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TFT | CHARACTER | UWVD | FSC | SEGMENT | CUSTOM | REPLACEMENT

## TFT Display Module

Part Number

E90RA-HW300-C

### Overview:

- 9.0-inch TFT (230.0x146.5mm)
- HDMI TFT Interface
- 800x480 pixels
- 5V (TYP.)
- USB CTP Interface
- Transmissive/ Normally White
- Capacitive Touch Panel
- 400 NITS
- CTP Driver: GT9271
- RoHS Compliant

## Description

This is a color active matrix TFT (Thin Film Transistor) LCD (Liquid Crystal Display) that uses amorphous silicon TFT as a switching device. This model is composed of a transmissive type TFT-LCD Panel with an HDMI module, driver circuit, capacitive touch panel and backlight unit. The resolution of the 9.0" TFT-LCD contains 800x480 pixels and can display up to 65K/262K/16.7M colors.

## Features

Low Input Voltage: 5V (TYP)

CTP Interface: Micro-USB 2.0

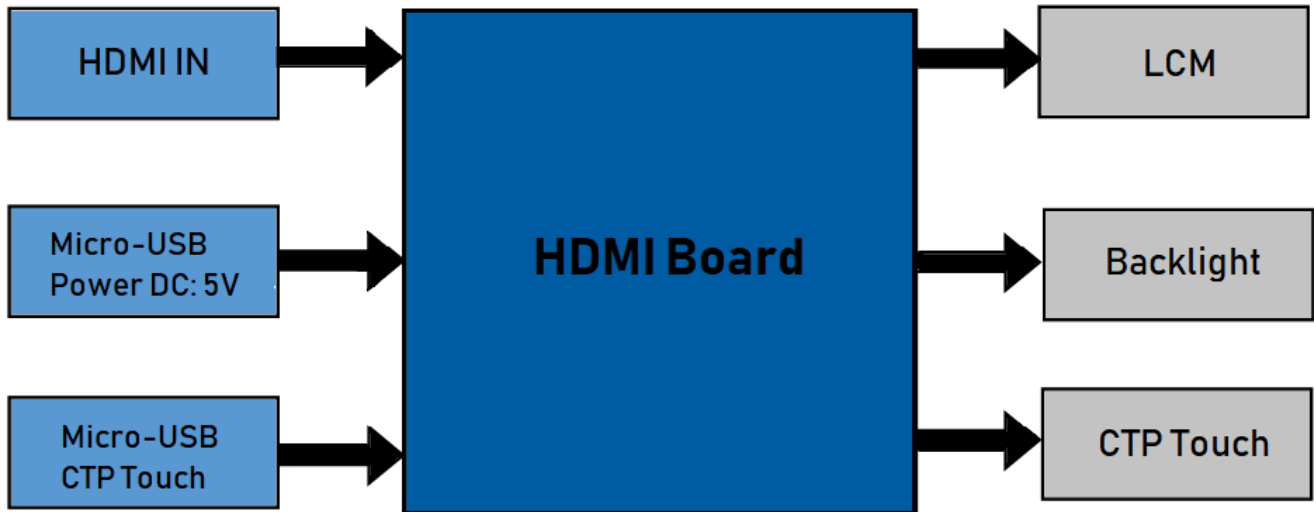
TFT Interface: HDMI

General Information Items	Specification	Unit	Note
	Main Panel		
TFT Display Area (AA)	198.00(H) x 111.696(V) (9.0 inch)	mm	-
CTP View Area	199.00(H) x 111.70(V)	mm	-
Driver Element	TFT active matrix	-	-
Display Colors	65K/262K/16.7M	colors	-
Number of Pixels	800(RGB)x480	dots	-
TFT Pixel Arrangement	RGB vertical stripe	-	-
Pixel Pitch	0.2327 (H) x 0.2327 (V)	mm	-
Viewing Angle	6:00	o'clock	-
CTP Driver IC	GT9271	-	-
LCM+CTP Luminance	400 nits (TYP)	-	-
CTP Interface	Micro-USB	-	-
Touch Cover Thickness	1.1mm with chemical strengthening	-	-
Touch Points	5	-	-
Video Input	HDMI	-	-
Plug & Play	DDC2B/VESA Standard	-	-
Power Consumption	4	W	-
Micro USB DC Power	5V, 2A (TYP)	-	-
Operating Temperature	-20~+70	°C	-
Storage Temperature	-30~+80	°C	-

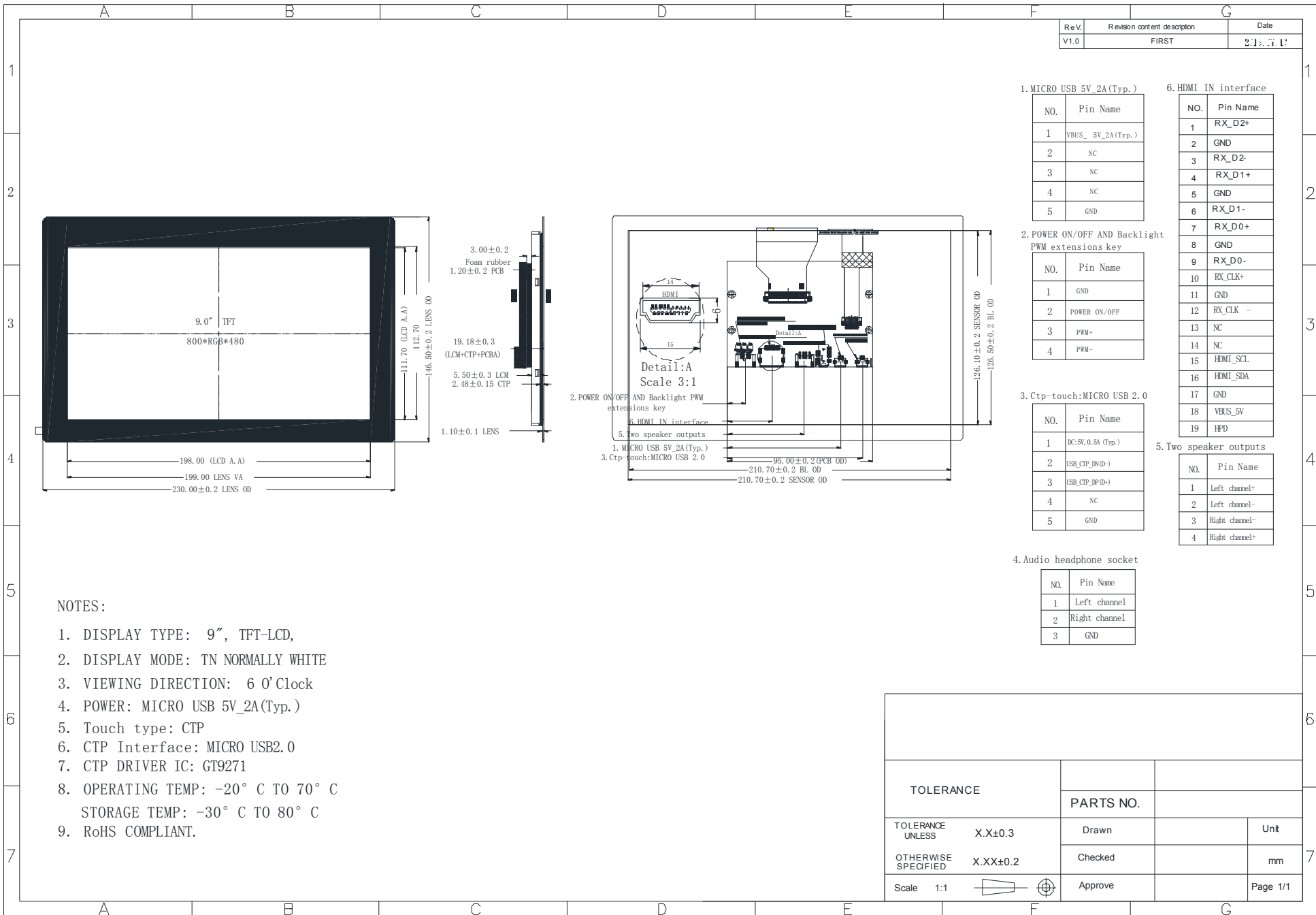
## Mechanical Information

Item		Min	Typ.	Max	Unit	Note
Module Size	Height (H)		230.00		mm	-
	Vertical (V)		146.50		mm	-
	Depth (D)		7.98		mm	-
Weight			TBD		g	-

## 1. Block Diagram



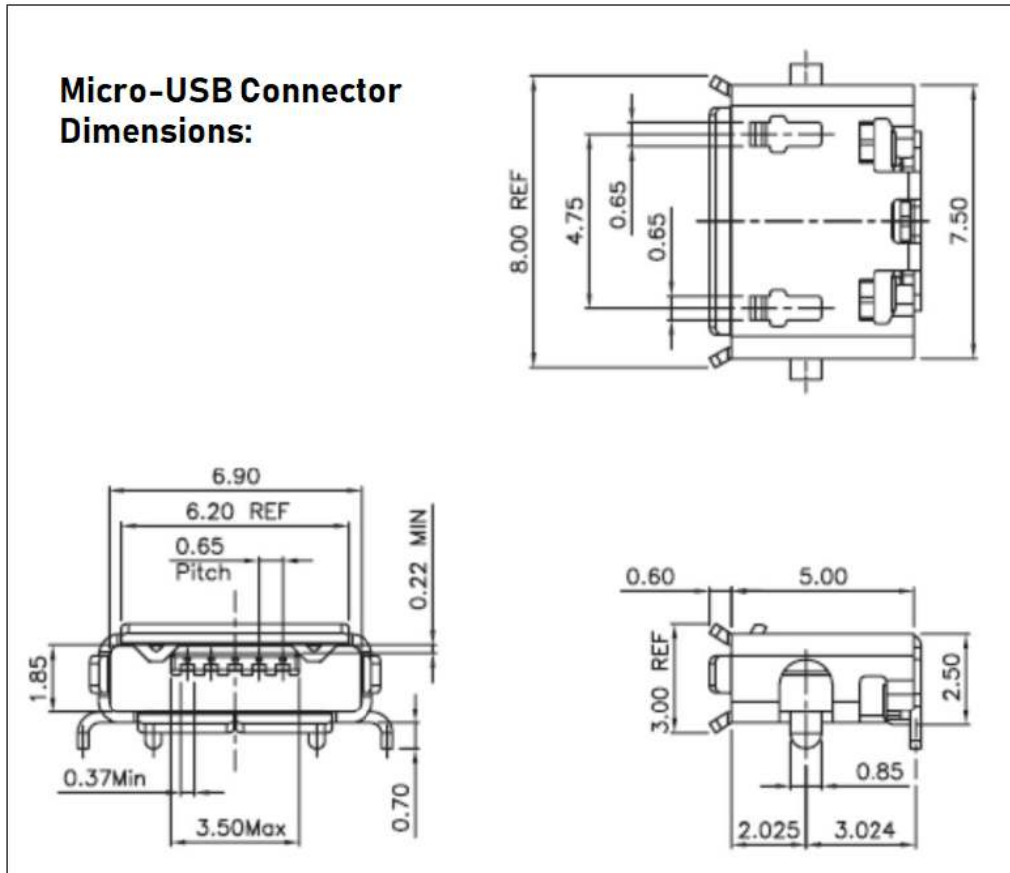
## 2. Outline Dimensions



### 3. Input Terminal Pin Assignment

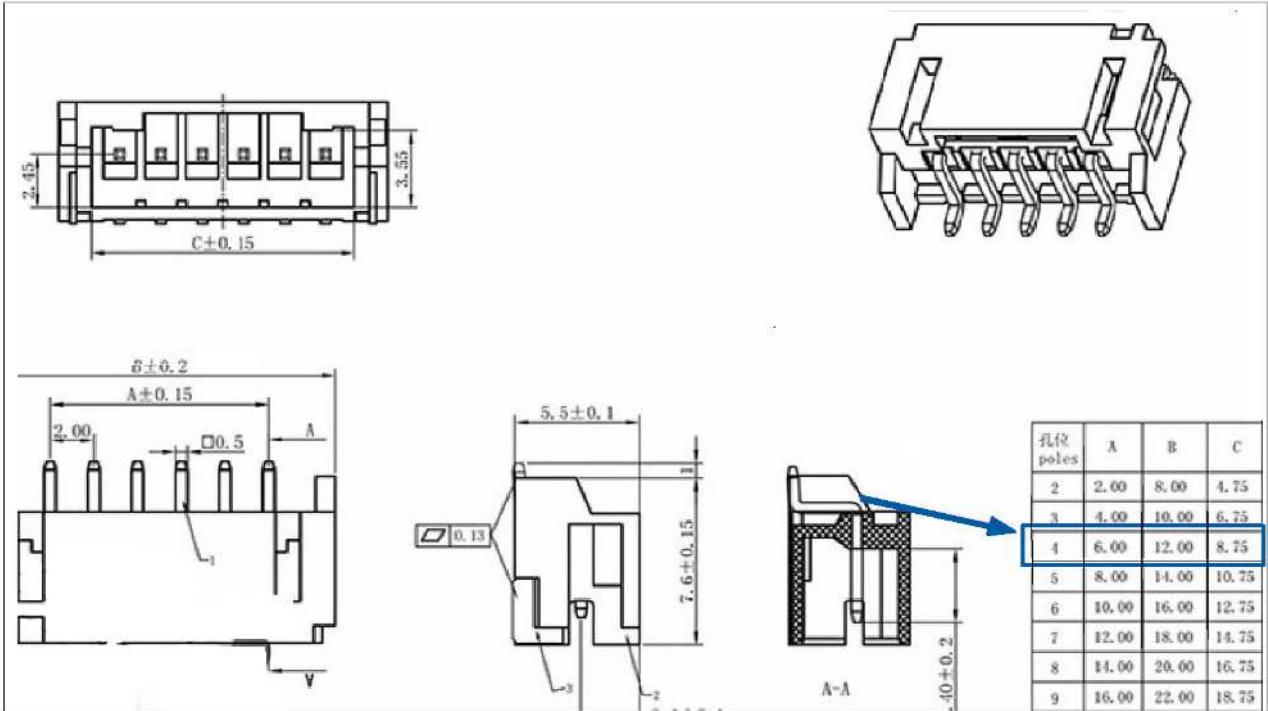
#### 3.1 Micro-USB 5V, 2A (TYP) Pin Definition & Signal Connector

NO.	Symbol	Description	I/O
1	DC:5V	Supply voltage (5.0V, 2A TYP.)	P
2	NC	No connection	
3	NC	No connection	
4	NC	No connection	
5	GND	Ground	P



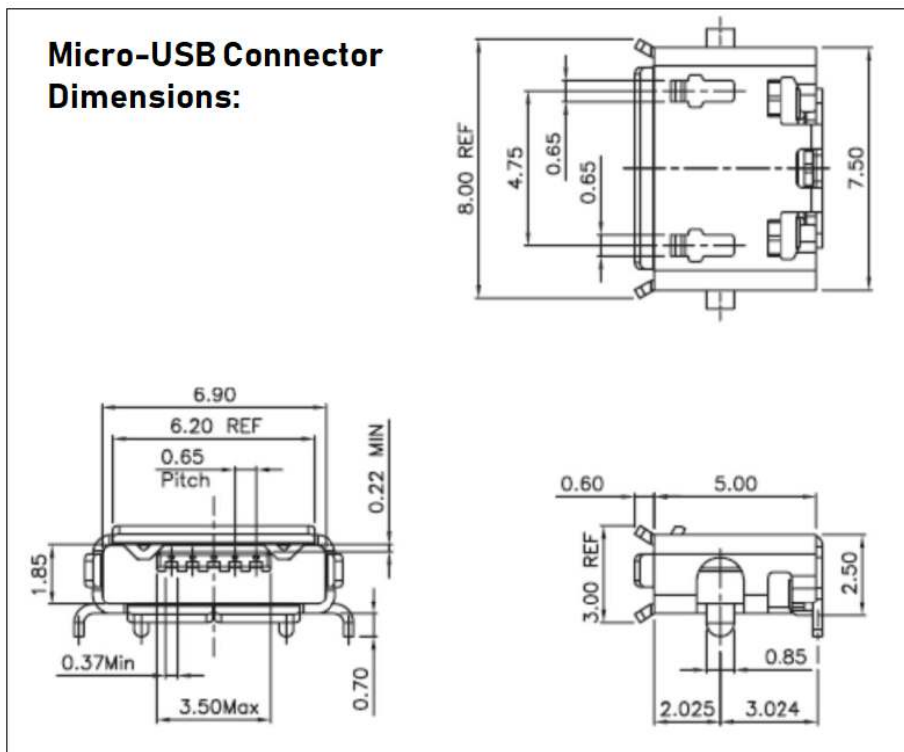
#### 3.2 Power ON/OFF and Backlight PWM Extensions Key

NO.	Symbol	Description	I/O
1	GND	Ground	P
2	POWER ON/OFF	ON/OFF key	P
3	PWM+	The backlight brightness of each button is increased by one level until the maximum brightness reaches level 9.	
4	PWM-	The backlight brightness of each button is reduced by one level until the lowest brightness reaches level 9.	



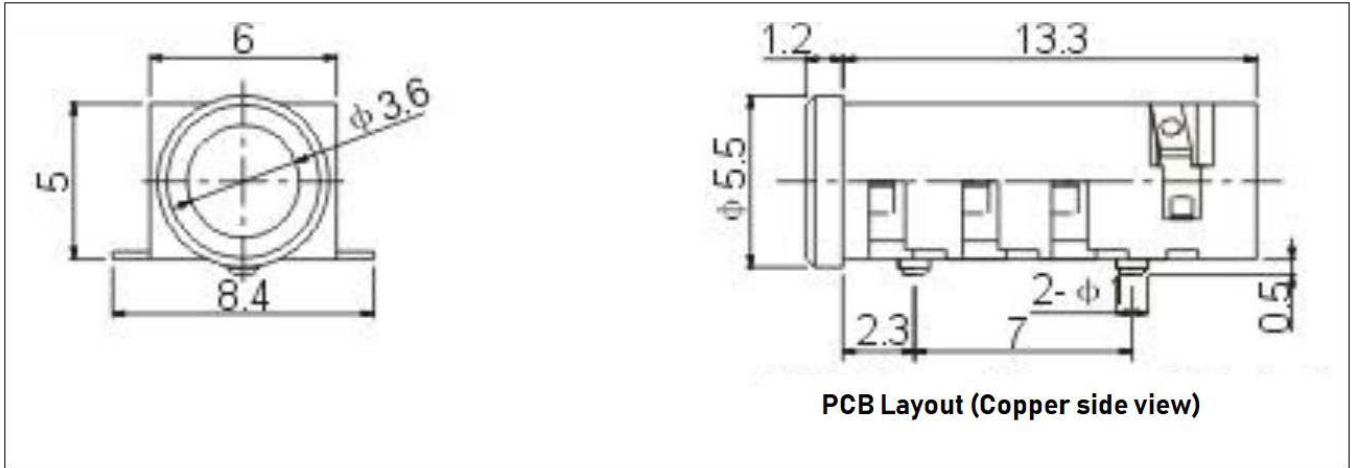
### 3.3 CTP: Micro-USB Pin Definition & Signal Connector

NO.	Symbol	Description	I/O
1	DC: 5V	Supply voltage (5.0V, 2A TYP.)	P
2	USB_CTP_DN(D-)	USB data negative analog input	I/O
3	USB_CTP_DP(D+)	USB data positive analog input	I/O
4	NC	No connection	I
5	GND	Ground	P



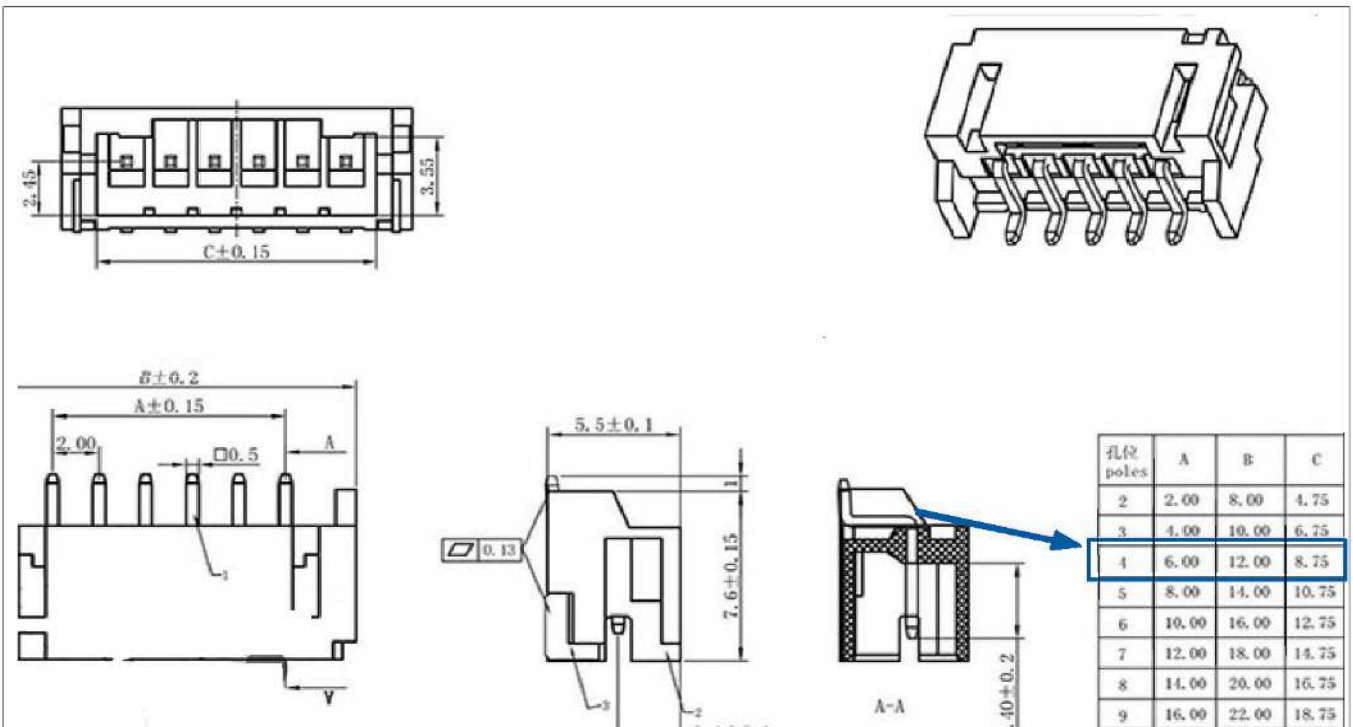
### 3.4 Audio Headphone Socket Pin Definition & Input Signal Connector

NO.	Symbol	Description	I/O
1	Left Channel	Audio output left channel	
2	Right Channel	Audio output right channel	
3	GND	Ground	
4	GND	Ground	



### 3.5 Two Speaker Outputs Pin Definition & Input Signal Connector

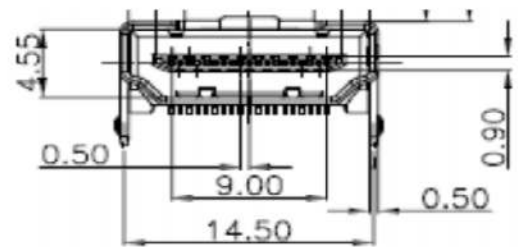
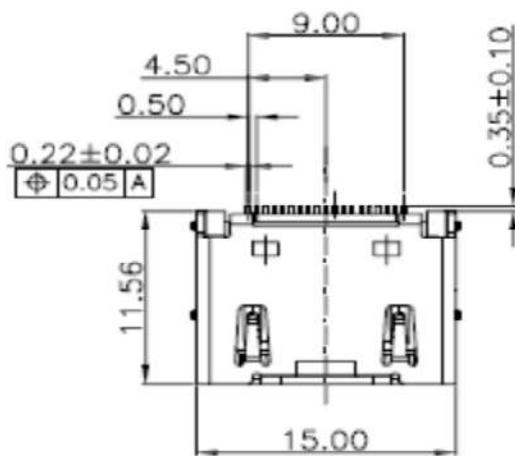
NO.	Symbol	Description	I/O
1	Left Channel+	Audio output left channel	
2	Left Channel-	Audio output left channel	
3	Right Channel-	Audio output right channel	
4	Right Channel+	Audio output right channel	



### 3.6 HDMI Pin Definition & Signal Connector

NO.	Symbol	Description	I/O
1	RX_D2+	HDMI receiver channel 2 positive analog input	I
2	GND	Ground	P
3	RX_D2-	HDMI receiver channel 2 negative analog input	I
4	RX_D1+	HDMI receiver channel 1 positive analog input	I
5	GND	Ground	P
6	RX_D1-	HDMI receiver channel 1 negative analog input	I
7	RX_D0+	HDMI receiver channel 0 positive analog input	I
8	GND	Ground	P
9	RX_D0-	HDMI receiver channel 0 negative analog input	I
10	RX_CLK+	HDMI receiver clock positive analog input	I
11	GND	Ground	P
12	RX_CLK-	HDMI receiver clock negative analog input	I
13	NC	Not connected	
14	NC	Not connected	
15	HDMI_SCL	HDMI receiver DDC data channel	I/O
16	HDMI_SDA	HDMI receiver DDC clock channel	I
17	GND	Ground	P
18	HDMI_5V	HDMI supply voltage 5.0V	P
19	HPD	HDMI receiver hot plug detect output	O

#### HDMI Connector Dimensions:





## 4. LCD Optical Characteristics

### 4.1 Optical Specifications

Item	Symbol	Condition	Min	Typ.	Max	Unit	Note	
Luminance	L	$\Theta = \phi = 0$ Normal viewing angle	200	250	--	cd/m <sup>2</sup>	(3)	
Luminance Uniformity	Y <sub>u</sub>		70	75	--	%		
Contrast Ratio	CR		400	500	--	--	(2)	
Response time	Rising		T <sub>R</sub>	--	10	20	ms	(4)
	Falling		T <sub>F</sub>	--	15	30	ms	(4)
Color Filter Chromaticity	White		W <sub>x</sub>	0.26	0.31	0.36		(5)(6)
			W <sub>y</sub>	0.28	0.33	0.38		
Viewing angle	Hor.		$\Theta_L$	$\phi=180^\circ$ (9 o'clock)	60	70	--	degree
		$\Theta_R$	$\phi=0^\circ$ (3 o'clock)	60	70	--		
	Ver.	$\Theta_T$	$\phi=90^\circ$ (12 o'clock)	40	50	--		
		$\Theta_B$	$\phi=270^\circ$ (6 o'clock)	60	70	--		
Option View Direction	6:00						(1)	

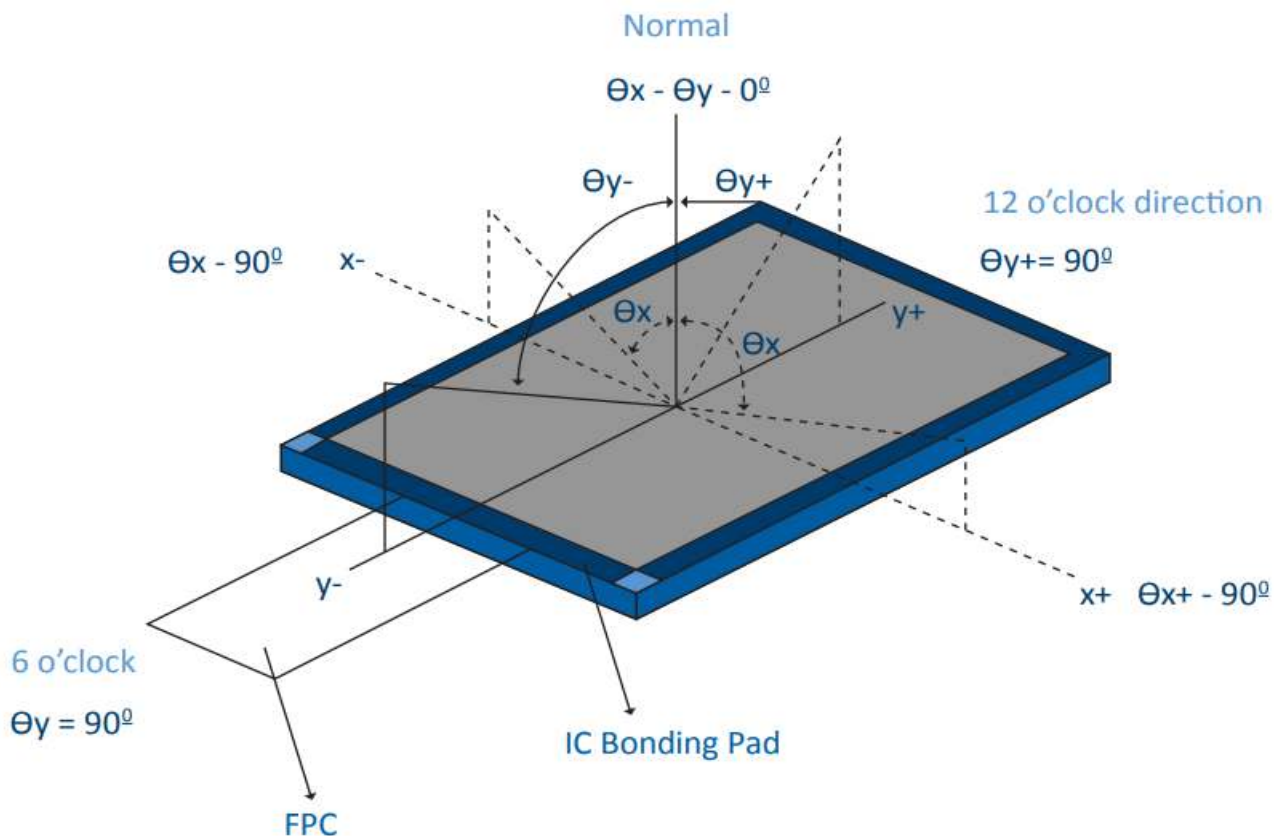
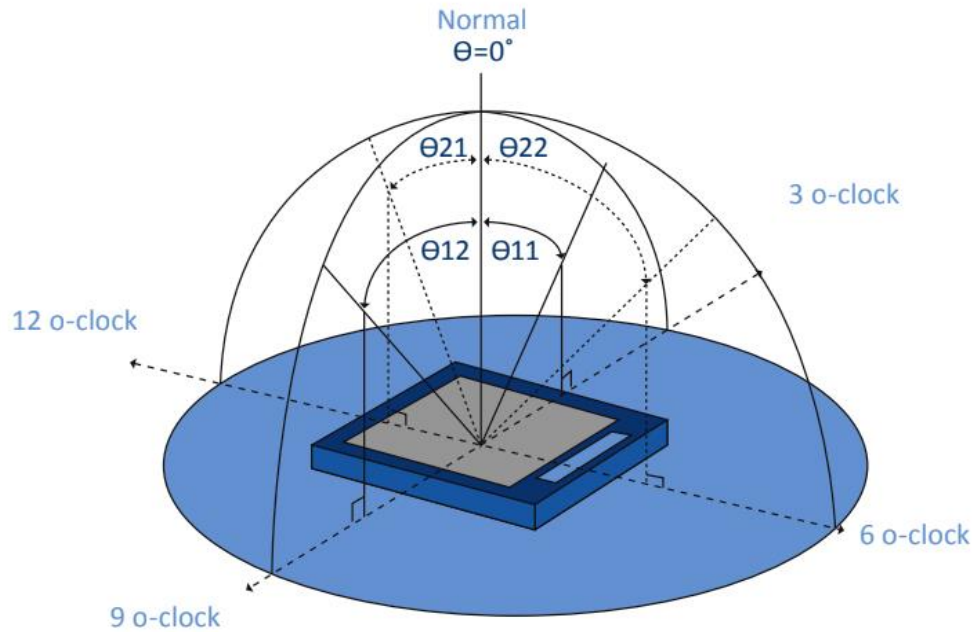
### 4.2 Operating Instructions

This product supports the following operating systems: Windows 7/8/10, Raspberry Pi, Ubuntu and Android.

- 1.) Connect the HDMI cable to the operating system.
- 2.) Connect the CTP to micro USB.
- 3.) Connect the micro USB to DC power.

**Optical Specification Reference Notes:**

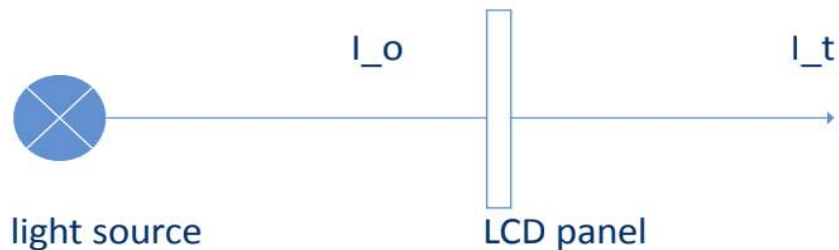
(1) Definition of Viewing Angle: The viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or 3,9 o'clock direction and the vertical or 6,12 o'clock direction with respect to the optical axis which is normal to the LCD surface.



(2) Definition of Contrast Ratio (Cr): measured at the center point of panel. The contrast ratio (Cr) measured on a module, is the ratio between the luminance (Lw) in a full white area (R=G=B=1) and the luminance (Ld) in a dark area (R=G=B=0).

$$Cr = \frac{L_w}{L_d}$$

(3) Definition of transmittance (T%): The transmittance of the panel including the polarizers is measured with electrical driving.



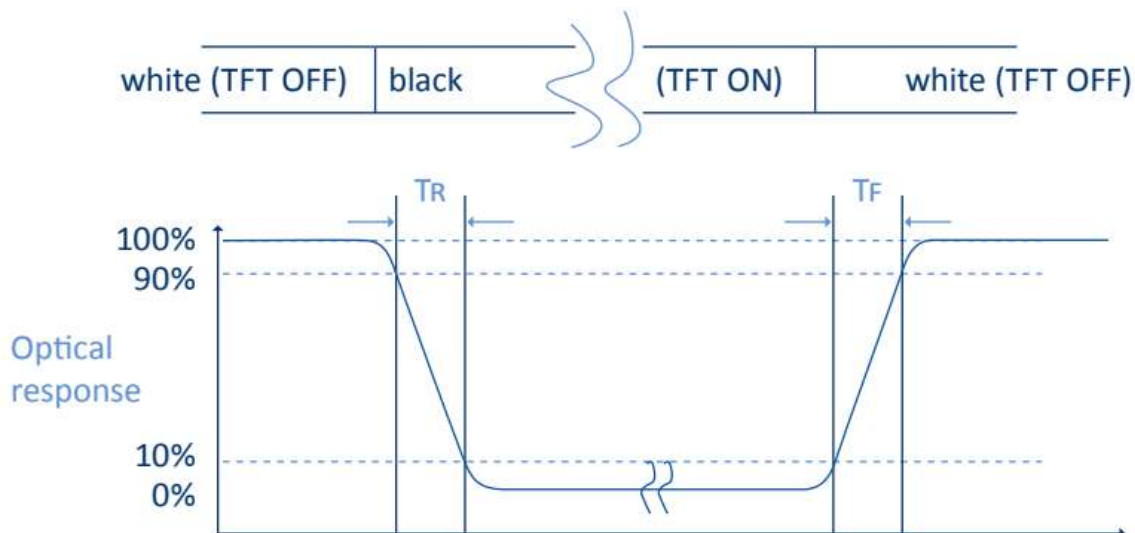
The transmittance is defined as:

$$Tr = \frac{I_t}{I_o} \times 100\%$$

$I_o$  = the brightness of the light source.

$I_t$  = the brightness after panel transmission

(4) Definition of Response Time (Tr, Tf): The rise time 'Tr' is defined as the time for luminance to change from 90% to 10% as a result of a change of the electrical condition. The fall time 'Tf' is defined as the time for luminance to change from 10% to 90% as a result of a change of the electrical condition.



(5) Definition of Color Gamut: Measuring machine CFT-01. NTSC's Primaries: R(x,y,Y),G(x,y,Y), B(x,y,Y). FPM520 of Westar Display Technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics. The color chromaticity shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

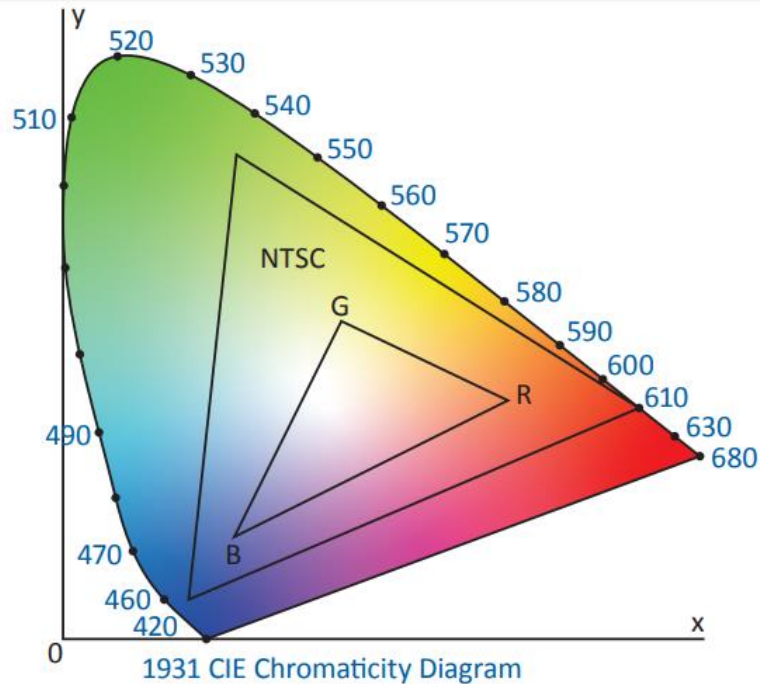
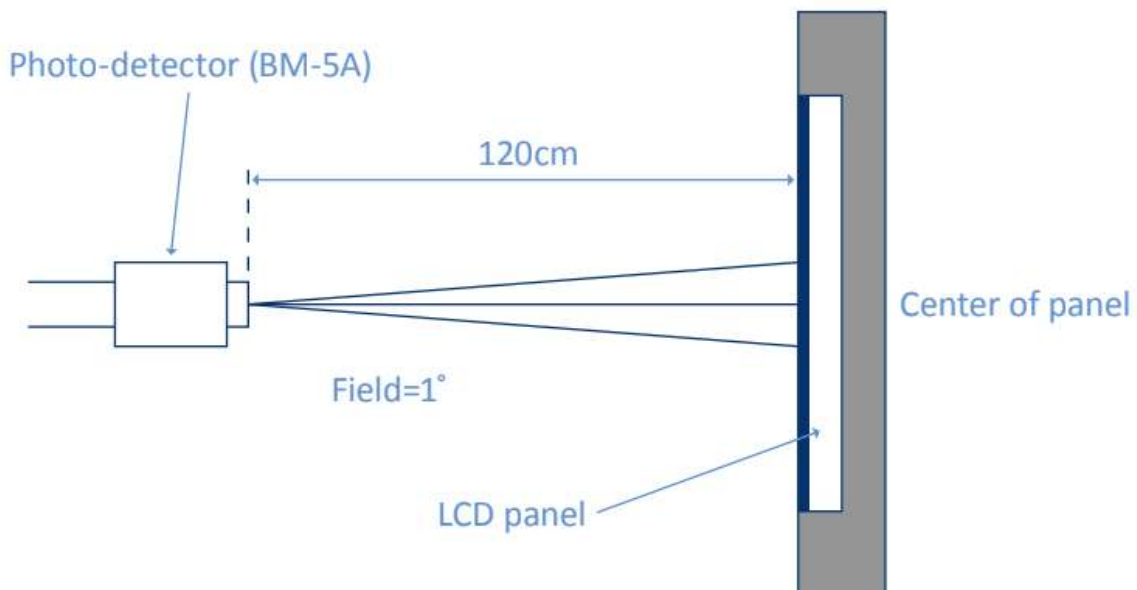


Fig. 1931 CIE chromacity diagram

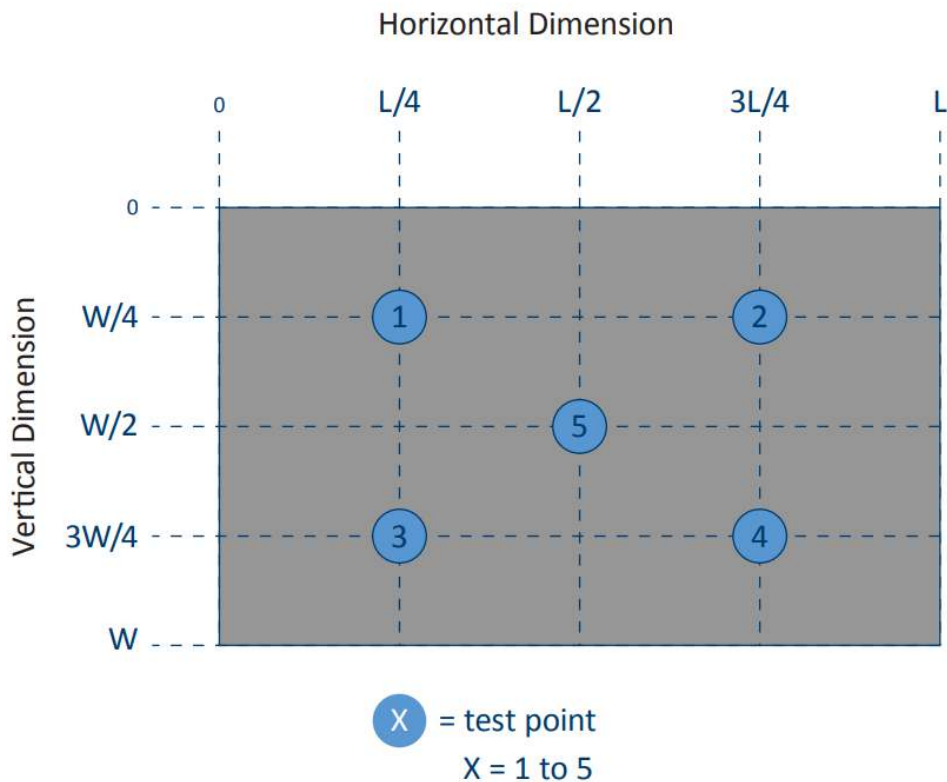
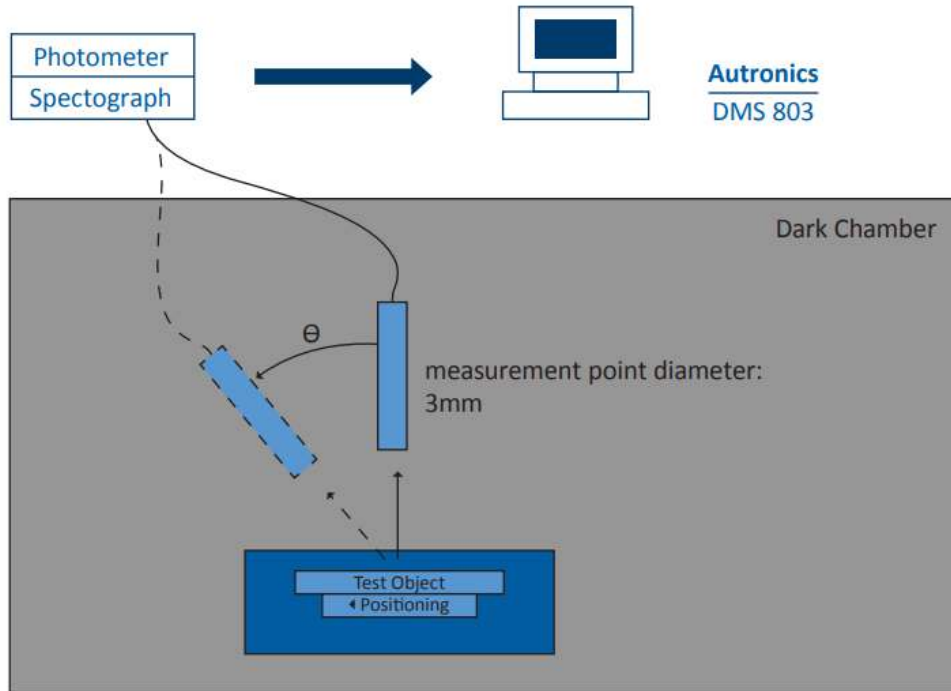
$$\text{Color gamut: } S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$

(6) Definition of Optical Measurement Setup:



(6) Optical Measurement Setup Continued:

The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting backlight for 20 minutes.



## 5. TFT Electrical Characteristics

### 5.1 Absolute Maximum Rating (Ta=25 °C, VSS=0V)

Characteristics	Symbol	Min	Max	Unit
Power Supply Voltage (Analog)	VDD-GND	-0.3	6.0	V
	VDDp-GND	-0.3	6.0	V
	AVDD	-0.5	13.5	V
	VGH	13.0	19.0	V
	VGL	-12.0	-2.0	V
	VGH-VGL	--	31.0	V
Input Signal Voltage (LED)	VLED	-0.3	6.0	V
Input Signal Voltage (PWR)	VPWR		5.5	
Operating Temperature	TOP	-20	+70	°C
Storage Temperature	TST	-30	+80	°C

*NOTE: If the absolute maximum rating of the above parameters is exceeded, even momentarily, the quality of the product may be degraded. Absolute maximum ratings specify the values which the product may be physically damaged if exceeded. Be sure to use the product within the range of the absolute maximum ratings.*

### 5.2 DC Electrical Characteristics

Characteristics	Symbol	Min	Typ.	Max	Unit	Note
Digital Supply Voltage	VDD	3.0	3.3	3.6	V	
Digital Interface Supply Voltage	VDDIO	3.0	3.3	3.6	V	
Normal Mode Current Consumption	ICC	--	5.5	10	mA	VGH=16.0V
	IGH	--	0.2	0.5	mA	VGL=-7.0V
	IGL	--	0.2	1.0	mA	VCC=3.3V
	I <sub>AVDD</sub>	--	32	50	mA	AVDD=10.4V
Level Input Voltage	V <sub>IH</sub>	0.7V <sub>DDIO</sub>	--	V <sub>DDIO</sub>	V	
	V <sub>IL</sub>	GND	--	0.3V <sub>DDIO</sub>	V	
Level Output Voltage	V <sub>OH</sub>	0.8V <sub>DDIO</sub>	--	V <sub>DDIO</sub>	V	
	V <sub>OL</sub>	GND	--	0.2V <sub>DDIO</sub>	V	

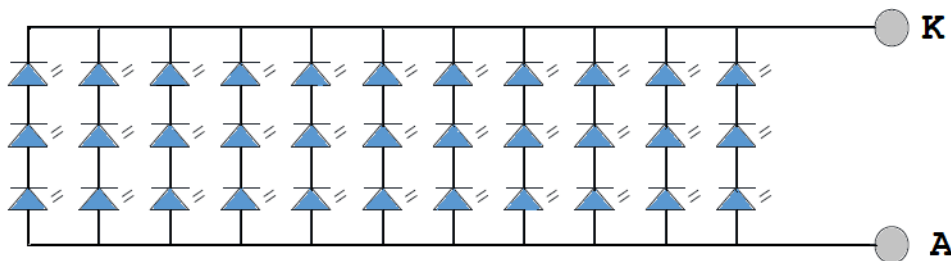
### 5.3 LED Backlight Characteristics

The backlight system is edge lighting type with 33 chips LED.

Item	Symbol	Min	Typ.	Max	Unit	Note
Forward Current	I <sub>F</sub>	198	220	242	mA	
Forward Voltage	V <sub>F</sub>	9.3	9.9	10.5	V	
LCM Luminance	LV	400	--	--	cd/m <sup>2</sup>	Note 3
LED lifetime	Hr	20000	--	--	hour	Note1 & 2
Uniformity	AV <sub>g</sub>	80	--	--	%	Note 3

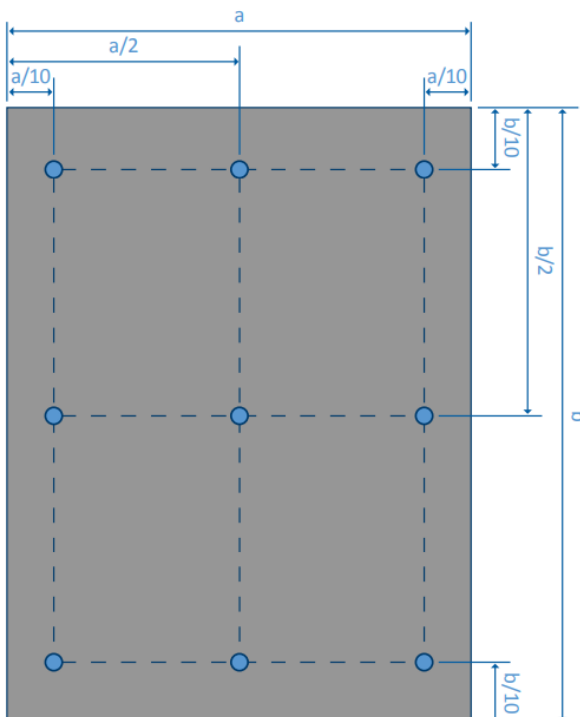
Note 1: LED lifetime (Hr) can be defined as the time in which it continues to operate under the condition: T<sub>a</sub>=25 ±3 °C, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note 2: The “LED lifetime” is defined as the module brightness decrease to 50% original brightness at T<sub>a</sub>=25°C and IL = 220mA. The LED lifetime could be decreased if operating IL is larger than 220mA. The constant current driving method is suggested.



**Backlight LED Circuit**

Note 3: Luminance Uniformity of these 9 points is defined as below:



$$\text{Luminance} = \frac{\text{(Total Luminance of 9 points)}}{9}$$

$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points(1-9)}}{\text{maximum luminance in 9 points(1-9)}}$$

## 6. AC Characteristics

### 6.1 AC Electrical Characteristics

Parameter	Symbol	Min	Typ.	Max	Unit	Note
HS Setup Time	Thst	8	--	--	ns	
HS Hold Time	Thhd	8	--	--	ns	
VS Setup Time	Tvst	8	--	--	ns	
VS Hold Time	Tvhd	8	--	--	ns	
Data Setup Time	Tdsu	8	--	--	ns	
Data Hold Time	Tdhd	8	--	--	ns	
DE Setup Time	Tesu	8	--	--	ns	
DE Hold Time	Tehd	8	--	--	ns	
DVDD Power On Slew Rate	TPOR	--	--	20	ms	From 0 to 90% DVDD
Reset Pulse Width	TRst	1	--	--	ns	
DCLK Cycle Time	Tcoh	20	--	--	ns	
DCLK Pulse Duty	Tcwh	40	50	60	%	

Table 6.1: AC Electrical Timing Characteristics

### 6.2 Horizontal and Vertical Data Timing

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Horizontal Display Area	thd	--	800	--	DCLK	
DCLK Frequency	fclk	26.4	33.3	46.8	MHz	
One Horizontal Line	th	862	1056	1200	DCLK	
HS Pulse Width	thpw	1	--	40	DCLK	
HS Blanking	thb	46	46	46	DCLK	
HS Front Porch	thfp	16	210	354	DCLK	

Table 6.2: Horizontal Data Timing Characteristics

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Vertical Display Area	tvd	--	480	--	TH	
VS Period Time	tv	510	525	650	TH	
VS Pulse Width	tvpw	1	--	20	TH	
VS Blanking	tvb	23	23	23	TH	
VS Front Porch	tvfp	7	22	147	TH	

Table 6.3: Vertical Data Timing Characteristics



### 6.3 Timing Diagrams

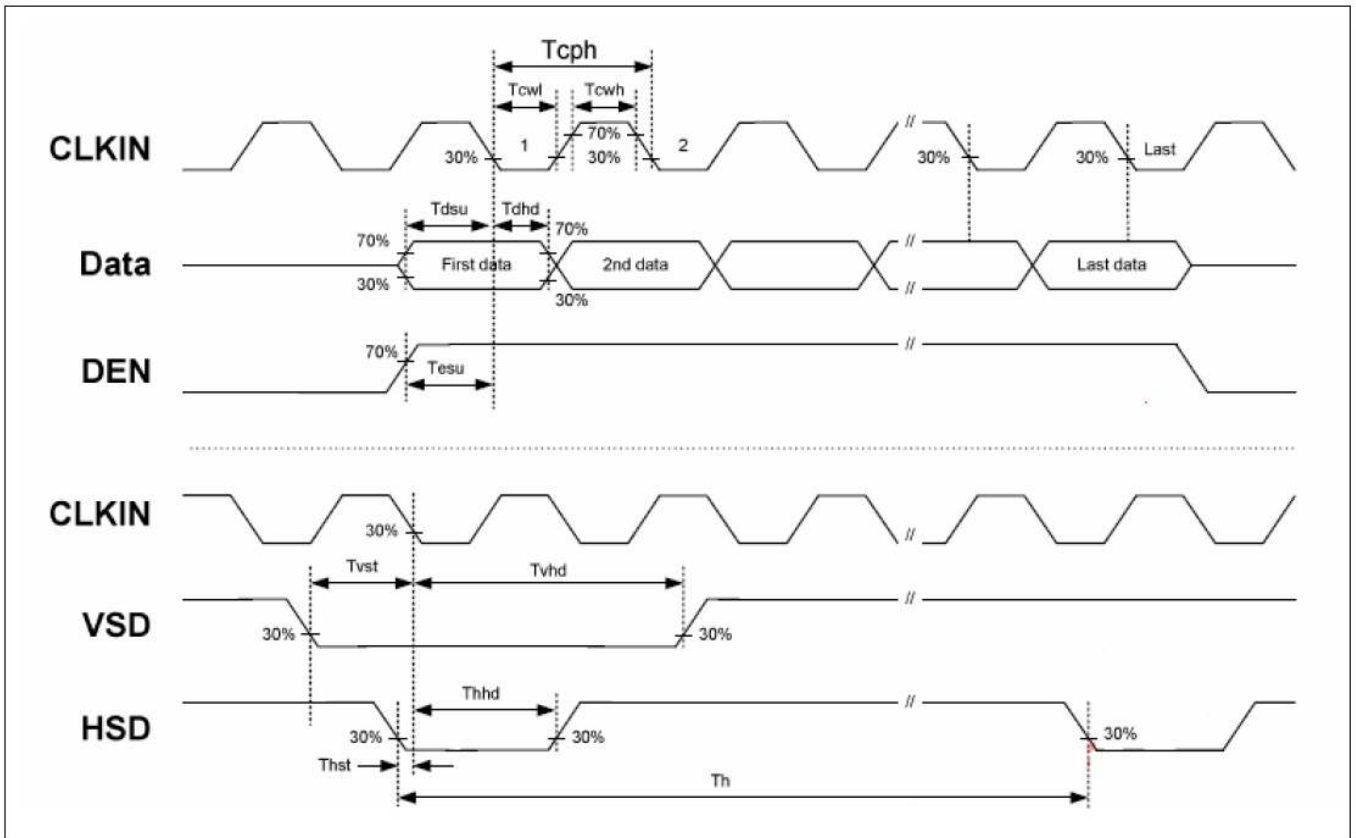


Figure 6.1: Clock and Data Timing Diagram

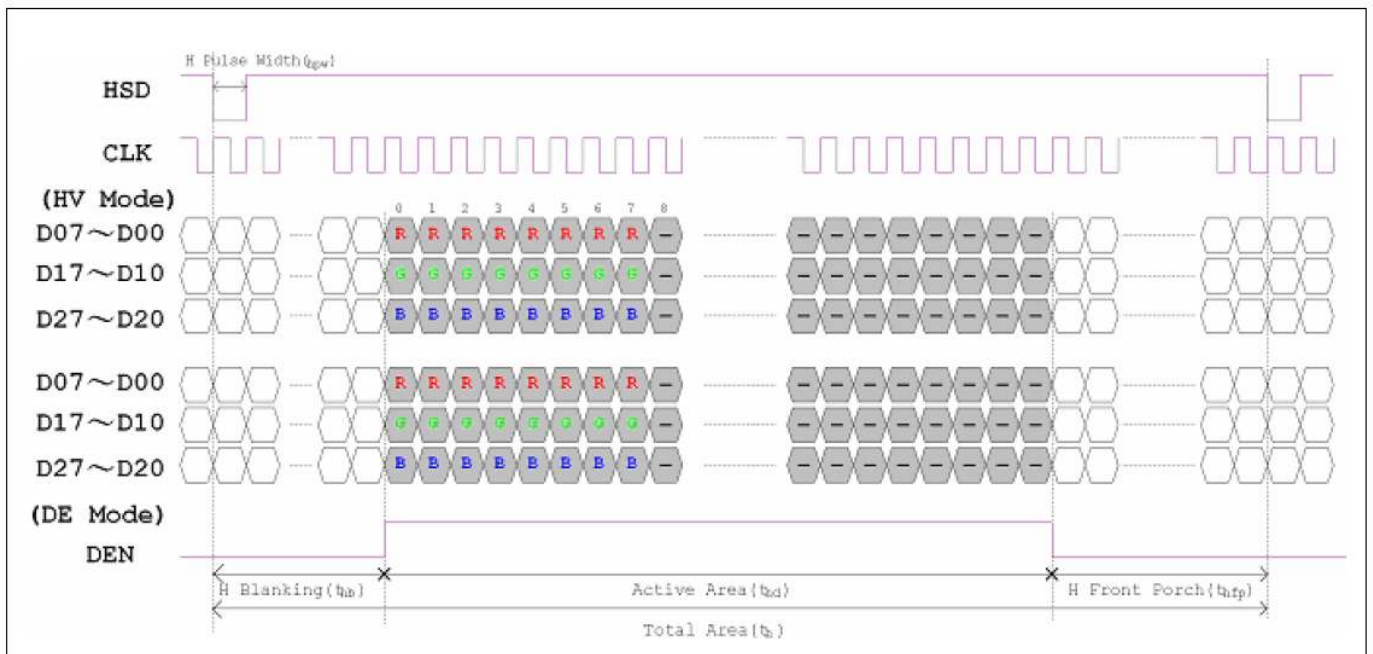


Figure 6.2: HV and DE Clock and Data Timing Diagram

## 7. CTP Electrical Characteristics

### 7.1 Absolute Maximum Rating

Characteristics	Symbol	Min	Max	Unit
Power Supply Voltage	VDD	-0.3	3.47	V
I/O Digital Voltage	VDDIO	-0.3	3.47	V
Operating Temperature	TOP	-20	+70	°C
Storage Temperature	TST	-30	+80	°C

Table 7.1: CTP Absolute Maximum Rating Characteristics

NOTE: If used beyond the absolute maximum ratings, GT9271 may be permanently damaged. It is strongly recommended that the device be used within the electrical characteristics in normal operations. If exposed to the conditions not within the electrical characteristics, it may affect the reliability of the device.

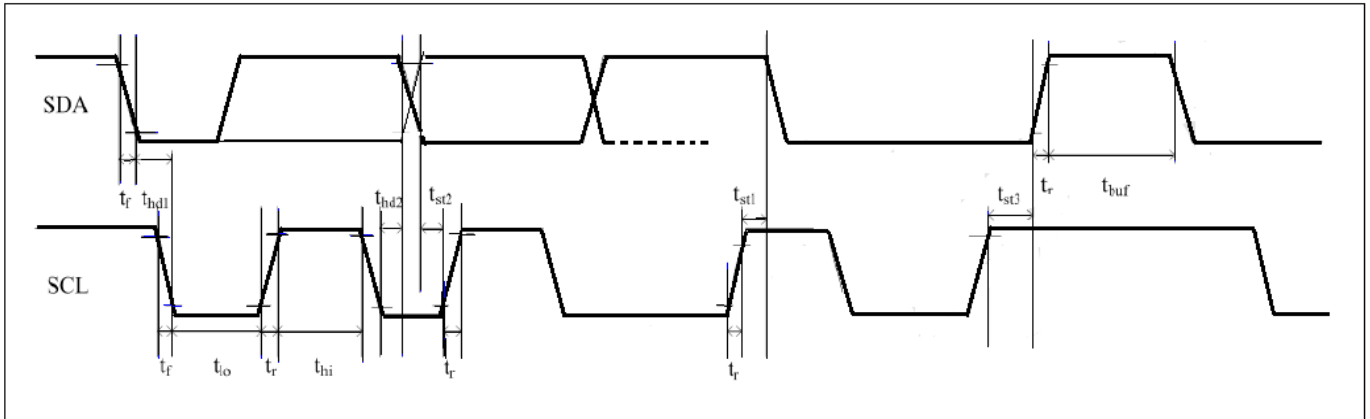
### 7.2 DC Electrical Characteristics (Ta=25°C)

Characteristics	Symbol	Min	Typ.	Max	Unit
Digital Supply Voltage	VDD	2.8	--	3.3	V
I/O Digital Supply Voltage	VDDIO	1.8	--	3.3	V
Normal Operation Mode Current Consumption	Iopr	--	13	--	mA
Green Mode Current Consumption	I <sub>mon</sub>	--	4.5	--	mA
Sleep Mode Current Consumption	I <sub>slp</sub>	70	--	120	uA
Level Input Voltage	V <sub>IH</sub>	0.75VDDIO	--	VDDIO+0.3	V
	V <sub>IL</sub>	-0.3	--	0.25VDDIO	V
Level Output Voltage	V <sub>OH</sub>	0.85VDDIO	--	--	V
	V <sub>OL</sub>	--	--	0.15VDDIO	V

Table 7.2: CTP DC Electrical Characteristics

### 7.3 I2C Interface Characteristics

GT9271 provides a standard I2C interface for SCL and SDA to communicate with the host. GT9271 always serves as slave device in the system with all communication being initialized by the host. It is recommended that transmission rate be kept at or below 400kbps. The figure shown below is the I2C timing:



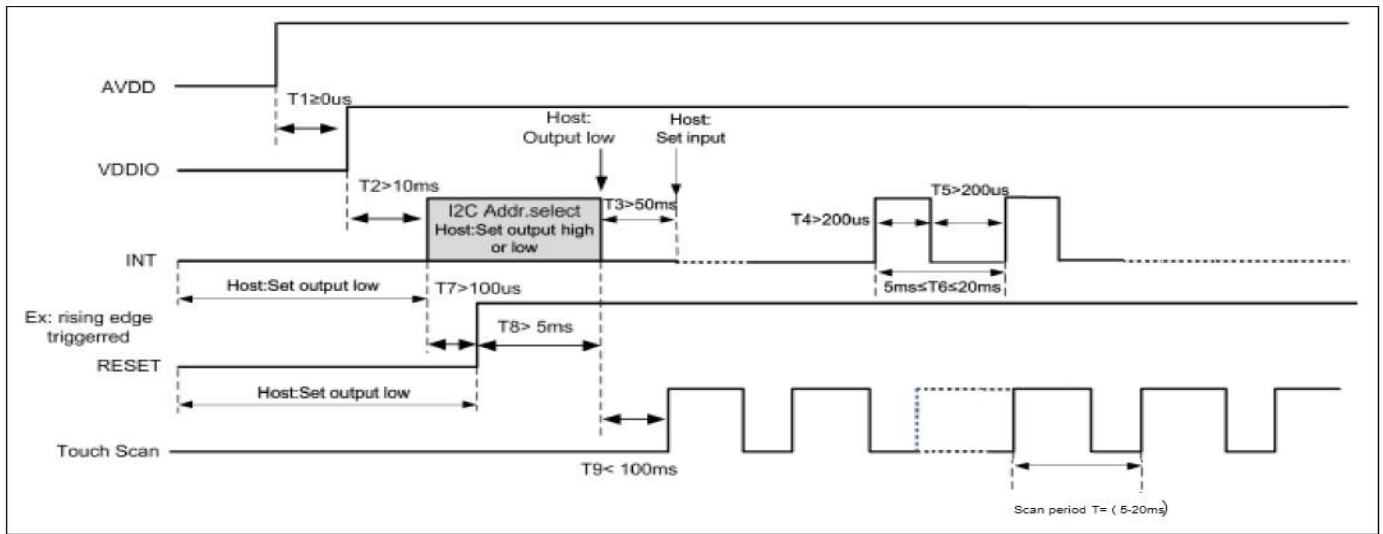
Parameter	Symbols	Condition	Min	Max	Units
SCL low period	t <sub>lo</sub>		1.3		us
SCL high period	t <sub>hi</sub>		0.6		us
SCL setup time for start condition	t <sub>st1</sub>		0.6		us
SCL setup time for stop condition	t <sub>st3</sub>		0.6		us
SCL hold time for start condition	t <sub>hd1</sub>		0.6		us
SDA setup time	t <sub>st2</sub>		0.1		us
SDA hold time	t <sub>hd2</sub>		0		us

*Table 7.3: I2C AC Characteristics, 1.8V interface voltage, 400kbps transmission rate, 2k pull-up resistor*

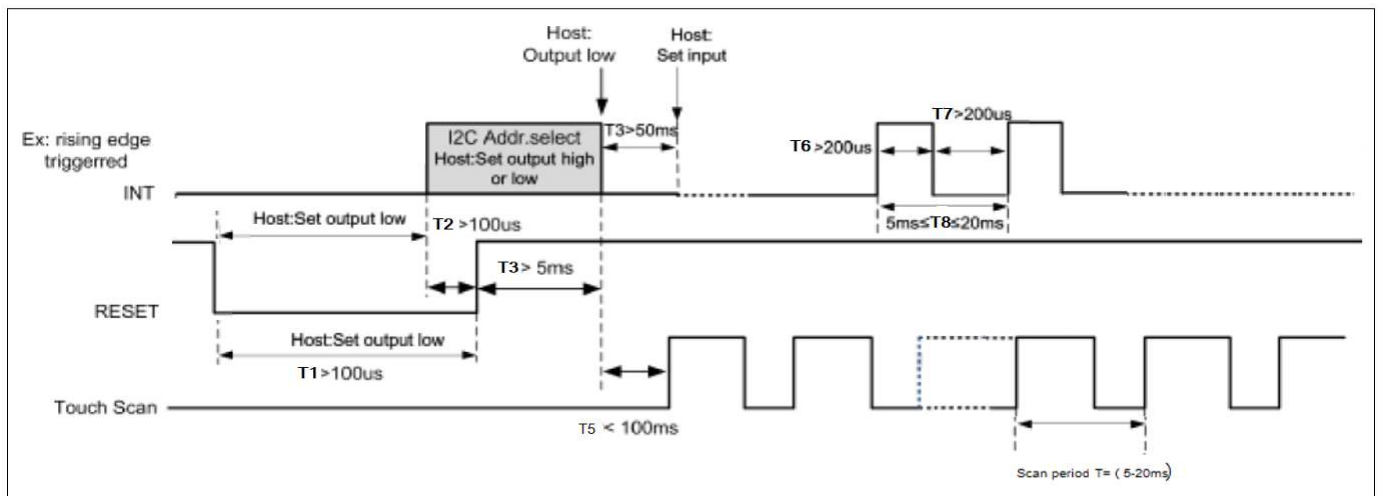
Parameter	Symbols	Condition	Min	Max	Units
SCL low period	t <sub>lo</sub>		1.3		us
SCL high period	t <sub>hi</sub>		0.6		us
SCL setup time for start condition	t <sub>st1</sub>		0.6		us
SCL setup time for stop condition	t <sub>st3</sub>		0.6		us
SCL hold time for start condition	t <sub>hd1</sub>		0.6		us
SDA setup time	t <sub>st2</sub>		0.1		us
SDA hold time	t <sub>hd2</sub>		0		us

*Table 7.4: I2C AC Characteristics, 3.3V interface voltage, 400kbps transmission rate, 2k pull-up resistor*

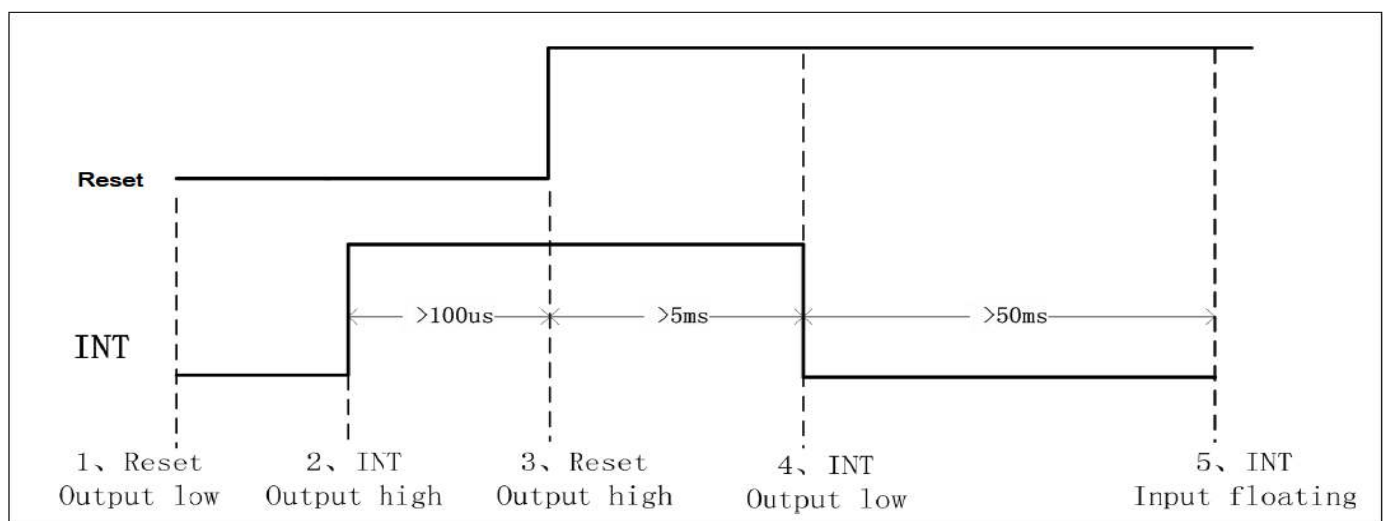
GT9271 supports two I2C slave addresses: 0xBA/0xBB and 0x28/0x29. The host can select the address by changing the status of Reset and INT pins during the power-on initialization phase. The configuration methods and timings are shown below:



**Figure 7.1: I2C Power on Timing**



**Figure 7.2: I2C Host Resetting Timing**



**Figure 7.3: Setting Slave Address to 0x28/0x29 Timing**

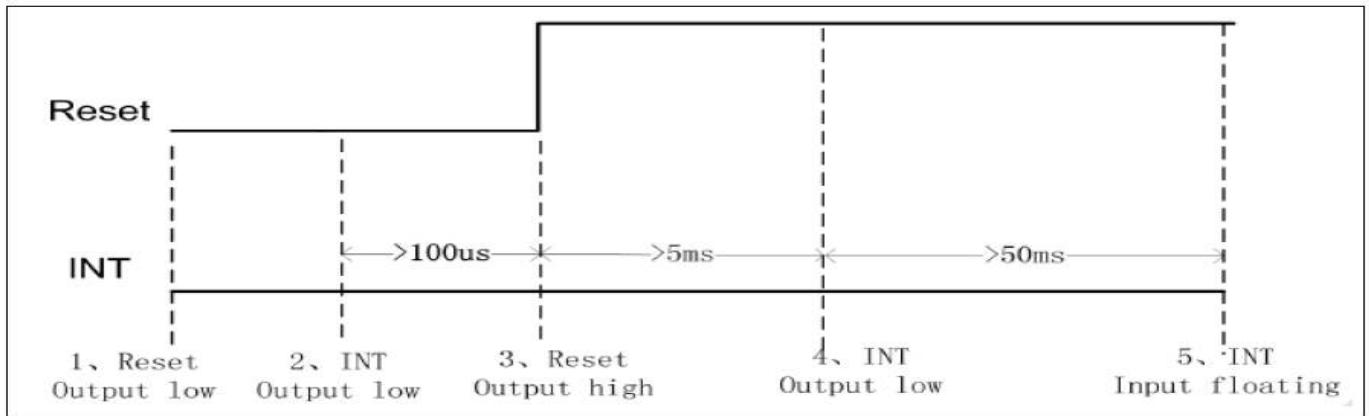


Figure 7.4: Setting Slave Address to 0xBA/0xBB Timing

### Data Transmission (ex. 0xBA/0xBB)

Communication is always initiated by the host. Valid start condition is signaled by pulling SDA line from high to low when SCL is high. Data flow or address is transmitted after the start condition.

All slave devices connected to I2C bus should detect the 8-bit address issued after start condition and send the correct ACK. After receiving matching address, GT9271 acknowledges by configuring SDA line as output port and pulling SDA line low during the ninth SCL cycle. When receiving unmatched address, namely not 0xBA or 0xBB, GT9271 will stay in an idle state.

For data bytes on SDA, each of the 9 serial bits will be sent on nine SCL cycles. Each data byte consists of 8 valid data bits and one ACK or NACK bit sent by the recipient. The data transmission is valid when SCL line is high. When communication is completed the host will issue the stop condition. Stop condition implies the transition of SDA line from low to high when SCL is high.

### Writing Data to GT9271

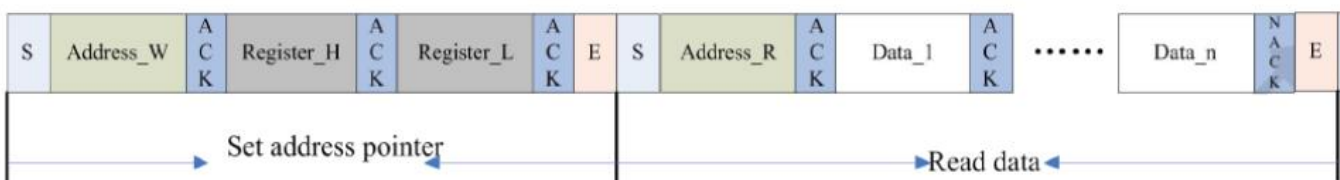
The diagram displays the timing sequence of the host writing data onto GT9271. First the host issues a start condition. The host sends 0xBA (address bits and R/W bit; R/W bit as 0 indicates write operation) to the slave device. After receiving ACK, the host sends the 16-bit register address (where writing starts) and the 8-bit data bytes (to be written onto the register)



The location of the register address pointer will automatically add 1 every write operation. When the host needs to perform write operations on a group of registers of continuous addresses it can write continuously. The write operation is terminated when the host issues the stop condition.

### Reading Data from GT9271

The diagram below is the timing sequence of the host reading data from GT9271. The host issues the start condition and sends 0xBA (Address bits and R/W bit, R/W bit as 0 indicates write operation) to the slave device. After receiving ACK, the host sends the 16-bit register address (where reading starts) to the slave device. Then the host sets register addresses which need to be read.



The host issues the start condition once again and sends 0xBB (read operation). After receiving ACK, the host starts to read the data. GT9271 also supports continuous read operation. When receiving a byte of data, the host sends an ACK signal indicating successful reception. After receiving the last byte of data, the host sends a NACK signal followed by a STOP condition which terminates communication.

## 8. Cautions and Handling Precautions

### 8.1 Handling and Operating the Module

1. When the module is assembled, it should be attached to the system firmly. Do not warp or twist the module during assembly work.
2. Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and back-light unit.
3. Note that polarizer is very fragile and could be easily damaged. Do not press or scratch the surface.
4. Do not allow drops of water or chemicals to remain on the display surface. If you have the droplets for a long time, staining and discoloration may occur.
5. If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
6. The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane. Do not use ketene type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
7. If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs, or clothes, it must be washed away thoroughly with soap.
8. Protect the module from static; it may cause damage to the CMOS ICs.
9. Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
10. Do not disassemble the module.
11. Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
12. Pins of I/F connector shall not be touched directly with bare hands.
13. Do not connect, disconnect the module in the "Power ON" condition.
14. Power supply should always be turned on/off by the item Power On Sequence & Power Off Sequence.

### 8.2 Storage and Transportation.

1. Do not leave the panel in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%
2. Do not store the TFT-LCD module in direct sunlight.
3. The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.
4. It is recommended that the modules should be stored under a condition where no condensation is allowed. Formation of dewdrops may cause an abnormal operation or a failure of the module. In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.
5. This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.