Crystalfontz

TFT GRAPHIC DISPLAY MODULE DATASHEET

Part Number:
CFAF480480A0-040TN

Features:
480x480 4" TFT LCD
24bit RGB interface + SPI initialization
IPS (easily viewable from all directions)

Datasheet Release Date 2020-11-11
for
CFAF480480A0-040TN

Revision A0

Crystalfontz America, Inc.

12412 East Saltese Avenue
Spokane Valley, WA 99216-0357
Phone: 888-206-9720
Fax: 509-892-1203
Email: support@crystalfontz.com
URL: www.crystalfontz.com

CONTENTS

1. General Information

Datasheet Revision History
Datasheet Release: **2020-11-11** Datasheet for the CFAF480480A0-040TN TFT graphic display module.

Product Change Notifications
Check for or subscribe to Part Change Notices for this display module on our website.

Variations
Slight variations between lots are normal (e.g., contrast, color, or intensity).

Volatility
This display module has volatile memory.

Disclaimer
Certain applications using Crystalfontz America, Inc. products may involve potential risks of death, personal injury, or severe property or environmental damage ("Critical Applications"). CRYSTALFONTZ AMERICA, INC. PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. Inclusion of Crystalfontz America, Inc. products in such applications is understood to be fully at the risk of the customer. In order to minimize risks associated with customer applications, adequate design and operating safeguards should be provided by the customer to minimize inherent or procedural hazard. Please contact us if you have any questions concerning potential risk applications. Crystalfontz America, Inc. assumes no liability for applications assistance, customer product design, software performance, or infringements of patents or services described herein. Nor does Crystalfontz America, Inc. warrant or represent that any license, either express or implied, is granted under any patent right, copyright, or other intellectual property right of Crystalfontz America, Inc. covering or relating to any combination, machine, or process in which our products or services might be or are used. All specifications in datasheets on our website are, to the best of our knowledge, accurate but not guaranteed. Corrections to specifications are made as any inaccuracies are discovered. Company and product names mentioned in this publication are trademarks or registered trademarks of their respective owners. Copyright © 2020 by Crystalfontz America, Inc.,12412 East Saltese Avenue, Spokane Valley, WA 99216 U.S.A.

2. Module Description

This is a 16.7M color TFT graphic display module with a white LED backlight. This display has a built-in ST7701-G5 controller.

