

Display Elektronik GmbH

DATA SHEET

TFT MODULE

DEM 480128E VMX-PW-N
(C-TOUCH)
3,9" TFT

Product Specification

Version: 0

09.12.2024

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1. Basic Specifications

* 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 module is composed of a Transmissive type TFT-LCD Panel, driver circuit, capacitance touch panel, backlight unit. The resolution of a 3.9 " TFT-LCD contains 480X128 pixels, and can display up to 16.7M colors.

1.1 TFT Features

General Information Items	Specification	Unit	Note
	Main Panel		
Display Area	95.04 x 25.34 (3.9 Inch)	mm	-
Driver Element	TFT Active Matrix	-	-
Display Colors	16.7 Million	colors	-
Number of Pixels	480 x RGB x 128	dots	-
TFT Pixel Arrangement	RGB Vertical Stripe	-	-
Pixel Pitch	0.198 x 0.198	mm	-
Viewing Angle	ALL	o'clock	-
TFT Controller IC	ST7282A (Sitronix)	-	-
LCM Interface	24-BIT-RGB	-	-
Display Mode	IPS, Transmissive / Normally Black	-	-
Operating Temperature	-30 ~ +85	°C	-
Storage Temperature	-30 ~ +85	°C	-
Module Bonding Technology	Optical bonding between LCM and CTP	-	-

1.2 CTP Features

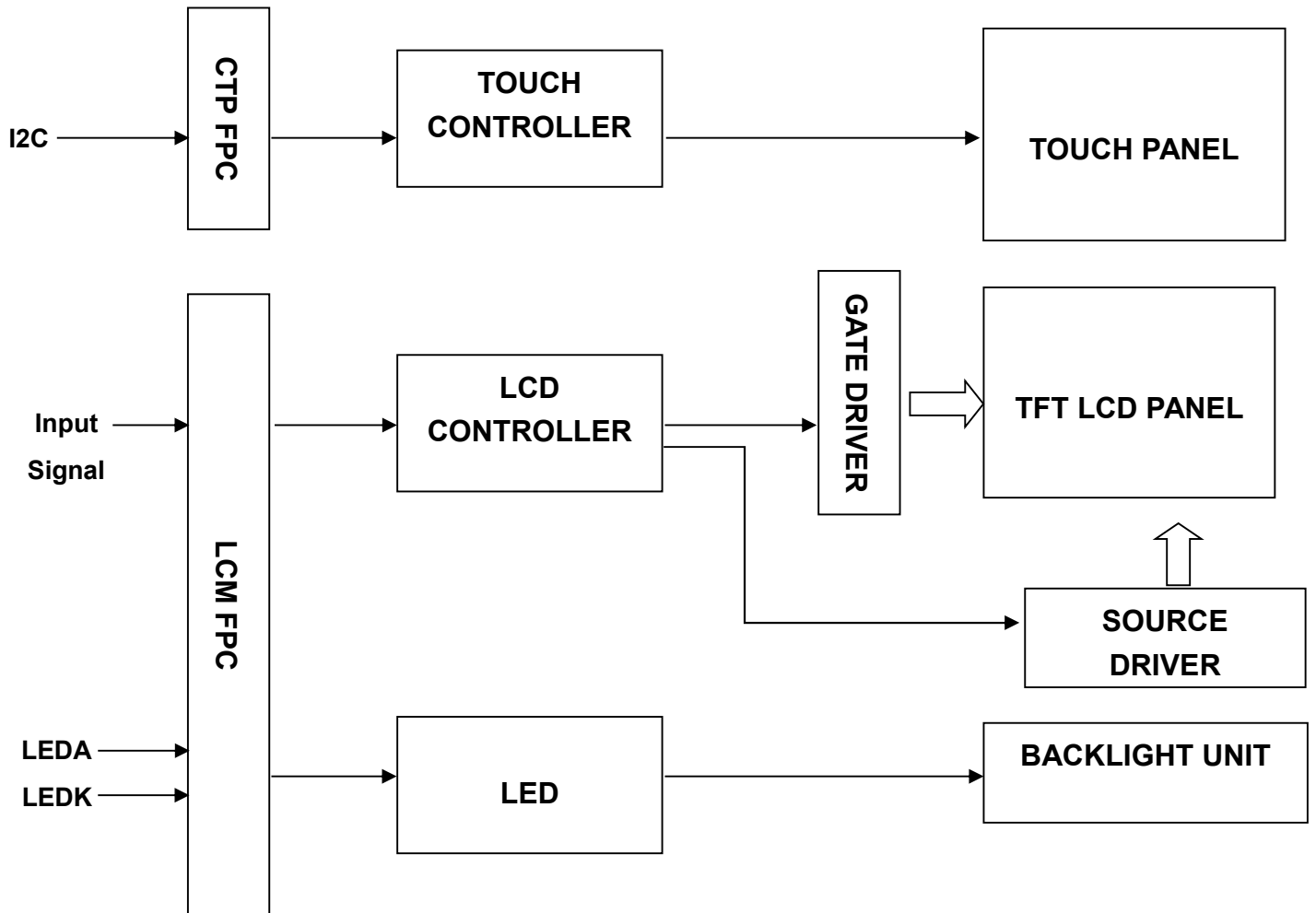
General Information Items	Specification	Unit	Note
	Main Panel		
Resolution	480 x 128	-	
Structure	G+G	-	
Controller IC	GT911	-	
Interface	I2C	-	
Slave Address	0x5D (7bit) or 0x14 (7bit)	-	Note1
Touch Mode	MULTI TOUCH	-	-
Logic Level	3.3	V	

Note1: For specific configuration method, please refer to section 9.2

1.3 Mechanical Information

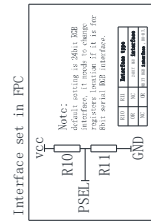
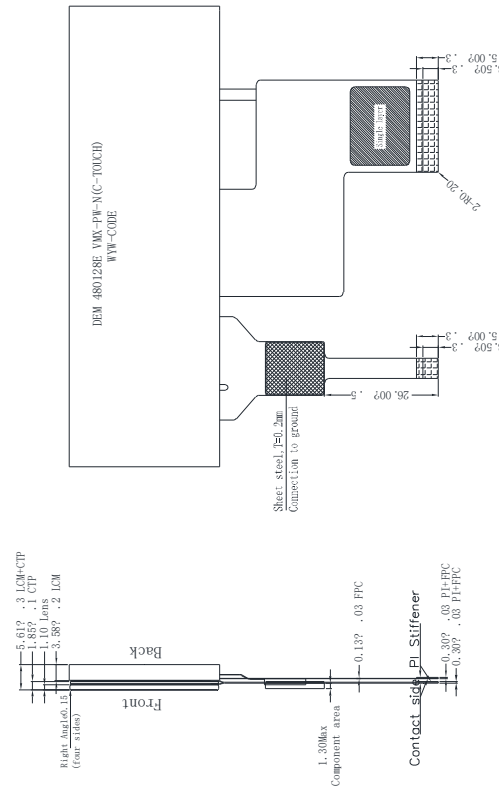
Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal(H)	-	102.46	-	mm	-
	Vertical(V)	-	34.40	-	mm	-
	Depth(D)	-	5.61	-	mm	-
Weight		-	TBD	-	g	-

2. Block Diagram

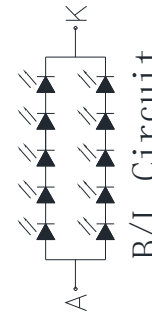


3. Outline Dimension

Pin	Name
1	VLED+
2	VLED-
3	VDD
4	VDD
5	R0
6	R1
7	R2
8	R3
9	R4
10	R5
11	R6
12	R7
13	G0
14	G1
15	G2
16	G3
17	G4
18	G5
19	G6
20	G7
21	B0
22	B1
23	B2
24	B3
25	B4
26	B5
27	B6
28	B7
29	GND
30	PCLK
31	DSP
32	BSYNC
33	VSYNC
34	DE
35	NC
36	GND
37	VA(ND)
38	VD(ND)
39	VA(ND)
40	VD(ND)



Pin	Logic
1	GND
2	NC
3	VDD
4	SCL
5	SDA
6	INT
7	RST
8	GND



- NOTE:
1. DISPLAY TYPE: 3.9" TFT-LCD, 16.7M COLORS
 2. DISPLAY MODE: NORMALLY BLACK/IPS
 3. VIEWING DIRECTION: ALL
 4. LCM DRIVER IC: ST7282A (COG)
LCM Interface: 24BIT RGB Interface
 5. Touch Mode: CTP
Touch Driver IC: GT911
Touch Interface: IIC
Touch And LCM Bonding Technology: Optical Bonding
 6. VDD: 3.3V (TYP.)
 7. OPERATING TEMP: -30°C TO 85°C
STORAGE TEMP: -30°C TO 85°C
 8. BACK LIGHT: LED WHITE, 10 LED, 40mA, 13.5~17.0V
 9. RoHS COMPLIANT.

4. Input terminal Pin Assignment

4.1 TFT PIN Define

NO.	SYMBOL	DISCRIPTION	I/O
1	VLED-	Cathode pin OF backlight	P
2	VLED+	Anode pin of backlight	P
3	GND	Ground.	P
4	VDD	Supply voltage(3.3V).	P
5	R0	Red data input.	I
6	R1	Red data input.	I
7	R2	Red data input.	I
8	R3	Red data input.	I
9	R4	Red data input.	I
10	R5	Red data input.	I
11	R6	Red data input.	I
12	R7	Red data input.	I
13	G0	Green data input.	I
14	G1	Green data input.	I
15	G2	Green data input.	I
16	G3	Green data input.	I
17	G4	Green data input.	I
18	G5	Green data input.	I
19	G6	Green data input.	I
20	G7	Green data input.	I
21	B0	Blue data input.	I
22	B1	Blue data input.	I
23	B2	Blue data input.	I
24	B3	Blue data input.	I
25	B4	Blue data input.	I
26	B5	Blue data input.	I

27	B6	Blue data input.	I
28	B7	Blue data input.	I
29	GND	Ground.	P
30	PCLK	Clock signal. Latching data at the rising edge	I
31	DISP	Standby setting for testing, it should be connected to VDD in normal operation mode. If connected to GND, the IC is in standby mode.	I
32	HSYNC	Horizontal Sync input. Negative polarity.	I
33	VSYNC	Vertical Sync input. Negative polarity.	I
34	DE	Data input Enable. Active High to enable the data input Bus under "DE Mode".	I
35	NC	--	--
36	GND	Ground.	P
37	XR(NC)	--	--
38	YD(NC)	--	--
39	XL(NC)	--	--
40	YU(NC)	--	--

4.2 CTP PIN Define

NO.	SYMBOL	DISCRIPTION	I/O
1	GND	Ground	P
2	NC	No Connection	--
3	VDD	Supply voltage	P
4	SCL	I2C clock input	I
5	SDA	I2C data input and output	I
6	INT	External interrupt to the host	I
7	RST	External Reset, Low is active	I
8	GND	Ground	P

5. LCD Optical Characteristics

5.1 Optical Specification

Item	Symbol	Condition	Min.	Typ.	Max.	Unit.	Note	
Contrast Ratio	CR	$\Theta=0$	1000	1200	--		(1)(2)	
Response Time	Rising	T_{R+TF}	Normal viewing angle	--	30	35	msec	
	Falling							(1)(3)
Color Gamut	S(%)	-	40	45	--	%		
Color Filter Chromaticity	White	W_X	-	-0.04	0.319	+0.04	-	(1)(4) CA-310
		W_Y	-		0.348			
	Red	R_X	-		0.590			
		R_Y	-		0.361			
	Green	G_X	-		0.335			
		G_Y	-		0.559			
	Blue	B_X	-		0.160			
		B_Y	-		0.139			
Viewing Angle	Hor.	Θ_L	CR>10	80	85	--	-	(1)(4)
		Θ_R		80	85	--		
	Ver.	Θ_U		80	85	--		
		Θ_D		80	85	--		
Option View Direction	ALL							

*The data comes from the LCD specification.

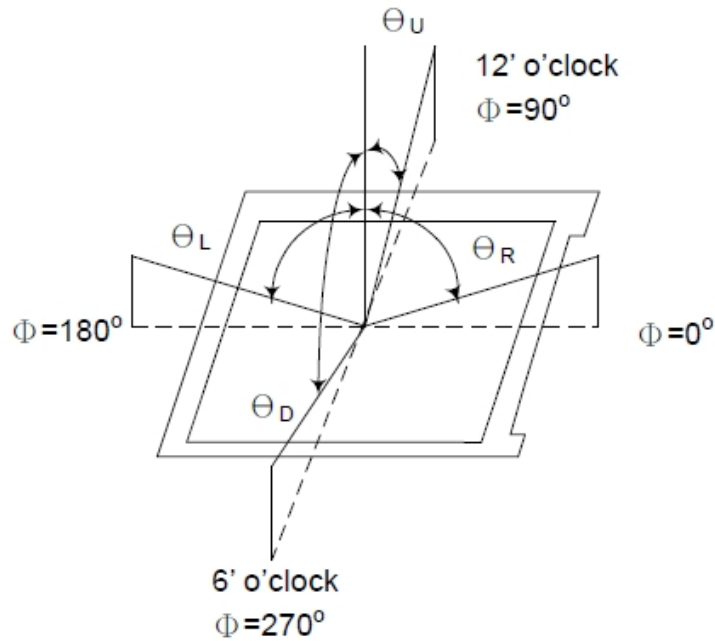
Measuring Condition

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

Measuring Equipment

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

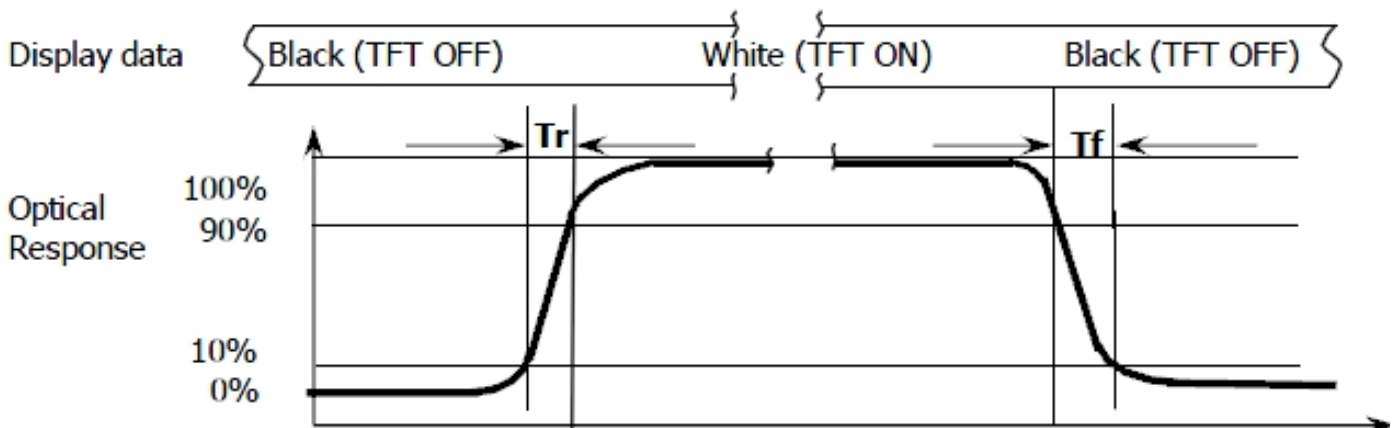
Note (1): Definition of Viewing Angle :



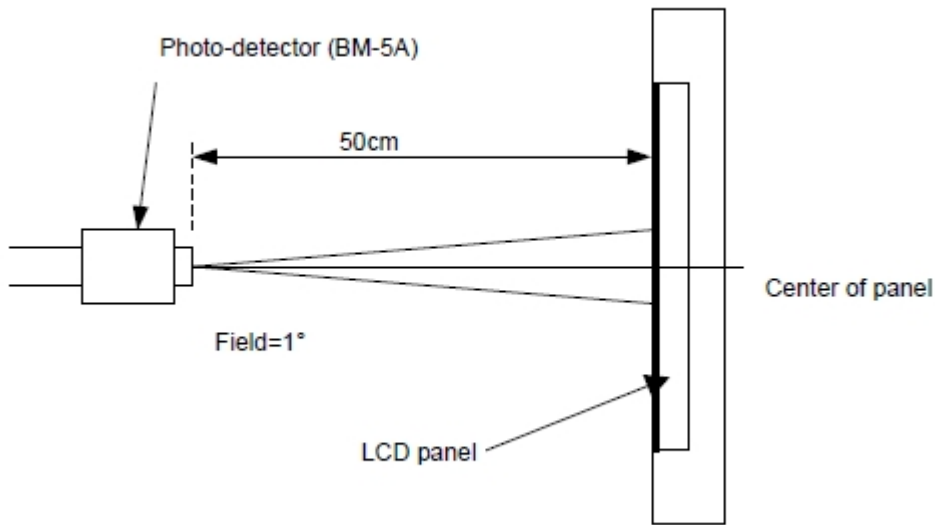
Note (2): Definition of Contrast Ratio(CR) :measured at the center point of panel

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

Note (3): Response Time



Note (4): Definition of optical measurement setup



6. Electrical Characteristics

6.1 Absolute Maximum Rating (Ta=25 VSS=0V)

Characteristics	Symbol	Min.	Max.	Unit
Digital Supply Voltage	VDD	-0.3	4.0	V
Operating Temperature	T _{OP}	-30	+85	°C
Storage Temperature	T _{ST}	-30	+85	°C

NOTE: If the absolute maximum rating of even is one of the 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.

6.2 DC Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Digital Supply Voltage	VDD	3.0	3.3	3.6	V	
Normal Mode Current Consumption	IDD	--	12	24	mA	
Level Input Voltage	V _{IH}	0.7V _{DD}		V _{DD}	V	
	V _{IL}	GND		0.3V _{DD}	V	
Level Output Voltage	V _{OH}	V _{DD} -0.4		V _{DD}	V	
	V _{OL}	GND		GND+0.4	V	

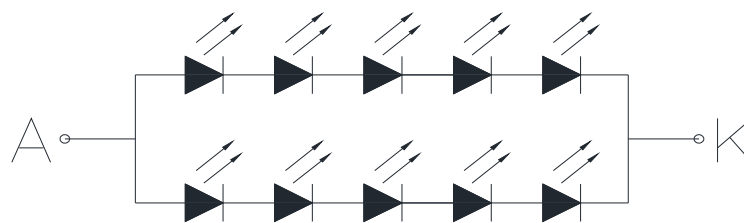
6.3 LED Backlight Characteristics

The backlight system is edge-lighting type with 10 chips White LED

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I_F	--	40	--	mA	
Forward Voltage	V_F	13.5	14.5	17	V	
LCM Luminance ($I_F=40mA$)	L_v	1600	1900	--	cd/m ²	Note3
LED Lifetime	Hr	50000	--	--	Hour	Note1,2
Uniformity	AVg	80	--	--	%	Note3

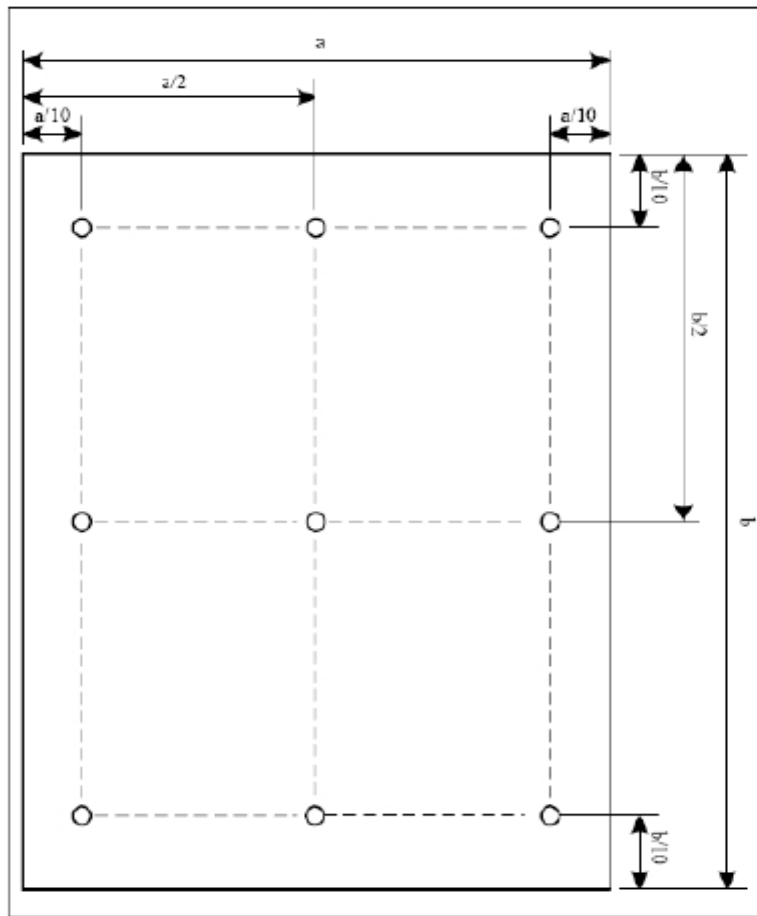
Note (1) LED Lifetime (Hr) can be defined as the time in which it continues to operate under the condition: $T_a=25^{\circ}C\pm 3^{\circ}C$, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note (2) The “LED life time” is defined as the module brightness decrease to 50% original brightness at $T_a=25^{\circ}C$ and $I_L=40mA$. The LED lifetime could be decreased if operating I_L is larger than 40mA. The constant current driving method is suggested.



LED (B/L) CIRCUIT

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

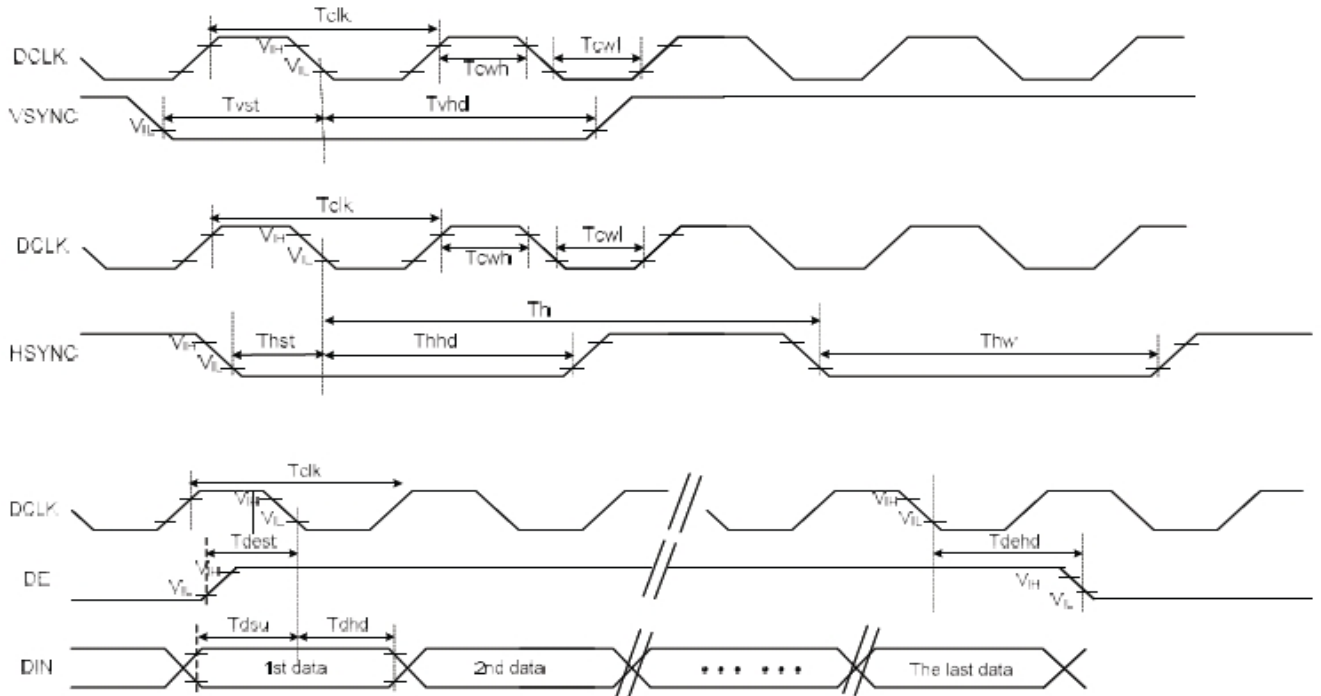


$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$

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

7. AC Characteristic

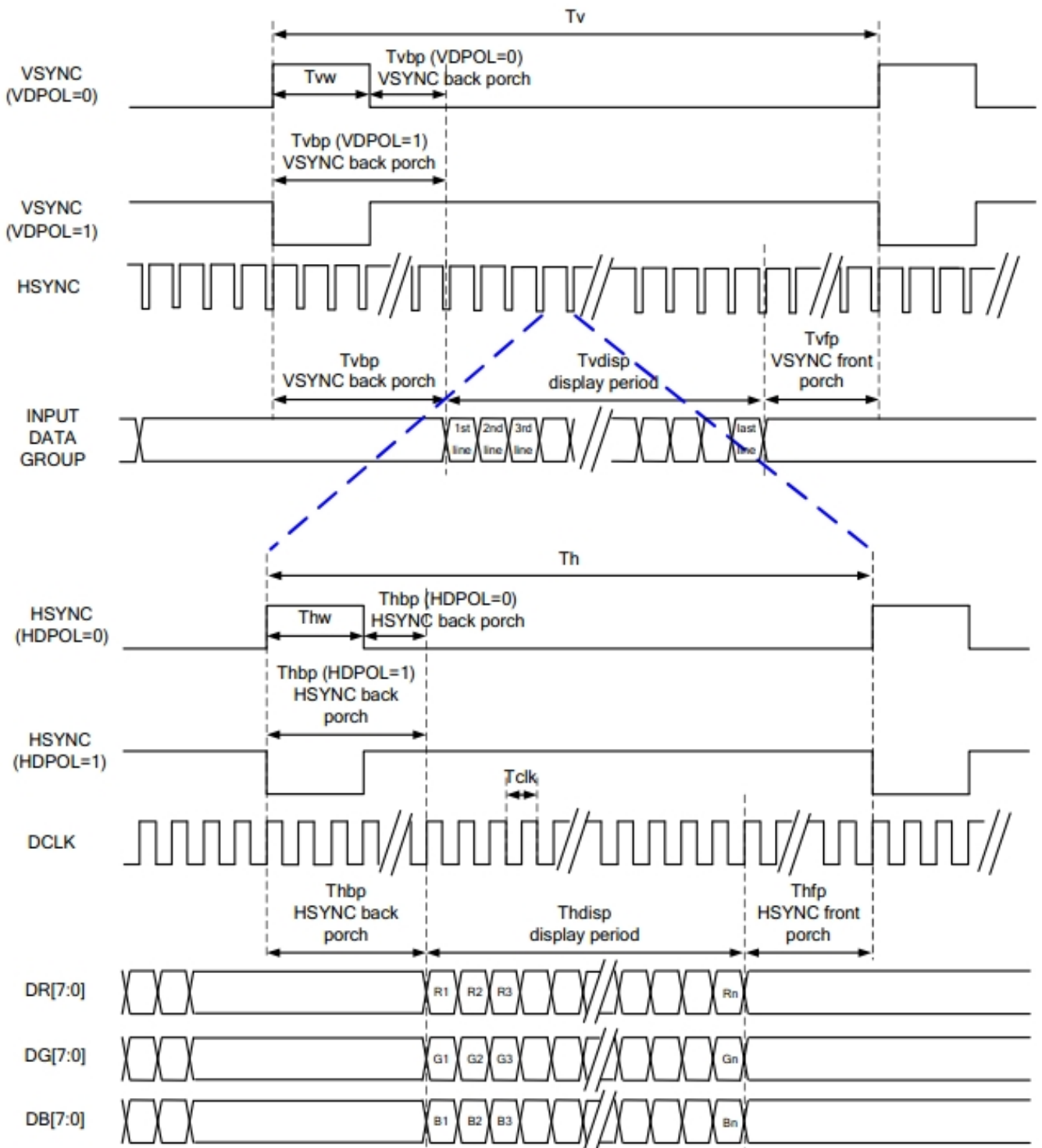
7.1 System Bus Timing for RGB Interface



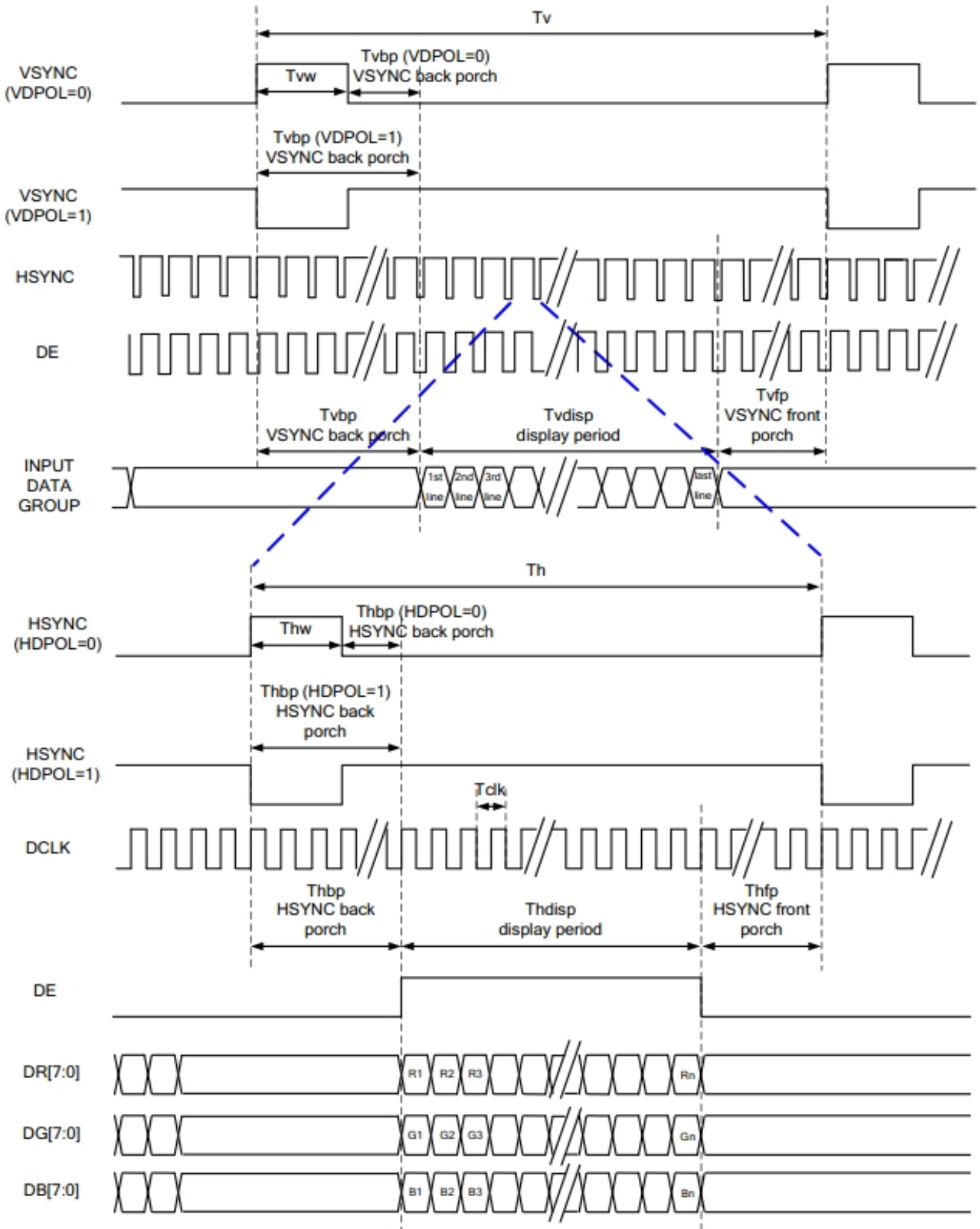
Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLK Pulse Duty	Tcw	40	50	60	%	
HSYNC Width	Thw	2	-	-	DCLK	
HSYNC Period	Th	55	60	65	us	
VSYNC Setup Time	Tvst	12	-	-	ns	
VSYNC Hold Time	Tvhd	12	-	-	ns	
HSYNC Setup Time	Thst	12	-	-	ns	
HSYNC Hold Time	Thhd	12	-	-	ns	
Data Setup Time	Tdsu	12	-	-	ns	
Data Hold Time	Tdhd	12	-	-	ns	
DE Setup Time	Tdest	12	-	-	ns	
DE Hold Time	Tdehd	12	-	-	ns	

7.2 RGB Interface

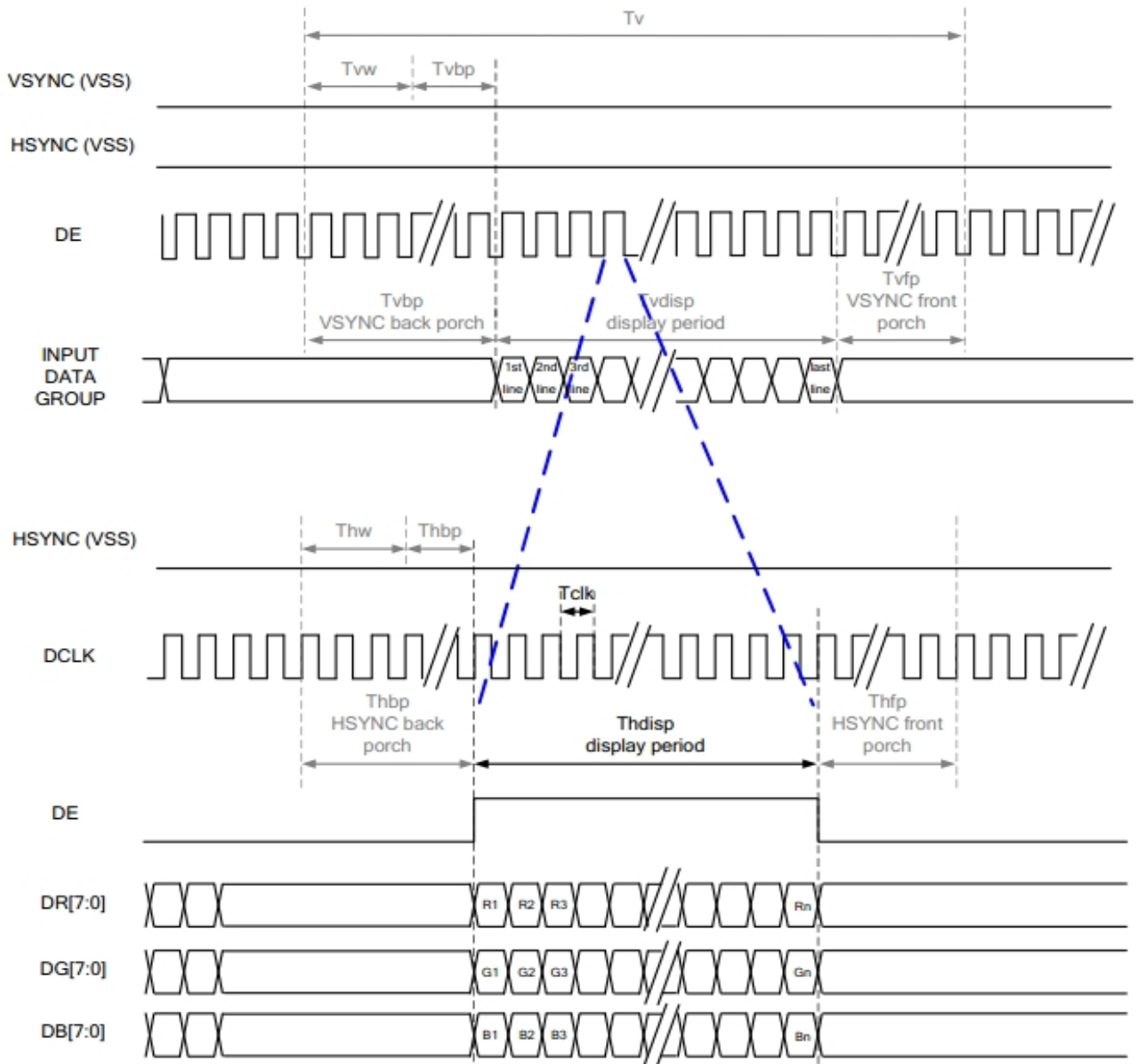
7.2.1 SYNC Mode



7.2.2 SYNC-DE Mode



7.2.3 DE Mode

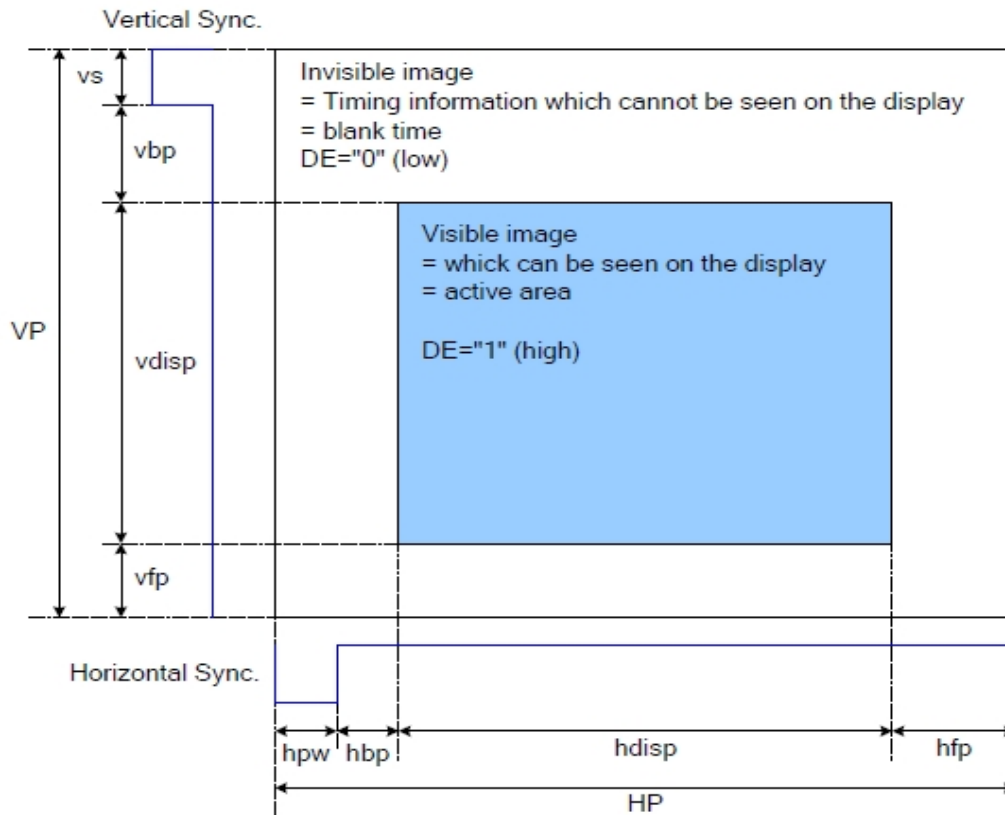


RGB Mode Selection Table	DCLK	HSYNC	VSYNC	DE
SYNC - DE Mode	Input	Input	Input	Input
SYNC Mode	Input	Input	Input	GND
DE Mode	Input	GND	GND	Input

Note: "Input" means these signals are driven by host side.

7.3 RGB Input Timing Table

Parallel 24-bit RGB Timing Table

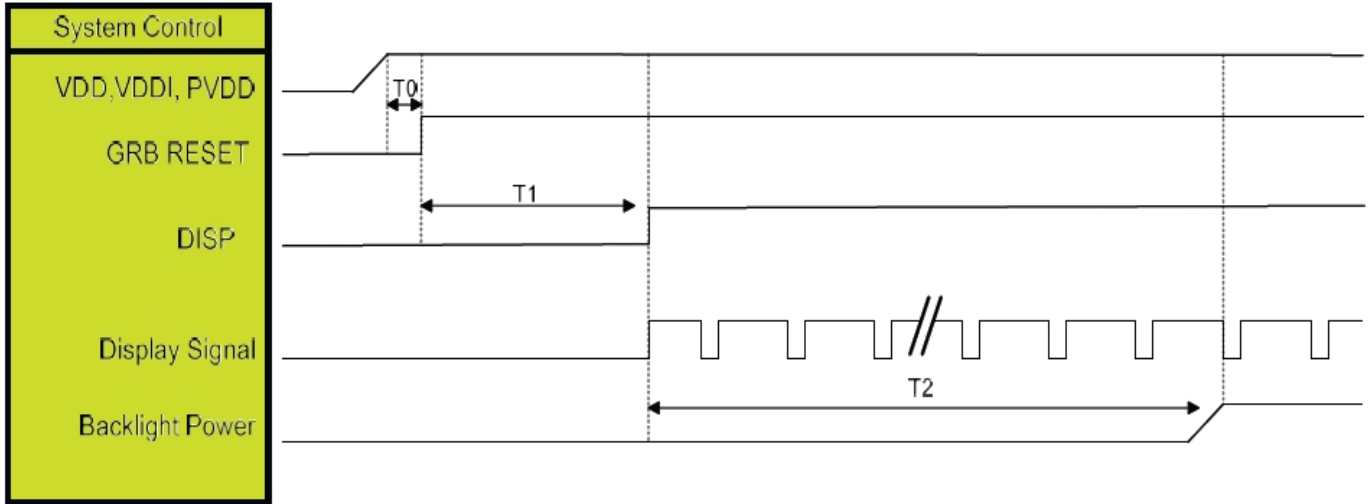


Parameter	Symbol	Min.	Typ.	Max.	Unit
DCLK frequency	FCLK	--	(6)	--	MHz
Horizontal display area	HDISP	--	480	--	Clock
Horizontal Sync. Width	hpw	1	4	--	Clock
Horizontal Sync. Back Porch	hbp	1	60	--	Clock
Horizontal Sync. Front Porch	hfp	1	40	--	Clock
Vertical display area	VDISP	--	128	--	Line
Vertical Sync. Width	vs	1	4	--	Line
Vertical Sync. Back Porch	vbp	1	30	--	Line
Vertical Sync. Front Porch	vfp	1	8	--	Line
Frame-Rate		--	60	--	Hz

Note: 1. Typical value are related to the setting frame rate is 60Hz.

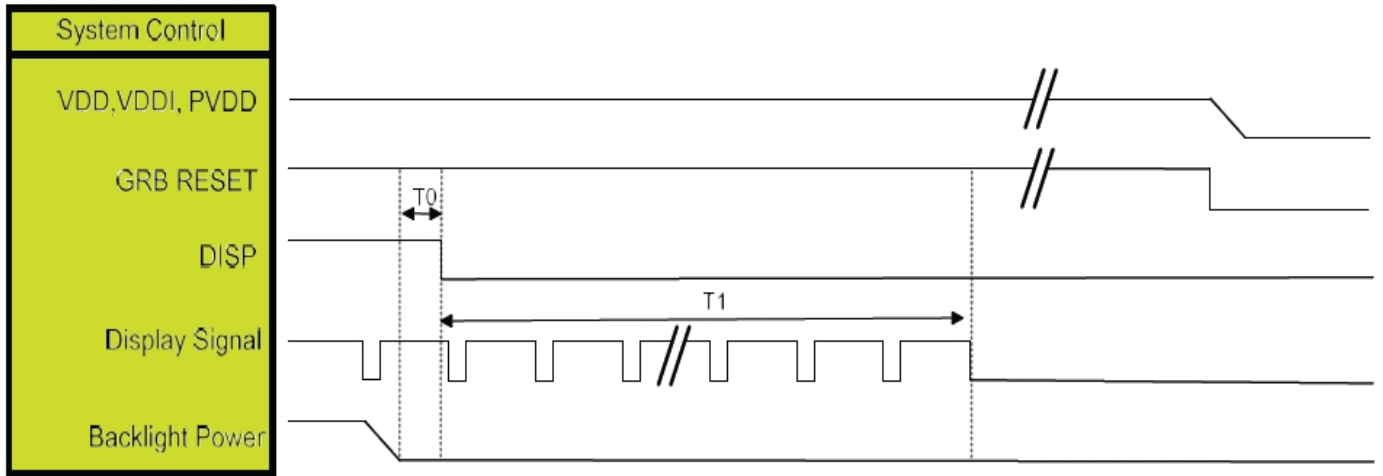
8. LCM POWER ON/OFF SEQUENCE

8.1 Power On Sequence



Symbol	Description	Min. Time	Unit
T0	System power stability to GRB RESET signal	0	ms
T1	GRB RESET= "High" to DISP="High"	10	ms
T2	Display Signal output to Backlight Power on	250	ms

8.2 Power Off Sequence



Symbol	Description	Min. Time	Unit
T0	Backlight Power off to DISP="Low"	5	ms
T1	DISP="Low" to IC internal voltage discharge complete	80	ms

9. CTP Specification

9.1 Electrical Characteristics

9.1.1 Absolute Maximum Rating

Item	Symbol	Min.	Max	Unit	Note
Power Supply Voltage	VDD	2.66	3.47	V	
Operating Temperature	T _{OP}	-30	+85	°C	
Storage Temperature	T _{ST}	-30	+85	°C	

9.1.2 DC Electrical Characteristics (Ta=25°C)

(Ambient Temperature: 25°C, VDD=2.8V, VDDIO=1.8V or VDDIO=VDD)

Item	Min.	Typ.	Max.	Unit	Note
Power Supply Voltage/VDD	2.66	3.3	3.47	V	
Normal mode operating current	--	8	14.5	mA	
Green mode operating current	--	3.3	--	mA	
Sleep mode operating current	70	--	120	uA	
Doze mode operating current	--	0.78	--	mA	
Digital Input low voltage/VIL	-0.3	--	0.25*VDD	V	
Digital Input high voltage/VIH	0.75*VDD	--	VDD+0.3	V	
Digital Output low voltage/VOL	--	--	0.15*VDD	V	
Digital Output high voltage/VOH	0.85*VDD	--	--	V	

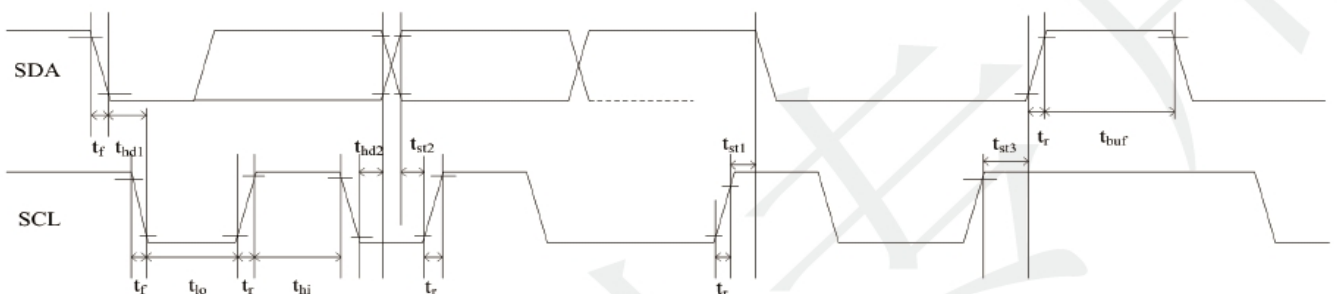
9.1.3 AC Characteristics

(Ambient Temperature: 25°C, VDD=2.8V, VDDIO=1.8V)

Parameter	Min	Typ	Max	Unit	Note
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	

9.2 I2C Timing

GT911 provides a standard I2C interface for SCL and SDA to communicate with the host. GT911 always serves as slave device in the system with all communication being initialized by the host. It is strongly recommended that transmission rate be 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

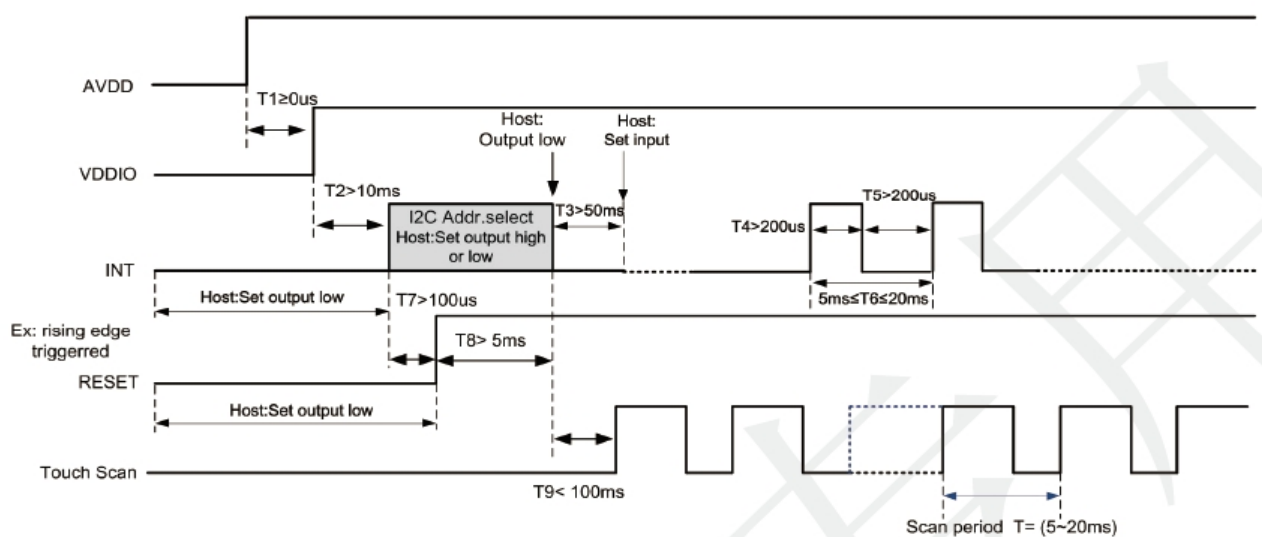
Parameter	Symbol	Min.	Max.	Unit
SCL low period	t_{lo}	1.3	-	us
SCL high period	t_{hi}	0.6	-	us
SCL setup time for Start condition	t_{st1}	0.6	-	us
SCL setup time for Stop condition	t_{st3}	0.6	-	us
SCL hold time for Start condition	t_{hd1}	0.6	-	us
SDA setup time	t_{st2}	0.1	-	us
SDA hold time	t_{hd2}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

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

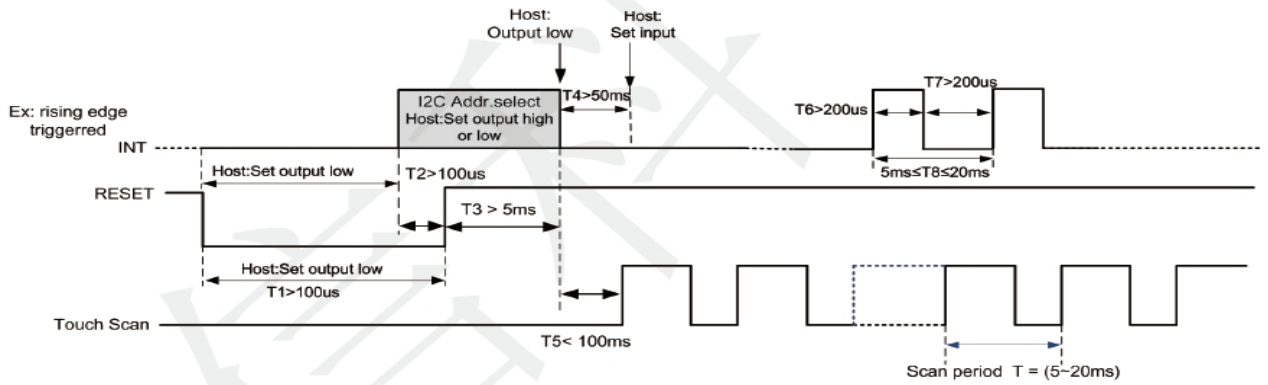
Parameter	Symbol	Min.	Max.	Unit
SCL low period	t_{lo}	1.3	-	us
SCL high period	t_{hi}	0.6	-	us
SCL setup time for Start condition	t_{st1}	0.6	-	us
SCL setup time for Stop condition	t_{st3}	0.6	-	us
SCL hold time for Start condition	t_{hd1}	0.6	-	us
SDA setup time	t_{st2}	0.1	-	us
SDA hold time	t_{hd2}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

GT911 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. See the diagram below for configuration methods and timings:

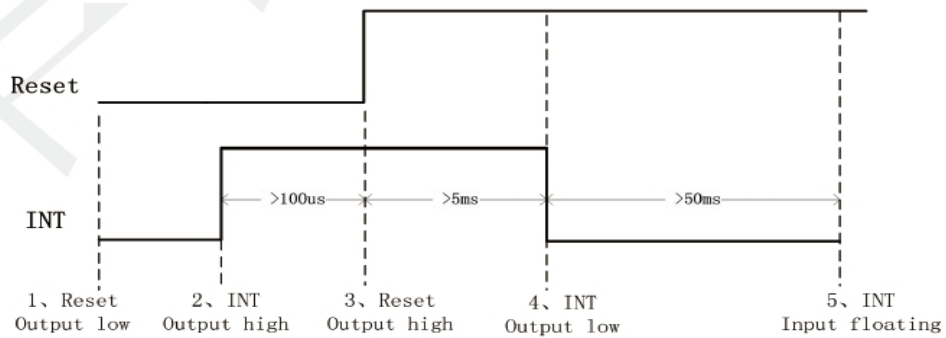
Power-on Timing:



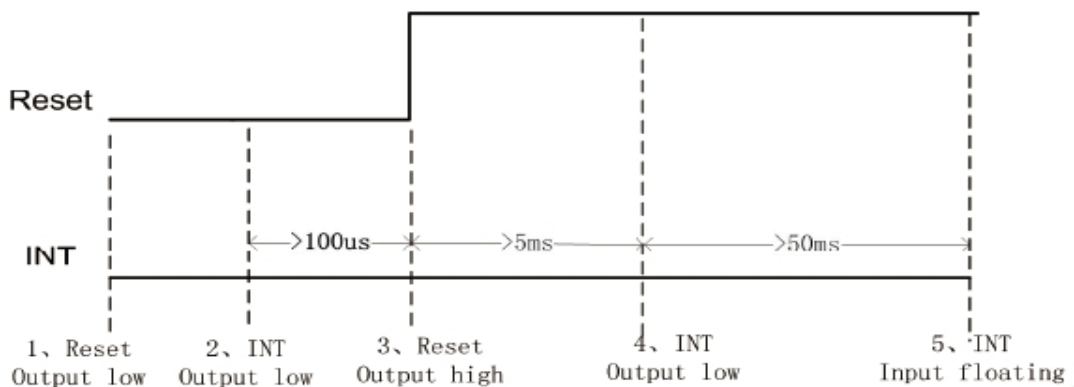
Timing for host resetting GT911:



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



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



a) Data Transmission

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

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

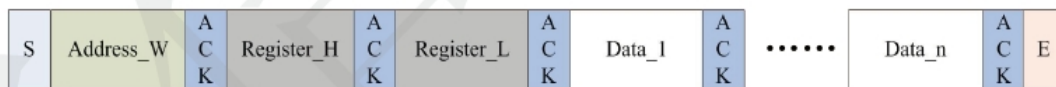
All slave devices connected to I²C bus should detect the 8-bit address issued after Start condition and send the correct ACK. After receiving matching address, GT911 acknowledges by configuring SDA line as output port and pulling SDA line low during the ninth SCL cycle. When receiving unmatched address, namely, not 0xBA or 0xBB, GT911 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”.

b) Writing Data to GT911

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



Timing for Write Operation

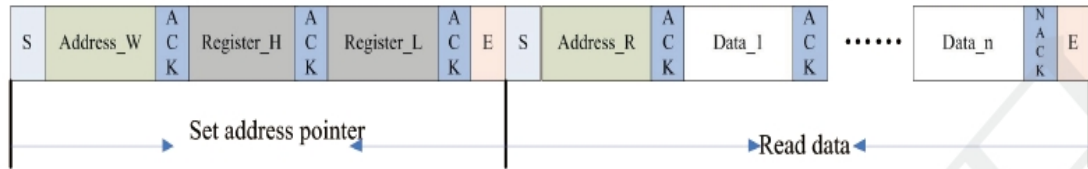
The diagram above displays the timing sequence of the host writing data onto GT911. First, the host issues a Start condition. Then, the host sends 0xBA (address bits and R/W bit; R/W bit as 0 indicates Write operation) to the slave device.

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 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.

c) Reading Data from GT911

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



Timing for Read Operation

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.

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.

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.

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.

10. LCD Module Out-Going Quality Level

10.1 VISUAL & FUNCTION INSPECTION STANDARD

10.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

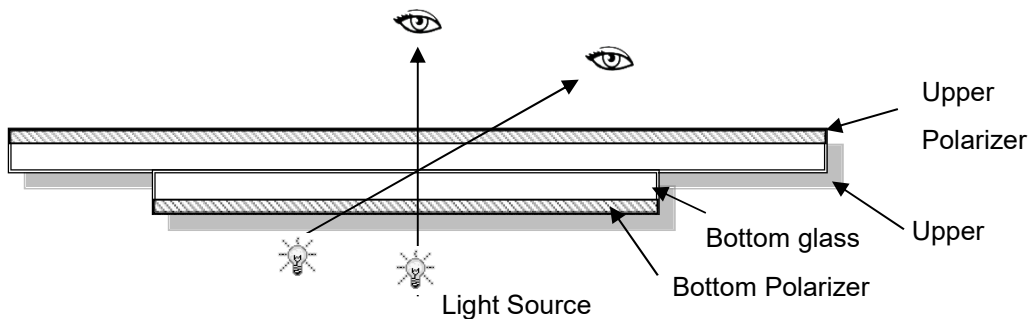
Temperature: 25°C±5°C

Humidity: 65%±10%RH

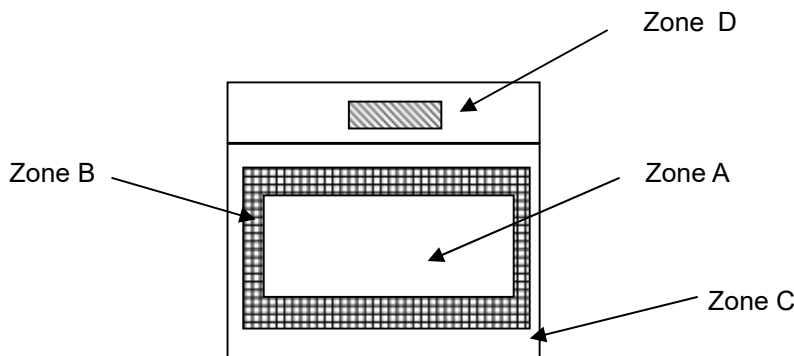
Viewing Angle: Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance: 30-50cm



10.1.2 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 can not be seen after assembly by customer

Zone D : IC Bonding Area

Note: As a general rule ,visual defects in Zone C can be ignored when it doesn't effect product function or appearance after assembly by customer

10.1.3 Sampling Plan

According to GB/T 2828-2012; normal inspection, Class II

AQL:

Major defect	Minor defect
0.65	1.5

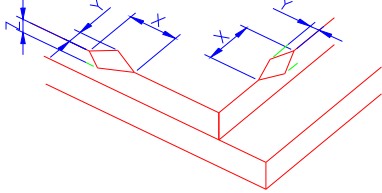
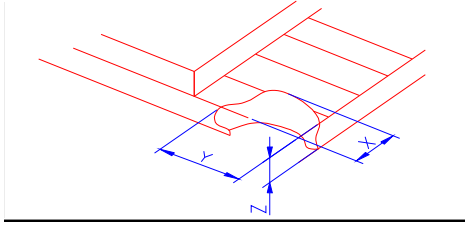
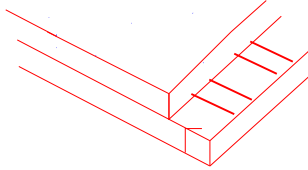
LCD: Liquid Crystal Display, LCM: Liquid Crystal Module, CTP: Capacitive Touch Panel

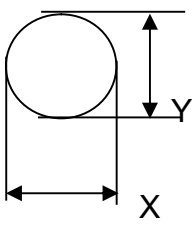
No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. etc	Major
2	Missing	Missing components and etc	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed, deformation and etc	
4	Color tone	Color unevenness, refer to limited sample	Minor
5	Spot/Line defect	Light dot, Dim spot, (Note 1) Polarizer Air Bubble, Polarizer accidented spot and etc.	
6	Soldering appearance	Good soldering , Peeling off is not allowed and etc.	
7	LCD/Polarizer/CTP	Black/White spot/line, scratch, crack, etc.	



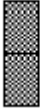
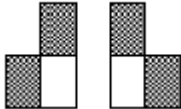
Note1:


- a) Light dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.
- b) Dim dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.

10.1.4 Criteria (Visual)

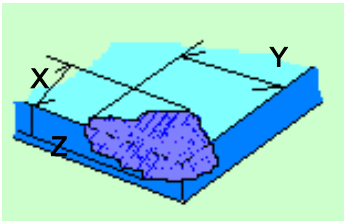
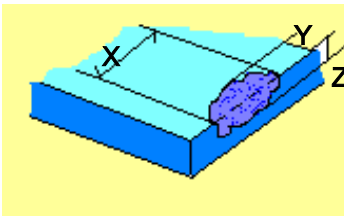
Number	Items	Criteria(mm)						
1.0 LCD Crack/Broken NOTE: X: Length Y: Width Z: Height L: Length of ITO, T: Height of LCD	(1) The edge of LCD broken	 <table border="1" data-bbox="751 651 1453 801"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td><Inner border line of the seal</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3.0mm	<Inner border line of the seal	≤T
X	Y	Z						
≤3.0mm	<Inner border line of the seal	≤T						
	(2) LCD corner broken	 <table border="1" data-bbox="831 1111 1374 1211"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td>≤L</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3.0mm	≤L	≤T
X	Y	Z						
≤3.0mm	≤L	≤T						
	(3) LCD crack	 <p style="text-align: center;">Crack Not allowed</p>						

2.0	Spot defect	① light dot (black/white spot , pinhole, stain, etc.)																												
	 <p style="text-align: center;">$\Phi=(X+Y)/2$</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Zone Size (mm)</th> <th colspan="3" style="text-align: center;">Acceptable Qty</th> </tr> <tr> <th style="text-align: center;">A</th> <th style="text-align: center;">B</th> <th style="text-align: center;">C</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">$\Phi \leq 0.15$</td> <td colspan="3" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;">$0.15 < \Phi \leq 0.25$</td> <td colspan="3" rowspan="2" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;">$0.25 < \Phi \leq 0.4$</td> <td colspan="2" style="text-align: center;">3(distance ≥ 10mm)</td> </tr> <tr> <td style="text-align: center;">$\Phi > 0.4$</td> <td colspan="3" style="text-align: center;">2(distance ≥ 10mm)</td> </tr> <tr> <td style="text-align: center;">$\Phi > 0.4$</td> <td colspan="3" style="text-align: center;">0</td> </tr> </tbody> </table>			Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.15$	Ignore			$0.15 < \Phi \leq 0.25$	Ignore			$0.25 < \Phi \leq 0.4$	3(distance ≥ 10 mm)		$\Phi > 0.4$	2(distance ≥ 10 mm)			$\Phi > 0.4$	0		
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3.0	LCD Pixel defect	<p>Pixel bad points</p> <table border="1"> <thead> <tr> <th data-bbox="534 293 727 344">Item</th> <th data-bbox="727 293 1241 344">Zone A</th> <th data-bbox="1241 293 1493 344">Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td data-bbox="534 344 727 506" rowspan="3">Bright dot</td> <td data-bbox="727 344 1241 400">Random</td> <td data-bbox="1241 344 1493 400">N≤2</td> </tr> <tr> <td data-bbox="727 400 1241 456">2 dots adjacent</td> <td data-bbox="1241 400 1493 456">N≤0</td> </tr> <tr> <td data-bbox="727 456 1241 506">3 dots adjacent</td> <td data-bbox="1241 456 1493 506">N≤0</td> </tr> <tr> <td data-bbox="534 506 727 676" rowspan="3">Dark dot</td> <td data-bbox="727 506 1241 562">Random</td> <td data-bbox="1241 506 1493 562">N≤2</td> </tr> <tr> <td data-bbox="727 562 1241 618">2 dots adjacent</td> <td data-bbox="1241 562 1493 618">N≤0</td> </tr> <tr> <td data-bbox="727 618 1241 676">3 dots adjacent</td> <td data-bbox="1241 618 1493 676">N≤0</td> </tr> <tr> <td data-bbox="534 676 727 983">Distance</td> <td data-bbox="727 676 1241 983"> 1. Minimum Distance Between Bright dots. 2. Minimum Distance Between dark dots 3. Minimum Distance Between dark and bright dot. </td> <td data-bbox="1241 676 1493 983">5mm</td> </tr> <tr> <td colspan="2" data-bbox="534 983 1241 1039">Total bright and dark dot</td> <td data-bbox="1241 983 1493 1039">N≤4</td> </tr> </tbody> </table> <p>Note:</p> <p>A) Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.</p> <p>B) Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.</p> <p>C) 2 dot adjacent = 1 pair = 2 dots</p> <p>Picture:</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;">  <p>2 dot adjacent</p> </div> <div style="text-align: center;">  <p>2 dot adjacent</p> </div> </div> <div style="display: flex; justify-content: space-around; align-items: flex-start; margin-top: 20px;"> <div style="text-align: center;">  <p>2 dot adjacent (vertical)</p> </div> <div style="text-align: center;">  <p>2 dot adjacent (slant)</p> </div> </div>	Item	Zone A	Acceptable Qty	Bright dot	Random	N≤2	2 dots adjacent	N≤0	3 dots adjacent	N≤0	Dark dot	Random	N≤2	2 dots adjacent	N≤0	3 dots adjacent	N≤0	Distance	1. Minimum Distance Between Bright dots. 2. Minimum Distance Between dark dots 3. Minimum Distance Between dark and bright dot.	5mm	Total bright and dark dot		N≤4
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Total bright and dark dot		N≤4																							

4.0	Line defect (LCD /Polarizer backlight black/white line, scratch, stain)  W: width, L : length N : Count	<table border="1"> <thead> <tr> <th rowspan="2">Width(mm)</th> <th rowspan="2">Length(m)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.05$</td> <td>Ignore</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.05 < W \leq 0.06$</td> <td>$L \leq 4.0$</td> <td colspan="3">$N \leq 3$</td> </tr> <tr> <td>$0.06 < W \leq 0.08$</td> <td>$L \leq 3.0$</td> <td colspan="3">$N \leq 2$</td> </tr> <tr> <td>$W > 0.08$</td> <td colspan="4">Define as spot defect</td> </tr> </tbody> </table>	Width(mm)	Length(m)	Acceptable Qty			A	B	C	$\Phi \leq 0.05$	Ignore	Ignore			$0.05 < W \leq 0.06$	$L \leq 4.0$	$N \leq 3$			$0.06 < W \leq 0.08$	$L \leq 3.0$	$N \leq 2$			$W > 0.08$	Define as spot defect			
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$W > 0.08$	Define as spot defect																													
5.0	Electronic Components SMT.	Not allow missing parts, solderless connection, cold solder joint, mismatch, The positive and negative polarity opposite																												
6.0	Display color& Brightness.	1. Color: Measuring the color coordinates, The measurement standard according to the datasheet or samples. 2. Brightness: Measuring the brightness of White screen, The measurement standard according to the datasheet or Samples.																												
7.0	LCD Mura/Waving/ Hot spot	Not visible through 5% ND filter in 50% gray or judge by limit sample if necessary.																												

8.0	CTP Related	CTP Cover sensor accidented black/white spot	<table border="1"> <thead> <tr> <th rowspan="2">Size Φ(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.1$</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.1 < \Phi \leq 0.2$</td> <td colspan="3">0 (distance $> 10mm$)</td> </tr> <tr> <td>$0.20 < \Phi \leq 0.25$</td> <td colspan="3">0 (distance $> 10mm$)</td> </tr> <tr> <td>$\Phi > 0.25$</td> <td colspan="3">0</td> </tr> </tbody> </table>	Size Φ (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.1$	Ignore			$0.1 < \Phi \leq 0.2$	0 (distance $> 10mm$)			$0.20 < \Phi \leq 0.25$	0 (distance $> 10mm$)			$\Phi > 0.25$	0							
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		CTP Cover Pinhole/ Lack of ink	<table border="1"> <thead> <tr> <th>Zone Size (mm)</th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.1$</td> <td>Ignore</td> </tr> <tr> <td>$0.1 < \Phi \leq 0.25$</td> <td>3(distance ≥ 10mm)</td> </tr> <tr> <td>$0.25 < \Phi \leq 0.3$</td> <td>2(distance ≥ 10mm)</td> </tr> <tr> <td>$\Phi > 0.3$</td> <td>0</td> </tr> </tbody> </table>	Zone Size (mm)	Acceptable Qty	$\Phi \leq 0.1$	Ignore	$0.1 < \Phi \leq 0.25$	3(distance ≥ 10 mm)	$0.25 < \Phi \leq 0.3$	2(distance ≥ 10 mm)	$\Phi > 0.3$	0							
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		Assembly deflection	beyond the edge of backlight ≤ 0.2 mm																	
		CTP cover broken X : length Y : width Z : height	<table border="1"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>$X \leq 0.5$mm</td> <td>$Y \leq 0.5$mm</td> <td>Z < cover thickness s</td> </tr> </tbody> </table> <p>* Circuitry broken is not allowed.</p> 	X	Y	Z	$X \leq 0.5$ mm	$Y \leq 0.5$ mm	Z < cover thickness s											
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X	Y	Z																		
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Criteria (functional items)

Number	Items	Criteria (mm)
1	No display	Not allowed
2	Missing segment	Not allowed
3	Short	Not allowed
4	Backlight no lighting	Not allowed
5	CTP no function	Not allowed

11. Reliability Test Result

Item	Condition	Inspection after test
High Temperature Operating	85°C,96H	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/line; 4. Glass crack; 5. Current IDD is twice higher than initial value.
Low Temperature Operating	-30°C, 96HR	
High Temperature Storage	85°C, 96HR	
Low Temperature Storage	-30°C, 96HR	
High Temperature & High Humidity Operating	+60°C, 90% RH ,96 hours.	
Thermal Shock (Non-operation)	-10°C,30 min ↔ +60°C,30 min, Change time: 5min 20CYC.	
ESD test	C=150pF, R=330,5points/panel Air:±8KV, 5times; Contact:±6KV, 5 times; (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 for total) (Package condition).	
Box Drop Test	1 Corner 3 Edges 6 faces,80cm(MEDIUM BOX)	

Remark:

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 normal state after resetting, it would be judged as a good part.
5. Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.
6. The color fading mura of polarizing filter should not care.

12. Cautions and Handling Precautions

12.1 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 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

12.2 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.