# GRAPHIC TFT MODULE DATA SHEET

Preliminary


**Preliminary Data Sheet Release Date 2014-08-01**
**for**
**CFAF240320H-022T**

**Crystalfontz America, Incorporated**

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## CFAF240320H-022T Data Sheet Revision History

Preliminary Data Sheet Release: 2014-08-01.
Improved Module Outline Drawing (Pg. 7). The AutoCAD 2D file is available for download under the Datasheets&Files tab for this product.

Preliminary Data Sheet Release: 2014-06-16.
Data Sheet is revised to reflect changes for this display. For details, see Product Notices tab.

Data Sheet Preliminary Release: 2011-08-09.

## About Variations

We work continuously to improve our products. Because display technologies are quickly evolving, these products may have component or process changes. Slight variations (for example, contrast, color, or intensity) between lots are normal. If you need the highest consistency, whenever possible, order and arrange delivery for your production runs at one time so your displays will be from the same lot.

Preliminary

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Preliminary

## About Volatility

This module has volatile memory.

# CONTENTS

**MECHANICAL SPECIFICATIONS** ---- **5**
Physical Characteristics ---- 5
Additional Features ---- 6
Module Outline Drawing ---- 7
**ELECTRICAL SPECIFICATIONS** ---- **8**
Absolute Maximum Ratings ---- 8
Recommended DC Characteristics (3.0v Operation) ---- 8
Details Of Interface Pin Functions ---- 9
ESD (Electro-Static Discharge) ---- 10
**OPTICAL SPECIFICATIONS** ---- **11**
**LED BACKLIGHT CHARACTERISTICS** ---- **13**
**MODULE RELIABILITY AND LONGEVITY** ---- **14**
Module Reliability ---- 14
Module Longevity (EOL/Replacement Policy) ---- 14
**CARE AND HANDLING PRECAUTIONS** ---- **15**
**APPENDIX A: QUALITY ASSURANCE STANDARDS** ---- **17**
**APPENDIX B: TFT MODULE TERMS AND SYMBOLS** ---- **20**

Preliminary

# MECHANICAL SPECIFICATIONS

## PHYSICAL CHARACTERISTICS

* 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, back-light unit. The resolution of a 2.2" TFT-LCD contains 240 x 320pixels, and can display up to 262K colors.

* Features

-Low Input Voltage: VCI: 2.8V~3.3V
-Display Colors of TFT LCD: 262K colors
- Interface: 8-bits,MCU interface.
-Internal Power Supply Circuit.

Preliminary

| General Information Items | Specification | Unit | Note |
|---|---|---|---|
| | Main Panel | | |
| Display area(AA) | 33. 48(H) *44.64(V) (2. 2inch ) | mm | - |
| Driver element | TFT active matrix | - | - |
| Display colors | 262K | colors | - |
| Number of pixels | 240(RGB) *320 | dots | - |
| Pixel arrangement | | - | - |
| Pixel pitch | 0.1395 (H) x 0.1395 (V) | mm | - |
| Viewing angle | 12 | o'clock | - |
| Controller IC | RM68090 | - | - |
| Display mode | Transmissive/ Normally Black | - | - |
| Operating temperature | -20～+70 | ℃ | - |
| Storage temperature | -30～+80 | ℃ | - |

* **Mechanical Information**

| Item | | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Module size | Horizontal(H) | | 41.70 | | mm | - |
| | Vertical(V) | | 56.16 | | mm | - |
| | Depth(D) | | 2.6 | | mm | - |
| Weight | | | TBD | | g | - |

# ADDITIONAL FEATURES

- These display modules have a Raydium RM68090 Single Chip Driver with 262K color. For interface information and other details, see controller datasheets on our website.
- To download the most current Certificate of Compliance for ISO, RoHS, and REACH, go to the DATASHEETS & FILES tab on the part number's website page.

