



5" TFT DISPLAY MODULE  
WITH EVE GRAPHICS ACCELERATOR

DATASHEET



**CFAF800480E0-050SC-A1-1**

Datasheet Release: 2019/04/10

**Crystalfontz America, Inc.**

12412 East Saltese Avenue  
Spokane Valley, WA 99216-0357  
Phone: 888-206-9720  
Fax: 509-892-1203

Email: [support@crystalfontz.com](mailto:support@crystalfontz.com)  
URL: [www.crystalfontz.com](http://www.crystalfontz.com)



## **Table of Contents**

<b>1. GENERAL INFORMATION .....</b>	<b>3</b>
<b>2. INTRODUCTION.....</b>	<b>4</b>
<b>3. KEY FEATURES.....</b>	<b>5</b>
3.1. MODULE FEATURES.....	5
3.2. EVE GRAPHICS ACCELERATOR FEATURES .....	5
<b>4. MECHANICAL DATA .....</b>	<b>5</b>
<b>5. MECHANICAL DRAWINGS .....</b>	<b>6</b>
<b>6. MODULE DETAILS .....</b>	<b>7</b>
6.1. GENERAL INFORMATION.....	7
6.2. EMBEDDED VIDEO ENGINE PROGRAMMER'S MODEL.....	7
6.3. INTERFACE PIN FUNCTION.....	8
6.4. ABSOLUTE MAXIMUM RATINGS .....	9
6.5. ELECTRICAL CHARACTERISTICS.....	9
6.6. BACKLIGHT CHARACTERISTICS .....	9
6.7. OPTICAL CHARACTERISTICS .....	9
<b>7. LCD MODULE PRECAUTIONS .....</b>	<b>10</b>
7.1. MODULES.....	10
7.2. HANDLING PRECAUTIONS.....	10
7.3. STORING PRECAUTIONS.....	11
7.4. DESIGNING PRECAUTIONS.....	11
7.5. DISPOSING PRECAUTIONS.....	11
7.6. OTHER PRECAUTIONS.....	12



## 1. General Information

### Datasheet Revision History

Datasheet Release: 2019/04/10  
Datasheet for the CFAF800480E0-050SC-A1-1 display module.

### Product Change Notifications

You can 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 © 2017 by Crystalfontz America, Inc., 12412 East Saltese Avenue, Spokane Valley, WA 99216 U.S.A.



## 2. Introduction

The Crystalfontz CFAF800480E0-050SC-A1-1 is a revolutionary new accelerated display for embedded systems based on the FTDI/BridgeTek FT813 EVE (Embedded Video Engine) graphics accelerator.

Traditionally, to connect a TFT to an embedded system, you either had to choose a very powerful processor that supports a frame buffer and RGB interface or write directly to the frame buffer on the TFT's controller. Either of these methods relies on software rendering of graphics primitives. To make a simple, non-antialiased, may take hundreds or thousands of write operations. Sometimes read-modify-write operations are required, which increases the again by double or more—further slowing the display performance.

Additionally, either of these methods use a lot of GPIO or GPIO configured as the RGB interface, often requiring you to choose a larger processor package. There are examples of using SPI to control small TFT LCDs, but even on small displays the performance is often dismal.

Another hurdle with traditional TFT implementations is text. Fonts can use up a lot of memory to store, and rendering them to the frame buffer can be complex—especially if they need to be rotated or antialiased. Typically, the compromise of having only a couple of bitmapped, non-antialiased fonts rendered at only horizontal and vertical is used. Angle a font at 45° to put labels on some data? Not without a very complete and complex (also typically big and slow) graphic library.

Imagine if there was a display that accepted high-level commands. Writing just a few instructions would completely describe a line. As long as we are imagining, why not further imagine that the line was fully anti-aliased, and any width you could want? What if writing a few more commands could render beautiful, anti-aliased text from a wide selection of fonts at any angle?

The FTDI/BridgeTek FT813 EVE graphics accelerator at the heart of the CFAF800480E0-050SC-A1-1 display solves all these problems and more.

Embedded systems based on simple 8-bit processors can now have beautiful, responsive, multi-touch enabled user interfaces that do not tax the host processor.

