深圳市拓普微科技开发有限公司
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LMT070DDCFWD-NNC-1

LCD Module User Manual

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Date: 2018-10-12	Date:	Date:

Rev.	Descriptions	Release Date
0.1	Preliminary release	2018-10-12

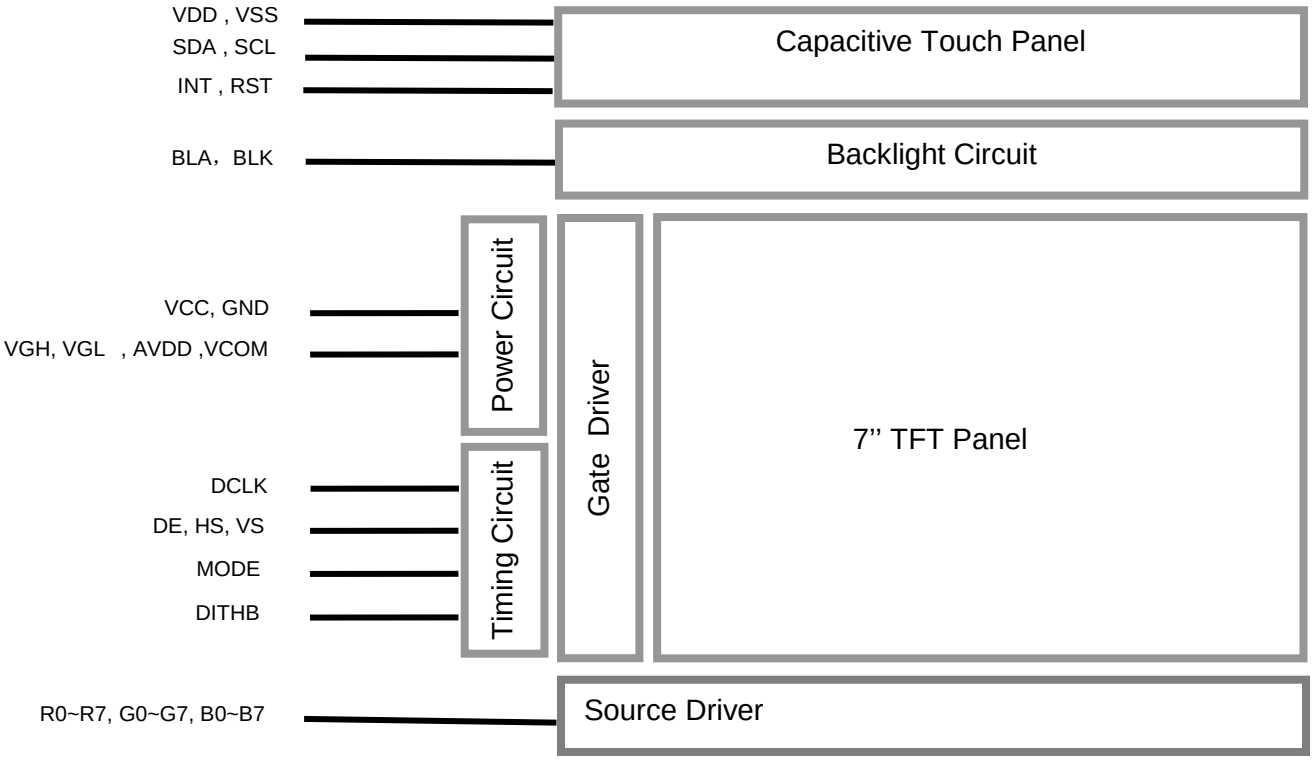
Table of Content

1. General Specification

TFT Interface :	Digital 24-bits RGB
CTP Interface:	I^2C
Display Technology :	a-Si TFT active matrix
Display Mode :	Transmissive / Normal White
Screen Size(Diagonal) :	7.0”
Outline Dimension :	164.9 x 100.0 x 7.28 (mm) (see attached drawing for details)
Active Area :	154.08 x 85.92 (mm)
Number of dots :	800 x 3 (RGB) x 480
Pixel Pitch :	0.1926 x 0.179 (mm)
Pixel Configuration :	RGB Stripe
Backlight :	LED
Viewing Direction :	6 o’clock(Gray scale Inversion) (*1) 12 o’clock (*2)
Operating Temperature :	-20 ~ +70°C
Storage Temperature :	-30 ~ +80°C
Touch Panel Type :	Capacitive Touch Panel(*4)
Touch points:	5 points touch

Note:
*1. For saturated color display content (eg. pure-red, pure-green, pure-blue or pure-colors-combinations).
*2. For “color scales” display content.
*3. Color tone may slightly change by temperature and driving condition.
*4. Applicable cover panel/cover glass thickness = 2.0MAX.(Without air gap)

2. Block Diagram



3. Terminal Function

3.1 K1 TFT Input Terminal

Pin No.	Pin Name	I/O	Descriptions
1	BLA	Power	Positive Backlight Power Supply
2	BLA		
3	BLK	Power	Negative Backlight Power Supply
4	BLK		
5	GND	Power	Power GND (0V)
6	VCOM	Input	Common voltage
7	VCC	Power	Power for Digital Circuit
8	MODE	Input	DE/SYNC mode select (*1)
9	DE	Input	Data input enable
10	VS	Input	Vertical Sync Input
11	HS	Input	Horizontal Sync Input
12	B7	Input	8bit Data for Blue
:	:		
19	B0		
20	G7	Input	8bit Data for Green
:	:		
27	G0		
28	R7	Input	8bit Data for Red
:	:		
35	R0		
36	GND	Power	Power GND (0V)
37	DCLK	Input	Sample clock(*2)
38	GND	Power	Power GND (0V)
39	L/R	Input	Left / right selection (*3)
40	U/D	Input	Up/down selection (*3)
41	VGH	Power	Gate ON Voltage
42	VGL	Power	Gate OFF Voltage
43	AVDD	Power	Power for Analog Circuit
44	RESET	Input	Global reset pin (*4)
45	NC	-	No connection
46	VCOM	Input	Common Voltage
47	DITHB	Input	Dithering function (*5)
48	GND	Power	Power GND (0V)
49	NC	-	No connection
50	NC		

Note:

* 1: DE/SYNC mode select. Normally pull high.
  When select DE mode, MODE="1", VS and HS must pull high.
  When select SYNC mode, MODE= "0", DE must be grounded.
* 2: Data shall be latched at the falling edge of DCLK.
* 3: Selection of scanning mode

Setting of scan control input		Scanning direction
U/D	L/R	
GND	VCC	Up to down, left to right
VCC	GND	Down to up, right to left
GND	GND	Up to down, right to left
VCC	VCC	Down to up, left to right

*4: Global reset pin. Active low to enter reset state. Suggest to connect with an RC reset circuit for stability. Normally pull high.
*5: Dithering function enable control, normally pull high.
When DITHB="1",Disable internal dithering function.
When DITHB="0",Enable internal dithering function.

3.2 K2 CTP Input Terminal

Pin No	Pin Name	I/O	Descriptions
1	/RST	P	Global reset pin, active low reset
2	VDD	P	Power supply
3	VSS	P	Ground
4	/INT	I	Interrupt signal, active low Interrupt
5	SDA	I/O	I^2C data
6	SDL	I	I^2C clock

Note

*1.Note:The capacitance touch drive IC is GT911.

4. Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Power voltage	V_{DD}	-0.3	5.0	V	
	V_{CC}	-0.3	5.0	V	
	AV_{DD}	6.5	13.5	V	
	V_{GH}	-0.3	40.0	V	
	V_{GL}	-20.0	0.3	V	
	V_{GH}-V_{GL}	-	40.0	V	
Operating Temperature	T_{OP}	-20	70	°C	No Condensation
Storage Temperature	T_{ST}	-30	80	°C	No Condensation

Note:

*1.This rating applies to all parts of the module. And should not be exceeded.

*2.The operating temperature only guarantees operation of the circuit. The contrast, response speed, and the other specification related to electro-optical display quality is determined at the room temperature, T_{OP}=25.

*3.Ambient temperature when the backlight is lit (reference value)

*4.Any Stresses exceeding the Absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

5. Electrical Characteristics

5.1 DC Characteristics

VCC= VDD=3.3V,GND=VSS=0V, Top=25℃

Items	Symbol	Min.	Typ.	Max.	Unit	Remark
Power voltage	V_{DD}	3.0	3.3	3.6	V	
	V_{CC}	3.0	3.3	3.6	V	*2
	AV_{DD}	10.2	10.4	10.6	V	
	V_{GH}	14.5	15.0	15.5	V	
	V_{GL}	-10.5	-10.0	-9.5	V	
Input signal voltage	V_{COM}	3.54	4.04	4.54	V	
Input logic high voltage	V_{IH}	$0.7V_{CC}$	-	V_{CC}	V	*3
Input logic low voltage	V_{IL}	0	-	$0.3V_{CC}$	V	

Note:
*1: Be sure to apply VCC and VGL to the LCD first, and then apply VGH.
*2: VCC setting should match the signals output voltage (refer to Note 3) of customer's system board.
*3: DCLK,HS,VS,RESET,U/D, L/R,DE,R0~R7,G0~G7,B0~B7,MODE,DITHB,/RST,/INT,SDA,SDL.

5.2 Current Consumption

Items	Symbol	Min.	Typ.	Max.	Unit	Remark
Current for Driver	IVDD	-	6.2	16.0	mA	VDD=3.3V
	IVCC	1	4.0	10.0	mA	VCC=3.3V
	IAVDD	5	20	50	mA	AVDD= 10.4V
	IGH	0.05	0.2	1.0	mA	VGH = 15.0V
	IGL	0.2	0.5	1.0	mA	VGL = -10.0V

5.3 LED Backlight Circuit Characteristics

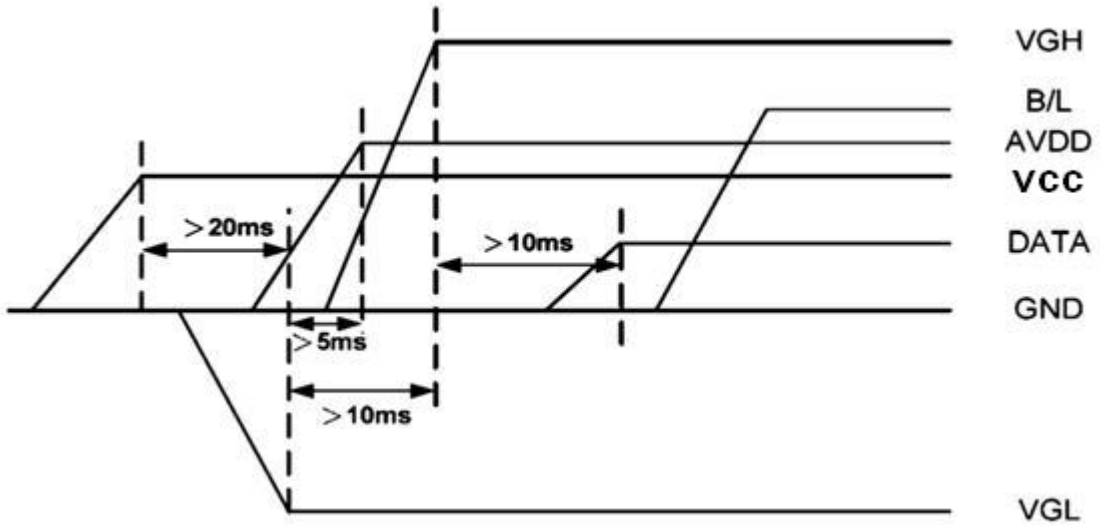
Top=25℃

Items	Symbol	MIN.	TYP.	MAX.	Unit	Note
Forward Voltage	Vf	9.0	9.6	10.5	V	If = 180mA
Forward Current	If	-	180		mA	

Cautions:
Exceeding the recommended driving current could cause substantial damage to the backlight and shorten its lifetime.

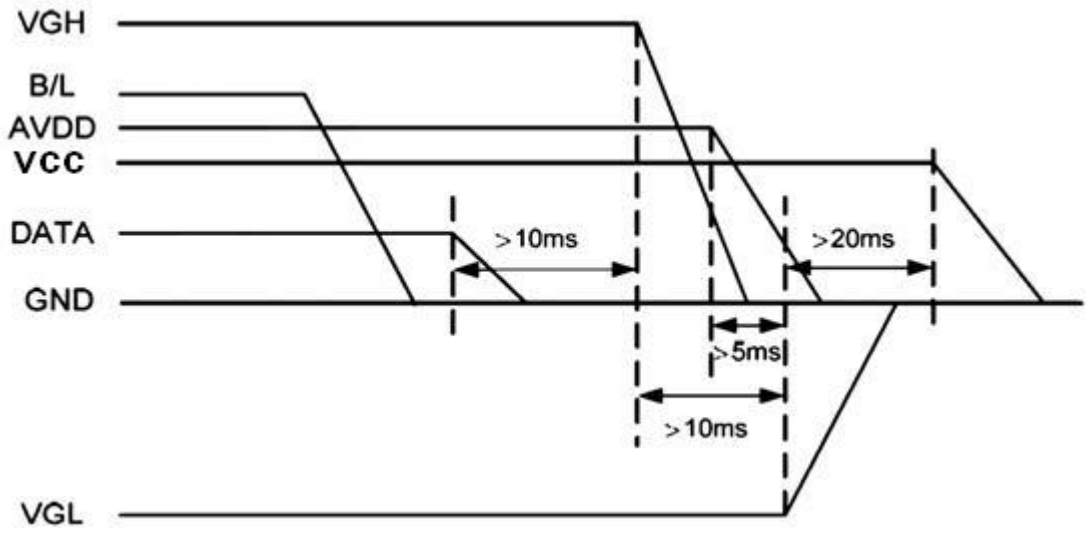
5.4 Power Sequence

Power on Sequence:



VCC →VGL→AVDD→VGH→Data→B/L

Power off Sequence:



B/L →Data→VGH→AVDD →VGL→VCC

Note :

*1.Data include R0~R7,B0~B7,G0~G7,U/D,L/R,DCLK,HS,VS,DE.

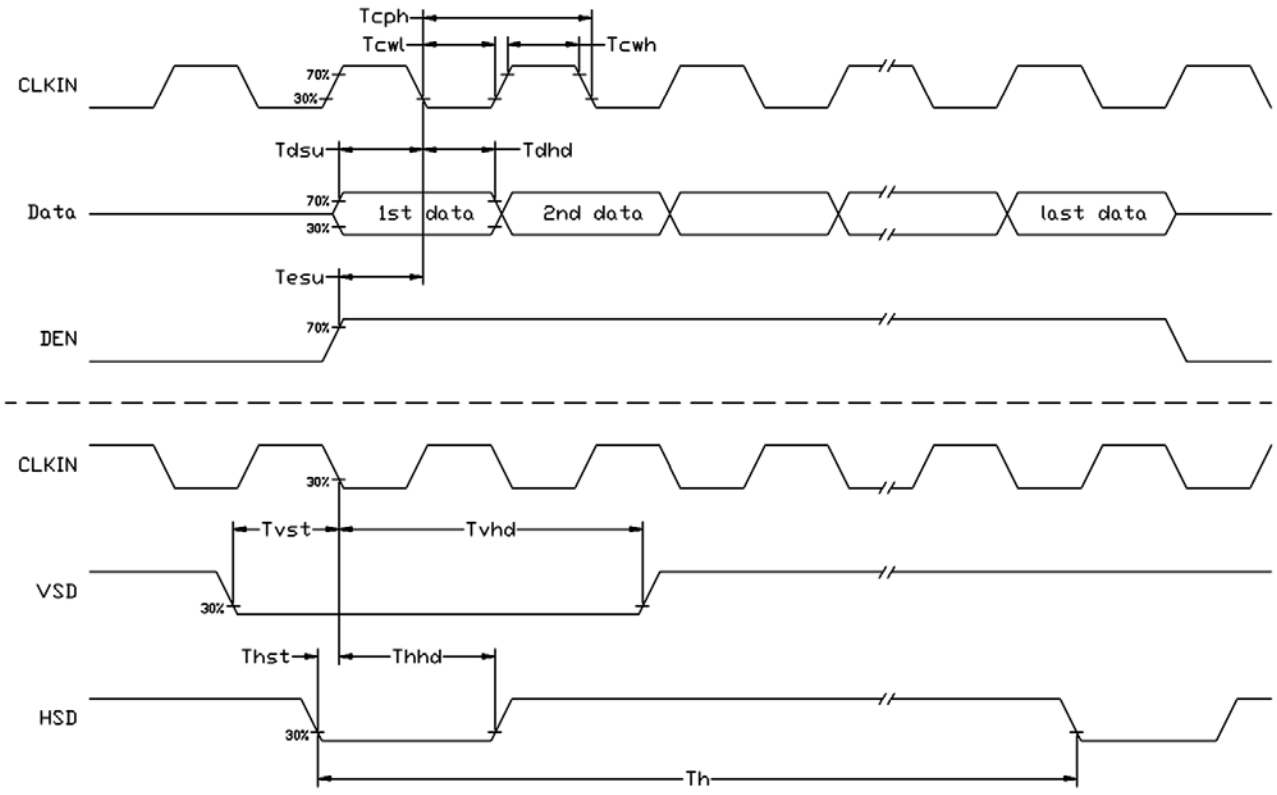
6. AC Characteristics

6.1 TFT Timing Characteristics

Item	Symbol	MIN.	TYP.	MAX.	Unit	Remark
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 hole time	Tdhd	8	-	-	ns	
DE setup time	Tesu	8	-	-	ns	
V_{CC} Power On Slew rate	TPOR	-	-	20	ms	From 0 to 90% V_{CC}
DCLK cycle time	Tcph	20	-	-	ns	
DCLK pulse duty	Tcwh	40	50	60	%	

Note: For the details of the timing, please see the Driver IC data sheet.

Input Clock and Data Timing Diagram



6.2 Recommended Timing Setting Of TCON

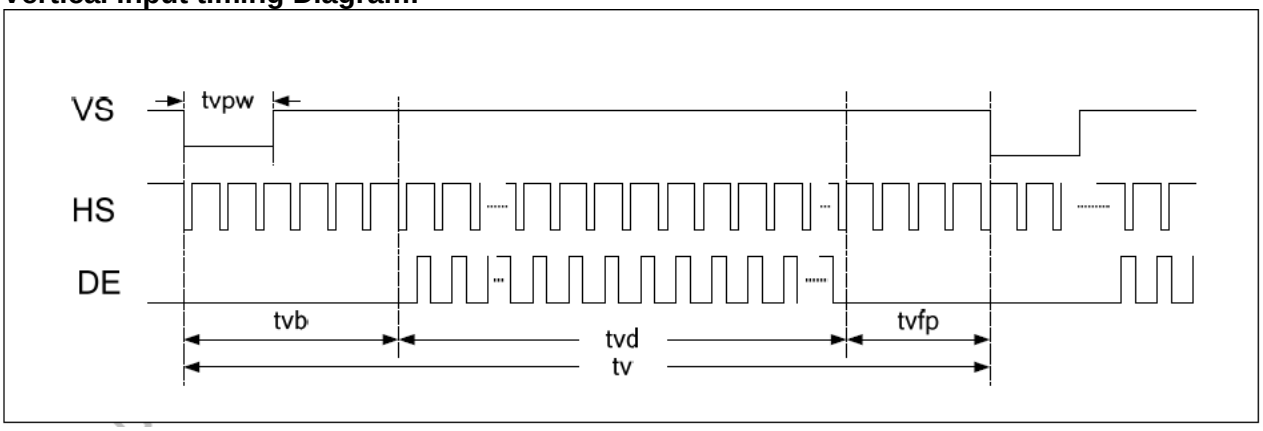
TCON (Embedded In Source IC) Input Timing (DCLK, HSD, VSD, DE)

VCC=3.3V, AVDD=10.4V, GND=0V, Ta=25℃

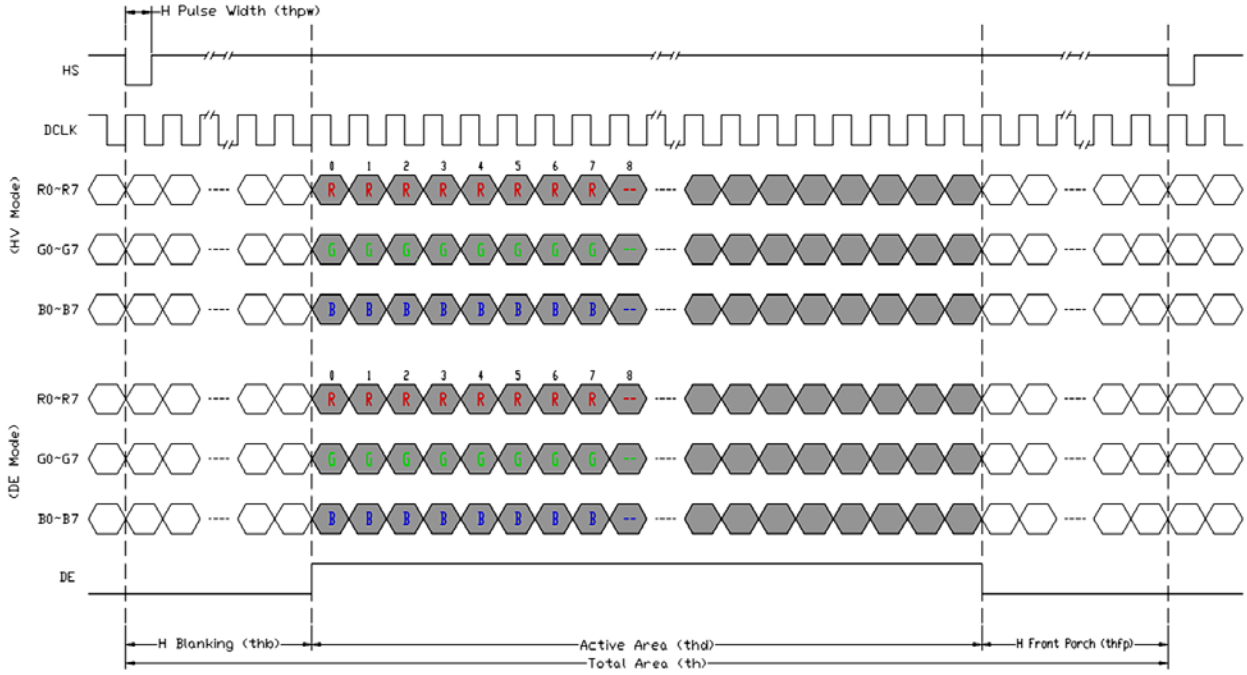
Item	Symbol	MIN.	TYP.	MAX.	Unit	Remark
DCLK	fclk	26.4	33.3	46.8	MHz	
HSD	thd	-	800	-	DCLK	
	th	862	1056	1200	DCLK	
	thpw	1	-	40	DCLK	
	thb	46	46	46	DCLK	
	thfp	16	210	354	DCLK	
VSD	tvd	-	480	-	TH	
	tv	510	525	650	TH	
	tvpw	1	-	20	TH	
	tvb	23	23	23	TH	
	tvfp	7	22	147	TH	

Note: DE timing refer to HSD, VSD input timing.

Vertical input timing Diagram:



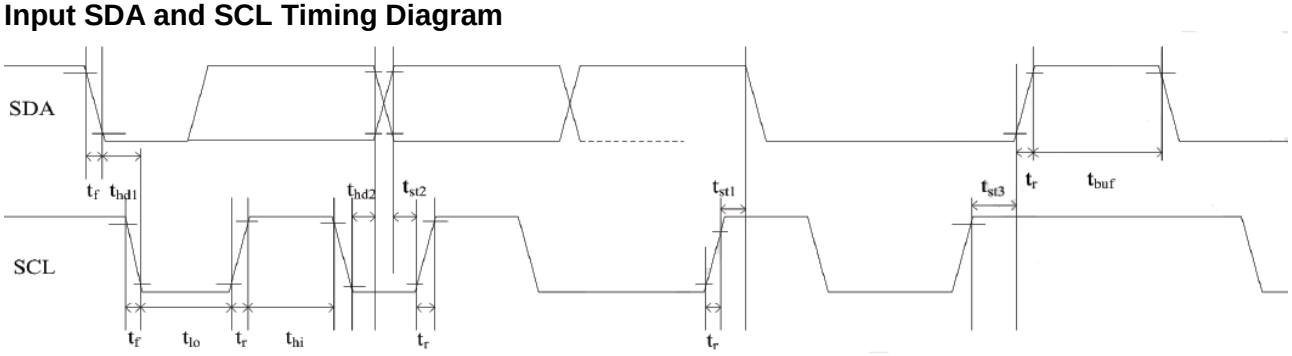
6.3 Horizontal input timing Diagram



6.4 I²C Timing Characteristics(CTP)

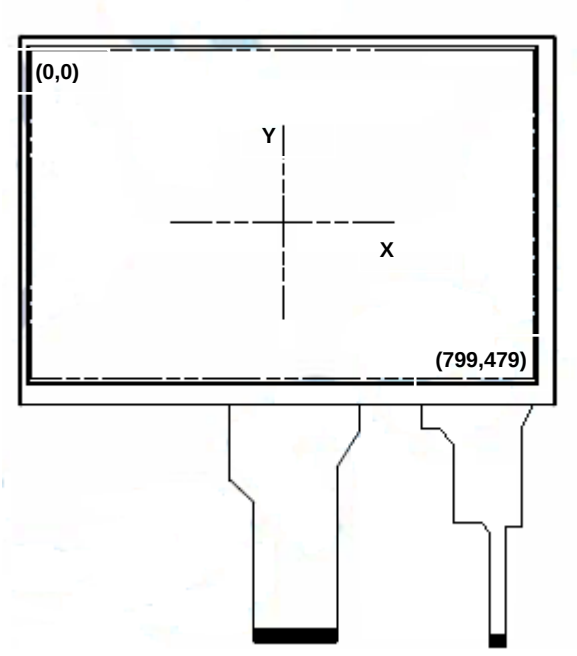
Item	Symbol	MIN.	MAX.	Unit	Remark
SCL low period	tlo	1.3	-	us	
SCL high period	thi	0.6	-	us	
SCL setup time for Start condition	tst1	0.6	-	us	
SCL setup time for Stop condition	tst3	0.6	-	us	
SCL hold time for Start condition	thd1	0.6	-	us	
SDA setup time	tst2	0.1	-	us	
SDA hold time	thd2	0	-	us	

