FOCUS LCDs
LCDs MADE SIMPLE®

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

TFT Display Module

Part Number

E24RF-I-MW680-CB

Overview:

- 2.4-inch TFT (48.72x70.26mm)
- 480x640 Pixels
- 2-Lane MIPI DSI
- Wide Temperature Range
- All Viewing Angles

- IPS, Transmissive
- Capacitive Touch Panel
- 680 NITS
- TFT IC: ST7701SI, CTP IC: FT5436
- 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 2.4" TFT- LCD contains 480x640 pixels and can display up to 65K/262K/16.7M colors.

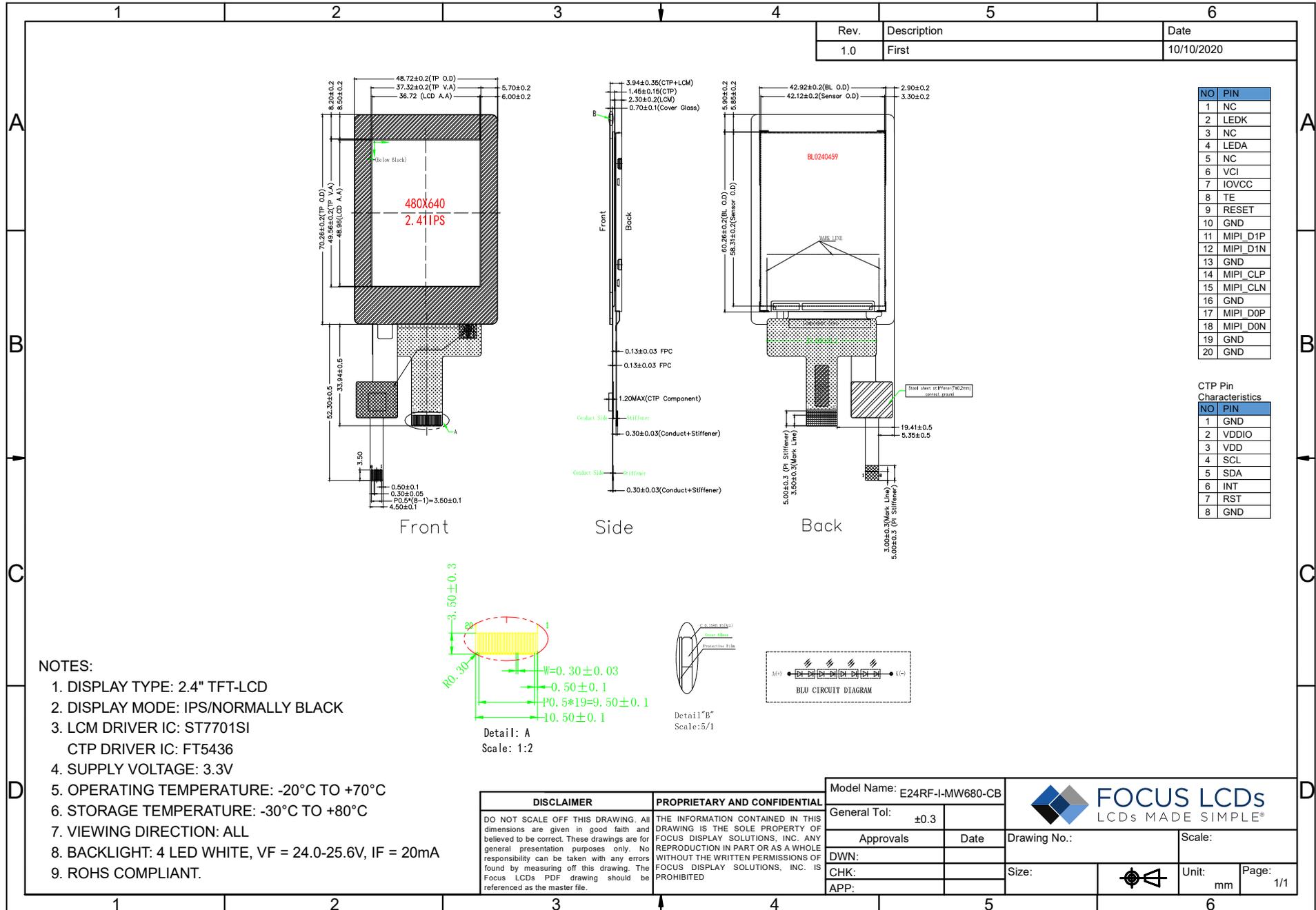## Features

Input Voltage: 3.3V
TFT Interface: 2-Lane MIPI
CTP Interface: I2C

General Information Items	Specification	Unit	Note
	Main Panel		
TFT Display Area (AA)	36.72(H) x 48.96(V) (2.4 inch)	mm	--
CTP View Area	37.32(H) x 49.56(V)	mm	--
Driver Element	TFT active matrix	--	--
Display Colors	65K/262K/16.7M	colors	--
Number of Pixels	480(RGB)x640	dots	--
TFT Pixel Arrangement	RGB vertical stripe	--	--
Pixel Pitch	0.0765 (H) x 0.0765 (V)	mm	--
Viewing Angle	ALL	o'clock	--
TFT Controller IC	ST7701SI	--	--
CTP Driver IC	FT5436	--	--
Display Mode	Transmissive/Normally Black	--	--
Touch Points	5-point and Gestures	--	--
Operating Temperature	-20 to +70	°C	--
Storage Temperature	-30 to +80	°C	--

Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	--	48.72	--	mm	--
	Vertical (V)	--	70.26	--	mm	--
	Depth (D)	--	3.94	--	mm	--
Weight		--	TBD	--	g	--

www.FocusLCDs.com

1. Outline Dimensions

Rev.	Description	Date
1.0	First	10/10/2020

Front / **Side** / **Back**

480X640
2.4IPS

BL0240459

MARK LINE

Detail: A
Scale: 1:2

Detail"B"
Scale:5/1

BLU CIRCUIT DIAGRAM

NO	PIN
1	NC
2	LEDK
3	NC
4	LEDA
5	NC
6	VCI
7	IOVCC
8	TE
9	RESET
10	GND
11	MIPI_D1P
12	MIPI_D1N
13	GND
14	MIPI_CLP
15	MIPI_CLN
16	GND
17	MIPI_D0P
18	MIPI_D0N
19	GND
20	GND

CTP Pin Characteristics

NO	PIN
1	GND
2	VDDIO
3	VDD
4	SCL
5	SDA
6	INT
7	RST
8	GND

NOTES:
1. DISPLAY TYPE: 2.4" TFT-LCD
2. DISPLAY MODE: IPS/NORMALLY BLACK
3. LCM DRIVER IC: ST7701SI
   CTP DRIVER IC: FT5436
4. SUPPLY VOLTAGE: 3.3V
5. OPERATING TEMPERATURE: -20°C TO +70°C
6. STORAGE TEMPERATURE: -30°C TO +80°C
7. VIEWING DIRECTION: ALL
8. BACKLIGHT: 4 LED WHITE, VF = 24.0-25.6V, IF = 20mA
9. ROHS COMPLIANT.

DISCLAIMER

DO NOT SCALE OFF THIS DRAWING. All dimensions are given in good faith and believed to be correct. These drawings are for general presentation purposes only. No responsibility can be taken with any errors found by measuring off this drawing. The Focus LCDs PDF drawing should be referenced as the master file.

PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF FOCUS DISPLAY SOLUTIONS, INC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSIONS OF FOCUS DISPLAY SOLUTIONS, INC. IS PROHIBITED

Model Name: E24RF-I-MW680-CB

General Tol: ±0.3

Approvals	Date	Drawing No.:		Scale:
DWN:				
CHK:		Size:		Unit: mm
APP:				Page: 1/1

2. Block Diagram

3. Input Terminal Pin Assignment

3.1   TFT Pin Assignment

Recommended TFT Connector: FH12S-20S-0.5SH(55)

NO.	Symbol	Description	I/O
1	NC	No connection.	--
2	LEDK	Cathode pin of backlight.	P
3	NC	No connection.	--
4	LEDA	Anode pin of backlight.	P
5	NC	No connection.	--
6	VCI	Supply voltage (3.3V).	P
7	IOVCC	I/O power supply voltage.	P
8	TE	Tearing effect output. Leave this pin open when not in use.	O
9	RESET	The external reset input. Initializes the chip with a low input. Be sure to execute a power-on reset after supplying power.	I
10	GND	Ground.	P
11	MIPI_D1P	MIPI DSI differential data pair (DSI-Dn+/-).	I/O
12	MIPI_D1N		
13	GND	Ground.	P
14	MIPI_CLP	MIPI DSI differential clock pair (DSI-CLK+/-).	I
15	MIPI_CLN		
16	GND	Ground.	P
17	MIPI_D0P	MIPI DSI differential data pair (DSI-Dn+/-).	I/O
18	MIPI_D0N		
19	GND	Ground.	P
20	GND	Ground.	P

I: Input, O: Output, P: Power

3.2   CTP Pin Assignment

NO.	Symbol	Description	I/O
1	GND	Ground.	P
2	VDDIO	I/O power supply voltage.	P
3	VDD	Supply voltage.	P
4	SCL	I2C clock input.	I
5	SDA	I2C data input and output.	I/O
6	INT	External interrupt to the host.	I
7	RST	External reset, low is active.	I
8	GND	Ground.	P

4. LCD Optical Characteristics

4.1 Optical Specifications

Item		Symbol	Condition	Min	Typ.	Max	Unit	Note
Color Gamut		S(%)		50	55	--	%	(5)
Contrast Ratio		CR		800	1000	--	%	(2)
Response Time	Rising	TR	θ=0 Normal viewing angle	--	--	35	ms	(4)
	Falling	TF						
Color Filter Chromaticity	White	WX		0.2620	0.3020	0.3420		(5)(6)
		WY		0.2850	0.3250	0.3650		
	Red	RX		0.5690	0.6090	0.6490		
		RY		0.3120	0.3520	0.3920		
	Green	GX		0.2880	0.3280	0.3680		
		GY		0.5400	0.5800	0.6200		
	Blue	BX		0.1140	0.1540	0.1940		
		BY		0.0410	0.0810	0.1210		
Viewing Angle	Hor.	ΘL	CR>10	70	80	--	degree	(1)(6)
		ΘR		70	80	--		
	Ver.	ΘT		70	80	--		
		ΘB		70	80	--		
Option View Direction			ALL					(1)

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.
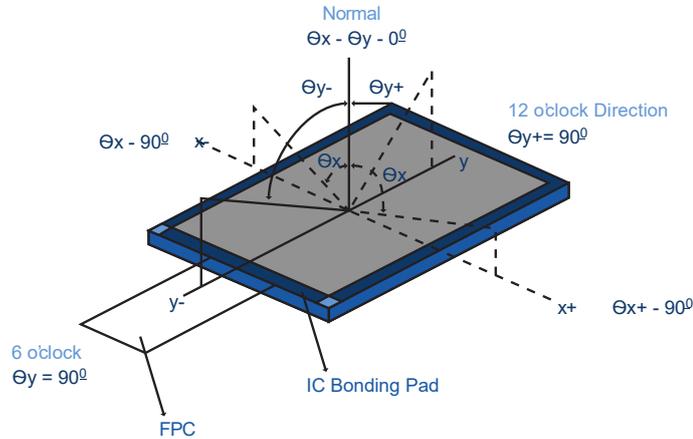
(2) Definition of Contrast Ratio:

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:

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

Io = the brightness of the light source.

It = the brightness after panel transmission
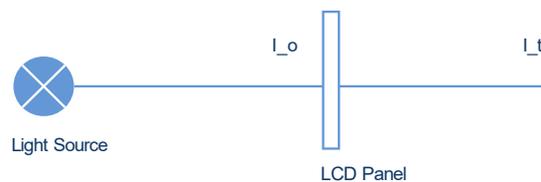
(4) Definition of Response Time (T_R, T_F):

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.

www.FocusLCDs.com
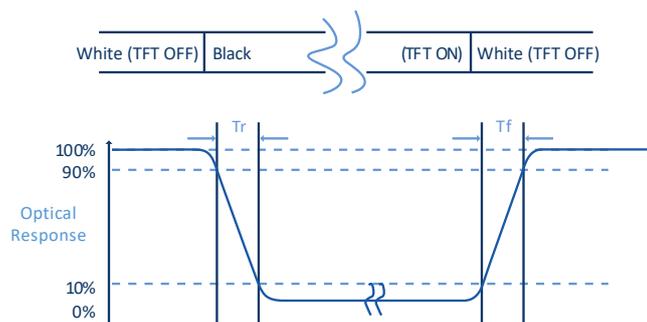
(5) Definition of Color Gamut:

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.
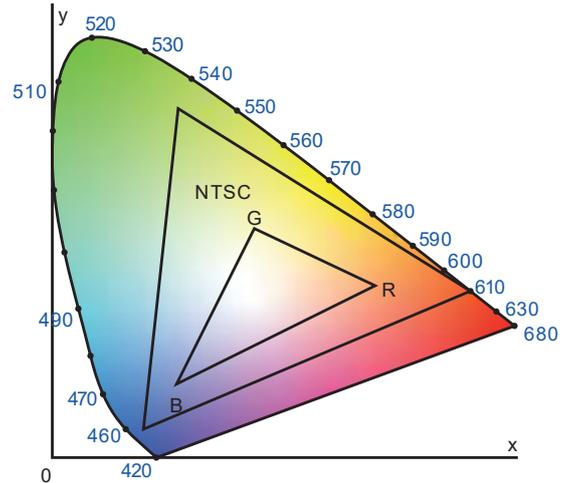

Fig. 1931 CIE Chromacity Diagram

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

(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.

www.FocusLCDs.com
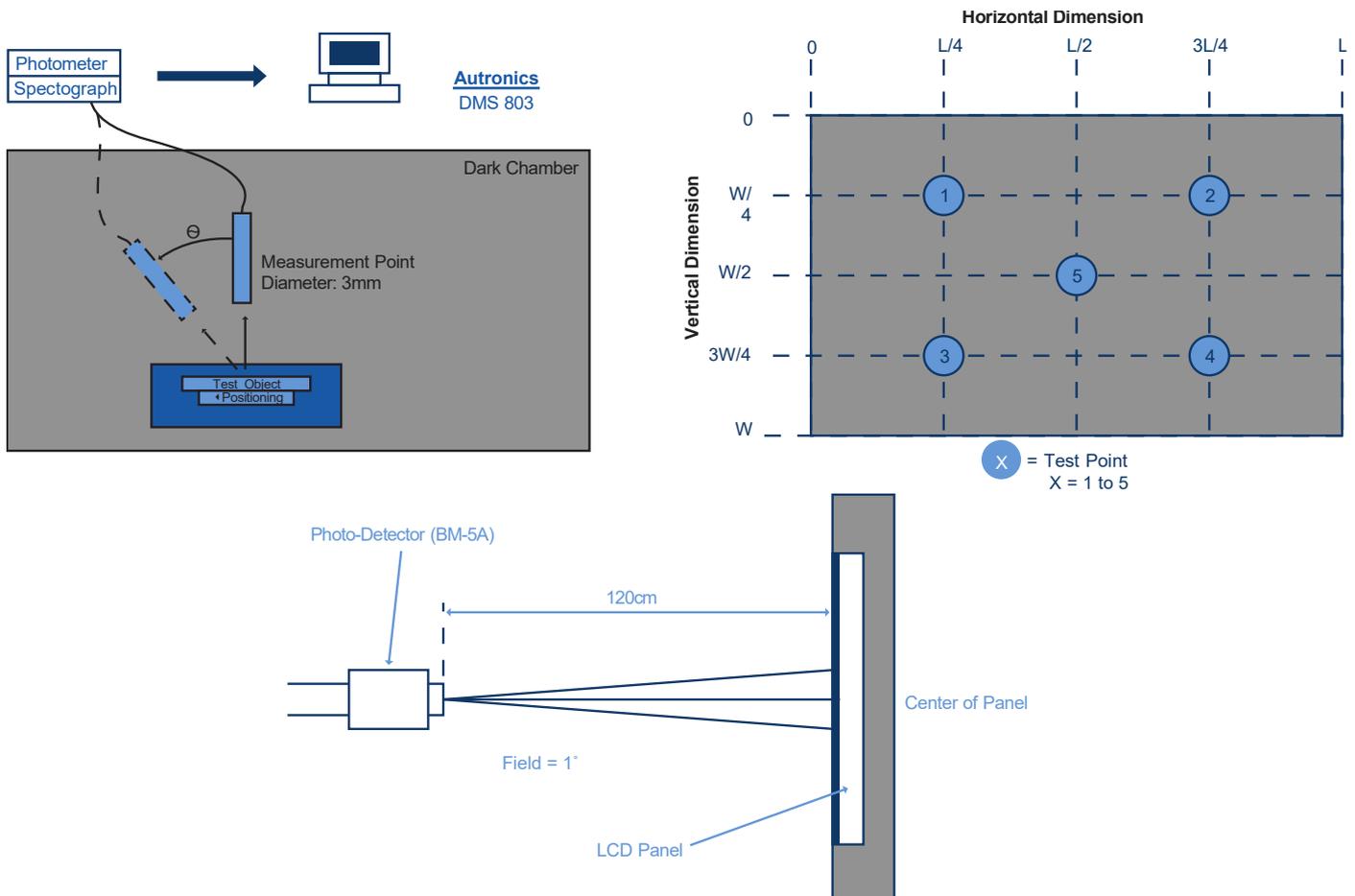
5. TFT Electrical Characteristics

