	
4	VCI	Power voltage	
5~13	GND	Power ground	
14	VS	Vertical sync signal	
15	HS	Horizontal sync signal	
16	PCLK	Pixel clock	
17	DE	Data enable	
18~22	B0~B4	Blue data	
23~28	G0~G5	Green data	
29~33	R0~R4	Red data	
34	RESET	Reset signal pin	
35	CS	Chip select signal	
36	SCL	Serial clock input	
37	SDA	Serial data input	
38	IOVCC	Power voltage	
39	GND	Power ground	
40	IOVCC	Power voltage	

5.2 MIPI Pin Description

No	Symbol	Description	Remarks
1	LEDK	Power for LED Backlight cathode	
2	LEDA	Power for LED Backlight anode	
3	GND	Power ground	
4	VCI	Power voltage	
5	DN0	Negative MIPI differential data inputs	
6	DP0	Positive MIPI differential data inputs	
7	GND	Power ground	

8	CKN	Negative MIPI differential clock inputs	
9	CKP	Positive MIPI differential clock inputs	
10	GND	Power ground	
11	DN1	Negative MIPI differential data inputs	
12	DP1	Positive MIPI differential data inputs	
13~33	GND	Power ground	
34	RESET	Reset signal pin	
35~38	GND	Power ground	
39~40	IOVCC	Power voltage	

6. Absolute maximum Ratings

6.1. Electrical Absolute max. ratings

Parameter	Symbol	MIN	MAX	Unit	Remark
Power Supply Voltage	VCI	-0.3	3.6	V	
	IOVCC	-0.3	3.6	V	

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	Condition
Power Supply Voltage	VCI	2.5	2.8	3.6	V	
	IOVCC	1.65	1.8	3.3	V	
Input Voltage "L" level	VIL	0	-	0.3*VCI	V	
Input Voltage "H" level	VIH	0.7*VCI	-	VCI	V	