Want proof? Our demo for the CFAF800480E0-050SC-A1-1 was intentionally written to fit nicely on a Seeeduno v4.2 (this is a 3.3v version of the Arduino Uno). And as always, we freely supply all the source code.





### 3. Key Features

#### 3.1. Module Features

- 5-inch 800x480 sunlight readable TFT LCD
- 5-point capacitive touch sensing screen
- FTDI/BridgeTek FT813 EVE graphics accelerator
- SPI Single or Quad host interface
- Compact 30-position 0.5mm FPC/ZIF host connection
- Threaded mounting standoffs for simple mechanical design
- Compact form-factor, overall size is no larger than LCD
- Single +3.3V power supply (backlight supply can be 3.3v to 6v)

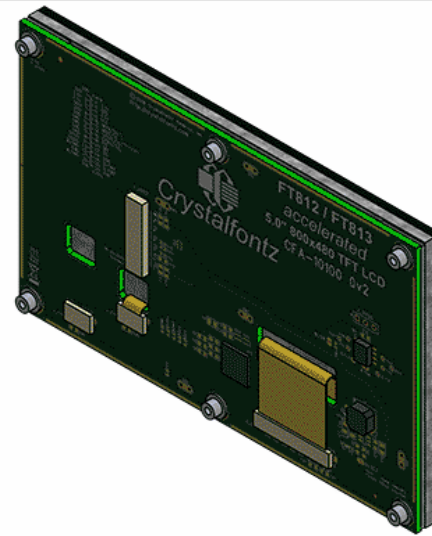
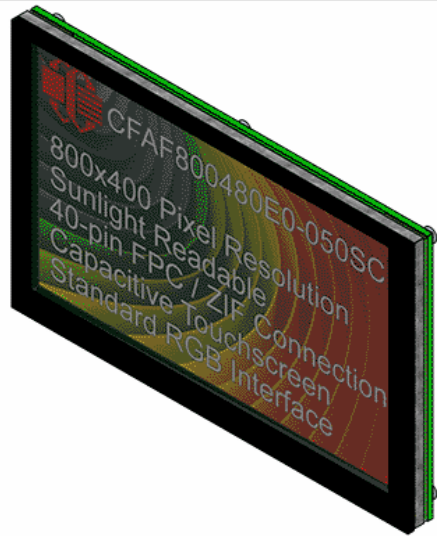
#### 3.2. EVE Graphics Accelerator Features

- Support multiple widgets for simplified design implementation
- User interface design software (PC) simplifies the design process
- Hardware engine can recognize touch tags and track touch movement
- Enhanced sketch processing
- Anti-aliasing of primitive displayed objects for higher-quality graphics
- Assorted graphical effects such as alpha-blending, shadows, transitions, wipes, etc.
- Programmable interrupt controller provides interrupts to host MCU
- Support playback of motion-JPEG encoded AVI videos
- Mono audio channel output with wave playback and built-in sound synthesizer
- PWM output for display backlight dimming control