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

Characteristics	Symbol	Min	Max	Unit
Digital Supply Voltage	VDD	-0.3	4.6	V
Supply Voltage (Logic)	IOVCC	-0.3	4.6	V
Operating Temperature	T_{OP}	-30	+80	°C
Storage Temperature	T_{ST}	-30	+80	°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.

5.2 DC Electrical Characteristics

| Characteristics	Symbol	Min	Typ.	Max	Unit	Note
Digital Supply Voltage	VCI	2.5	3.3	3.6	V	--
Supply Voltage (Logic)	IOVCC	1.65	1.8	3.3	V	--
Normal Mode Current Consumption	IDD	--	20	40	mA	--
Differential Input High Threshold Voltage	VIT+	--	0	50	mV	MIPI_CLK MIPI_Data
Differential Input Low Threshold Voltage	VIT-	-50	0	--	mV	
Sigle-ended Receiver Input Operation Voltage Range	VIR	0.5	--	1.2	V	

5.3 LED Backlight Characteristics

The backlight system is edge lighting type with 4 double LED Chips

Item	Symbol	Min	Typ.	Max	Unit	Note
Forward Current	I_F	--	20	--	mA	--
Forward Voltage	V_F	--	24.0	25.6	V	--
LCM Luminance	L_V	640	680	--	cd/m2	(3)
LED Lifetime	Hr	--	50000	--	hour	(1)(2)
Uniformity	Avg	80	--	--	%	(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 IF = 20mA. The LED lifetime could be decreased if operating IF is larger than 20mA. The constant current driving method is suggested.
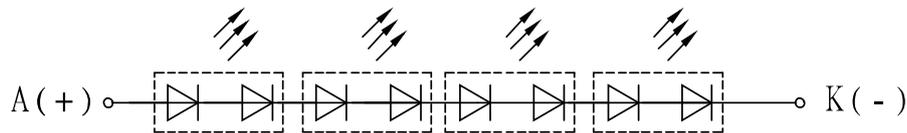
BL CIRCUIT DIAGRAM

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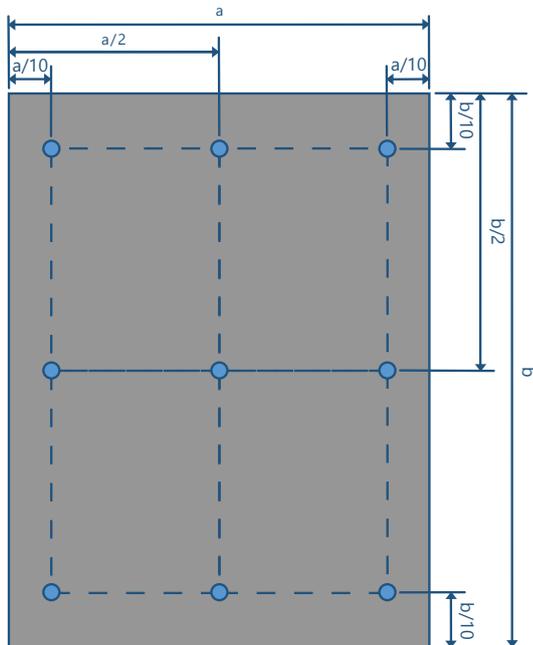
$$Luminance = \frac{(Total\ Luminance\ of\ 9\ Points)}{9}$$