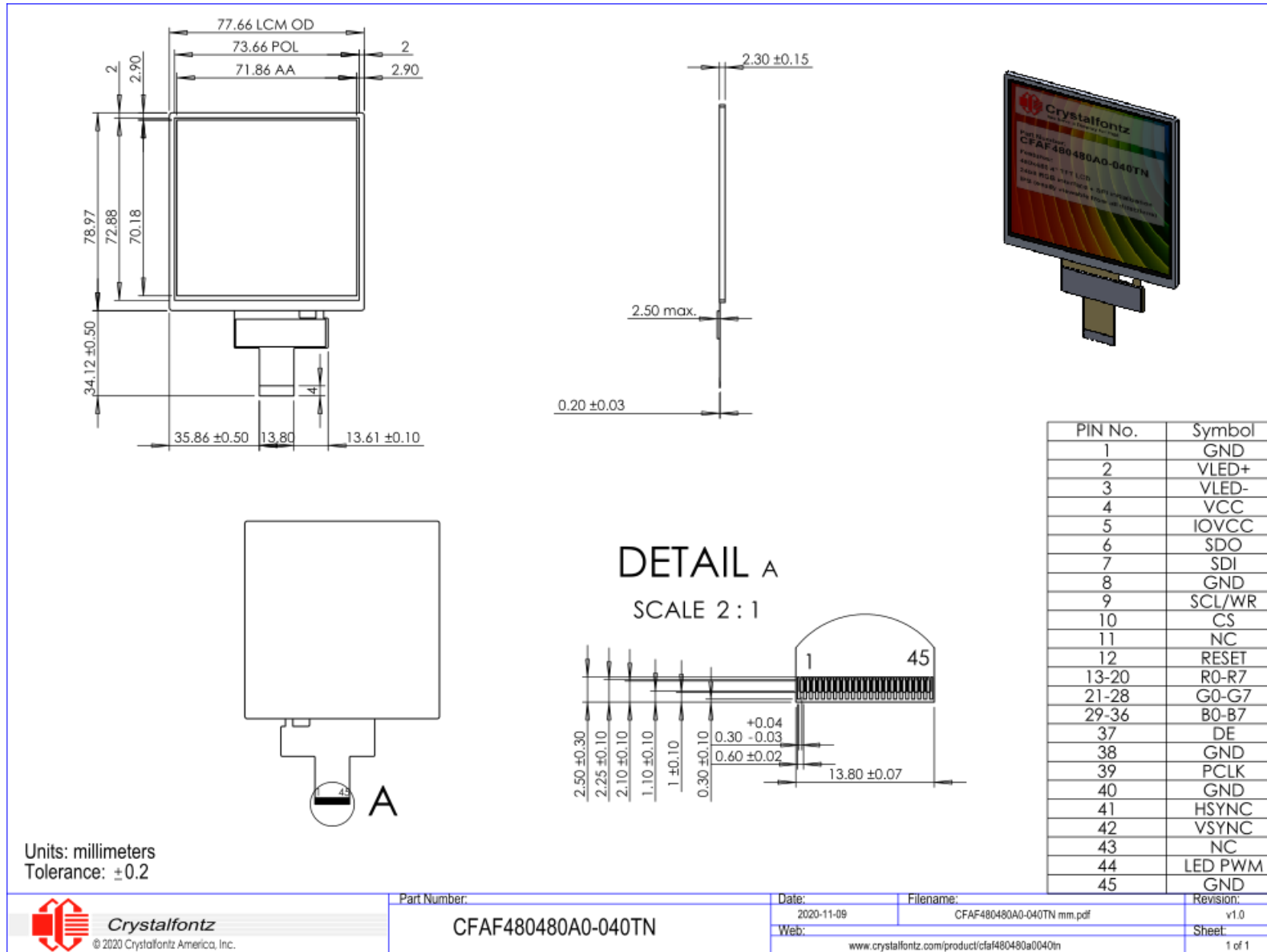Please see the Sitronix ST7701 datasheet for further reference.

3. Features

- 480*480 Dot Matrix
- Viewing Direction: Free
- Built-in Controller: ST7701-G5 (or equivalent)
- Operating Temperature: -20 – 70°C
- Storage Temperature: -30 – 80°C
- +3.3V Logic Supply
- +15V Backlight Supply
  - o Power consumption 0.6 W
- Interface: RGB with SPI initialization

4. Mechanical Data

Item	Specification (mm)	Specification (inch, reference)
Overall Dimensions	77.66 x 78.97 x 2.3	3.06 x 3.11 x 0.09
Active Area	71.86 x 70.18	2.83 x 2.76
Pixel Pitch	0.149 x 0.146	0.006 x 0.006
Weight (Typical)	29.1 grams	1.03 oz

5. Mechanical Drawing

PIN No.	Symbol
1	GND
2	VLED+
3	VLED-
4	VCC
5	IOVCC
6	SDO
7	SDI
8	GND
9	SCL/WR
10	CS
11	NC
12	RESET
13-20	R0-R7
21-28	G0-G7
29-36	B0-B7
37	DE
38	GND
39	PCLK
40	GND
41	HSYNC
42	VSYNC
43	NC
44	LED PWM
45	GND

DETAIL A
SCALE 2 : 1

Units: millimeters
Tolerance: ±0.2

Crystalfontz
© 2020 Crystalfontz America, Inc.

Part Number:	Date:	Filename:	Revision:
CFAF480480A0-040TN	2020-11-09	CFAF480480A0-040TN mm.pdf	v1.0
	Web:		Sheet:
		www.crystalfontz.com/product/cfaf480480a0040tn	1 of 1

6. Interface Pin Function

PIN No.	Symbol	Function
1	GND	Ground
2	V_{LED+}	Backlight LED Anode (15V)
3	V_{LED-}	Backlight LED Cathode
4	V_{CC}	Power supply (3.3V)
5	IOV_{CC}	Power supply (1.8V)
6	SDO	Serial Data Output
7	SDI	Serial Data Input
8	GND	Ground
9	SCL WR	Serial Clock Parallel Write
10	CS	Chip Select
11	NC	No Connect
12	RESET	Reset
13-20	R0-R7	Red Data bus
21-28	G0-G7	Green Data bus
29-36	B0-B7	Blue Data bus
37	DE	Data Enable. Active HIGH
38	GND	Ground
39	PCLK	Dot Clock. Input data latched on rising edge.
40	GND	Ground
41	HSYNC	Horizontal sync. Negative polarity
42	VSYNC	Vertical sync. Negative polarity.
43	NC	No Connect.
44	LED PWM	Pulse width modulation for the LED driver
45	GND	Ground

7. System Block Diagram
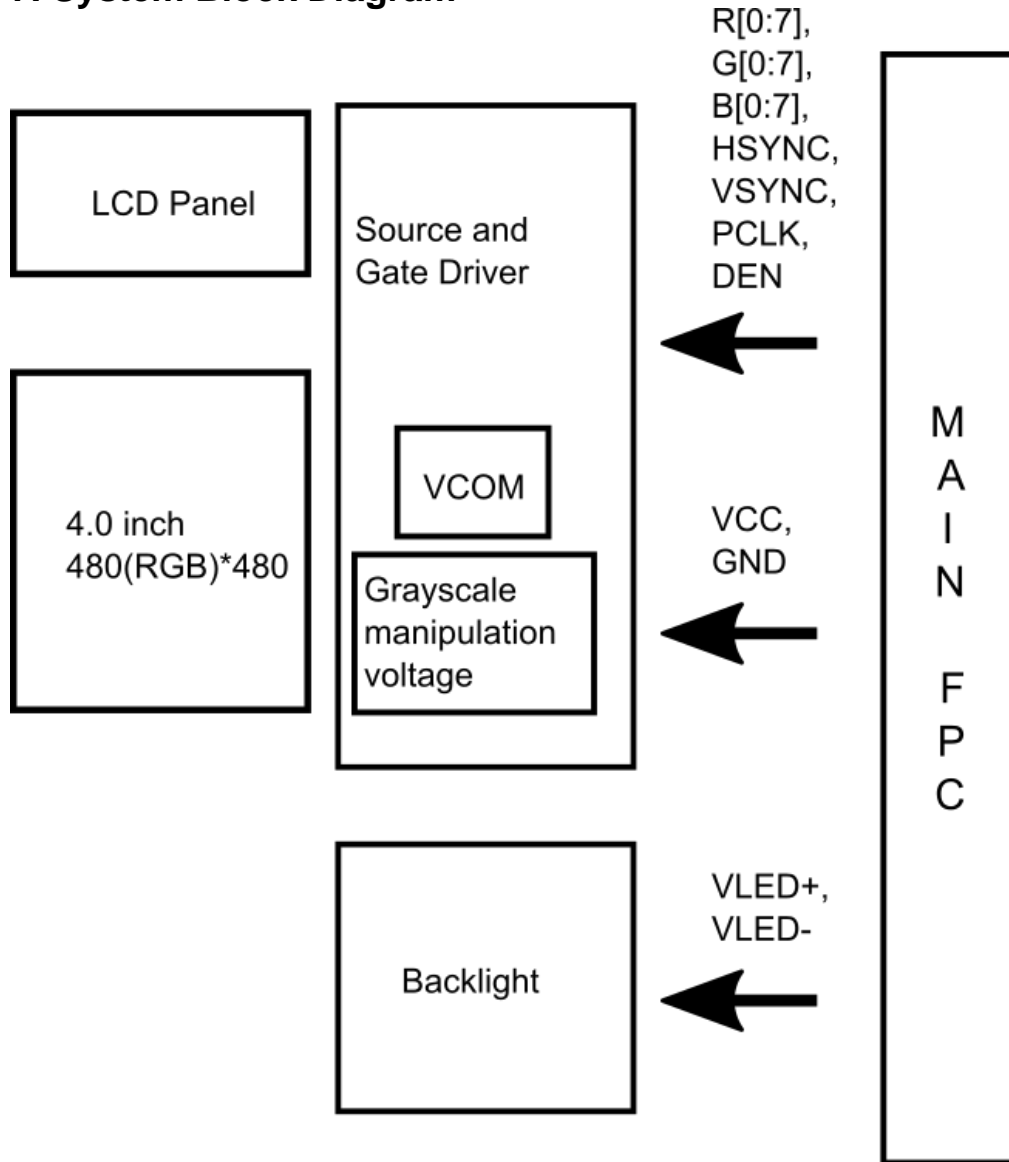
8. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Supply Voltage for Logic	V_{CC}	-0.5	5	V
Operating Temperature	T_{OP}	-20	70	°C
Storage Temperature	T_{STG}	-30	80	°C

Notes:
(1) These are stress ratings only. Extended exposure to the absolute maximum ratings listed above may affect device reliability or cause permanent damage.
(2) Functional operation should be restricted to the limits in the Electrical Characteristics table below.

9. Electrical Characteristics

Item	Symbol	Min	Typ	Max	Unit
Supply Voltage for Logic	V_{CC}	3.0	3.3	3.6	V
High-level Input	V_{IH}	$0.7 \times V_{CC}$	-	V_{CC}	V
Low-level Input	V_{IL}	GND	-	$0.3 \times V_{CC}$	V
High-level Output	V_{OH}	$V_{CC}-0.4$	-	V_{CC}	V
Low-level Output	V_{OL}	GND	-	$V_{CC}+0.4$	V
Power Consumption (Panel+LSI)	Black Mode (60 Hz)	-	74	-	nW
	Standby	-	50	-	µW

10. Optical Characteristics

Item		Symbol	Condition	Min	Typ	Max	Unit
View Angle		$(V)\theta$	CR≥10	-	160	-	deg
		$(H)\varphi$		-	160	-	deg
Contrast Ratio		CR	Dark	500	700	-	-
Response Time		$T_{rise}+ T_{fall}$	-	-	25	35	ms
Surface Luminance		LV	θ=0°	-	350	-	cd/m²
Luminance Uniformity		Yu	θ=0°	55	60	-	%
NTSC		-	θ=0°	-	50	-	%
Chromaticity	Red	R	θ=0° Φ = 0° T_a = 25°	0.5784	0.6284	0.6784	
		R		0.3046	0.3546	0.4046	
	Green	G		0.2914	0.3414	0.3914	
		G		0.5068	0.5568	0.6068	
	Blue	B		0.0952	0.1452	0.1952	
		B		0.0297	0.0797	0.1298	
	White	W		0.2511	0.3011	0.3511	
		W		0.2526	0.3026	0.3526	

11. Backlight Characteristics

| Item	Symbol	Min	Typ	Max	Unit
Forward Current	I_F	-	40	-	mA
Forward Voltage	V_F	14.4	15	15.6	V
Backlight Power Consumption	W_{BL}	-	0.6	-	W
LED Lifetime	-	-	30,000	-	Hr.

Notes:
(1) For each LED, I_F=20mA, V_F=3.2±0.2V
(2) Lifetime is defined as the amount of time when the luminance has decayed to <50% of the initial value, and this value is provided as an estimate only. Operating at high current, ambient temperature, or humidity conditions will reduce the lifetime.
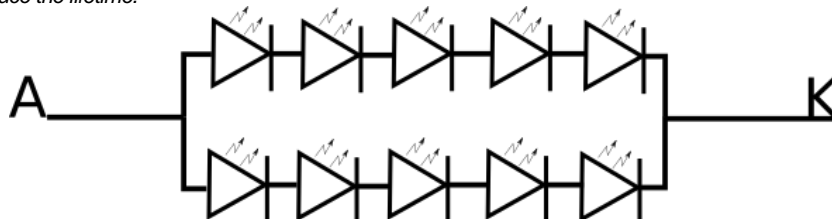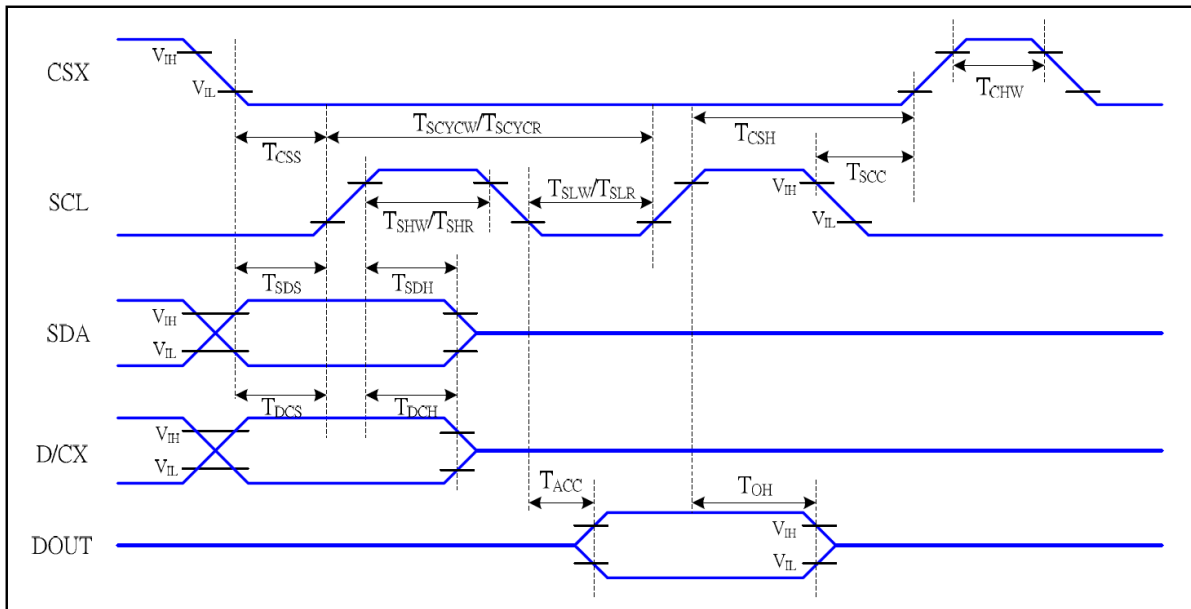
12. Interface Timing

12.1. Serial Interface Characteristics (3-Wire SPI)
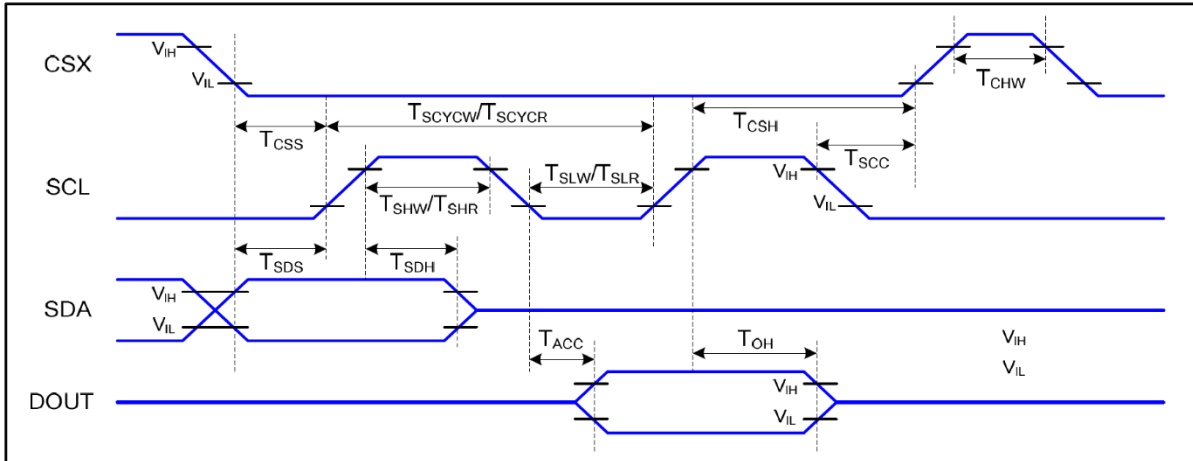
Signal	Symbol	Parameter	Min	Max	Unit
CSX	T_{CSS}	Chip Select Setup time (write)	15	-	ns
	T_{CSH}	Chip Select Hold time (write)	15	-	ns
	T_{CSS}	Chip Select Setup time (read)	60	-	ns
	T_{CSH}	Chip Select Hold time (read)	60	-	ns
	T_{CHW}	Chip Select "H" pulse width	40	-	ns
SCL	T_{SCYCW}	Serial Clock Cycle (write)	66	-	ns
	T_{SHW}	SCL "H" pulse width (write)	15	-	ns
	T_{SLW}	SCL "L" pulse 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	T_{SDS}	Data setup time	10	-	ns
	T_{SDH}	Data hold time	10	-	ns

12.2. Serial Interface Characteristics (4-Wire SPI)

Signal	Symbol	Parameter	Min	Max	Unit
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_{CSH}	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" pulse 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
D/C#	T_{DCS}	D/C# setup time	10	-	ns
	T_{DCH}	D/C# hold time	10	-	ns
SDA	T_{SDS}	Data setup time	10	-	ns
	T_{SDH}	Data hold time	10	-	ns

12.3. RGB Interface Characteristics
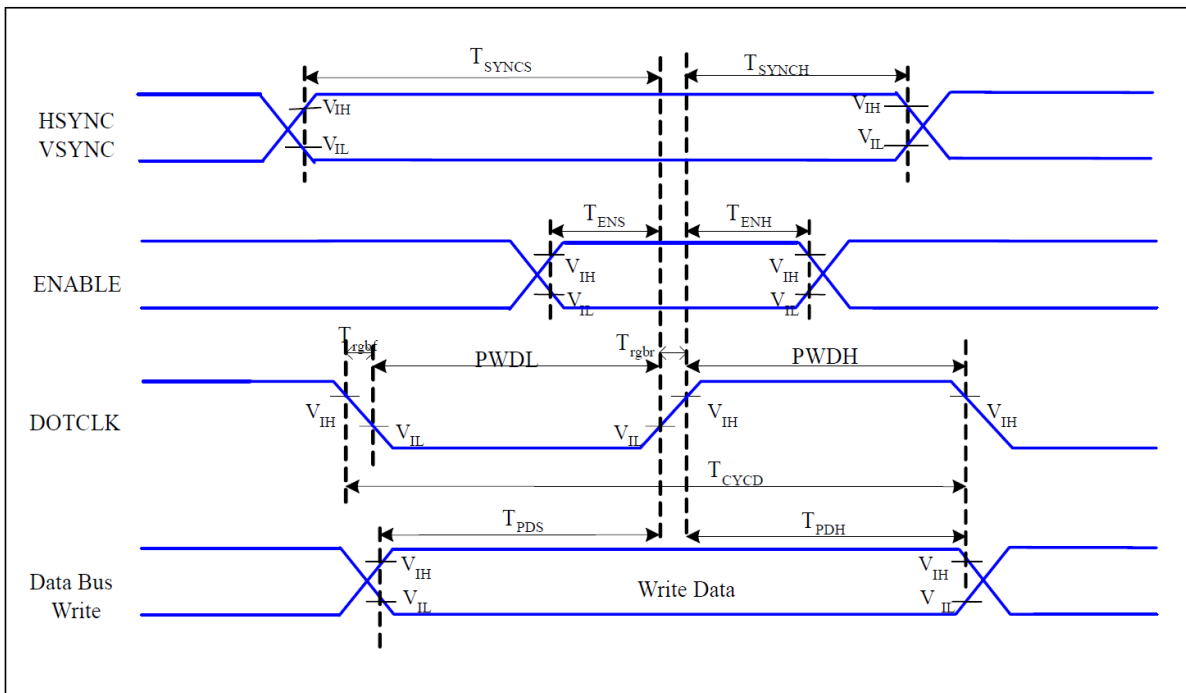
Signal	Symbol	Parameter	Min	Max	Unit
VSYNC, HSYNC	T_{SYNCS}	VSYNC, HSYNC Setup Time	5	-	ns
ENABLE	T_{ENS}	Enable Setup Time	5	-	ns
	T_{ENH}	Enable Hold Time	5	-	ns
PCLK (DOTCLK)	PWDH	PCLK High-level Pulse Width	15	-	ns
	PWDL	PCLK Low-level Pulse Width	15	-	ns
	T_{CYCD}	PCLK Cycle Time	33	-	ns
	T_{RGHR}, T_{RGHF}	PCLK Rise/Fall Time	-	15	ns
DB	T_{PDS}	PD Data Setup Time	5	-	ns
	T_{PDH}	PD Data Hold time	5	-	ns

For more timing information, see the ST7701 datasheet

13. LCD Module Precautions

The precautions below should be followed when using LCD modules to help ensure personal safety, module performance, and compliance of environmental regulations.

13.1. Modules

- Avoid applying excessive shocks to module.
- Do not make extra holes on the printed circuit board, modify its shape or change the components of LCD display module.
- Do not disassemble, alter, or modify the LCD display module.
- Do not operate the LCD display module above the absolute maximum rating.
- Do not drop, bend or twist the LCD display module.
- Solder only to the I/O terminals.
- Store in an anti-static electricity container and clean environment.
- It is common to use the "screen saver" to extend the lifetime of the LCD display module.
  - Do not use the fixed information for long periods of time in real application.
  - Do not use fixed information in LCD panel for long periods of time to extend "screen burn" effect time.
- Crystalfontz has the right to change the passive components, including R2 and R3 adjust resistors. (Resistors, capacitors and other passive components will have different appearance and color caused by the different supplier.)
- Crystalfontz has the right to change the PCB Rev. (In order to satisfy the supplying stability, management optimization and the best product performance, etc., under the premise of not affecting the electrical characteristics and external dimensions, Crystalfontz has the right to modify the version.).

13.2. Handling Precautions

- Since the display panel is made of glass, do not apply mechanical impacts such as dropping from a high position.
- If the display panel is accidently broken, and the internal organic substance leaks out, be careful not to inhale or touch the organic substance.
- If pressure is applied to the display surface or its neighborhood of the LCD display module, the cell structure may be damaged, so be careful not to apply pressure to these sections.
- The polarizer covering the surface of the LCD display module is soft and can be easily scratched. Please be careful when handling the LCD display module.
- Clean the surface of the polarizer covering the LCD display module if it becomes soiled using following adhesion tape.
  - Scotch Mending Tape No. 810 or an equivalent
  - Never breathe the soiled surface or wipe the surface using a cloth containing solvent such as ethyl alcohol, since the surface of the polarizer will become cloudy.
  - The following liquids/solvents may spoil the polarizer:
    - Water
    - Ketone
    - Aromatic Solvents
- Hold the LCD display module very carefully when placing the LCD display module into the system housing.
- Do not apply excessive stress or pressure to the LCD display module. And, do not over bend the film with electrode pattern layouts. These stresses will influence the display performance. Also, be sure to secure the sufficient rigidity for the outer cases.
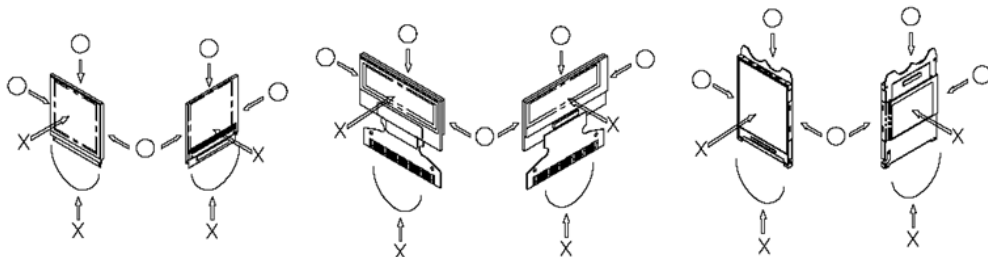
- Do not apply stress to the LSI chips and the surrounding molded sections.
- Do not disassemble or modify the LCD display module.
- Do not apply input signals while the logic power is off.
- Pay sufficient attention to the working environments when handing the LCD display module to prevent occurrence of element breakage accidents by static electricity.
  - Be sure to make human body grounding when handling LCD display modules.
  - Be sure to ground tools to use for assembly such as soldering irons.
  - To suppress generation of static electricity, avoid carrying out assembly work under dry environments.
  - Protective film is being applied to the surface of the display panel of the LCD display module. Be careful since static electricity may be generated when exfoliating the protective film.
- Protection film is being applied to the surface of the display panel. Remove the protection film before assembling it. At this time, if the LCD display module has been stored for a long period of time, residue adhesive material of the protection film may remain on the surface of the display panel after the film has been removed. In such a case, remove the residue material by the method discussed above.
- If electric current is applied when the LCD display module is being dewed or when it is placed under high humidity environments, the electrodes may become corroded. If this happens proceed with caution when handling the LCD display module.

