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

## TFT Display Module

Part Number

E18RG42432LBAM300-R

### Overview:

- 1.8-inch TFT: 240x320 (34.7x46.7)
- 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
- Resistive Touch Panel
- 300 NITS
- Controller: ST7789V
- 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, back-light unit. The resolution of a 1.8" 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: 65Kcolors

TFT Interface:

8/9/16/18Bit MCU

3/4SPI+16/18Bit RGB

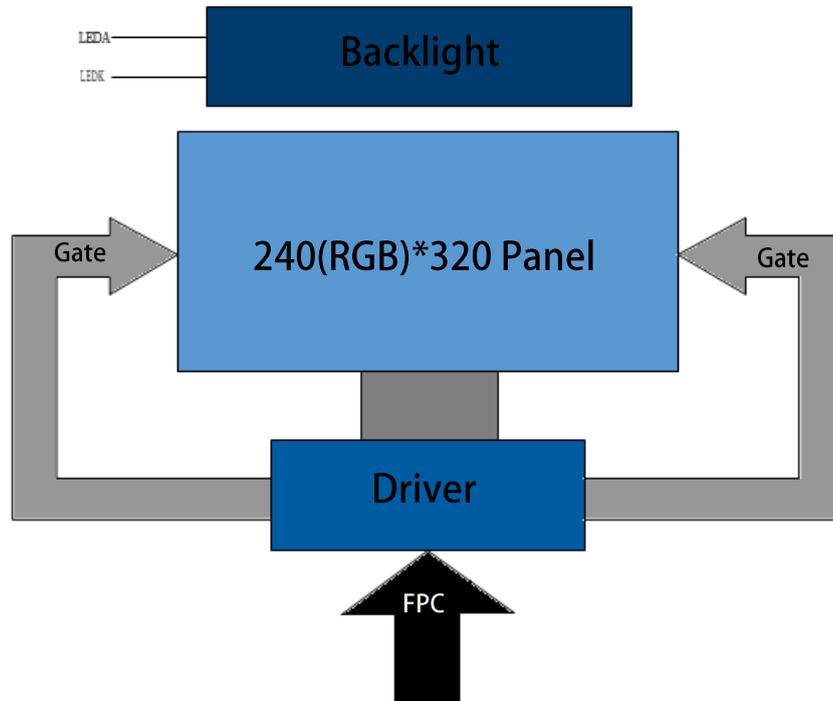
3-line/4-line Serial Interface

General Information Items	Specification	Unit	Note
	Main Panel		
Display area (AA)	26.64(H) *35.52(V) (1.8 inch)	mm	-
Driver element	TFT active matrix	-	-
Display colors	65K/262K	colors	-
Number of pixels	240(RGB)*320	dots	-
TFT Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.111 (H) x 0.111 (V)	mm	-
Viewing angle	FREE	o'clock	-
TFT Controller IC	ST7789V	-	-
Display mode	Transmissive/Normally Black	-	-
Operating temperature	-20~+70	°C	-
Storage temperature	-30~+80	°C	-

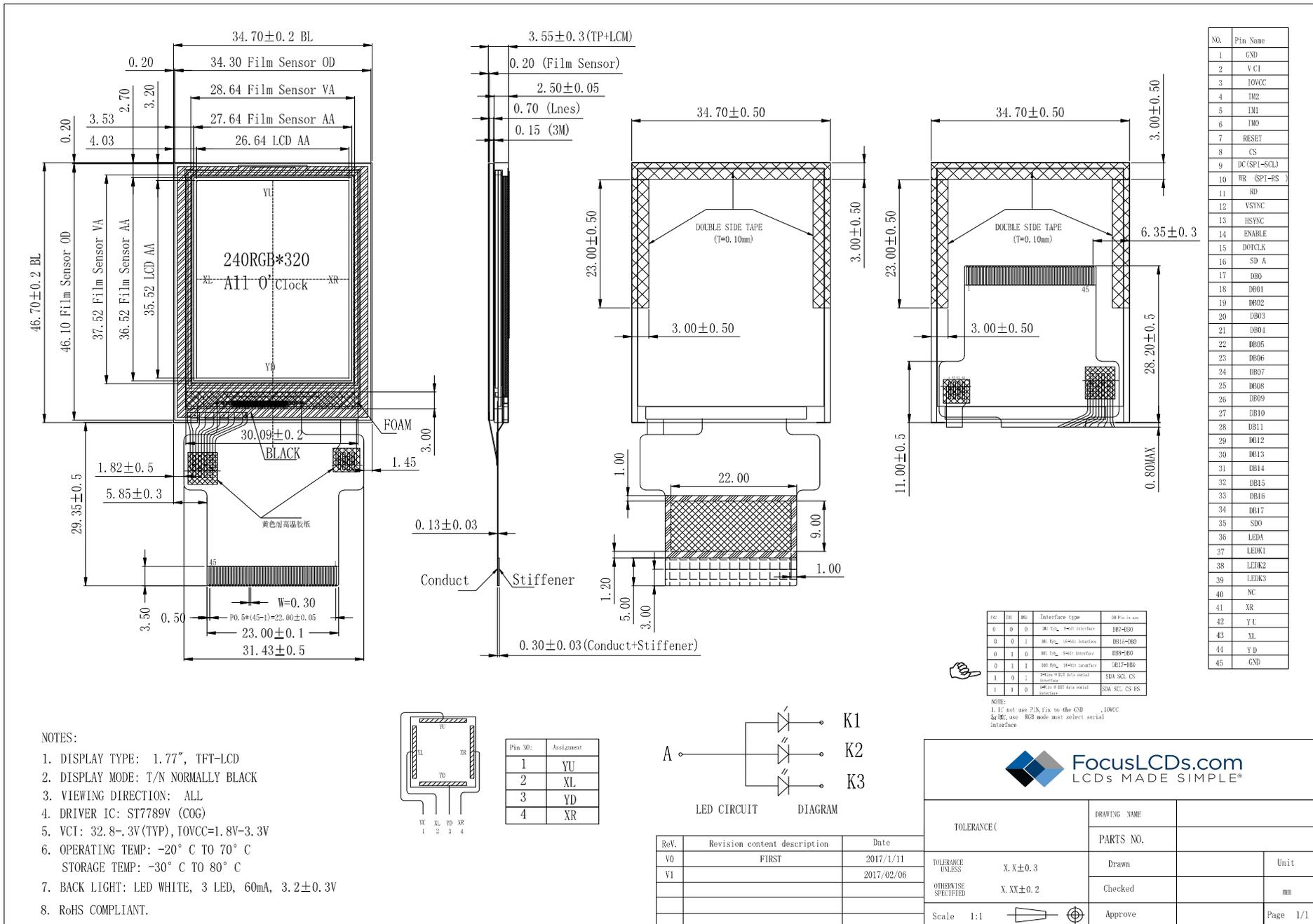
## Mechanical Information

Item		Min	Typ.	Max	Unit	Note
Module size	Horizontal(H)		34.7		mm	-
	Vertical(V)		46.7		mm	-
	Depth(D)		3.55		mm	-
Weight			TBD	TBD	g	-

## 1. Block Diagram



## 2. Outline dimensions



### 3. Input Terminal Pin Assignment

Recommended TFT Connector: FH12S-45S-0.5SH(55) | Recommended RTP Connector: FH33-4S-1SH(10)

No.	Symbol	Description	I/O
1	GND	Ground.	P
2	VCI/VCC	Supply voltage (3.3V).	P
3	IOVCC	Supply voltage (1.65-3.3V).	P
4	IM2	Interface selecting signal.	I
5	IM1		I
6	IM0		I
7	RESET	Reset signal. Must be applied to properly initialize the chip.	I
8	CS	Chip select input pin ("Low" enable). Fix at VCI or GND when not in use.	I
9	DC(SPI-SCL)	Display data/command selection pin in parallel interface. This pin is used to be serial interface clock. DC='1': display data or parameter. DC='0': command data. If not used, please fix this pin at VDDI or DGND.	I
10	WR(SPI-RS)	Write enable in MCU parallel interface. Display data/command selection pin in 4-line serial interface. Second Data lane in 2 data lane serial interface. If not used, please fix this pin at VDDI or DGND.	I
11	RD	Read signal and MCU read data at rising edge. Fix to VCI or GND when not used.	I
12	VSYNC	Frame synchronous signal. Low active. Connect to GND when DPI is not selected.	I
13	HSYNC	Line synchronous signal. Low active. Connect to GND when DPI is not selected.	I
14	ENABLE	Data enable signal in DPI operation. Low: Select (Accessible) High: Not select (Inaccessible) Connect to GND when DPI is not selected.	I
15	DOTCLK	Pixel clock signal. The data input timing is set on the rising edge. Connect to GND when DPI is not selected.	I
16	SDA	Serial data input/output in DBI type C operation.	I
17-34	DB0-DB17	Data bus. Connect to GND when not used.	P
35	TE	Tearing effect output pin synchronize MPU to frame writing. Activated by S/W command. When not activated, pin is low.	O
36	LEDA	Anode pin of backlight	P
37	LEDK1	Cathode pin of backlight	P
38	LEDK2	Cathode pin of backlight	P
39	LEDK3	Cathode pin of backlight	P
40	NC	NC	
41	XR	Touch panel right glass terminal	A/D
42	YU	Touch panel top film terminal	A/D
43	XL	Touch panel left glass terminal	A/D
44	YD	Touch panel bottom film terminal	A/D
45	GND	Ground	P

## 4. LCD Optical Characteristics

### 4.1 Optical specification

Item	Symbol	Condition	Min.	Typ.	Max.	Unit.	Note
Contrast Ratio	CR	$\theta=0$	500	600	--		(2)
Response time	Rising	TR	--	20	45	msec	(4)
	Falling	TF		35	50		
Color gamut	S (%)		--	49.3	--	%	(5)
Color Filter Chromaticity	White	W <sub>x</sub>	0.260	0.300	0.340		(5)
		W <sub>y</sub>	0.280	0.320	0.360		
	Red	R <sub>x</sub>	0.609	0.629	0.649		
		R <sub>y</sub>	0.307	0.327	0.347		
	Green	G <sub>x</sub>	0.292	0.312	0.332		
		G <sub>y</sub>	0.535	0.555	0.575		
	Blue	B <sub>x</sub>	0.144	0.164	0.184		
		B <sub>y</sub>	0.149	0.169	0.189		
Viewing angle	Hor.	$\theta_L$	CR>10	60	85	--	(1)(6)
		$\theta_R$		60	85	--	
	Ver.	$\theta_U$		60	85	--	
		$\theta_D$		60	85	--	
Option View Direction	FREE						(1)

### 4.2 Measuring conditions

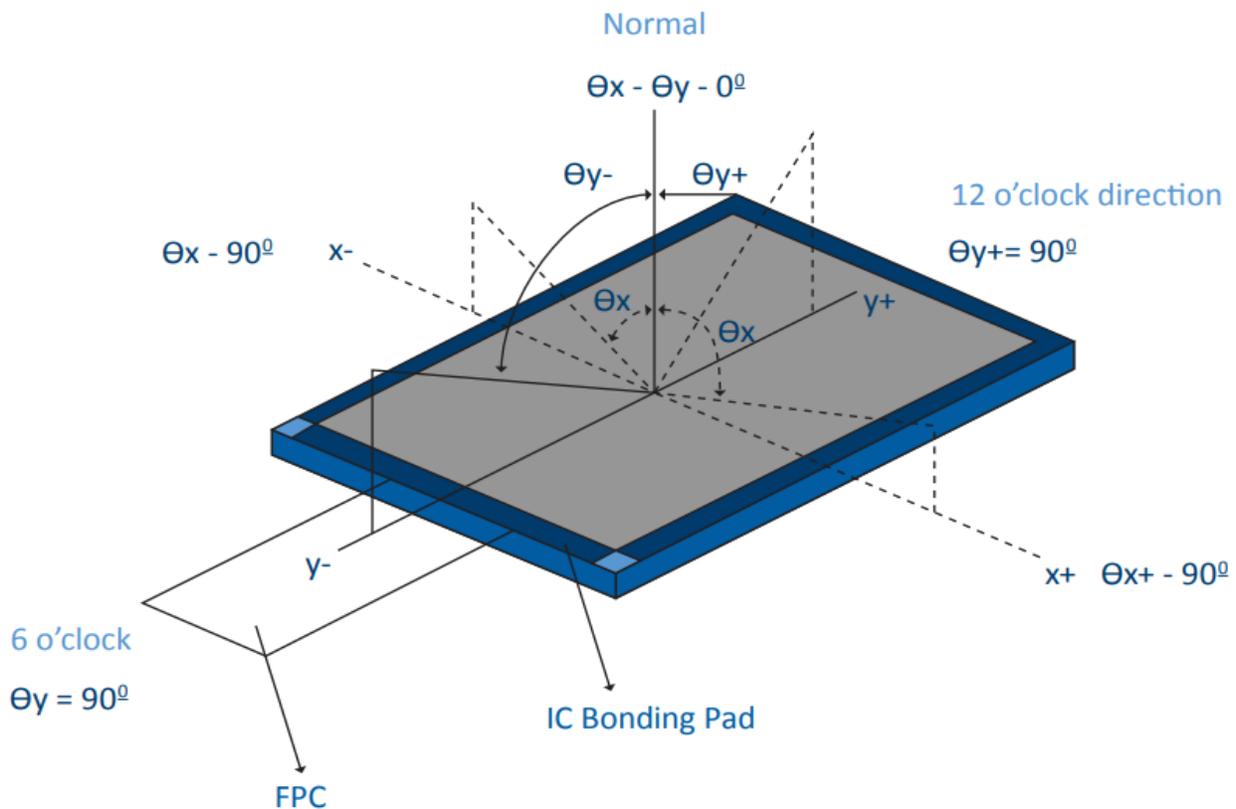
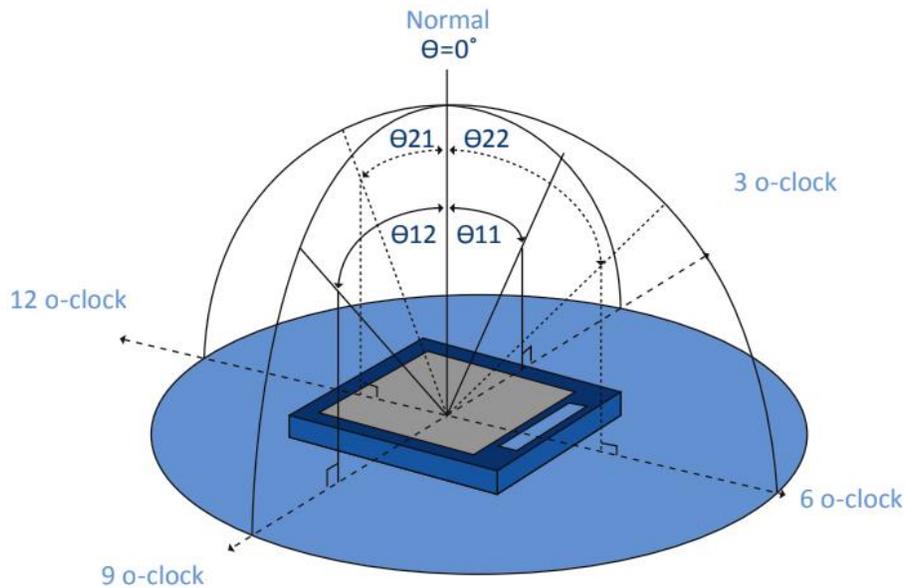
Measuring surrounding: dark room

Ambient temperature: 25±2 °C

15min. warm-up time.

**Optical Specification Reference Notes:**

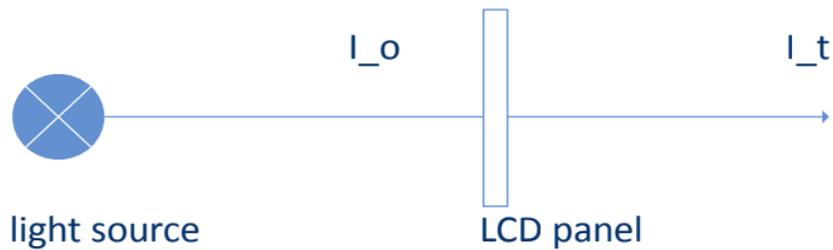
(1) Definition of Viewing Angle: The viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or 3,9 o'clock direction and the vertical or 6,12 o'clock direction with respect to the optical axis which is normal to the LCD surface.



(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.



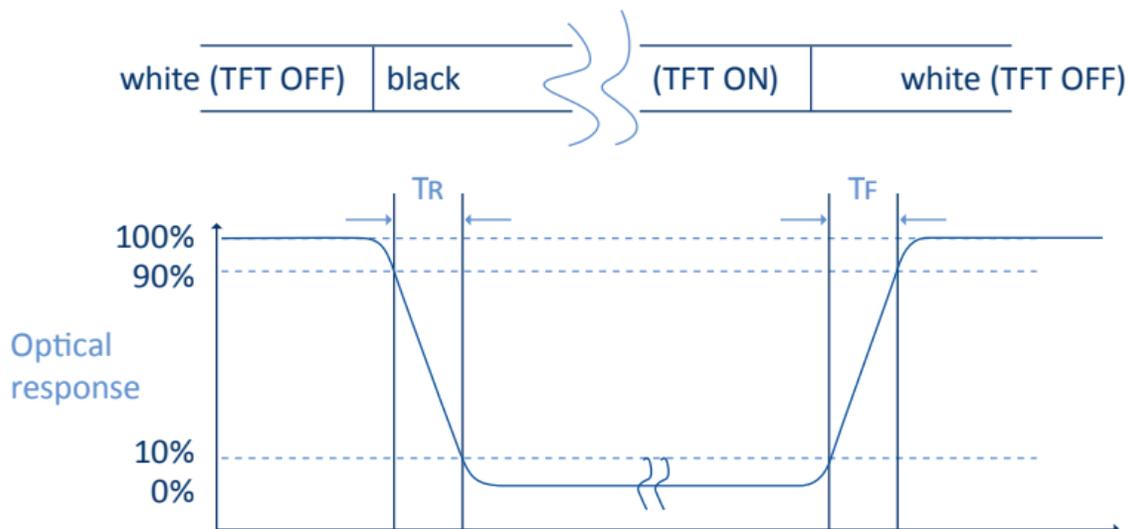
The transmittance is defined as:

$$Tr = \frac{I_t}{I_o} \times 100\%$$

I<sub>o</sub> = the brightness of the light source.

I<sub>t</sub> = 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.

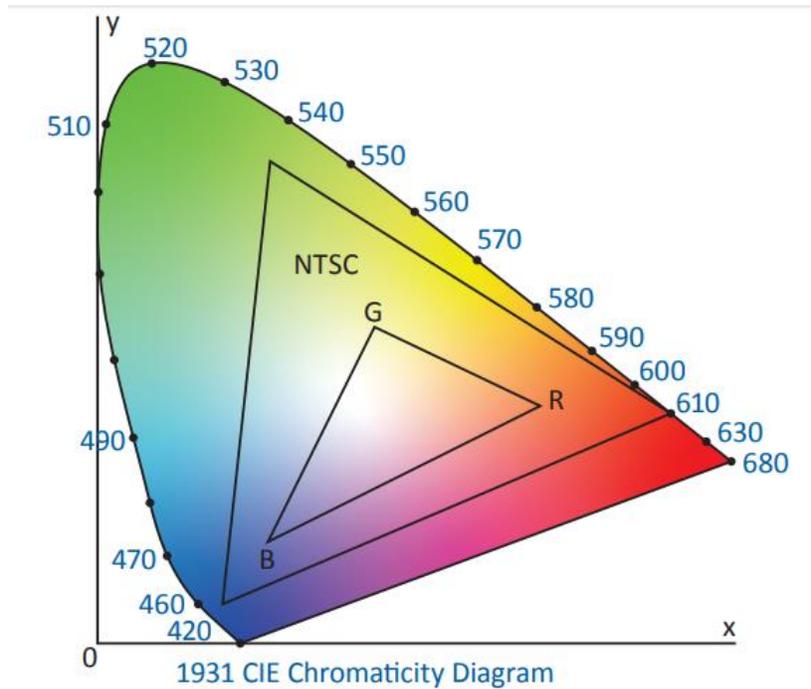
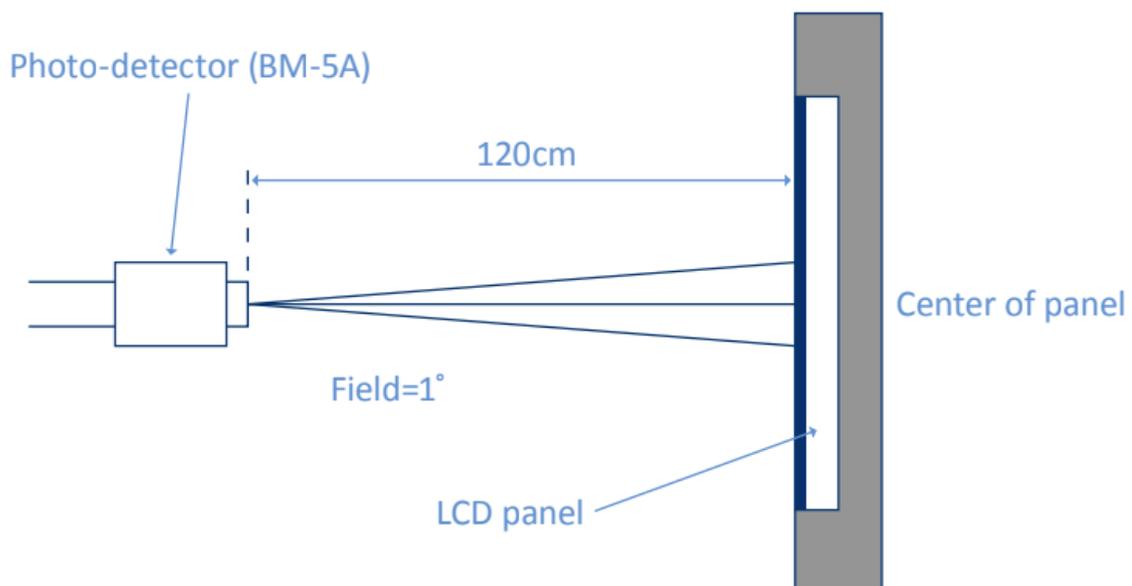


Fig. 1931 CIE chromacity diagram

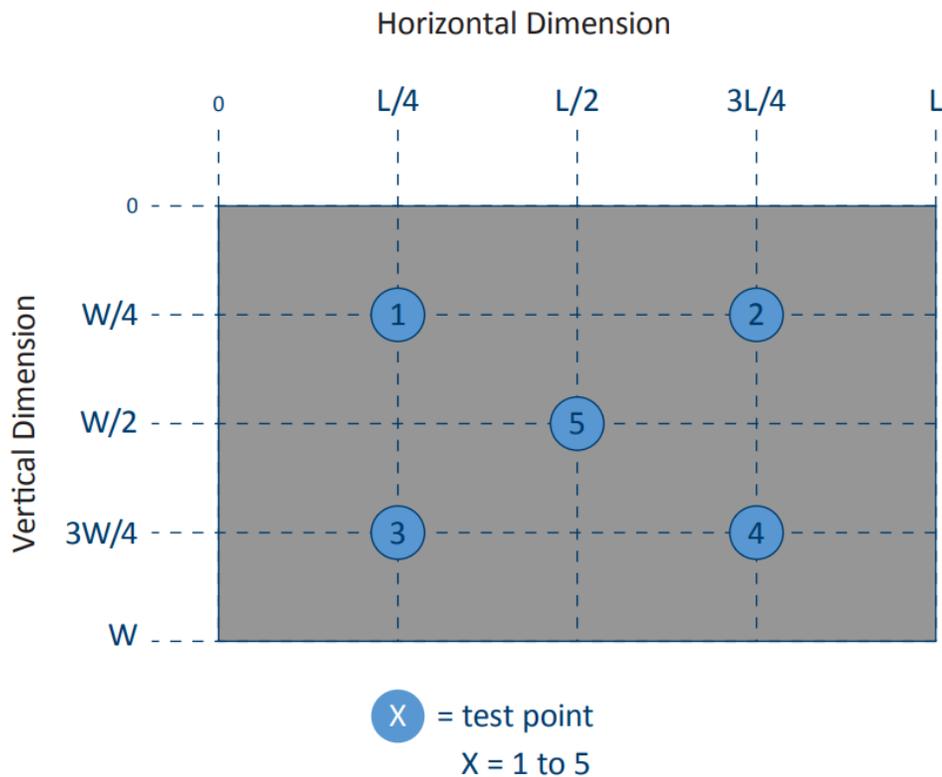
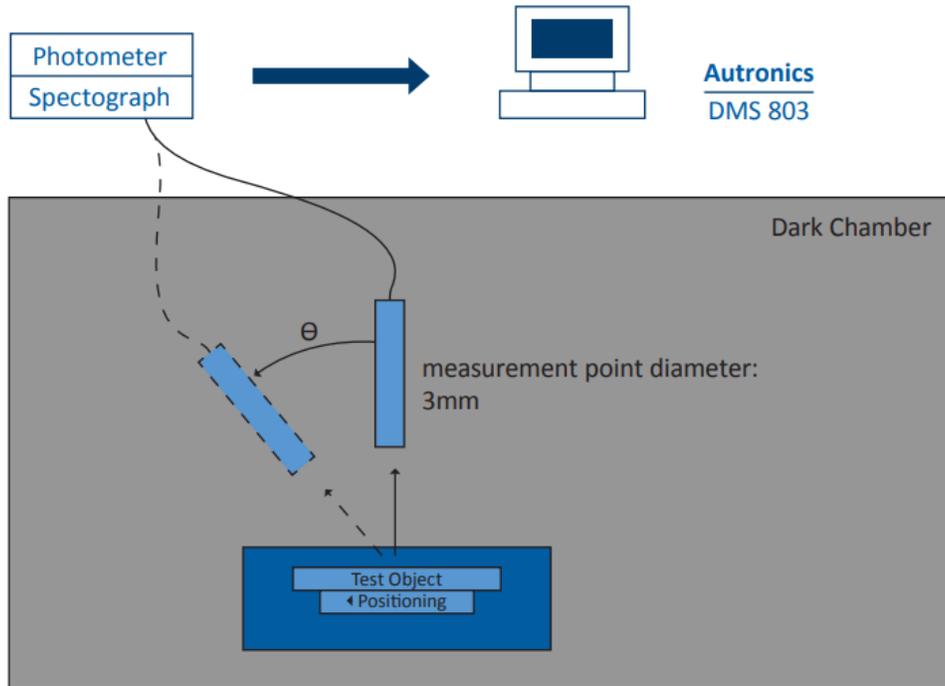
$$\text{Color gamut: } S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$

(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	VDD	-0.3	4.6	V
Interface Operation Voltage	VDDIO	-0.3	4.6	V
Operating temperature	T <sub>OP</sub>	-20	+70	°C
Storage temperature	T <sub>ST</sub>	-30	+80	°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.

### 5.2 DC Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Digital Supply Voltage	V <sub>CI</sub>	2.4	2.8	3.3	V	
Digital Interface Operation Voltage	V <sub>DDIO</sub>	1.65	1.8	3.3	V	
Normal Mode Current Consumption	I <sub>DD</sub>	--	7	--	mA	
Level input voltage	V <sub>IH</sub>	0.7 V <sub>DDIO</sub>		V <sub>DDIO</sub>	V	
	V <sub>IL</sub>	GND		0.3 V <sub>DDIO</sub>	V	
Level output voltage	V <sub>OH</sub>	0.8 V <sub>DDIO</sub>		V <sub>DDIO</sub>	V	
	V <sub>OL</sub>	GND		0.2 V <sub>DDIO</sub>	V	

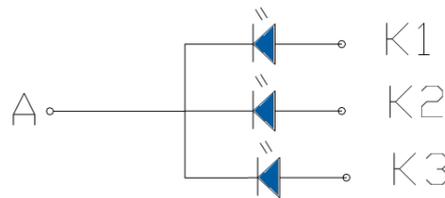
### 5.3 LED Backlight Characteristics

Item	Symbol	Min	Typ.	Max	Unit	Note
Forward Current	IF	45	60	--	mA	
Forward Voltage	VF	--	3.2	--	V	
LCM Luminance	LV	250	300	--	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 3 chips White LED

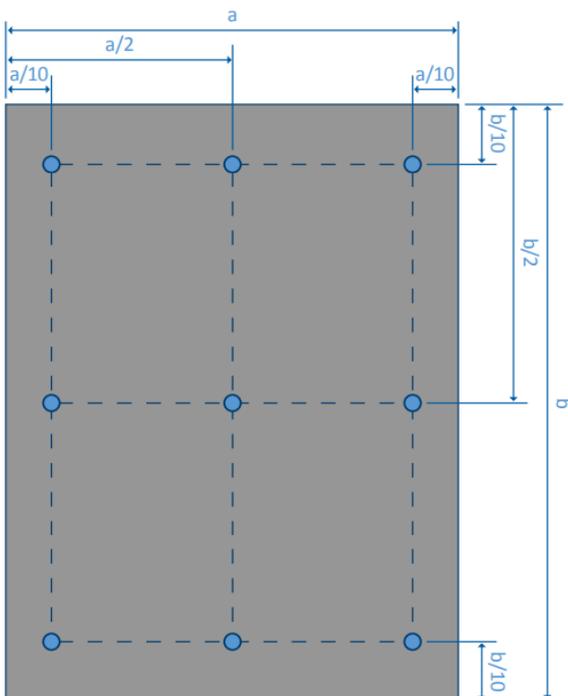
Note 1: LED lifetime (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25 ±3 °C, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note 2: The "LED lifetime" is defined as the module brightness decrease to 50% original brightness at Ta=25°C and IL=60mA. The LED lifetime could be decreased if operating IL is larger than 60mA. The constant current driving method is suggested.



LED Circuit Diagram

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



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

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

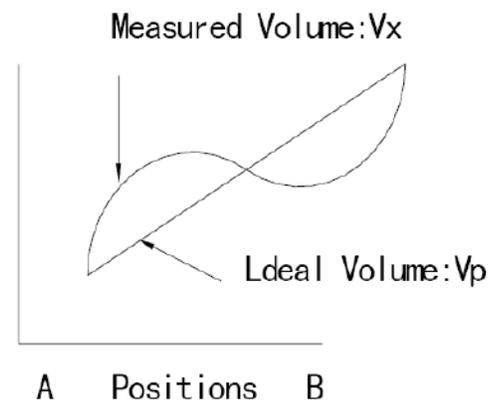
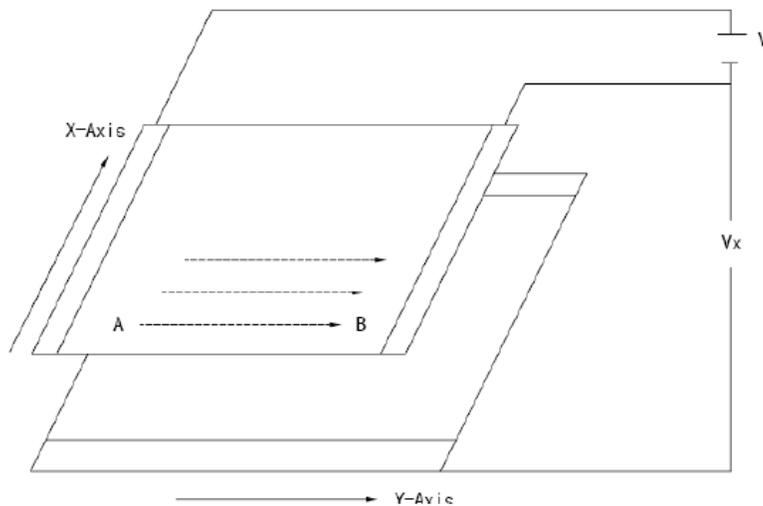
## 6. TP Feature

### 6.1 Conditions of Use and Storage

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

### 6.2 Electrical Property

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



### 6.3 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 (polyacetal) 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

### 6.4 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	

## 7. AC Characteristic

### 7.1 RGB Interface Characteristics

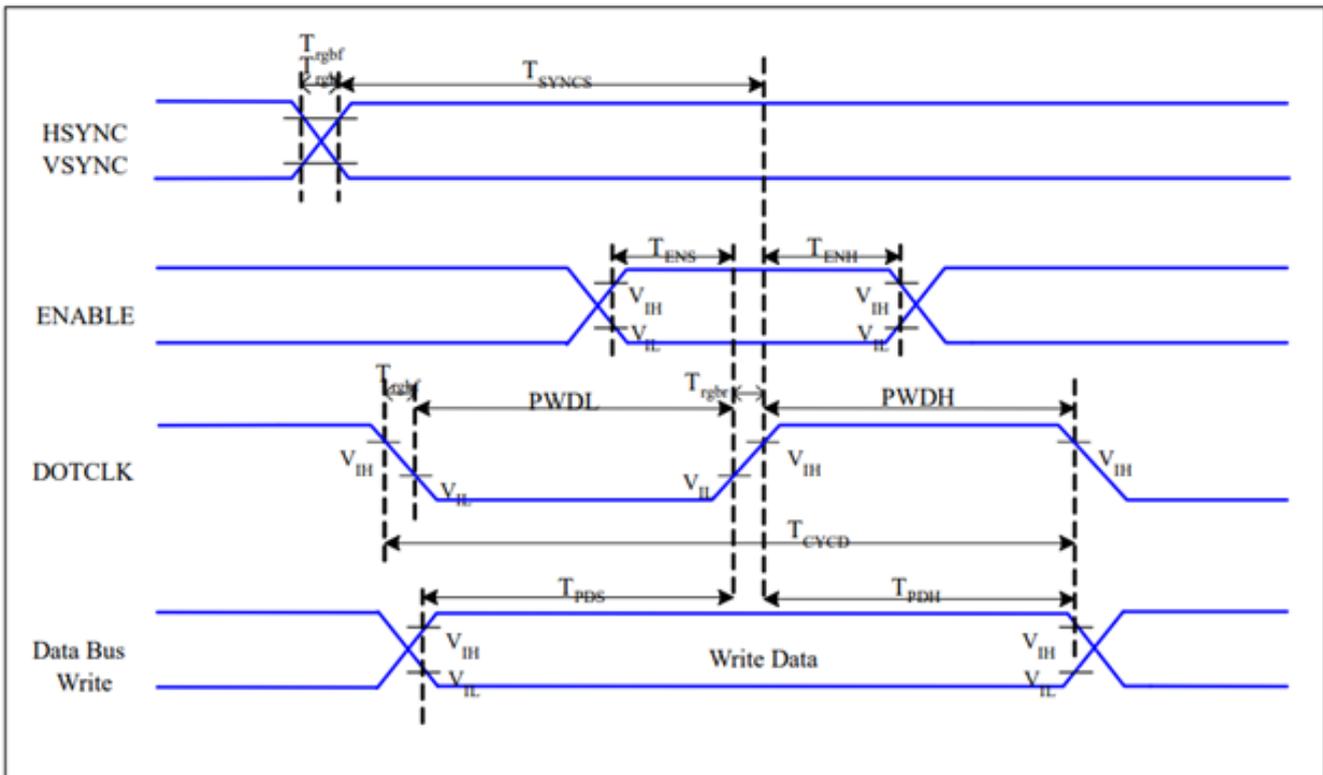


Figure 7.1: RGB Interface Timing Characteristics

Signal	Symbol	Parameter	Min	Max	Unit	Description
HSYNC, VSYNC	$T_{SYNCS}$	VSYNC, HSYNC Setup Time	30	-	ns	
ENABLE	$T_{ENS}$	Enable Setup Time	25	-	ns	
	$T_{ENH}$	Enable Hold Time	25	-	ns	
DOTCLK	PWDH	DOTCLK High-level Pulse Width	60	-	ns	
	PWDL	DOTCLK Low-level Pulse Width	60	-	ns	
	$T_{CYCD}$	DOTCLK Cycle Time	120	20	ns	
	$T_{RGHR}, T_{RGHF}$	DOTCLK Rise/Fall Time	-	-	ns	
DB	$T_{PDS}$	PD Data Setup Time	50	-	ns	
	$T_{PDH}$	PD Data Hold Time	50	-	ns	

Table 7.1: 18/16-bit RGB Interface Timing Characteristics

## 7.2 8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus

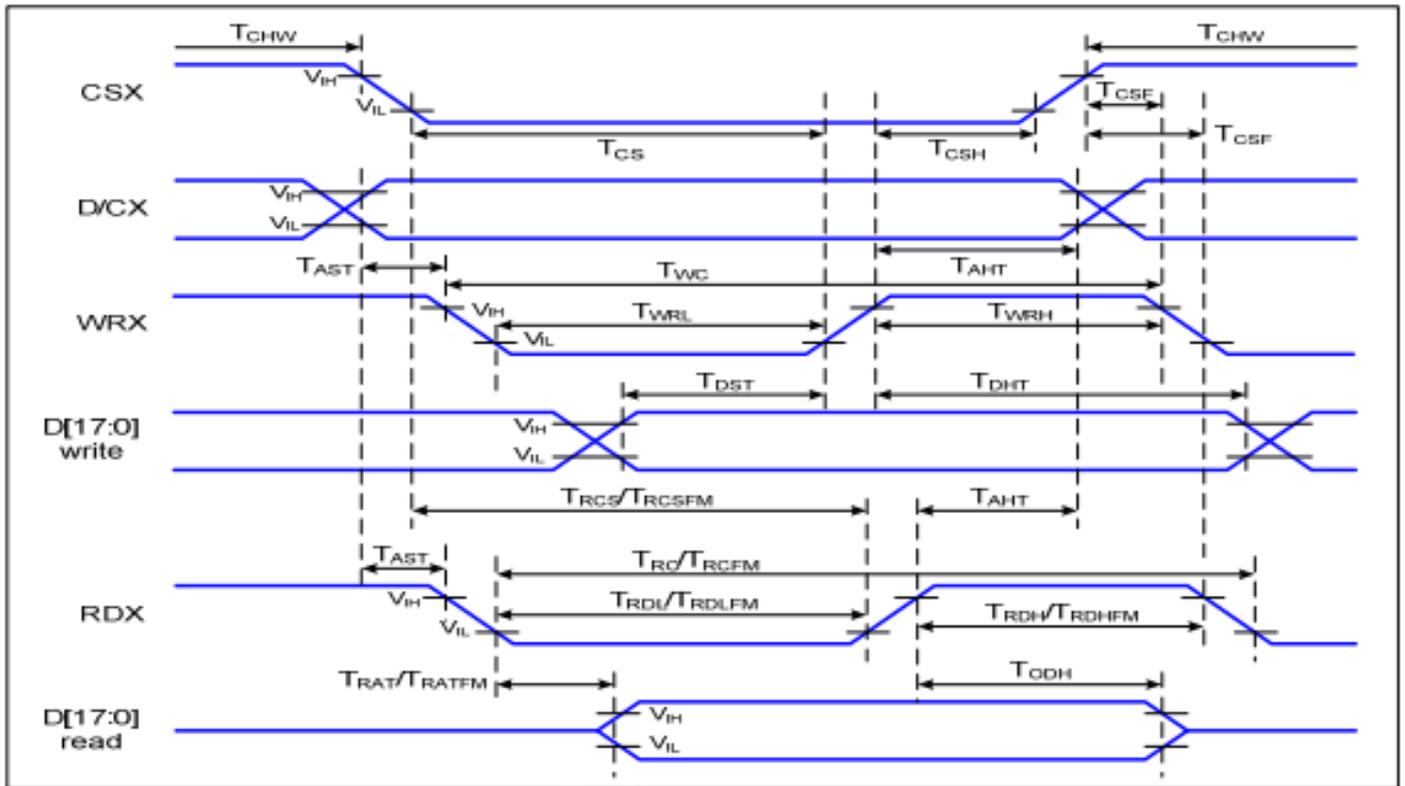
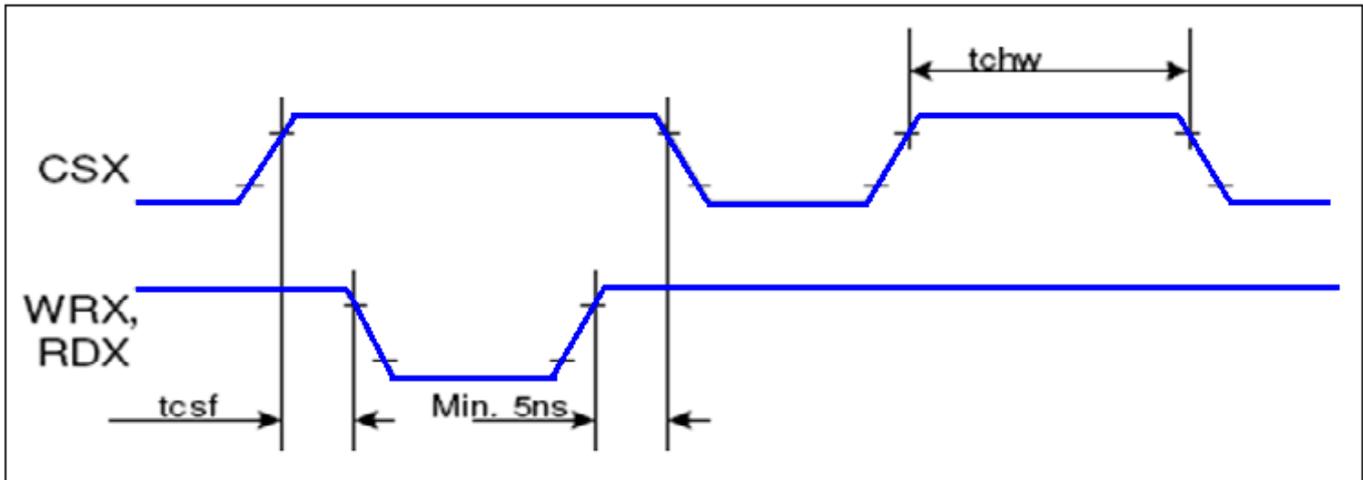


Figure 7.2: Parallel Interface Timing Characteristics (8080-Series MCU Interface)

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] D[15:0], D[8:0], D[7:0]	$T_{DST}$	Write data setup time	10	-	ns	For max CL=30pF
	$T_{DHT}$	Write data hold time	10	-	ns	
	$T_{RAT}$	Read access time (ID)	-	40	ns	For min CL=8pF
	$T_{RATFM}$	Read access time (FM)	-	340	ns	
	$T_{ROD}$	Output disable time	20	80	ns	

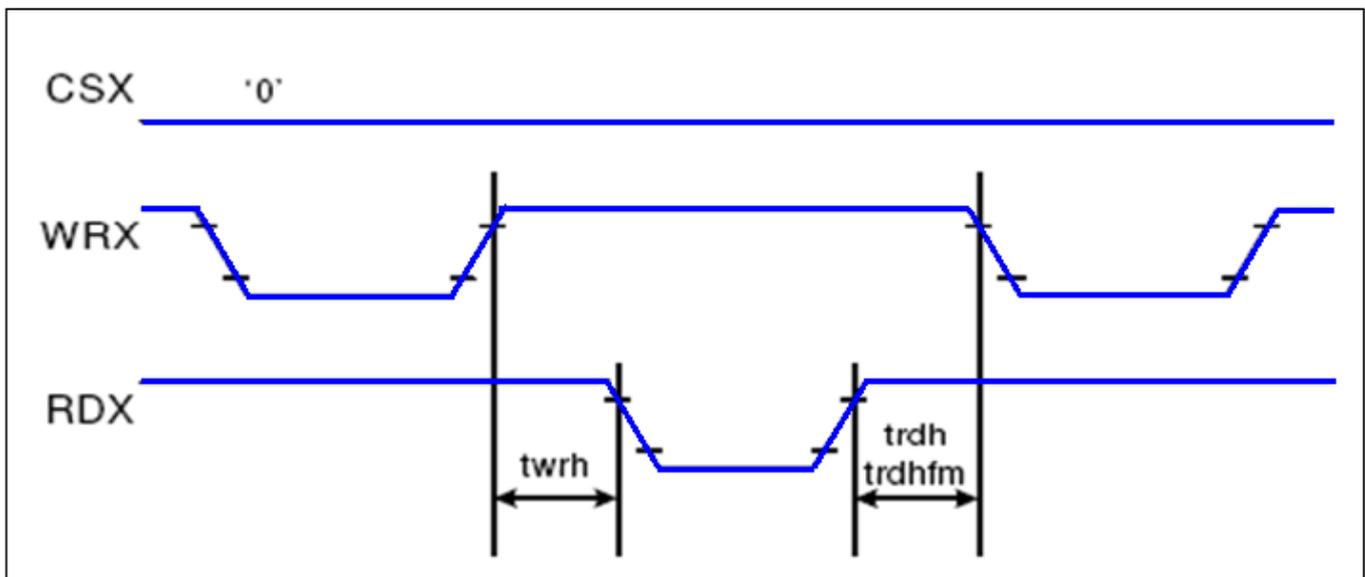
Table 7.2: 8080 Series MCU Parallel Timing Characteristics

CSX timings:

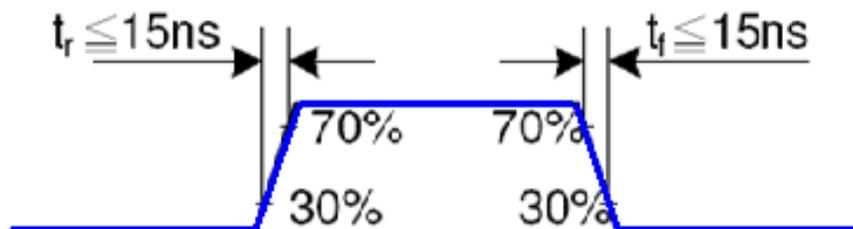


Note: Logic high and low levels are specified as 30% and 70% of IOVCC for input signals.

Write to read or read to write timings:



Note:  $T_a = -30$  to  $70$  C, IOVCC = 1.65V to 2.8V, VCI = 2.6V to 3.3V, GND = 0V.



### 7.3 Display Serial Interface Characteristics (3-line SPI system)

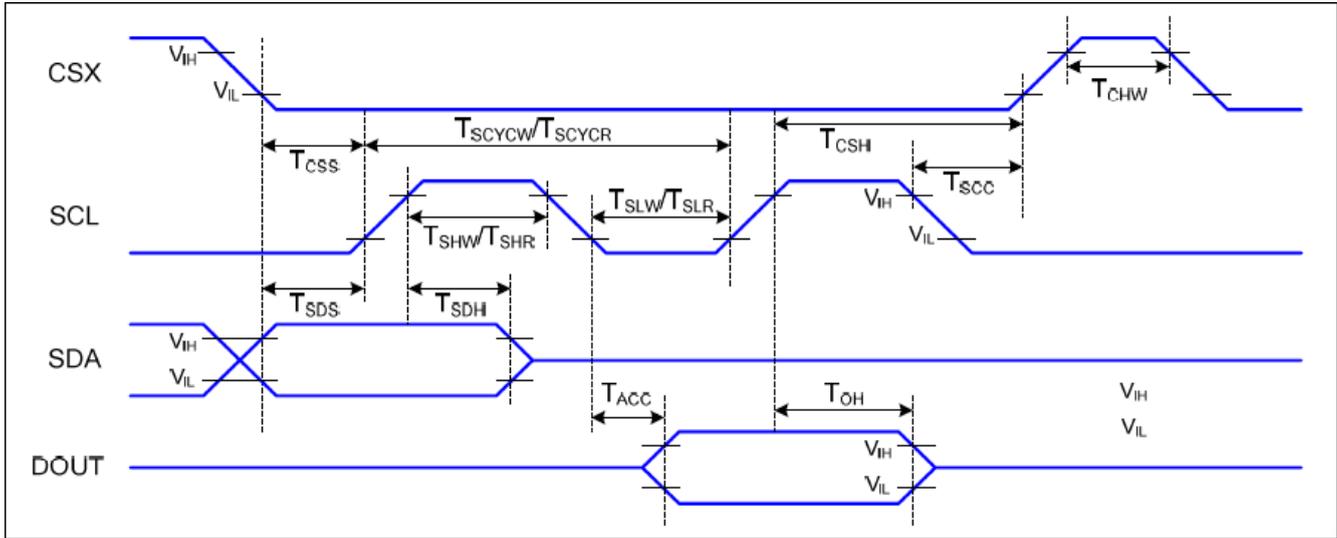


Figure 7.3: Serial Interface 3-SPI Timing Diagram

$V_{DDI} = 1.64 \text{ to } 3.3\text{V}$ ,  $V_{DD} = 2.4 \text{ to } 3.3\text{V}$ ,  $AGND= DGND=0\text{V}$ ,  $T_a = -30 \text{ to } 70 \text{ }^\circ\text{C}$

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		ns	
DOUT	$T_{ACC}$	Access time	10	50	ns	For max CL=30pF For min CL=8pF
	$T_{OH}$	Output disable time	15	50		

Table 7.3: 3-line Serial Interface Timing Characteristics

Note: The rising time and falling time ( $T_r$ ,  $T_f$ ) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of  $V_{DDI}$  for Input signals

### 7.4 Display Serial Interface Characteristics (4-line SPI serial)

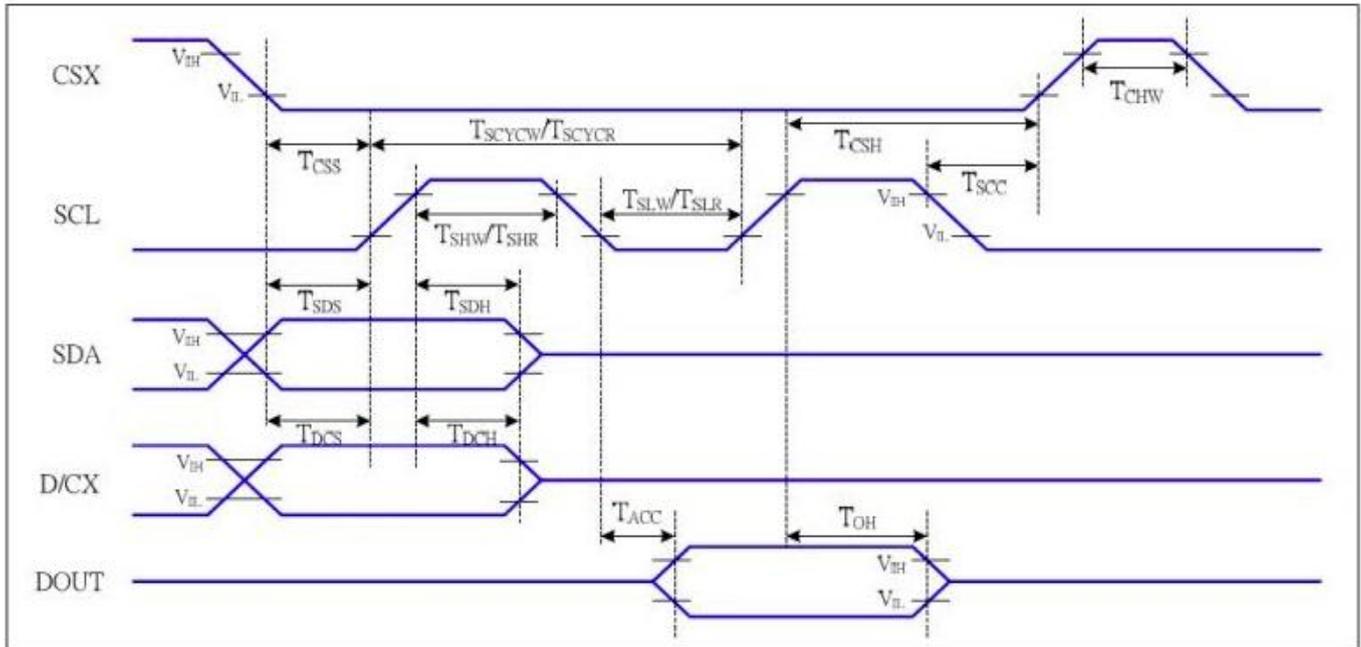


Figure 7.4: Serial Interface 4-SPI Timing Diagram

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 For min CL=8pF
	$T_{OH}$	Output disable time	15	50	ns	

Table 7.4: 4-line Serial Interface Timing Characteristics

Note: The rising time and falling time ( $T_r$ ,  $T_f$ ) 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.

## 7.5 Reset Timing

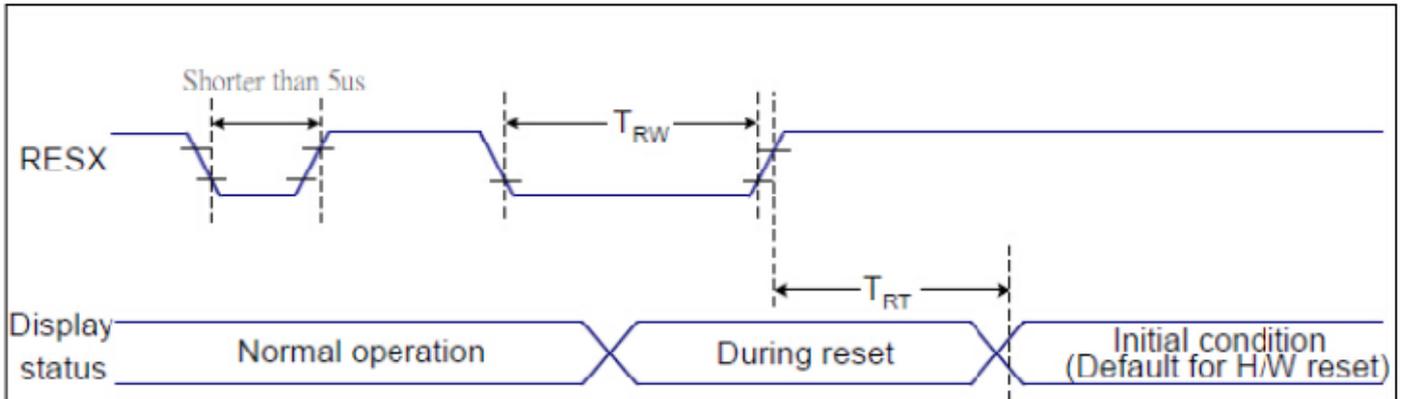


Figure 7.5: Reset Timing

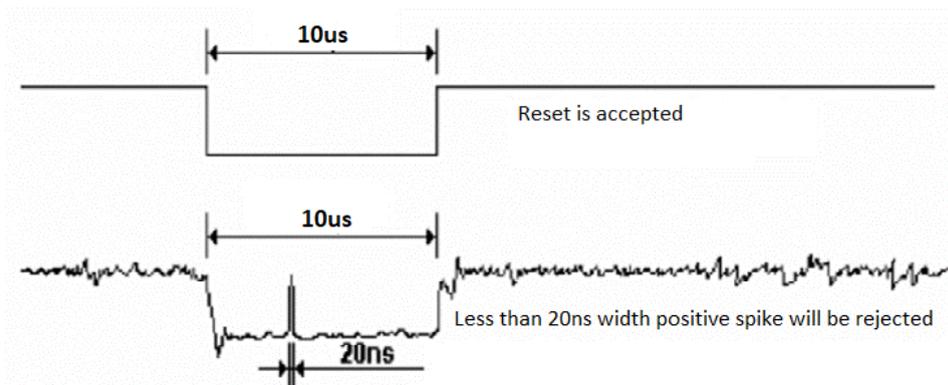
Related Pins	Symbol	Parameter	Min	Max	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1,5)	ms
				120 (Note 1, 6, 7)	ms

### Notes:

- 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.
- 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

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



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

## 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 °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.