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

6. TFT AC Characteristics

6.1 MIPI Interface High Speed Mode Timing Characteristics

For MIPI Interface High Speed Mode Timing characteristics, diagrams, and tables, see table and diagram on page 49 of the data sheet for controller IC ST7701SI. The data sheet can be found here:*https://focuslcds.com/wp-content/uploads/Drivers/ST7701SI.pdf?srsltid=AfmBOor972WjWO3hur_DV6FMZMvSfxBYFYyzrhX9Q6aQupS9JLSOMh-*

6.2 Turnaround Procedure

For turnaround procedure diagrams and tables, see table and diagrams on page 50 of the data sheet for controller IC ST7701SI. The data sheet can be found here: *https://focuslcds.com/wp-content/uploads/Drivers/ST7701SI.pdf?srsltid=AfmBOor972WjWO3hur_DV6FMZMvSfxBYFYyzrhX9Q6aQupS9JLSOMh-*

6.3 Switching the Clock Lane Between Low Power Mode and High Speed Mode

For switching the clock lane between low power mode and high speed mode tables and diagrams, see pages 51-52 of the data sheet for controller IC ST7701SI. The data sheet can be found here: *https://focuslcds.com/wp-content/uploads/Drivers/ST7701SI.pdf?srsltid=AfmBOor972WjWO3hur_DV6FMZMvSfxBYFYyzrhX9Q6aQupS9JLSOMh-*

6.4 Reset Timing Characteristics

For the reset timing characteristics tables and diagrams, see pages 53-54 for the data sheet for controller IC ST7701SI. The data sheet can be found here: *https://focuslcds.com/wp-content/uploads/Drivers/ST7701SI.pdf?srsltid=AfmBOor972WjWO3hur_DV6FMZMvSfxBYFYyzrhX9Q6aQupS9JLSOMh-*

7. CTP Electrical Characteristics

7.1 Absolute Maximum Rating

Item	Symbol	Min	Max	Unit	Note
Power Supply Voltage	VDD	-0.3	3.6	V	1
I/O Digital Voltage	VDDIO	1.8	3.6	V	1
Operating Temperature	T_{OP}	-20	+70	°C	
Storage Temperature	T_{ST}	-30	+80	°C	

NOTE:
1) If used beyond the absolute maximum ratings, FT5436 may be permanently damaged. It is strongly recommended that the device be used within the electrical characteristics in normal operations. If exposed to the condition not within the electrical characteristics, it may affect the reliability of the device.

7.2 DC Electrical Characteristics

Ambient temperature: 25°C

Item	Min	Typ.	Max	Unit	Note
Normal Mode Operating Current	--	11	--	mA	
Monitor Mode Operating Current	--	0.43	--	mA	
Sleep Mode Operating Current	--	42	--	uA	
Digital Input Low Voltage/VIL	-0.3	--	0.3*VDDIO	V	
Digital Input High Voltage/VIH	0.7*VDDIO	--	VDDIO	V	
Digital Output Low Voltage/VOL	--	--	0.3*VDDIO	V	
Digital Output High Voltage/VOH	0.7*VDDIO	--	--	V	

7.3 AC Characteristics

Ambient temperature: 25°C, VDD3=2.8V

Parameter	Min	Typ.	Max	Unit
OSC Oscillation Frequency	49	50	51	MHZ
I/O Output Rise Time, Low to High	--	210	--	ns
I/O Output Fall Time, High to Low	--	210	--	ns

7.4 I2CTiming

For I2C timing diagrams and tables, see pages 5-6 of the data sheet for touch panel IC FT5436. The data sheet for FT5436 can be found here: *https://focuslcds.com/wp-content/uploads/Drivers/FT5436.pdf?srsltid=AfmBOopQlhDG57yGwZ9Wb_quJYAS3Bk3g1ySCSLFQ-54iz-PNgNvNqnm*

7.5   Power-On Timing

For the power on timing diagrams and table, see pages 8-9 of the data sheet for touch panel IC FT5436. The data sheet for FT5436 can be found here: _https://focuslcds.com/wp-content/uploads/Drivers/FT5436.pdf?srsltid=AfmBOopQlhDG57yGwZ9Wb_quJYAS3Bk3g1ySCSLFQ-54iz-PNgNvNqnm_

8. Quality Inspection Standards

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

9. Cautions and Handling Precautions

9.1   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.

9.2   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.