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

TFT Display Module

Part Number

E144RG11212LW6M250-N

Overview:

- 1.44-inch TFT (32.36x38.0mm)
- 128x128 pixels
- 3/4-line SPI+18-bit RGB Interfaces
- 8/16-bit 8080 CPU
- White LED back-light
- Transmissive/ Normally White
- No Touch Panel
- 250 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 and backlight unit. The resolution of the 1.44" TFT-LCD contains 128x128 pixels and can display up to 65K colors.

Features

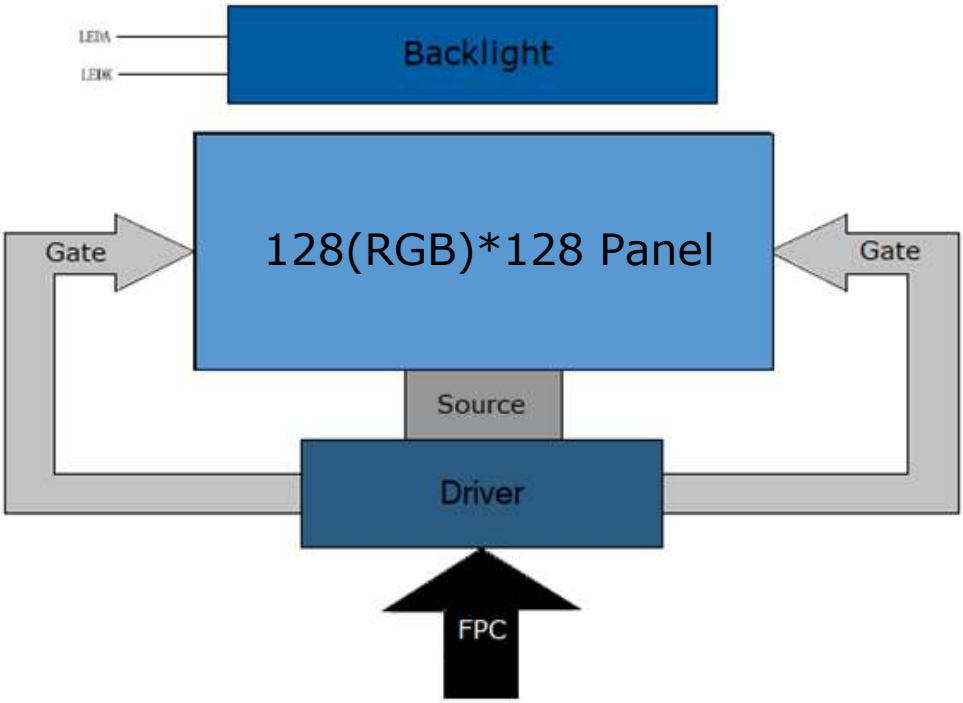
Low Input Voltage: 3.3V (TYP)
Display Colors of TFT LCD: 65K colors
TFT Interface: 8/16-bit 8080 CPU
3/4-line SPI options

General Information Items	Specification	Unit	Note
	Main Panel		
TFT Display area (AA)	25.50(H) x 26.50(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	-
CTP Driver IC	ST7735S	-	-
Display mode	Transmissive/ Normally White	-	-
Operating temperature	-20～+70	℃	-
Storage temperature	-30～+80	℃	-

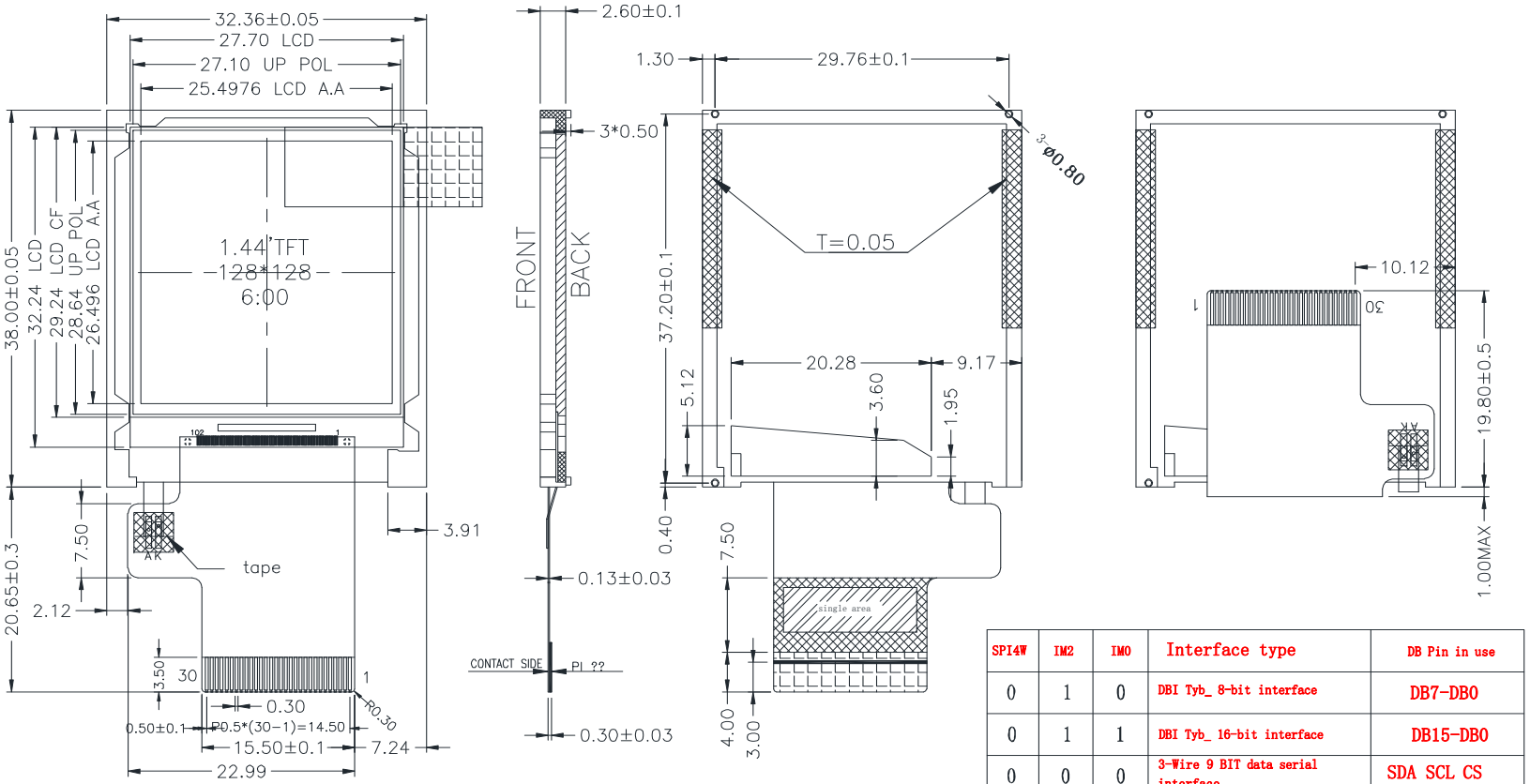
Mechanical Information

Item		Min	Typ.	Max	Unit	Note
Module size	Height (H)		32.36		mm	-
	Vertical (V)		38.00		mm	-
	Depth (D)		2.60		mm	-
Weight			TBD		g	-

1. Block Diagram



2. Outline Dimensions



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

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:
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, 1 LED, 15-20mA, 3.2±0.3V
8. RoHS COMPLIANT.

ReV.	Revision content description	Date
V0	FIRST	2015/07/14

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TOLERANCE( )	DRAWING NAME	E144RG11212LW6M250-N	
	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 Connector: FH19C-30S-0.5SH(99)

NO.	Symbol	Description	I/O
1	GND	Ground	P
2	VCC	Supply voltage (3.3V)	P
3	IOVCC	Supply voltage for I/O (1.8V-3.3V)	P
4	IM0	IM0='1': MCU 8-bit parallel mode IM0='0': MCU 16-bit parallel mode	I
5	IM2	MCU parallel interface and serial interface select IM2='1': Parallel interface mode IM2='0': Serial interface mode	I
6	SPI4W	SPI4W='0': 3-line SPI enable SPI4W='1': 4-line SPI enable If not used, fix to ground.	I
7-22	DB15-DB0 (SPI-SDA)	DB[15:0] are used as MCU parallel interface data bus. DB0 is the serial input/output signal in serial interface mode. In serial interface, DB[15:1] are not used and should be fixed to ground.	I/O
23	RD	Read enable in 8080 MCU parallel interface.	I
24	RS(SPI-SCL)	Display data/command selection pin in MCU interface. RS='1': Display data or parameter RS='0': Command data In serial interface this is used as SCL. If not used fix to IOVCC or GND.	I
25	RESET	Reset signal of device. Must be applied to properly initialize the chip.	I
26	CS	Chip selection pin. Low enable.	I
27	WR(SPI-RS)	Write enable in MCU parallel interface. In 4-line SPI, this pin is used as RS (data/command selection). If not used, fix pin to IOVCC or GND.	I
28	LEDK	Cathode pin of backlight	P
29	LEDA	Anode pin of backlight	P
30	GND	Ground	P

I: Input, O: Output, P: Power

4. LCD Optical Characteristics

4.1 Optical Specifications

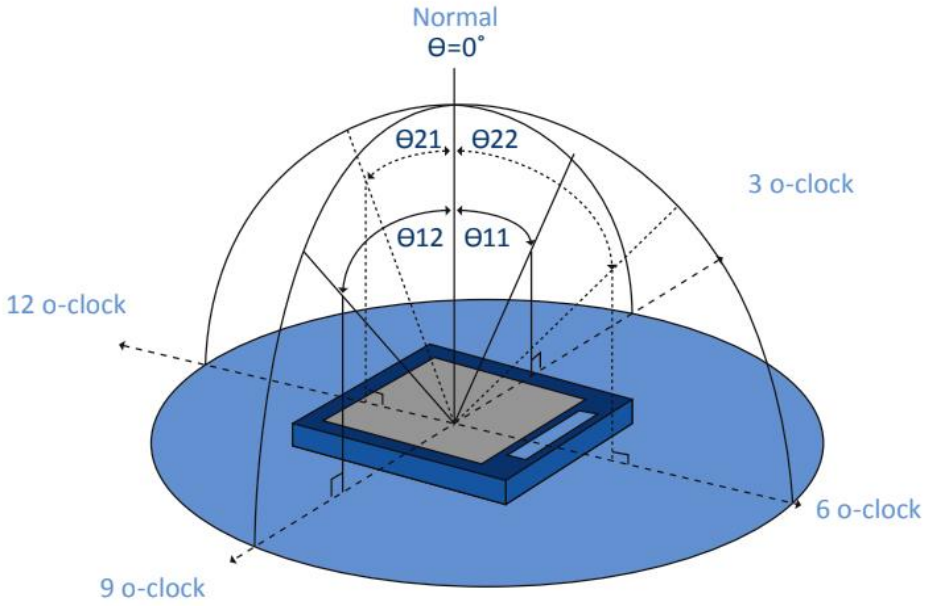
Item		Symbol	Condition	Min	Typ.	Max	Unit	Note
Transmittance (with polarizer)		Tr	Θ = ϕ = 0 Normal viewing angle	--	5	--	%	(3)
Contrast Ratio		CR		500	700	--	--	(2)
Response time	Rising	TR		--	5	10	ms	(4)
	Falling	TF		--	15	25	ms	(4)
Color Gamut		S		--	40	--	%	(5)
Color Filter Chromaticity	White	W_X		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	0.135	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)

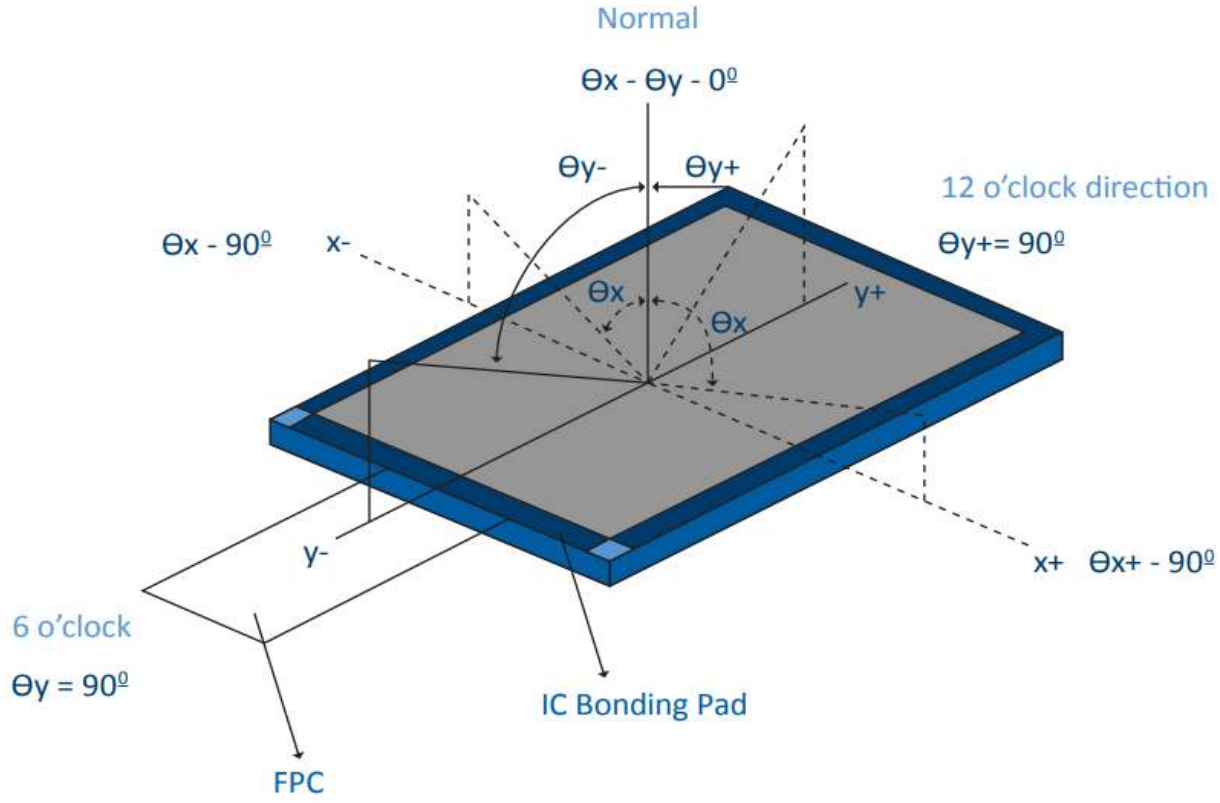
4.2 Measuring Condition

VDD = 3.3V, IL = 260mA (Backlight current)
Ambient temperature: 25 ± 2℃
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.

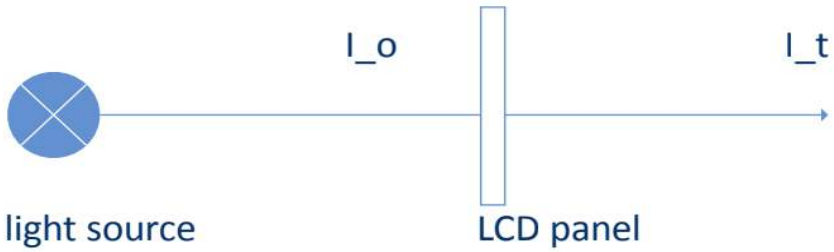




(2) Definition of Contrast Ratio (Cr): measured at the center point of panel. The contrast ratio (Cr) measured on a module, is the ratio between the luminance (Lw) in a full white area (R=G=B=1) and the luminance (Ld) in a dark area (R=G=B=0).

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

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

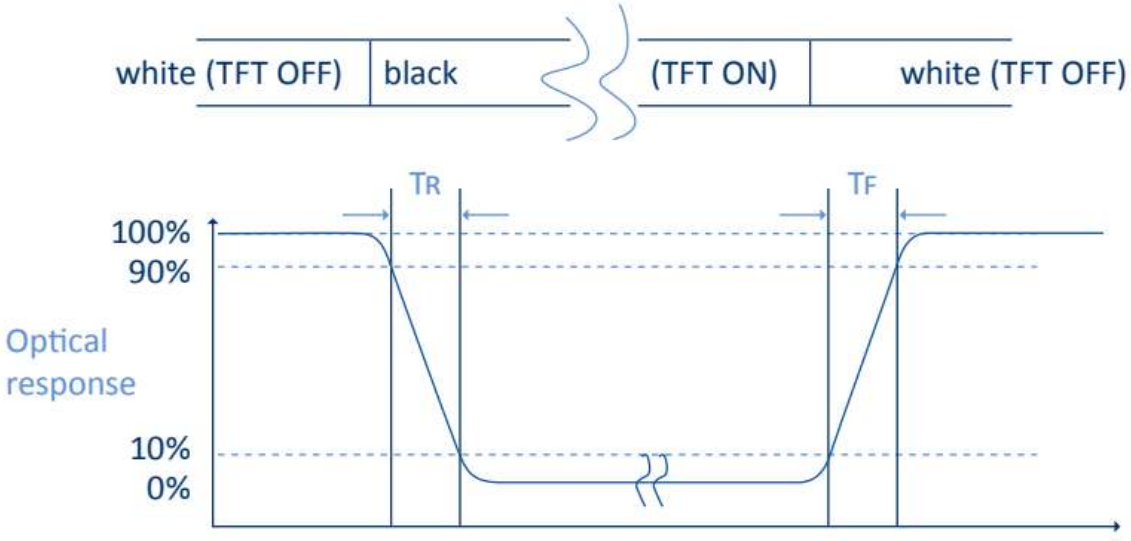


The transmittance is defined as:

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

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. The color chromaticity shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

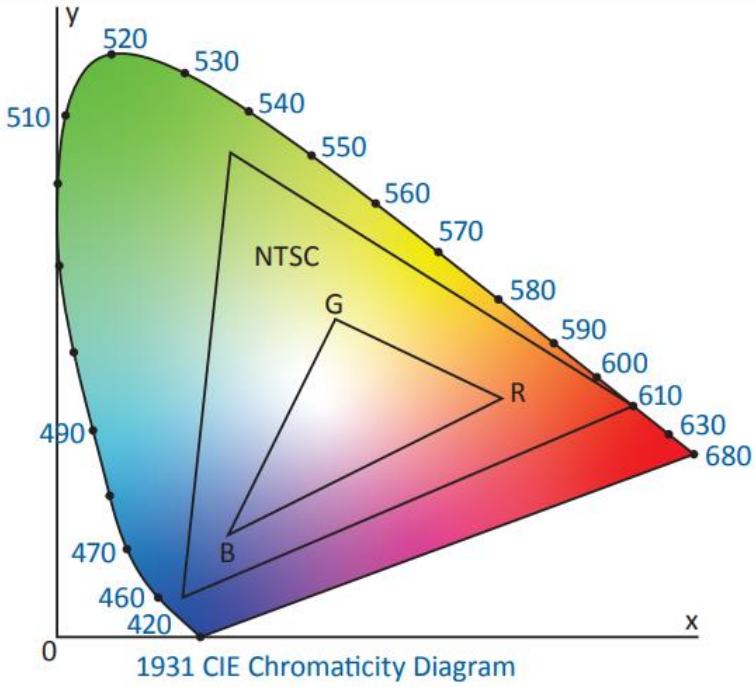
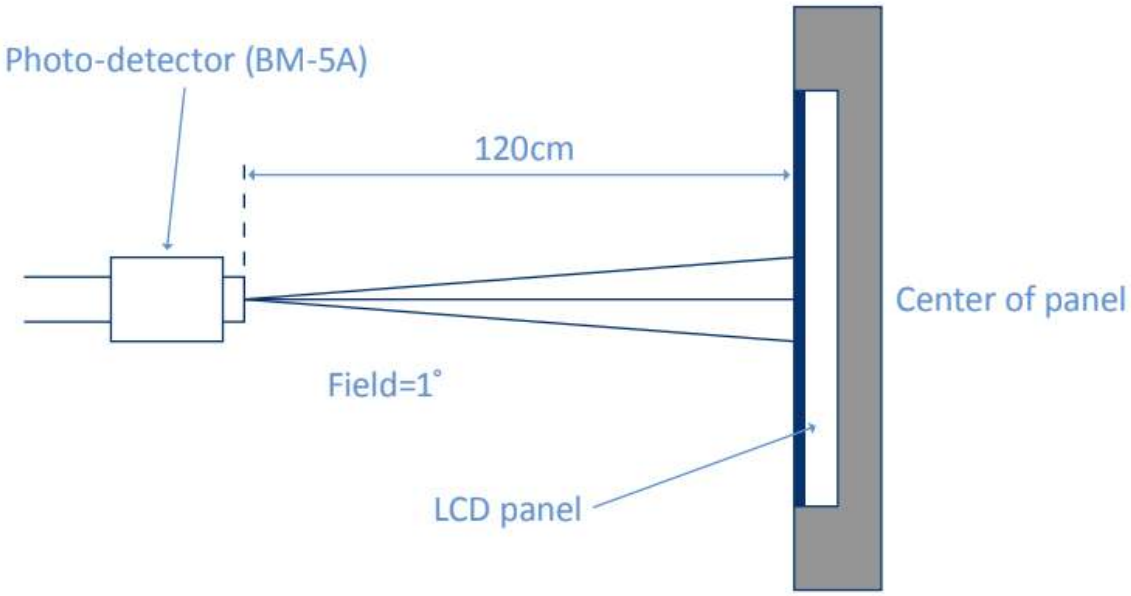


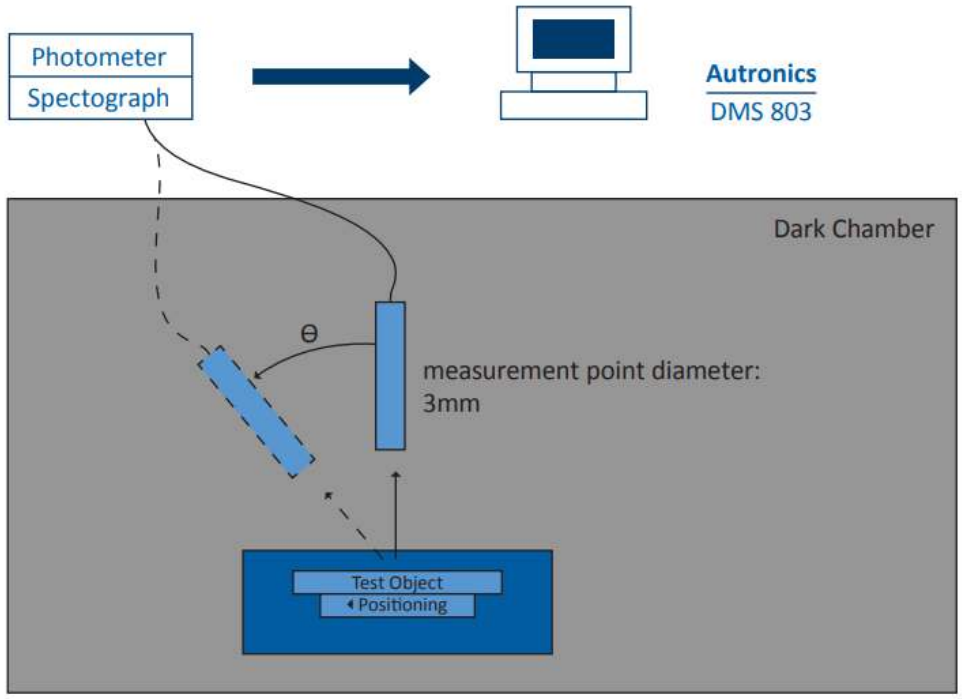
Fig. 1931 CIE chromacity diagram

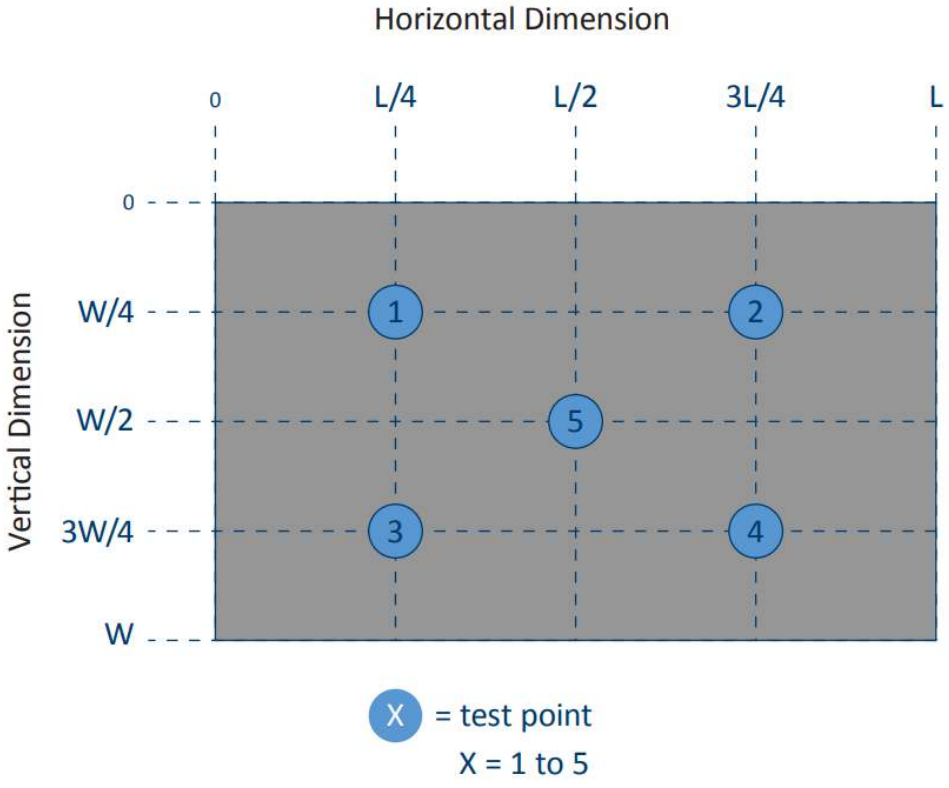
$$\text{Color gamut: } S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$

(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	VDD	-0.3	4.8	V
Digital Interface Supply Voltage	VDDIO	-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	VDD	2.4	3.3	4.8	V	
Digital Interface Supply Voltage	VDDIO	1.65	3.3	4.8	V	
Normal Mode Current Consumption	IDD	--	1.2	--	mA	
Level Input Voltage	VIH	0.7VDDIO	--	VDDIO	V	
	VIL	GND	--	0.3VDDIO	V	
Level Output Voltage	VOH	0.8VDDIO	--	VDDIO	V	
	VOL	GND	--	0.2VDDIO	V	

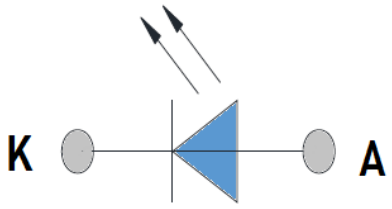
5.3 LED Backlight Characteristics

The backlight system is edge lighting type with 1 chip White LED.

Item	Symbol	Min	Typ.	Max	Unit	Note
Forward Current	IF	15	20	--	mA	
Forward Voltage	VF	--	3.2	--	V	
LCM Luminance	LV	140	--	--	cd/m2	Note 3
LED lifetime	Hr	50000	--	--	hour	Note1 & 2
Uniformity	AVg	80	--	--	%	Note 3

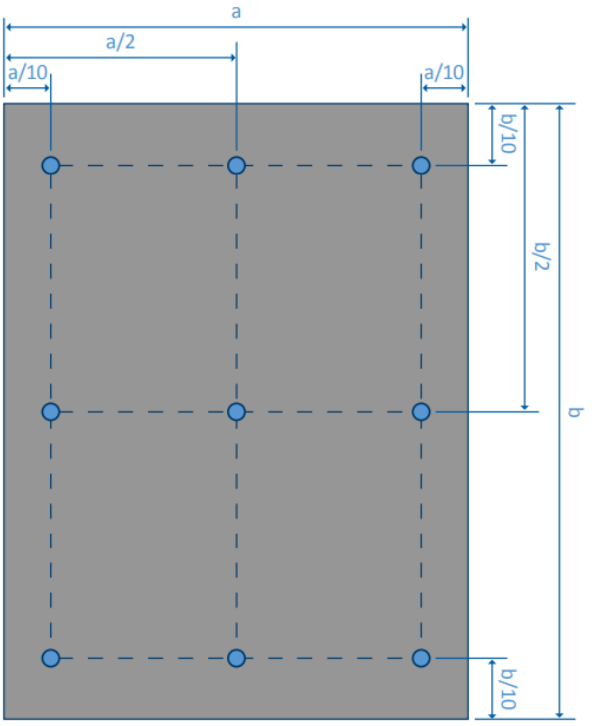
Note 1: LED lifetime (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25 ±3 ℃, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note 2: The "LED lifetime" is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and IL = 20mA. The LED lifetime could be decreased if operating IL is larger than 20mA. 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 Timing Characteristics

6.1 8080 Series MCU Parallel Interface Timing Characteristics

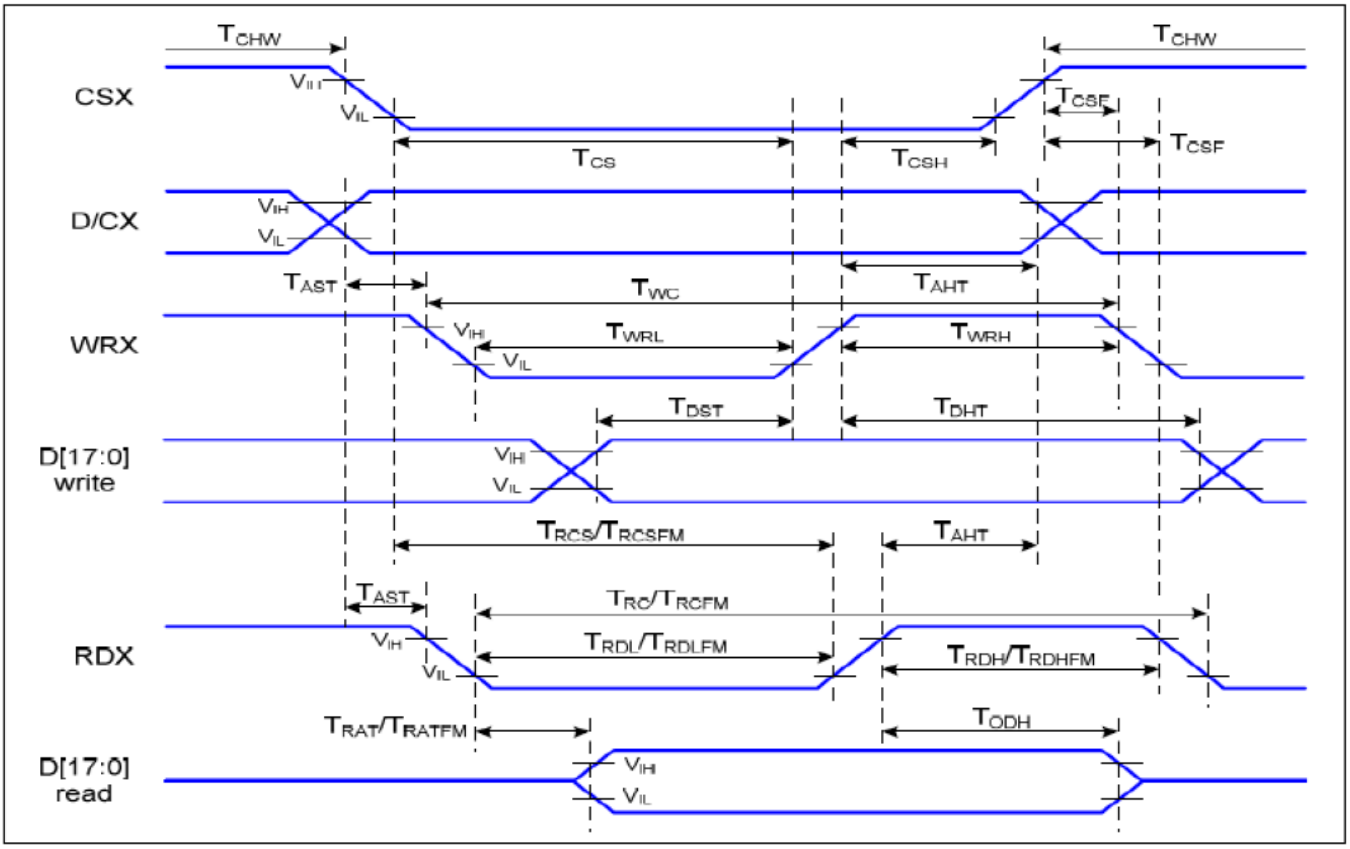


Figure 6.1: 8080 Series MCU Parallel Interface Timing Diagram

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Address Setup Time	TAST	0			ns	
Address Hold time (write/read)	THAT	10			ns	
Chip Select “H” Pulse Width	TCHW	0			ns	
Chip Select Setup Time (write)	TCS	15			ns	
Chip Select Setup Time (read ID)	TRCS	45			ns	
Chip Select Setup Time (read FM)	TRCSFM	355			ns	
Chip Select Wait Time (write/read)	TCSF	10			ns	
Chip Select Hold Time	TCSH	10			ns	
Write Cycle	TWC	66			ns	
Control Pulse “H” Duration	TWRH	15			ns	
Control Pulse “L” Duration	TWRL	15			ns	
Read Cycle (ID)	TRC	160			ns	
Control Pulse “H” Duration (D)	TRDH	90			ns	When Read ID Data
Control Pulse “L” Duration (ID)	TRDL	45			ns	

Table 6.1: 8080 Series MCU Parallel 8/16-bit Input Timing Characteristics

6.2 Serial Interface Characteristics (3-line Serial)

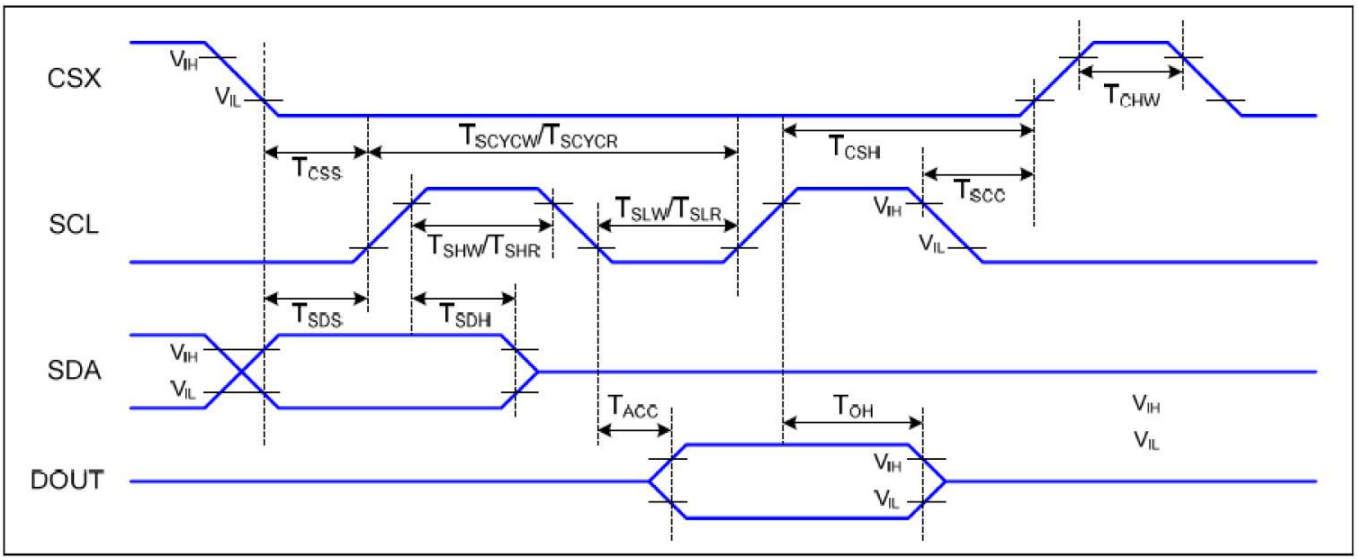


Figure 6.2: 3-line Serial Interface Timing Diagram

Signal	Symbol	Parameter	Min	Max	Unit	Note
CSX	TCSS	Chip select setup time (write)	15		ns	
	TCSH	Chip select hold time (write)	15		ns	
	TCSS	Chip select setup time (read)	60		ns	
	TSCC	Chip select hold time (read)	65		ns	
	TCHW	Chip select “H” pulse width	40		ns	
SCL	TSCYCW	Serial clock cycle (write)	66		ns	
	TSHW	SCL “H” pulse width (write)	15		ns	
	TSLW	SCL “L” pulse width (write)	15		ns	
	TSCYCR	Serial clock cycle (read)	150		ns	
	TSHR	SCL “H” pulse width (read)	60		ns	
	TSLR	SCL “L” pulse width (read)	60		ns	
SDA (DIN) (DOUT)	TSDS	Data setup time	10		ns	For max, CL=30pF For min, CL=8pF
	TSDH	Data hold time	10		ns	
	TACC	Access time	10	50	ns	
	TOH	Output disable time	15	50	ns	

Table 6.2: 3-line Serial Interface Data Timing Characteristics

6.3 Serial Interface Characteristics (4-line Serial)

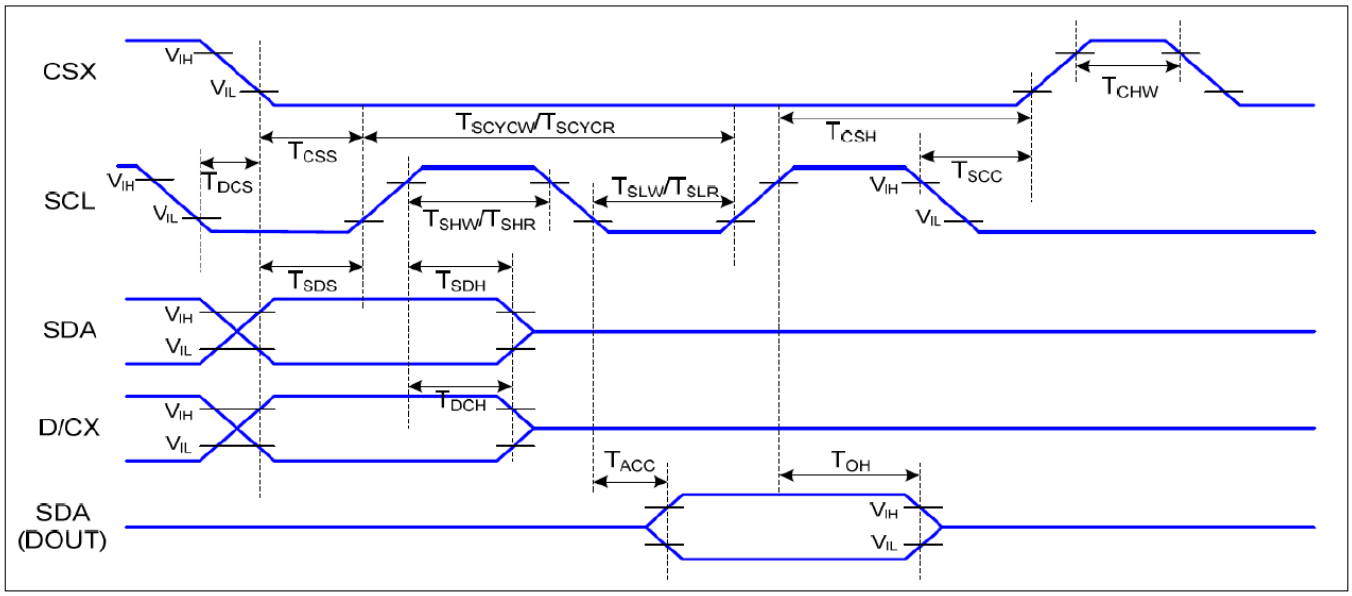


Figure 6.3: 4-line Serial Interface Timing Diagram

Signal	Symbol	Parameter	Min	Max	Unit	Note
CSX	TCSS	Chip select setup time (write)	45		ns	
	TCSH	Chip select hold time (write)	45		ns	
	TCSS	Chip select setup time (read)	60		ns	
	TSCC	Chip select hold time (read)	65		ns	
	TCHW	Chip select “H” pulse width	40		ns	
SCL	TSCYCW	Serial clock cycle (write)	66		ns	Write command & data RAM
	TSHW	SCL “H” pulse width (write)	15		ns	
	TSLW	SCL “L” pulse width (write)	15		ns	
	TSCYCR	Serial clock cycle (read)	150		ns	Read command & data RAM
	TSHR	SCL “H” pulse width (read)	60		ns	
	TSLR	SCL “L” pulse width (read)	60		ns	
D/CX	TDCS	D/CX setup time	10			
	TDCH	D/CX hold time	10			
SDA (DIN) (DOUT)	TSDS	Data setup time	10		ns	For max, CL=30pF For min, CL=8pF
	TSDH	Data hold time	10		ns	
	TACC	Access time	10	50	ns	
	TOH	Output disable time	15	50	ns	

Table 6.3: 4-line Serial Interface Data Timing Characteristics

6.5 Reset Timing

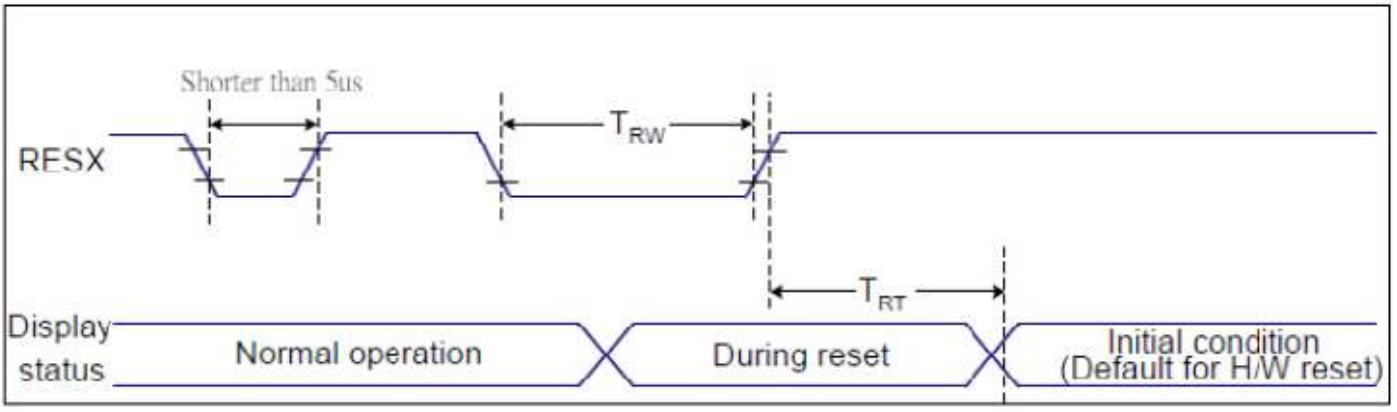


Figure 6.5: Reset Timing Diagram

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:

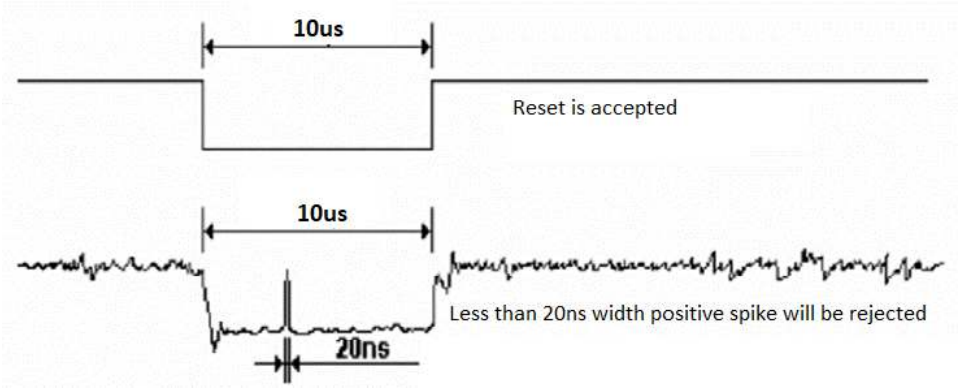
1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5ms after a rising edge of RESX.

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. Cautions and Handling Precautions

7.1 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.

7.2 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.