13.3. Storage Precautions

- Store LCD modules in static electricity preventive bags. Avoid exposure to direct sunlight and fluorescent lamps. Also avoid high temperature and high humidity environments and low temperatures (less than 0°C) environments. (We recommend you store these modules in the packaged state when they were shipped from Crystalfontz). Be careful not to let water drops adhere to the packages or bags, and do not let dew gather on them.
- If electric current is applied when water drops are adhering to the surface of the LCD display module the LCD display module may have become dewed. If a dewed LCD display module is placed under high humidity environments it may cause the electrodes to become corroded. If this happens proceed with caution when handling the LCD display module.

13.4. Designing Precautions

- The absolute maximum ratings are the ratings that cannot be exceeded for LCD display module. If these values are exceeded, panel damage may happen.
- To prevent occurrence of malfunctioning by noise pay attention to satisfy the V_{IL} and V_{IH} specifications and, at the same time, to make the signal line cable as short as possible.
- We recommend that you install excess current preventive unit (fuses, etc.) to the power circuit (V_{DD}). (Recommend value: 0.5A)
- Pay sufficient attention to avoid occurrence of mutual noise interference with the neighboring devices.
- As for EMI, take necessary measures on the equipment side.
- When fastening the LCD display module, fasten the external plastic housing section.
- If the power supply to the LCD display module is forcibly shut down, by such errors as taking out the main battery while the LCD display panel is in operation, we cannot guarantee the quality of this LCD display module.
  - Connection (contact) to any other potential than the above may lead to rupture of the IC.

13.5. Disposing Precautions

- Request the qualified companies to handle the industrial wastes when disposing of the LCD display modules. Observe all environmental and hygienic laws and regulations.

13.6. Other Precautions

- When an LCD display module is operated for a long period of time with a fixed pattern, the fixed pattern may remain as an after image or a slight contrast deviation may occur.
  - Restore the display by shutting the display off for an extended period.

- o This will not cause a problem in the reliability of the module.
- To protect the LCD display module from performance drops by static electricity rapture, etc., do not touch the following sections whenever possible while handling the LCD display modules.
  - o Pins and electrodes
  - o Pattern layouts such as the TCP & FPC
- With this LCD display module, the LCD driver is being exposed. Generally speaking, semiconductor elements change their characteristics when light is radiated according to the principle of the solar battery. Consequently, if this LCD driver is exposed to light, malfunctioning may occur.
  - o Design the product and installation method so that the LCD driver may be shielded from light in actual usage.
  - o Design the product and installation method so that the LCD driver may be shielded from light during the inspection processes.
- Excessive electrical noise may compromise the performance of the LCD module. Ensure system design suppresses noise generation and protect the module from noise.
- We recommend that software periodically refreshes the operation statuses (reset the commands and resend the display data), to cope with noise.
- Resistors, capacitors, and other passive components may have different appearances and colors.
- Crystalfontz has the right to upgrade and modify the product function.
- The limitation of FPC bending: