



TFT GRAPHIC DISPLAY MODULE DATASHEET



Datasheet Release Date 2023-06-20
for

CFAF240320D0-020FN/CFAF240320D0-020FR

Crystalfontz America, Inc.

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1. General Information

Datasheet Revision History

Datasheet Release: 2023-06-20
Datasheet for the CFAF240320D0-020FN/CFAF240320D0-020FR TFT graphic 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.

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2. Module Description

This is a full color (65k or 262k) transreflective TFT LCD module with a white LED backlight. Transreflective technology combines the benefits of transmissive and transreflective technology for great performance both inside and outside while maintaining low power requirements.

CFAF240320D0-020FN – no touch panel

CFAF240320D0-020FR– resistive touch panel

This display has a built-in Sitronix ST7789 or equivalent controller. Please see the [Sitronix ST7789 Controller datasheet](#) for further reference. Relevant sections include:

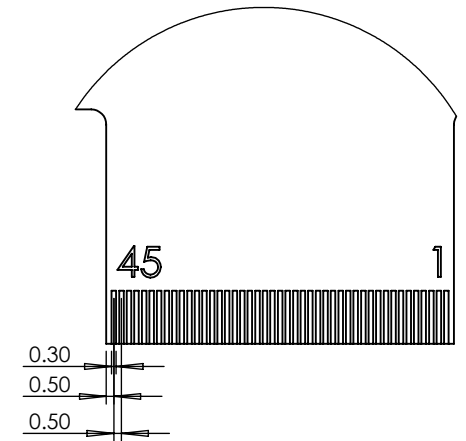
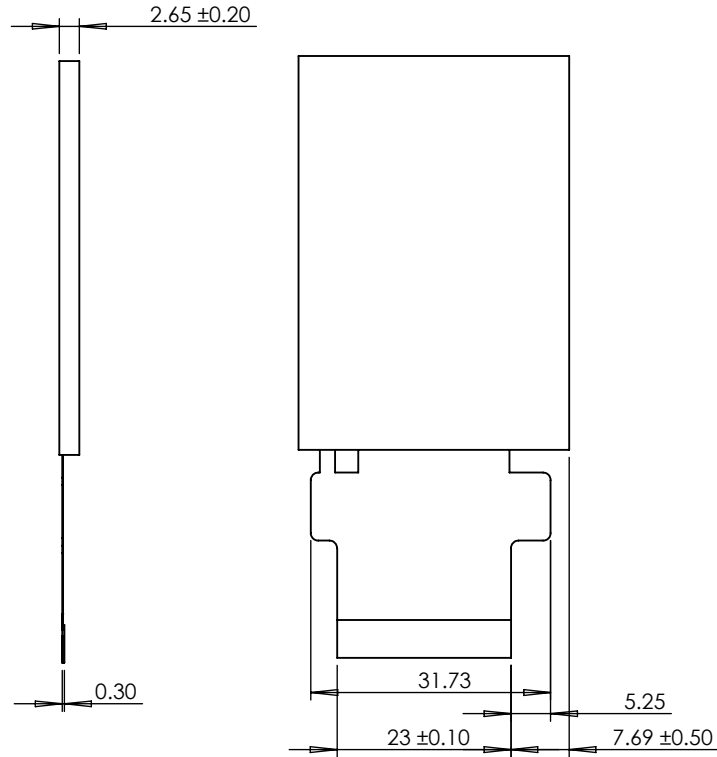
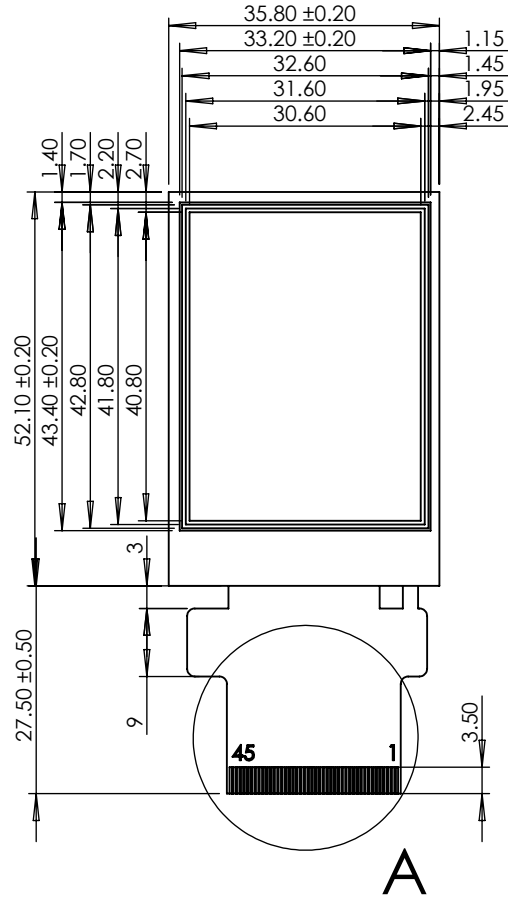
- 7.4 AC Characteristics