Input SDA and SCL Timing Diagram



7. CTP Functional Characteristics

7.1 CTP Coordinate

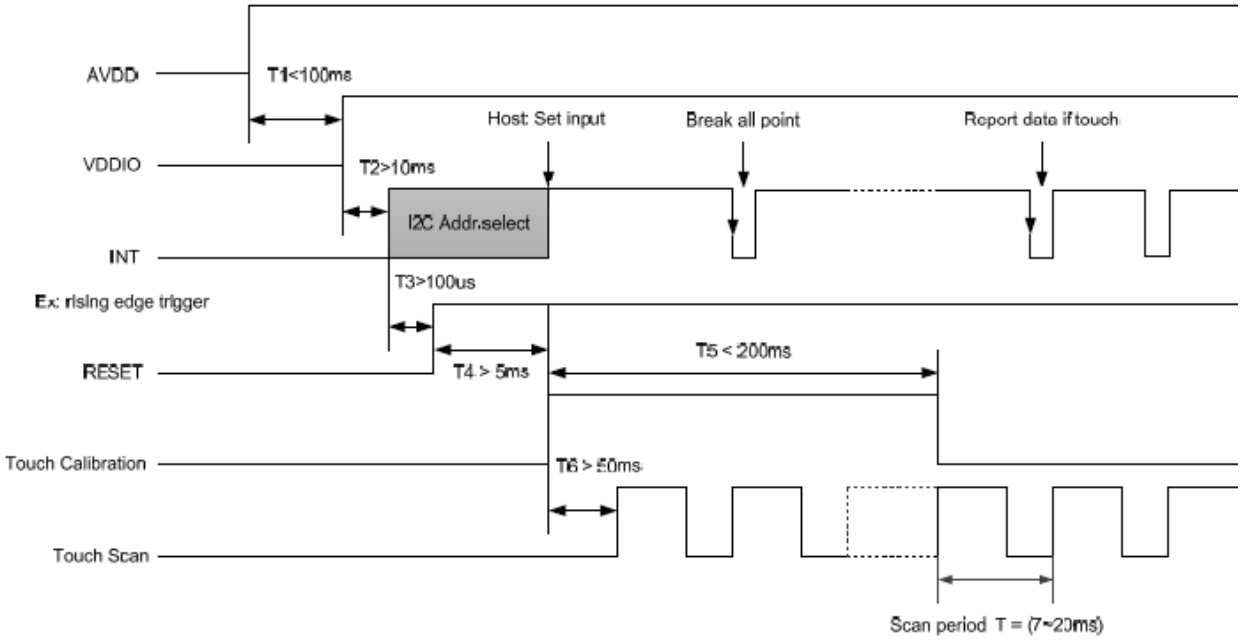


Note: *1: Top left corner is the origin.
* 2: Default resolution 800*480.

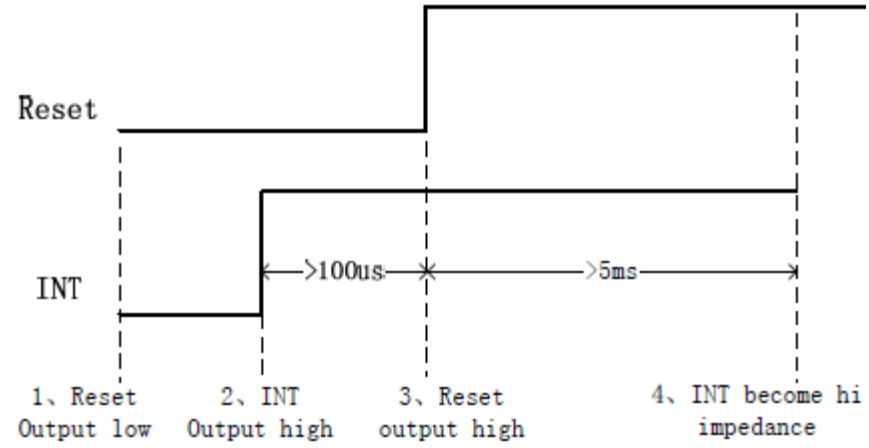
7.2 I²C Slave Addresses

CTP has 2 sets of slave address 0xBA/0xBB & 0x28/29. Master can control Reset & INT pin to configure the slave address in power on initial state like following:

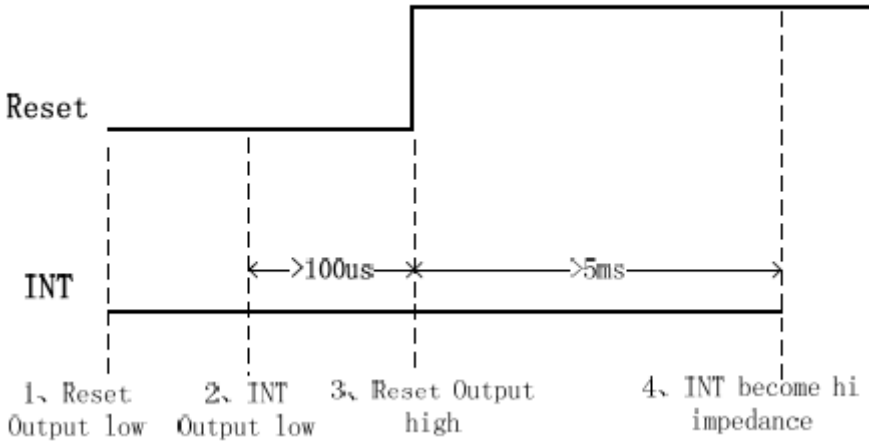
Power on diagram:



Timing for setting slave address to 0x28/0x29:



Timing for setting slave address to 0xBA/0xBB:



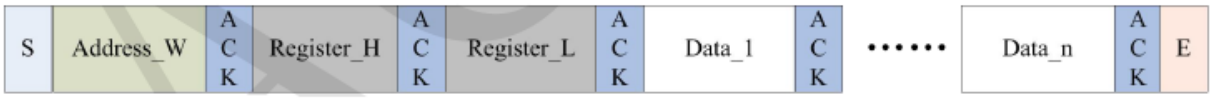
7.3 I²C Data Transmission

(For example：device address is 0xBA/0xBB)

1. Communication is always initiated by the host. Valid Start condition is signaled by pulling SDA linefrom "high" to "low" when SCL line is "high". Data flow or address is transmitted after the Startcondition.
2. 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, GT911 acknowledges by configuring SDA line as output port and pulling SDA line low during the ninth SCL cycle. When receiving unmatchedaddress, namely, not 0XBA or 0XBB, GT911 will stay in an idle state.
3. For data bytes on SDA, each of 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".
4. 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 line is "high".

CTP I²C Data Write

(For example：device address is 0xBA/0xBB)

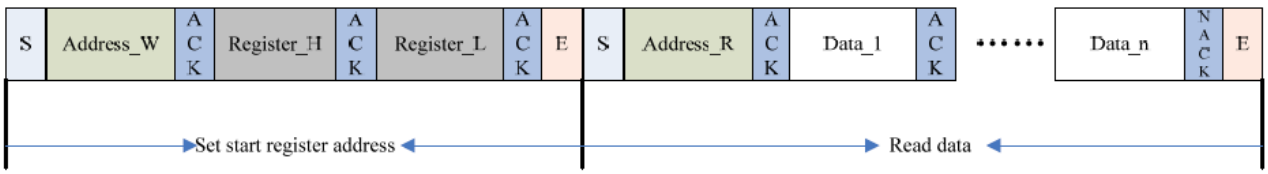


Timing for Write Operation

1. The diagram above displays the timing sequence of the host writing data onto GT911. First, the host issues a Start condition. Then, the host sends 0XBA (address bits and R/W bit; R/W bit as 0 indicates Write operation) to the slave device.
2. 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).
3. The location of the register address pointer will automatically add 1 after every Write Operation. Therefore, when the host needs to perform Write Operations on a group of registers of continuous addresses, it is able to write continuously. The Write Operation is terminated when the host issues the Stop condition.

CTP I²C Data Read

(For example：device address is 0xBA/0xBB)



Read operations

1. The diagram above is the timing sequence of the host reading data from GT911. First, the host issues.a Start condition and sends 0XBA (address bits and R/W bit; R/W bit as 0 indicates Write operation) to the slave device.
2. 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.
3. Also after receiving ACK, the host issues the Start condition once again and sends 0XBB (Read Operation). After receiving ACK, the host starts to read data.
4. GT911 also supports continuous Read Operation and, by default, reads data continuously. Whenever.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.

7.4 CTP Register

Register Table

Register	Access	Descriptions
0x8140	R	Product ID (first byte，ASCII)
0x8141	R	Product ID (second byte，ASCII)
0x8142	R	Product ID (third byte，ASCII)
0x8143	R	Product ID (forth byte，ASCII)
0x8144	R	Firmware version (HEX.low byte)
0x8145	R	Firmware version (HEX.high byte)
0x8146	R	x coordinate resolution (low byte)
0x8147	R	x coordinate resolution (high byte)
0x8148	R	y coordinate resolution (low byte)
0x8149	R	y coordinate resolution (high byte)
0x814A	R	Vendor_id (current module option information)
0x814B	R	Reserved
0x814C	R	Reserved
0x814D	R	Reserved
0x814E	R/W	D[7,6]: buffer status D[5,4]: large detect D[3,2]: reserved D[1,0]: number of touch points
0x814F	R	track id
0x8150	R	point 1 x coordinate (low byte)
0x8151	R	point 1 x coordinate (high byte)
0x8152	R	point 1 y coordinate (low byte)
0x8153	R	point 1 y coordinate (high byte)
0x8154	R	Point 1 size (low byte)
0x8155	R	point 1 size (high byte)
0x8156	R	Reserved
0x8157	R	track id
0x8158	R	point 2 x coordinate (low byte)
0x8159	R	point 2 x coordinate (high byte)
0x815A	R	point 2 y coordinate (low byte)
0x815B	R	point 2 y coordinate (high byte)
0x815C	R	point 2 size (low byte)
0x815D	R	point 2 size (high byte)
0x815E	R	Reserved
0x815F	R	track id
0x8160	R	point 3 x coordinate (low byte)
0x8161	R	point 3 x coordinate (high byte)
0x8162	R	point 3 y coordinate (low byte)
0x8163	R	point 3 y coordinate (high byte)
0x8164	R	point 3 size (low byte)
0x8165	R	point 3 size (high byte)

Register	Access	Descriptions
0x8166	R	Reserved
0x8167	R	track id
0x8168	R	point 4 x coordinate (low byte)
0x8169	R	point 4 x coordinate (high byte)
0x816A	R	point 4 y coordinate (low byte)
0x816B	R	point 4 y coordinate (high byte)
0x816C	R	point 4 size (low byte)
0x816D	R	point 4 size (high byte)
0x816E	R	Reserved
0x816F	R	track id
0x8170	R	point 5 x coordinate (low byte)
0x8171	R	point 5 x coordinate (high byte)
0x8172	R	point 5 y coordinate (low byte)
0x8173	R	point 5 y coordinate (high byte)
0x8174	R	point 5 size (low byte)
0x8175	R	point 5 size (high byte)
0x8176	R	Reserved
0x8177	R	Reserved

Note:Please refer to C911 IC datasheet for detail

8. Optical Characteristics

Item	Symbol	Condition	MIN.	TYP.	MAX.	UNIT	Note.
Viewing angle (CR⩾10)	θ_L	9 o'clock	60	70	-	degree	*2
	θ_R	3 o'clock	60	70	-		
	θ_T	12 o'clock	40	50	-		
	θ_B	6 o'clock	60	70	-		
Response Time	T_f	Normal θ=0°	-	10	20	msec	*3
	T_r		-	15	30	msec	
Contrast ratio	CR		400	500	-	-	*1
Color chromaticlty	W_X		0.26	0.31	0.26	-	
	W_Y		0.28	0.33	0.38	-	
Luminance	L		-	400	-	Cd/m^2	*4
Luminance uniformity	Y_U		70	75	-	%	*4

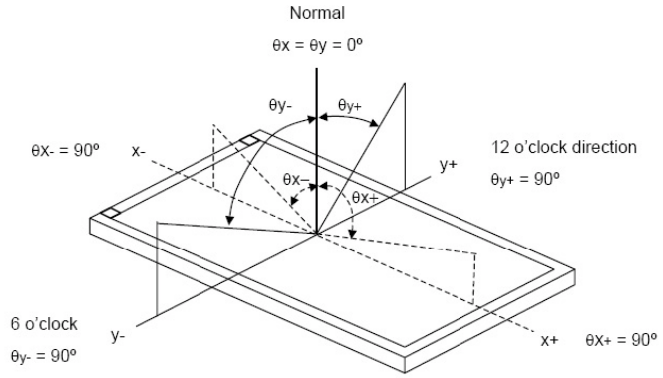
Note:

*1. Definition of Contrast Ratio

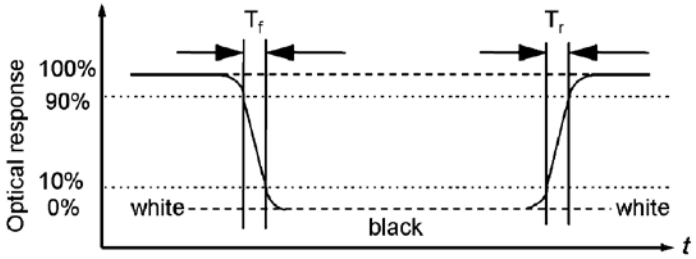
The contrast ratio could be calculate by the following expression:

Contrast Ratio (CR) = Luminanc with all pixels white / Luminance with all pixels black

*2 Definition of Viewing Angle

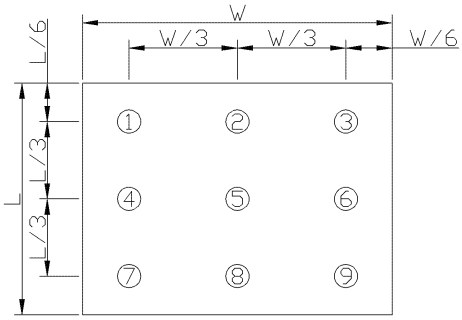


*3 Definition of response time



*4 Definition of Luminance Uniformity

Luminance uniformity (Lu)=Mi. Luminance form pt1~pt9 / Max Luminance form Pt1~pt9



9. Precautions of using LCD Modules

Mounting

- Mounting must use holes arranged in four corners or four sides.
- The mounting structure so provide even force on to LCD module. Uneven force (ex. Twisted stress) should not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- It is suggested to attach a transparent protective plate to the surface in order to protect the polarizer. It should have sufficient strength in order to the resist external force.
- The housing should adopt radiation structure to satisfy the temperature specification.
- Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. Never rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics deteriorate the polarizer.)
- When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer

Operating

- The spike noise causes the mis-operation of circuits. It should be within the ±200mV level (Over and under shoot voltage)
- Response time depends on the temperature.(In lower temperature, it becomes longer.)
- Brightness depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer.
- Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- When fixed patterns are displayed for a long time, remnant image is likely to occur.
- Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference

Electrostatic Discharge Control

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

Storage

When storing modules as spares for a long time, the following precautions are necessary.

- Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

Protection Film

- When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- The protection film is attached to the polarizer with a small amount of glue. If some stress is applied to rub the protection film against the polarizer during the time you peel off the film, the glue is apt tore main on the polarizer. Please carefully peel off the protection film without rubbing it against the polarizer.
- When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the polarizer after the protection film is peeled off.
- You can remove the glue easily. When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

Transportation

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