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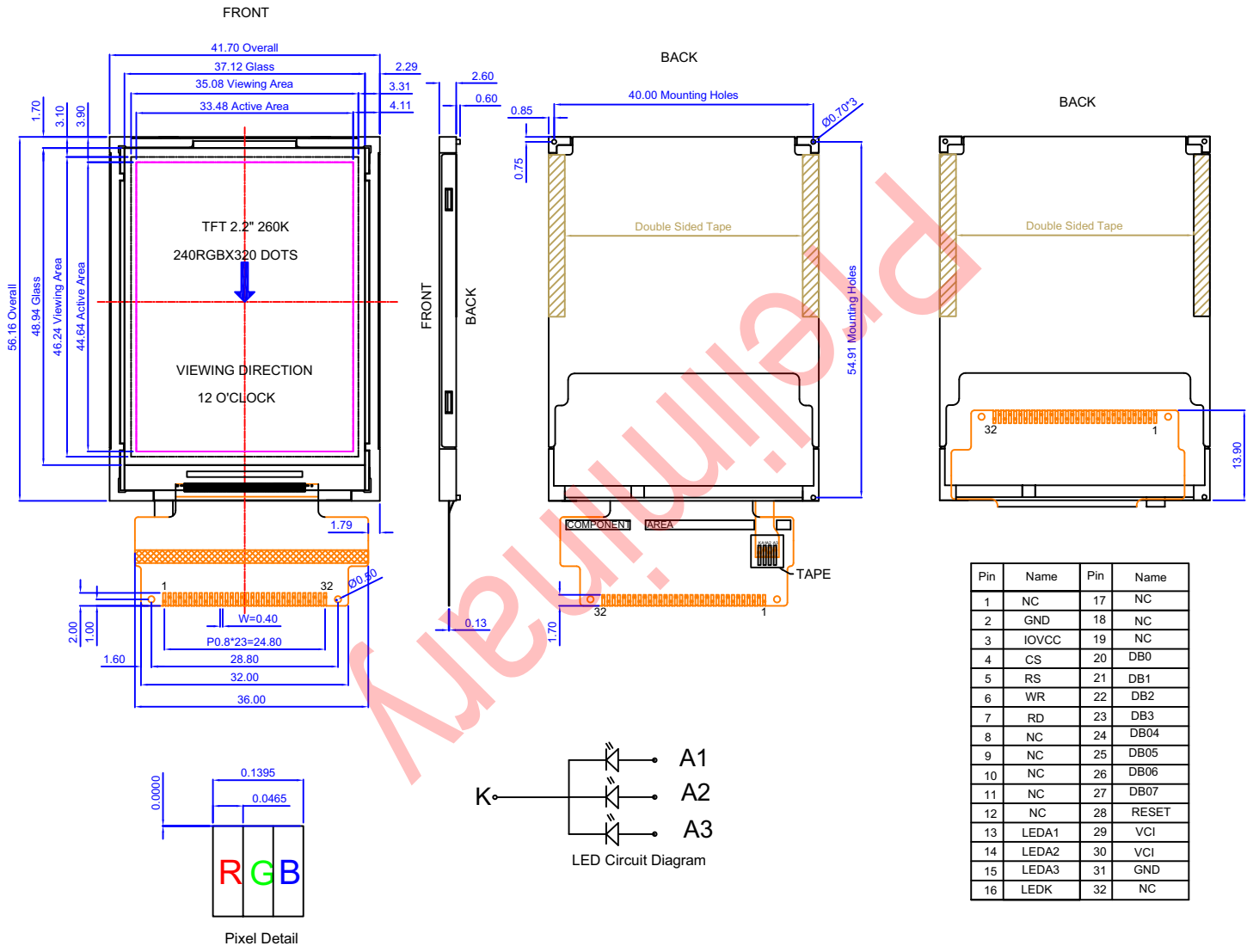
# MODULE OUTLINE DRAWING




| Pin | Name | Pin | Name |
|---|---|---|---|
| 1 | NC | 17 | NC |
| 2 | GND | 18 | NC |
| 3 | IOVCC | 19 | NC |
| 4 | CS | 20 | DB0 |
| 5 | RS | 21 | DB1 |
| 6 | WR | 22 | DB2 |
| 7 | RD | 23 | DB3 |
| 8 | NC | 24 | DB04 |
| 9 | NC | 25 | DB05 |
| 10 | NC | 26 | DB06 |
| 11 | NC | 27 | DB07 |
| 12 | NC | 28 | RESET |
| 13 | LEDA1 | 29 | VCI |
| 14 | LEDA2 | 30 | VCI |
| 15 | LEDA3 | 31 | GND |
| 16 | LEDK | 32 | NC |