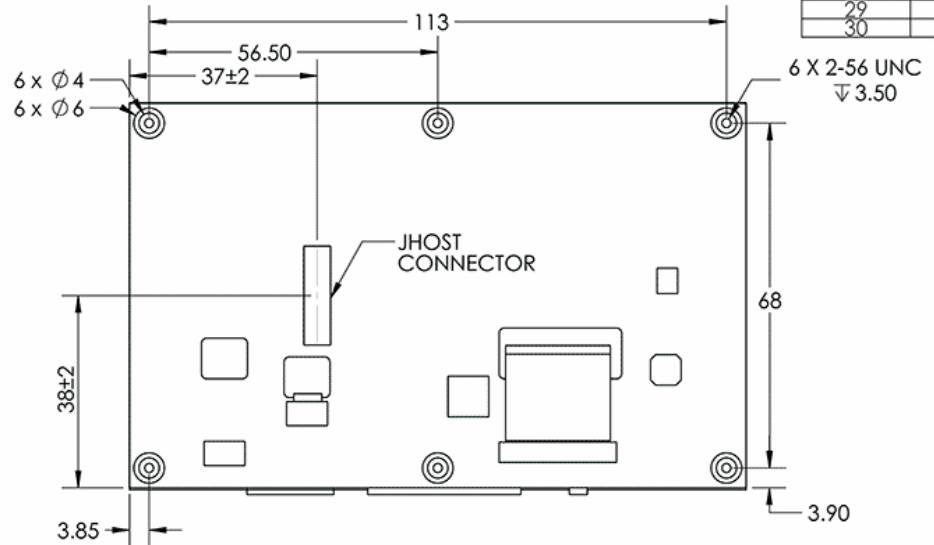
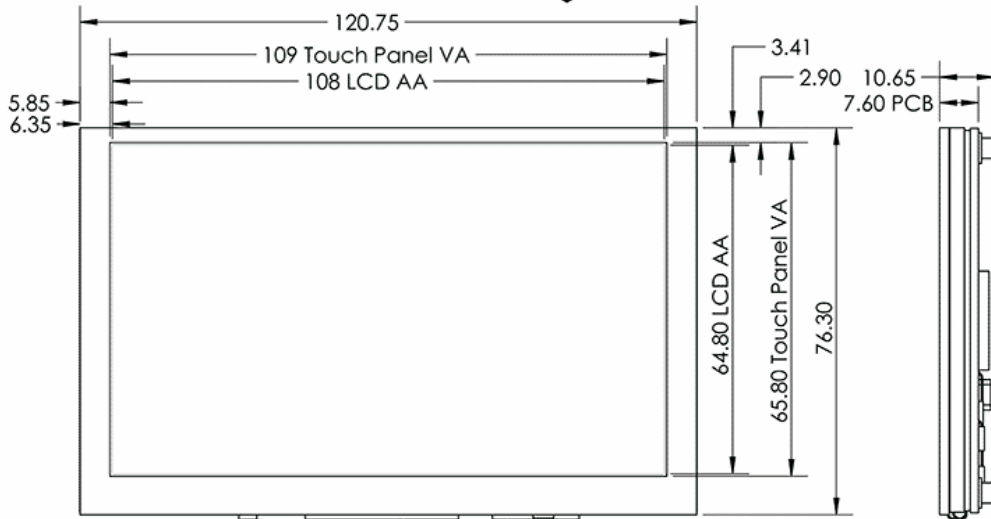
### 4. Mechanical Data

Item	Specification (mm)	Specification (inch)
Overall Module Dimension	120.7 (W) x 76.3 (H) x 10.65 (D)	4.752 (W) x 3.004 (H) x 0.419 (D)
Viewing Area	109.0 (W) x 65.8 (H)	4.292 (W) x 2.591 (H)
Active Area	108.0 (W) x 64.8 (H)	4.252 (W) x 2.551 (H)
Dot Pitch	0.135 (W) x 0.135 (H)	0.0053 (W) x 0.0053 (H)
Weight (Typical)	133.7 grams	4.716 ounces


# 5. Mechanical Drawings



JHOST CONNECTOR PIN #	FUNCTION
1	GND
2	3V3
3	3V3
4	GND
5	3V3
6	3V3
7	GND
8	SCK
9	GND
10	MOSI/D0
11	GND
12	MISO/D1
13	GND
14	GPIO0/D2
15	GND
16	GPIO1/D3
17	GND
18	nCS
19	GND
20	nINT
21	GPIO2
22	nPD
23	AUDIO PWM
24	GND
25	BLPWR
26	BLPWR
27	GND
28	BLPWR
29	BLPWR
30	GND



Tolerance: ±0.5mm Unless Noted  
 All Dimensions In Millimeters  
 JHOST is a 30pin, 0.5mm Pitch, Bottom Contact ZIF Connector  
 FOLDED FLEX CABLE EXTENDS BELOW DISPLAY ASSEMBLY IN THIS AREA

 <b>Crystalfontz</b> <small>© 2019 Crystalfontz America, INC.</small>	Part Number:	Date:	Filename:	Revision:
	CFAF800480E0-050SC-A1-1	2019-03-08	CFAF800480E0-050SC-A1-1.pdf	v 1.1
		Web:		Sheet:
		www.crystalfontz.com/CFAF800480E0-050SC-A1-1		1 of 1



## 6. Module Details

### 6.1. General Information

The CFAF800480E0-050SC-A1-1 is a high-brightness, sunlight readable, 5-inch TFT display module based around a FTDI/BridgeTek FT813 Embedded Video Engine (EVE).

