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

TFT Display Module

Part Number

E22RA-FW280-N

Overview:

- 2.2-inch TFT (41.7x56.16mm)
- 240(RGB)x320 pixels
- 3-wire SPI+16/18-bit RGB Interface
- White LED Backlight
- Wide Temp
- Transmissive/ Normally Black
- No Touch Panel
- 280 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 and backlight unit. The resolution of the 2.2" TFT-LCD contains 240x320 pixels and can display up to 65K/262Kcolors.

Features

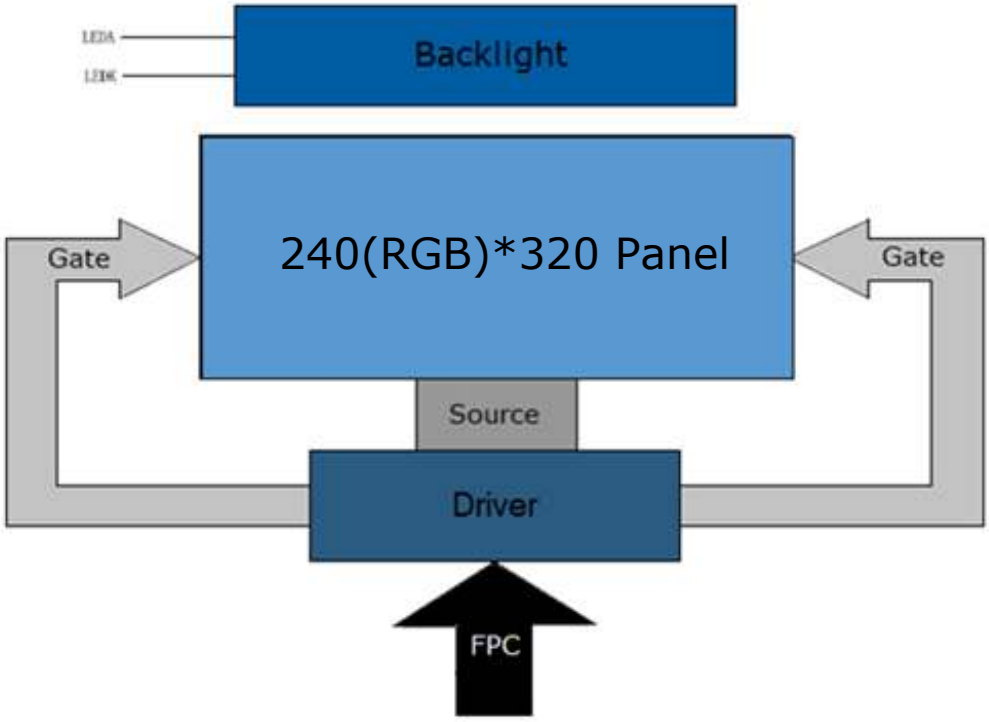
Low Input Voltage: 3.3V (TYP)
Display Colors of TFT LCD: 65K/262K colors
TFT Interfaces: 3SPI+16/18-bit RGB

General Information Items	Specification Main Panel	Unit	Note
TFT Display area (AA)	33.84 (H) x 45.12 (V) (1.5 inch)	mm	-
Driver element	TFT active matrix	-	-
Display colors	65K/262K	colors	-
Number of pixels	240(RGB)x320	dots	-
TFT Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.141 (H) x 0.141 (V)	mm	-
Viewing angle	6:00	o'clock	-
TFT Driver IC	ST7789V	-	-
Display mode	Transmissive/ Normally Black	-	-
Operating temperature	-20～+70	℃	-
Storage temperature	-30～+80	℃	-

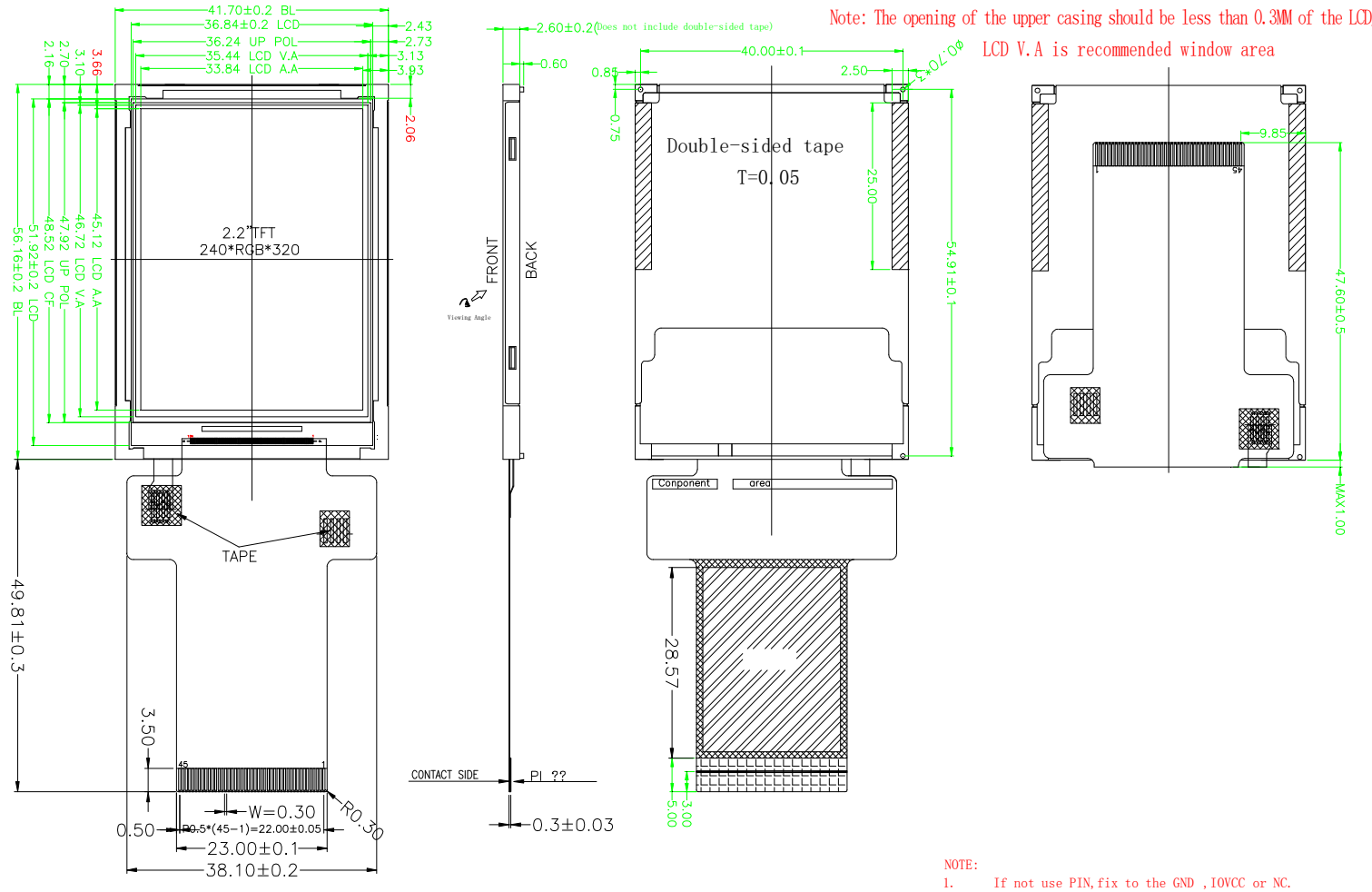
Mechanical Information

Item		Min	Typ.	Max	Unit	Note
Module size	Height (H)		41.70		mm	-
	Vertical (V)		56.16		mm	-
	Depth (D)		2.60		mm	-
Weight			TBD		g	-

1. Block Diagram



2. Outline Dimensions



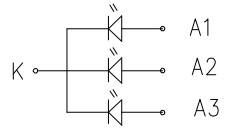
Note: The opening of the upper casing should be less than 0.3MM of the LCD/CF area.

LCD V.A is recommended window area

NO.	Pin Name
1	GND
2	XR
3	YD
4	XL
5	YU
6	NC
7	NC
8	NC
9	NC
10	RESET
11	VSYNC
12	HSYNC
13	DOTCLK
14	DE
15	DB17
16	DB16
17	DB15
18	DB14
19	DB13
20	DB12
21	DB11
22	DB10
23	DB9
24	DB8
25	DB7
26	DB6
27	DB5
28	DB4
29	DB3
30	DB2
31	DB1
32	DB0
33	SDO
34	SDI
35	NC
36	SCL
37	NC
38	CS
39	VCC
40	VCC
41	LEDK
42	LEDA1
43	LEDA2
44	LEDA3
45	GND

NOTE:

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



LED CIRCUIT DIAGRAM

NOTES:

1. DISPLAY TYPE: 2.2", TFT-LCD, 65K COLORS
2. DISPLAY MODE: T/N NORMALLY WHITE
3. VIEWING DIRECTION: 6:00
4. DRIVER IC: ST7789V (COG)
5. VCI: 3.3V,IOVCC: 1.8V-3.3V(TYP)
6. OPERATING TEMP: -20°C TO 70°C
   STORAGE TEMP: -30°C TO 80°C
7. BACK LIGHT: LED WHITE, 3 LED, 45-60mA, 3.2±0.3V
8. RoHS COMPLIANT.

ReV.	Revision content description	Date
A	FIRST	2015/09/21

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TOLERANCE()		DRAWING NAME	E22RA-FW280-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: FH12S-45S-0.5SH(55)

NO.	Symbol	Description	I/O
1	GND	Ground	P
2	XR(NC)	Touch panel right glass terminal	A/D
3	YD(NC)	Touch panel bottom film terminal	A/D
4	XL(NC)	Touch panel left glass terminal	A/D
5	YU(NC)	Touch panel top film terminal	A/D
6	NC	NC	
7	NC	NC	
8	NC	NC	
9	NC	NC	
10	RESET	Reset signal of device. Setting either pin low initializes the LSI. Must be reset to properly initialize the chip.	I
11	VSYNC	Vertical (frame) synchronizing input signal for RGB interface. If not used, fix to VDDI or DGND.	I
12	HSYNC	Horizontal (Line) synchronizing input signal for RGB interface. If not used, fix to VDDI or DGND.	I
13	DOTCLK	Dot clock signal for RGB interface. If not used, fix to VDDI or DGND.	I
14	DEN	Data enable signal for RGB interface. If not used, fix to VDDI or DGND.	I
15-32	DB17-DB0	DB17-DB0 are used as RGB interface data bus. 16-bit RGB I/F: DB17-DB13, DB11-DB1 18-bit RGB I/F: DB17-DB0 If not used, fix to VDDI or DGND.	I/O
33	SDO	SPI interface output pin. The data is output on the falling edge of the SCL signal. If not used, leave pin open.	O
34	SDA	SPI interface input pin. The data is latched on the rising edge of the SCL signal. If not used, fix to VDDI or DGND.	O
35	NC	NC	
36	SCL	Serial interface clock pin. If not used, pin to VDDI or DGND.	I
37	NC	NC	
38	CS	Chip select input pin. Low enabled.	I
39	VCC	Supply voltage (3.3V)	P
40	VCC	Supply voltage (3.3V)	P
41	LEDK	Cathode pin of backlight	P
42	LEDA1	Anode pin of backlight	P
43	LEDA2	Anode pin of backlight	P
44	LEDA3	Anode pin of backlight	P
45	GND	Ground	P

