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

TFT Display Module

Part Number

E144RB-FW400-R

Overview:

- 1.44-inch TFT (32.36x38.0 mm)
- 128(RGB)x128 pixels
- 8/16-bit MCU Interface
- 3/4-line Serial Interface
- Bottom View
- Transmissive/Normally White
- Resistive Touch Panel
- 400 nits
- Controller: ST7735S
- 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, resistive touch panel and backlight unit. The resolution of the 1.44" TFT-LCD contains 128x128 pixels and can display up to 65K colors.

Features

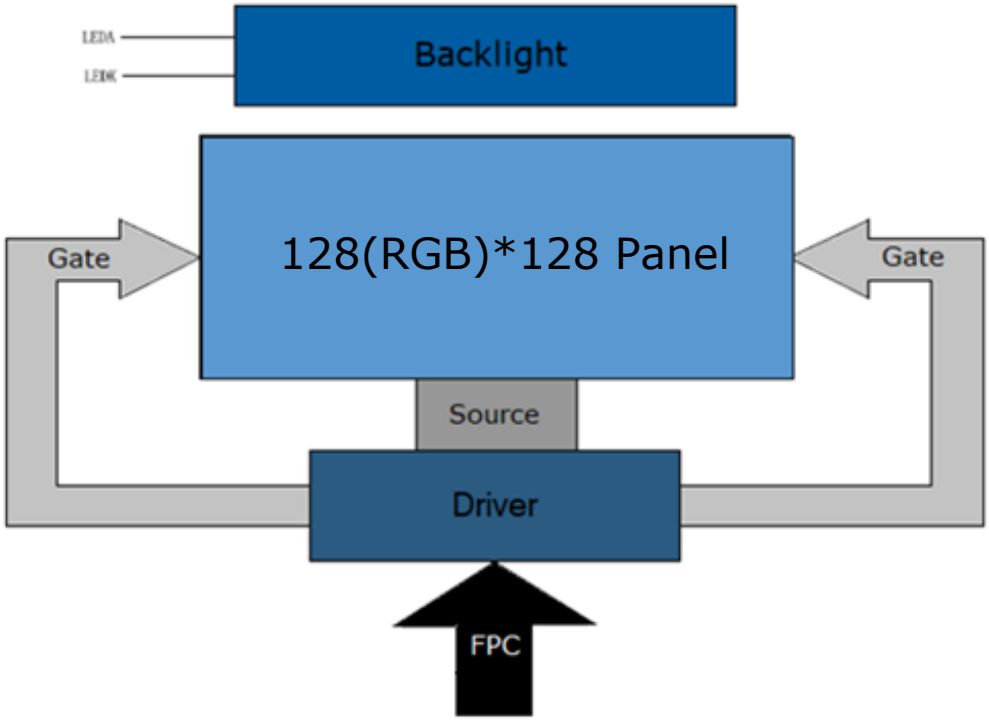
Low Input Voltage: 3.3V (TYP)
Display Colors of TFT LCD: 65K colors
TFT Interfaces: 8/16-bit MCU
3/4-line Serial

General Information Items	Specification Main Panel	Unit	Note
TFT Display area (AA)	25.4976 (H) x 26.496 (V) (1.44 inch)	mm	-
Driver element	TFT active matrix	-	-
Display colors	65K	colors	-
Number of pixels	128(RGB)x128	dots	-
TFT Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.1992 (H) x 0.207 (V)	mm	-
Viewing angle	6:00	o'clock	-
TFT Driver IC	ST7735S	-	-
Display mode	Transmissive/ Normally White	-	-
Operating temperature	-20～+70	℃	-
Storage temperature	-30～+80	℃	-

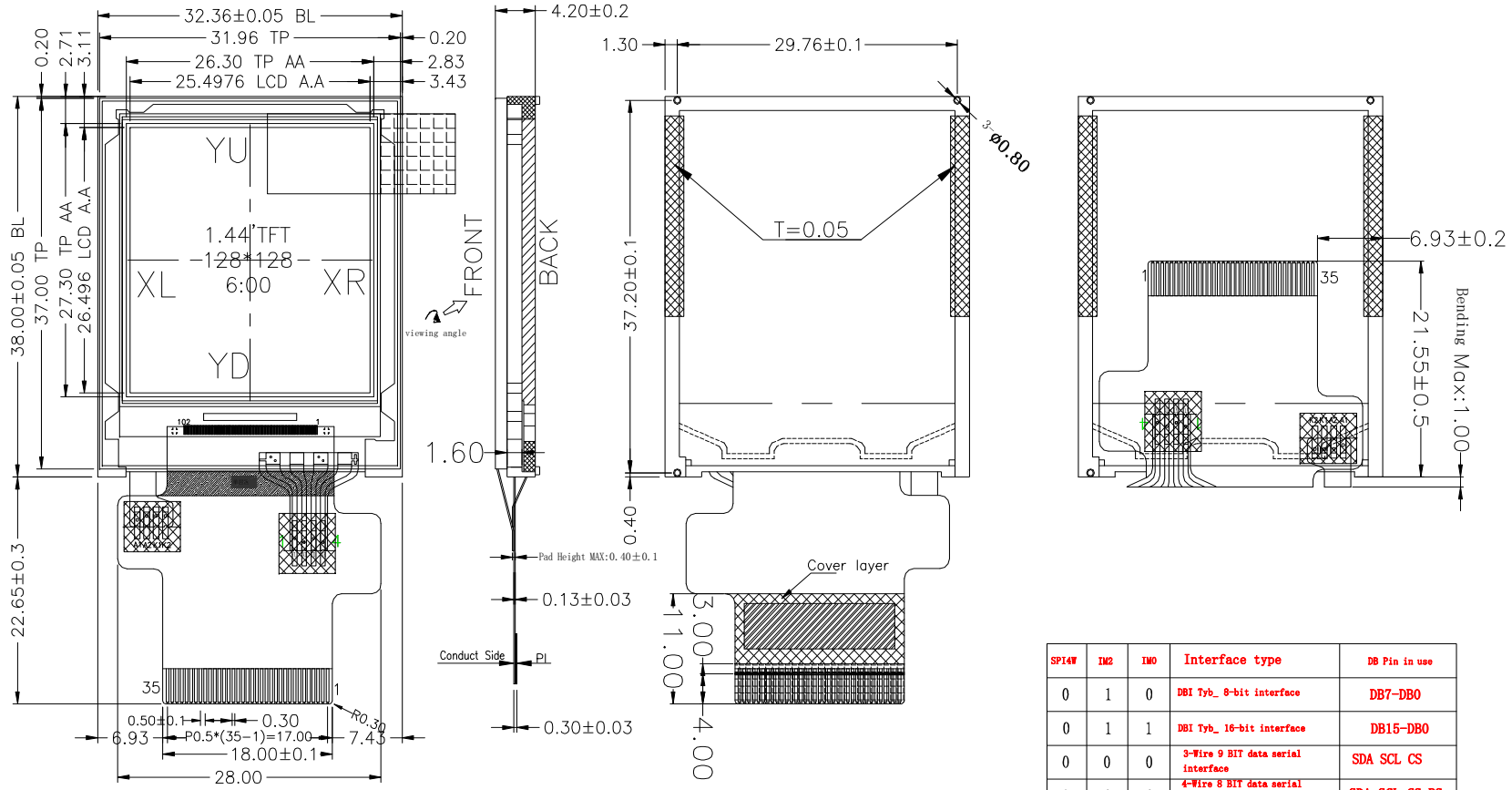
Mechanical Information

Item		Min	Typ.	Max	Unit	Note
Module size	Height (H)		32.36		mm	-
	Vertical (V)		38.0		mm	-
	Depth (D)		4.2		mm	-
Weight			TBD		g	-

1. Block Diagram



2. Outline Dimensions



NO.	PIN NAME
1	YU
2	XL
3	YD
4	XR
5	GND
6	VCC
7	IOVCC
8	IM0
9	IM2
10	SPI4W
11	DB15
12	DB14
13	DB13
14	DB12
15	DB11
16	DB10
17	DB09
18	DB08
19	DB07
20	DB06
21	DB05
22	DB04
23	DB03
24	DB02
25	DB01
26	DB0(SPI-SDA)
27	RD
28	RS(SPI-SCL)
29	RESET
30	CS
31	WR(SPI-RS)
32	LEDK1
33	LEDK2
34	LEDA1
35	LEDA2

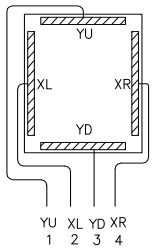
SPI4W	IM2	IM0	Interface type	DB Pin in use
0	1	0	DBI Tyb_ 8-bit interface	DB7-DB0
0	1	1	DBI Tyb_ 16-bit interface	DB15-DB0
0	0	0	3-Wire 9 BIT data serial interface	SDA SCL CS
1	0	0	4-Wire 8 BIT data serial interface	SDA SCL CS RS

NOTE:
1. If not use PIN, fix to the GND , IOVCC or NC.

Notes:TP FPC AND HR4 8878 2.2 SHARED

NOTES:

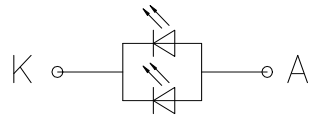
1. DISPLAY TYPE: 1.44", TFT-LCD
2. DISPLAY MODE: T/N NORMALLY WHITE
3. VIEWING DIRECTION: 6:00
4. DRIVER IC: ST7735S (COG)
5. VCI: 2.8-3.3V(TYP),IOVCC=1.8V-3.3V
6. OPERATING TEMP: -20°C TO 70°C
   STORAGE TEMP: -30°C TO 80°C
7. BACK LIGHT: LED WHITE, 2 LED, 40mA, 3.2±0.3V,LV Min:400cd/m2
8. RoHS COMPLIANT.



Trace Diagram

Pin NO:	Assignment
1	YU
2	XL
3	YD
4	XR

Logic Diagram



ReV.	Revision content description	Date
V0	FIRST	2016/08/05

FOCUS LCDs
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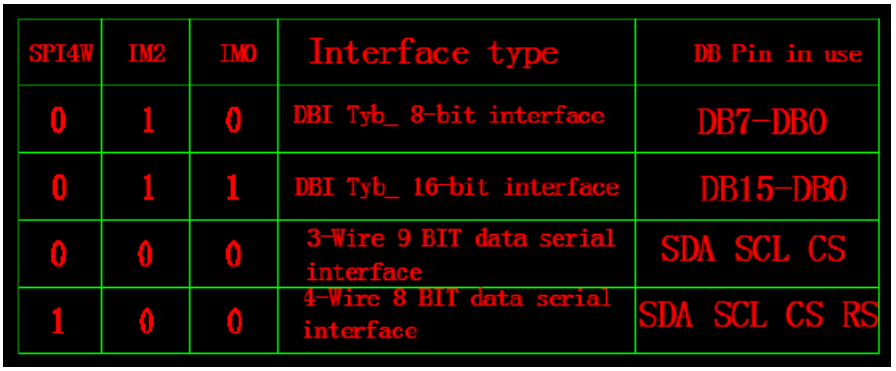
TOLERANCE( )	DRAWING NAME	E144RB-FW400-R	
	PARTS NO.		
TOLERANCE UNLESS OTHERWISE SPECIFIED X.X±0.3 X.XX±0.2	Drawn		Unit
	Checked		mm
Scale 1:1	Approve		Page 1/1

3. Input Terminal Pin Assignment

Recommended TFT Connector: FH12-35S-0.5SH(55) | Recommended RTP Connector: FH33-4S-1SH(10)

TFTNO.	Symbol	Description	I/O
1	YU	Touch panel top film terminal	A/D
2	XL	Touch panel left glass terminal	A/D
3	YD	Touch panel bottom film terminal	A/D
4	XR	Touch panel right glass terminal	A/D
5	GND	Ground	P
6	VCC	Supply voltage (3.3V)	P
7	IOVCC	Supply voltage (1.65-3.3V)	P
8	IM0	MCU Parallel Interface Type selection	I
9	IM2		
10	SPI4W		
11-25	DB15-DB1	DB[15:1] are used as MCU parallel interface data bus. In serial interface, D[15:1] are not used and should be fixed at VsDDI or DGND level	I/O
26	DB0 (SPI-SDA)	DB0 is the serial input/output signal in serial interface mode	I/O
27	RD	Read enable in 8080 MCU parallel interface If not used, fix to VDDI or DGND	I
28	RS (SPI-SCL)	Display data/command selection pin in MCU interface D/CX='1': Display data or parameter D/CX='0': Command data In serial interface, this is used as SCL If not used fix to VDDI or DGND	I
29	RESET	Reset signal of device. Must be applied to properly initialize the chip. Signal is active low	I
30	CS	Chip select pin. Low enable.	I
31	WR (SPI-RS)	Write enable in MCU parallel interface. In 4-line SPI, this pin is used as D/CX (data/command selection) If not used pin to VDDI or DGND	I
32	LEDK1	Cathode pin of backlight	P
33	LEDK2	Cathode pin of backlight	P
34	LEDA1	Anode pin of backlight	P
35	LEDA2	Anode pin of backlight	P

I: Input, O: Output, P: Power

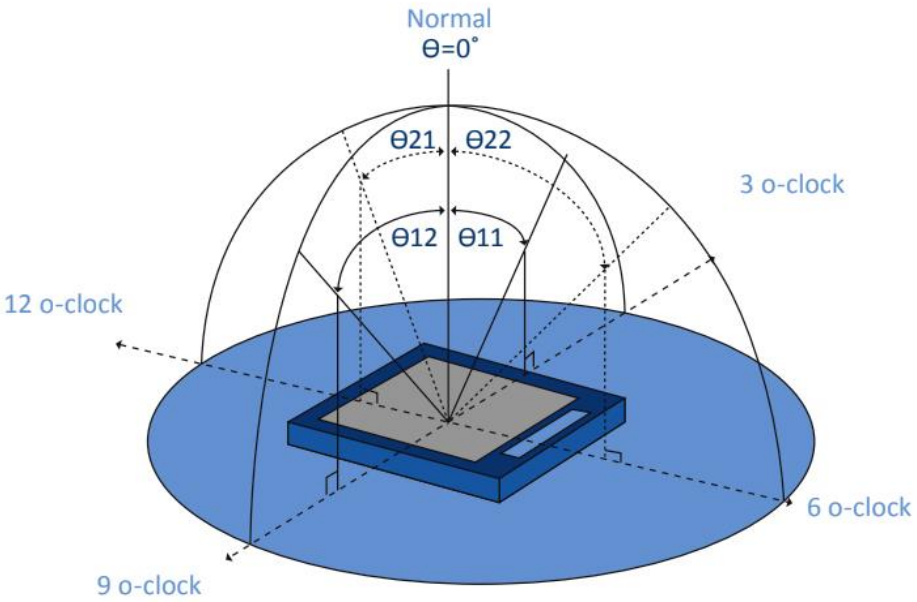
4. LCD Optical Characteristics

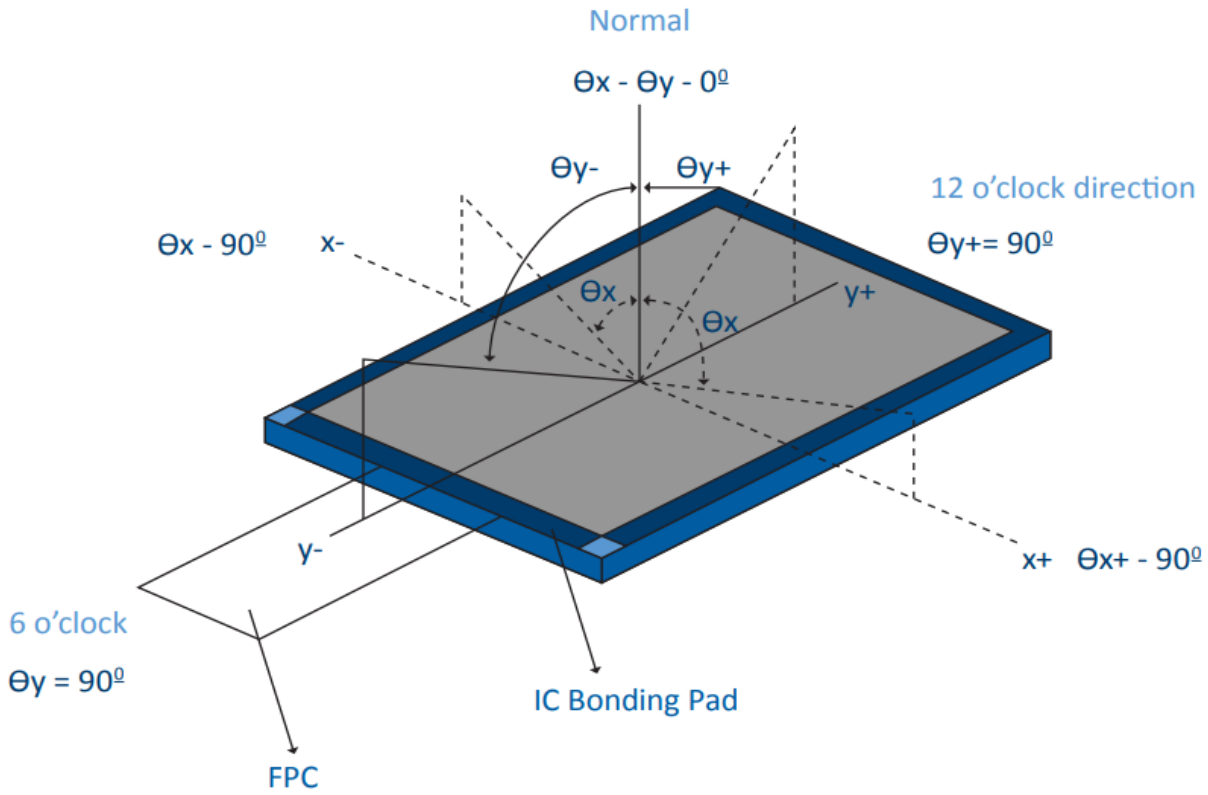
4.1 Optical Specifications

Item		Symbol	Condition	Min	Typ.	Max	Unit	Note
Contrast Ratio		CR	θ=0 Normal viewing angle	--	300	--	%	(2)
Color Filter Chromaticity	White	W_X		0.285	0.305	0.325		(5)(6)
		W_Y		0.314	0.334	0.354		
	Red	R_X		0.588	0.608	0.628		
		R_Y		0.296	0.316	0.336		
	Green	G_X		0.285	0.305	0.325		
		G_Y		0.536	0.556	0.576		
	Blue	B_X		0.115	0.315	0.155		
		B_Y		0.117	0.137	0.157		
Viewing angle	Hor.	ΘL	CR≥10	--	60	--	degree	(1)(6)
		ΘR		--	60	--		
	Ver.	ΘT		--	30	--		
		ΘB		--	60	--		
Option View Direction		6:00						(1)

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.

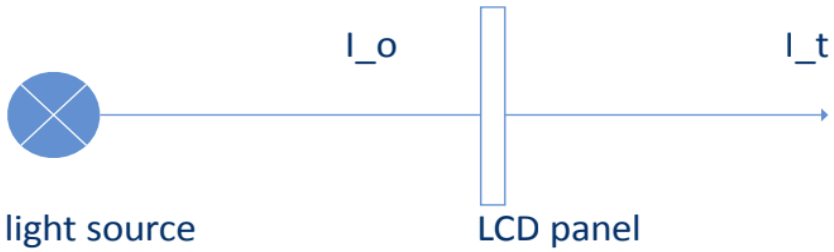




(2) Definition of Contrast Ratio (Cr): measured at the center point of panel. The contrast ratio (Cr) measured on a module, is the ratio between the luminance (Lw) in a full white area (R=G=B=1) and the luminance (Ld) in a dark area (R=G=B=0).

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

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

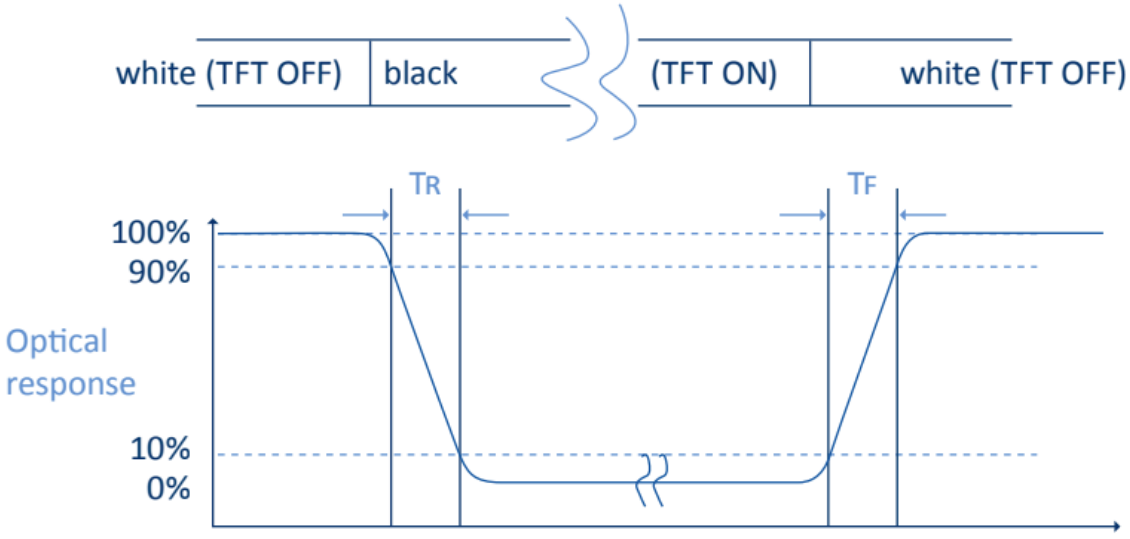


The transmittance is defined as:

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

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.

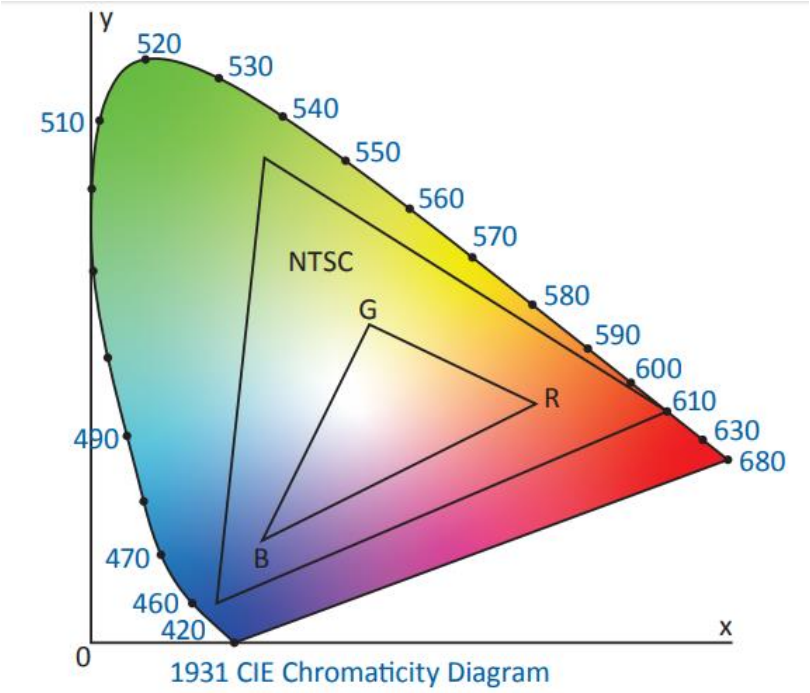
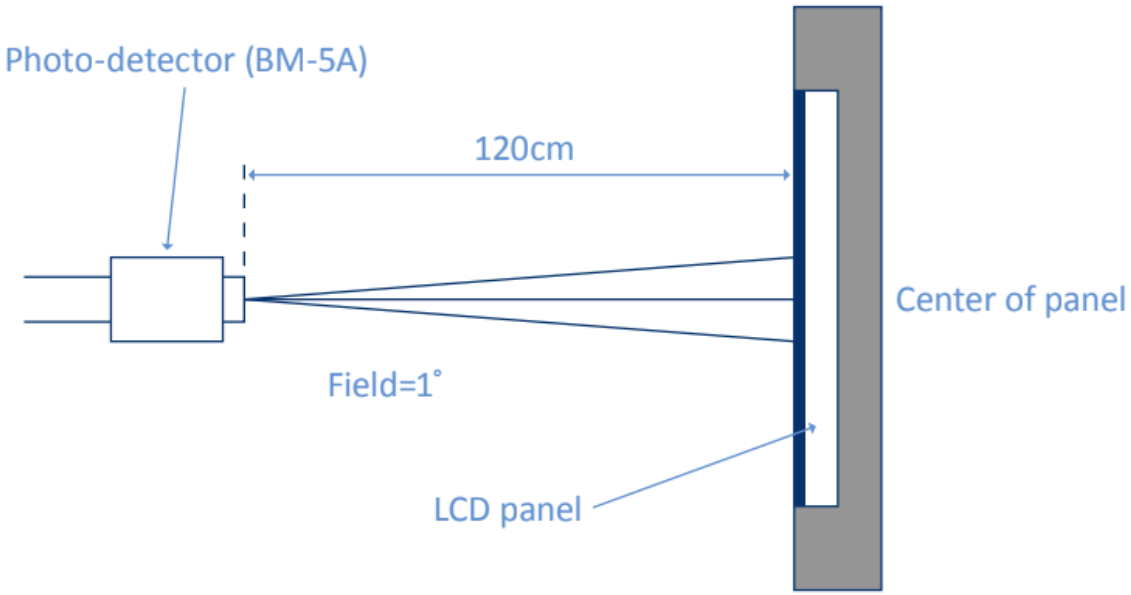


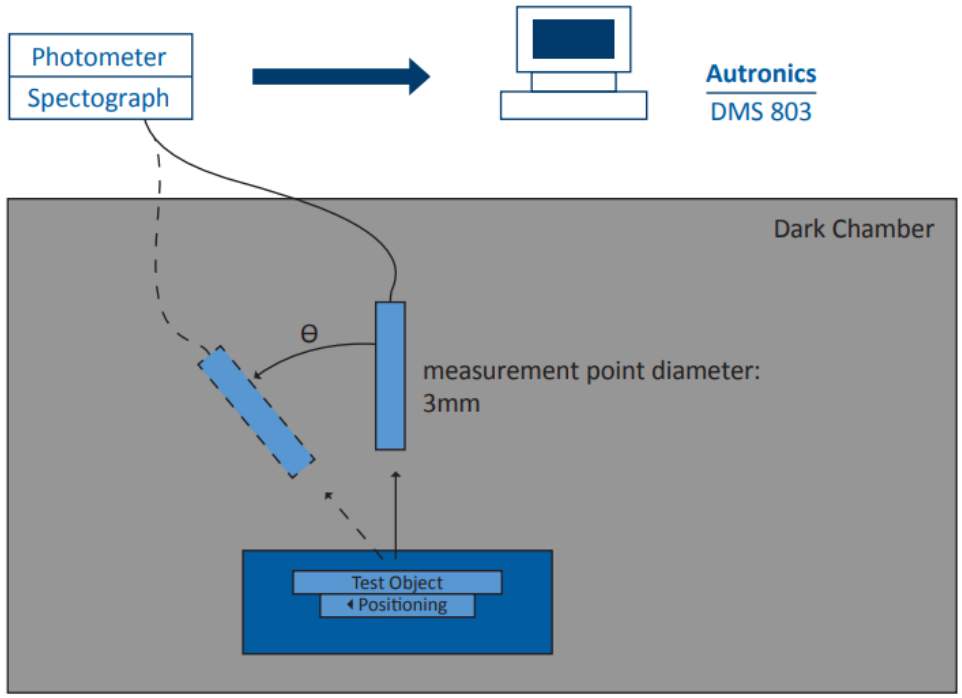
Fig. 1931 CIE chromacity diagram

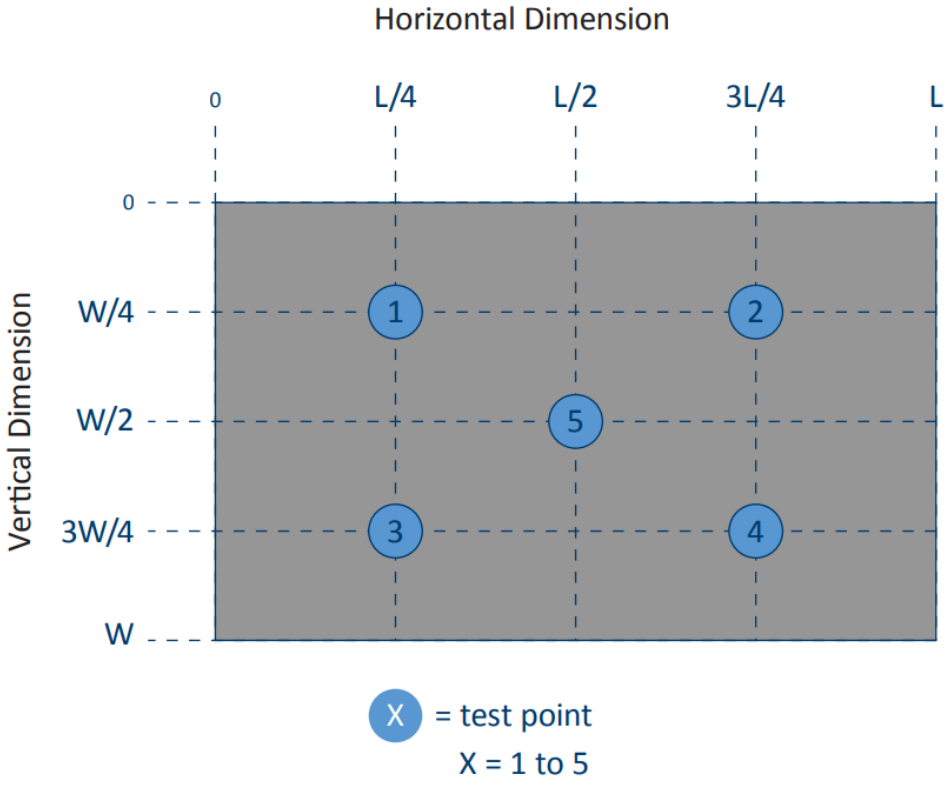
$$\text{Color gamut: } S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$

(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. TFT Electrical Characteristics

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

Characteristics	Symbol	Min	Max	Unit
Digital Supply Voltage	VCc	-0.3	4.8	V
Digital Interface Supply Voltage	IOVCC	-0.3	4.6	V
Operating Temperature	TOP	-20	+70	℃
Storage Temperature	TST	-30	+80	℃

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

5.2 DC Electrical Characteristics

Characteristics	Symbol	Min	Typ.	Max	Unit	Note
Digital Supply Voltage	VCC	2.5	2.8/3.3	4.8	V	
Digital Interface Supply Voltage	IOVCC	1.65	1.8	3.3	V	
Normal Mode Current Consumption	IDD	--	1.2	--	mA	
Level Input Voltage	VIH	0.7IOVCC	--	IOVCC	V	
	VIL	GND	--	0.3IOVCC	V	
Level Output Voltage	VOH	0.8IOVCC	--	IOVCC	V	
	VOL	GND	--	0.2IOVCC	V	

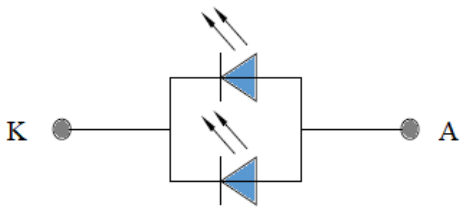
5.3 LED Backlight Characteristics

The backlight system is edge lighting type with 2 chips LED.

Item	Symbol	Min	Typ.	Max	Unit	Note
Forward Current	IF	30	40	--	mA	
Forward Voltage	VF	--	3.2	--	V	
LCM Luminance	LV	380	--	--	cd/m2	Note 3
LED lifetime	Hr	50000	--	--	hour	Note1 & 2
Uniformity	AVg	80	--	--	%	Note 3

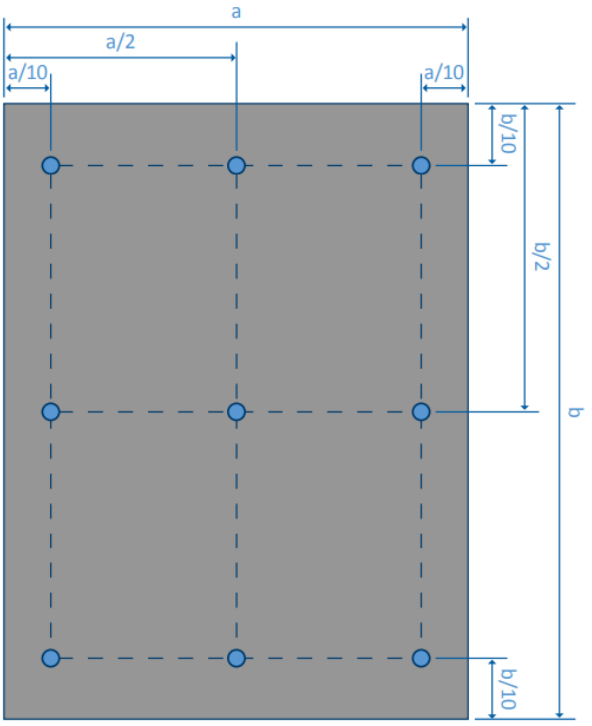
Note 1: LED lifetime (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25 ±3 ℃, typical IL value indicated in the above table until the brightness becomes less than 50%.

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



Backlight LED Circuit

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



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

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

6. AC Electrical Characteristic

6.1 8080 System MCU Parallel Interface Characteristics: 8/16-bit Bus

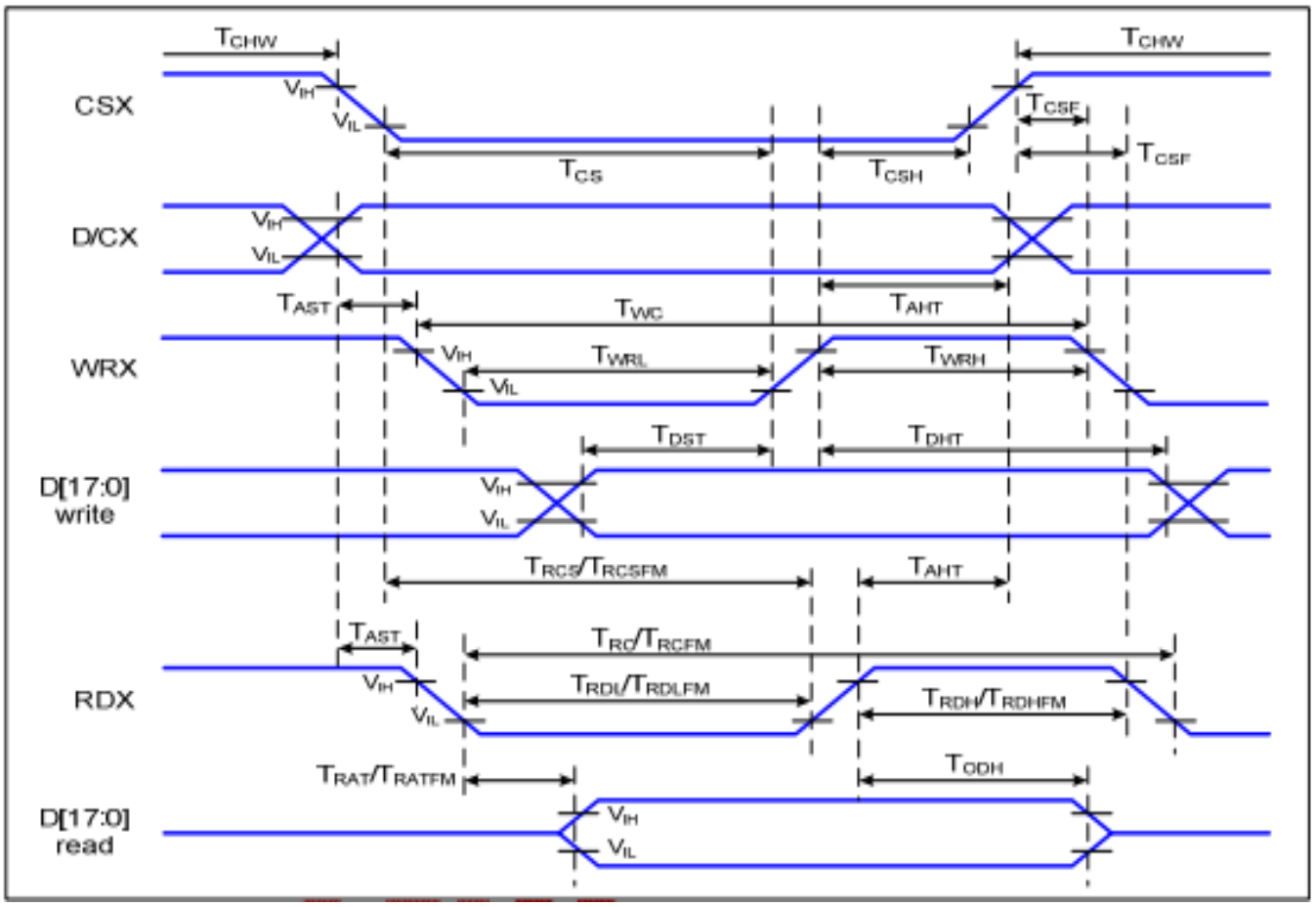
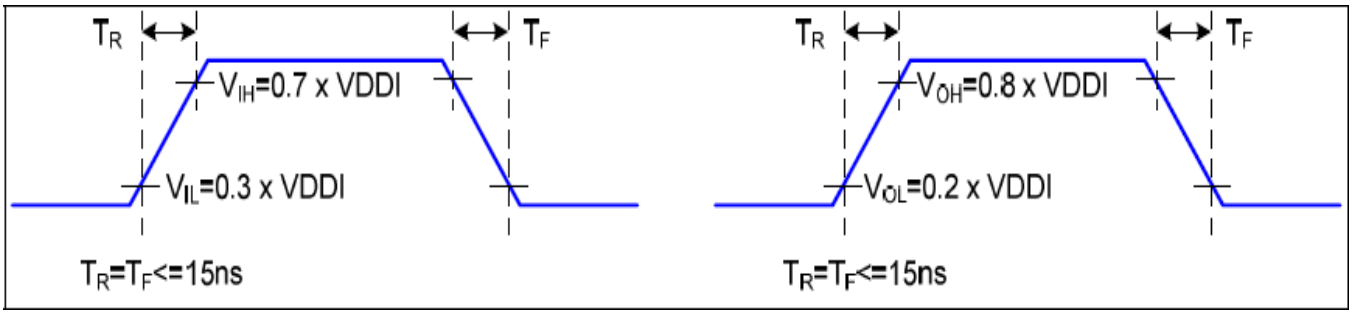


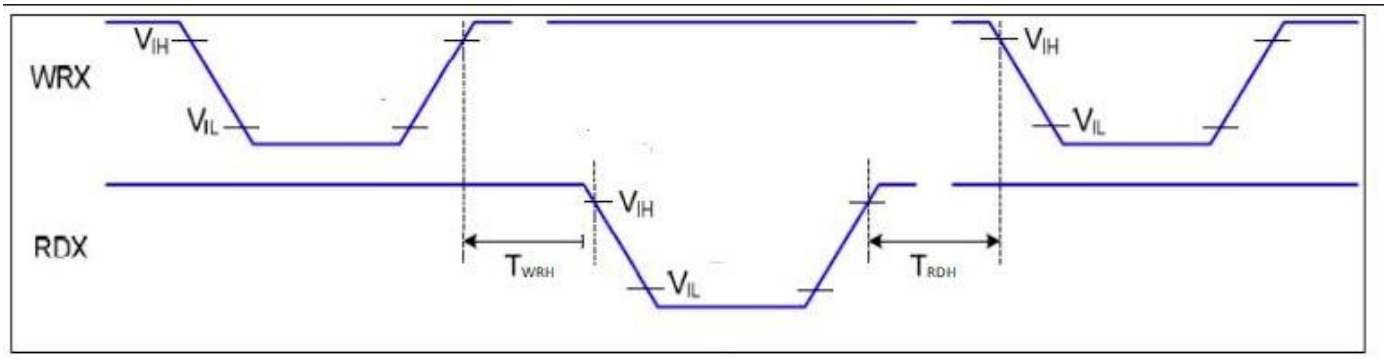
Figure 6.1: Parallel Interface Timing Characteristics (8080-Series MCU Interface)



Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	T_{AST}	Address setup time	0		ns	-
	T_{AHT}	Address hold time (Write/Read)	10		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)	10		ns	
	T_{CSH}	Chip select hold time	10		ns	
WRX	T_{WC}	Write cycle	66		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[17:0],	T_{DST}	Data setup time	10		ns	For max CL=30pF For min CL=8pF
	T_{DHT}	Data hold time	10		ns	
	T_{RAT}	Read access time (ID)		40	ns	
	T_{RATFM}	Read access time (FM)		340	ns	
	T_{ODH}	Output disable time	20	80	ns	

Table 6.3: 8080 Series MCU Parallel Timing Characteristics

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



6.2 Display Serial Interface Characteristics (3-line serial)

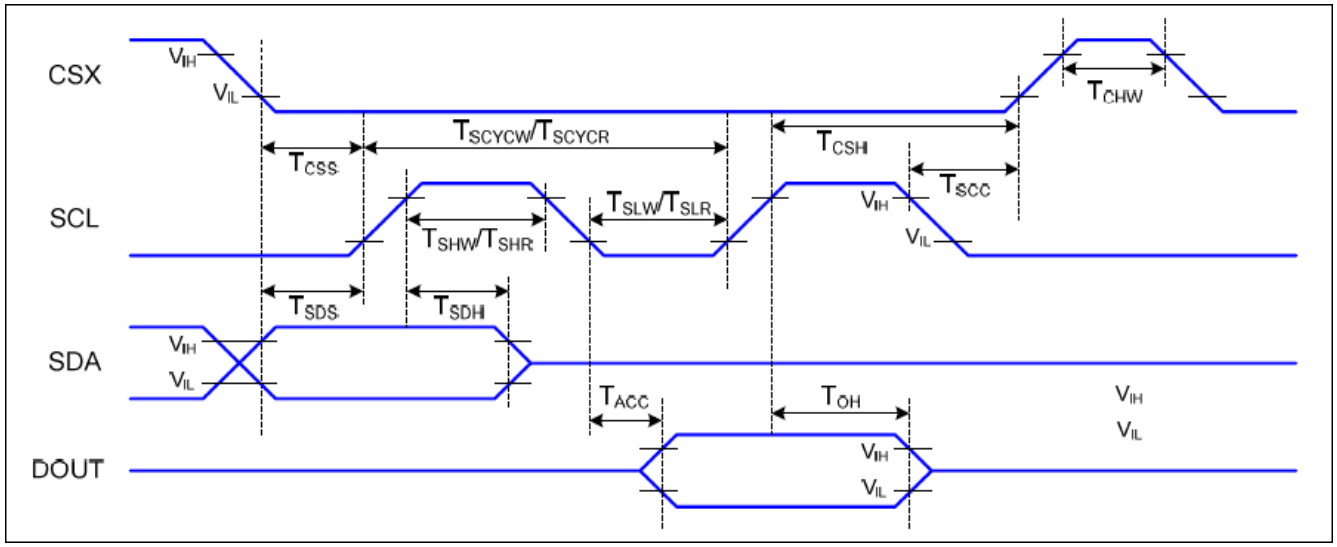


***Figure 6.2: Serial Interface* 3-SPI Timing Diagram**

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)	15		ns	-
	T_{CSH}	Chip select hold time (write)	15		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)	66		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 (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10			
DOUT	T_{ACC}	Access time	10	50	ns	For max CL=30pF For min CL=8pF
	T_{OH}	Output disable time	15	50		

Table 6.2: 3-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

6.3 Serial Interface Characteristics (4-line serial)

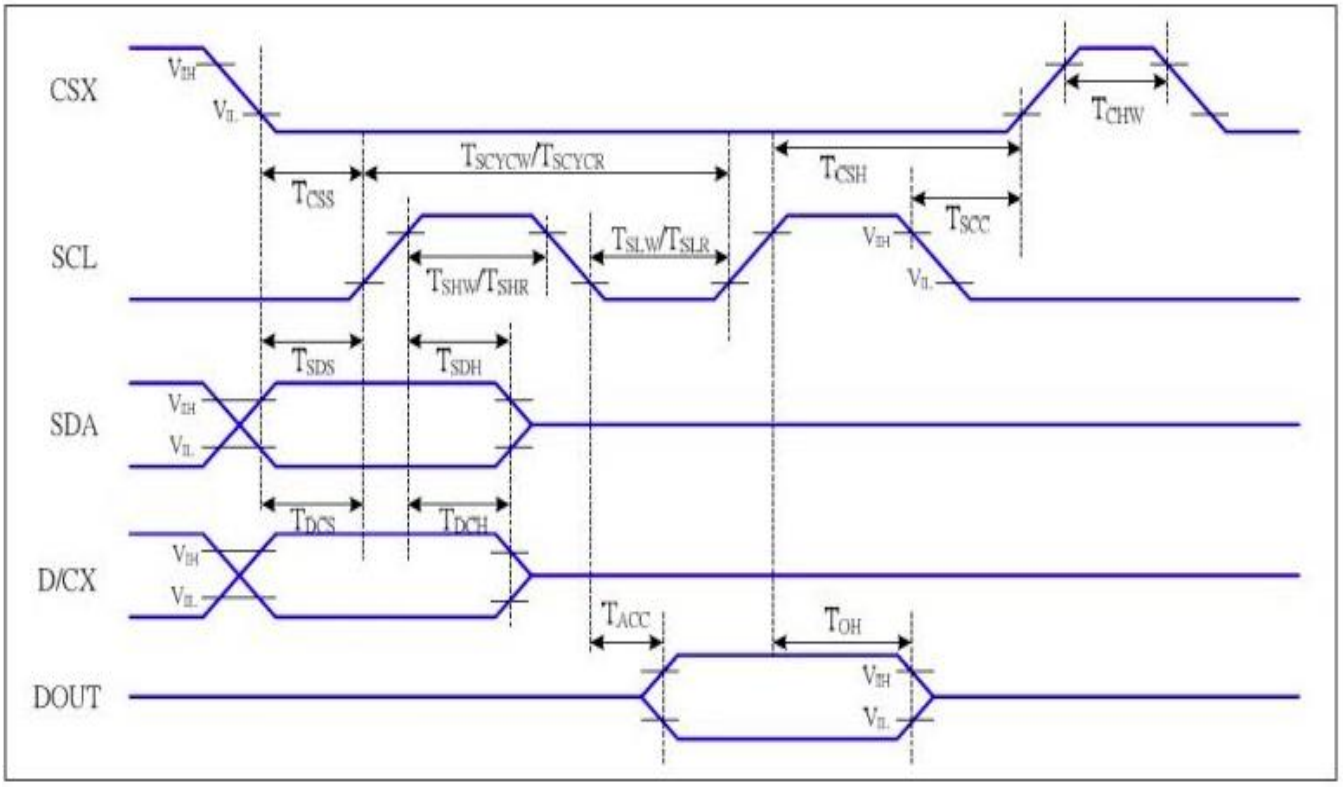


Figure 6.3: Serial Interface **4-SPI Timing Diagram**

Signal	Symbol	Parameter	Min	Max	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		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)	66		ns	write command & data ram
	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	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	10	50	ns	For max CL=30pF
	T_{OH}	Output disable time	15	50	ns	For min CL=8pF

Table 6.3: 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.

6.4 Reset Timing

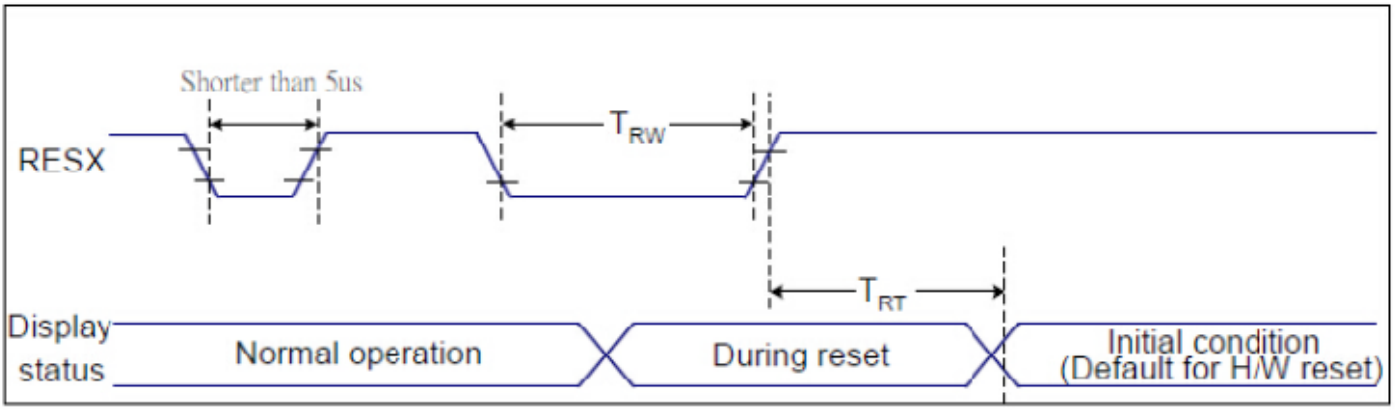


Figure 6.4: Reset Timing

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:

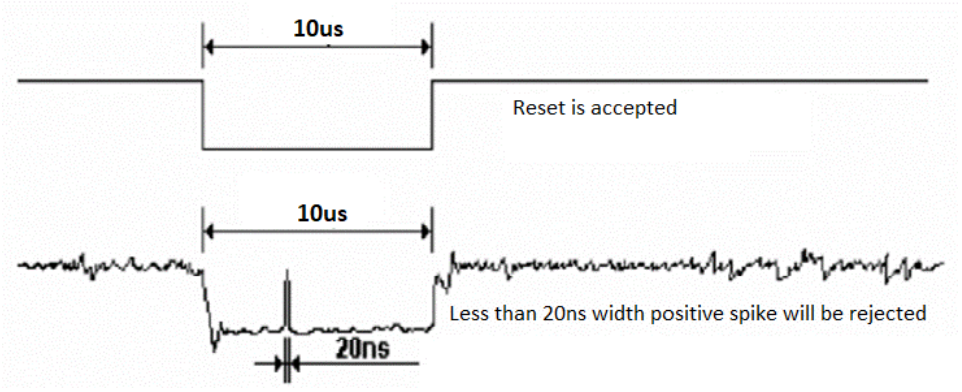
1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5ms after a rising edge of RESX.

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.

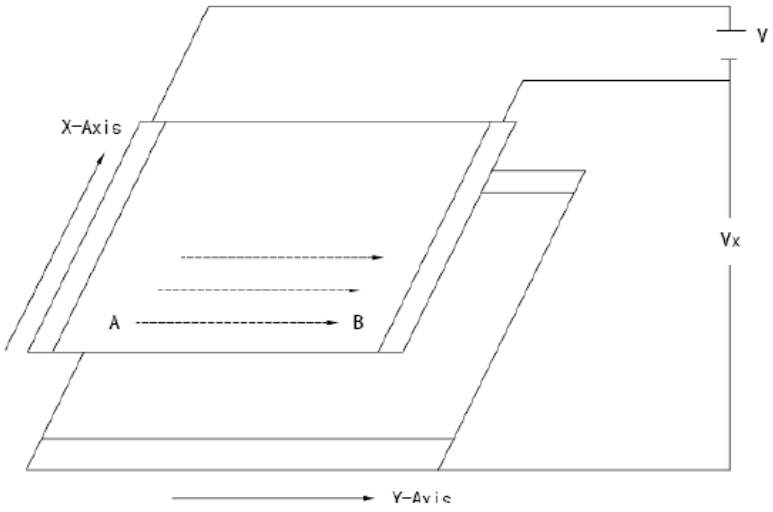
7. TP Feature

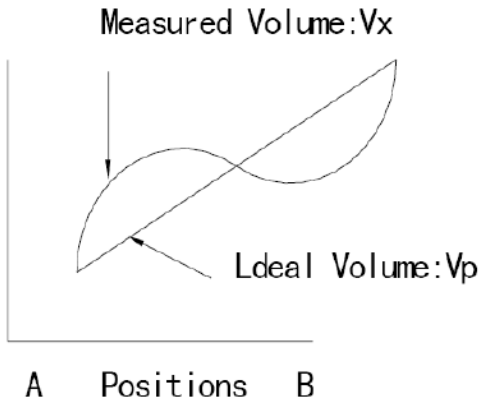
7.1 Conditions of Use and Storage

Item	Condition	Note
Temperature range upon operation	Humidity: 20%-90% non-dew, condensation -20℃~70℃	In a simple substance
Temperature range upon storage	Humidity: 20%-90% non-dew, condensation -30℃~80℃	In a simple substance

7.2 Electrical Property

Item	Value	Note
Maximum voltage	DC 5V	
Resistance between terminal	X direction (film side): 200-600 Ω	
	Y direction (glass side): 300-900 Ω	
Insulation resistance	DC 25V, 20MΩ or above	Connect X + ~X and Y+ ~Y, apply 25V DC Between X and Y for perform measurements
Chattering	10ms or below	
Rating	Voltage is 5V DC	





7.3 Mechanical Property

Item	Value		Note
Input method	Used of an exclusive pen or finger		
Load upon operation	Exclusive pen	60-100g or below	Operation and measurement with a pen must be carried out under the following tip conditions: Stylus pen material: POM (ployacetal) Tip: Diameter 3.0mm, SR 0.8 mm
	Finger	60-100g or below	Operation and measurement with a pen must be carried out under the following tip conditions: Stylus pen material: Silicon rubber (Hardness: 30°Hs) Tip: Diameter 12.0mm, SR 12.5 mm
Surface hardness	Pencil hardness: 3H or above		It complies with the way of test method JIS K5400

7.4 Optical Property

Item	Performance	Note
Total light transmittance	80% or above	JIS K7105
Haze	5% or below	JIS K7136
Film specification	Polished type with hard coated surface	

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.