7.2 LED Backlight

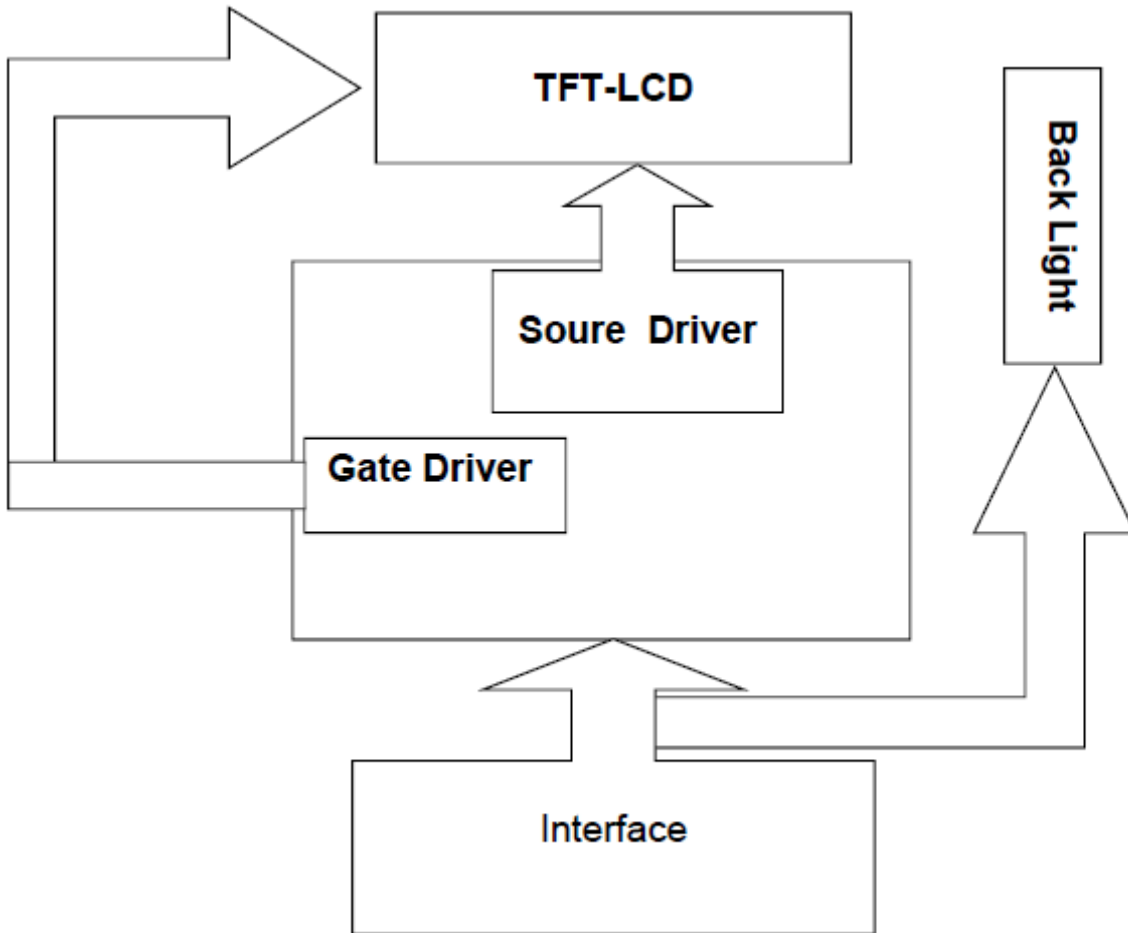
Ta=25°C

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	IF	-	20	-	mA	

Forward Voltage	VF	11.6	12	13.6	V	
LED life time	--	--	30,000	--	Hrs	Note

Note : 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 larger than 20mA.

7.3 Block Diagram of LCM

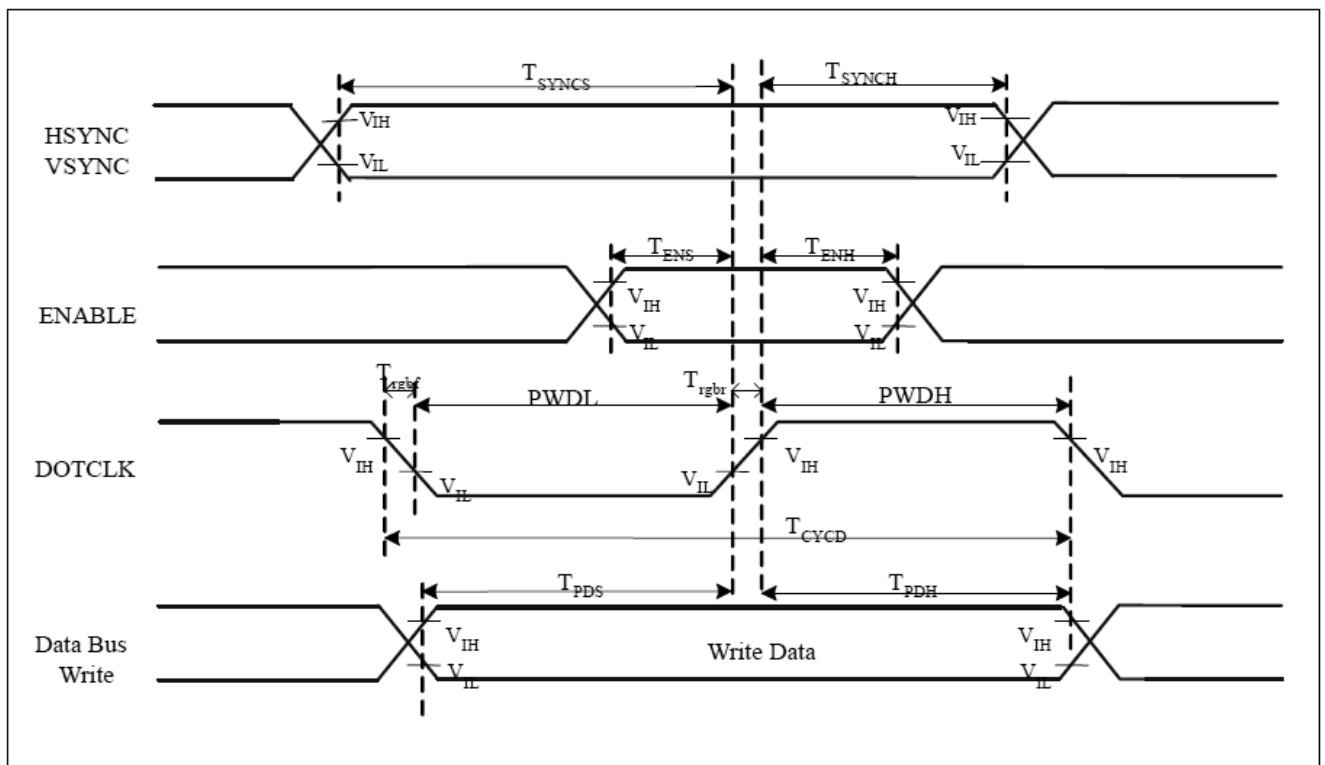


8. Command/AC Timing

8.1 RGB Interface Characteristics

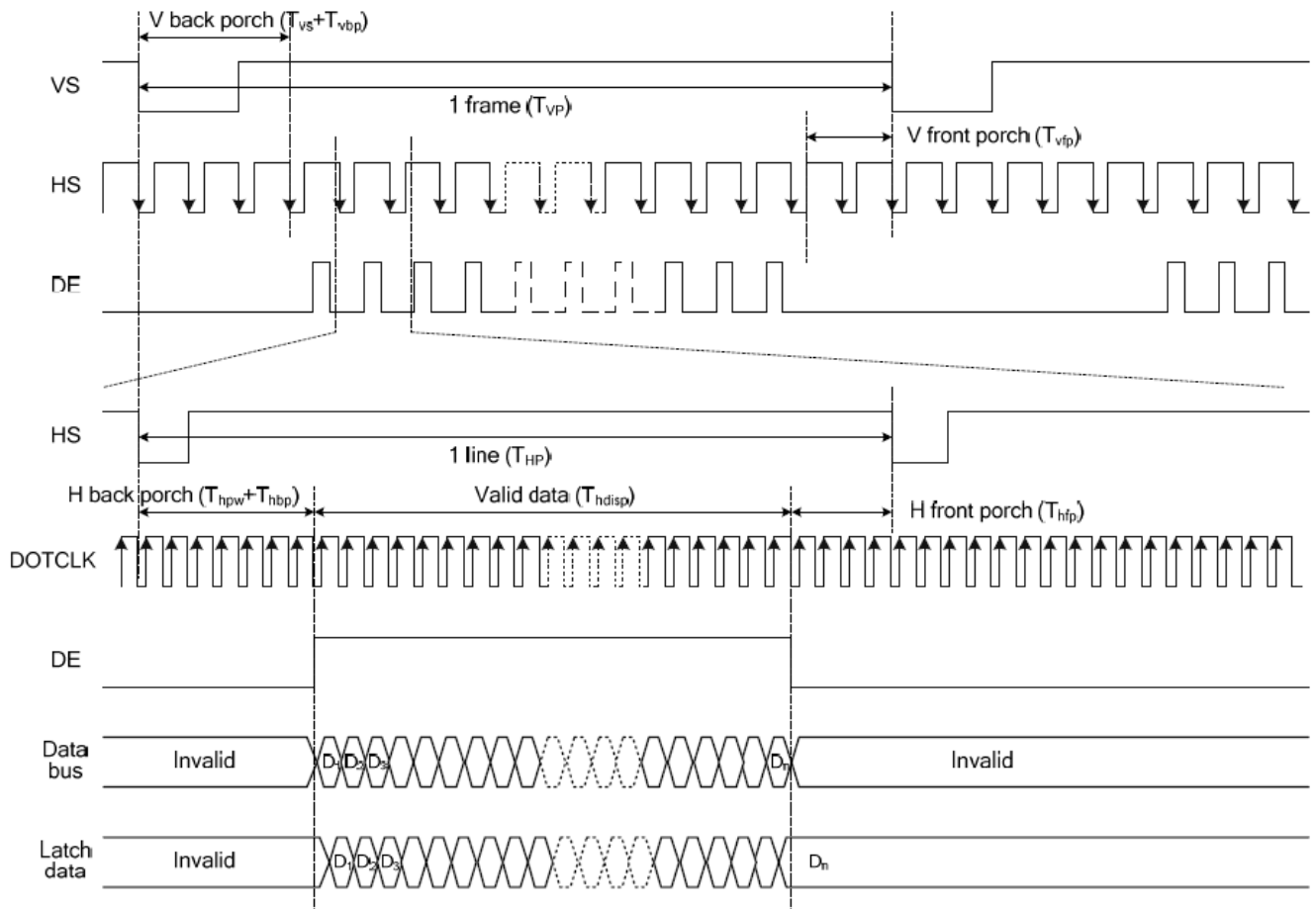
VDDI=1.8V, VDD-2.8V, AGND=DGND=0V, Ta=25°C

Signal	Symbol	Parameter	MIN	MAX	Unit
HSYNC, VSYNC	T _{SYNCS}	VSYNC, HSYNC setup time	5	-	ns
ENABLE	T _{ENS}	Enable setup time	5	-	ns
	T _{ENH}	Enable hold time	5	-	ns
DOTCLK	PWDH	DOTCLK high-level pulse width	15	-	ns
	PWDL	DOTCLK low-level pulse width	15	-	ns
	T _{CYCD}	DOTCLK cycle time	33	-	ns
	Trghr, Trghf	DOTCLK rise/fall time	-	15	ns
DB	T _{PDS}	PD data setup time	5	-	ns
	T _{PDH}	PD data hold time	5	-	ns



8.2 RGB Interface Timing

The timing chart of RGB interface DE mode is shown as follow.

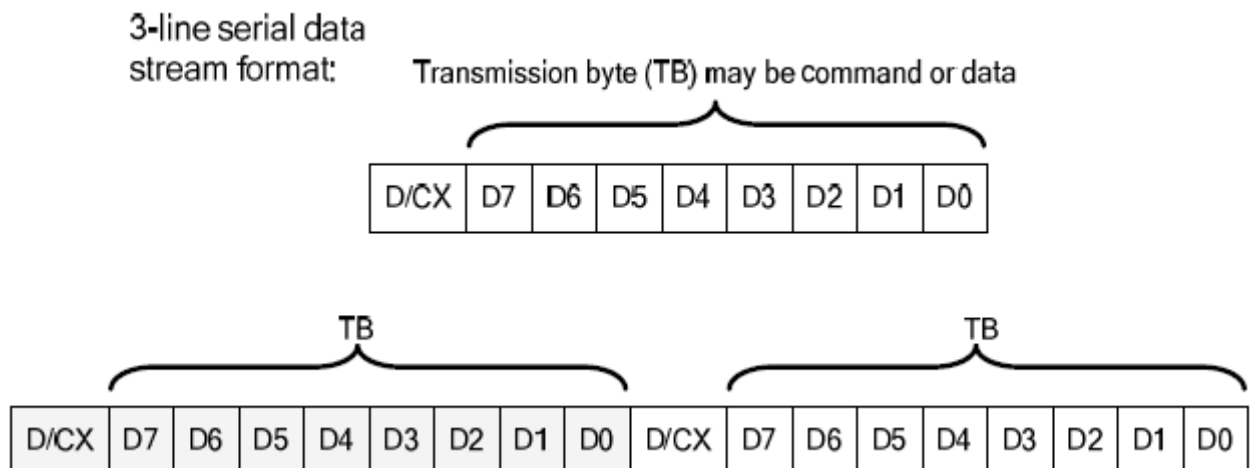


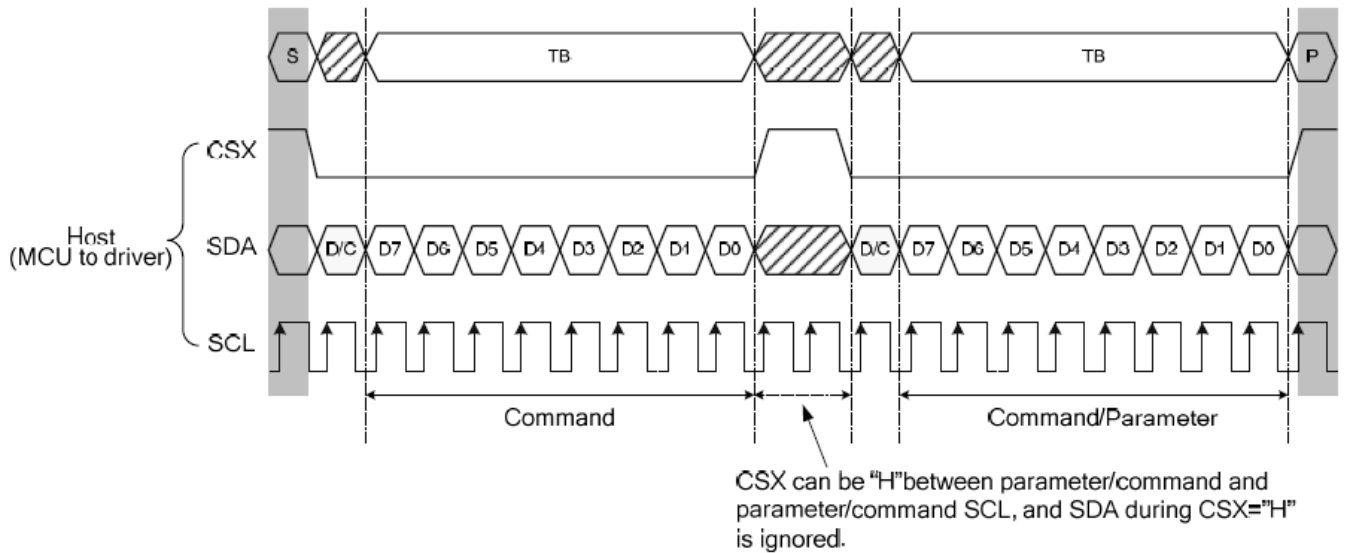
Note: The setting of front porch and back porch in host must match that in IC as this mode.

8.3 SPI Interface Timing

The write mode of the interface means the micro controller writes commands and data to the LCD driver. 3-lines serial data packet contains a control bit D/CX and a transmission byte. In 4-lines serial interface, data packet contains just transmission byte and control bit D/CX is transferred by the D/CX pin. If D/CX is "low", the transmission byte is interpreted as a command byte. If D/CX is "high", the transmission byte is command register as parameter.

Any instruction can be sent in any order to the driver. The MSB is transmitted first. The serial interface is initialized when CSX is high. In this state, SCL clock pulse or SDA data have no effect. A falling edge on CSX enables the serial interface and indicates the start of data transmission.





8.4 MIPI Interface Characteristics

8.4.1 High Speed Mode



Figure: DSI clock channel timing

VDDI=1.8, VDD=2.8, AGND=DGND=0V, Ta=25 °C

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
DSI-CLK+/-	2xUI_INSTA	Double UI instantaneous	4	25	ns	
DSI-CLK+/-	UI_INSTA UI_INSTB	UI instantaneous halves	2	12.5	ns	UI=UI_INSTA= UI_INSTB
DSI-Dn+/-	tDS	Data to clock setup time	0.15	-	UI	
DSI-Dn+/-	tDH	Data to clock hold time	0.15	-	UI	

Table: MIPI Interface- High Speed Mode Timing Characteristics

8.4.2 Low Power Mode

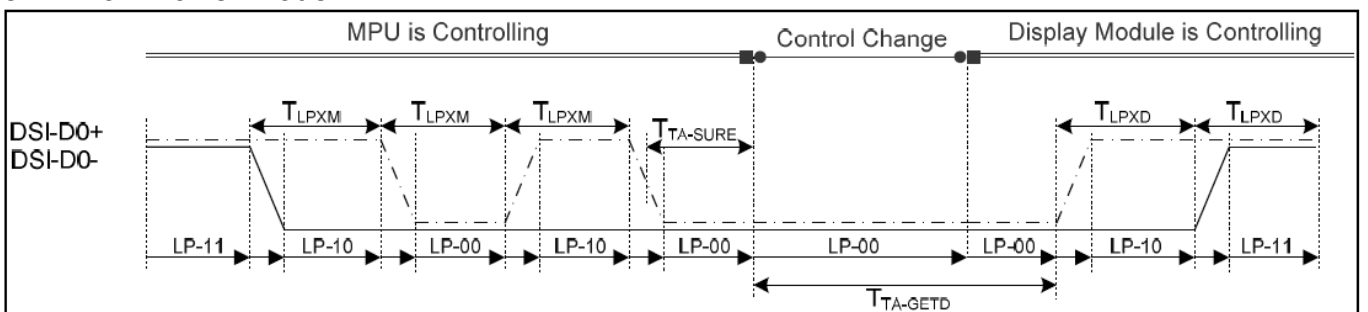


Figure: Bus Turnaround (BTA) from display module to MPU Timing

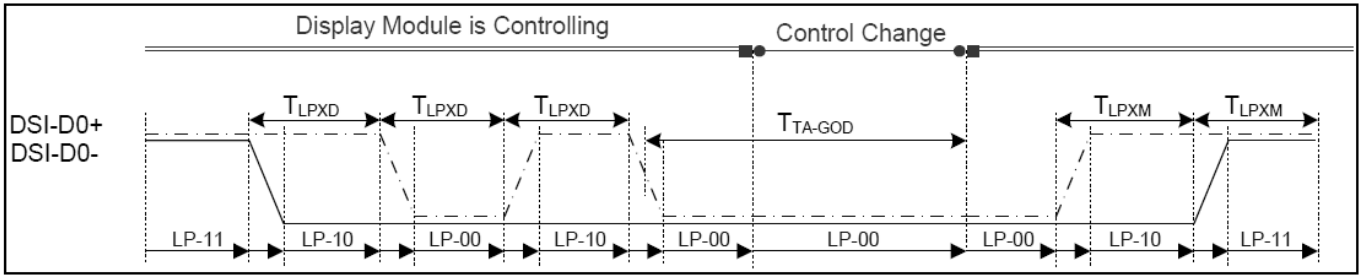


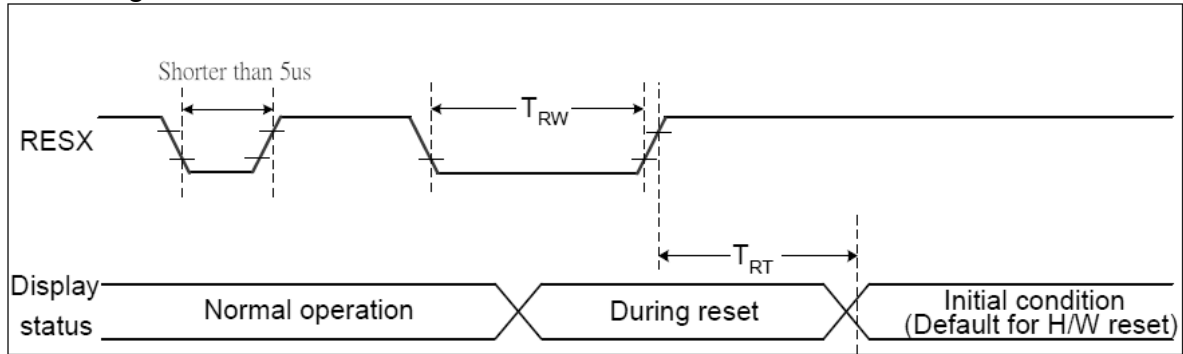
Figure: Bus Turnaround (BTA) from MPU to display module Timing

VDDI=1.8, VDD=2.8, AGND=DGND=0V, Ta=25 °C

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
DSI-D0+/-	TLPXM	Length of LP-00,LP-01, LP-10 or LP-11 periods MPU→Display Module	50	75	ns	Input
DSI-D0+/-	TLPXD	Length of LP-00,LP-01, LP-10 or LP-11 periods MPU→Display Module	50	75	ns	Output
DSI-D0+/-	TTA-SURED	Time-out before the MPU start driving	TLPXD	2xTLPXD	ns	Output
DSI-D0+/-	TTA-GETD	Time to drive LP-00 by display module	5xTLPXD		ns	Input
DSI-D0+/-	TTA-GOD	Time to drive LP-00 after turnaround request-MPU	4xTLPXD		ns	Output

Table: MIPI Interface Low Power Mode Timing Characteristics

8.2 Reset Timing



VDDI=1.8V, VDD=2.8V, AGND=DGND=0V, Ta=25°C

Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5(Note 1,5)	ms
			-	120(Note 1,6, 7)	ms

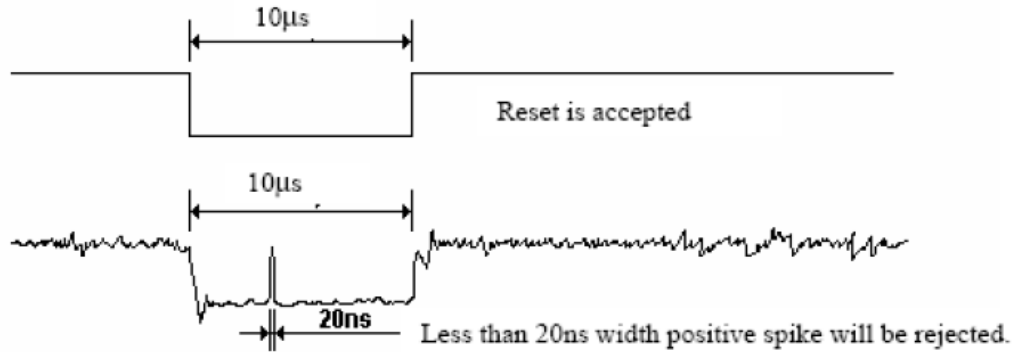
Note1: The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

Note2: Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset starts

Note3: During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode.) and then return to Default condition for Hardware Reset.

Note4: Spike Rejection also applies during a valid reset pulse as shown below:



Note5: When Reset applied during Sleep In Mode.

Note6: When Reset applied during Sleep Out Mode.

Note7: It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec

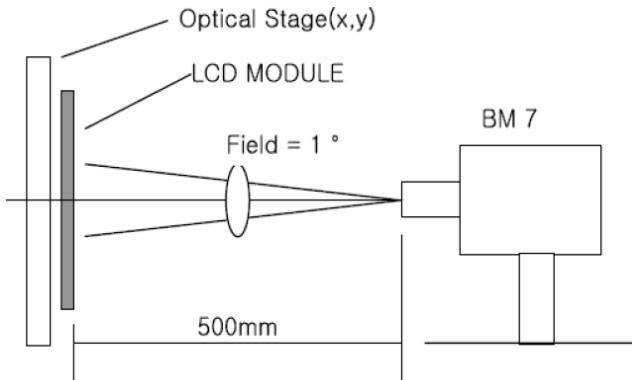
9. Optical Specification

Item	Symbol	Condition	Min	Typ.	Max.	Unit	Remark
Contrast Ratio	CR	$\theta=0^\circ$	-	1000	-		Note1 Note2
Response Time	Tr+Tf	25°C	-	35	-	ms	Note1 Note3
View Angles	ΘT	CR \geq 10	-	80	-	Degree	Note 4
	ΘB		-	80	-		
	ΘL		-	80	-		
	ΘR		-	80	-		
Chromaticity	White	Brightness is on	x	0.27	0.30	0.33	Note5, Note1
			y	0.29	0.32	0.35	
Luminance	L		560	620	-	cd/m ²	Note1 Note6
Uniformity (White)	U		80	-	-	%	Note1 Note7

Note 1: Definition of optical measurement system.

Temperature = 25°C(±3°C)

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

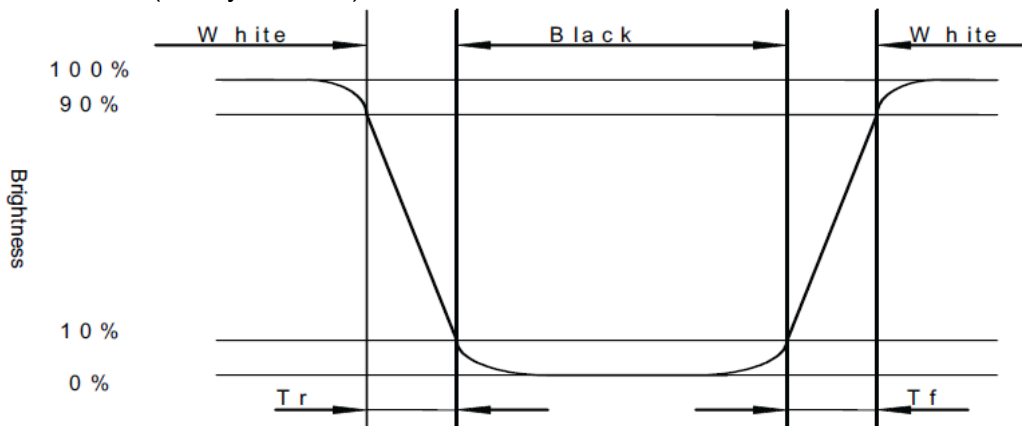


Note 2: Contrast ratio is defined as follow:

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

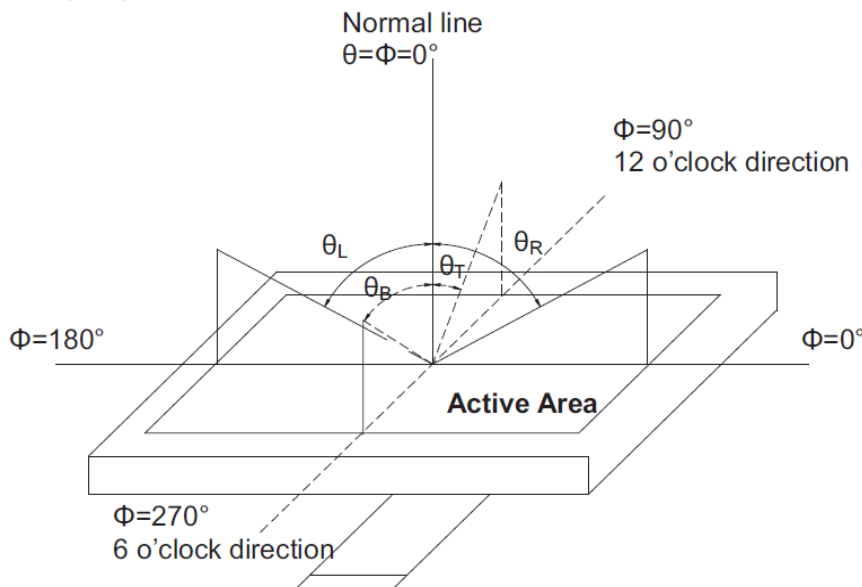
Note 3: Response time is defined as follow:

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).



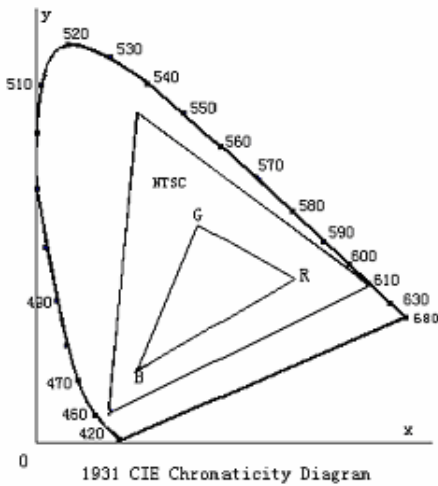
Note 4: Viewing angle range is defined as follow:

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.

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

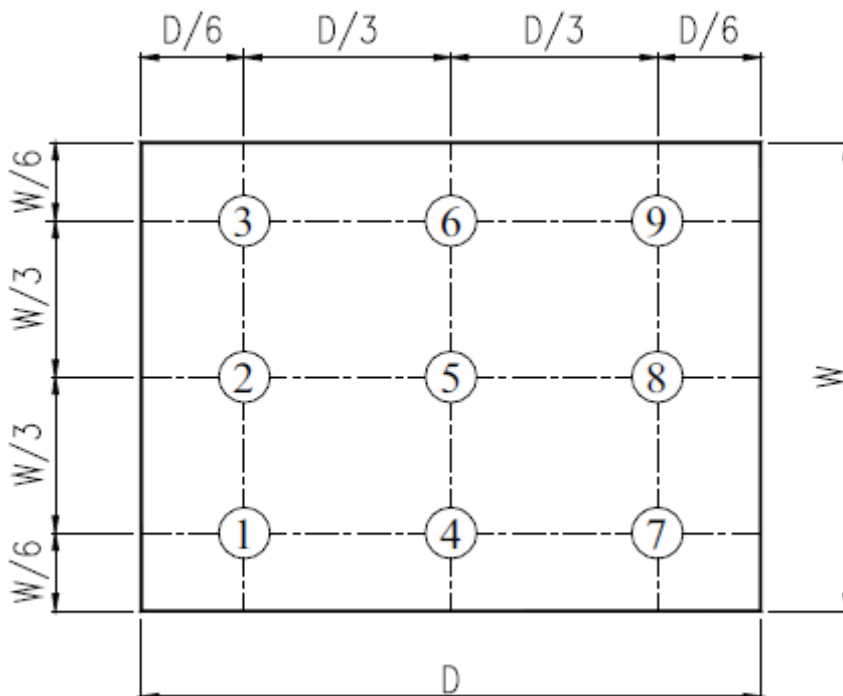


Fig. 2 Definition of uniformity

10. Environmental / Reliability Tests

No	Test Item	Condition	Judgment criteria
1	High Temp Operation	Ts=+70°C, 96hrs	Per table in below
2	Low Temp Operation	Ta=-20°C, 96hrs	Per table in below
3	High Temp Storage	Ta=+80°C, 96hrs	Per table in below
4	Low Temp Storage	Ta=-30°C, 96hrs	Per table in below
5	High Temp & High Humidity Storage	Ta=+60°C, 90% RH 96 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

- 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.