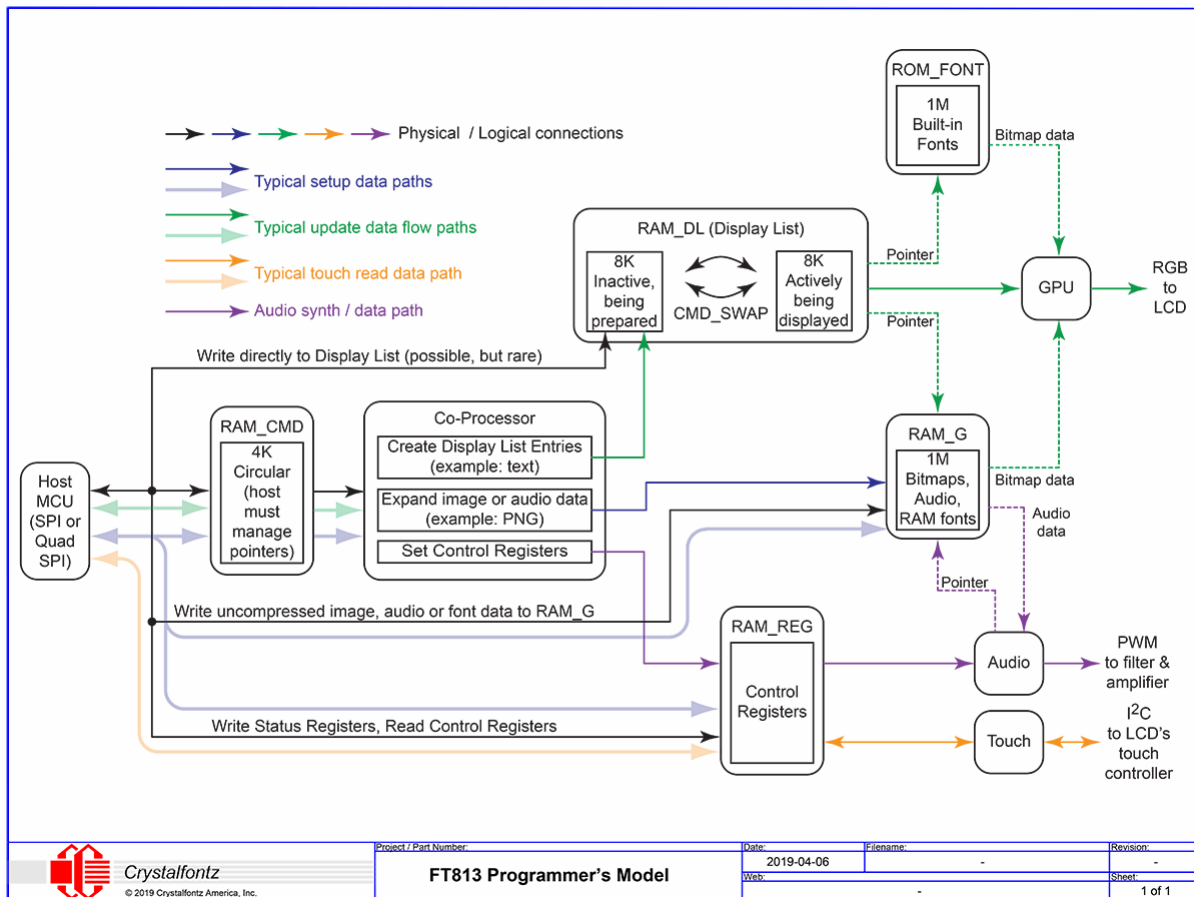
All display, touch sensing, backlight control and audio features are controlled via the Embedded Video Engine which appears to the host MCU as a memory-mapped SPI device. The host MCU sends commands and data over the EVE SPI serial protocol.

For detailed information on the Embedded Video Engine, please see the documents which can be found on our website here: <https://www.crystalfontz.com/controllers/FTDI/FT81x/>.

Further information including programming examples, interface design software, and more can be found on FTDI's website here: <https://www.ftdichip.com/Support/Utilities.htm>.

### 6.2. Embedded Video Engine Programmer's Model

The diagram below is a basic overview of the EVE programming model showing data flow paths to and from the SPI host interface to the memory and processing blocks of the embedded video engine. For more information, please see the "FT81x Series Programmers Guide" documentation.





### 6.3. Interface Pin Function

Host data connection and power supply is achieved via a single 30 pin flat-cable connector (labeled J\_HOST) on the rear of the module. Any 30 pin FFC-FPC ZIF cable with a 0.5mm pitch and bottom contacts will be compatible with this module.

J_HOST Connection			
Pin	Symbol	Signal Direction	Function
1	GND		Power Ground <sup>(1)</sup>
2	3V3		Logic Power Supply <sup>(1)</sup>
3	3V3		Logic Power Supply <sup>(1)</sup>
4	GND		Power Ground <sup>(1)</sup>
5	3V3		Logic Power Supply <sup>(1)</sup>
6	3V3		Logic Power Supply <sup>(1)</sup>
7	GND		Power Ground <sup>(1)</sup>
8	SCK	Input	SPI Clock
9	GND		Power Ground <sup>(1)</sup>
10	MOSI / D0	Input	SPI Single Mode: SPI MOSI SPI Dual/Quad Mode: SPI Data Line 0
11	GND		Power Ground <sup>(1)</sup>
12	MSIO / D1	Output	SPI Single Mode: SPI MISO SPI Dual/Quad Mode: SPI Data Line 1
13	GND		Power Ground <sup>(1)</sup>
14	GPIO0 / D2	Input / Output	SPI Single/Dual Mode: General Purpose IO0 SPI Quad Mode: SPI Data Line 2
15	GND		Power Ground <sup>(1)</sup>
16	GPIO1 / D3	Input / Output	SPI Single/Dual Mode: General Purpose IO1 SPI Quad Mode: SPI Data Line 3
17	GND		Power Ground <sup>(1)</sup>
18	nCS	Input	SPI Slave Chip-Select
19	GND		Power Ground <sup>(1)</sup>
20	nINT	Output	Interrupt to Host
21	GPIO2		General purpose IO2
22	nPD	Input	Chip Power Down Mode
23	AUDIO PWM	Output	Audio PWM
24	GND		Power Ground <sup>(1)</sup>
25	BLPWR		Backlight Power Supply <sup>(1)</sup>
26	BLPWR		Backlight Power Supply <sup>(1)</sup>
27	GND		Power Ground <sup>(1)</sup>
28	BLPWR		Backlight Power Supply <sup>(1)</sup>
29	BLPWR		Backlight Power Supply <sup>(1)</sup>
30	GND		Power Ground <sup>(1)</sup>

Notes:

1. It is recommended that these pins are all connected to their respective power source. Not doing so may produce unpredictable results.





#### 6.4. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Logic Power Supply	3V3	0.0	4.0	V
Backlight Power Supply	BLPWR	0.0	6.0	V
Operating Temperature	T <sub>OP</sub>	-20	+70	°C
Storage Temperature	T <sub>ST</sub>	-30	+80	°C

Notes:

- These are stress ratings only. Extended exposure to the absolute maximum ratings listed above may affect device reliability or cause permanent damage.
- Temp. ≤60°C, 90% RH Maximum Temp. >60°C Absolute humidity < 90% RH at 60°C

#### 6.5. Electrical Characteristics

Item	Symbol	Min	Typ	Max	Unit
Logic Power Supply	3V3	2.97	3.30	3.63	V
Input Logic High	V <sub>IH</sub>	2.0	-	3V3	V
Input Logic Low	V <sub>IL</sub>	0	-	0.8	V
Logic Supply Current	I <sub>3V3</sub>	--	133	-	mA

#### 6.6. Backlight Characteristics

Item	Symbol	Conditions	Min	Typ	Max	Unit
Supply Voltage	BLPWR		2.7	3.3	5.5	V
Supply Current	IBLPWR	BLPWR=5V	-	550	650	mA
		BLPWR=3.3V	-	900	1000	mA
LED Lifetime		at 100% brightness	-	25000	-	hours

#### 6.7. Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit	
Response Time	T <sub>r</sub>	25°C	-	20	30	ms	
	T <sub>f</sub>		-	20	30	ms	
Contrast Ratio	(CR)	θ=0°	500	600	-	-	
White Chromaticity	W <sub>x</sub>	Backlight On	0.324	0.326	0.328	ms	
	W <sub>y</sub>		0.364	0.366	0.368	ms	
Viewing Angle	Horizontal	CR ≥ 10	θ <sub>L</sub>	60	70	-	Degree
			θ <sub>R</sub>	60	70	-	
	Vertical		θ <sub>T</sub>	40	50	-	
			θ <sub>B</sub>	60	70	-	
Luminance	L	-	1000	1300	-	cd/m <sup>2</sup>	
Viewing Direction	12 o'clock						



## 7. LCD Module Precautions

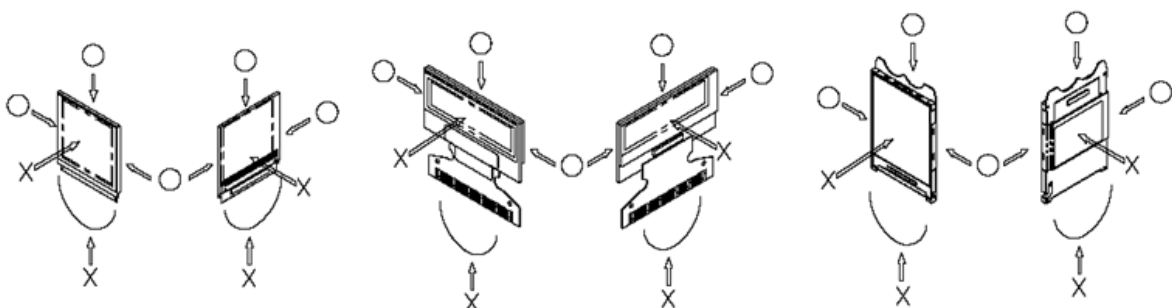
The precautions below should be followed when using LCD modules to help ensure personal safety, module performance, and compliance of environmental regulations.

### 7.1. Modules

- Avoid applying excessive shocks to module or making any alterations or modifications to it.
- Do not make extra holes on the printed circuit board, modify its shape or change the components of LCD display module.
- Do not disassemble 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.
- Soldering: 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 passive components on the display module (resistors, capacitors and other passive components may have different appearance and color).
- Crystalfontz has the right to change the PCB revision/version in order to satisfy the supply stability, management optimization, the best product performance, etc., under the premise of not affecting the electrical characteristics and external dimensions.

### 7.2. 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 accidentally 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 handling 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 and removes 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.

### 7.3. Storing Precautions

- When storing the LCD display modules put them in static electricity preventive bags to 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.

### 7.4. 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 VIL and VIH 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 (VDD). (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.

### 7.5. Disposing Precautions

- Request the qualified companies to handle the industrial wastes when disposing of the LCD display modules. Or, when burning them, be sure to observe the environmental and hygienic laws and regulations.



## 7.6. 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.
  - If the operation is interrupted and left unused for a while, normal state can be restored.
  - 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.
  - Pins and electrodes
  - 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.
  - Design the product and installation method so that the LCD driver may be shielded from light in actual usage.
  - Design the product and installation method so that the LCD driver may be shielded from light during the inspection processes.
- Although this LCD display module stores the operation state data by the commands and the indication data, when excessive external noise, etc. enters into the module, the internal status may be changed. Therefore, it is necessary to take appropriate measures to suppress noise generation or to protect from influences of noise on the system design.
- We recommend that you construct its software to make periodical refreshment of the operation statuses (re-setting of the commands and re-transference of the display data), to cope with catastrophic noise.
- Resistors, capacitors, and other passive components will have different appearance and color caused by the different supplier.
- Crystalfontz has the right to upgrade and modify the product function.
- The limitation of FPC bending:

