SPECIFICATION
FOR
TFT LCD MODULE

CUSTOMER : _____

CUSTOMER MODULE : _____

HL MODEL : HG070WU038T01

□**Preliminary Specification**

■**Final Specification**

Customer Confirmation column:

Approved by :_____ Dept. :_____ Data :_____

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Designed by	Checked by	Approved by

Record of Revision

Version	Revise Date	Page	Content
V1.0	3/21/2020		To release 1st version

Contents

1. General Specifications

1.1. Description

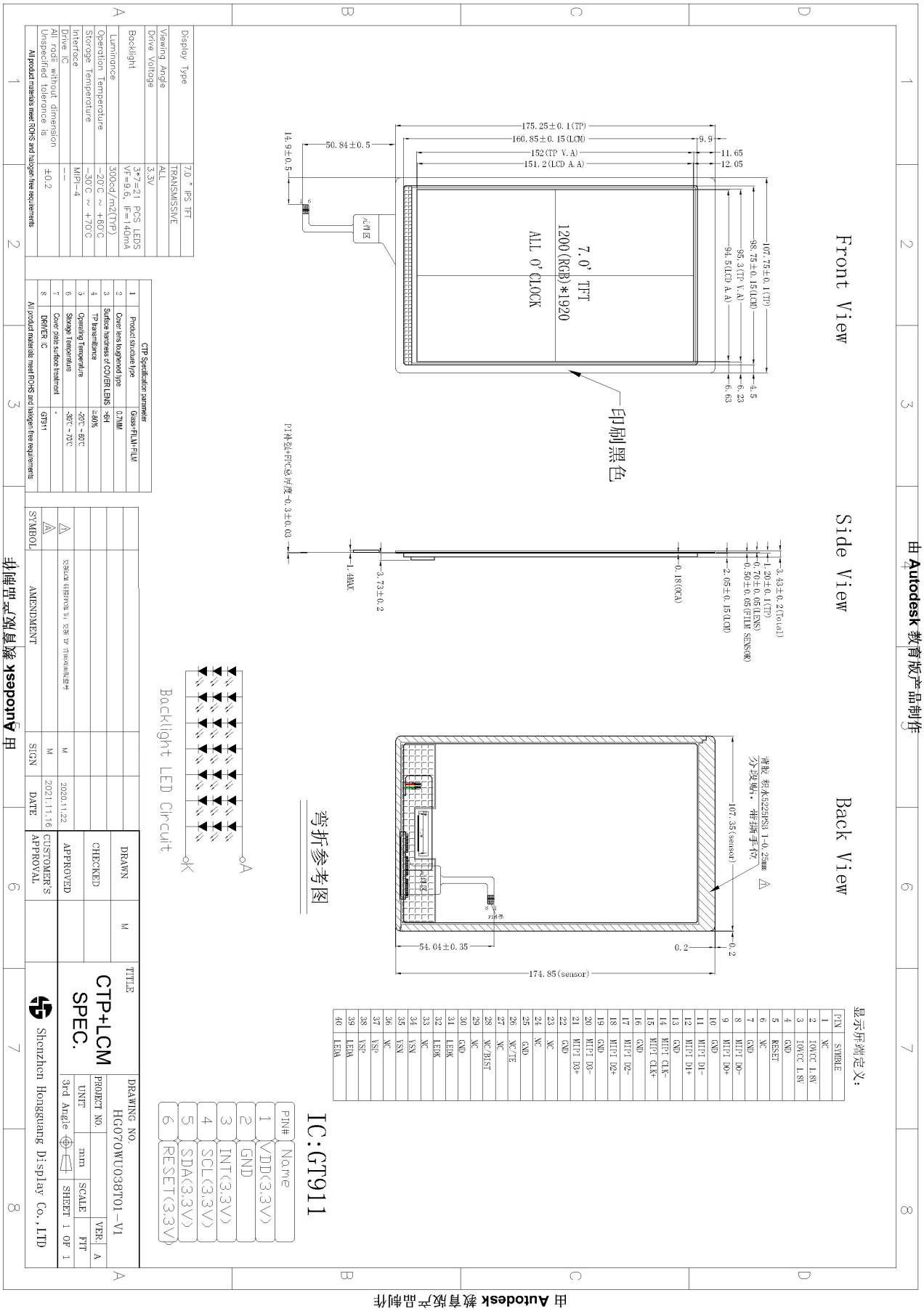
This model is a color active matrix TFT LCD that uses Low-temperature poly-silicon TFT as a switching device. It is composed of a TFT LCD cell, IC and FPC. And it has a 7.02 (10:16) inch diagonally measured active display area with WUXGA (1200 horizontal by 1920 vertical pixel) resolution.

1.2. GENERAL SPEC1F1CATIONS

No.	Item	specification	Unit	Remark
1	Size	7.02 (Diagonal)	inch	-
2	Driver element	LTPS TFT active matrix		-
3	Resolution	1200 × 3(RGB) × 1920		-
4	Display mode	Normally Black		-
5	View direction(Gray Inversion)	Free		-
6	Pixel pitch	0.07875(W) × 0.07875(H)	mm	
7	Active area	94.5(W) × 151.2(H)	mm	
8	Panel size	98.75(W)x160.85(H)x2.1(D) (Typ.)	mm	Note 1
9	Surface treatment	Hard coating		
10	Color arrangement	RGB-stripe		
11	Interface	MIPI		
12	Panel power consumption	Typ. 0.14 (max. 0.17)	W	
13	Weight	27.17	g	

Note 1: Refer to mechanical drawing.

2. Mechanical Drawing



3.Pin Assignment

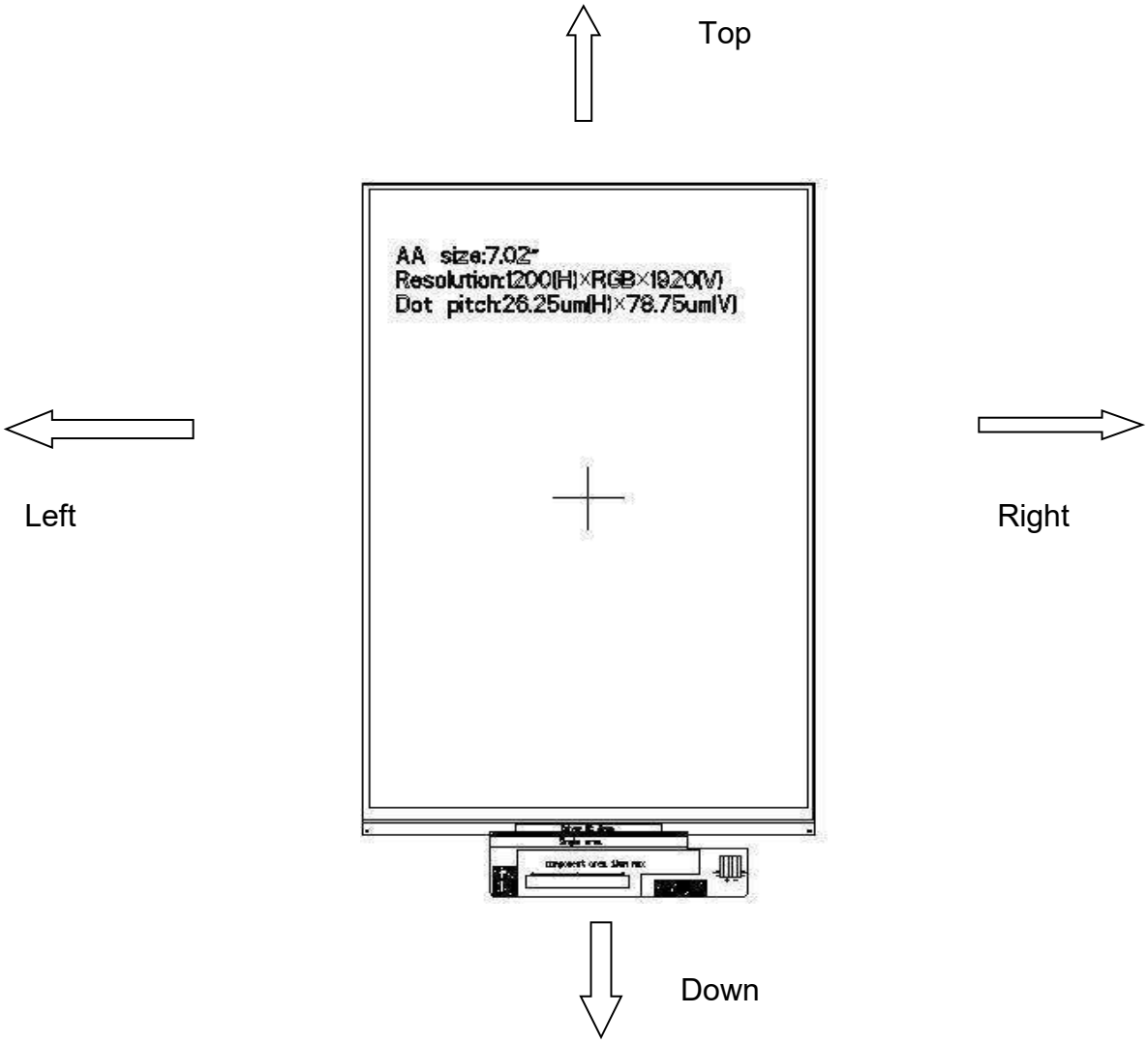
3.1.Pin assignment for LCM

A 40pin connector is used for the module electronics interface. This model used “F62240-H1210B” manufactured by Vigorconn Technology.

Pin No.	symbol	Description
1	NC	No connection
2	1OVCC	Power supply for system ,IOVCC=1.8V
3	1OVCC	
4	GND	Ground
5	RST	Device reset signal
6	NC	No connection
7	GND	Ground
8	MIPI- 0N	MIPI Negative data signal (-)
9	MIPI-0P	MIPI Positive data signal (+)
10	GND	Ground
11	MIPI-01N	MIPI Negative data signal (-)
12	MIPI-1P	MIPI Positive data signal (+)
13	GND	Ground
14	MIPI-CKN	MIPI Negative clock signal (-)
15	MIPI-CKP	MIPI Positive clock signal (+)
16	GND	Ground
17	MIPI- 2N	MIPI Negative data signal (-)
18	MIPI- 2P	MIPI Positive data signal (+)
19	GND	Ground
20	MIPI- 3N	MIPI Negative data signal (-)
21	MIPI- 3P	MIPI Positive data signal (+)
22	GND	Ground
23	HS	Horizontal scan Signal for touch
24	VS	Vertical scan Signal for touch
25	GND	Ground
26	NC/TE	Tearing effect output signal for NVM(OTP),Let it open when not in use
27	PWMO	PWM control signal for LED driver (CABC)
28	NC/BIST	Enables the Test Image Generation function, if not used, connect to ground
29	NC	No connection
30	GND	Ground
31	LED-	LED cathode
32	LED-	

33	NC	No connection
34	VSN	Analog supply negative voltage
35	VSN	
36	NC	No connection
37	VSP	Analog supply positive voltage
38	VSP	
39	LED＋	LED anode
40	LED＋	

Note: Definition of scanning direction. Refer to the figure as below:



4.Electrical specifications

4.1 Backlight Characteristic

Item	Symbol	Min	Typical	Max	Unit
LED module Forward voltage	V_F	-	9.6V	-	V
LED module current	IF		140		mA
Surface Luminance ☆1	L_S		300		Cd/㎡
LCM Surface brightness uniform☆2	L_D	80			%

☆ 1Test condition is:

(a) Center point on active area.

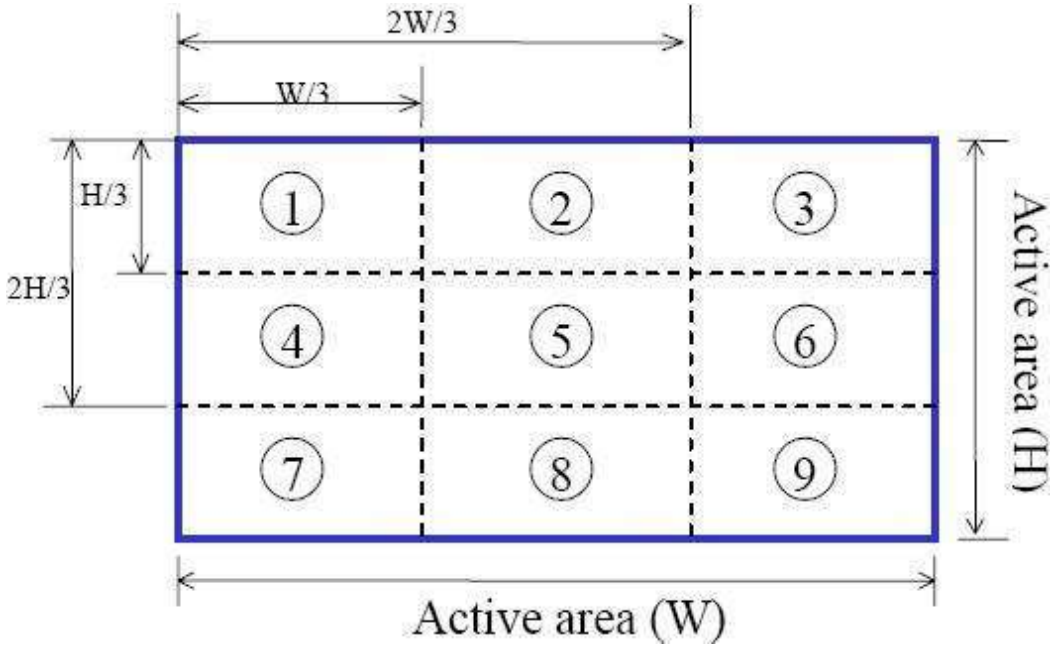
(b) Blank Display

☆2Uniform measure condition:

(1)Measure 9 point. Measure location show below;

(2)Uniform=(Min. brightness /Max. brightness)*100%

(3) Blank Display



4.2. ABSOLUTE MAXIMUM RATINGS

(GND=AV_{SS}=0V, Note 1)

Item	Symbol	Values		Unit	Remark
		Min.	Max.		
Power voltage	IOVCC	0	4.6	V	
	VSP	0	6.5	V	
	VSN	-6.5	0	V	
Operation Temperature Storage Temperature	T_{OP}	-10	60	℃	
	T_{ST}	-30	70	℃	

Note : The absolute maximum ratings are the values that must not be exceeded at any time for this product. It is not allowed for any of these ratings to be exceeded. Should a module be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme case, the module may be permanently destroyed. Therefore, when designing a system incorporating the module, make sure that adequate attentions be paid to the variations in the supply voltages, the characteristics of parts that are connected, surges in the input and output lines, and the ambient temperatures.

4.3. Typical Operation Conditions

4.3.1. DC Characteristics

(Ta=25°C)

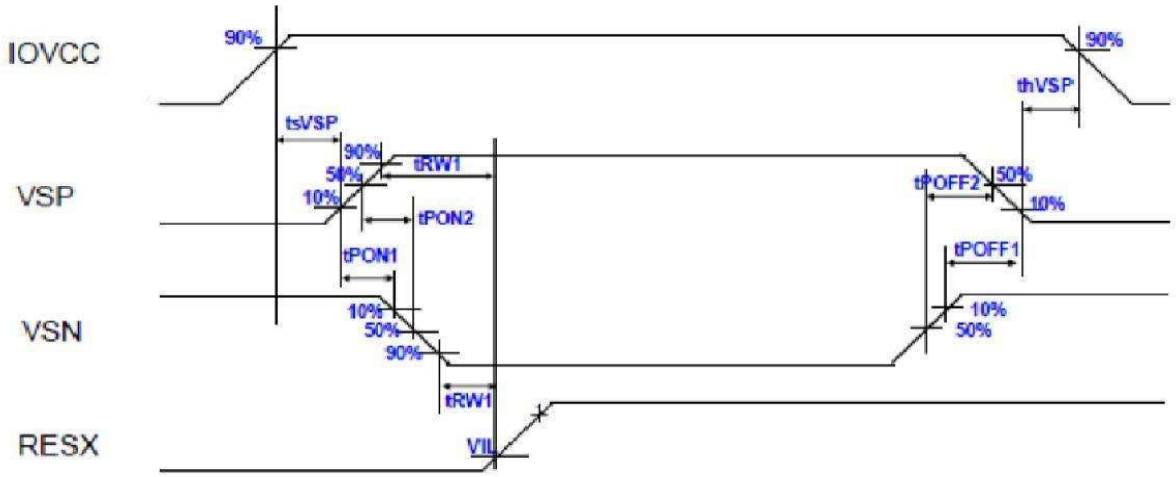
Item		Symbol	Min.	Typ.	Max.	Unit	Remark
Power supply voltage for Analog		VSP	5.3	5.5	5.7	V	
		VSN	-5.7	-5.5	-5.3	V	
Power supply voltage for Logic		IOVCC	1.70	1.80	1.90	V	
Input signal voltage (RES)		V_{IL}	0	-	0.3*IOVCC	V	XRES
		V_{IH}	0.7*IOVCC	-	IOVCC	V	
Output signal voltage (TE)		V_{OL}	0	-	0.2*IOVCC	V	TE
		V_{OH}	0.8*IOVCC	-	IOVCC	V	
Input signal voltage (DSI)	Low level	$V_{IL(DSI)}$	-50	-	550	mV	Low Power Receiver
	High level	$V_{IH(DSI)}$	880	-	1350	mV	
	Input voltage	V_{CMRX}	70	-	330	mV	High Speed Receiver
	Differential input low threshold	V_{IDTL}	-70	-	-	mV	
	Differential input high threshold	V_{IDTH}	-	-	70	mV	

Note 1) The recommended operating conditions refers to a range in which operation of this product is guaranteed. Should this range is exceeded, the operation cannot be guaranteed even if the values may be withing the absolute maximum ratings. Accordingly, please make sure that the module is used within this range.

4.3.2. Current Consumption

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Current for Driver	IOVCC	-	12	24	mA	White Pattern
	VSP	-	10	13	mA	
	VSN	-	10	13	mA	

4.3.3. Power Sequence

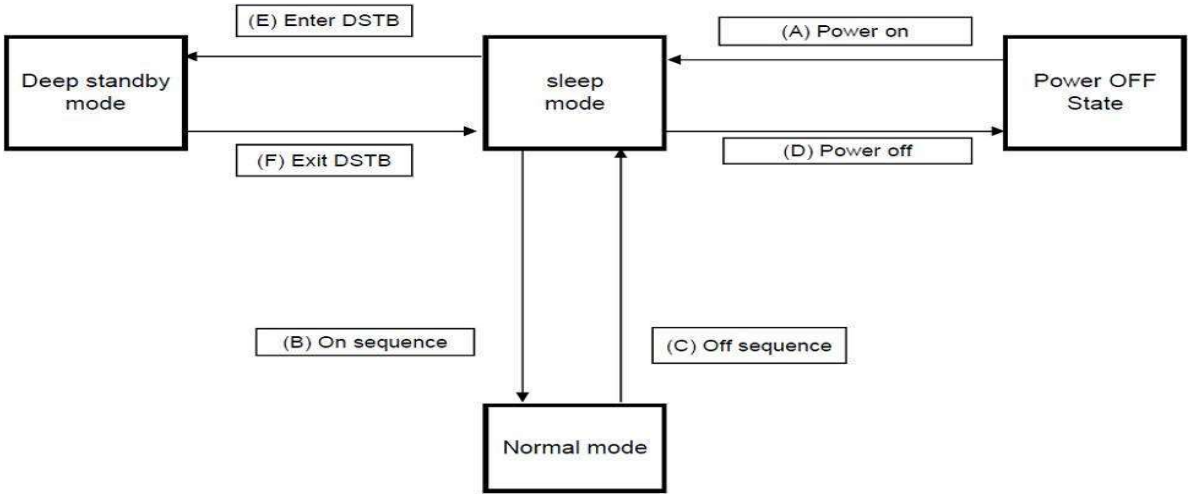


Item	Symbol	Unit	Min	Max
IOVCC on to VSP on time	tsVSP	ms	1	-
VSP on to VSN on time	tPON1	ms	0	-
VSN on to REST on time	tRW1	ms	1	-
VSN off to VSP off time	tPOFF1	ms	0	-
VSP off to IOVCC off time	thVSP	ms	0	-

4.4. Command sequence

4.4.1 Status Flow

(1200RGBx1920, R69429, MIPI 4lane)



4.4.2 Sequence

(A) Power on

sequence	DataType (hex)	index (hex)	parameters #	parameters (hex)	description	comment
POWER OFF STATE						
PWR supply on					IOVCC on	DSI input should be at GND level while IOVCC off
wait 5ms						
PWR supply on					VSP,VSN on	
wait 20ms						
RESET L->H					RESET L->H	
wait 10ms						
PWR supply off					VSP,VSN off	(*1)Can skip "VSP/VSN off" in case of going to normal mode without staying sleep status.
(wait 20ms)						
SLEEP MODE						

(B) On sequence

sequence	DataType (hex)	Index (hex)	parameters #	parameters (hex)	description	comment
SLEEP MODE						
PWR supply on					VSP,VSN on	
wait 20ms						
command	05	01	-	-	soft reset	
wait 10ms						
command	23	B0	1	00	MCAP	
command	29	B3	1	14	Interface setting	
			2	08		
			3	00		
			4	22		
			5	00		
command	29	B4	1	0C	Interface ID setting	
command	29	B6	1	3A	DSI control	
			2	D3		
command	15	51	1	E6-	write display brightness	
command	15	53	1	2C	write control display	
command	05	29	-	-	set display on	
wait 10ms						
command	05	11	-	-	exit sleep mode	
Wait 120ms						
NORMAL MODE						

(C) Off sequence

sequence	DataType (hex)	index (hex)	parameters #	parameters (hex)	description	comment
NORMAL MODE						
↓						
command	05	28	-	-	set display off	
wait 20ms						
command	05	10	-	-	enter sleep mode	
wait 80ms						
stop HS transmission						
PWR supply off					VSP,VSN off	
wait 20ms						
↓						
SLEEP MODE						

(D) Power off

sequence	DataType (hex)	index (hex)	parameters #	parameters (hex)	description	comment
SLEEP MODE						
↓						
RESET H->L						
PWR supply off					IOVCC off	DSI data/clk should be at GND level after IOVCC off.
↓						
POWER OFF STATE						

(E) Enter DSTB

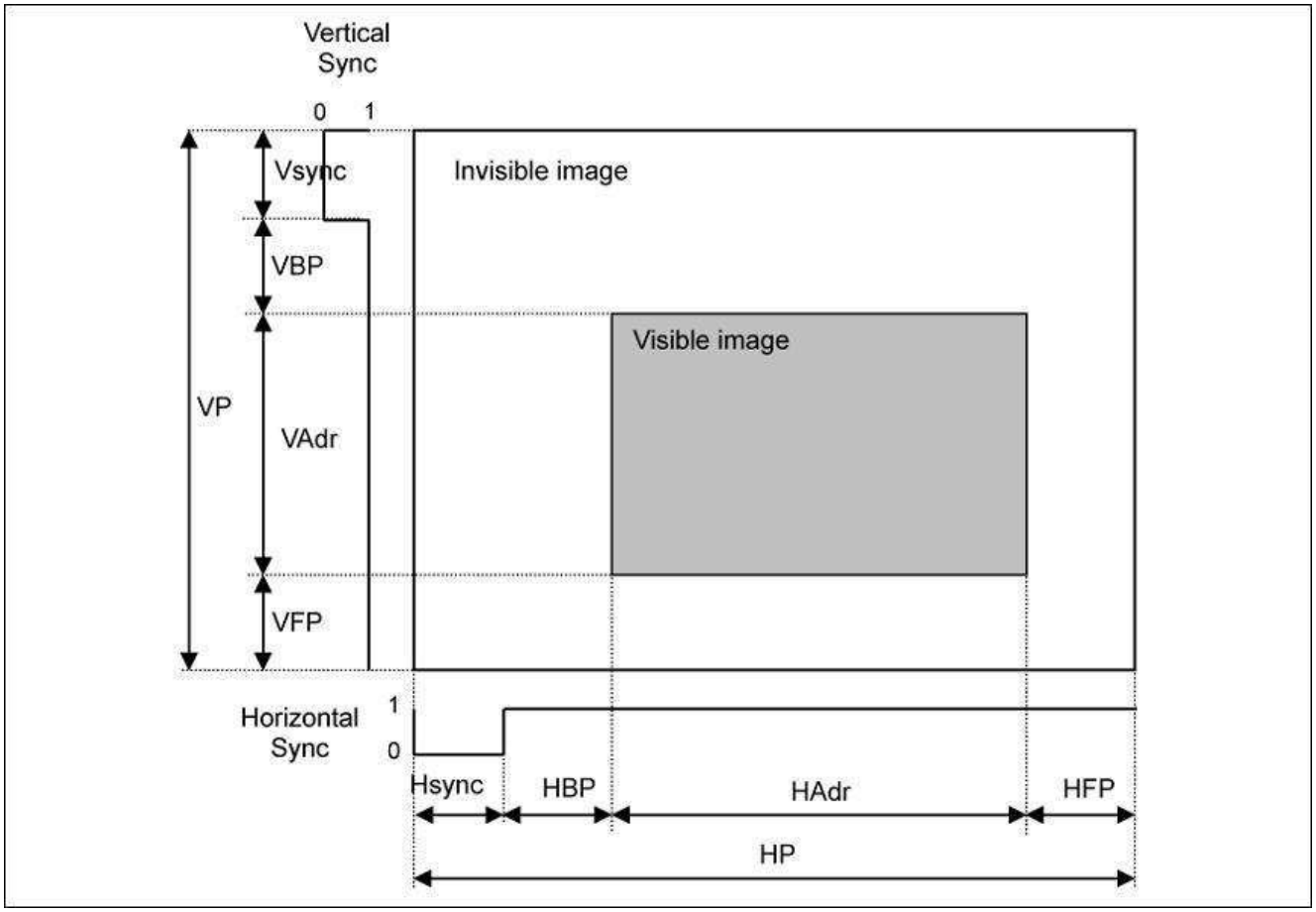
sequence	DataType (hex)	index (hex)	parameters #	parameters (hex)	description	comment
SLEEP MODE						
↓						
command	23	B0	1	00	MCAP	
command	23	B1	1	01	DSTB=1	
↓						
DSTB MODE						

(F) Exit DSTB

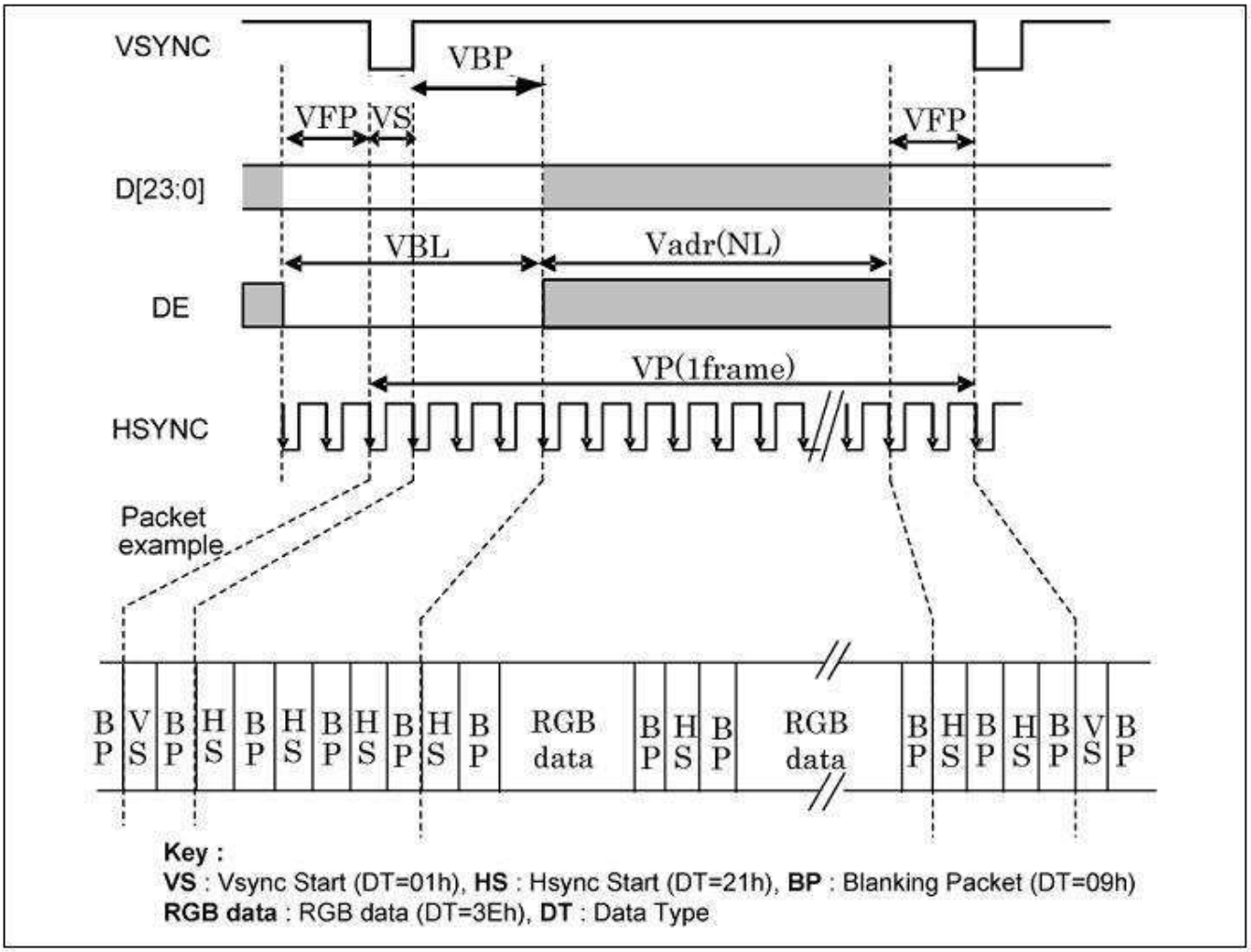
sequence	DataType (hex)	index (hex)	parameters #	parameters (hex)	description	comment
DSTB MODE						
↓						
RESET H -> L						
wait 10ms						
PWR supply on					VSP,VSN on	
wait 20ms						
RESET L->H					RESET L->H	
wait 10ms						
PWR supply off					VSP,VSN off	(*1)Can skip "VSP/VSN off" in case of going to normal mode without staying sleep status.
(wait 20ms)						
↓						
SLEEP MODE						

4.5. Display Timing (Video Mode)

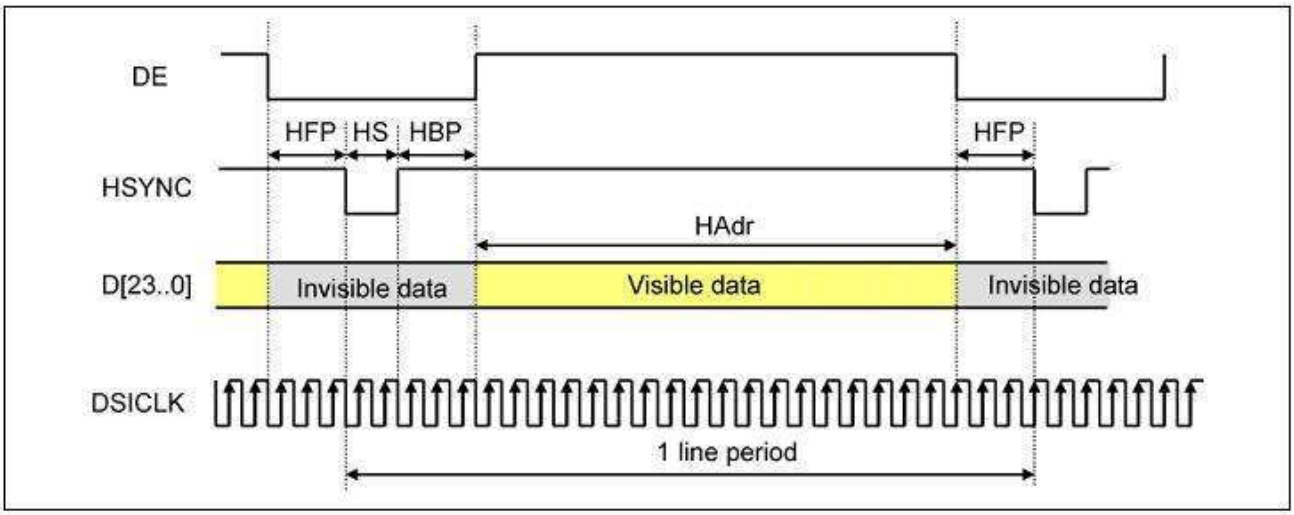
Transmission packet sequence in video mode	RSP LCD driver implementation
Non-burst mode with sync pulses	Not supported
Non-burst mode with sync events	Supported
Burst mode	Supported



Vertical Display Timing



Horizontal Display Timing



Vertical Display Timing (Video Mode, RM = 1h, DM = 3h, Method-1)

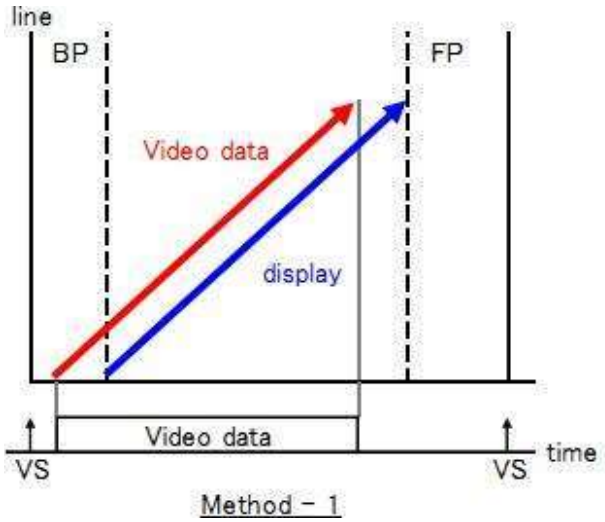
Item	Symbol	Condition	Unit	Min.	Typ.	Max.	Notes
Vertical cycle	VP		Line	1448	1928	1928	
Vertical low pulse width	VS		Line	1	1	-	See
Vertical front porch	VFP		Line	4	-	-	
Vertical back porch	VBP		Line	4	-	BP-3	See
Vertical data start point	-	VS+VBP	Line	5	-	BP-4	See
Vertical blanking period	VBL	VBP+VFP	Line	8	-	-	
Vertical active area	Vadr		Line	1440	1920	1920	

Note: "VS + VBP" is set as back porch by BP register.
1 line : prescribed by HSYNC (when RM = 2'h0, DM = 4'h1)
prescribed by RTN setting (whenRM = 2'h1, DM = 4'h3)
BP : register setting

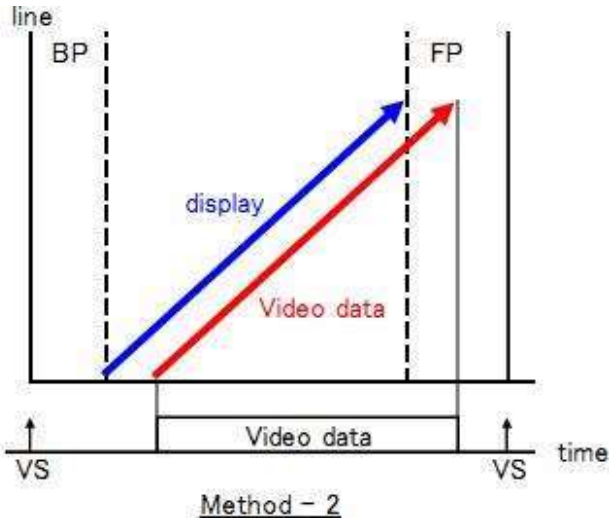
Vertical Display Timing (Video Mode, RM = 1h, DM = 3h, Method-2)

Item	Symbol	Condition	Unit	Min.	Typ.	Max.	Notes
Vertical cycle	VP		Line	1448	1928	1928	
Vertical low pulse width	VS		Line	1	1	-	See
Vertical front porch	VFP		Line	4	-	-	
Vertical back porch	VBP		Line	BP+3	-	-	See
Vertical data start point	-	VS+VBP	Line	BP+4	-	-	See
Vertical blanking period	VBL	VBP+VFP	Line	BP+7	-	-	See
Vertical active area	Vadr		Line	1440	1920	1920	

Note: "VS + VBP" is set as back porch by BP register.
1 line : prescribed by HSYNC (when RM = 2'h0, DM = 4'h1)
prescribed by RTN setting (whenRM = 2'h1, DM = 4'h3)
BP : register setting



Method – 1



Method – 2

Horizontal Display Timing (Video Mode, RM = 1h, DM = 3h)

Item	Symbol	Condition	Unit	Min.	Typ.	Max.	Notes
Horizontal front porch	HFP		ByteClock	4lane:100+β	-	-	
Horizontal data start point	-	HS+HBP	ByteClock	45+α	-	-	
Horizontal active area	Hadr		Pixel	1080 -	- 1280	1200 -	1Chip 2Chip

Note: fByteClock = (1/4) * fDSICLK. fByteClock = frequency of ByteClock.
α, β ≦ 45 ByteClock
Please refer to the following restrictions about α, β.

Vertical Display Timing (Video Mode, DM = 1h)

Item	Symbol	Condition	Unit	Min.	Typ.	Max.	Notes
Vertical cycle	VP		Line	1448	1928	-	
Vertical low pulse width	VS		Line	1	1	-	See
Vertical front porch	VFP		Line	4	-	-	
Vertical back porch	VBP		Line	4	-	-	See
Vertical data start point	-	VS+VBP	Line	5	-	-	
Vertical blanking period	VBL	VBP+VFP	Line	8	-	-	
Vertical active area	Vadr		Line	1440	1920	-	

Note: "VS + VBP" is set as back porch by BP register.
1 line : prescribed by HSYNC (when RM = 2'h0, DM = 4'h1)
prescribed by RTN setting (when RM = 2'h1, DM = 4'h3)

Horizontal Display Timing (Video Mode, RM = 0h, DM = 1h)

Item	Symbol	Condition	Unit	Min.	Typ.	Max.	Notes
Horizontal front porch	HFP		ByteClock	4lane:100+β	-	-	
Horizontal data start point	-	HS+HBP	ByteClock	45+α	-	-	
Horizontal active area	Hadr		Pixel	1080 -	- 1280	1200 -	1Chip 2Chip

Note: fByteClock = (1/4) * fDSICLK. fByteClock = frequency of ByteClock.
α, β ≦ 45 ByteClock
Please refer to the following restrictions about α, β.

5.OPTICAL CHARACTERISTICS

(T_a=+25℃)

Item	Symbol	Condition	Values			Unit	Remark
			Min.	Typ.	Max.		
Viewing angle (CRS 10)	0_L	0=180°(9 o'clock)	-	80	-	degree	Note 1 Note 5
	0_R	0=0°(3 o'clock)	-	80	-		
	0_T	0=90°(12 o'clock)	-	80	-		
	0_B	0=270°(6 o'clock)	-	80	-		
Response time	T_{ON+} T_{OFF}	Normal 0=0=0°		25		msec	Note 2 Note 3
Contrast ratio	CR			1200	-	-	Note 4 Note 5
Color chromaticity	W_X		-	0.31	-	-	Note 5
	W_Y		-	0.33	-	-	
Transmittance	Tr	-	-	3.8	-	%	Note 5
NTSC Ratio				71.5		%	Note 5

Test Conditions:

VCC=1.8V, the ambient temperature is 25℃.

The test systems refer to Note 2.

Note 1: Definition of viewing angle range

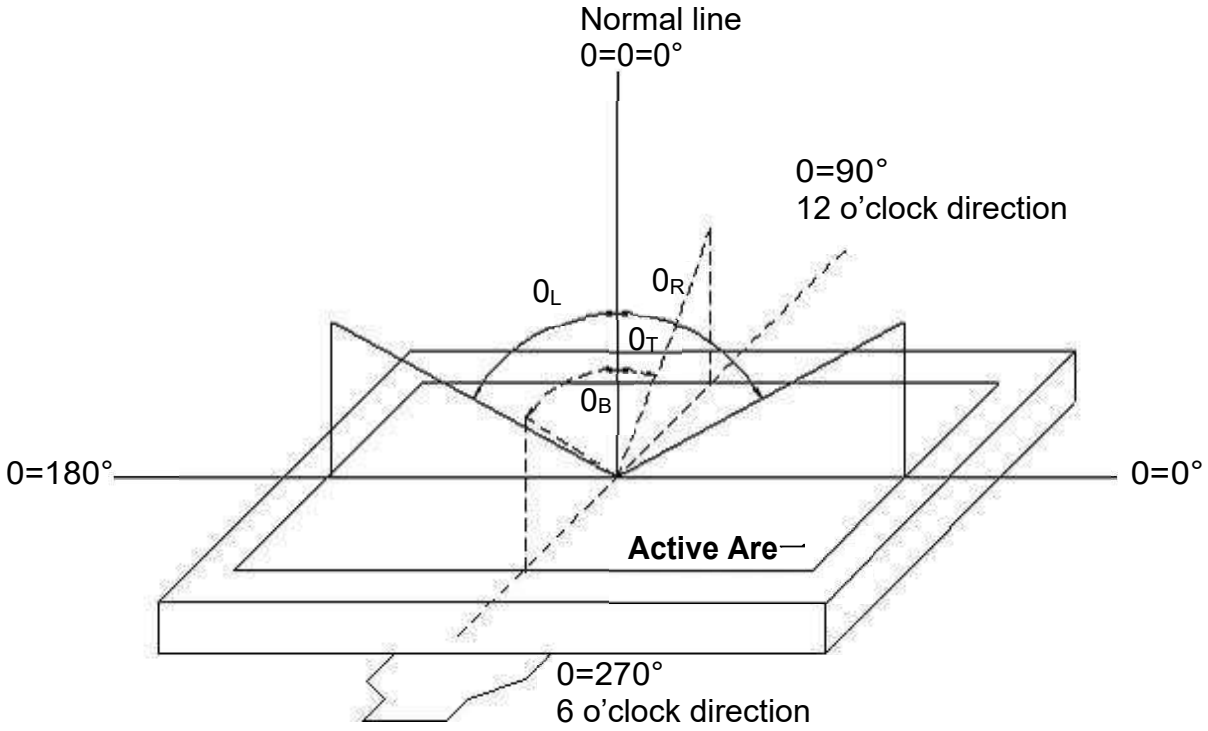


Fig. 4-1 Definition of viewing angle

Note 2: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 30 minutes operation, the optical properties are measured at the center point of the LCD screen. (Viewing angle is measured by ELDIM-EZ contrast/Height :1.2mm, Response time is measured by Photo detector TOPCON BM-7, other items are measured by BM-5A/ Field of view: 1° /Height: 500mm.)

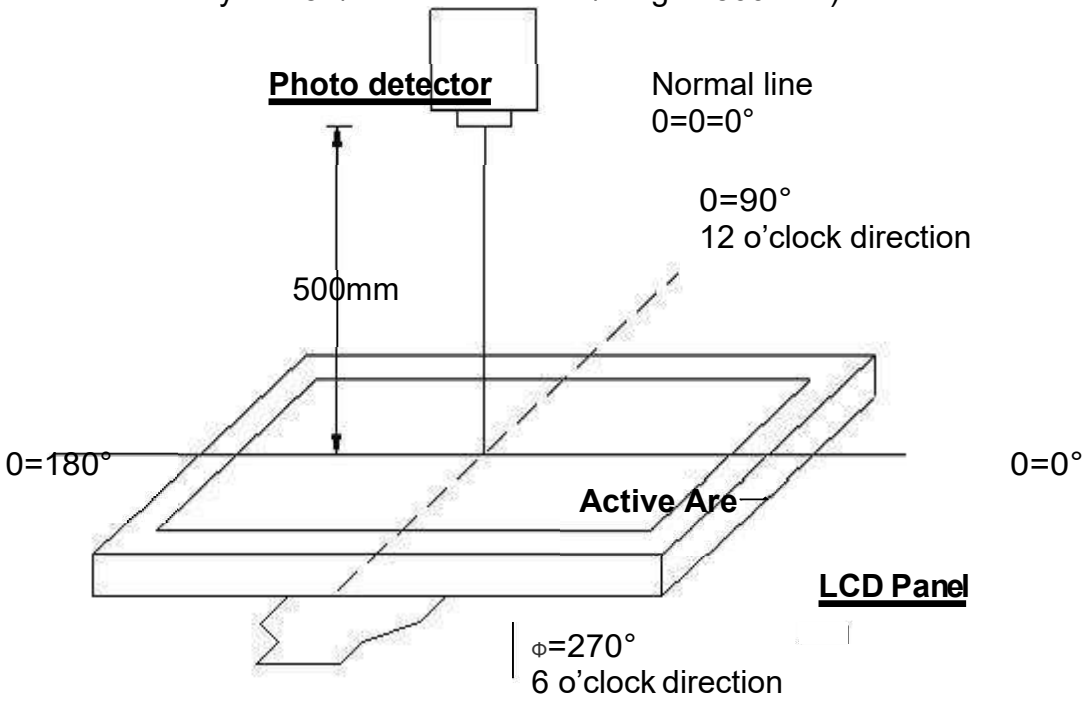


Fig. 4-2 Optical measurement system setup

Note 3: Definition of Response time

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time (T_{ON}) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T_{OFF}) is the time between photo detector output intensity changed from 10% to 90%.

5.

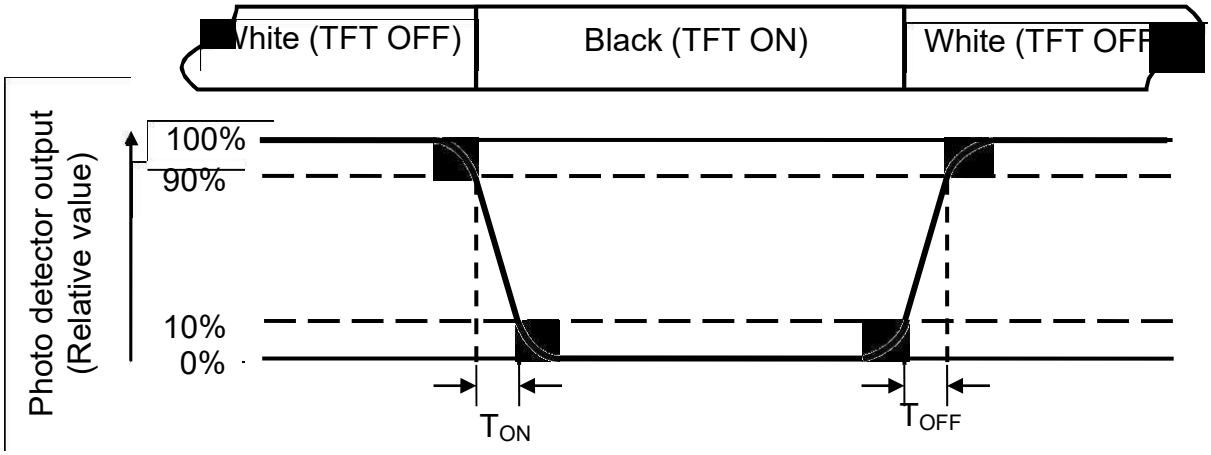


Fig. 4-3 Definition of response time

Note 4: Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured w henLCD on the " White" state}}{\text{Luminance measured w henLCD on the "Black" state}}$$

Note 5: Definition of backlight

The data is measured by using TDI’s backlight system.

6.Reliability Test Items

High Temperature Storage	Ta = 70℃ 240hrs	Note 1，Note 4
Low Temperature Storage	Ta = -30℃ 240hrs	Note 1，Note 4
High Temperature Operation	Ts = 60℃ 240hrs	Note 2，Note 4
Low Temperature Operation	Ta = -10℃ 240hrs	Note 1，Note 4
Operate at High Temperature and Humidity	Ta=40℃ H=95%RH 240hrs	Note 4
Thermal Shock	-30℃/30 min ~ +70℃/30 min for a total 50 cycles, Start with cold temperature and end with high temperature.	Note 4
Package Vibration Test	Random vibration 0.015 G_2/Hz fram 5~200Hz -6dB/octave from 200~500Hz 2hours every X,Y,Z, total 6 hours	
Package Drop Test	Drop a full transportation package from a height : 72 cm(Weight<=10Kg); 60 cm(Weight>10Kg); 1 corner, 3 edges, 6faces.	

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.

7.Handling Precautions

a. Safety

i. 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.

b. Handling

i. 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.
ii. Do not handle the product by holding the flexible pattern portion in order to assure the reliability
iii. 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.
iv. Provide a space so that the panel does not come into contact with other components.
v. To protect the product from external force, put a covering lens (acrylic board or similar board) and keep an appropriate gap between them.
vi. Transparent electrodes may be disconnected if the panel is used under environmental conditions where dew condensation occurs.
vii. Property of semiconductor devices may be affected when they are exposed to light, possibly resulting in IC malfunctions.
viii. 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.
ix.

c. Static Electricity

i. Ground soldering iron tips, tools and testers when they are in operation.
ii. Ground your body when handling the products.
iii. Power on the LCD module BEFORE applying the voltage to the input terminals.
iv. DO NOT apply voltage which exceeds the absolute maximum rating.
v. Store the products in an anti-electrostatic bag or container.
vi.

d. Storage

i. Store the products in a dark place at +25℃±10℃ with low humidity (65%RH or less).
ii. DO NOT store the products in an atmosphere containing organic solvents or corrosive gas.
iii.

e. Cleaning

i. DO NOT wipe the touch panel with dry cloth, as it may cause scratch.
ii. 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 caus any organic solvent or dete