



## TFT GRAPHIC DISPLAY MODULE DATASHEET



Datasheet Release Date 2022-01-27  
for  
**CFAF240320H1-022T**

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## 1. General Information

### Datasheet Revision History

Datasheet Release: **2022-01-27**  
Datasheet for the CFAF240320H1-022T 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 2.2-inch full color TFT LCD graphic display module with a white LED backlight. The display only requires a single 3.3V power supply. This display has a built-in Sitronix ST7789V controller.

Please see [Sitronix ST7789V LCD Controller Datasheet](#) for further reference, including timing diagrams.

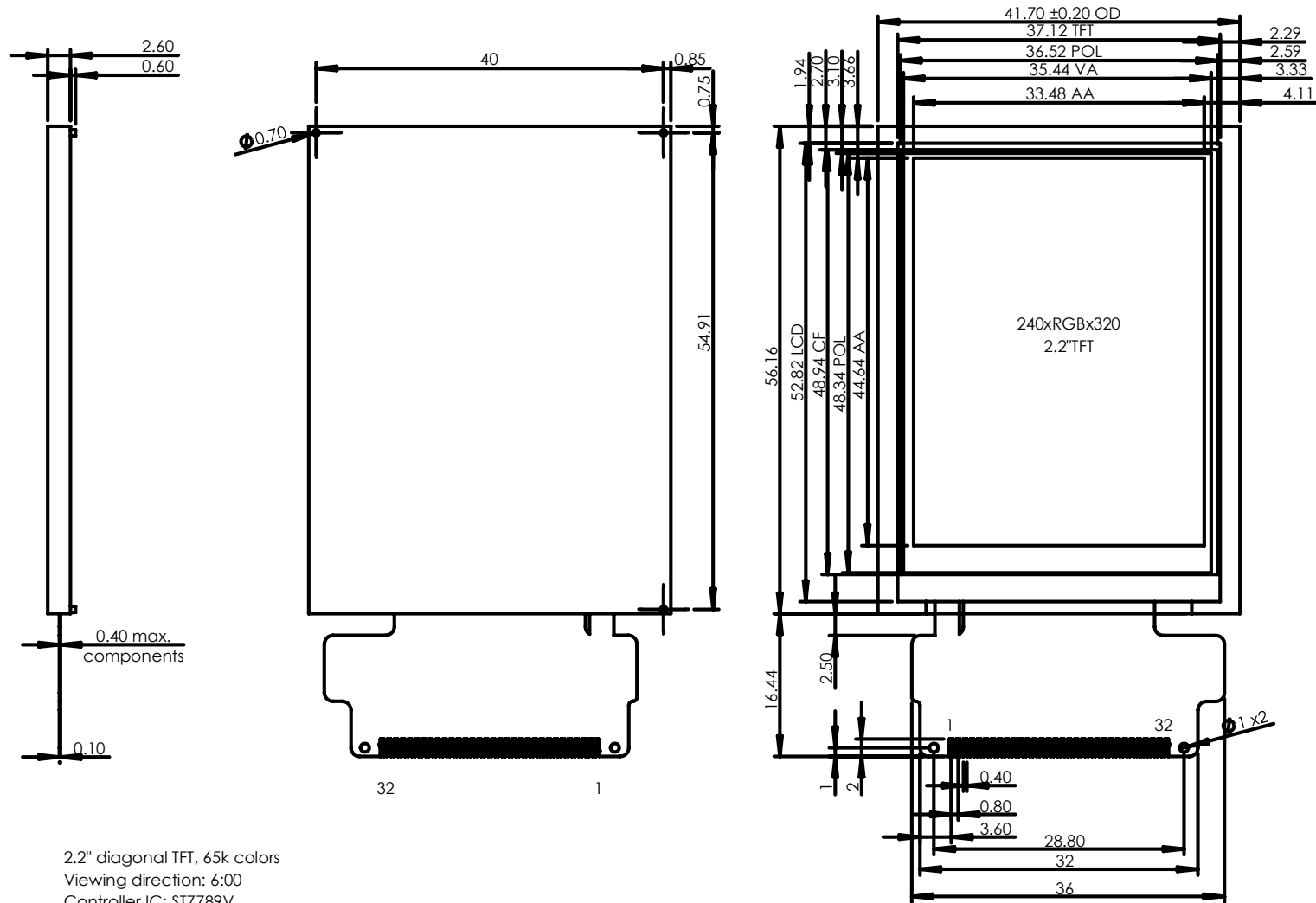
## 3. Features

- 240\*320 Dot Matrix
- 3.3V Power Supply
- Display Colors: 65K
- Diagonal Dimension: 2.2-inch
- Viewing Direction: 6 o'clock
- Built-in Controller: ST7789V (or equivalent)
- Operating Temperature: -20°C to +70°C
- Storage Temperature: -30°C to +80°C
- Interface: 8-Bit Parallel

## 4. Mechanical Data

Item	Specification (mm)	Specification (inch, reference)
Overall Width and Height	41.7 (W) x 56.16 (H) x 2.6 (D)	1.64 (W) x 2.21 (H) x 0.10 (D)
Active Area	33.48 (W) x 44.64(H)	1.32 (W) x 1.78 (H)
Dot Pitch	0.14 (W) x 0.14 (H)	0.006 (W) x 0.006 (H)
Weight (Typical)	10 grams	0.4 ounces

## 5. Mechanical Drawing



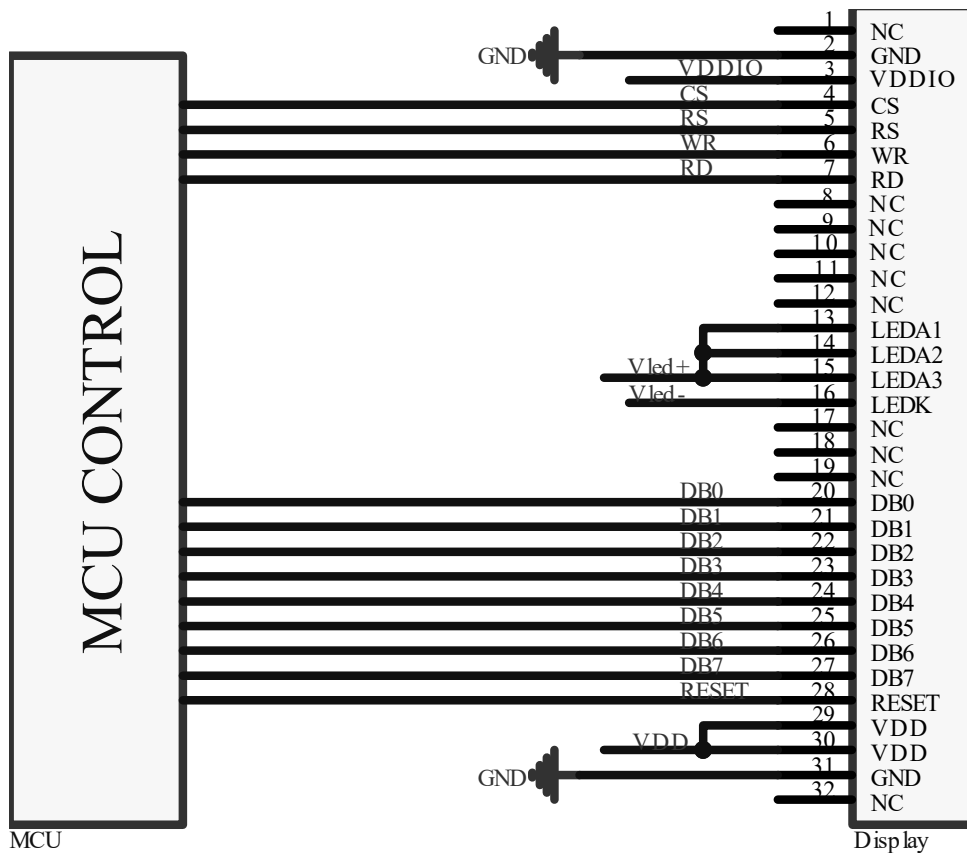
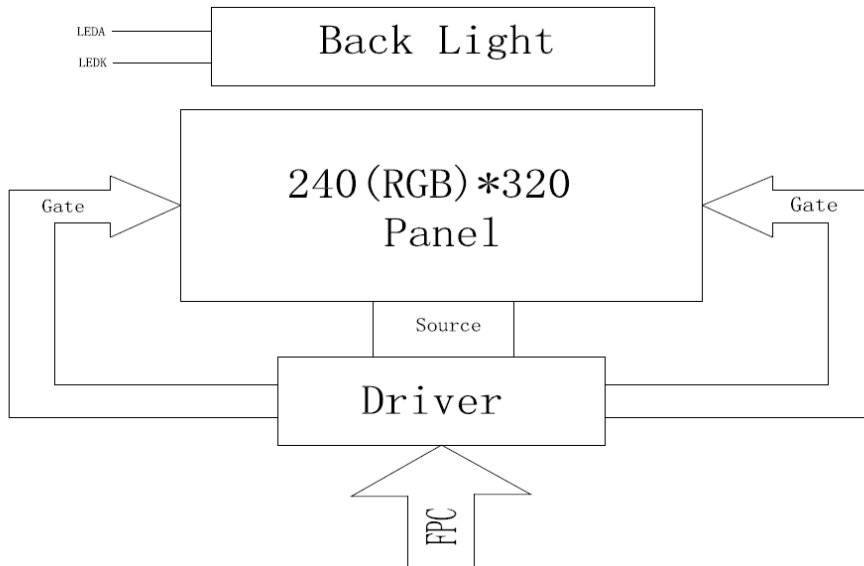
2.2" diagonal TFT, 65k colors  
Viewing direction: 6:00  
Controller IC: ST7789V  
SuPLY, logic, and backlight voltages: 3.3v typ  
Operating temp: -20 to 70C

Units: millimeters  
Tolerance:  $\pm 0.3$

## 6. Interface Pin Function

Pin	Symbol	Function
1	NC	No Connection
2	GND	Ground
3	V <sub>DDIO</sub>	Digital Interface Supply Voltage
4	CS	Chip Select Input Pin ("Low" enable).
5	RS	Register Select: Display Data/Command Selection Pin Data when high, command when low.
6	WR	Write enable in parallel.
7	RD	Read enable in 8080 MCU Parallel Interface. When not in use, connect to IOVCC.
8	NC	No Connection
9	NC	No Connection
10	NC	No Connection
11	NC	No Connection
12	NC	No Connection
13	LEDA1	Anode Pin of Backlight
14	LEDA2	Anode Pin of Backlight
15	LEDA3	Anode Pin of Backlight
16	LEDK	Cathode Pin of Backlight
17	NC	No Connection
18	NC	No Connection
19	NC	No Connection
20 -27	DB0-DB7	8-Bit Parallel Bi-Directional Data Bus for MCU Interface Mode. Fix to GND level when not in use.
28	RESET	Reset Pin. Setting pin to "Low" initializes the LSI. Must be reset after power is applied.
29	V <sub>DD</sub>	Digital Supply Voltage (3.3V)
30	V <sub>DD</sub>	Digital Supply Voltage (3.3V)
31	GND	Ground
32	NC	No Connection

## 7. System Block Diagrams



- NOTE:
1. Interface: 8BIT MCU
  2. VDD=3.3V. VDDIO=3.3V
  3. Vled=3.2V Iled=60mA

## 8. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Digital Supply Voltage	$V_{DD}$	-0.3	4.6	V
Digital Interface Supply Voltage	$V_{DDIO}$	-0.3	4.6	V
Operating Temperature	$T_{OP}$	-20	+70	°C
Storage Temperature	$T_{ST}$	-30	+80	°C

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

## 9. Electrical Characteristics

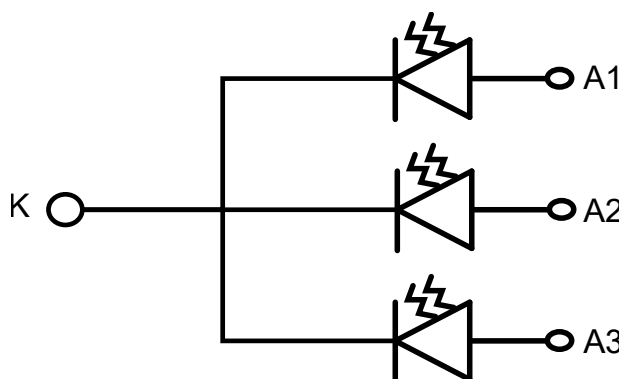
Item	Symbol	Min	Typ	Max	Unit
Digital Supply Voltage	$V_{DD}$	2.4	3.3	3.6	V
Digital Interface Supply Voltage	$V_{DDIO}$	1.8	3.3	3.3	V
Normal Mode Current Consumption	$I_{DD}$	-	5	-	mA
Level Input Voltage	$V_{IH}$	$0.7V_{DDIO}$	-	$V_{DDIO}$	V
	$V_{IL}$	GND	-	$0.3V_{DDIO}$	V
Level Output Voltage	$V_{OH}$	$0.8V_{DDIO}$	-	$V_{DDIO}$	V
	$V_{OL}$	GND	-	$0.2V_{DDIO}$	V

## 10. Backlight Characteristics

Item	Symbol	Min	Typ	Max	Unit	Notes
Forward Current	$I_F$	45	60	-	mA	(1)
Forward Voltage	$V_F (V_{led})$	2.8	3.2	3.4	V	-
LCM Luminance ( $I_F=60mA$ )	$L_v$	230	280	-	cd/m <sup>2</sup>	-
Uniformity	Avg	80	-	-	%	-
LED Lifetime	Hr.	50K	-	-	Hr.	(2)
Color	White					

Notes:

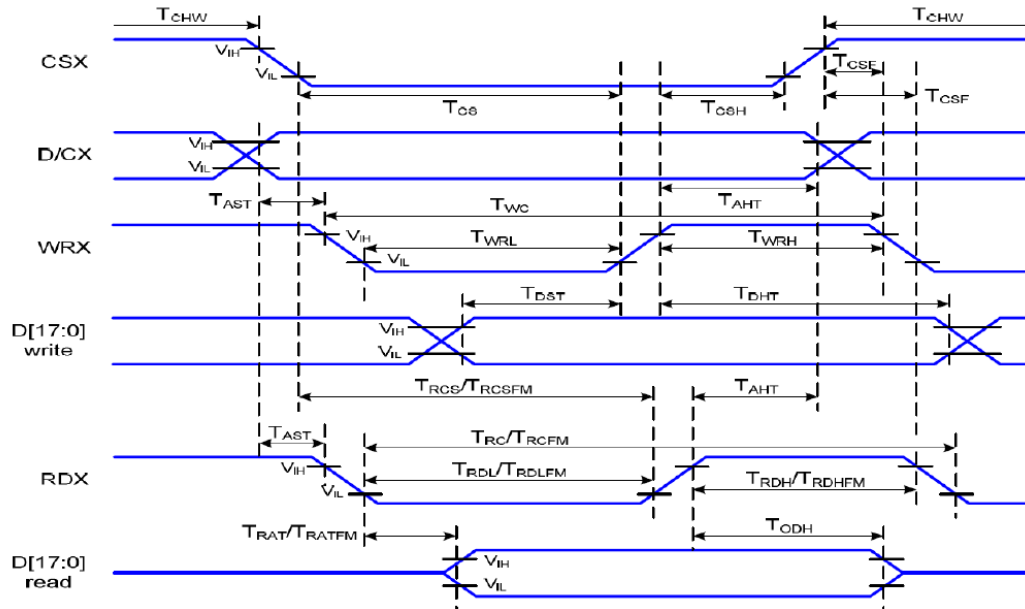
- (1) Forward current minimum value is only for reference since the LED brightness efficiency keeps enhancing. Current consumption decreases to achieve the same luminance.
- (2) Lifetime is defined as the amount of time until the luminance has decayed to <50% of the initial value (50K hours is an estimate for reference only).





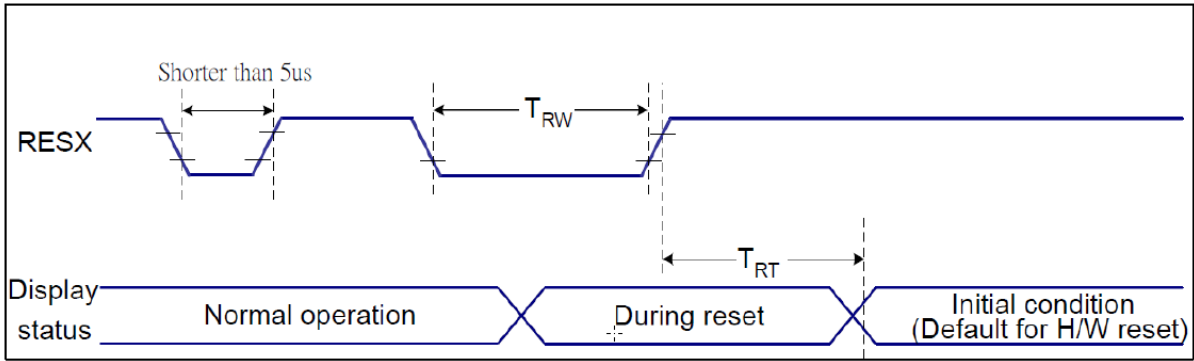
## 11. AC Characteristics

### 11.1. Display Parallel 8-Bit Interface Timing Characteristics (8080 System)



Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	$T_{AST}$	Address Setup Time	0	-	ns	-
	$T_{AHT}$	Address Hold Time (Write/Read)	10	-	ns	
CSX	$T_{CHW}$	Chip Select "H" Pulse Width	0	-	ns	-
	$T_{CS}$	Chip Select Setup Time (Write)	15	-	ns	
	$T_{RCS}$	Chip Select Setup Time (Read ID)	45	-	ns	
	$T_{RCSFM}$	Chip Select Setup Time (Read FM)	355	-	ns	
	$T_{CSF}$	Chip Select Wait Time (Write/Read)	10	-	ns	
WRX	$T_{WC}$	Write Cycle	66	-	ns	-
	$T_{WRH}$	Control Pulse "H" Duration	15	-	ns	
	$T_{WRL}$	Control Pulse "L" Duration	15	-	ns	
RDX (ID)	$T_{RC}$	Read Cycle (ID)	160	-	ns	When Read ID Data
	$T_{RDH}$	Control Pulse "H" Duration (ID)	90	-	ns	
	$T_{RDL}$	Control Pulse "L" Duration (ID)	45	-	ns	
RDX (FM)	$T_{RCFM}$	Read Cycle (FM)	450	-	ns	When Read from Frame Memory
	$T_{RDHFM}$	Control Pulse "H" Duration (FM)	90	-	ns	
	$T_{RDLFM}$	Control Pulse "L" Duration (FM)	355	-	ns	
D[17:0]	$T_{DST}$	Data Setup Time	10	-	ns	For CL=30pF

## 11.2. Reset Timing Characteristics



Signal	Symbol	Parameter	Min	Max	Unit	Notes
RESX	$T_{RW}$	Reset Pulse Duration	10	-	us	-
	$T_{RT}$	Reset Cancel	-	5	ms	(1)(5)
			-	120	ms	(1)(6)(7)

**Notes:**

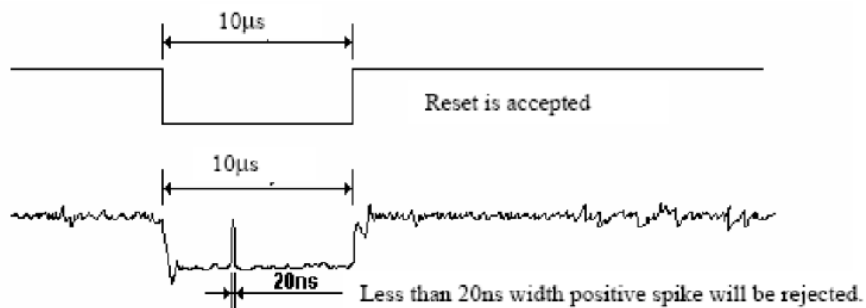
(1) The reset cancel includes also required time for loading ID bytes,  $V_{COM}$  setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time ( $T_{RT}$ ) within 5 ms after a rising edge of RESX.

(2) Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

RESX	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset Starts

(3) During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode.) and then return to Default condition for Hardware Reset.

(4) Spike Rejection also applies during a valid reset pulse as shown below:



(5) When Reset applied during Sleep In Mode.

(6) When Reset applied during Sleep Out Mode.

(7) It is necessary to wait 5msec after releasing RESX before sending commands. Also, Sleep Out command cannot be sent for 120msec.

## 12. Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
Transmittance (with Polarizer)	T(%)	-	5.5	6.0	-	%
Contrast Ratio	CR	$\theta=0$	400	500	-	%
Response Time	$T_R+T_F$	25°C	-	8	16	ms
NTSC	S(%)	-	49	54	-	%
Color Filter Chromaticity	White	Wx	C-light	0.2698	-	-
		Wy		0.2943		
	Red	Rx		0.5882		
		Ry		0.3592		
	Green	Gx		0.2969		
		Gy		0.5648		
	Blue	Bx		0.1509		
		By		0.0802		
View Angle	Hor.	$\theta_L$	60	70	-	Degree
		$\theta_R$	60	70	-	
	Ver.	$\theta_T$	60	70	-	
		$\theta_B$	45	55	-	
Viewing Direction	6 o'clock					

## 13. LCD Module Precautions

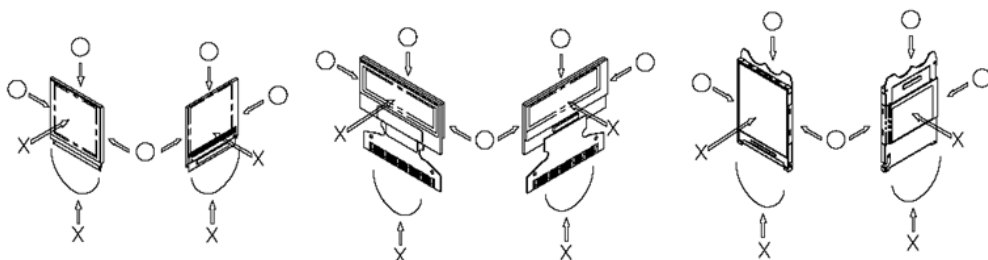
The precautions below should be followed when using LCD modules to help ensure personal safety, module performance, and compliance of environmental regulations.

### 13.1. Modules

- Avoid applying excessive shocks to module 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 the passive components. (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 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 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 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.

### 13.3. Storage 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.

### 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. Or, when burning them, be sure to observe the 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.
  - 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:

