PRODUCT SPECIFICATIONS

For Customer: _____

☐ : APPROVAL FOR SPECIFICATION

Customer Model No. _____

☐ : APPROVAL FOR SAMPLE

Module No.: __PV04016D0130Q_____   _Date : 2023.6.6___

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For Customer's Acceptance:

Approved By	Comment

PREPARED	CHECKED	VERIFIED BY QA DEPT	VERIFIED BY R&D DEPT
Nikola			

2. Revision Record

Date	Rev.No.	Page	Revision Items	Prepared
2023.6.6	V0		The first release	Nikola

3. General Specifications

PV04016D0130Q *is a TFT-LCD module. It is composed of a TFT-LCD panel, driver IC, FPC,a back light unit . The 4.0′ display area contains 720X(RGB)x720 pixels and can display up to 16.7M colors. This product accords with ROHS environmental criterion.*
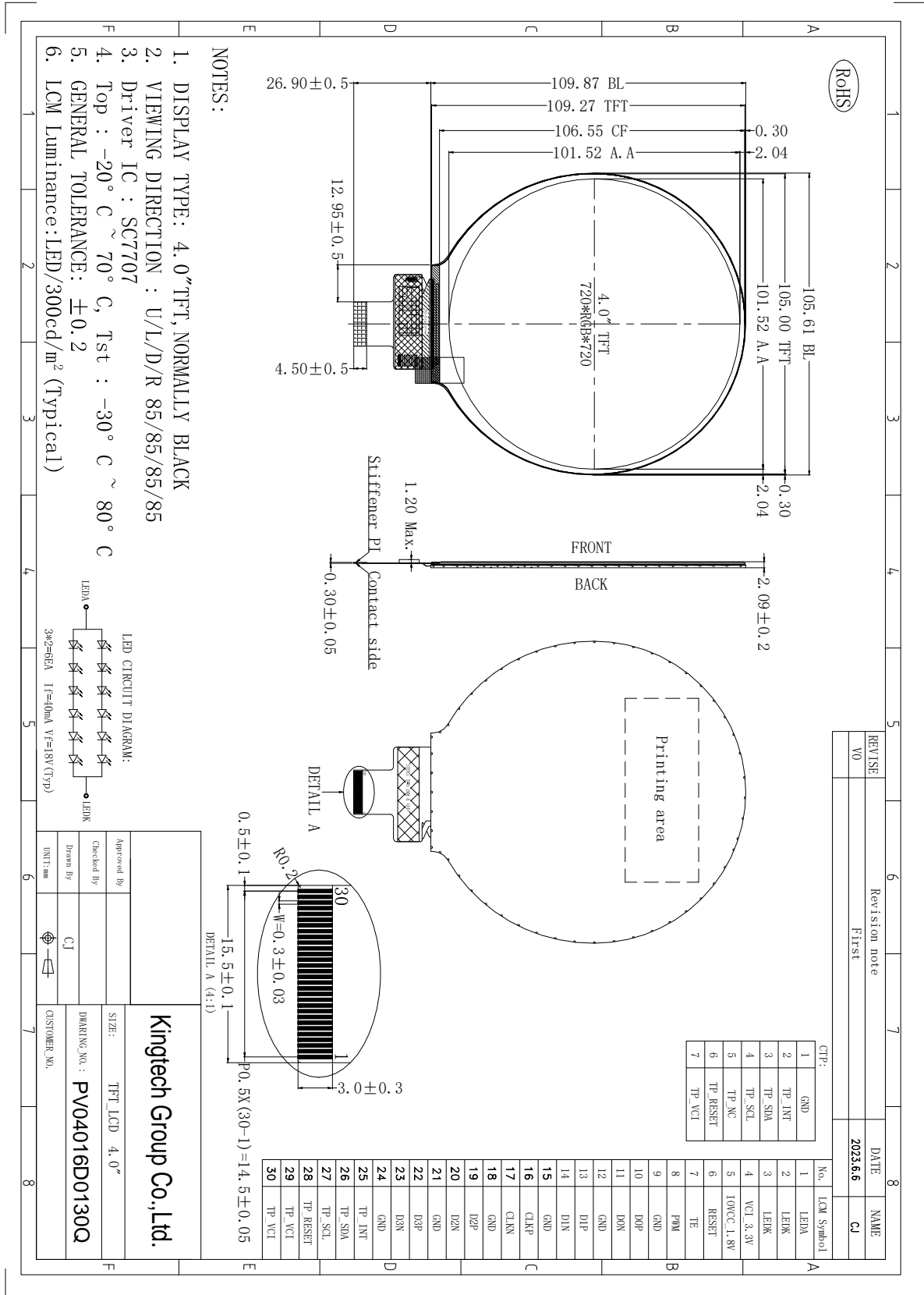
Item	Contents	Unit	Note
LCD Type	TFT	-	
Display color	16.7M		1
Viewing Direction	ALL	O'Clock	
Operating temperature	-20~+70	℃	
Storage temperature	-30~+80	℃	
Module size	105.61X109.87X2.09	mm	2
Active Area(W×H)	101.52X101.52	mm	
Number of Dots	720×720	dots	
Controller	SC7707	-	
Backlight	6S2P-LEDs (white)	pcs	
Weight	---	g	
Interface	MIPI	-	

Note 1:   Color tune is slightly changed by temperature and driving voltage.

Note 2:   Without FPC and Solder.

4.Outline.Drawing

NOTES：

1. DISPLAY TYPE：4.0"TFT, NORMALLY BLACK
2. VIEWING DIRECTION：U/L/D/R 85/85/85/85
3. Driver IC：SC7707
4. Top：-20°C ~ 70°C, Tst：-30°C ~ 80°C
5. GENERAL TOLERANCE：±0.2
6. LCM Luminance：LED/300cd/m² (Typical)

LED CIRCUIT DIAGRAM:

3*2=6EA   If=40mA Vf=18V(Typ)

109.87 BL
109.27 TFT
106.55 CF
101.52 A.A

26.90±0.5
12.95±0.5
4.50±0.5

105.61 BL
105.00 TFT
101.52 A.A

0.30
2.04

4.0" TFT
720*RGB*720

0.30
2.04

1.20 Max.
0.30±0.05

FRONT
BACK
2.09±0.2

Stiffener PI
Contact side

DETAIL A

Printing area

0.5±0.1
R0.2
15.5±0.1
DETAIL A (4:1)
W=0.3±0.03
30
1
P0.5X(30-1)=14.5±0.05
3.0±0.3

	REVISE	Revision note
V0	First

	DATE	NAME
	2023.6.6	CJ

Kingtech Group Co.,Ltd.

SIZE: TFT_LCD 4.0"

DRAWING NO. : PV04016D0130Q

CUSTOMER NO.

	Approved By	
	Checked By	
	Drawn By	CJ
UNIT: mm		

CTP:

No.	Symbol
1	GND
2	TP_INT
3	TP_SDA
4	TP_SCL
5	TP_NC
6	TP_RESET
7	TP_VCI

No.	LCM Symbol
1	LEDA
2	LEDK
3	LEDK
4	VCI_3.3V
5	IOVCC_1.8V
6	RESET
7	TE
8	PWM
9	GND
10	DOP
11	DON
12	GND
13	D1P
14	D1N
15	GND
16	CLKP
17	CLKN
18	GND
19	D2P
20	D2N
21	GND
22	D3P
23	D3N
24	GND
25	TP_INT
26	TP_SDA
27	TP_SCL
28	TP_RESET
29	TP_VCI
30	TP_VCI

4

5. Absolute Maximum Ratings(Ta=25℃)

5.1 Electrical Absolute Maximum Ratings.(Vss=0V ,Ta=25℃)

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	VCI_3.3V	-0.3	6.6	V	1.2
Power Supply Voltage for I/O	IOVCC_1.8V	-0.3	3.3	V	

Notes:

1. If the module is above these absolute maximum ratings. It may become permanently damaged. Using the module within the following electrical characteristic conditions are also exceeded, the module will malfunction and cause poor reliability.

2. $V_{CI} > V_{SS}$ must be maintained.
3. Please be sure users are grounded when handing LCD Module.

5.2 Environmental Absolute Maximum Ratings.

Item	Storage		Operating		Note
	MIN.	MAX.	MIN.	MAX.	
Ambient Temperature	-30℃	80℃	-20℃	70℃	1,2
Humidity	-	-	-	-	3

Notes:

1. The response time will become lower when operated at low temperature.

2. Background color changes slightly depending on ambient temperature.
   The phenomenon is reversible.

3. Ta<=40℃:85%RH MAX.
   Ta>=40℃:Absolute humidity must be lower than the humidity of 85%RH at 40℃.

6. Electrical Specifications

6.1 Electrical characteristics(Vss=0V ,Ta=25℃)

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Note
Power supply		VCC_3.3V	Ta=25℃	2.6	2.8	3.3	V	
		IOVCC_1.8V	Ta=25℃	1.65	1.8	3.3		
Input voltage	'H'	V_{IH}	IOVCC_1.8V= 1.8V	0.8*IOVCC _1.8V	-	IOVCC_1. 8V	V	
	'L'	V_{IL}	IOVCC_1.8V= 1.8V	0	-	0.2*IOVC C_1.8V	V	

6.2 LED backlight specification(VSS=0V ,Ta=25℃)

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply voltage	V_f	If=40mA	-	18.0	-	V	
Uniformity	△Bp	If=40mA	80	-	-	%	
Life Time	time	If=40mA	30K	-		hours	1
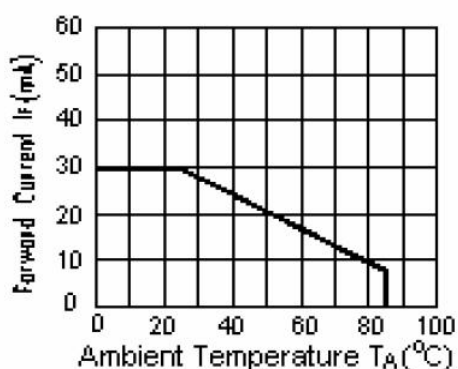
Note 1:   Brightness to be decreased to 50% of the initial value at ambient temperature TA=25℃

6.3 Interface signals

Pin No.	Symbol	I/O	Function
1	LEDA	P	LED back light(Anode).
2-3	LEDK	P	LED back light(Cathode).
4	VCI_3.3V	P	Power Supply +3.3V.
5	IOVCC_1.8V	P	Power Supply +1.8V.
6	RESET	I	Global reset signal input pin.
7	TE	I	Tearing effect output.
8	PWM	I	The PWM frequency output for LCD driver control. Please NC
9	GND	P	Ground.
10	D0P	I	DSI-D0+ data signal.
11	D0N	I	DSI-D0- data signal.
12	GND	P	Ground.
13	D1P	I	DSI-D1+ data signal.
14	D1N	I	DSI-D1- data signal.
15	GND	P	Ground.
16	CLKP	I	DSI-Clock+.
17	CLKN	I	DSI-Clock-.
18	GND	P	Ground.
19	D2P	I	DSI-D2+ data signal.
20	D2N	I	DSI-D2- data signal.
21	GND	P	Ground.
22	D3P	I	DSI-D3+ data signal.
23	D3N	I	DSI-D3- data signal.
24	GND	P	Ground.
25	TP_INT	I	Touch Interrupt. Please NC
26	TP_SDA	I	Touch IIC Data signal. Please NC
27	TP_SCL	I	Touch IIC Clock signal. Please NC
28	TP_RESET	I	Touch Reset Signal.Please NC
29	TP_VCI	P	Touch Power supply.Please NC
30	TP_VCI	P	Touch Power supply.Please NC

6.4 AC Characteristics

6.4.1 Vertical Timings for DSI video mode
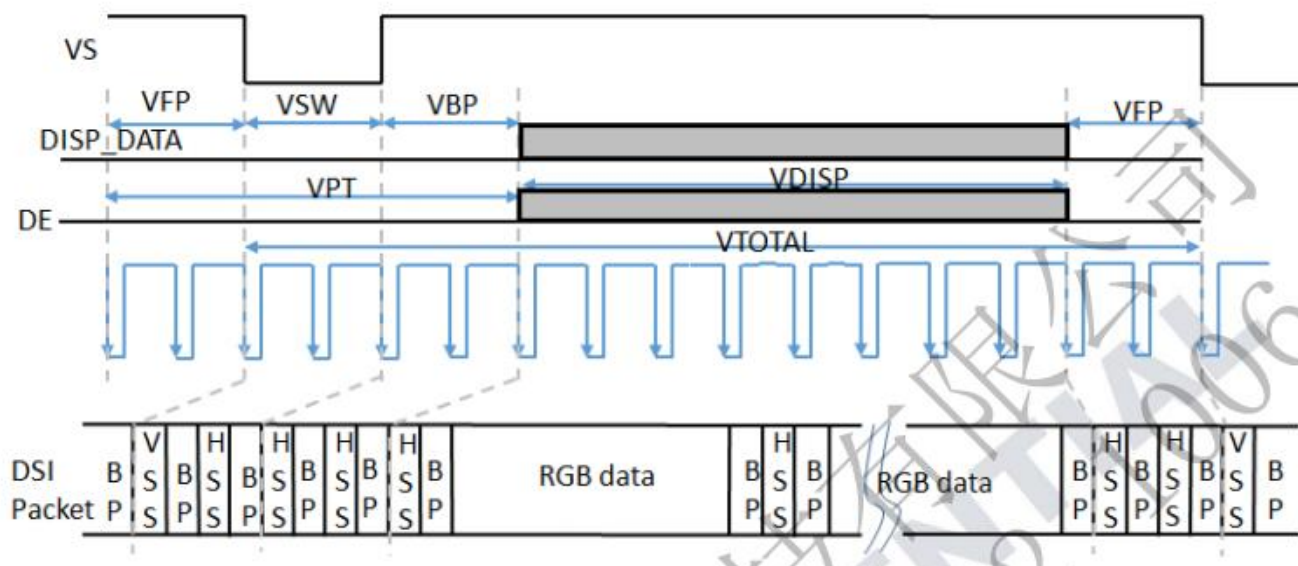
Vertical timings for DSI interface

Condition : Ta =25℃,Resolution = 720(RGB)*1280.

Parameter	Symbol	Conditions	Specification			Unit	Notes
			MIN	TYP	MAX		
Vertical Total	V_{TOTAL}		1286			Line	
Vertical low pulse width	V_{SW}		2			Line	1
Vertical front porch	V_{FP}		2			Line	
Vertical back porch	V_{BP}		2			Line	1
Vertical data start point		$V_{SW}+V_{BP}$	4			Line	1
Vertical blanking period	V_{PT}	$V_{SW}+V_{BP}+V_{FP}$	6			Line	
Vertical active area		V_{DISP}	-	1280	1760	Line	
Vertical Frame rate	V_{FR}			60		Hz	

Note 1: The VSW and VBP pulse width are related to panel GOA timing. The GOA timing must be set at corresponding position for LCM normal display.

6.4.2 Horizontal Timings for DSI video mode
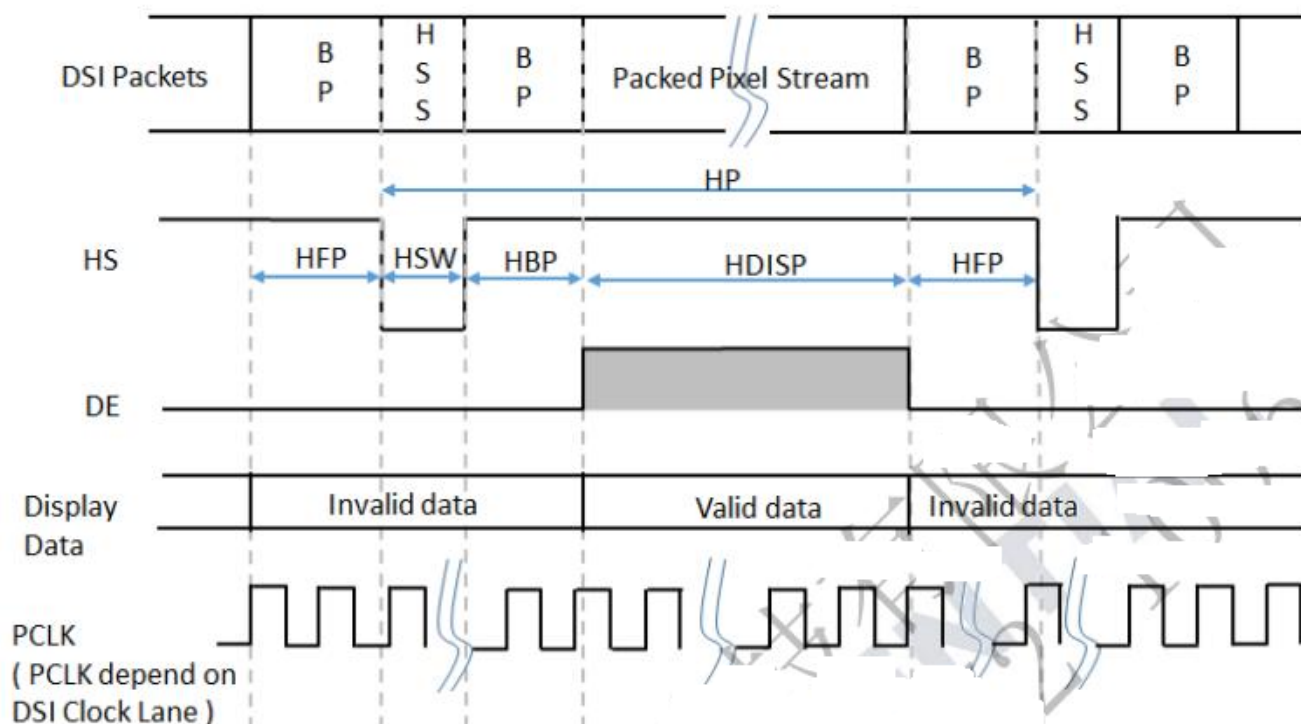
Horizontal timings for DSI video mode

Condition : Ta =25℃,Resolution = 720(RGB)*1280.

Parameter	Symbol	Conditions	Specification MIN	Specification TYP	Specification MAX	Unit	Notes
HS low pulse width	HSW		0.2			uS	
Horizontal back porch	HBP		1.0			uS	
Horizontal front porch	HFP		1.0			uS	
Horizontal data start point		HSW+HBP	1.2			uS	
Horizontal blanking period	HBLK	HSW+HBP+HFP	2.2			uS	
Horizontal active area	HDISP			-	720	DCLK	

6.5 MIPI AC Characteristics

6.5.1 High Speed Mode - Clock Timings
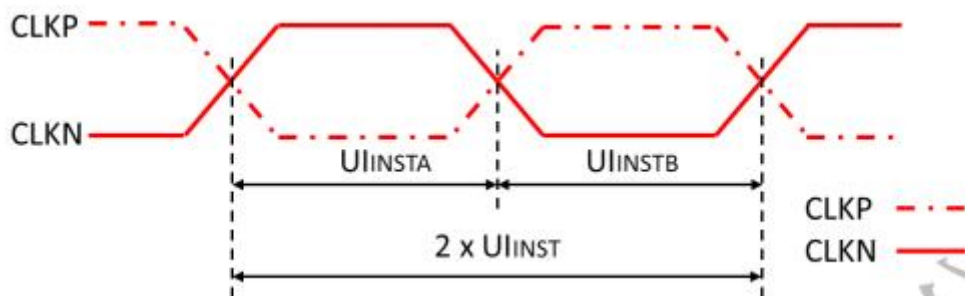
Clock Timing

Signal	Symbol	Parameter	Specification			Unit	Notes
			MIN	TYP	MAX		
CLK P/N	$2xUI_{INST}$	Double UI instantaneous	2.5		12.5	ns	
CLK P/N	UI_{INSTA}, UI_{INSTB}	UI instantaneous Half	1.25		6.25	ns	1,2

Note 1: UI = UI_{INSTA} = UI_{INSTB}.
Note 2: ICNL9707 can support max 600Mbps/lane at 4 lane and max 800Mbps/lane at 3 lane application.

6.5.2 High Speed Mode - Clock / Data Timings
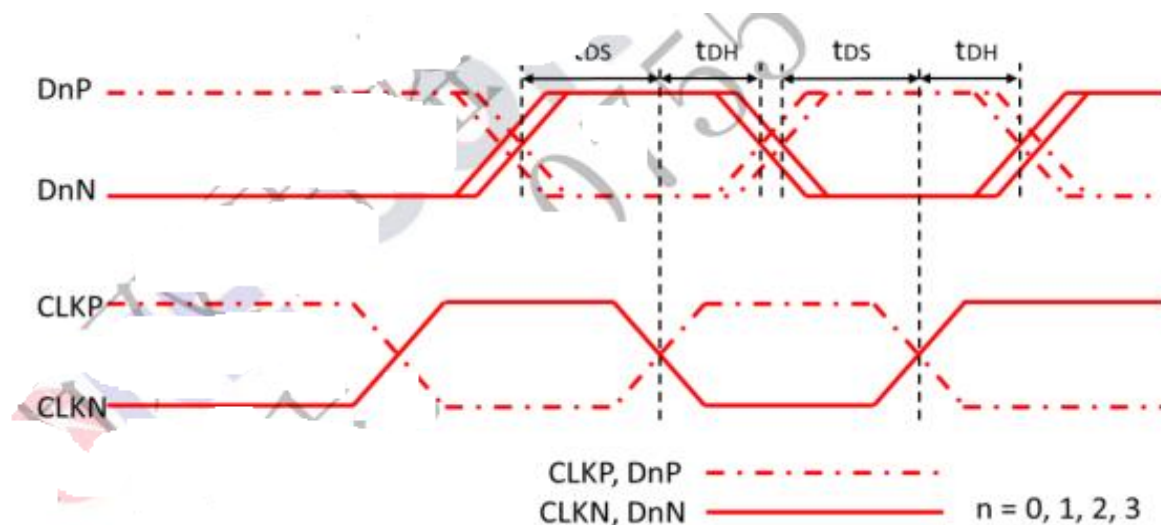
DSI Clock / Data Timings

Signal	Symbol	Parameter	Specification			Unit	Notes
			MIN	TYP	MAX		
Dn P/N	tDS	Data to Clock Setup time	0.15*UI			UI	
(n=0,1,2 and 3)	tDH	Clock to Data Hold time	0.15*UI			UI	

6.5.3 High Speed Mode - Rising and Falling Timings
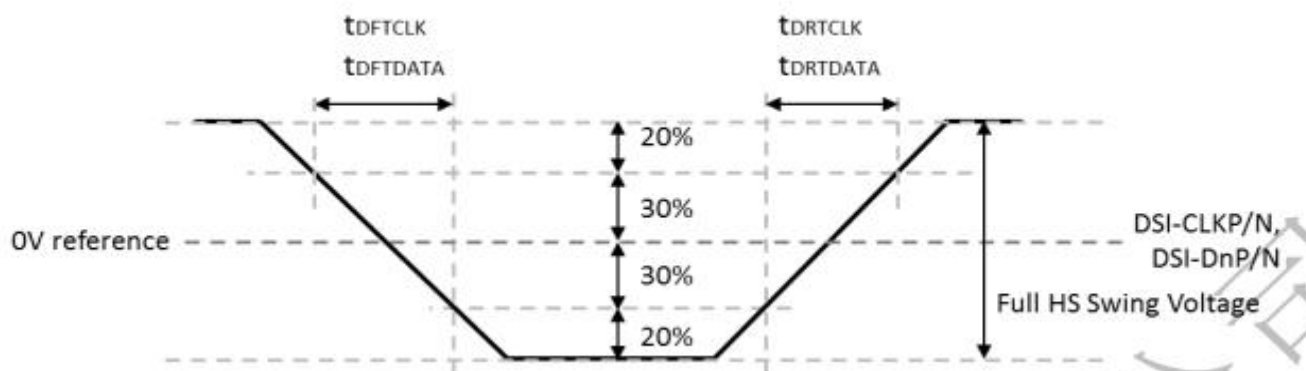
Rising and Falling Timings

Parameter	Symbol	Conditions	Specification			Unit	Notes
			MIN	TYP	MAX		
Differential Rise Time for Clock	t_{DRTCLK}	CLKP/N	150pS		0.3*UI		2,3
Differential Rise Time for Data	$t_{DRTDATA}$	DnP/N	150pS		0.3*UI		1,2,3
Differential Fall Time for Clock	t_{DFTCLK}	CLKP/N	150pS		0.3*UI		2,3
Differential Fall Time for Data	$t_{DFTDATA}$	DnP/N	150pS		0.3*UI		1,2,3

Note 1: DnP/N, n =0,1,2 and 3.
Note 2: The display module has to meet timing requriements,which are defined for the transmitter (MCU) on MIPI D-PHY standard.
Note 3: DSI-CLK+ = CLKP, DSI-CLK- =CLKN, DSI-D0+ =D0P, DSI-D0- =D0N.

6.5.4 Low Speed Mode - Bus Turn Around
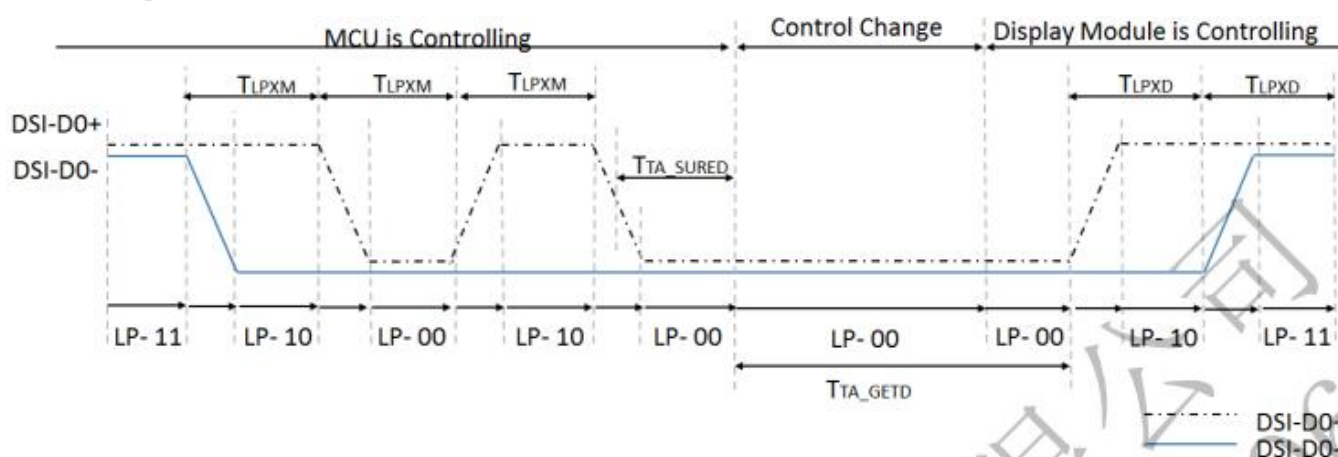
Bus Turnaround (BTA) from MCU to display module Timing
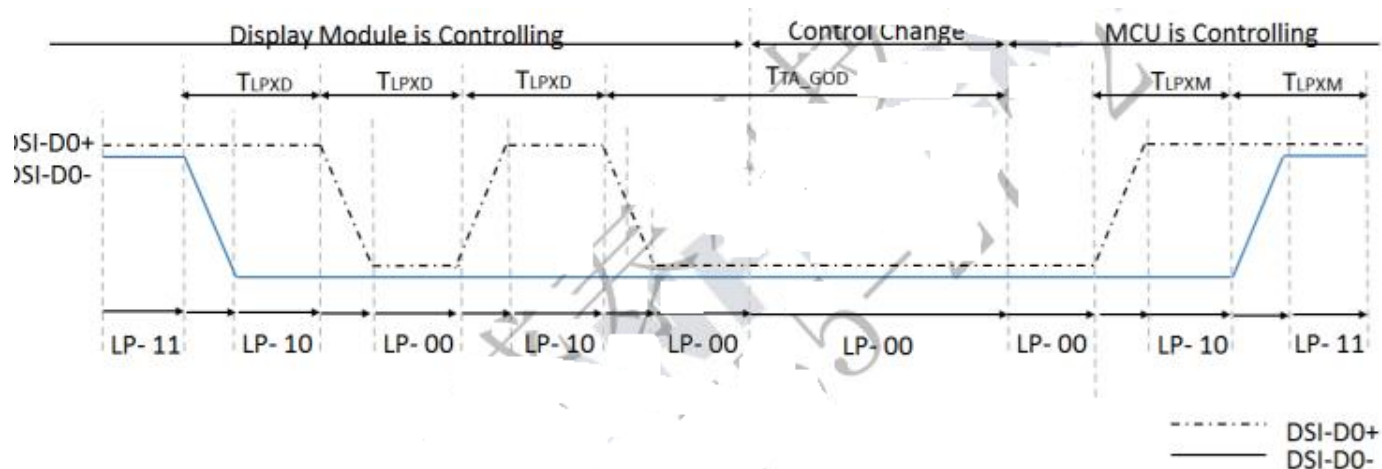
Bus Turnaround (BTA) from Display module to MCU Timing

Signal	Symbol	Parameter	Specification MIN	Specification TYP	Specification MAX	Unit	Notes
D0P/N	T_{LPXM}	Length of LP-00,LP-01,LP-10 or LP11 periods MCU to Display Module	50		75	nS	1
D0P/N	T_{LPXD}	Length of LP-00,LP-01,LP-10 or LP11 periods Display Module to MCU	50		75	nS	1
D0P/N	T_{TA_SURED}	Time-out before the Display Module starts driving	T_{LPXD}		$2* T_{LPXD}$	nS	1
D0P/N	T_{TA_GETD}	Time to drive LP-00 by Display Module	$5* T_{LPXD}$			nS	1
D0P/N	T_{TA_GOD}	Time to drive LP-00 after turnaround request -MCU	$4 * T_{LPXD}$			nS	1

Note 1: D0P = DSI-D0+, D0N = DSI-D0-.

6.5.5 Data Lanes from Low Power Mode to High Speed Mode
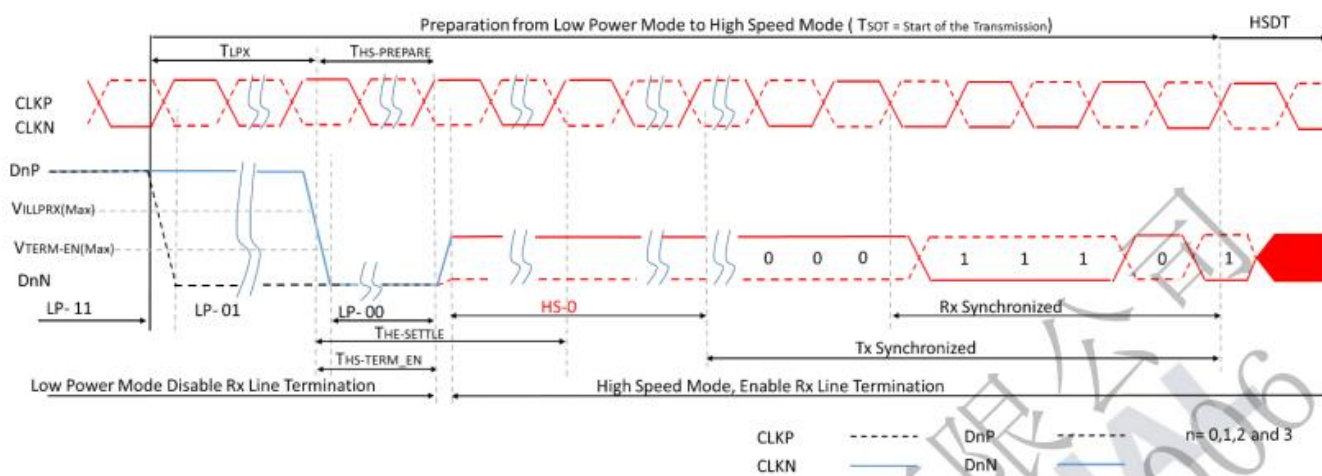
Data Lanes from Low Power Mode to High Speed Mode Timing

Signal	Symbol	Parameter	Specification			Unit	Notes
			MIN	TYP	MAX		
DnP/N	T_{LPX}	Length of any Low Power State Period	50			nS	1
DnP/N	$T_{HS-PREPARE}$	Time to drive LP-00 to prepare for HS Transmission	40+4*UI		85+6*UI	nS	1
DnP/N	$T_{HS-TREM-EN}$	Time to enable Data lane Receiver line termination measured from when Dn crosses VILMAX			35+4*UI	nS	1

Note 1: DnP/N, n=0,1,2 and 3.
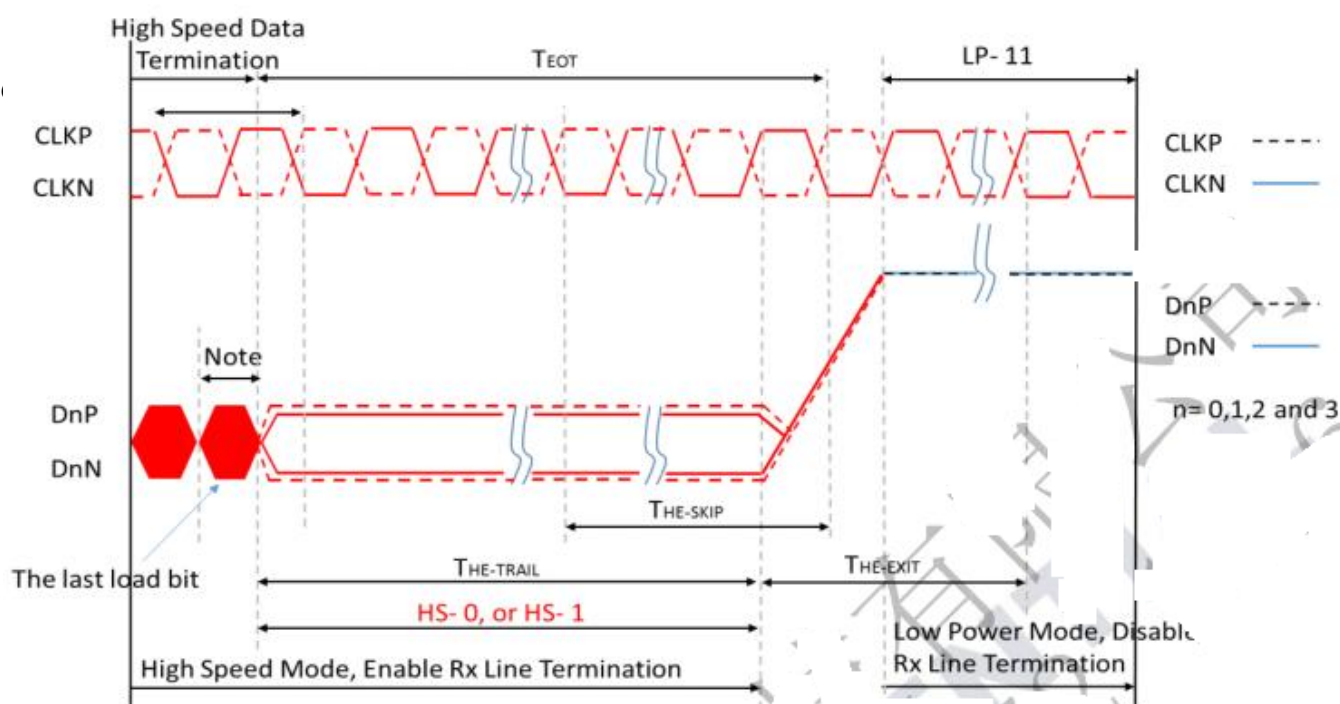
Note:
If the last load bit is HS- 0, the transmitter changes from HS- 0 to HS- 1.
If the last load bit is HS- 1, the transmitter changes from HS- 1 to HS- 0

Signal	Symbol	Parameter	Specification			Unit	Notes
			MIN	TYP	MAX		
DnP/N	$T_{HS-SKIP}$	Time-Out at Display Module to ignore transition period of EoT	40		55+4*UI	nS	1
DnP/N	$T_{HS-EXIT}$	Time to drive LP-11 after HS burst	100			nS	1

Note 1: DnP/N, n=0,1,2 and 3.

6.5.7 DSI Clock Burst － High speed mode to /from Low Power Mode
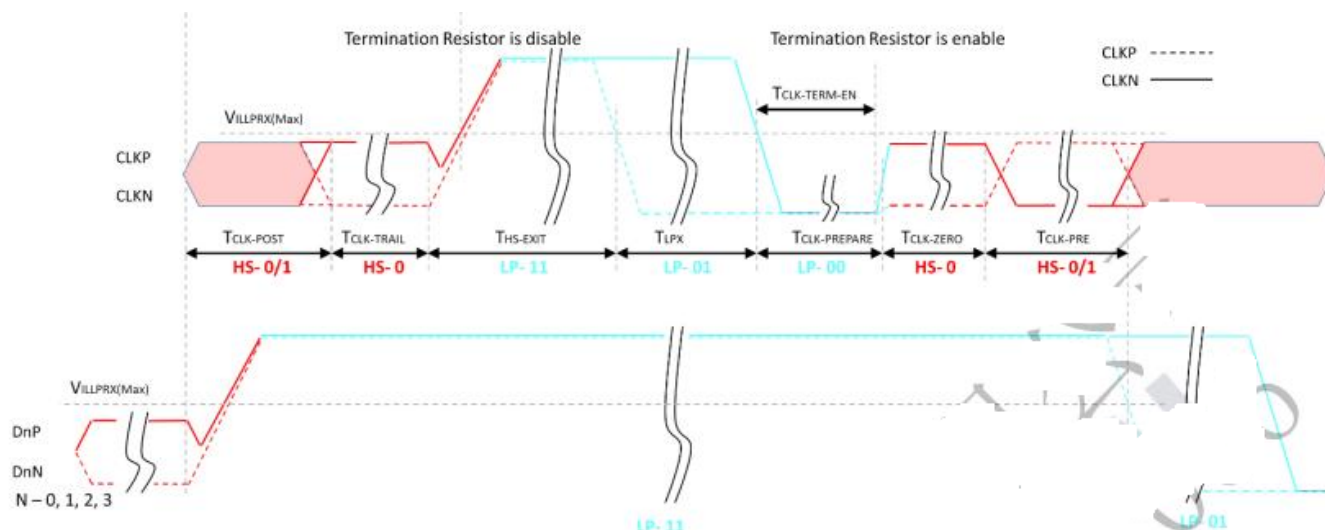
Clock Lane －High speed mode to / from Low Power Mode Timing

Signal	Symbol	Parameter	Specification			Unit	Notes
			MIN	TYP	MAX		
CKP/N	$T_{CK-POST}$	Time that the MCU shall continue sending HS clock after the last associated Data Lanes has transitioned to LP mode	60+52*UI			nS	
CKP/N	$T_{CLK-TRAIL}$	Time to drive HS differential state after last payload clock bit or a HS transmission burst	60			nS	
CKP/N	$T_{HS-EXIT}$	Time to drive LP-11 after HS burst	100			nS	
CKP/N	$T_{CLK-PREPARE}$	Time to drive LP-00 to prepare for HS transmission	38		95	nS	
CKP/N	$T_{CLK-TERM-EN}$	Time-out at Clock Lane to enable HS termination			38	nS	
CKP/N	$T_{CLK-PREPARE}$ $T_{CLK-ZERO}$	Minimum lead HS-0 drive period before starting Clock	300			nS	
CKP/N	$T_{CLK-PRE}$	Time that the HS clock shall be driven prior to any associated Data Lane beginning the transition from LP to HS mode	8*UI			nS	

6.6 Reset Timing
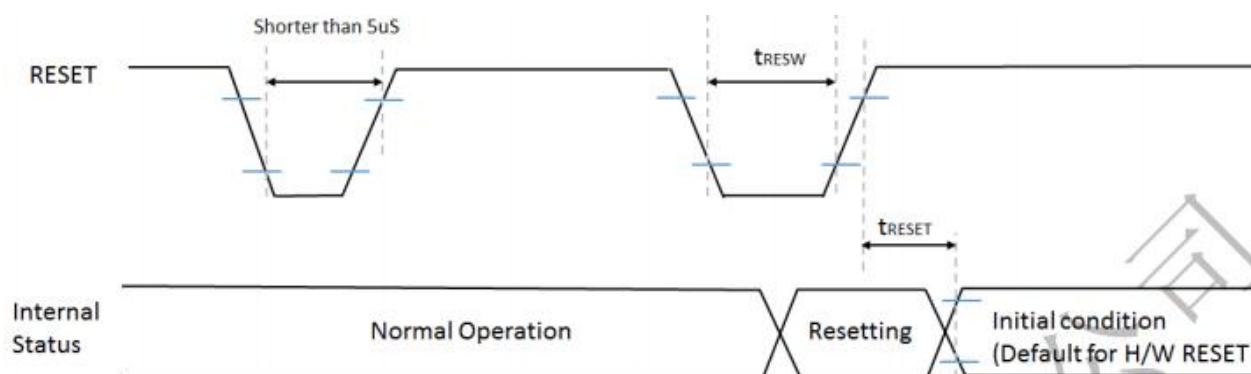
Reset Input Timing

Table 4-2 Reset Input Timing

Signal	Symbol	Parameter	Description	Specification			Unit	Notes
				MIN	TYP	MAX		
RESET	tRESW	Reset "L" pulse width		10			uS	1
	tRESET	Reset complete time	When reset applied during Sleep in mode			5	mS	2
			When reset applied during Sleep Out mode			120	mS	5

Note 1: Condition : Ta =25℃.

Note 2: Spike due to an electrostatic discharge on RESET line does not cause irregular system reset according to the table below.

RESET Pulse	Action
Less than 5us	Reset Rejected
More than 10uS	Reset
Between 5us and 10uS	Reset Start

Note 2: During the resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120ms, when Reset Starts in sleep out mode. The display remains the blank state in sleep in mode) and then return to Default condition for H/W RESET.

Note3: During Reset Complete Time, values in OTP memory will be latched to internal register during this period. This loading is done every time when there is H/W RESET complete time (tRESET) within 5ms after a rising edge of RESET.

Note 4: Spike Rejection also applies during a valid reset pulse as shown below:
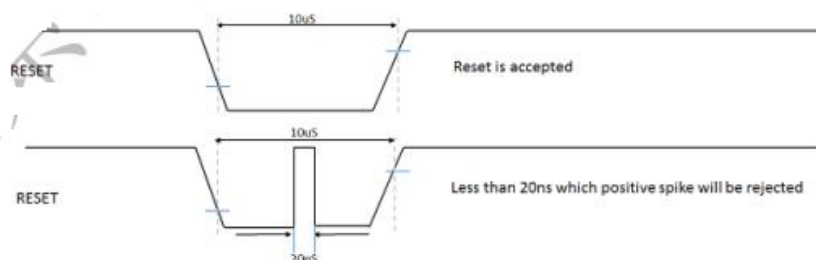
Note 5: It is necessary to wait 5ms after releasing RESET when sending commands, and Sleep Out command can not be sent within 120ms.

7. Optical Characteristics

Item	Symbol		Condition	Min.	Typ.	Max.	Unit	Note
Brightness	Bp		$\theta=0°$ $\Phi=0°$	-	300	-	Cd/m^2	1
Uniformity	⊿Bp			80	-	-	%	1,2
Viewing Angle	3:00		Cr≥10	-	85	-	Deg	3
	6:00			-	85	-		
	9:00			-	85	-		
	12:00			-	85	-		
Contrast Ratio	Cr		$\theta=0°$ $\Phi=0°$	-	600	-	-	4
Response Time	T$_{r+}$T$_f$			-	30	35	ms	5
Color of CIE Coordinate	W	x	$\theta=0°$ $\Phi=0°$	Typ -0.05	0.292	Typ +0.05	-	1,6
		y			0.337		-	
	R	x			0.650		-	
		y			0.322		-	
	G	x			0.280		-	
		y			0.563		-	
	B	x			0.135		-	
		y			0.141		-	
NTSC Ratio	S			-	68	-	%	

Note：The parameter is slightly changed by temperature, driving voltage and materiel

Note 1: The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment BM-7
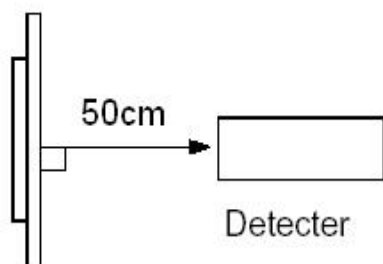
(Φ5mm)

Measuring condition:

- Measuring surroundings: Dark room.
- Measuring temperature: Ta=25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.

Measured value at the center point of LCD panel after more than 5 minutes while backlight turning on.

Note 2: The luminance uniformity is calculated by using following formula.

$\triangle Bp = Bp$ (Min.) $/ Bp$ (Max.)$\times100$ (%)

Bp (Max.) = Maximum brightness in 9 measured spots
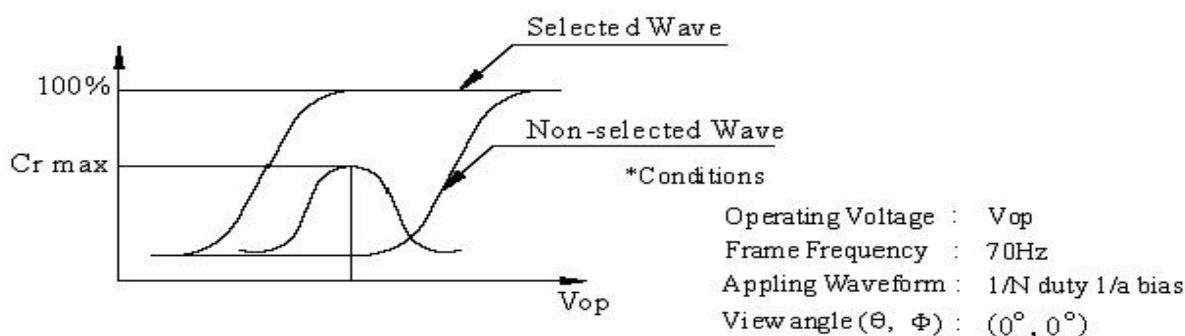
Bp (Min.) = Minimum brightness in 9 measured spots.
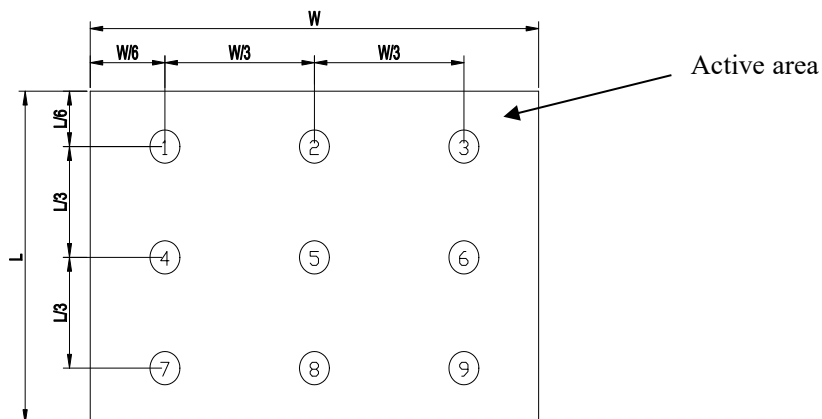
Note 3: The definition of viewing angle:
*Refer to the graph below marked by θ and Φ*
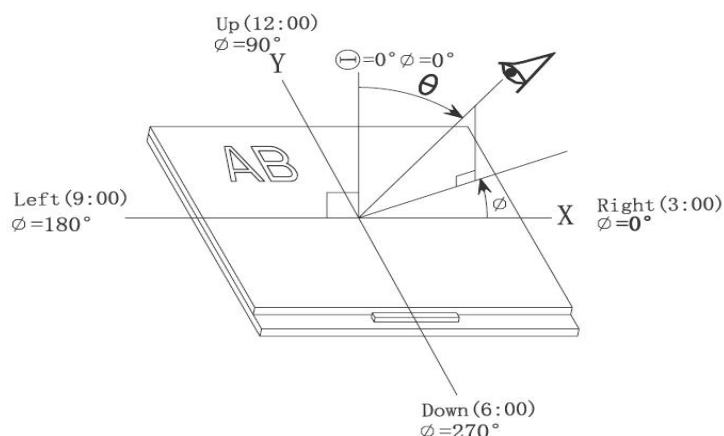
Note 4: Definition of contrast ratio.(Test LCD using DMS501)

