FOCUS LCDs
LCDs MADE SIMPLE®

TFT | OLED | CHARACTER | GRAPHIC | UWVD | SEGMENT | CUSTOM

TFT Display Module

Part Number

E20RC-I-RS900-N

Overview:

- 2.0-inch TFT (46.5X41.56mm)
- 480x360 Pixels
- 3SPI+16/18/24-Bit RGB
- Special Temperature Range
- All Viewing Angle

- Transmissive, Normally Black
- No Touch Panel
- 900 NITS
- TFT IC: ST7701S
- 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, capacitive touch panel and backlight unit. The resolution of the 2.0" TFT-LCD contains 480(RGB)x360 pixels and can display up to 16.7M colors.

Features

Input Voltage: 3.3V

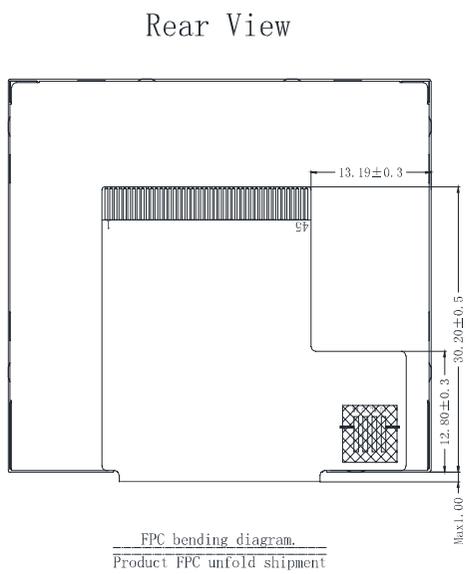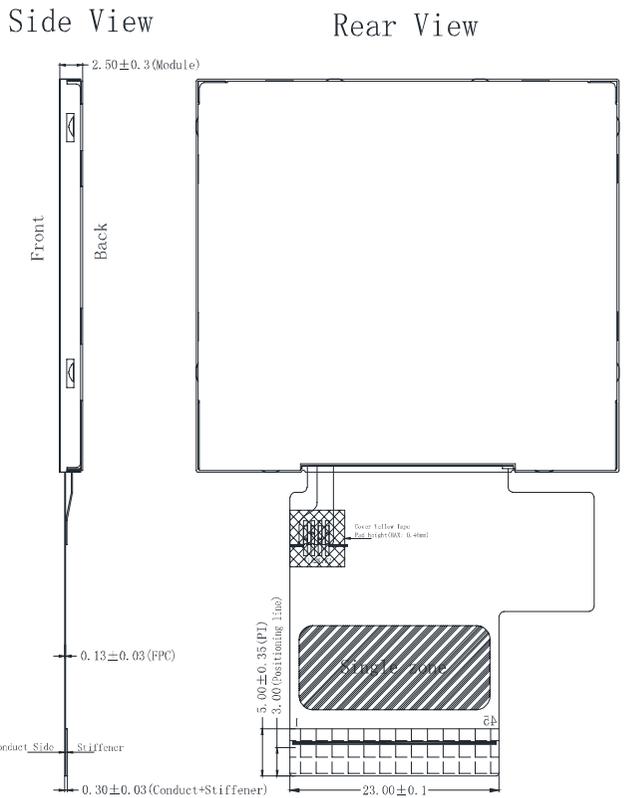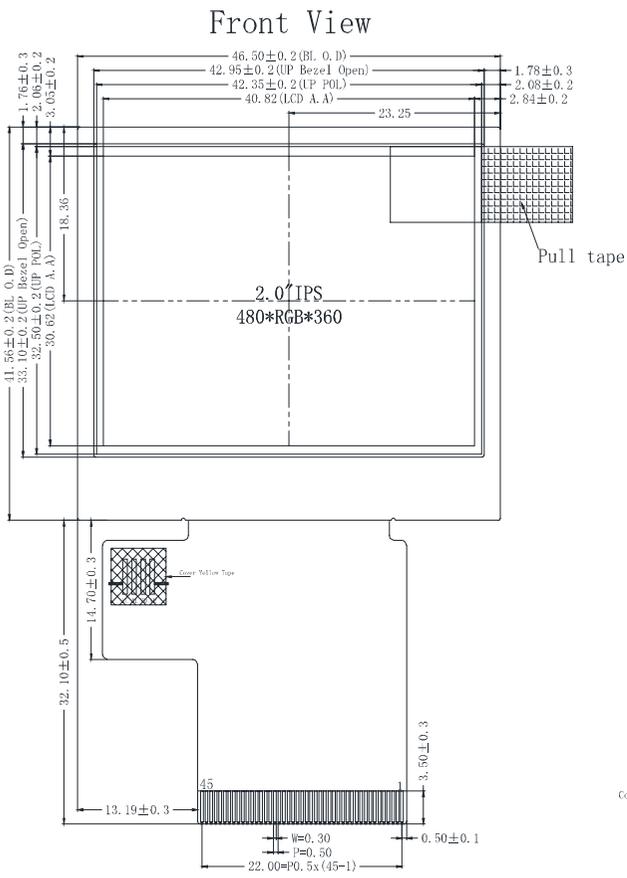TFT Interface: 3SPI+16/18/24-Bit RGB

Controller IC: ST7701S

General Information Items	Specification Main Panel	Unit	Note
TFT Display Area (AA)	40.82(H)*30.62(V) (2.0inch)	mm	
Driver Element	TFT active matrix	--	
Display Colors	16.7M	colors	
Number of Pixels	480(RGB)*360	dots	
TFT Pixel Arrangement	RGB tilt stripe	--	
Pixel Pitch	0.08505(H)*0.08505(V)	mm	
Viewing Angle	All	o'clock	
TFT Controller IC	ST7701S	--	
LCM Interface	3SPI+16/18/24-Bit RGB	--	
Display Mode	Transmissive/Normally Black	--	
Operating Temperature	-30 to +85	°C	
Storage Temperature	-30 to +85	°C	

Mechanical Information

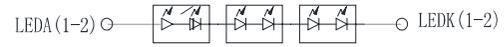| Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	--	46.5	--	mm	
	Vertical (V)	--	41.56	--	mm	
	Depth (D)	--	2.5	--	mm	
Weight		--	10	--	g	Approximate

Rev.	Description	Date
1.0	First	09-17-2020

Note: The upper case window must be smaller than LCD POL 0.3mm or more,
LCD V.A is recommended for the upper lens window.

Front View

46.50±0.2 (BL O.D)
42.95±0.2 (UP Bezel Open)
42.35±0.2 (UP POL)
40.82 (LCD A.A)
23.25

1.78±0.3
2.06±0.2
2.08±0.2
2.84±0.2

1.76±0.3
2.06±0.2
3.05±0.2

18.36

41.56±0.2 (BL O.D)
33.10±0.2 (UP Bezel Open)
32.50±0.2 (UP POL)
30.62 (LCD A.A)

2.0"IPS
480*RGB*360

Pull tape

14.70±0.3
Cover Yellow Tape

32.10±0.5
3.50±0.3

45
13.19±0.3

W=0.30
P=0.50
0.50±0.1
22.00=P0.5x(45-1)

Side View

2.50±0.3 (Module)

Front   Back

0.13±0.03 (FPC)

Conduct_Side   Stiffener

0.30±0.03 (Conduct+Stiffener)

Rear View

Cover Yellow Tape
Pad height(MAX: 0.48mm)

5.00±0.35 (P1)
3.00 (Positioning line)

Single Zone

42
1
23.00±0.1

FPC_bending_diagram.
Product FPC unfold shipment

Rear View

13.19±0.3
45

30.20±0.5
12.80±0.3
Max1.00

NO	PIN
1	XR(NC)
2	YD(NC)
3	XL(NC)
4	YU(NC)
5	GND
6	GND
7	VCI
8	IOVCC
9	SDO
10	SDI
11	SCL
12	CS
13	RESET
14	DB23(R7)
15	DB22(R6)
16	DB21(R5)
17	DB20(R4)
18	DB19(R3)
19	DB18(R2)
20	DB17(R1)
21	DB16(R0)
22	DB15(G7)
23	DB14(G6)
24	DB13(G5)
25	DB12(G4)
26	DB11(G3)
27	DB10(G2)
28	DB9(G1)
29	DB8(G0)
30	DB7(B7)
31	DB6(B6)
32	DB5(B5)
33	DB4(B4)
34	DB3(B3)
35	DB2(B2)
36	DB1(B1)
37	DB0(B0)
38	DE
39	PCLK
40	HSYNC
41	VSYNC
42	NC
43	LEDK(1-2)
44	NC
45	LEDA(1-2)

NOTES:

1. DISPLAY TYPE: 2.0" TFT-LCD, 16.7M COLORS
2. DISPLAY MODE: ADS
3. LCM DRIVER IC: ST7701S
4. LCD INTERFACE: 3SPI+16/18/24-Bit RGB
5. VCI: 3.3V; IOVCC: 1.8V-3.3V
6. OPERATING TEMPERATURE: -30°C TO +85°C
7. STORAGE TEMPERATURE: -30°C TO +85°C
8. VIEWING DIRECTION: ALL
9. BACKLIGHT: WHITE LED, 6 LED, 20mA, 18.6+/-0.3V
10. ROHS COMPLIANT.

LEDA (1-2) ○———▷▷—▷▷—▷▷———○ LEDK (1-2)

Model Name:	E20RC-I-RS900-N		
General Tol:	±0.3		
Approvals		Date	
DWN:			
CHK:			
APP:			

FOCUS LCDs
LCDs MADE SIMPLE®

Drawing No.:

Scale:

Size:

Unit: mm

Page: 1/1

2. Input Terminal Pin Assignment

2.1 TFT Pin Assignment

Recommended TFT Connector: FH12S-45S-0.5SH(55)

NO.	Symbol	Description	I/O
1	XR (NC)	Touch panel Right Glass Terminal. Leave the pin open when not in use.	A/D
2	YD (NC)	Touch panel Bottom Film Terminal. Leave the pin open when not in use.	A/D
3	XL (NC)	Touch panel Left Glass Terminal. Leave the pin open when not in use.	A/D
4	YU (NC)	Touch panel Top Film Terminal. Leave the pin open when not in use.	A/D
5	GND	Ground.	P
6	GND	Ground.	P
7	VCI	Supply voltage (3.3V).	P
8	IOVCC	Supply voltage (Logic)(1.8~3.3V).	P
9	SDO	Serial data output pin used for the SPI Interface. Leave the pin open when not in use.	O
10	SDI	SDI: Serial data input/output bidirectional pin for SPI Interface.	I/O
11	SCL	SCL: Serial clock input for SPI interface.	I
12	CS	- A chip select signal. Low: the chip is selected and accessible. High: the chip is not selected and not accessible.	I
13	RESET	-The external reset input. -Initializes the chip with a low input. Be sure to execute a power-on reset after supplying the power.	I
14-37	DB23-DB0	24-bit parallel data bus for RGB interface. Connect to IOVCC pin or GND pin when not in use.	I/O
38	DE	Data enable signal for RGB interface operation. Low: access enabled. High: access inhibited. Fix to IOVCC pin or GND pin when not in use.	I
39	PCLK	Dot clock signal for RGB interface operation.	I
40	HSYNC	Line synchronizing signal for RGB interface operation.	I
41	VSYNC	Frame synchronizing signal for RGB interface operation.	I
42	NC	Not Connected.	--
43	LEDK(1-2)	Cathode pin of backlight.	P
44	NC	Not Connected.	--
45	LEDA(1-2)	Anode pin of backlight.	P

I: Input, O: Output, P: Power

3. LCD Optical Characteristics

3.1 Optical Specifications

Item		Symbol	Condition	Min	Typ.	Max	Unit	Note
Contrast Ratio		CR		800	1000	--		(2)
Response Time	Rising	$T_R + T_F$		--	35	45	ms	(4)
	Falling							
Color Gamut		S(%)		50	55	--	%	(5)
Color Filter Chromaticity	White	W_X	θ=0 Normal viewing angle	0.2691	0.3091	0.3491		(5)(6) CA-310
		W_Y		0.2980	0.3380	0.3780		
	Red	R_X		0.5654	0.6054	0.6454		
		R_Y		0.3283	0.3683	0.4083		
	Green	G_X		0.2905	0.3305	0.3805		
		G_Y		0.5355	0.5755	0.6155		
	Blue	B_X		0.1046	0.1446	0.1846		
		B_Y		0.0437	0.0837	0.1237		
Viewing Angle	Hor.	Θ_L	CR≥10	75	80	--	degree	(1)(6)
		Θ_R		75	80	--		
	Ver.	Θ_U		75	80	--		
		Θ_D		75	80	--		
Option View Direction			All					

Measuring Conditions:

1. Dark Room
2. Ambient Temperature of 25±2°C
3. 15 Minute Warm up

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.
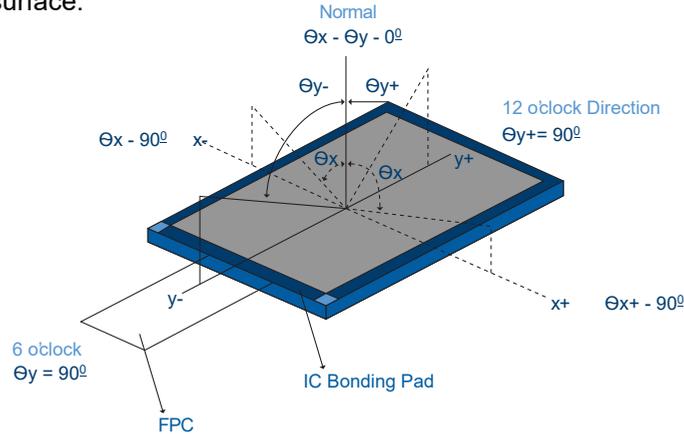

(2) Definition of Contrast Ratio:

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 equation for transmittance Tr is:

$$Tr = \frac{It}{Io} \times 100\%$$
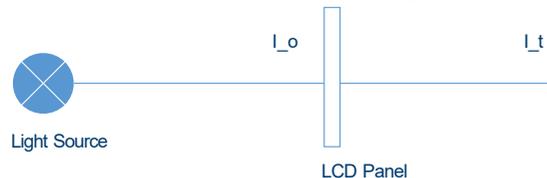
Io = the brightness of the light source.
It = the brightness after panel transmission

(4) Definition of Response Time (T$_R$, T$_F$):

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.
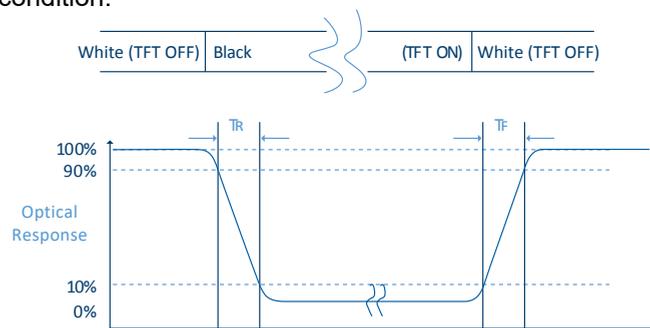
(5) Definition of Color Gamut:

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.
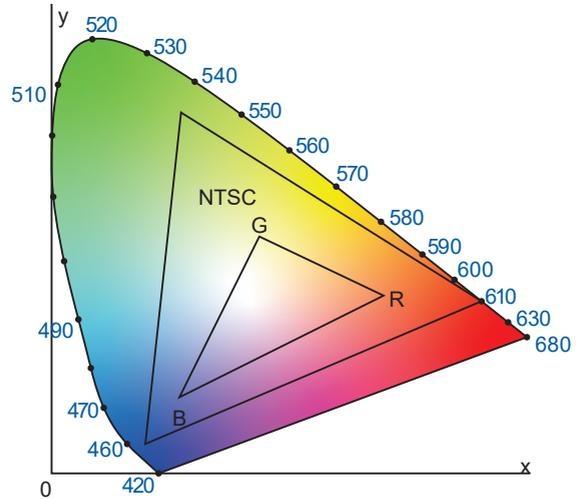

Fig. 1931 CIE Chromacity Diagram

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

(6) Definition of Optical Measurement Setup:

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.
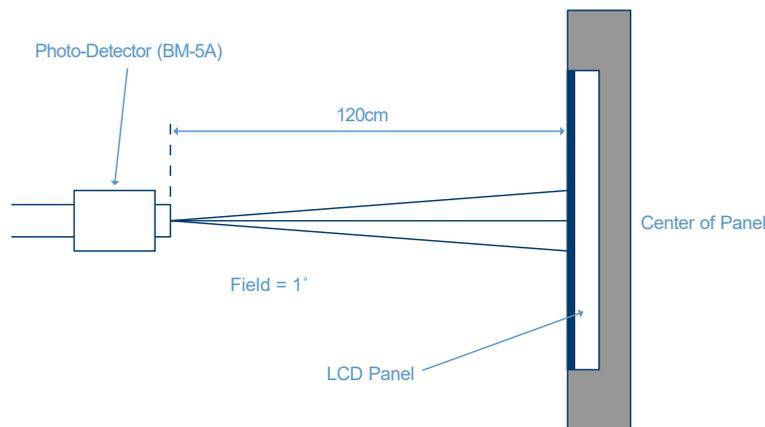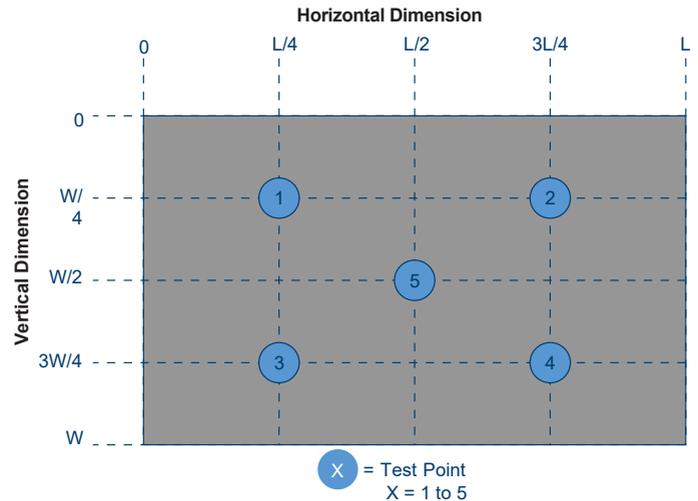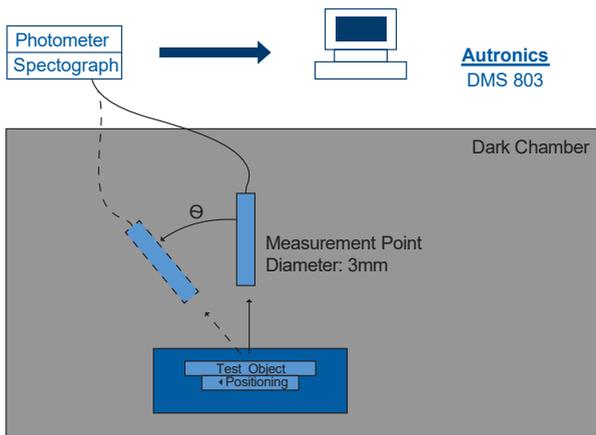
4. TFT Electrical Characteristics

4.1 Absolute Maximum Rating (Ta=25°C, VSS=0V)

Characteristics	Symbol	Min	Max	Unit
Digital Supply Voltage	VCI	-0.3	4.6	V
Digital Interface Supply Voltage	IOVCC	-0.3	4.6	V
Operating Temperature	T_{OP}	-30	+85	°C
Storage Temperature	T_{ST}	-30	+85	°C

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.

4.2 DC Electrical Characteristics

Characteristics	Symbol	Min	Typ.	Max	Unit	Note
Digital Supply Voltage	VCI	2.5	3.3	3.6	V	
Digital Interface Supply Voltage	IOVCC	1.65	1.8	3.3	V	
Normal Mode Current	IDD	--	25	50	mA	
Level Input Voltage	V_{IH}	0.7* IOVCC	--	IOVCC	V	
	V_{IL}	GND	--	0.3* IOVCC	V	
Level Output Voltage	V_{OH}	0.8* IOVCC	--	IOVCC	V	
	V_{OL}	GND	--	0.2* IOVCC	V	

4.3 LED Backlight Characteristics

Characteristics	Symbol	Min	Typ.	Max	Unit	Note
Forward Current	I_F	15	20	--	mA	
Forward Voltage	V_F	--	18.6	--	V	
LCM Luminance	LV	850	900	--	cd/m2	Note 3
LED life time	Hr	30000	--	--	Hour	Note 1, 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°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 I_F=20mA. The LED lifetime could be decreased if operating IF is larger than 20mA. The constant current driving method is suggested.

B/L Circuit
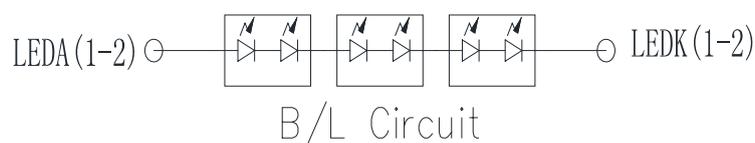
Note 3: *Luminance Uniformity of these 9 points is defined as below:*
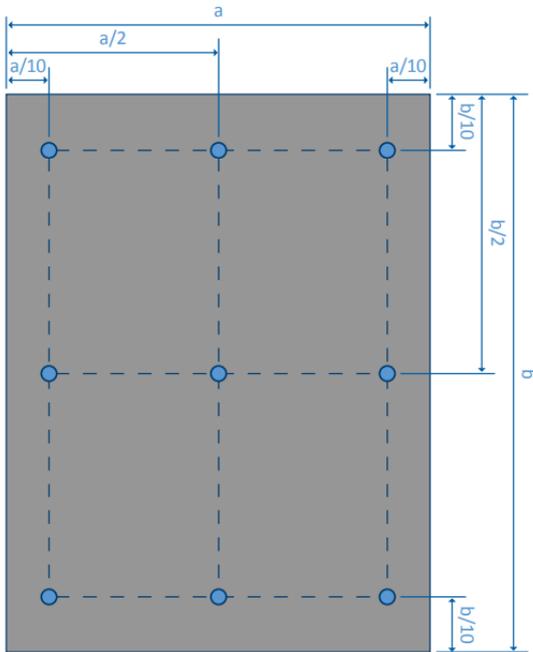
$$Luminance = \frac{(Total\ Luminance\ of\ 9\ Points)}{9}$$

$$Uniformity = \frac{Minimum\ Luminance\ in\ 9\ Points(1\text{-}9)}{Maximum\ Luminance\ in\ 9\ Points(1\text{-}9)}$$

www.FocusLCDs.com

5.0 TFT AC Characteristics

5.1 High Speed Data Transmission: Data-Clock Timing

For high speed data transmission data-clock timing diagrams and tables, see table and diagram on page 95 of the data sheet for controller IC ST7701S. The data sheet can be found here: https://focuslcds.com/wp-content/uploads/Drivers/ST7701S-V1.2.pdf

5.2 High Speed Data Transmission

For high speed data transmission diagrams and tables, see the first table and diagram page 95 of the data sheet for controller IC ST7701S. The data sheet can be found here: https://focuslcds.com/wp-content/uploads/Drivers/ST7701S-V1.2.pdf

5.3 Turnaround Procedure

For turnaround procedure diagrams and tables, see the second table and diagram page 99 of the data sheet for controller IC ST7701S.The data sheet can be found here: https://focuslcds.com/wp-content/uploads/Drivers/ST7701S-V1.2.pdf

5.4 Switching the Clock Lane Between Clock Transmission and Low-Power Mode

For switching the clock lane between clock transmission and low-power mode tables and diagrams, see page 81 of the data sheet for controller IC ST7701S. The data sheet can be found here: https://focuslcds.com/wp-content/uploads/Drivers/ST7701S-V1.2.pdf

5.5 Reset Timing Characteristics

For the reset timing characteristics table and diagram, see page 47 for the data sheet for controller IC ST7701S. The data sheet can be found here: https://focuslcds.com/wp-content/uploads/Drivers/ST7701S-V1.2.pdf

6.0 Quality Inspection Standards

For TFT quality inspection standards, please see the following link: https://focuslcds.com/lcd-resources/tft-quality-inspection-standards/

7.0 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.