3. Features

- 240x320 Dot Matrix
- Wide viewing angle
- Transreflective – sunlight readable
- Built-in Controller: Sitronix ST7789
- Operating Temperature: -20 – 70°C
- Storage Temperature: -30 – 80°C
- +3.3V Logic Power, +3.2 Backlight Power
- Interface: 3-Wire SPI, 4-wire SPI, 8/9/16/18 Bit Parallel, SPI+ 16/18 Bit RGB

4. Mechanical Data

Item	Version	Specification (mm)
Module Width x Height x Depth	CFAF240320D0-020FN	35.8 x 52.1 x 2.65
	CFAF240320D0-020FR	35.8 x 52.1 x 3.85
Active Area	Both	30.6 x 40.8
Pixel Pitch	Both	0.1275 x 0.1275
Weight (Typical)	CFAF240320D0-020FN	10.6 grams
	CFAF240320D0-020FR	14.6 grams



DETAIL A

SCALE 2 : 1

PIN No.	Symbol
1	GND
2	VCI
3	IOVCC
4	IM2
5	IM1
6	IM0
7	RESET
8	CS
9	D/C, SCL
10	WR, RS
11	RD
12	VSYNC
13	HSYNC
14	ENABLE
15	DOTCLK
16	SDA
17-34	DB0-DB17
35	SDO
36	LEDA
37-40	LEDK1-4
41-44	NC
45	GND

Display Controller	ST7789
Brightness	260 nits transflective
Viewing Direction	ALL
Operating Temperature	-20 to 70 °C
Voltage Levels	3.3v

Units: millimeters
Tolerance: ±0.3



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Part Number:

CFAF240320D0-020FN

Date:

6/15/2023

Filename:

CFAF240320D0-020FN mm.pdf

Revision:

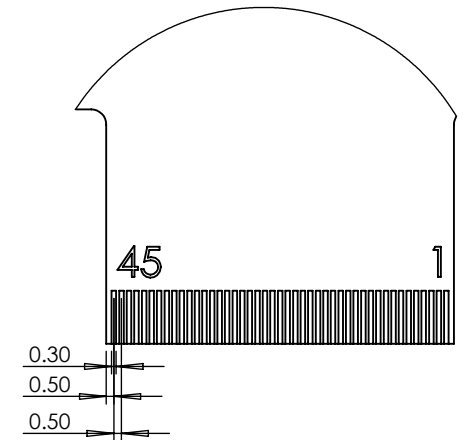
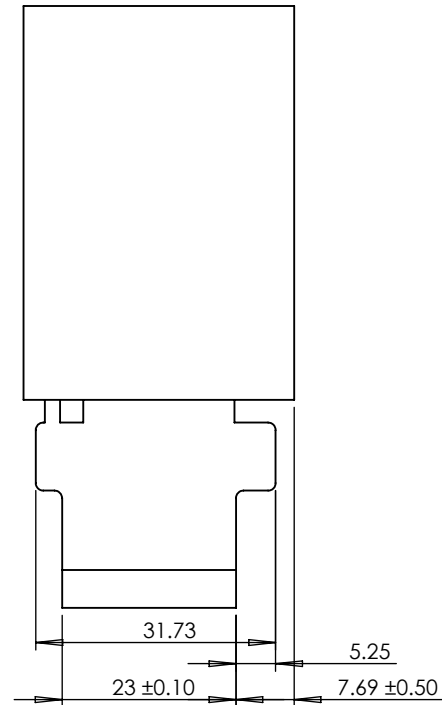
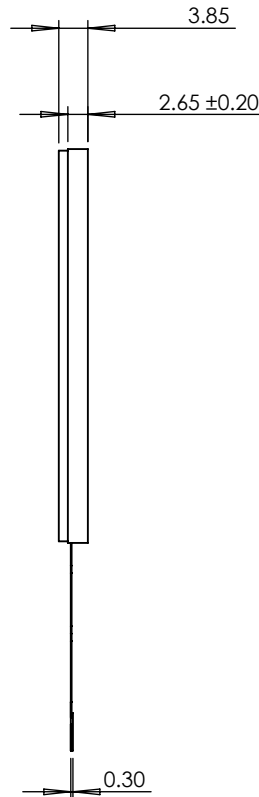
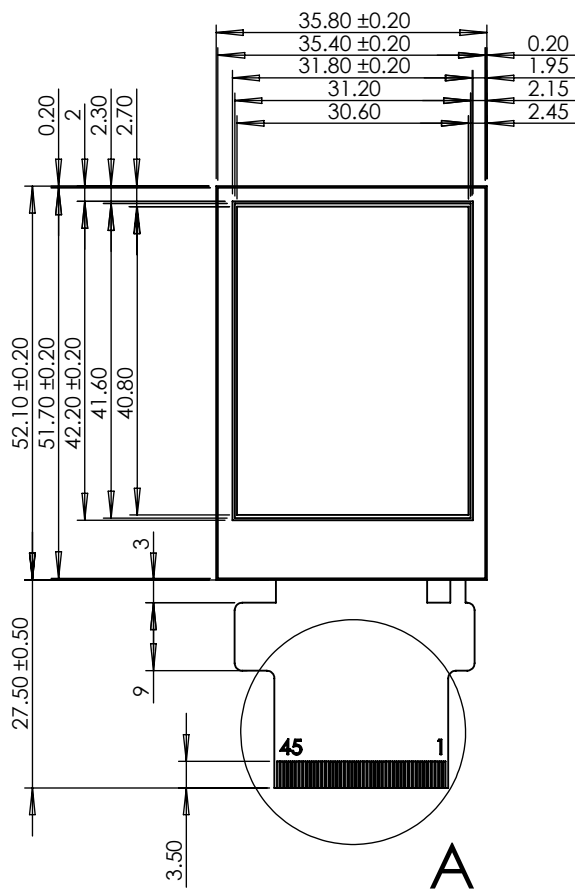
v1.0

Web:

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DETAIL A

SCALE 2 : 1

PIN No.	Symbol
1	GND
2	VCI
3	IOVCC
4	IM2
5	IM1
6	IM0
7	RESET
8	CS
9	D/C, SCL
10	WR, RS
11	RD
12	VSYNC
13	HSYNC
14	ENABLE
15	DOTCLK
16	SDA
17-34	DB0-DB17
35	SDO
36	LEDA
37-40	LEDK1-4
41-44	Touch Panel
45	GND

Display Controller	ST7789
Brightness	200 nits transflective
Viewing Direction	ALL
Operating Temperature	-20 to 70 °C
Voltage Levels	3.3v

Units: millimeters
Tolerance: ±0.3



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Sheet:

1 of 1



6. Interface Pin Function

PIN No.	Symbol	Function																																					
1	GND	Ground																																					
2	V _{CI}	Supply Voltage																																					
3	IOV _{CC}	I/O Supply Voltage																																					
4	IM2	<table border="1"> <thead> <tr> <th>IM2</th> <th>IM1</th> <th>IM0</th> <th>Interface</th> <th>Data Lines</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>8-bit parallel</td> <td>DB[7:0]</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>16-bit parallel</td> <td>DB[15:0]</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td>9-bit parallel</td> <td>DB[8:0]</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>18-bit parallel</td> <td>DB[17:0]</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>3-line 9-bit SPI</td> <td>SDA, SCL, CS</td> </tr> <tr> <td>6</td> <td>IM0</td> <td>1</td> <td>1</td> <td>0</td> <td>4-line 8-bit SPI</td> <td>SDA, SCL, CS, RS</td> </tr> </tbody> </table>	IM2	IM1	IM0	Interface	Data Lines	0	0	0	8-bit parallel	DB[7:0]	0	0	1	16-bit parallel	DB[15:0]	0	1	0	9-bit parallel	DB[8:0]	0	1	1	18-bit parallel	DB[17:0]	1	0	1	3-line 9-bit SPI	SDA, SCL, CS	6	IM0	1	1	0	4-line 8-bit SPI	SDA, SCL, CS, RS
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6	IM0	1	1	0	4-line 8-bit SPI	SDA, SCL, CS, RS																																	
5	IM1																																						
6	IM0																																						
7	RESET	Reset signal, active low. Must be applied to properly initialize the display. Keep high during use.																																					
8	CS	Chip Select pin, active low. Fix low when not in use.																																					
9	D/C SCL	Parallel – Data/command selection pin. High for data, low for command register. SPI – Serial clock																																					
10	WR RS	Parallel – Write enable SPI – Register Select (D/C) High for data, low for command register.																																					
11	RD	Read enable pin, data is read at the rising edge. Fix high or low when not in use.																																					
12	VS _{SYNC}	Frame synchronizing signal for RGB. Fix low when not in use																																					
13	HS _{SYNC}	Line synchronizing signal for RGB. Fix low when not in use																																					
14	ENABLE	Data enable signal for RGB interface. Fix low when not in use.																																					
15	DOTCLK	Dot clock for RGB interface. Fix low when not in use																																					
16	SDA	Serial data input signal. Data is latched on the rising edge of the SCL signal.																																					
17-34	DB0-DB17	18-bit bi-directional data bus. Fix low when not in use.																																					
35	SDO	Serial data output pin. Data is output on the falling edge of the SCL signal. Leave open if not in use.																																					
36	LEDA	Anode pin of backlight																																					
37-40	LEDK1-4	Cathode pins of backlight																																					
41	XR	Touch panel right, CFAF240320D0-020FR only NC if not used																																					
42	YU	Touch panel top, CFAF240320D0-020FR only NC if not used																																					
43	XL	Touch panel left, CFAF240320D0-020FR only NC if not used																																					
44	YD	Touch panel down, CFAF240320D0-020FR only NC if not used																																					
45	GND	Ground																																					



7. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Supply Voltage for Logic	V _{CI} , IOV _{CC}	-0.3	4.6	V
Operating Temperature	T _{OP}	-20	70	eIC
Storage Temperature	T _{STG}	-30	80	°C

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

8. Electrical Characteristics

Item	Symbol	Min	Typ	Max	Unit
Supply Voltage for Logic	V _{CI}	2.5	3.3	3.6	V
Digital Interface Supply Voltage	IOV _{CC}	1.65	1.8	3.3	V
Normal Current Consumption	I _{DD}	-	6	12	mA
High-level Input	V _{IH}	0.7 x IOV _{CC}	-	IOV _{CC}	V
Low-level Input	V _{IL}	GND	-	0.3 x IOV _{CC}	V
High-level Output	V _{OH}	0.8 x IOV _{CC}	-	IOV _{CC}	V
Low-level Output	V _{OL}	GND	-	0.2 x IOV _{CC}	V

9. Optical Characteristics

9.1. With Backlight

Item	Symbol	Condition	Min	Typ	Max	Unit
Viewing Angle	(V)θ	CR>10	120	160	-	deg
	(H)φ	CR>10	120	160	-	deg
Contrast Ratio	CR	Dark	200	250	-	-
Transmittances	T		-	2.0	-	%
Response Time	T _{rise} +T _{fall}	-	-	25	50	ms
Color Filter Chromacity CFT-01 Reference only	White	W _X	0.2293	0.2693	0.3098	
		W _Y	0.2521	0.2921	0.3321	
	Red	R _X	0.35308	0.5708	0.6108	
		R _Y	0.2970	0.3370	0.3770	
	Green	G _X	0.2797	0.3197	0.3597	
		G _Y	0.5252	0.5652	0.6052	
Blue	B _X	0.1122	0.1522	0.1922		
	B _Y	0.0416	0.0816	0.1216		



9.2. Without Backlight

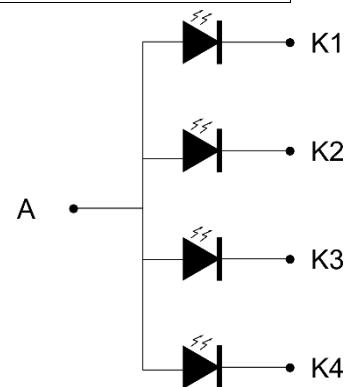
Item	Symbol	Condition	Min	Typ	Max	Unit
View Angle	(V) θ	CR>2	-	90	-	deg
	(H) ϕ	CR>2	-	90	-	deg
Contrast Ratio	CR	Dark	-	5	-	-
Reflection Ratio	R		-	7	-	%

10. Backlight Characteristics

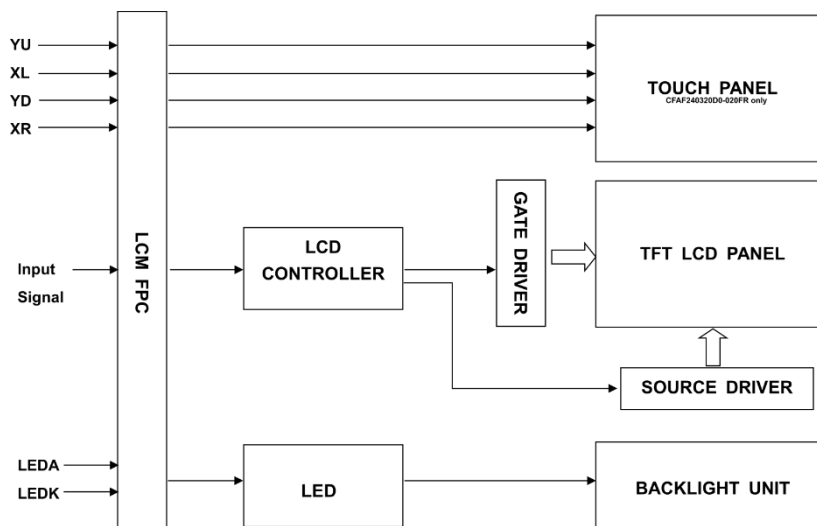
Item	Symbol	Min	Typ	Max	Unit
Supply Current	I _F	60	80	-	mA
Supply Voltage	V _F	2.8	3.2	3.3	V
Luminous Intensity for LCM	L _V	200	260	-	cd/m ²
	With RTP	150	200	-	cd/m ²
Uniformity for LCM	-	80	-	-	%
LED Lifetime	-	-	50,000	-	Hr.
Color	White				

Notes:

- (1) Supply current minimum value is only for reference since the LED brightness efficiency keeps enhancing. Current consumption becomes less and less to achieve the same luminance.
- (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. This value is estimated assuming T_a=25°C.



11. Block Diagram





12. LCD Module Precautions

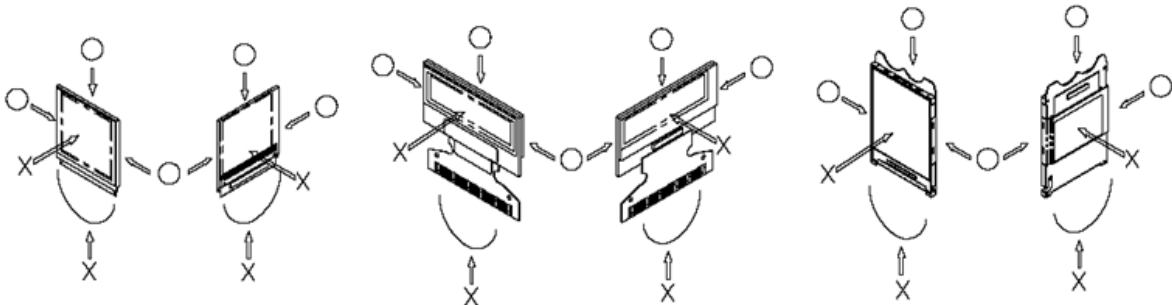
These precautions help ensure personal safety, module performance, and compliance of environmental regulations when using an LCD module.

12.1. Modules

- Avoid excessive physical and electrical shocks to module.
- Do not drop, bend, or twist the LCD display module.
- Do not make extra holes, modify the shape, or change the components of the printed circuit board.
- Do not disassemble the LCD display module.
- Do not operate the LCD display module outside the absolute maximum rating.
- Only solder to the I/O terminals.
- Store in an anti-static electricity container and clean environment.
- Do not display static information for long periods of time to avoid burn in.
- 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.

12.2. Handling Precautions

- The display panel is made of glass. Do not apply mechanical impacts, stress or pressure to the LCD display module.
- Pressure applied to or near the display surface may damage the cell structure.
- If the display panel is accidentally broken and the internal organic substance leaks out, do not inhale or touch the organic substance.
- The polarizer covering the surface of the LCD display module is soft and can be easily scratched. Cover the polarizer in the final design.
- Clean the surface of the polarizer using Scotch Mending Tape No. 810 or an equivalent
 - Never breathe on the surface or wipe the surface using a cloth containing solvent such as ethyl alcohol, as the surface of the polarizer will become cloudy.
 - Water, ketone, and aromatic solvents may ruin the polarizer.
- Do not over bend the film with electrode pattern layouts. This can effect the display performance.



- Do not apply stress to the LSI chips and the surrounding molded sections.
- Do not apply input signals while the logic power is off.
- Prevent damage by electrostatic discharge (ESD) when handling the LCD display module:
 - Ground personnel handling LCD display modules.
 - Ground tools used for assembly such as soldering irons.
 - To suppress generation of ESD, avoid carrying out assembly work under dry environments.
 - Remove the protective film applied to the display panel slowly as ESD may be generated when removing the film.
- Protective film is applied to the surface of the display panel. Remove the film before assembly. 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 as discussed above.



12.3. Storing Precautions

- Store the LCD display modules in ESD preventative bags. Avoid exposure to direct sunlight and fluorescent lamps. Avoid high temperature and high humidity environments and low temperature (less than 0°C) environments. We recommend storing these modules in the packaged state in which they were shipped from Crystalfontz.
- Do not let water drops or dew adhere to the packages or bags.
- If electric current is applied when water is on the surface of the LCD display module, the module may become dewed. If a dewed LCD display module is placed under high humidity environments the electrodes may become corroded.

12.4. Designing Precautions

- The absolute maximum ratings cannot be exceeded for LCD display module. If these values are exceeded, panel damage may happen.
- Satisfy the VIL and VIH specifications and, ensure the signal line cable is as short as possible to avoid signal noise.
- Install excess current preventative unit (fuses, etc.) to the power circuit. Recommend value: 0.5A
- Avoid occurrence of mutual noise interference with the neighboring devices.
- 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.

12.5. Disposing Precautions

- Request qualified companies handle the industrial waste when disposing of the LCD display modules. Observe all relevant laws and regulations.

12.6. 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 exposed. 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 and 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.
- Periodically refresh the operation statuses in the software (reset the commands and retransfer 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:

