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

TFT Display Module

Part Number

E35RG13248LW2M450-C

Overview:

- 3.5-inch TFT: 320x480 (61.90x96.04)
- 3/4 SPI+16/18- bit RGB
- 8/9/16/18-bit MCU
- 3-line/4-line Serial Interface
- White LED back-light
- Transmissive/ Normally Black
- Capacitive Touch Screen
- 450 NITS
- Controller: ILI9488, FT6236
- RoHS Compliant

Description

This is a color active matrix TFT (Thin Film Transistor) LCD (Liquid Crystal Display) that uses amorphous silicon TFT as a switching device. This model is composed of a Transmissive type TFT-LCD Panel, driver circuit l·yŘ back-light unit. The resolution of a o.p" TFT-LCD contains 240X320 pixels, and can display up to 65K/262K colors

Features

Low Input Voltage: 3.3V (TYP)
Display Colors of TFT LCD: 65K/262K colors
TFT Interface: 8/9/16/18πōit MCU
3/4SPI+16/18Bit RGB
3-line/4-line serial interface

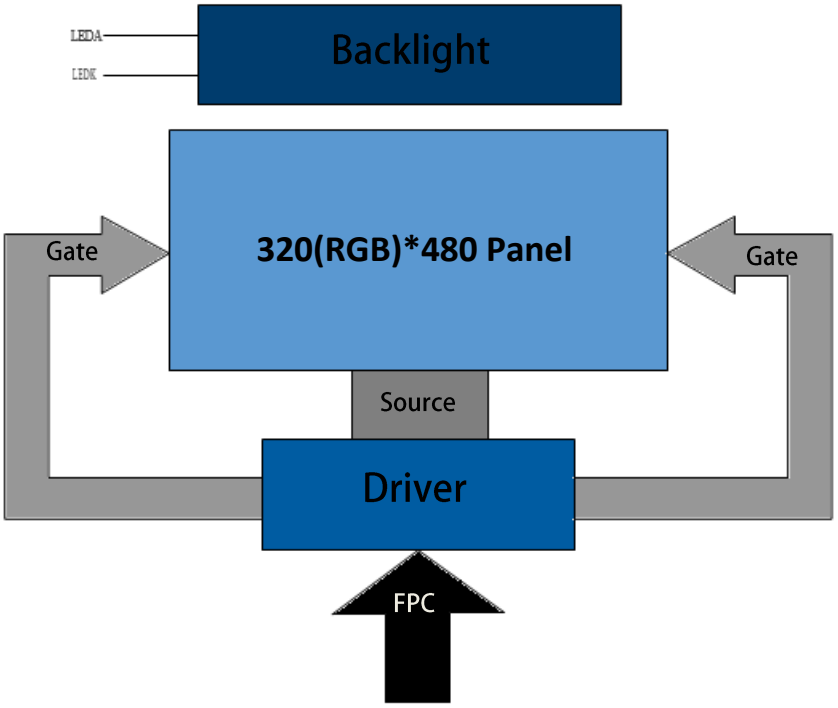
/¢t LyűŜ₩₣l·ŎŜʏ Lн/

General Information Items	Specification Main Panel	Unit	Note
Display area (AA)	пуΦфс(H) *то.пп(V) (o.p inch)	mm	-
CTP View Area	пфΦфс(H)*тпΦпп(V)	-	-
Driver element	TFT active matrix	-	-
Display colors	65K/262K	colors	-
Number of pixels	онл(RGB)*пул	dots	-
TFT Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.153(H) x 0.153(V)	mm	-
Viewing angle	! [[	o'clock	-
TFT Controller IC	L[Lфпуу	-	-
CTP Driver IC	FT6нос	-	
Display mode	Transmissive/Normally .fl·Ŏ¶	-	-
Touch mode	Single point and Gestures	-	-
Operating temperature	-20～+70	℃	-
Storage temperature	-30～+80	℃	-

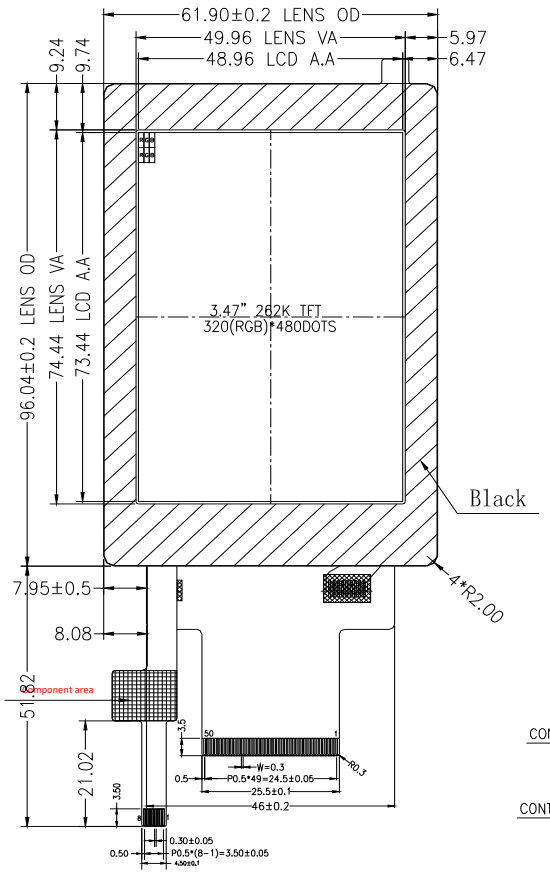
Mechanical Information

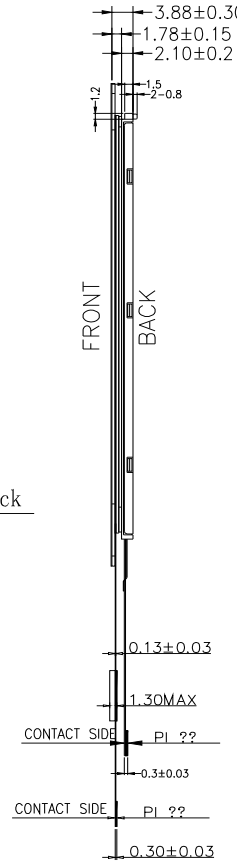
Item		Min	Typ.	Max	Unit	Note
Module size	Horizontal(H)		смΦфл		mm	-
	Vertical(V)		фсΦлп		mm	-
	Depth(D)		3.уу		mm	-
Weight			TBD		g	-

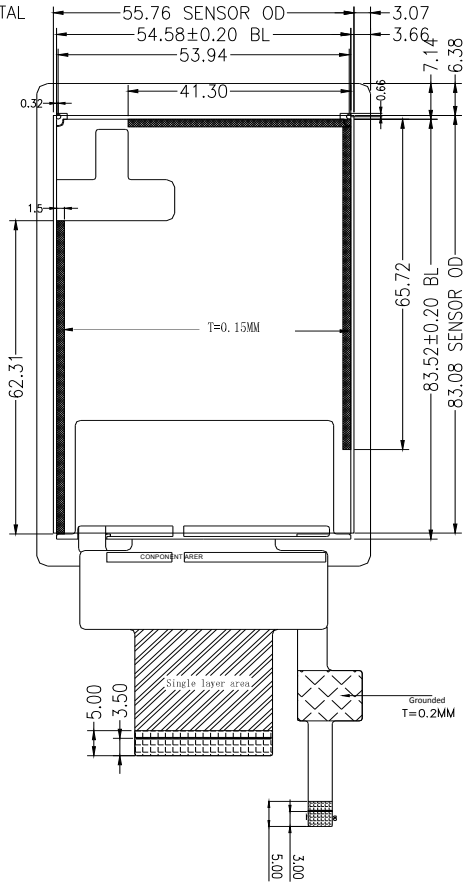
1. Block Diagram

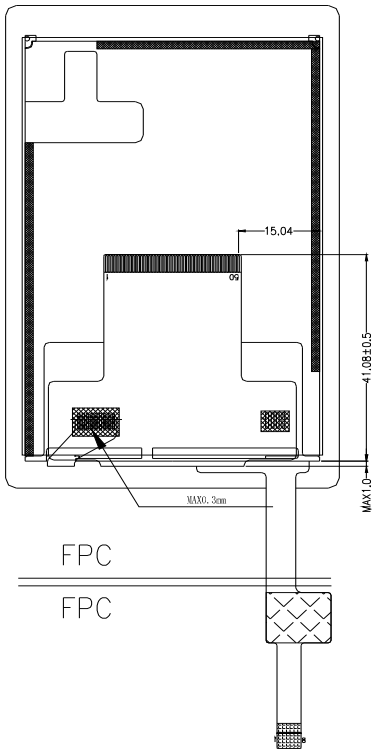


2. Outline Dimensions





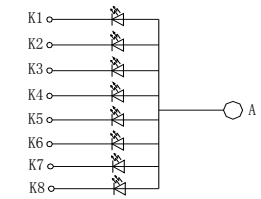




NO.	TFT Pin Name
1	GND
2	IOVCC
3	VCI
4	IM0
5	IM1
6	IM2
7	RESX
8	VSYNC
9	HSYNC
10	PCLK
11	DE
12	DB17/R5, MSb
13	DB16/R4
14	DB15/R3
15	DB14/R2
16	DB13/R1
17	DB12/R0,LSb
18	DB11/G5,MSb
19	DB10/G4
20	DB09/G3
21	DB08/G2
22	DB07/G1
23	DB06/G0,LSb
24	DB05/B5,MSb
25	DB04/B4
26	DB03/B3
27	DB02/B2
28	DB01/B1
29	DB0/B0,LSb
30	GND
31	DOUT
32	DIN_SDA
33	RDX
34	WRX_SCL
35	DCX
36	CSX
37	LEDA
38	LEDK1
39	LEDK2
40	LEDK3
41	LEDK4
42	LEDK5
43	LEDK6
44	LEDK7
45	LEDK8
46	XR(NC)
47	YD(NC)
48	XL(NC)
49	YU(NC)
50	GND

NOTES:

1. DISPLAY TYPE: 3.5", TFT-LCD, 262K COLORS
2. DISPLAY MODE: NORMALLY BLACK
3. VIEWING DIRECTION: ALL
4. TFT DRIVER IC: ILI9488 (COG)
   CTP DRIVER IC: FT6236
5. VCI: 2.5-3.3V, IOVCC:1.8-3.3V
6. CTP SURFACE HARDNESS: 6H
7. OPERATING TEMP: -20°C TO 70°C
   STORAGE TEMP: -30°C TO 80°C
8. BACK LIGHT: LED WHITE, 8 LED, 120-160mA, 3.2V±0.3V
9. RoHS COMPLIANT.



LED(B/L) CIRCUIT

IM2	IM1	IM0	Interface type	DB Pin in use
0	0	0	DBI Tyb_ 18-bit interface	DB17-DB0
0	0	1	DBI Tyb_ 9-bit interface	DB8-DB0
0	1	0	DBI Tyb_ 16-bit interface	DB15-DB0
0	1	1	DBI Tyb_ 8-bit interface	DB7-DB0
1	0	1	3-Wire 9 BIT data serial interface	SDI SCL CS
1	1	1	4-Wire 8 BIT data serial interface	SDI SCL CS RS

NOTE:
1. If not use PIN, fix to the GND , VCI or NC.
2. If use RGB interface must select serial interface

NO.	Pin Name
1	GND
2	VDDIO
3	VDD
4	SCL
5	SDA
6	INT
7	RST
8	GND

Rev.	Revision content description	Date
V0		

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	DRAWING NAME	E35RG13248LW2M450-C	
	PARTS NO.		
TOLERANCE UNLESS OTHERWISE SPECIFIED X.X±0.3 X.XX±0.2	Drawn		Unit
	Checked		mm
Scale 1:1	Approve		Page 1/1

3. Input TFT Terminal Pin Assignment

Recommended TFT Connector: FH12S-50S-0.5SH(55) | Recommended CTP Connector: FH12-8S-0.5SH(55)

<table>
<tr><th>NO.</th><th>Symbol</th><th>Description</th><th>I/O</th></tr>
<tr><td>1</td><td>GND</td><td>Ground.</td><td>P</td></tr>
<tr><td>2</td><td>IOVCC</td><td>Supply voltage for IO (1.8-3.3V)</td><td>P</td></tr>
<tr><td>3</td><td>VCI</td><td>Supply voltage (3.3V)</td><td>P</td></tr>
<tr><td>4</td><td>IM0</td><td rowspan="3"><table>
<tr><th>IM2</th><th>IM1</th><th>IM0</th><th>Interface type</th><th>DB Pin in use</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>DBI Tyb_ 18-bit interface</td><td>DB17-DB0</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>DBI Tyb_ 9-bit interface</td><td>DB8-DB0</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>DBI Tyb_ 16-bit interface</td><td>DB15-DB0</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>DBI Tyb_ 8-bit interface</td><td>DB7-DB0</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>3-Wire 9 BIT data serial interface</td><td>SDA SCL CS</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>4-Wire 8 BIT data serial interface</td><td>SDA SCL CS RS</td></tr>
</table></td><td rowspan="3">I</td></tr>
<tr><td>5</td><td>IM1</td></tr>
<tr><td>6</td><td>IM2</td></tr>
<tr><td>7</td><td>RESX</td><td>Reset the device and must be applied to properly initialize the chip.</td><td>I</td></tr>
<tr><td>8</td><td>VSYNC</td><td>Frame synchronizing signal for RGB interface operation. Fix this pin at VCI or GND when not in use.</td><td>I</td></tr>
<tr><td>9</td><td>HSYNC</td><td>Line synchronizing signal for RGB interface operation. Fix this pin at VCI or GND when not in use</td><td>I</td></tr>
<tr><td>10</td><td>PCLK</td><td>Dot clock for RGB interface. Fix this pin at VCI or GND when not in use.</td><td>I</td></tr>
<tr><td>11</td><td>DE</td><td>Data enable signal for RGB interface. Fix this pin at VCI or GND when not in use.</td><td>I</td></tr>
<tr><td>12-29</td><td>DB17-DB0</td><td>18-bit parallel bi-directional data bus for MCU system and RGB interface mode. Fix to GND level when not in use</td><td>I/O</td></tr>
<tr><td>30</td><td>GND</td><td>Ground</td><td>P</td></tr>
<tr><td>31</td><td>DOUT</td><td>Serial data output pin in serial bus system interface. If not used open this pin.</td><td>O</td></tr>
<tr><td>32</td><td>DIN_SDA</td><td>Serial input signal. Data is applied on the rising edge of the SCL signal. If not used, fix this pin at VCI or GND.</td><td>I</td></tr>
<tr><td>33</td><td>RDX</td><td>Serves as a read signal and MCU read data at the rising edge. Fix this pin at VCI or GND when not in use.</td><td>I</td></tr>
<tr><td>34</td><td>WR(SPI-SCL)</td><td>DBI Type B: WRX pin, serves as a write signal DBI Type C: SCL pin as Serial Clock when operates in the serial interface</td><td>I</td></tr>
<tr><td>35</td><td>DCX(RS)</td><td>Display data/ command selection pin</td><td>I</td></tr>
<tr><td>36</td><td>CSX</td><td>Chip select input pin (“Low” enable). Fix this pin at VCI or GND when not in use.</td><td>I</td></tr>
<tr><td>37</td><td>LEDA</td><td>Anode pin of backlight</td><td>P</td></tr>
<tr><td>38-45</td><td>LEDK(1-8)</td><td>Cathode pin of backlight</td><td>P</td></tr>
<tr><td>46</td><td>XR(NC)</td><td>Touch panel right glass terminal</td><td>A/D</td></tr>
<tr><td>47</td><td>YD(NC)</td><td>Touch panel bottom film terminal</td><td>A/D</td></tr>
<tr><td>48</td><td>XL(NC)</td><td>Touch panel left glass terminal</td><td>A/D</td></tr>
<tr><td>49</td><td>YU(NC)</td><td>Touch panel top film terminal</td><td>A/D</td></tr>
<tr><td>50</td><td>GND</td><td>Ground</td><td>P</td></tr>
</table>

3.1 CTP

No	Symbol	Description	I/O
1	GND	Ground	P
2	VDDIO	I/O power supply voltage	P
3	VDD	Supply voltage	P
4	SCL	I2C clock input	I
5	SDA	I2C data input and output	I/O
6	INT	External interrupt to the host	I
7	RST	External reset, low is active	I
8	GND	Ground	P

4. LCD Optical Characteristics

4.1 Optical specification

Item		Symbol	Condition	Min	Typ.	Max	Unit	Note
Contrast Ratio		CR	Θ=0 Normal viewing angle	--	500	--		(2)
Response time	Rising	TR+TF		--	35	50	msec	(4)
	Falling							
Color gamut		S (%)		--	70	--	%	(5)
Color Filter Chromaticity	White	W_X		--	0.301	0.303		(1)(5)
		W_Y		--	0.335	0.337		
	Red	R_X		--	0.631	0.633		
		R_Y		--	0.334	0.335		
	Green	G_X		--	0.316	0.318		
		G_Y		--	0.602	0.605		
	Blue	B_X		--	0.151	0.152		
		B_Y		--	0.047	0.049		
Viewing angle	Hor.	ΘL	CR>10	--	80	--		(1)(6)
		ΘR		--	80	--		
	Ver.	ΘU		--	80	--		
		ΘD		--	80	--		
Option View Direction		FREE						

4.2 Measuring conditions

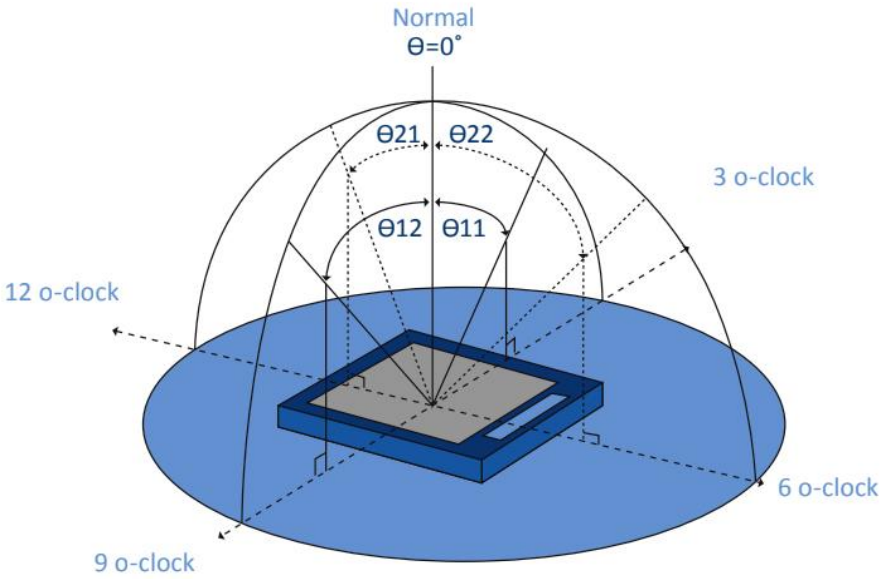
Measuring surrounding: dark room
Ambient temperature: 25±2 ℃
15min. warm-up time.

