Densitron

TFT LCD DISPLAY MODULE

Product Specification

Customer		
Product Number	DMT070F3NMCMI-1A	
Customer Part Number		
Customer Approval	**Date:**	

Internal Approvals		
Product Mgr	Doc. Control	Electr. Eng
Luo Luo	Filip Kaczorowski	Filip Kaczorowski
Date: 02/10/18	**Date: 02/10/18**	**Date: 02/10/18**

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Revision Record

Rev.	Date	Page	Chapt.	Comment	ECR no.
A	02/10/18	--	--	Initial Release	

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1.0 General Description

1.1 Introduction

This is a colour active matrix TFT (Thin Film Transistor) LCD (liquid crystal display) that uses amorphous silicon TFT as a switching device. This module is composed of a Transmissive type TFT-LCD Panel, driver circuit, projective capacitive touch panel and a back-light unit. The resolution of a 7.0 " TFT-LCD contains 1200x1920 pixels and can display up to 16.7M colours.

1.2 Main Features

Item	Contents
Display Type	TFT LCD
Screen Size	7” Diagonal
Display Format	1200 x RGB x 1920 Dots
N° of Colour	16.7M
Overall Dimensions	119.46 (H) x 176.78 (V) x 4.0 (D) mm
Active Area	94.5 (H) x 151.2 (V) mm
Pixel Arrangement	RGB Vertical Stripe
Pixel pitch	0.07875 (H) x 0.07875 (V) mm
Mode	Transmissive / Normally Black
Viewing Angle	Free
Interface	4 Lane MIPI
Controller IC	R69429
Backlight Type	LED, White, 20 chips, Edge-lighting
Module Bonding Technology	Optical bonding between LCP and PCT
Operating temperature	-10°C ~ +60°C
Storage temperature	-30°C ~ +70°C
ROHS	Compliant to 2011/65/EU

1.3 CTP Features

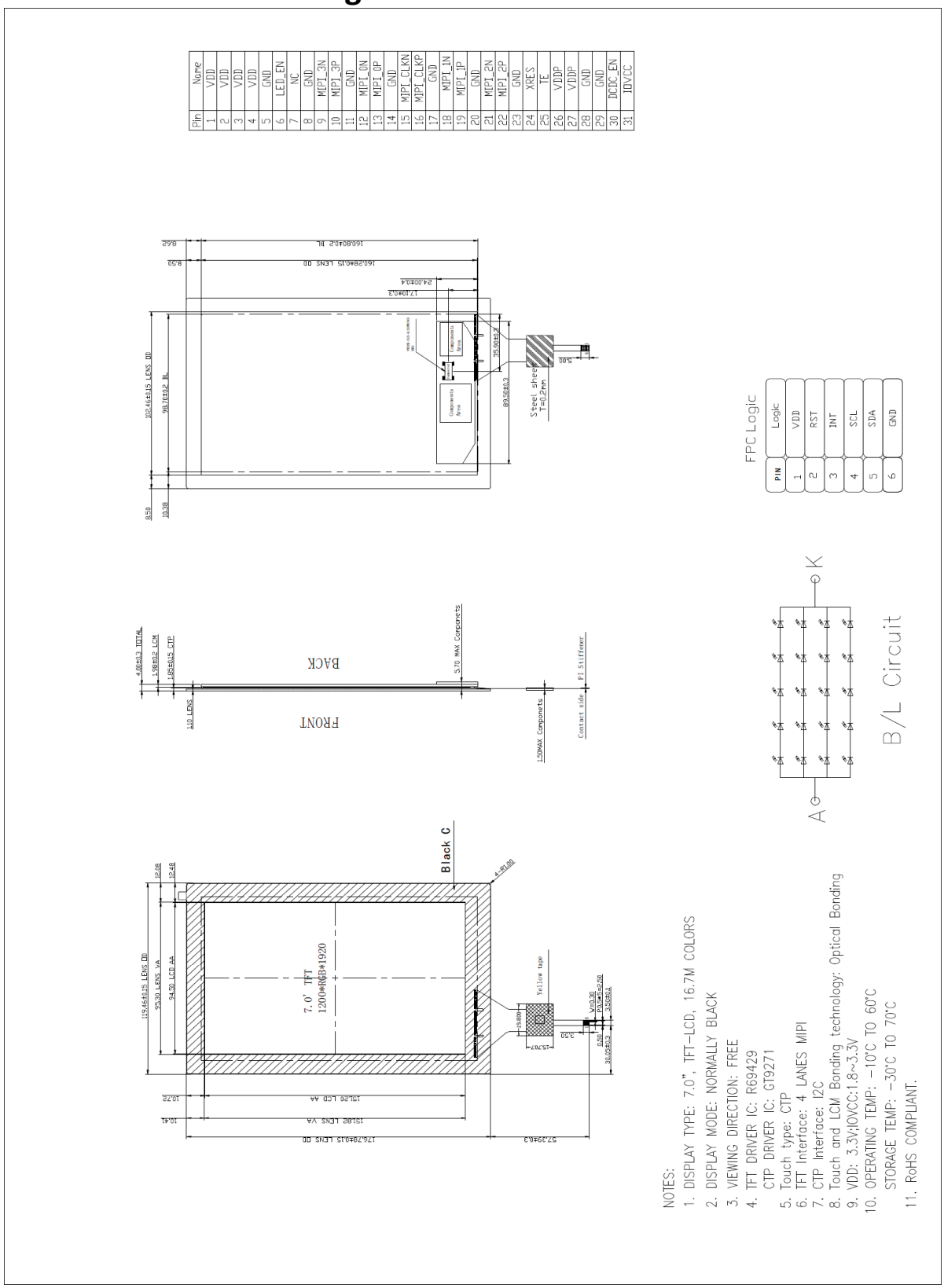
Item	Contents
Resolution	1200(H) x 1920(V)
Structure	G+G
Controller IC	GT9271
Interface	I2C
Slave Address	0x5D(7bit) or 0x14(7bit)
Touch Mode	Five points and gestures

2.0 Mechanical Specification

2.1 Mechanical Characteristics

Item	Characteristic	Unit
Display Format	1200 x RGB x 1920 Dots	Dots
Overall Dimensions	98.70 (H) x 176.78 (V) x 4.0 (D)	mm
Active Area	94.5 (H) x 151.2 (V)	mm
Pixel Pitch	0.07875(H) x 0.07875 (V)	mm
Weight	TBD	g

2.2 Mechanical Drawing



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3.0 Electrical Specification

3.1 Absolute Maximum Ratings

3.1.1 TFT

Item	Symbol	Min	Max	Unit	Note
Power Supply Voltage (Analog)	VDD-GND	-0.3	6.0	V	
	VDDp-GND	-0.3	6.0	V	
Power Supply Voltage (Logic)	IOVCC	-0.3	4.6	V	
Input Signal Voltage (RES)	V_I	-0.3	IOVCC+0.3	V	XRES
Input Signal Voltage (DSI)	$V_{I(DSI)}$	-0.3	1.8	V	
Input Signal Voltage (LED)	$V_{I(LED)}$	-0.3	6.0	V	LED_EN
Input Signal Voltage (PWR)	$V_{I(PWR)}$	-0.3	5.5	V	DCDC_EN
Operating Temperature	T_{OP}	-10	+60	°C	2
Storage Temperature	T_{STG}	-30	+70	°C	2
Static Electricity	Be sure that you are grounded when handling displays.				

Note 1: If the absolute maximum rating of even is one of above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.
Note 2: Non-condensing

3.1.2 PCT

Item	Symbol	Min	Max	Unit	Note
Power Supply Voltage	VDD	2.66	3.47	V	
Operating Temperature	T_{OP}	-10	+60	°C	
Storage Temperature	T_{STG}	-30	+70	°C	

3.2 Electrical Characteristics

3.2.1 TFT

Item		Symbol	Min	Typ.	Max	Unit	Note
Power Supply Voltage for Analog		VDD	3.0	-	5.0	V	
		VDDp	3.0	-	5.0	V	
Power Supply Voltage for Logic		IOVCC	1.70	1.80	1.90	V	
Input Signal Voltage (RES)		V_{IH}	0	-	0.3xIOVCC	V	XRES
		V_{IL}	0.7xIOVCC	-	IOVCC	V	
Output Signal Voltage (TE)		V_{OL}	0	-	0.2XIOVCC	V	TE
		V_{OH}	0.8IOVCC	-	IOVCC	V	
Input Signal voltage (DSI)	Low Level	$V_{IL(DSI)}$	-50	-	550	mV	Low Power Reciever
	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	
Input Signal Voltage (LED)		$V_{IL(LED)}$	1.5	-	VDD	V	LED_EN
		$V_{IL(LED)}$	0	-	0.5	V	
Input Signal Voltage (PWR)		$V_{IL(PWR)}$	1.4	-	VDDp	V	DCDC_EN
		$V_{IH(PWR)}$	0	-	0.4	V	

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

3.2.2 PCT

Item	Min.	Typ.	Max.	Unit	Note
Power Supply Voltage (VDD)	2.66	3.3	3.47	V	
Normal mode operating current	-	12	-	mA	
Green mode operating current	-	4.5	-	mA	
Sleep mode operating current	70	-	120	uA	
Digital Input low voltage	-0.3	-	0.25xVDD	V	
Digital input high voltage	0.7xVDD	-	VDD+0.3	V	

Digital output low voltage	-	-	0.15xVDD	V	
Digital output high voltage	0.85xVDD	-	-	V	
OSC oscillation frequency	59	60	61	MHz	
I/O output rise time, low to high	-	14	-	ns	
I/O output fall time, high to low	-	14	-	ns	

3.4 Input terminal Pin Assignment

3.4.1 TFT

Connector on FPC: FH35C-31S-0.3HW(50) (HIROSE)

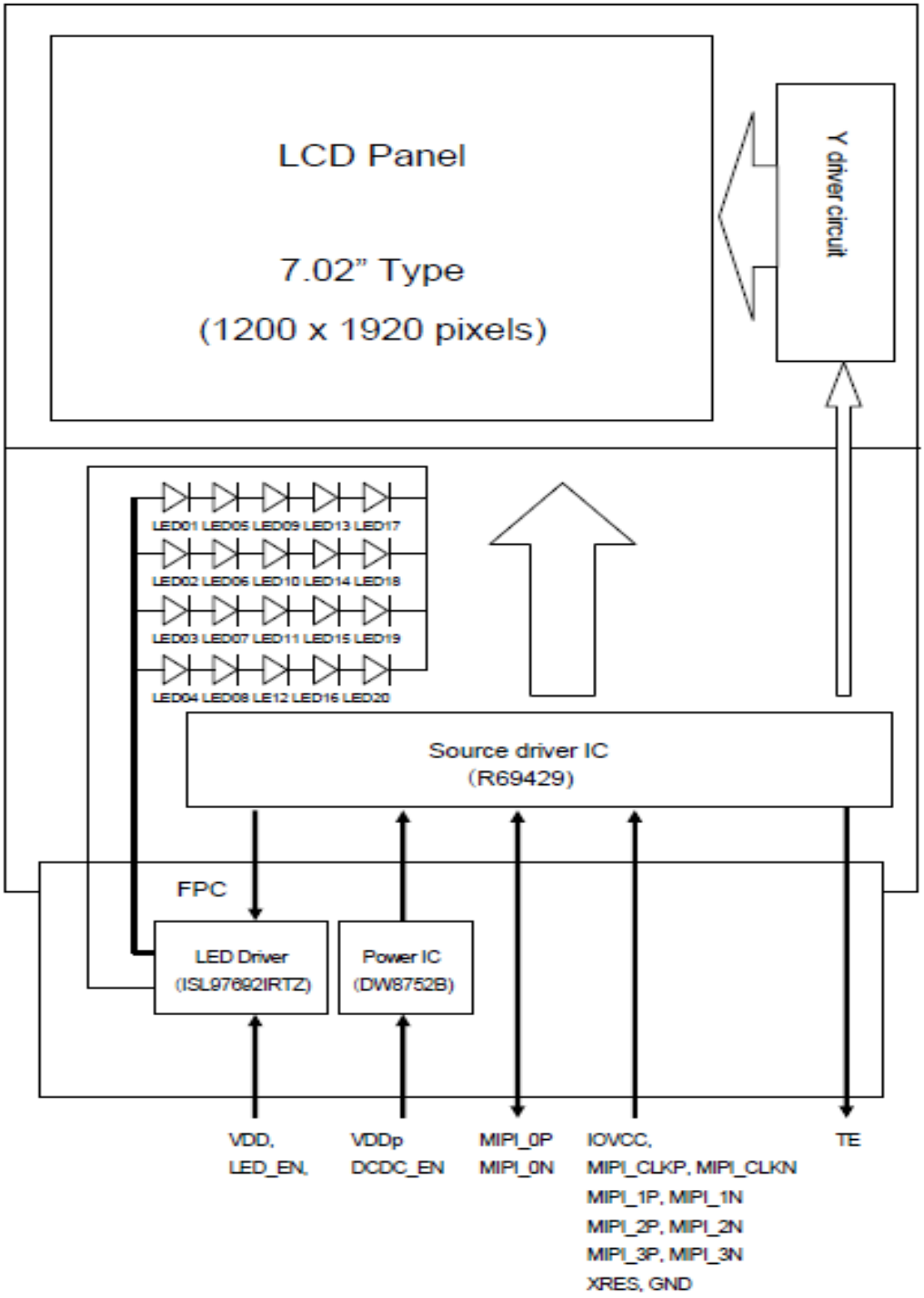
No.	Symbol	Function
1	VDD	LED power supply (3-5V).
2	VDD	LED power supply (3-5V).
3	VDD	LED power supply (3-5V).
4	VDD	LED power supply (3-5V).
5	GND	Ground.
6	LED_EN	LED backlight enable, active high.
7	NC	Not connected.
8	GND	Ground.
9	MIPI_3N	MIPI data 3 negative signal.
10	MIPI_3P	MIPI data 3 negative signal.
11	GND	Ground.
12	MIPI_0N	MIPI data 0 negative signal.
13	MIPI_0P	MIPI data 0 negative signal.
14	GND	Ground.
15	MIPI_CLKN	MIPI data CLK negative signal.
16	MIPI_CLKP	MIPI data CLK negative signal.
17	GND	Ground.
18	MIPI_1N	MIPI data 1 negative signal.
19	MIPI_1P	MIPI data 1 negative signal.
20	GND	Ground.
21	MIPI_2N	MIPI data 2 negative signal.
22	MIPI_2P	MIPI data 2 negative signal.
23	GND	Ground.
24	XRES	Reset, active low.
25	TE	

No.	Symbol	Function
26	VDDp	IC power supply (3-5V).
27	VDDp	IC power supply (3-5V).
28	GND	Ground.
29	GND	Ground.
30	DCDC_EN	IC power supply enable, active high.
31	IOVCC	Power supply for LCM (1.8 ± 0.1V).

3.4.2 PCT

No.	Symbol	Function
1	VDD	Supply voltage.
2	RST	External Reset, active low.
3	INT	Externa interrupt to the host.
4	SCL	I2C clock input.
5	SDA	I2C data input and output.
6	LED_EN	Ground.

3.5 Block Diagram



4.0 LED Backlight Specification

4.1 LED Backlight Characteristics

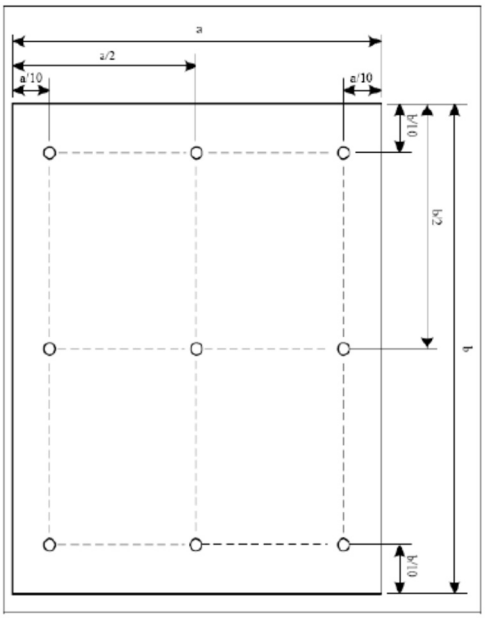
The backlight system is edge-lighting type with 20 chips LED.

Characteristics	Symbol	Min	Typ.	Max	Unit	Note
Forward Current	I_F	160	180	-	mA	-
LCM Luminance	LV	340	400	-	cd/m2	3
LED life time	Hr	-	50000	-	Hour	1, 2
Uniformity	AVg	80	-	-	%	3

Note 1: LED life time (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25±3 ℃, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note 2: The “LED life time” is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and IL=40mA. The LED lifetime could be decreased if operating IL is larger than 40mA. The constant current driving method is suggested.

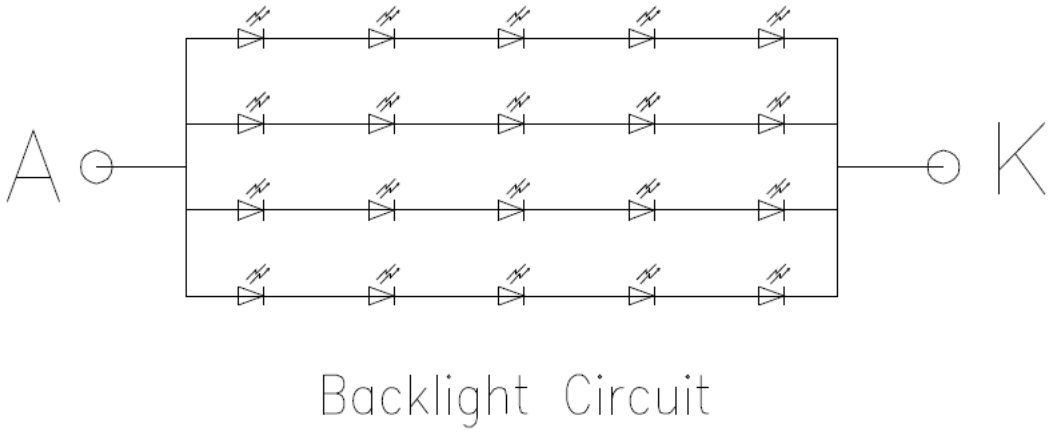
Note 3: luminance Uniformity of these 9 points is defined as below:



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

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

4.2 INTERNAL CIRCUIT DIAGRAM



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5.0 LCD Optical Characteristics

5.1 Optical specification

Characteristics		Symbol	Conditions	Min	Typ.	Max	Unit	Note
Contrast Ratio		CR	θ=Φ=0° Normal Viewing Angle	700	1100	-		
Uniformity		S(%)		-	71.5	-	%	
Colour Filter Chromaticity	White	W_X		0.27	0.31	0.35	-	4
		W_Y		0.29	0.33	0.37		
	Red	R_x		0.60	0.64	0.68		
		R_Y		0.29	0.33	0.37		
	Green	G_X		0.27	0.31	0.35		
		G_Y		0.57	0.61	0.65		
	Blue	B_X		0.11	0.15	0.19		
		B_Y		0.01	0.05	0.09		
Viewing angle	Hor.	θL	CR≥10	80	-	-	-	1
		θR		80	-	-		
	Ver.	θU		80	-	-		
		θD		80	-	-		
Option View Direction			Free					1

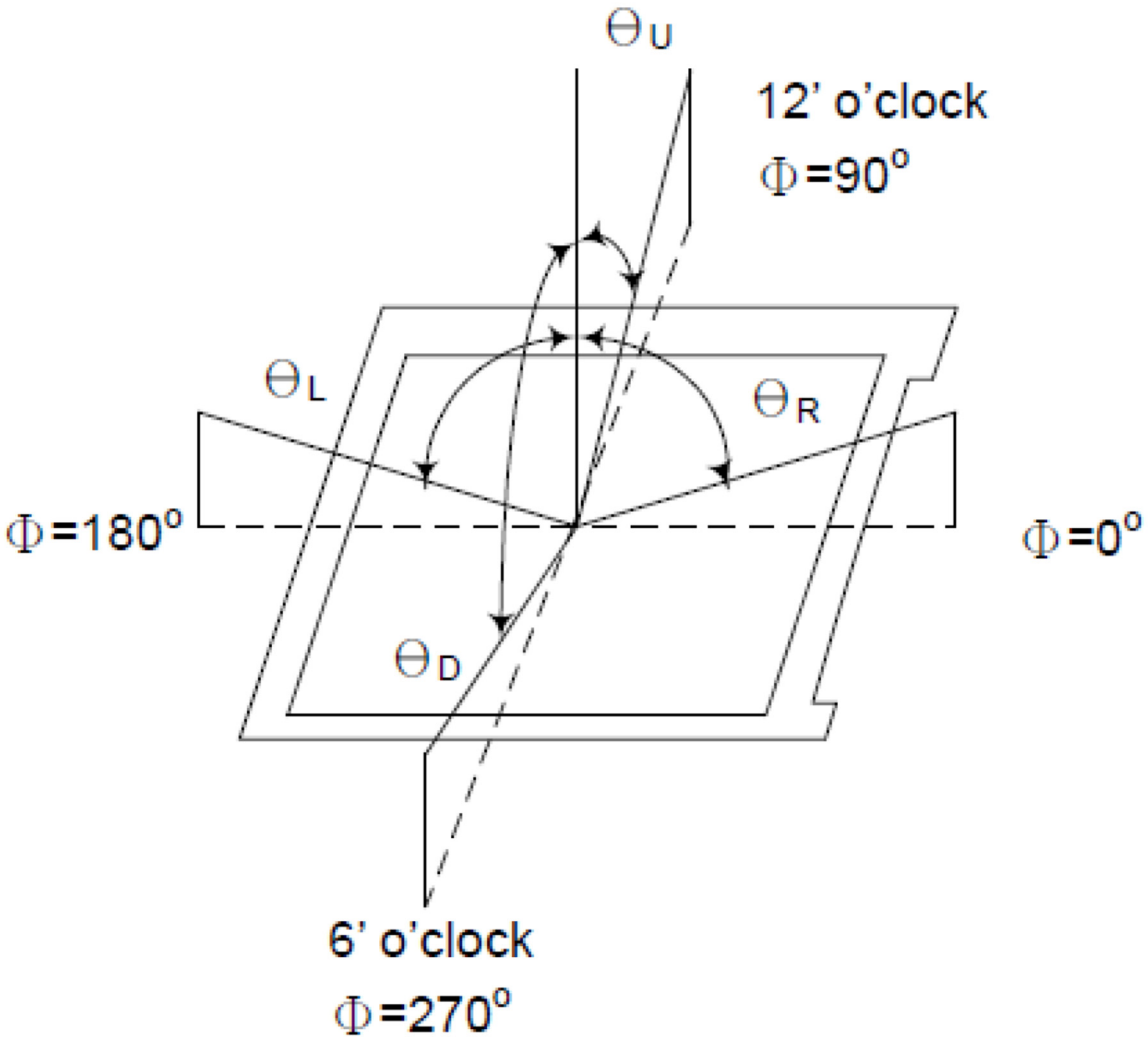
5.2 Measuring Condition

- Measuring surrounding: dark room
- Ambient temperature: 25±2°C
- 15min. warm-up time.

5.3 Measuring equipment

- FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics

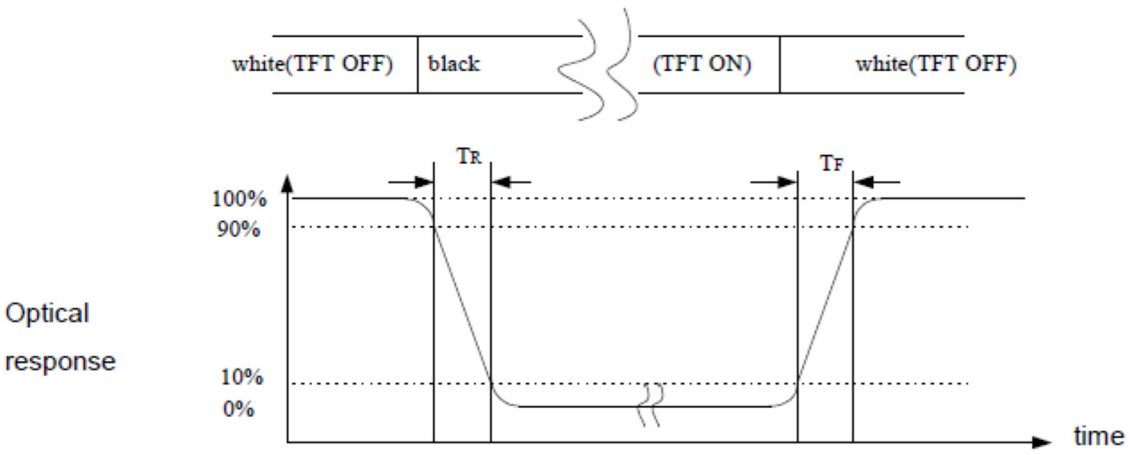
Note 1: Definition of Viewing Angle



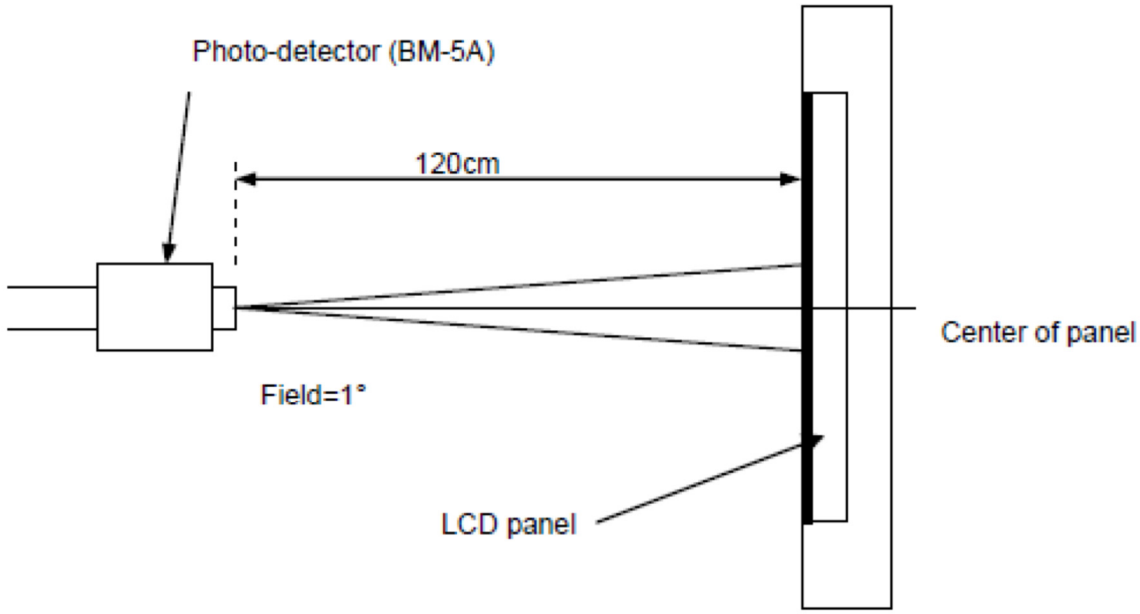
Note 2: Definition of Contrast Ratio (CR)
Measured at the centre point of panel

$$CR = \frac{Luminance\ with\ all\ pixels\ white}{Luminance\ with\ all\ pixesls\ black}$$

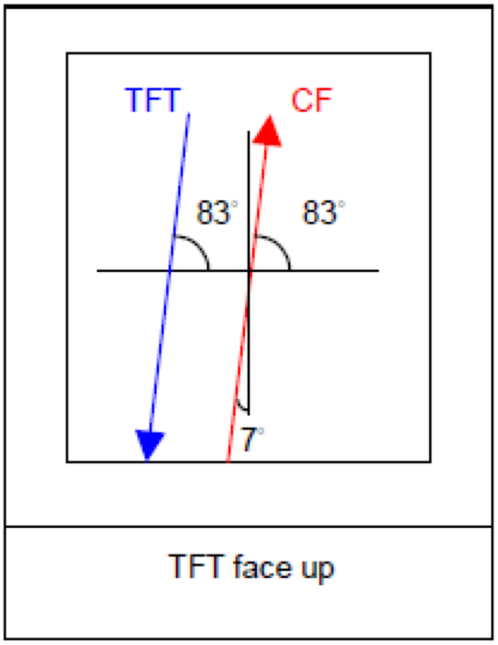
Note 3: Definition of Response Time: Sum of T_R and T_F



Note 4: Definition of optical measurement setup



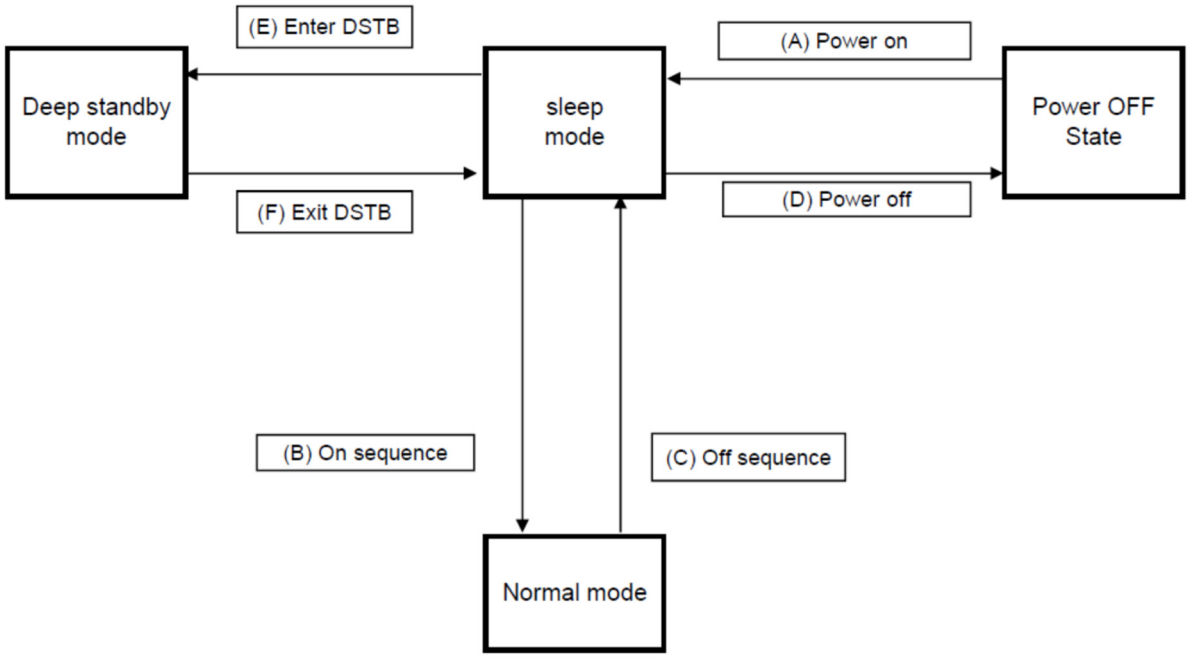
Note 5: Rubbing Direction (The different Rubbing Direction will cause the different optima view direction).



6.0 Command sequence

6.1 Status Flow

(1200 x RGB x 1920, R69429, MIPI 4lane)



6.2 Sequence

6.2.1 Power on

sequence	DataTyp (hex)	index (hex)	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					Vddp(VSP,VSN PWR) on	
wait 3ms						
DCDC_EN L->H					DCDC_EN L->H (VSP,VSN on)	
wait 20ms						
RESET L->H					RESET L->H	
wait 10ms						
DCDC_EN H->L					DCDC_EN H->L (VSP,VSN off)	(*1)Can skip "DCDC_EN H->L" in case of going to normal mode without staying sleep status.
wait 20ms						
SLEEP MODE						

6.2.2 On sequence

sequence	DataType (hex)	index (hex)	parameters #	(hex)	description	comment
SLEEP MODE						
↓						
DCDC_EN L->H					DCDC_EN L->H (VSP,VSN on)	
wait 20ms						
command	05	01	-	-	soft reset	
wait 5ms						
command	23	B0	1	00	MCAP	
command	29	B3	1 2 3 4 5	04 08 00 22 00	Interface setting	
command	29	B4	1	0C	Interface ID setting	
command	29	B6	1 2	3A D3	DSI control	
command	15	51	1	E6	write display brightness	
command	15	53	1	2C	write control display	
command	15	3A	1	77	set pixel format	
command	39	2A	1 2 3 4	00 00 04 AF	set column address	
command	39	2B	1 2 3 4	00 00 07 7F	set page address	
send image	39	2C/3C			write memory / write memory continue	
command	05	11	-	-	exit sleep mode	
wait 120ms						
command	05	29	-	-	set display on	
wait min 0ms						
LED_EN L->H					LED_EN L->H	
↓						
NORMAL MODE						

6.2.3 Off Sequence

sequence	DataTyp (hex)	index (hex)	parameters #	(hex)	description	comment
NORMAL MODE						
↓						
command	05	28	-	-	set display off	
wait 20ms						
command	05	10	-	-	enter sleep mode	
wait 80ms						
DCDC_EN H->L					DCDC_EN H->L (VSP,VSN off)	
wait 20ms						
↓						
SLEEP MODE						

6.2.4 Power Off

sequence	DataTyp (hex)	index (hex)	parameters #	(hex)	description	comment
SLEEP MODE						
↓						
RESET H->L						
PWR supply off					IOVcc off	DSI input should be at GND level while IOVcc off.
↓						
POWER OFF STATE						

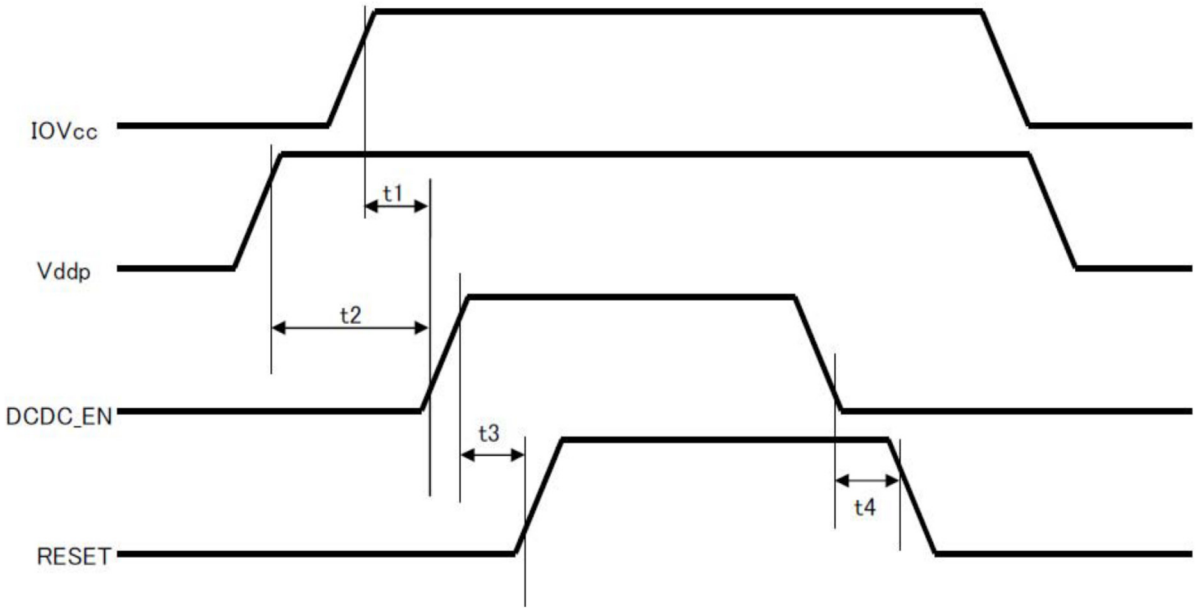
6.2.5 Enter DSTB

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

6.2.6 Exit DSTB

sequence	DataTyp (hex)	index (hex)	parameters #	(hex)	description	comment
DSTB MODE						
↓						
RESET H -> L						
wait 10ms						
PWR supply on					Vddp(VSP,VSN PWR) on	
wait 3ms						
DCDC_EN L->H					DCDC_EN L->H (VSP,VSN on)	
wait 20ms						
RESET L->H					RESET L->H	
wait 10ms						
DCDC_EN H->L					DCDC_EN H->L (VSP,VSN off)	(*1)Can skip "DCDC_EN H->L" in case of going to normal mode without staying sleep status.
wait 20ms						
↓						
SLEEP MODE						

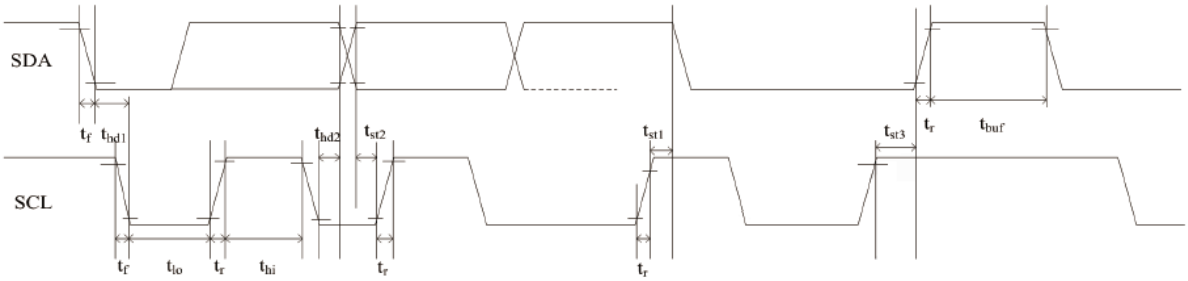
6.3 Power Supply Sequence



Parameter	Symbol	Min	Typ	Max	Unit
IOVCC on to DCDC_EN on time	t1	1	3	-	ms
VDDP on to DCDC_EN on time	t2	1	3	-	ms
DCDC_EN on to REST on time	t3	12	20	-	ms
DCDC_EN off to REST off time	t4	15	20	-	ms

7.0 I2C Timing

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



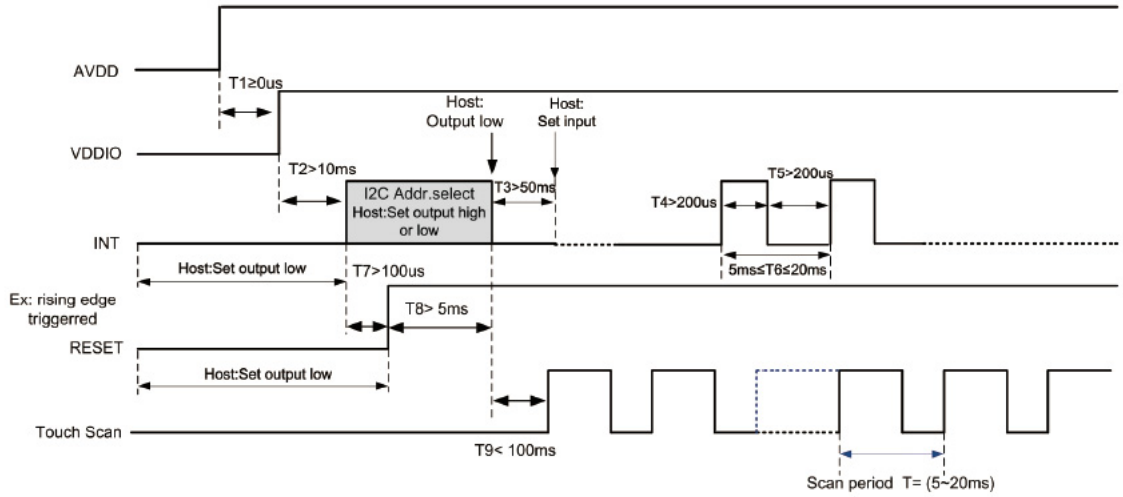
Test condition 1: 1.8V host interface voltage, 400Kbps transmission rate, 2k pull-up resistor

Parameter	Symbol	Min	Max	Unit
SCL low period	t_{lo}	1.3	-	µs
SCL high period	t_{hi}	0.6	-	µs
SCL setup time for Start condition	t_{st1}	0.6	-	µs
SCL setup time for Stop condition	t_{st3}	0.6	-	µs
SCL hold time for Start condition	t_{hd1}	0.6	-	µs
SDA setup time	t_{st2}	0.1	-	µs
SDA hold time	t_{hd2}	0	-	µs

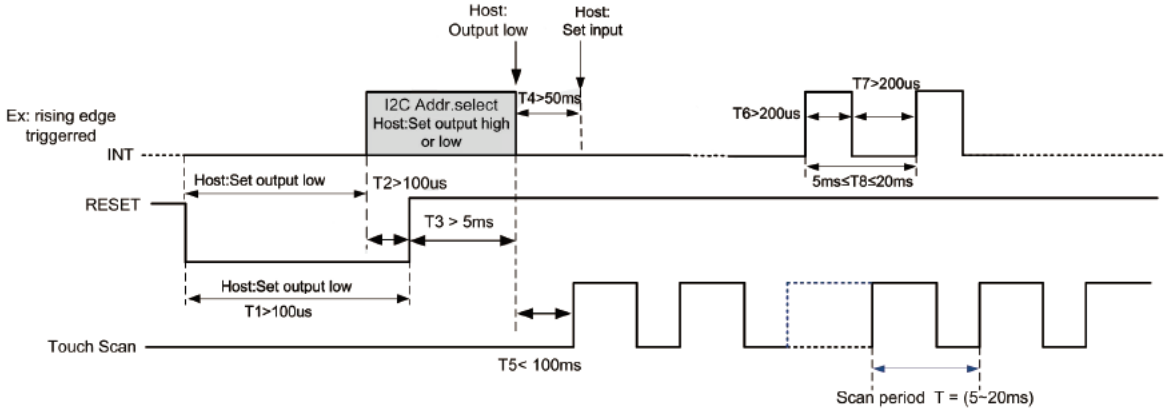
Test condition 2: 3.3V host interface voltage, 400Kbps transmission rate, 2k pull-up resistor

Parameter	Symbol	Min	Max	Unit
SCL low period	t_{lo}	1.3	-	µs
SCL high period	t_{hi}	0.6	-	µs
SCL setup time for Start condition	t_{st1}	0.6	-	µs
SCL setup time for Stop condition	t_{st3}	0.6	-	µs
SCL hold time for Start condition	t_{hd1}	0.6	-	µs
SDA setup time	t_{st2}	0.1	-	µs
SDA hold time	t_{hd2}	0	-	µs

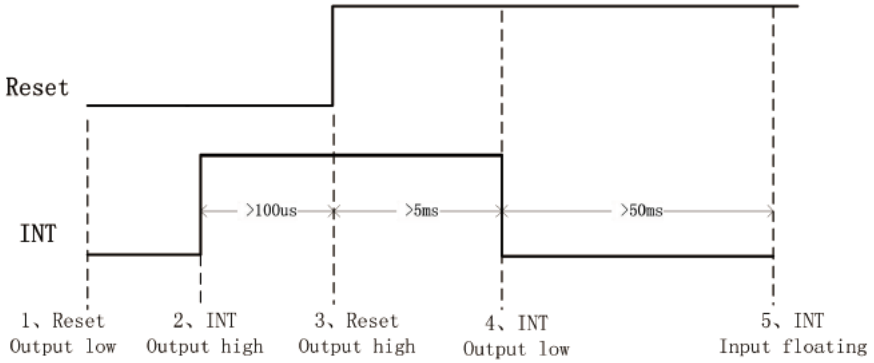
GT9271 supports two I2C slave addresses: 0xBA/0xBB and 0x02/0x29. The host can select the address by changing the status of Reset and INT pins during the power-on initialisation phase. See the diagram below for configuration methods and timings:
Power-on Timing:



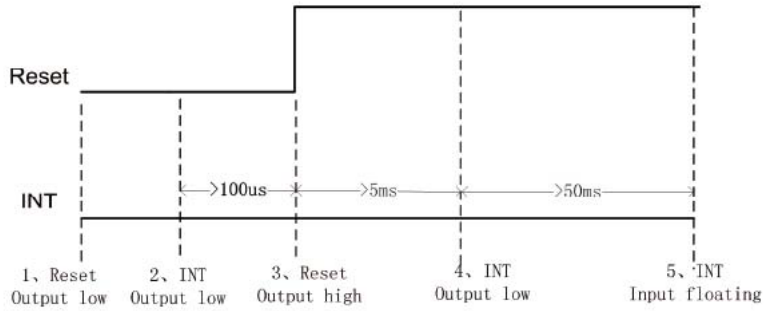
Timing for host resetting GT9271:



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



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



7.1 Data transmission

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

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

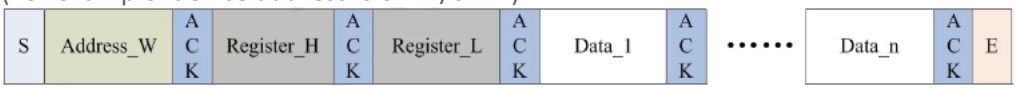
All slave devices connected to I2C bus should detect the 8-bit address issued after Start condition and send the correct ACK. After receiving matching address, GT9271 acknowledges by configuring SDA line as output port and pulling SDA line low during the ninth SCL cycle. When receiving unmatched address,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

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”.

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”.c

7.2 Writing Data to GT9271

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

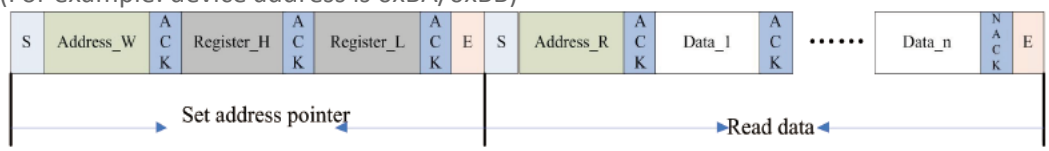


The diagram above displays the timing sequence of the host writing data onto GT9271. First the host issues a Start condition. Then, the host sends 0xBA (address bits and R/W bit; R/W bit as 0 indicates Write operation) to the slave device.

The location of the register address pointer will automatically add 1 after every Write Operation. Therefore, when the host needs to preform Write Operations on a group of registers of continuous addresses, it can write continuously. The Write Operation s terminated when the host issues the Stop condition.

7.3 Reading Data from GT9271

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



The diagram above is the timing sequence of the host reading data from GT9271. 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 device.
After receiving ACK, the host ends the 16-bit register address (where reading starts) to the slave device. Then the host sets register addresses which need to be read.
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.

GT9271 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.

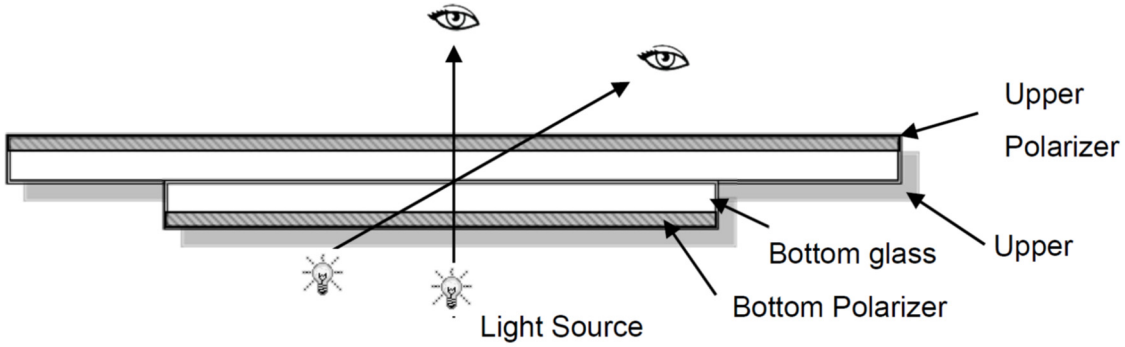
8.0 LCD Module Out-Going Quality Level

8.1 VISIUAL & FUNCTION INSPECTION STANDARD

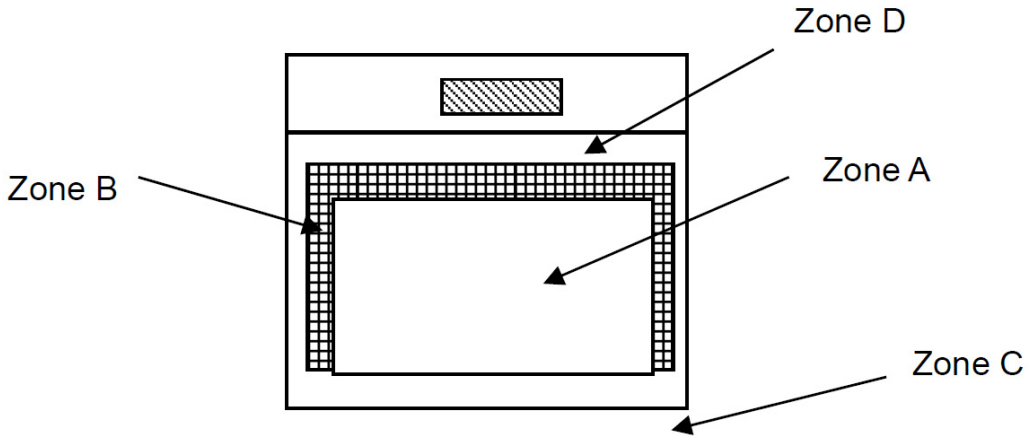
8.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

Temperature: 25 ±5°C
Humidity: 65%±10%RH
Viewing Angle: Normal viewing Angle.
Illumination: Single fluorescent lamp (300 to 700Lux)
Viewing distance:30-50cm



8.1.2 Definition



Zone A: Effective Viewing Area (Character or Digit can be seen)
Zone B: Viewing Area except Zone A
Zone C: Outside (Zone A + Zone B) which cannot be seen after assembly by customer.
Zone D: IC Bonding area
Note: As a rule, visual defects in Zone C can be ignored when it doesn't affect production or appearance after assembly by customer.

8.1.3 Sampling Plan

According to GB/T 2828-2003 ; , normal inspection, Class II
AQL:

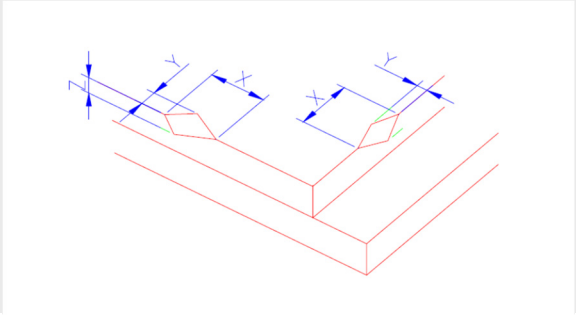
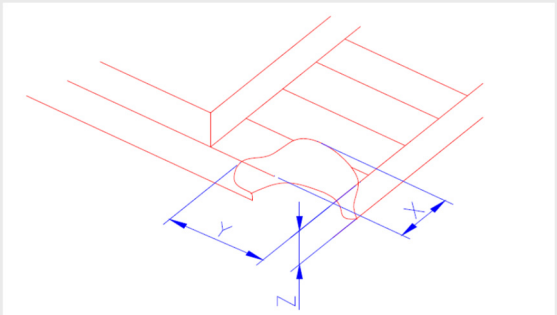
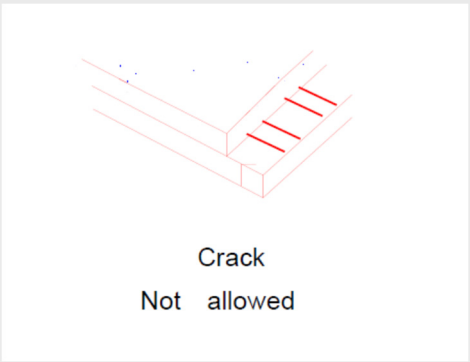
Major Defect	Minor defect
0.65	1.5

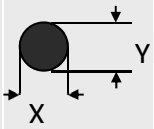
LCD: Liquid Crystal Display, TP: Touch Panel, LCM: Liquid Crystal Module

No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting 4) TP no function	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed	
4	Colour tone	Colour unevenness, refer to limited sample	Minor
5	Soldering appearance	Good soldering, Peeling is not allowed.	
6	LCD/Polarizer /TP	Black/White spot/line, scratch, crack, ect.	

8.1.4 Criteria (Visual)

<table>
<tr><th>Number</th><th>Items</th><th colspan="3">Criteria (mm)</th></tr>
<tr><td rowspan="5">1.0 LCD Crack/ Broken

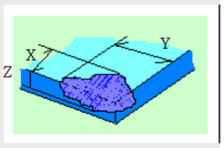
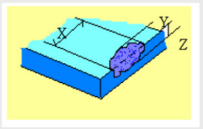
Note:
X: Length
Y: Width
Z: Height
L: Length of ITO,
T: Height of LCD</td><td rowspan="2">(1) The edge of LCD broken</td><td colspan="3">  </td></tr>
<tr><td>X</td><td>Y</td><td>Z</td></tr>
<tr><td>≤3.0mm</td><td><Inner border line of the seal</td><td>≤T</td></tr>
<tr><td rowspan="3">(2) LCD corner broken</td><td colspan="3">  </td></tr>
<tr><td>X</td><td>Y</td><td>Z</td></tr>
<tr><td>≤3.0mm</td><td>≤L</td><td>≤T</td></tr>
<tr><td>(3) LCD crack</td><td colspan="3"> 
Crack
Not allowed</td></tr>
</table>

<table>
<tr><th>Number</th><th>Items</th><th colspan="6">Criteria (mm)</th></tr>
<tr><td rowspan="16">2.0</td><td rowspan="12">Spot defects
 

Φ=(X+Y)/2</td><td colspan="6">① light dot（LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain）</td></tr>
<tr><td colspan="2" rowspan="2">Size (mm)</td><td rowspan="2">Zone</td><td colspan="3">Acceptable Qty</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td colspan="2">Φ≤0.10</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td colspan="2">0.10<Φ≤0.20</td><td colspan="2">3(distance≧10mm)</td></tr>
<tr><td colspan="2">0.20<Φ≤0.25</td><td colspan="2">2</td></tr>
<tr><td colspan="2">Φ＞0.25</td><td colspan="2">0</td></tr>
<tr><td colspan="6">②Dim spot（LCD/TP/Polarizer dim dot, light leakage、dark spot）</td></tr>
<tr><td colspan="2" rowspan="2">Size (mm)</td><td rowspan="2">Zone</td><td colspan="3">Acceptable Qty</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td colspan="2">Φ≤0.1</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td colspan="2">0.10<Φ≤0.20</td><td colspan="2">3(distance≧10mm)</td></tr>
<tr><td colspan="2">0.20<Φ≤0.30</td><td colspan="2">2</td></tr>
<tr><td colspan="2">Φ＞0.30</td><td colspan="2">0</td></tr>
<tr><td colspan="6">③ Polarizer accident spot</td></tr>
<tr><td colspan="2" rowspan="2">Size (mm)</td><td rowspan="2">Zone</td><td colspan="3">Acceptable Qty</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td colspan="2">Φ≤0.2</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td colspan="2">0.3<Φ≤0.5</td><td colspan="2">2(distance≧10mm)</td></tr>
<tr><td colspan="2">Φ>0.5</td><td colspan="2">0</td></tr>
<tr><td rowspan="4">Line defect (LCD/TP/ Polarizer black/ white line, scratch, stain)</td><td colspan="2" rowspan="2">Width(mm)</td><td rowspan="2">Length(mm)</td><td colspan="3">Acceptable Qty</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td colspan="2">Φ≤0.03</td><td>Ignore</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td colspan="2">0.03<W≤0.05</td><td>L≤3.0</td><td colspan="2">N≤2</td></tr>
<tr><td colspan="2">0.05<W≤0.08</td><td>L≤2.0</td><td colspan="2">N≤2</td></tr>
<tr><td colspan="2">0.08<W</td><td colspan="4">Define as spot defect</td></tr>
</table>

<table>
<tr><td rowspan="5">3.0</td><td rowspan="5">Polarizer Bubble</td><td colspan="2" rowspan="2">Size (mm)</td><td rowspan="2">Zone</td><td colspan="3">Acceptable Qty</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td colspan="2">Φ≤0.2</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td colspan="2">0.2<Φ≤0.4</td><td colspan="2">3(distance≧10mm)</td></tr>
<tr><td colspan="2">0.4<Φ≤0.6</td><td colspan="2">2</td></tr>
<tr><td colspan="2">0.6<Φ</td><td colspan="2">0</td></tr>
<tr><td rowspan="6">4.0</td><td rowspan="6">SMT</td><td colspan="5">According to IPC-A-610C class II standard. Function defect and missing part are major defect, the other are minor defects.</td></tr>
<tr><td rowspan="5">TP bubble/ accidented spot</td><td rowspan="2">Size Φ(mm)</td><td colspan="3">Acceptable Qty</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>Φ≤0.1</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.1<Φ≤0.25</td><td colspan="2">3(distance≧ 10mm)</td></tr>
<tr><td>0.25<Φ≤0.3</td><td colspan="2">2</td></tr>
<tr><td>0.3<Φ</td><td colspan="2">0</td></tr>
<tr><td>Assembly deflection</td><td colspan="4">Beyond the edge of backlight ≤0.15mm</td></tr>
<tr><td>5.0</td><td>TP Related</td><td>Newton Ring</td><td colspan="2">Newton Ring area>1/3 TP area
NG

Newton Ring area≤1/3 TP area
OK</td><td>  </td></tr>
</table>

		TP corner broken X: length Y: Width Z: Height	X	Y	Z	
			X≤3.0 mm	Y≤3.0 mm	Z< LCD thickness	
			Circuitry broken is not allowed.			
		TP edge broken X: length Y: Width Z: Height	X	Y	Z	
			X≤6.0 mm	Y≤2.0 mm	Z< LCD thickness	
			Circuitry broken is not allowed.			

Criteria (Functional items)

Number	Items	Criteria
1	No display	Not allowed
2	Missing segment	Not allowed
3	Short	Not allowed
4	Backlight no lighting	Not allowed
5	TP no function	Not allowed

9.0 Quality Assurance Specification

9.1 Conformity

The performance, function and reliability of the shipped products conform to the Product Specification.

9.2 Dealing with Customer Complaints

9.2.1 Non-conforming Analysis

Purchaser should supply Densitron with detailed data of non-conforming sample.

After accepting it, Densitron should complete the analysis in two weeks from receiving the sample. If the analysis cannot be completed on time, Densitron must inform the purchaser.

9.2.2 Handling of Non-conforming Displays

If any non-conforming displays are found during customer acceptance inspection which Densitron is clearly responsible for, return them to Densitron.
Both Densitron and customer should analyse the reason and discuss the handling of non-conforming displays when the reason is not clear.
Equally, both sides should discuss and come to agreement for issues pertaining to modification of Densitron quality assurance standard.

Densitron

10.0 Reliability Test Result

10.1 Condition

Test Item	Test Condition	Inspection after test
High Temperature Operating	60°C, 96 hrs	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1. Air bubble in the LCD; 2. Non-display; 3. Missing segments/lines; 4. Glass crack; 5. Current IDD is twice higher than initial value.
Low Temperature Operating	-10°C, 96 hrs	
High Temperature Storage	70°C, 96 hrs	
Low Temperature Storage	-30°C, 96 hrs	
Thermal Humidity Operating	50°C 90%RH, 96 hrs	
Thermal Shock (Non-operation)	-40°C,30 min ↔ 90°C,30 min, Change time: 5 min 20CYC.	
Low Temperature Storage	-30°C, 96 hrs	
ESD Test	150pF, 330Ω, ±6KV(Contact)/± 6KV(Air), 5 points/panel, 5 times/point (Environment: 15°C~35°C, 30%~60%).	
Vibration (Non-operation)	Frequency range: 10~55Hz, Stroke:1.5mm Sweep: 10Hz~55Hz~10Hz 2 Hours for each direction of X. Y >Z (6 hours total) (Package condition).	
Box Drop Test	1 Corner 3 Edge 6 faces, 80 cm (Medium Box)	

Notes:
1. The test samples should be applied to only one test item.
2. Sample size for each test item is 5~10pcs.
3. For Damp Proof Test, Pure water (Resistance>10MΩ) should be used.
4. In case of malfunction defect caused by ESD damage, if it would be recovered to a normal state after resetting, it would be judged as a good part.
5. Failure Judgment Criterion: Basic Specification, Electrical Characteristics, Mechanical Characteristics, Optical Characteristics.

11.0 Handling Precautions

11.1 Handling Precautions

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 finger-stalls 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 6.1 Power On Sequence &6.2 Power Off Sequence

11.2 Storage Precautions

1) When storing display modules, put them in static electricity preventive bags avoiding exposure to direct sun light nor to lights of fluorescent lamps, etc. and, also, avoiding high temperature and high humidity environments or low temperature (less than 0°C) environments. (We recommend you store these modules in the packaged state when they were shipped from Densitron) At that time, be careful not to let water drops adhere to the packages or bags nor let dewing occur with them.
2) If electric current is applied when water drops are adhering to the surface of the display module, when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful about the above.
3) 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 ℃ and relative humidity of less than 70%
4) Do not store the TFT-LCD module in direct sunlight.

5) 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.
6) 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.
7) This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.

11.3 Other Precautions

Request the qualified companies to handle industrial wastes when disposing of the display modules. Or, when burning them, be sure to observe the environmental and hygienic laws and regulations.