Conditions

Operating Voltage : Vop
Frame Frequency : 70Hz
Appling Waveform : 1/N duty 1/a bias
View angle(Θ, Φ) : (0°, 0°)

$$Contrast\ ratio(Cr) = \frac{Brightness\ of\ selected\ dots}{Brightness\ of\ non-selected\ dots}$$

*Note 5: Definition of Response time. (Test LCD using DMS501):*
The output signals of photo detector are measured when the input signals are changed
from"black"to"white"(rising time)   and   from" white"to "black"(falling time), respectively.
The response time is defined as the time interval between the 10% and 90% of
amplitudes.Refer to figure as below.
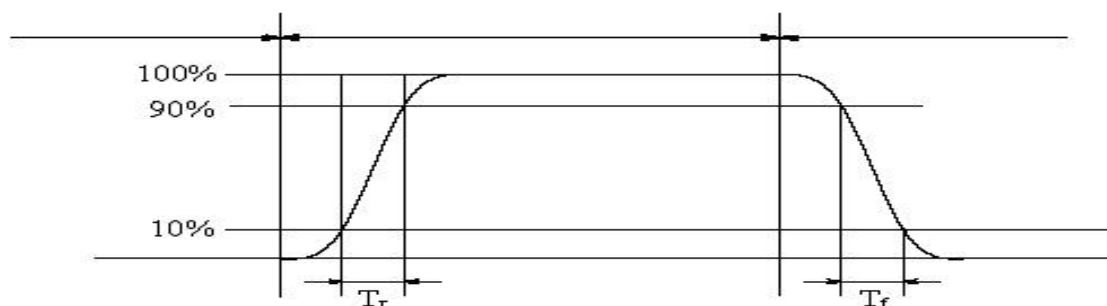
The definition of response time

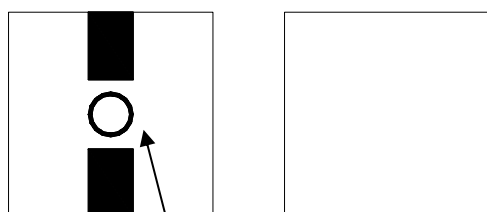*Note 6: Definition of Color of CIE Coordinate and NTSC Ratio.*

1931 CIE Chromaticity Diagram
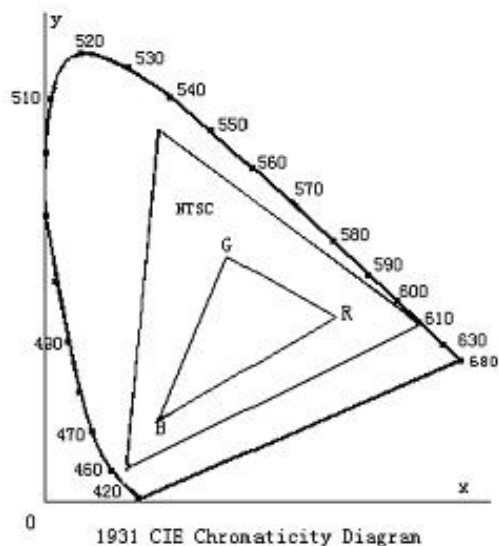
Color gamut:

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

Note 7: Definition of cross talk.

*Cross talk ratio(%)=|pattern A Brightness-pattern B Brightness|/pattern A Brightness*100*

Pattern A   Pattern B

Measurement point(center)

Electric volume value=3F+/-3Hex

8. Reliability Test Items and Criteria

Test Item	Test condition	Remark
High　Temperature Storage	Ta = 80℃　96hrs	Note1,Note3，4
Low　Temperature Storage	Ta = -30℃　96hrs	Note1,Note3，4
High　Temperature Operation	Ts = 70℃　96hrs	Note2,Note3，4
Low Temperature Operation	Ta = -20℃　96hrs	Note1,Note3，4
Operation at High Temperature/Humidity	+60℃, 90%RH 96hrs	Note3，4
Thermal Shock	-30℃/30 min ~ +80℃/30 min for a total 10 cycles, Start with cold temperature and end with high temperature.	Note3，4
Vibration Test	Frequency range:10~55Hz Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X. Y. Z. (6 hours for total)	
Mechanical Shock	100G 6ms,±X, ±Y, ±Z 3 times for each direction	
Package Vibration Test	Random Vibration : 0.015G*G/Hz from 5-200HZ, -6dB/Octave from 200-500HZ 2 hours for each direction of X. Y. Z. (6 hours for total)	
Package Drop Test	Height:60cm 1 corner, 3 edges, 6 surfaces	
Electro Static Discharge	±2KV, Human Body Mode, 100pF/1500Ω	

Note 1: Ta is the ambient temperature of samples.

Note 2: Ts is the temperature of panel's surface.

Note 3: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but don't guarantee all of the cosmetic specification.

Note 4: Before cosmetic and function test, the product must have enough recovery time,at least 2 hours at room temperature

9. *Precautions for Use of LCD Modules*

9.1 Handling Precautions

9.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

9.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

9.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

9.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

9.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

> *— Isopropyl alcohol   — Ethyl alcohol*

Solvents other than those mentioned above may damage the polarizer.   Especially, do not use the following:

> *— Water   — Ketone   — Aromatic solvents*

9.1.6 Do not attempt to disassemble the LCD Module.

9.1.7 If the logic circuit power is off, do not apply the input signals.

9.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

> *a. Be sure to ground the body when handling the LCD Modules.*
>
> *b. Tools required for assembly, such as soldering irons, must be properly ground.*
>
> *c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.*
>
> *d. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.*

9.2 Storage precautions

9.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

9.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature :   0℃ ～ 40℃

Relatively humidity: ≤80%

9.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

9.3 The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.

END