I: Input, O: Output, P: Power

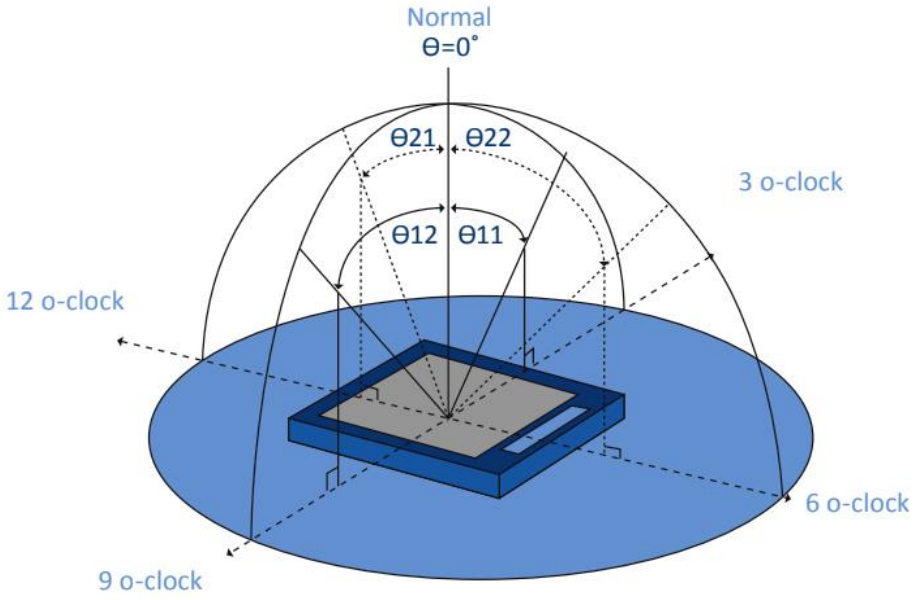
4. LCD Optical Characteristics

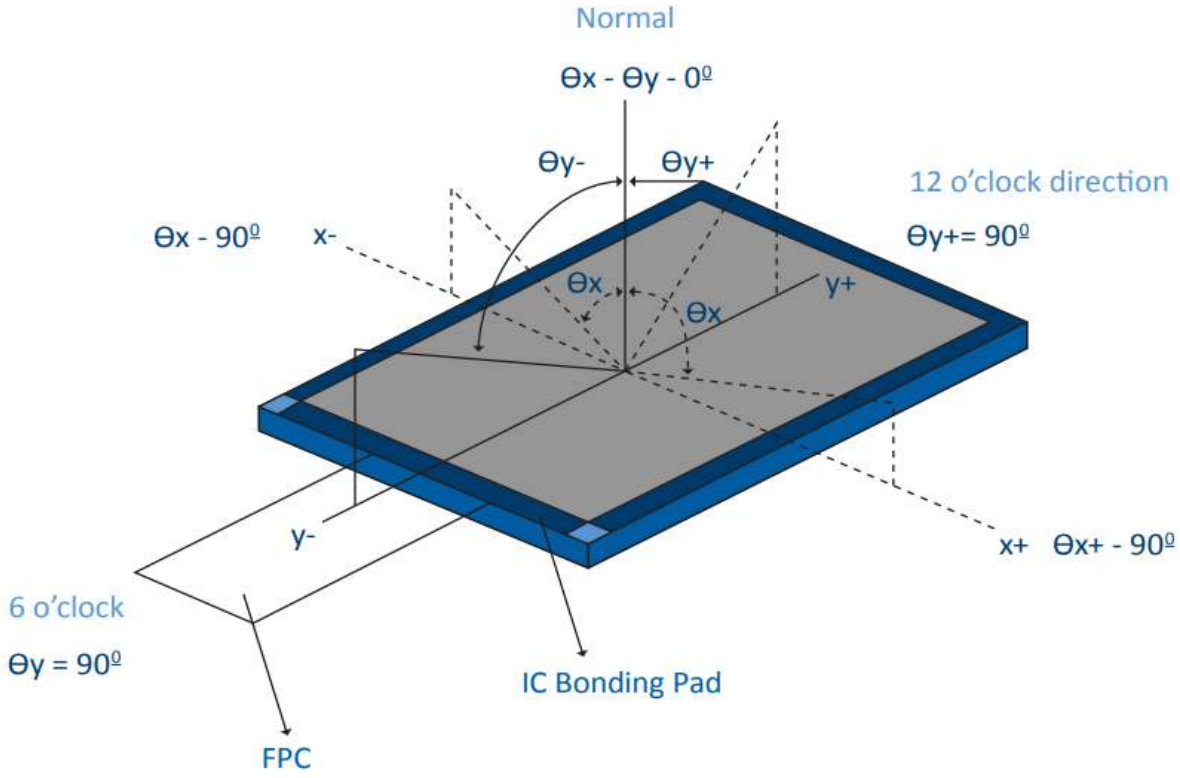
4.1 Optical Specifications

Item		Symbol	Condition	Min	Typ.	Max	Unit	Note
Transmittance		T(%)	--	5.5	6.0	--	%	(3)
Contrast Ratio		CR	θ=0	250	350	--	%	(2)
Response time	Rising	TON	25˚C	--	20	30	ms	(4)
	Falling	TOFF						
Color Gamut		S (%)		--	48	--	%	(5)
Color Filter Chromaticity	White	W_X		0.253	0.303	0.353		(5)(6)
		W_Y		0.309	0.359	0.409		
	Red	R_X		0.581	0.631	0.681		
		R_Y		0.265	0.315	0.365		
	Green	G_X		0.261	0.311	0.361		
		G_Y		0.478	0.528	0.578		
	Blue	B_X		0.081	0.131	0.181		
		B_Y		0.119	0.169	0.219		
Viewing angle	Hor.	ΘL	CR≥10	40	45	--	degree	(1)(6)
		ΘR		40	45	--		
	Ver.	ΘT		45	50	--		
		ΘB		15	20	--		
Option View Direction		ALL						(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.

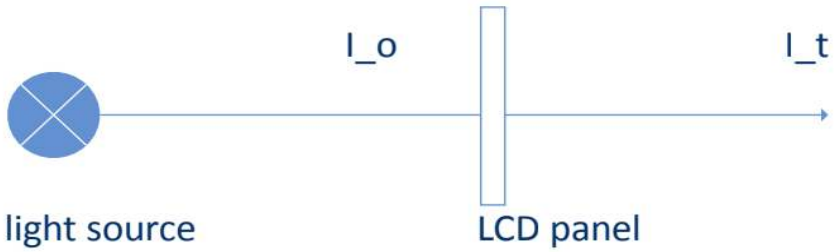




(2) Definition of Contrast Ratio (Cr): measured at the center point of panel. The contrast ratio (Cr) measured on a module, is the ratio between the luminance (Lw) in a full white area (R=G=B=1) and the luminance (Ld) in a dark area (R=G=B=0).

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

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

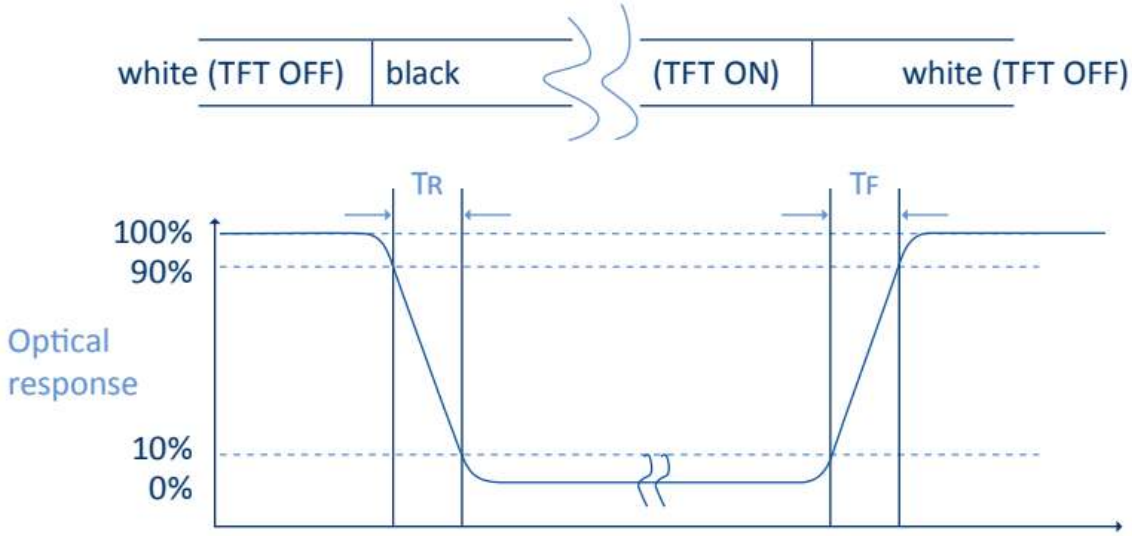


The transmittance is defined as:

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

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.