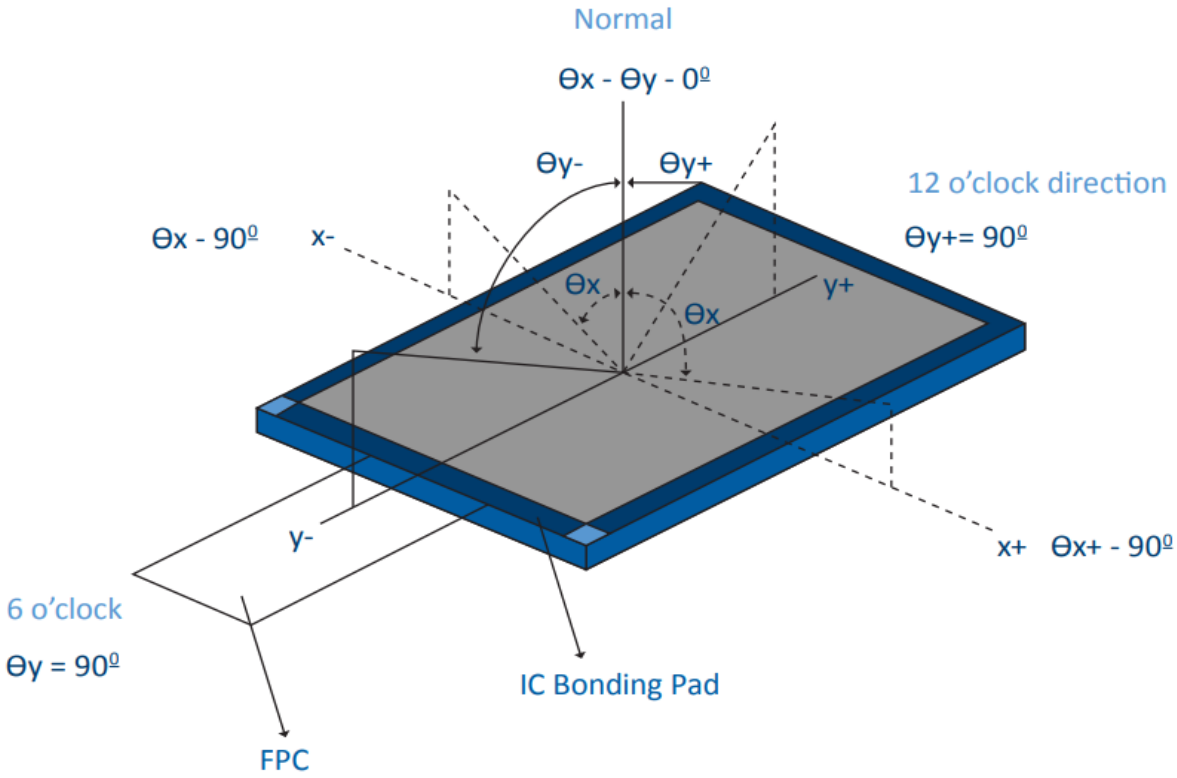
4.3 Measuring Equipment

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

Optical Specification Reference Notes:

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

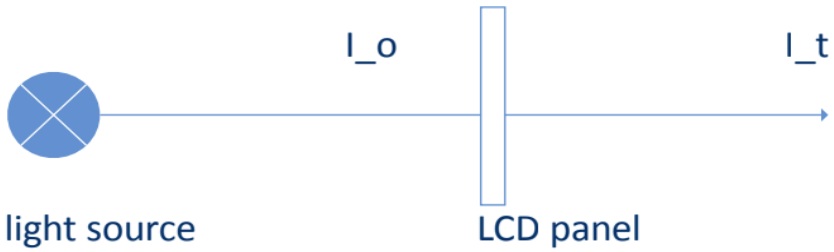




(2) Definition of Contrast Ratio (Cr): measured at the center point of panel. The contrast ratio (Cr) measured on a module, is the ratio between the luminance (Lw) in a full white area (R=G=B=1) and the luminance (Ld) in a dark area (R=G=B=0).

$$Cr = \frac{Lw}{Ld}$$

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

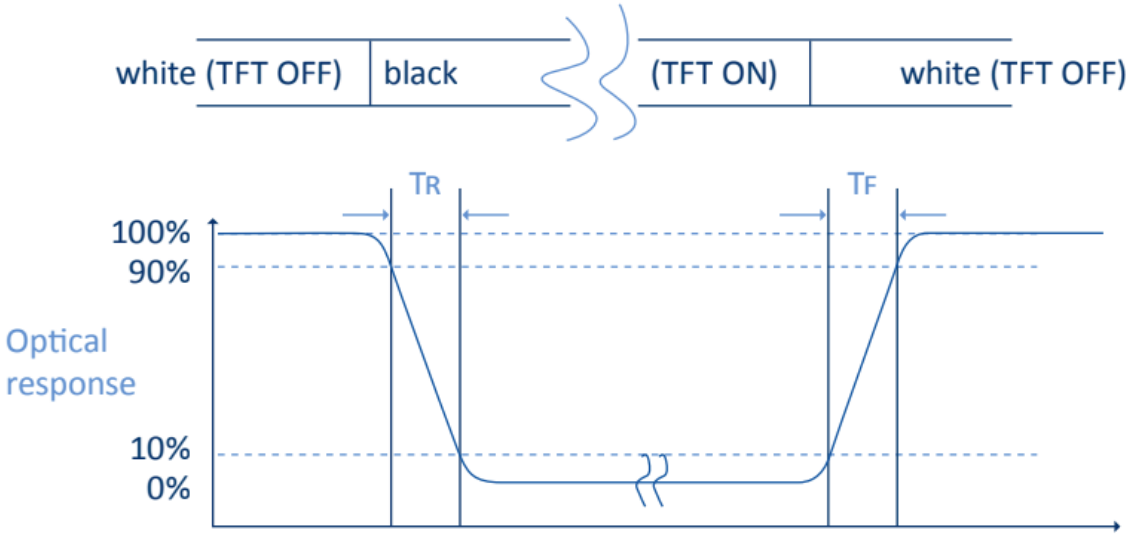


The transmittance is defined as:

$$Tr = \frac{It}{Io}\ x\ 100\%$$

Io = the brightness of the light source.
It = the brightness after panel transmission

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



(5) Definition of Color Gamut: Measuring machine CFT-01. NTSC's Primaries: R(x,y,Y),G(x,y,Y), B(x,y,Y). FPM520 of Westar Display Technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

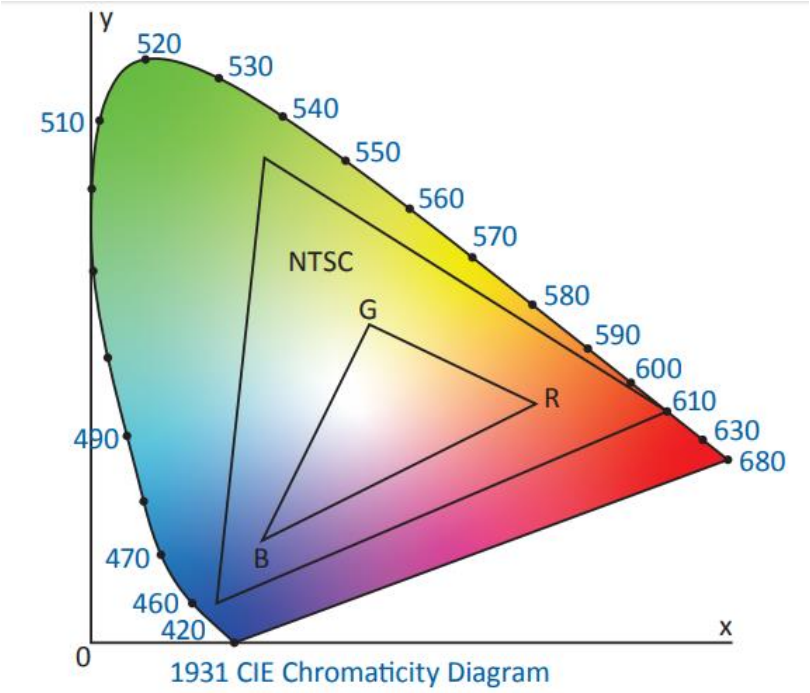
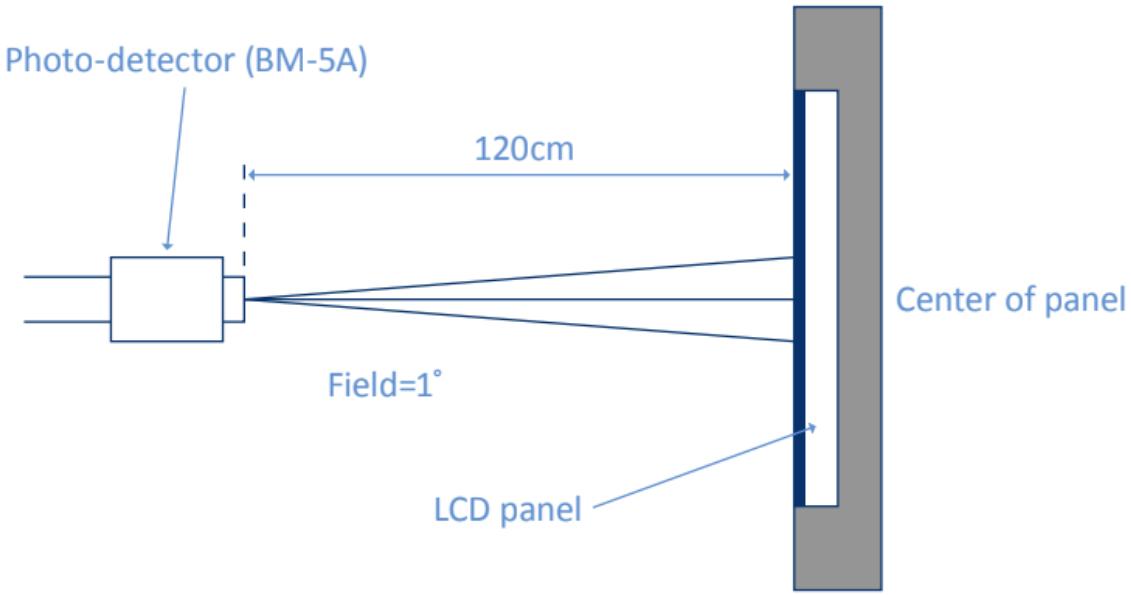


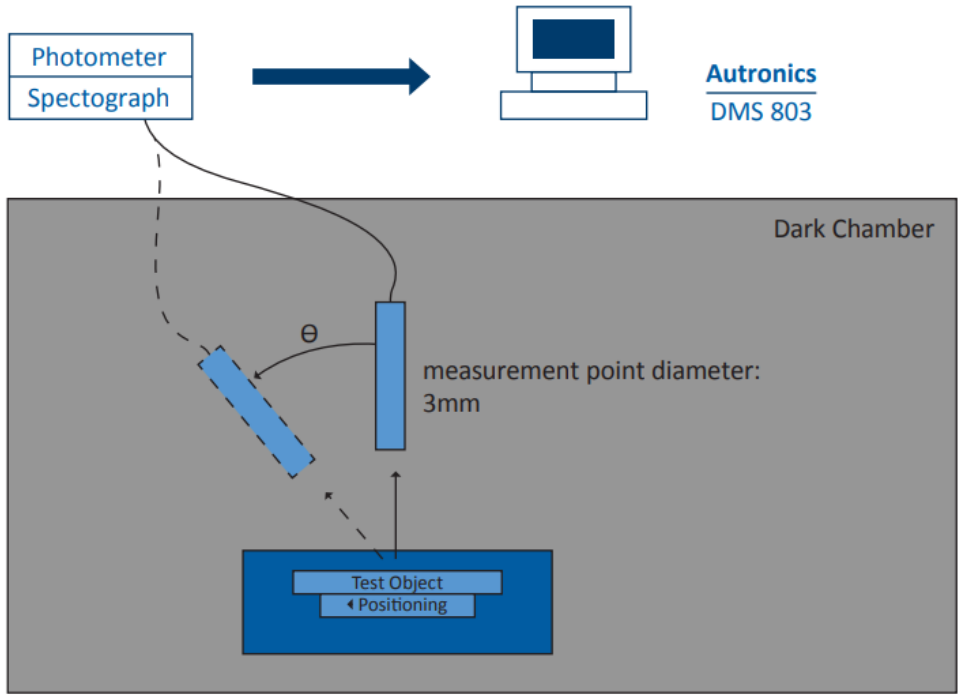
Fig. 1931 CIE chromacity diagram

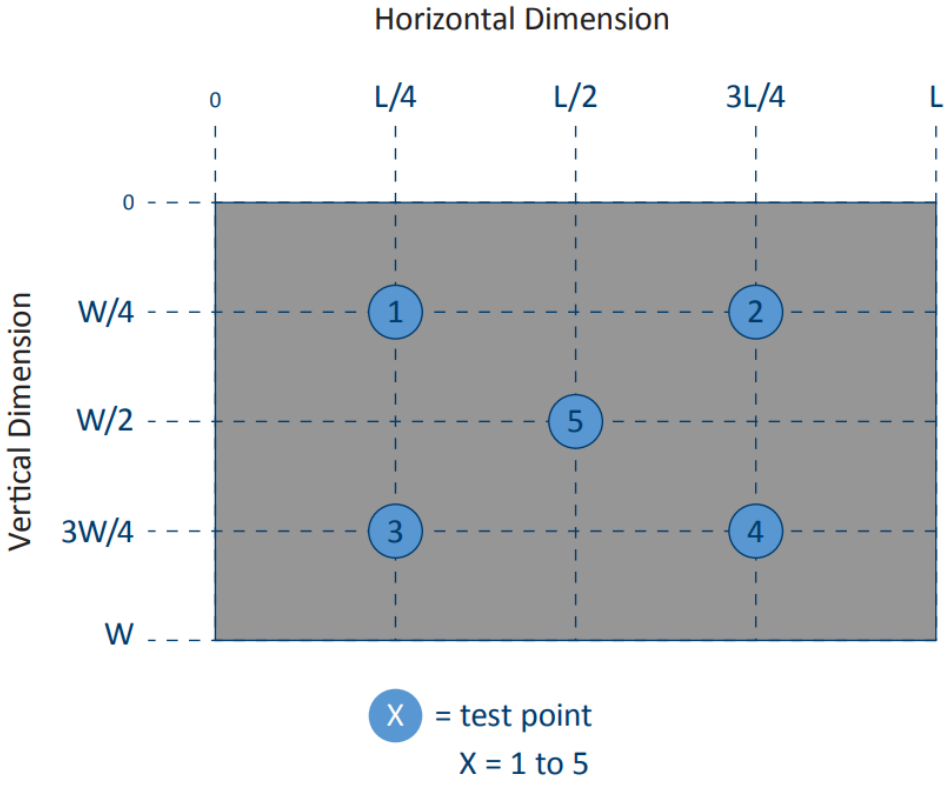
$$\text{Color gamut: } S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$

(6) Definition of Optical Measurement Setup:



(6) Optical Measurement Setup Continued:
The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting backlight for 20 minutes.





5. Electrical Characteristics

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

Characteristics	Symbol	Min	Max	Unit
Digital Supply Voltage	VCI/VDD	-0.3	4.6	V
Interface Operation Voltage	IOVCC	-0.3	4.6	V
Operating temperature	TOP	-20	+70	℃
Storage temperature	TST	-30	+80	℃

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.

5.2 DC Electrical Characteristics

Characteristics	Symbol	Min	Typ.	Max	Unit	Note
Digital Supply Voltage	VCI/VDD	2.4	2.8	3.3	V	
Interface Operation Voltage	IOVCC	1.65	1.8	3.3	V	
Normal Mode Current Consumption	IDD	--	7	--	mA	
Level input voltage	VIH	0.7 VDDIO		VDDIO	V	
	VIL	GND		0.3 VDDIO	V	
Level output voltage	VOH	0.8 VDDIO		VDDIO	V	
	VOL	GND		0.2 VDDIO	V	

5.3 LED Backlight Characteristics

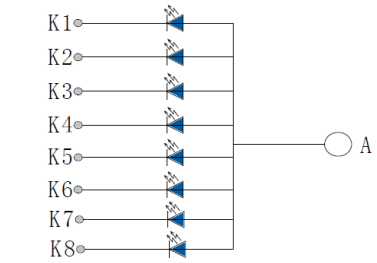
Item	Symbol	Min	Typ.	Max	Unit	Note
Forward Current	IF	150	160	--	mA	
Forward Voltage	VF	--	3.2	--	V	
LCM Luminance	LV	450	--	--	cd/m2	Note 3
LED lifetime	Hr	50000	--	--	hour	Note1 & 2
Uniformity	AVg	80	--	--	%	Note 3

The back-light system is edge-lighting type with 8 chips White LED

Note 1: LED lifetime (Hr) can be defined as the time in which it continues to operate under the condition:

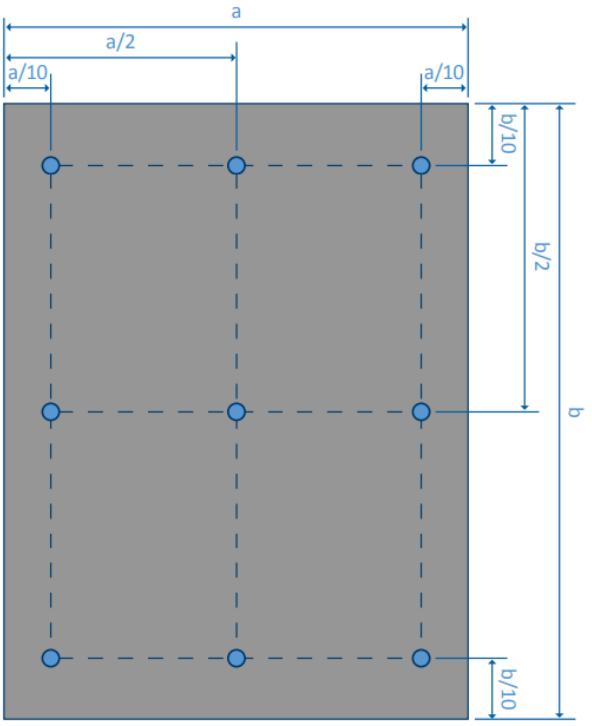
Ta=25±3 ℃, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note 2: The “LED lifetime” is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and IL=160mA. The LED lifetime could be decreased if operating IL is larger than 160mA. The constant current driving method is suggested.



LED(B/L) CIRCUIT

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



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

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

6. AC Characteristic

6.1 tI-ℕI-ftŜf wD. ¢ℵY'ℵyƎ /KI-ℕI-ŏúŜℕℵăúℵŏă

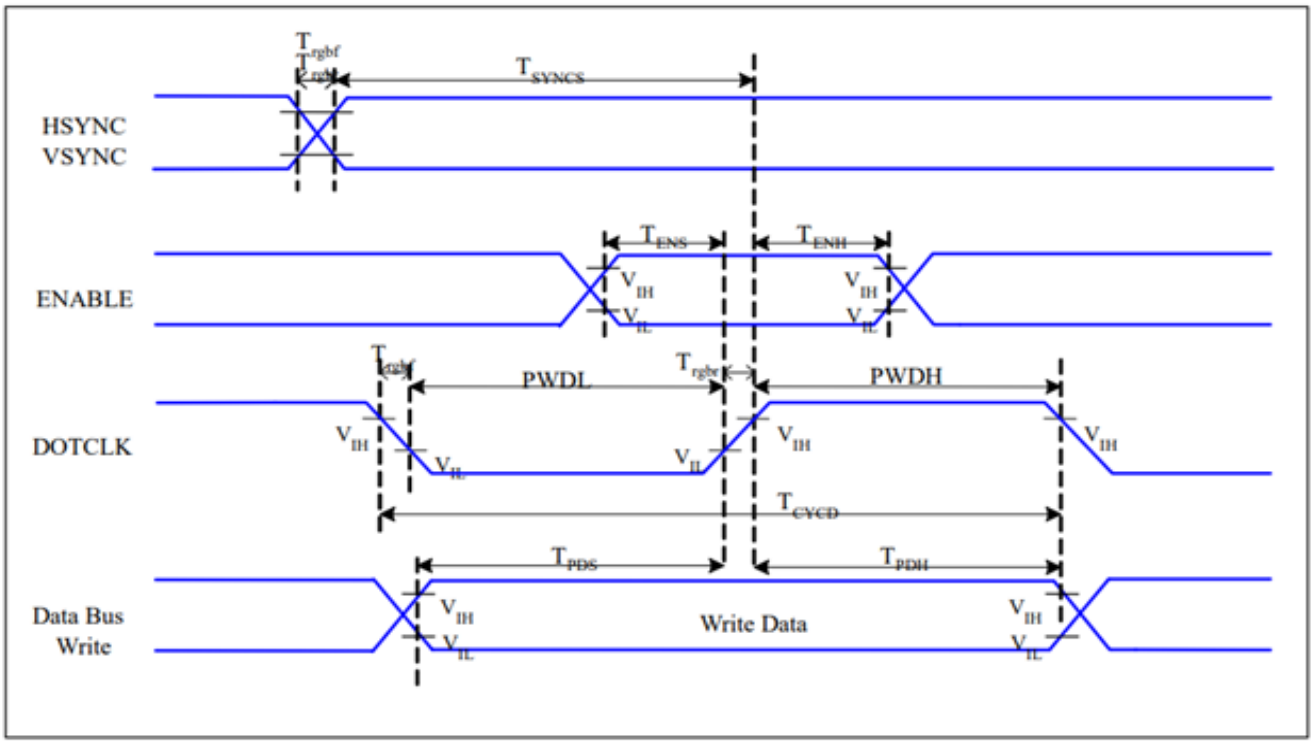
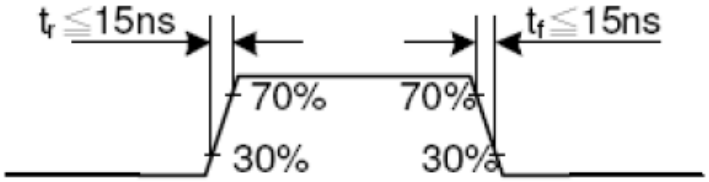
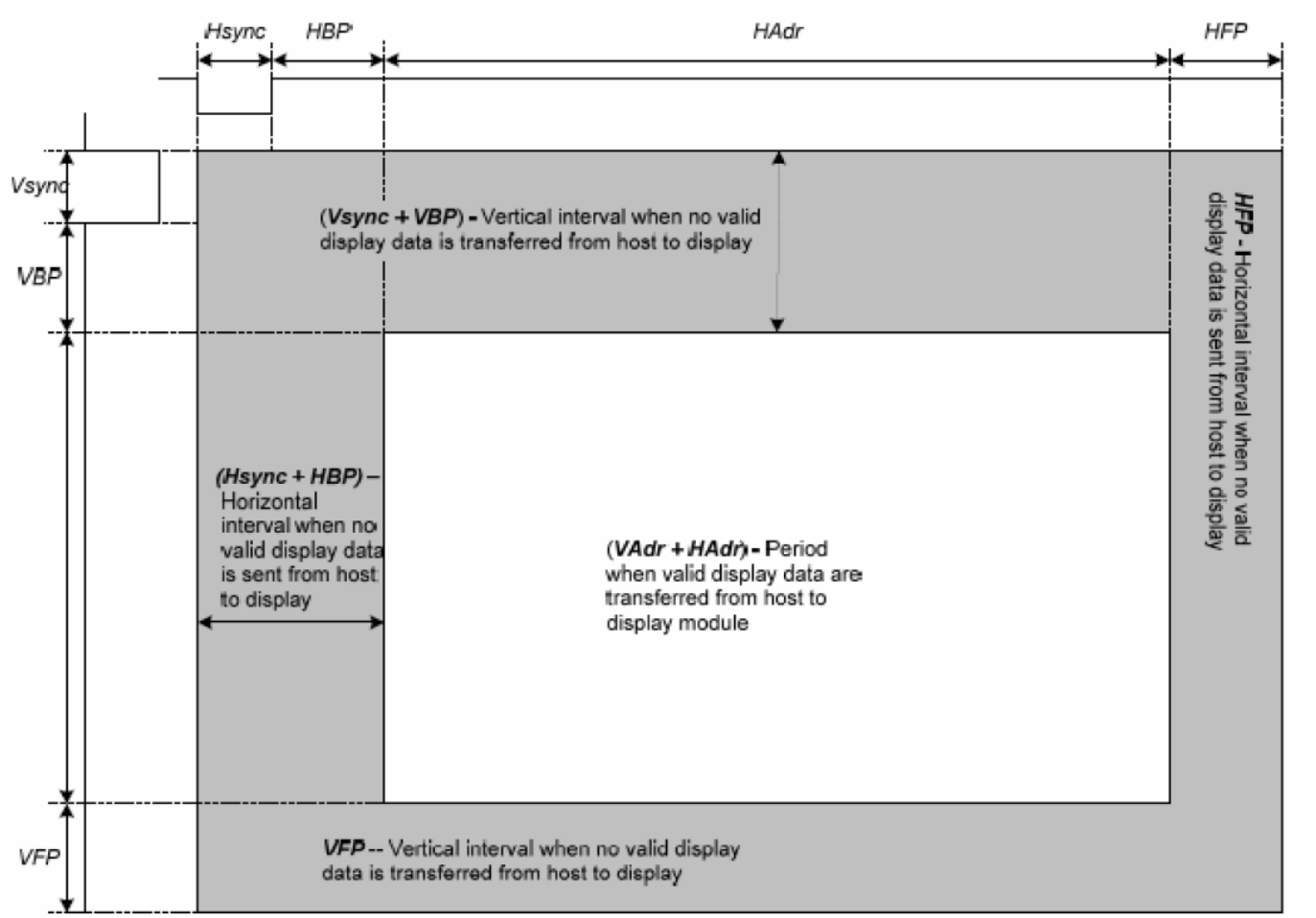


Figure 6.1: Parallel RGB 16/18/24-Bit Timing Diagram

Signal	Symbol	Parameter	Min	Max	Unit	Description
HSYNC/ VSYNC	T_{SYNCS}	VSYNC, HSYNC setup time	15	-	ns	18/16/6-bit bus RGB interface mode
	T_{SYNCH}	VSYNC, HSYNC hold time	15			
DE	T_{ENS}	Enable Setup Time	15	-	ns	
	T_{ENH}	Enable Hold Time	15	-	ns	
DOTCLK	PWDH	DOTCLK High-level Pulse Width	20	-	ns	
	PWDL	DOTCLK Low-level Pulse Width	20	-	ns	
	T_{CYCD}	DOTCLK Cycle Time	50	-	ns	
	T_{RGHR}, T_{RGHF}	DOTCLK, HSYNC, VSYNC Rise/Fall Time	-	15	ns	
D[23:0]	T_{PDS}	Data Setup Time	15	-	ns	
	T_{PDH}				ns	

Table 6.1: 8/16 Bits RGB Interface Timing Characteristics





Parameters	Symbols	Min	Typ.	Max	Units
PCLK cycle	PCLKcyc	100	80	66.6	Ns
Horiontal synchronization	Hsync	3	3	-	PCLK
Horizontal back porch	HBP	3	3	-	PCLK
Horizontal address	HAdr	-	320	-	PCLK
Horizontal front porch	HFP	3	3	-	PCLK
Vertical synchronization	Vsync	2	2	-	Line
Vertical back porch	VBP	2	2	-	Line
Vertical address	Vadr	-	480	-	Line
Vertical front porch	VFP	2	2	-	Line
Vertical frequency(*)		50	60	80	Hz
Horizontal frequency(*)		-	33	-	kHz
PCLK frequency(*)		10	12.5	15	MHz

Table 6.2: Vertical and Horizontal Timing Characteristics

Notes:

(1) Vertical period (one frame) shall be equal to the sum of Vsync + VBP + VAdr +VFP.

(2) Horizontal period (one line) shall be equal to the sum Hsync + HBP +HAdr + HFP.

(3) Control signals PCLK and Hsync shall be transmitted as specified at all times while valid pizels are transferred between the host processor and the display module.

6.2 Display Parallel 8/16-bit Interface Timing Characteristics (8080 system)

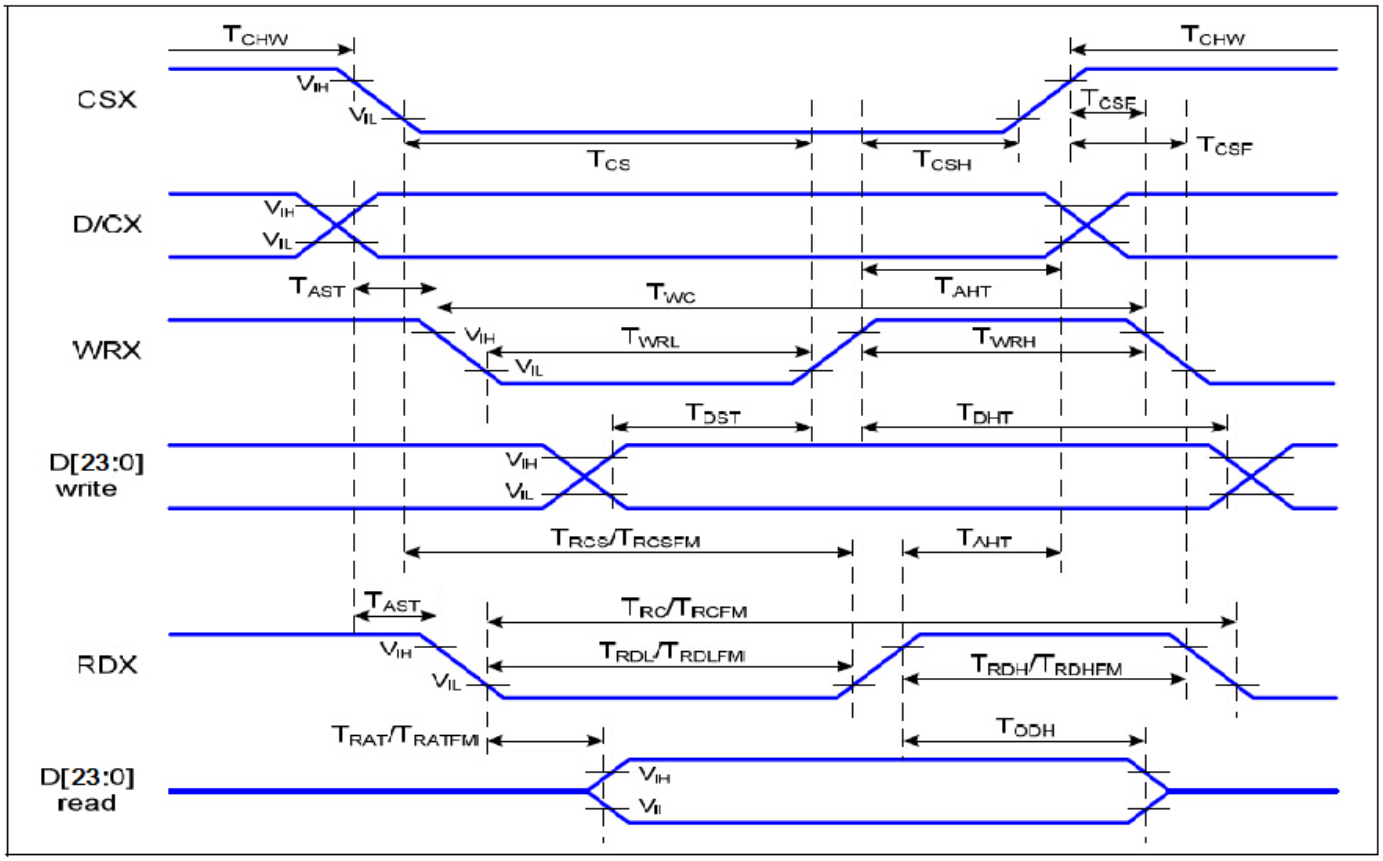
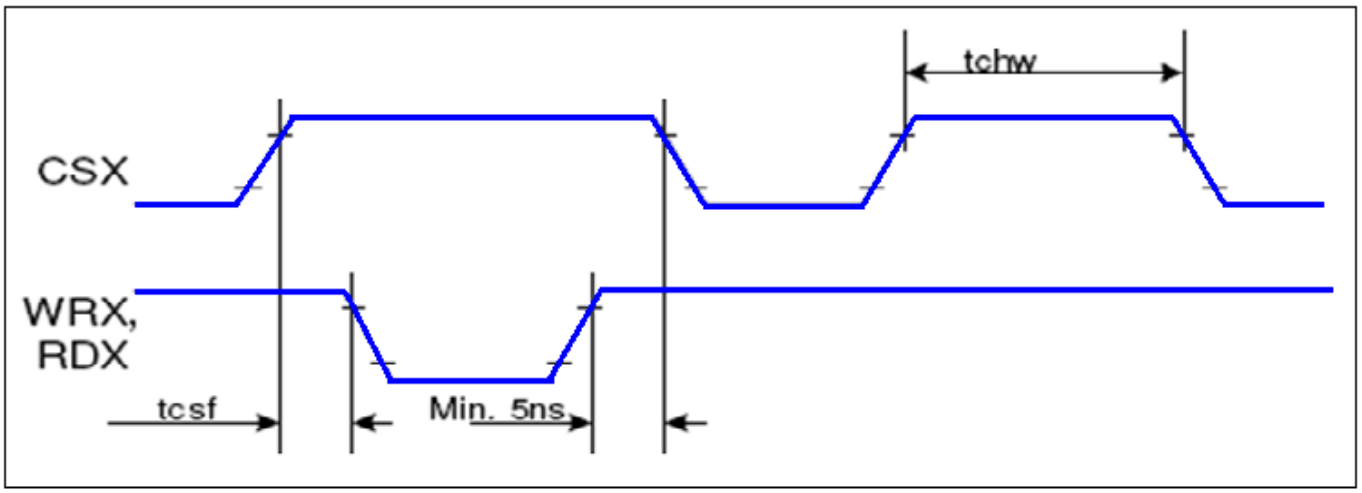


Figure 6.2: 8080 System Parallel Interface Timing Diagram

Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	T_{AST}	Address setup time	0	-	ns	
	T_{AHT}	Address hold time (Write/Read)	0	-	ns	
CSX	T_{CHW}	Chip select “H” pulse width	0	-	ns	
	T_{CS}	Chip select setup time (Write)	15	-	ns	
	T_{RCS}	Chip select setup time (Read ID)	45	-	ns	
	T_{RCSFM}	Chip select setup time (Read FM)	355	-	ns	
	T_{CSF}	Chip select wait time (Write/Read)	0	-	ns	
	T_{CSH}	Chip select hold time	0	-	ns	
WRX	T_{WC}	Write cycle	40	-	ns	
	T_{WRH}	Control pulse “H” duration	15	-	ns	
	T_{WRL}	Control pulse “L” duration	15		ns	
RDX (ID)	T_{RC}	Read cycle (ID)	160	-	ns	When read ID data
	T_{RDH}	Control pulse “H” duration (ID)	90	-	ns	
	T_{RDL}	Control pulse “L” duration	45	-	ns	
RDX (FM)	T_{RCFM}	Read cycle (FM)	450	-	ns	When read from frame memory
	T_{RDHFM}	Control pulse “H” duration (FM)	90	-	ns	
	T_{RDLFM}	Control pulse “L” duration (FM)	355	-	ns	
D[23:0], D[17:0], D[15:0], D[8:0], D[7:0]	T_{DST}	Write data setup time	10	-	ns	For max CL=30pF For min CL=8pF
	T_{DHT}	Write data hold time	10	-	ns	
	T_{RAT}	Read access time (ID)	-	40	ns	
	T_{RATFM}	Read access time (FM)	-	340	ns	
	T_{ROD}	Output disable time	20	80	ns	

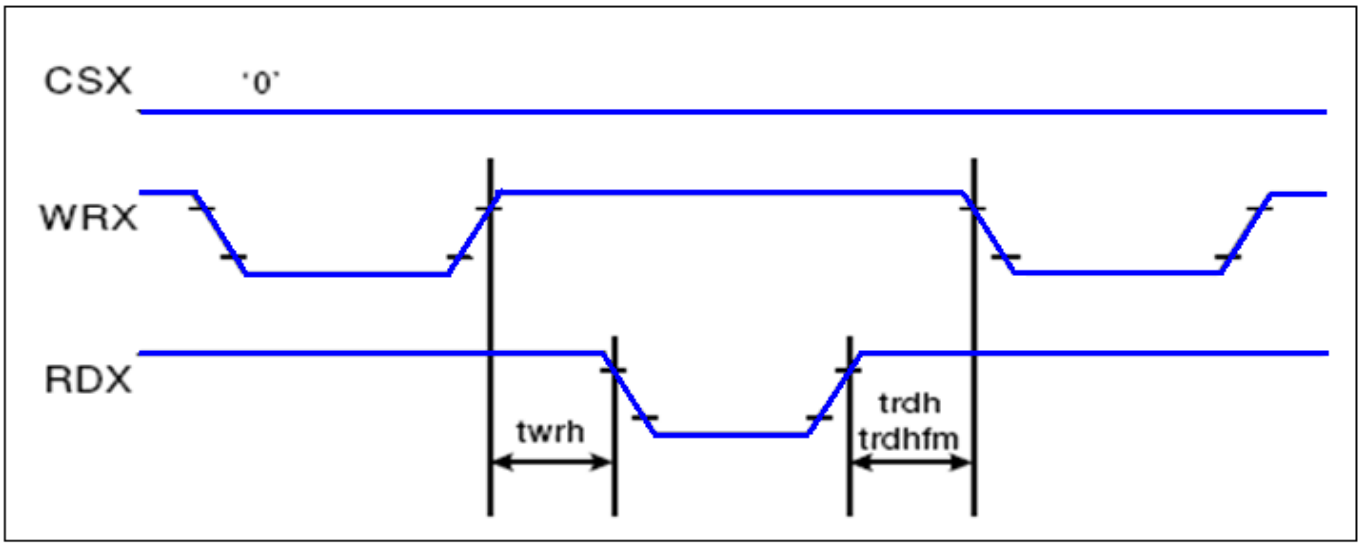
Table 6.3: 8080 System Parallel Interface Characteristics

CSX timings:

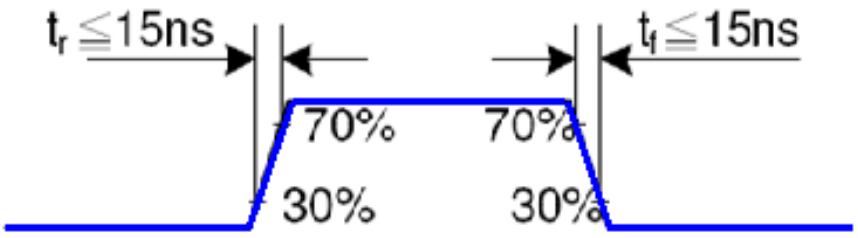


Note: Logic high and low levels are specified as 30% and 70% of IOVCC for input signals.

Write to read or read to write timings:



Note: Ta = -30 to 70 C, IOVCC = 1.65V to 2.8V, VCI = 2.5V to 3.3V, GND = 0V.



6.3 Display Serial Interface Characteristics (3-line SPI system)

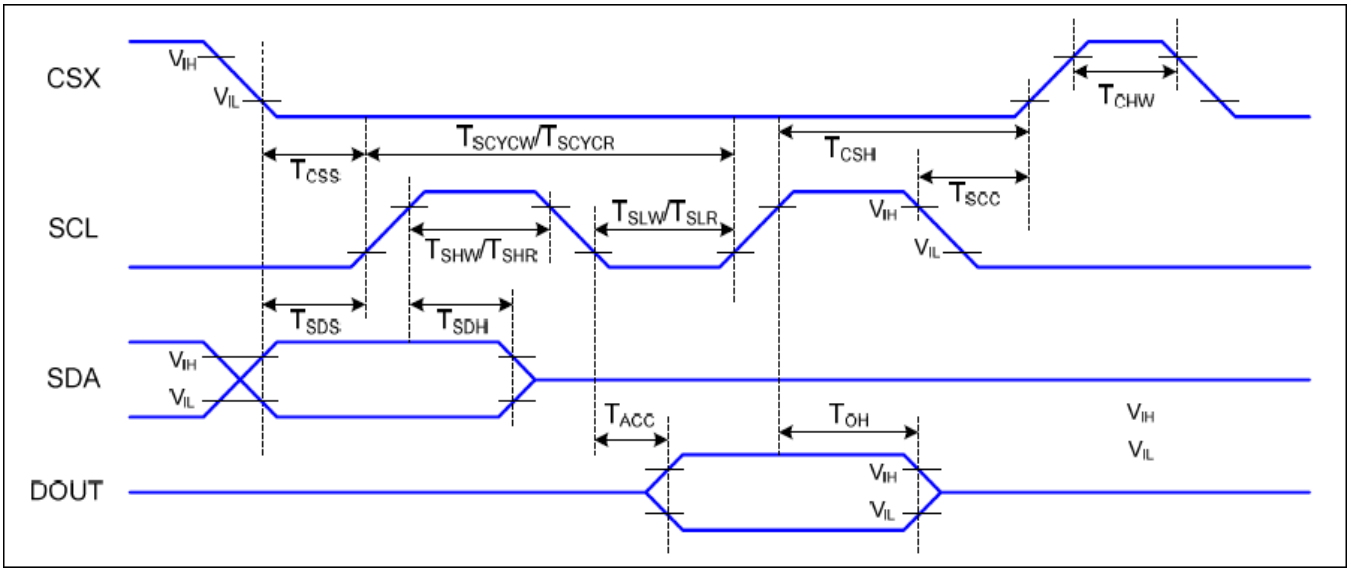


Figure 6.3: 3-line Serial Interface Timing Diagram

VDDI = 1.64 to 3.3V, VDD = 2.4 to 3.3V, AGND=DGND=0V, Ta=-30 to 70 C°

Signal	Symbol	Parameter	Min	Max	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	60		ns	-
	T_{CSH}	Chip select hold time (write)	65		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (write)	150		ns	
	T_{SHW}	SCL "H" pulse width (write)	15		ns	
	T_{SLW}	SCL "L" width (write)	15		ns	
	T_{SCYCR}	Serial clock cycle (read)	150		ns	
	T_{SHR}	SCL "H" pulse width (read)	60		ns	
	T_{SLR}	SCL "L" pulse width (read)	60		ns	
SDA/SDI (Input)	T_{SDS}	Data setup time (write)	10		ns	
	T_{SDH}	Data hold time (Write)	10			
SDA/SDO (Output)	T_{ACC}	Access time (read)	10	50	ns	For max CL=30pF
	T_{OH}	Output disable time (read)	15	50	ns	For min CL=8pF

Table 6.4: 3-line Serial Timing Characteristics

Note: The rising time and falling time (Tr, Tf) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals

6.4 Display Serial Interface Characteristics (4-line SPI serial)

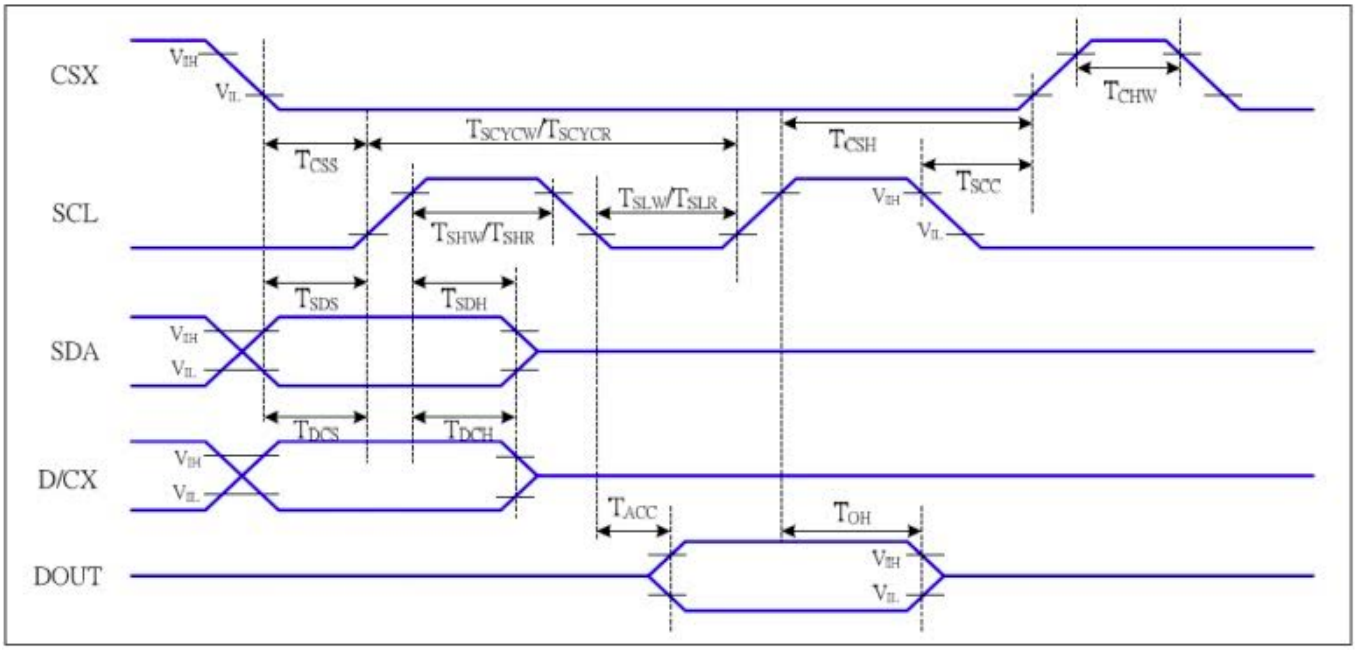


Figure 6.4: 4-line SPI Serial Interface Diagram

Signal	Symbol	Parameter	Min	Max	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (read)	15		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (write)	50		ns	write command & data ram
	T_{SHW}	SCL "H" pulse width (write)	10		ns	
	T_{SLW}	SCL "L" width (write)	10		ns	
	T_{SCYCR}	Serial clock cycle (read)	150		ns	read command & data ram
	T_{SHR}	SCL "H" pulse width (read)	60		ns	
	T_{SLR}	SCL "L" pulse width (read)	60		ns	
D/CX	T_{DCS}	D/CX setup time	10		ns	
	T_{DCH}	D/CX hold time	10		ns	
SDA (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10		ns	
DOUT	T_{ACC}	Access time (read)	10	50	ns	For max CL=30pF For min CL=8pF
	T_{OH}	Output disable time	15	50	ns	

Table 6.5: 4-line Serial Interface Timing Characteristics

Note: The rising time and falling time (Tr, Tf) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

6.5 Reset Timing

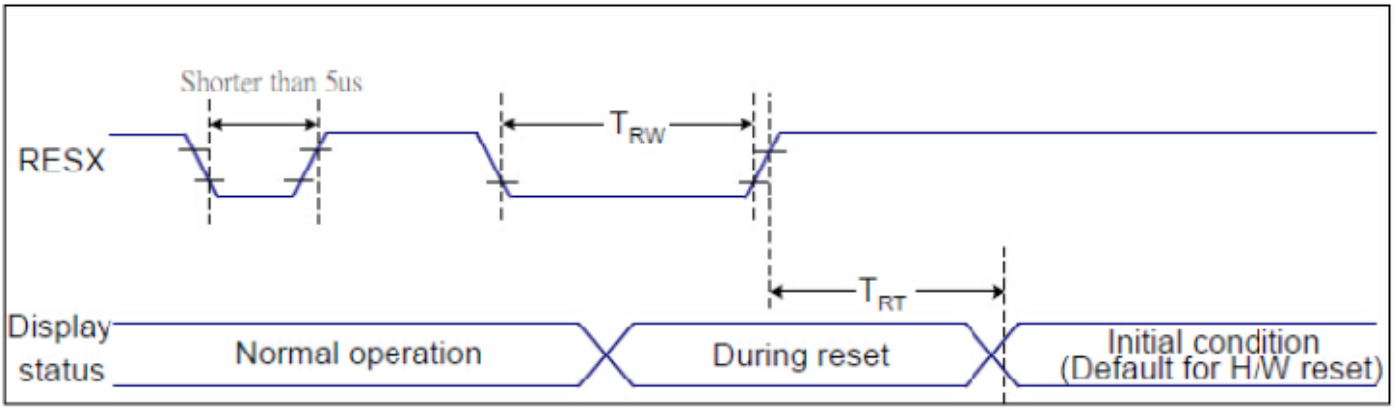


Figure 6.5: Reset Timing Diagram

Related Pins	Symbol	Parameter	Min	Max	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1,5)	ms
				120 (Note 1, 6, 7)	ms

Notes:

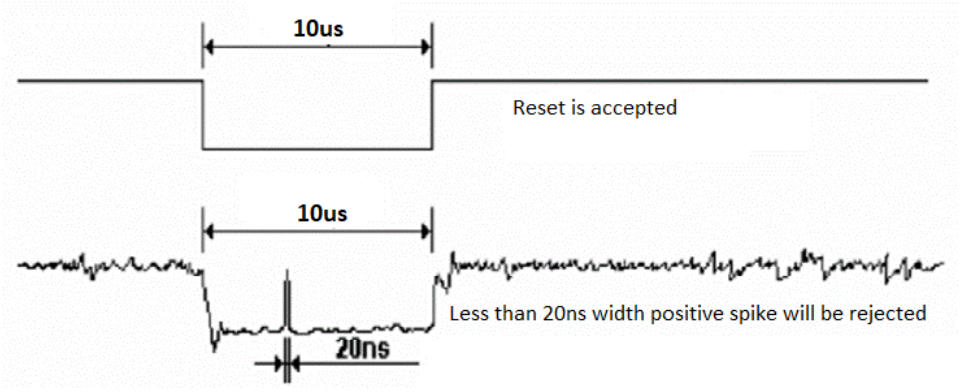
1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5ms after a rising edge of RESX.

2. Spike due to an electrostatic discharge on RESX line does not because irregular system reset according to the table below:

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9 us	Reset starts

3. During the resetting period, the display will be blanked (the display is entering blanking sequence, which maximum time is 120ms, when reset starts in Sleep Out mode. The display remains the blank state in Sleep in mode) and then return to Default condition for Hardware Reset.

4. Spike Rejection also applies during a valid reset pulse as shown below:



5. When Reset applied during Sleep In Mode.
6. When Reset applied during Sleep Out Mode.
7. It is necessary to wait 5ms after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120ms.

7. CTP Specification

7.1 Electrical Characteristics

7.1.1 Absolute Maximum Rating

Item	Symbol	Min	Max	Unit	Note
Power Supply Voltage	VDD	-0.3	3.6	V	1
I/O Digital Voltage	VDDIO	1.8	3.6	V	1
Operating Temperature	T	-20	+70	℃	-
Storage Temperature	T_{ST}	-30	+80	℃	-

Note: If used beyond the absolute maximum ratings, FT6236 may permanently damage. It is strongly recommended that the device be used within the electrical characteristics in normal operations. If exposed to the condition not within the electrical characteristics, it may affect the reliability of the device.

7.1.2 DC Electrical Characteristics (Ta=25℃)

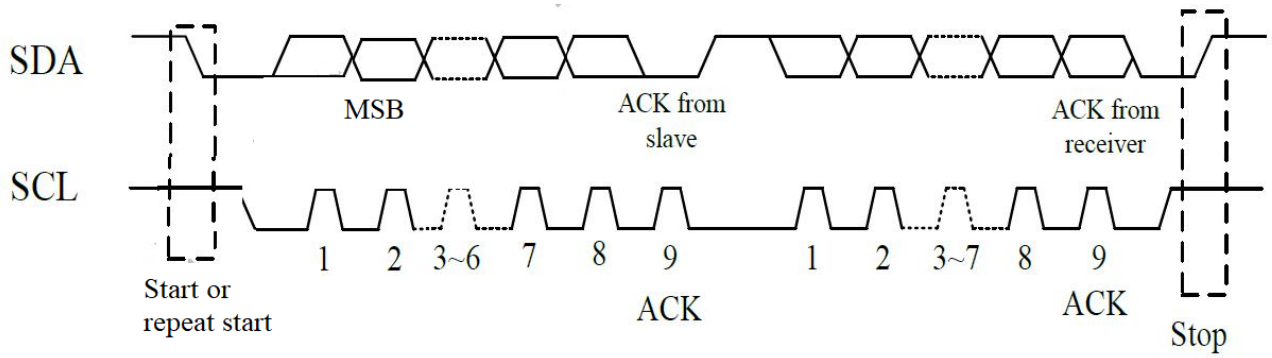
Item	Symbol	Condition	Min	Typ.	Max	Unit	Note
Digital supply voltage	VDD		2.8	3.3	3.6	V	
I/O Digital supply voltage	VDDIO		1.8	3.3	3.6	V	
Normal operation mode current consumption	I_{OPr}	VDD=2.8V Ta=25℃ MCLK=17.5MHz		4		mA	
Monitor mode current consumption	I_{mon}			1.5		mA	
Sleep mode current consumption	I_{sip}			50		uA	
Level input voltage	V_{IH}		0.7VDDIO		VDDIO	V	
	V_{IL}		-0.3		0.3VDDIO	V	
Level output voltage	V_{OH}	I_{OH}=-0.1mA	0.7VDDIO			V	
	V_{OL}	I_{OL}=0.1mA			0.3VDDIO	V	

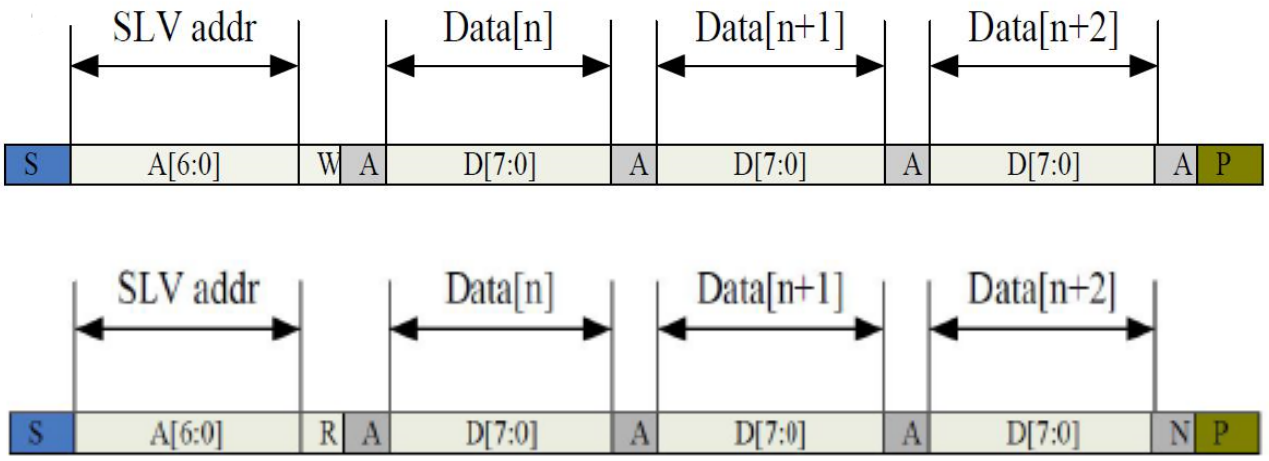
7.1.3 AC Characteristics

Item	Symbol	Test Condition	Min	Typ.	Max	Unit	Note
OSC clock 1	fosc1	VDDA=2.8V; Ta=25℃	34.65	35	35.35	MHz	
Sensor acceptable clock	ftx	VDDA=2.8V; Ta=25℃	0	100	300	kHz	
Sensor output rise time	Ttxr	VDDA=2.8V; Ta=25℃	-	100	-	Ns	
Sensor output fall time	Ttxf	VDDA=2.8V; Ta=25℃	-	80	-	Ns	
Sensor input voltage	Trxi	VDDA=2.8V; Ta=25℃	-	5	-	V	

7.1.4 I2C Interface

The I2C is always configured in the slave mode. The data transfer format is shown below.





The following table lists the meanings of the mnemonics used in the above figures.

Mnemonics	Description
S	I2C start or I2C restart
A [6:0]	Slave address
R/W	Read/Write bit, '1' for read, '0' for write
A(N)	ACK(NACK)
P	Stop: the indication of the end of a packet (if this bit is missing, S will indicate the end of the current packet and the beginning of the next packet)

I2C Interface Timing Characteristics

Parameter	Min	Max	Unit
SCL frequency	10	400	kHz
Bus free time between a stop and start condition	4.7	-	us
Hold time (repeated) start condition	4.0	-	us
Data setup time	250	-	us
Setup time for a repeated start condition	4.7	-	us
Setup time for stop condition	4.0	-	us

8. Cautions and Handling Precautions

8.1 Handling and Operating the Module

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

8.2 Storage and Transportation.

1. Do not leave the panel in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35 ℃ 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.