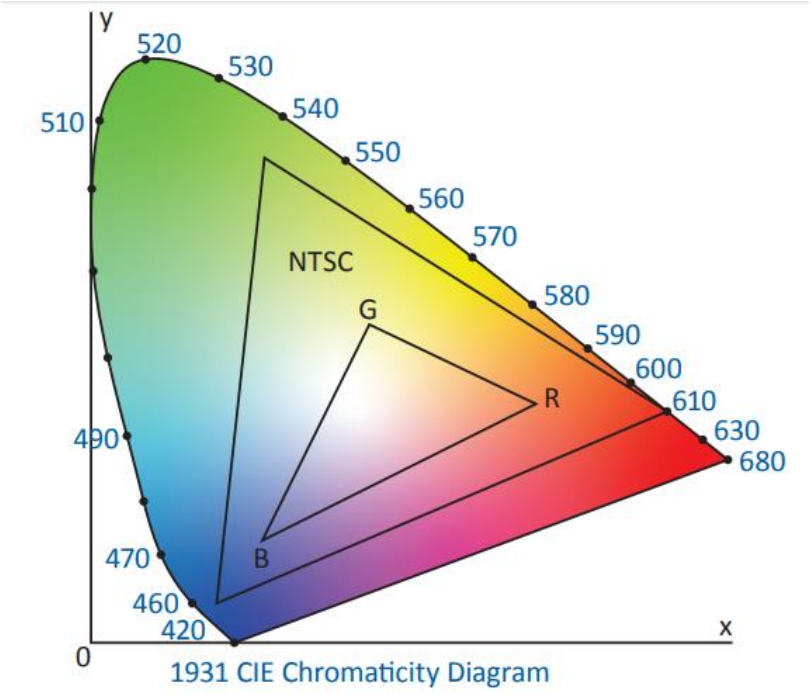
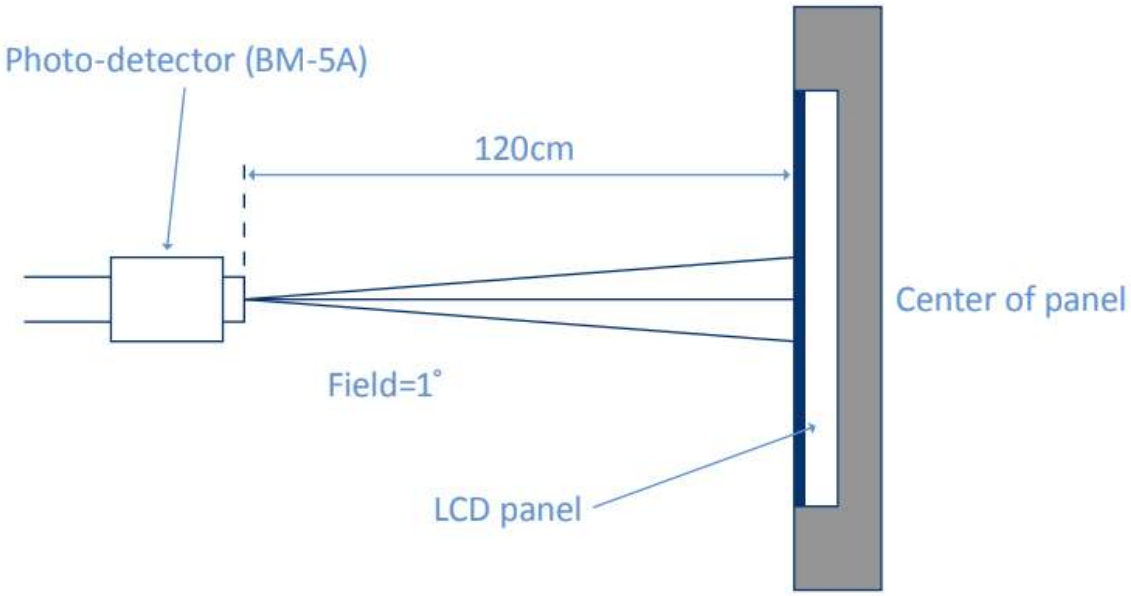


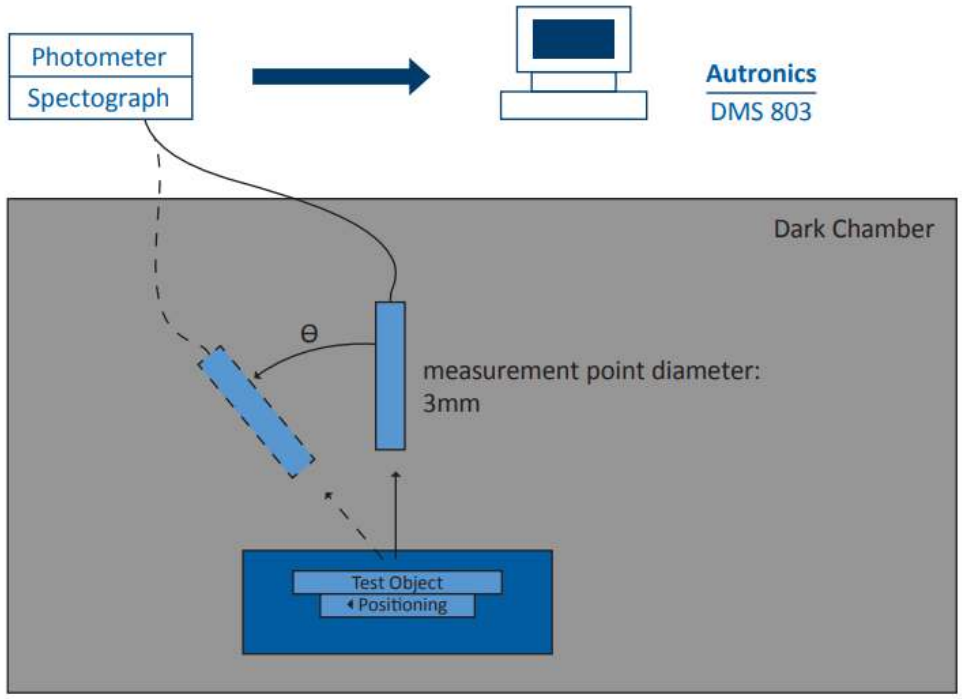
Fig. 1931 CIE chromacity diagram

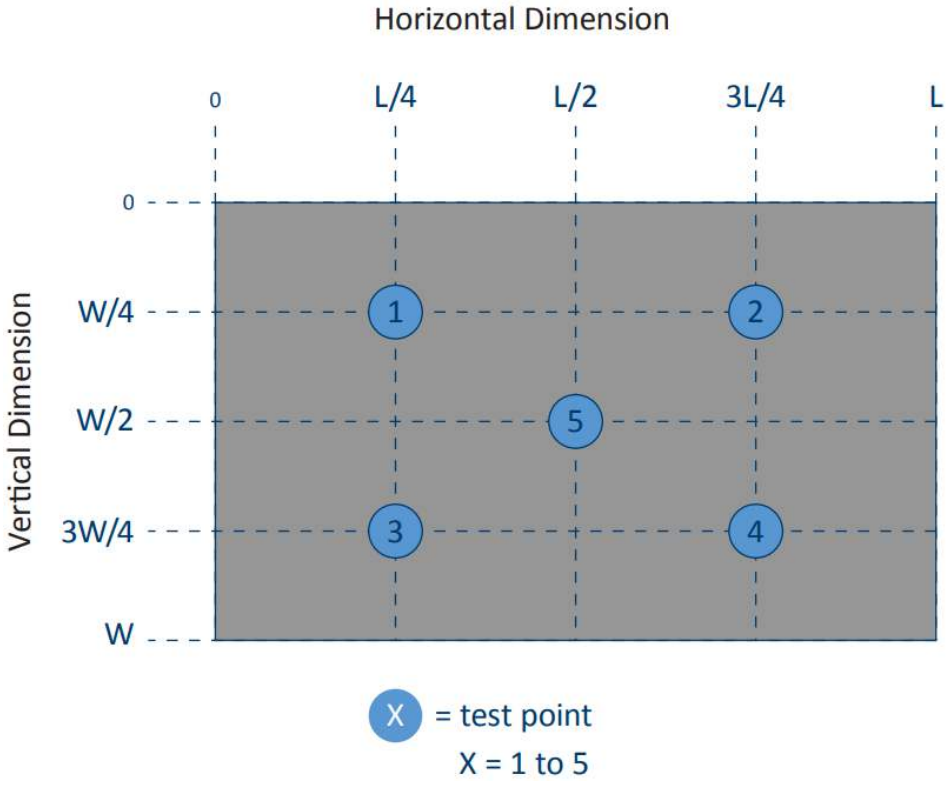
$$\text{Color gamut: } S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$

(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 ˚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	--	7	--	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	

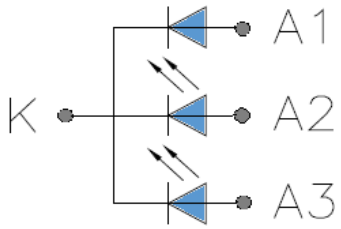
5.3 LED Backlight Characteristics

Item	Symbol	Min	Typ.	Max	Unit	Note
Forward Current	IF	45	60	--	mA	
Forward Voltage	VF	--	3.2	--	V	
LCM Luminance	LV	280	--	--	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

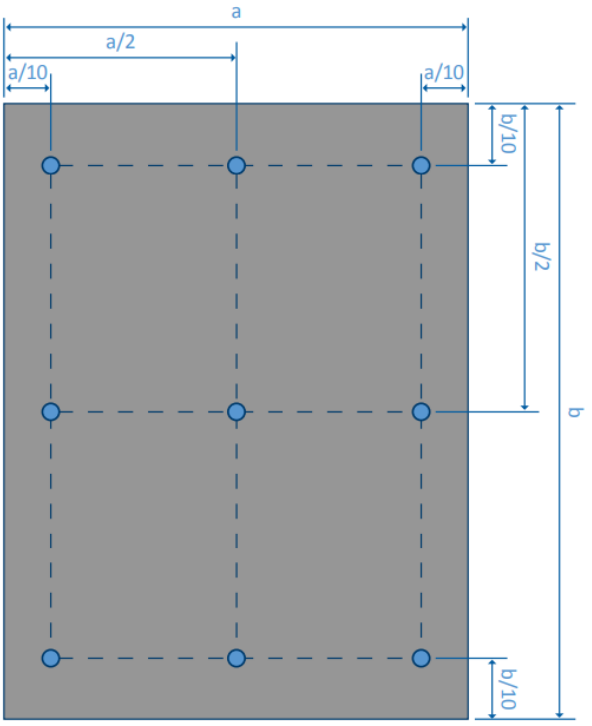
Note 1: LED lifetime (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25±3 ℃, typical IL value indicated in the above table until the brightness becomes less than 50%.

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



Backlight 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. AC Characteristic

6.1 RGB Interface Characteristics

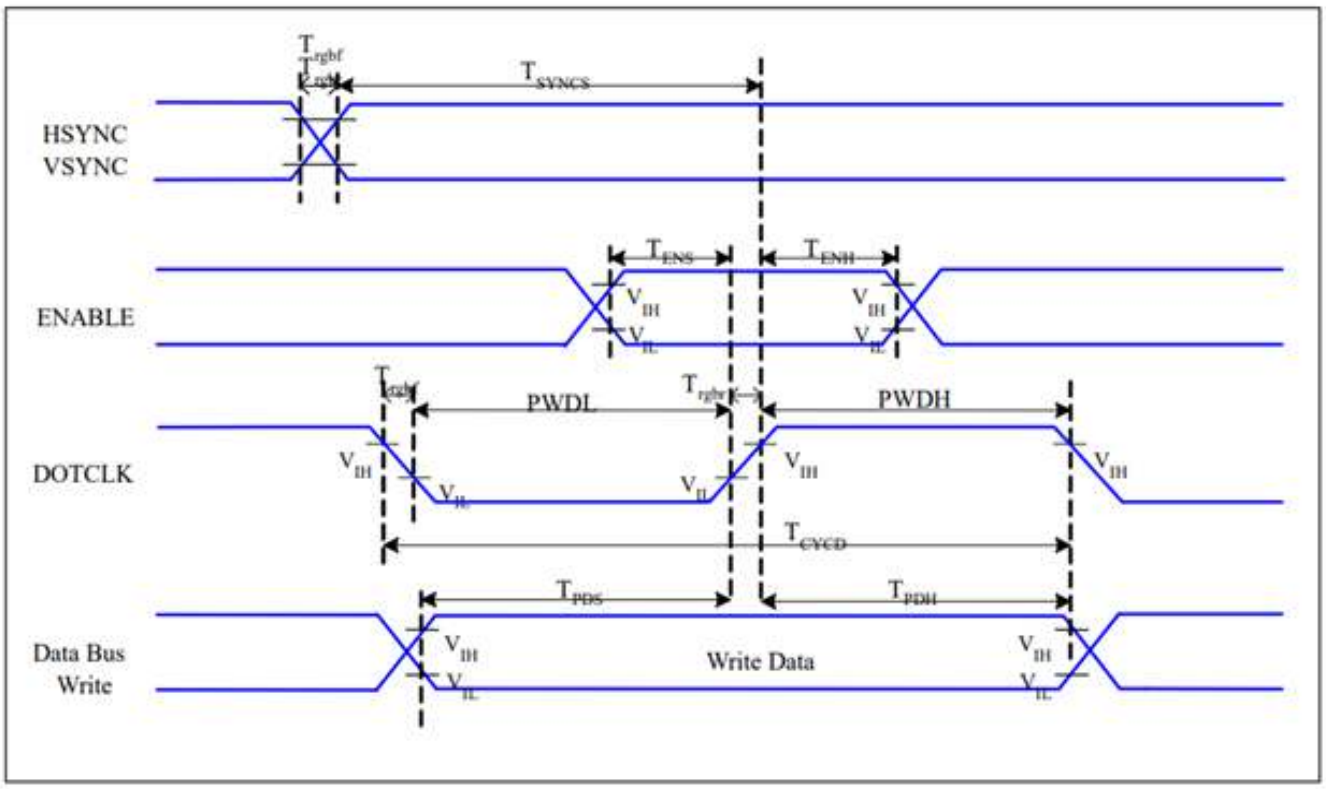


Figure 6.1: RGB Interface Timing Characteristics

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	-	ns	
	T_{RGHR}, T_{RGHF}	DOTCLK Rise/Fall Time	-	20	ns	
DB	T_{PDS}	PD Data Setup Time	50	-	ns	
	T_{PDH}	PD Data Hold Time	50	-	ns	

Table 6.1: 18/16-bit RGB Interface Timing Characteristics

6.2 Display Serial Interface Characteristics (3-line serial)

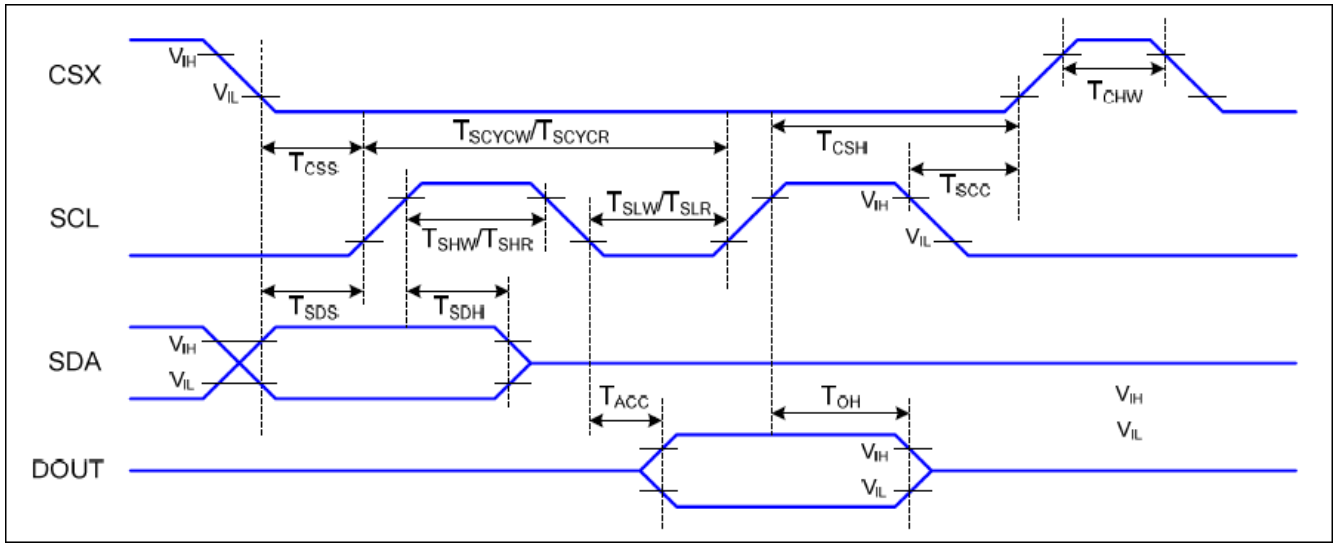


***Figure 6.3: Serial Interface* 3-SPI Timing Diagram**

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 Reset Timing

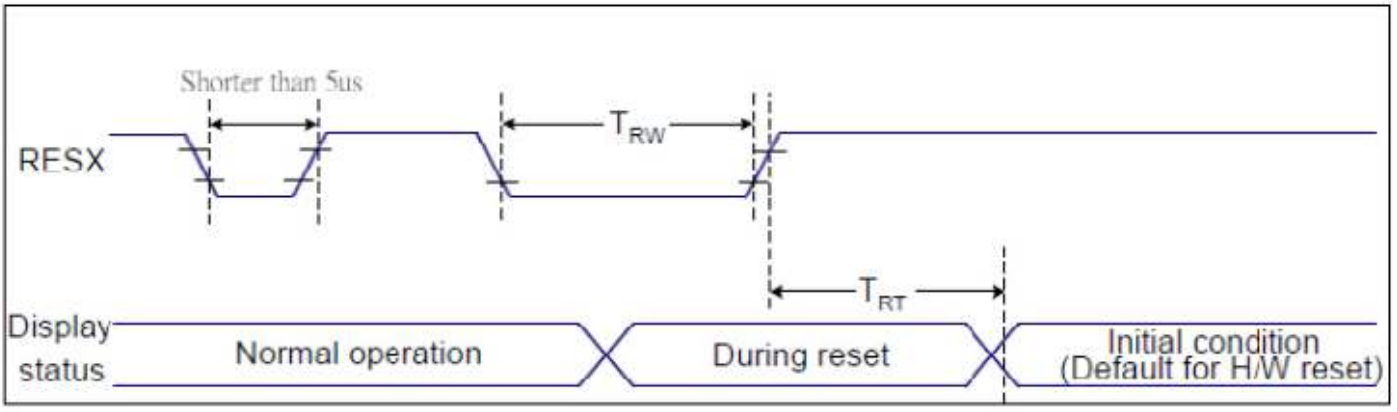


Figure 6.3: Reset Timing

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:

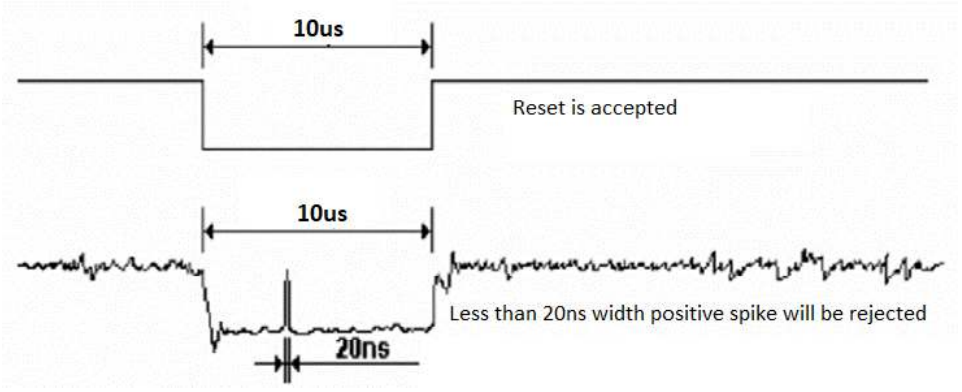
1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5ms after a rising edge of RESX.

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. 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.