Figure 1. Module Outline Drawing

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| Part No.(s): | Scale: | Drawing Number: | |
|---|---|---|---|
| CFAF240320H-022T Preliminary Drawing | Not to scale | CFAF240320H-022T | |
| | Units: Millimeters | Date: 2014-08-01 | Sheet: 1 of 1 |

# ELECTRICAL SPECIFICATIONS

## ABSOLUTE MAXIMUM RATINGS

| Characteristics | Symbol | Min. | Max. | Unit | Note |
|---|---|---|---|---|---|
| Power supply voltage | VCI | -0.3 | 5.0 | V | |
| Input Voltage | Vi | -0.3 | IOVCC+0.3 | V | |
| Operating temperature | $T_{OP}$ | -20 | + 70 | ℃ | |
| Storage temperature | $T_{ST}$ | -30 | + 80 | ℃ | |

## RECOMMENDED DC CHARACTERISTICS (3.0V OPERATION)

| Characteristics | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Power supply voltage | VCI | 2.8 | 3.3 | 3.6 | V | |
| Normal mode Current consumption | $Vcc_I$ | --- | 8 | -- | mA | |
| Level input voltage | $V_{IH}$ | $0.8V_{DDIO}$ | | - | V | |
| | $V_{IL}$ | - | | $0.2V_{DDIO}$ | V | |
| Level output voltage | $V_{OH}$ | $0.8V_{DDIO}$ | | - | V | |
| | $V_{OL}$ | - | | $0.2V_{DDIO}$ | V | |

Preliminary

# DETAILS OF INTERFACE PIN FUNCTIONS

| Pin NO. | Symbol | Function |
|---|---|---|
| 1. | NC | NC |
| 2 | GND | |
| 3 | IOVCC | Analog power supply, 2.8V~3.3V |
| 4 | CS | Chip select signal.<br>Low: chip can be accessed;<br>High: chip cannot be accessed. |
| 5 | RS | Data / Command Selection pin<br>If not use, please connect to GND. |
| 6 | WR | DBI Type-B: Serves as a write signal and write data at the low level. DBI Type-C: it servers as SCL (Serial Clock).<br>If not use, please connect to GND. |
| 7 | RD | DBI Type-B: Serves as a read signal and read data at the low level. If not use, please connect to IOVCC. |
| 8 | NC | NC |
| 9 | NC | NC |
| 10 | NC | NC |
| 11 | NC | NC |
| 12 | NC | NC |
| 13 | LEDA1 | Power supply for Backlight. |
| 14 | LEDA2 | Power supply for Backlight. |
| 15 | LEDA3 | Power supply for Backlight. |
| 16 | LEDK | Power supply for Backlight. |
| 17 | NC | NC |
| 18 | NC | NC |
| 19 | NC | NC |

Preliminary

| | | |
|---|---|---|
| 20-27 | DB0-DB7 | 8-bit bus: use DB0-DB7 |
| 28 | RESET | Reset pin. Setting either pin low initializes the LSI. Must be res etafter power is supplied. |
| 29 | VCI | Analog power supply, 2.8V~3.3V |
| 30 | VCI | Analog power supply, 2.8V~3.3V |
| 31 | GND | GND |
| 32 | NC | NC |

## ESD (ELECTRO-STATIC DISCHARGE)

The circuitry is industry standard CMOS logic and is susceptible to ESD damage. Please use industry standard antistatic precautions as you would for any other static sensitive devices such as expansion cards, motherboards, or integrated circuits. Ground your body, work surfaces, and equipment.

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# OPTICAL SPECIFICATIONS

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | Min | Typ | Max | |
| *1) Threshold Voltage | Vsat | 3.7 | 3.8 | 3.9 | V |
| | Vth | 1.9 | 2.0 | 2.1 | V |
| *1) Transmittance | T(%) | 3.86 | 4.40 | - | % |
| *1) Contrast Ratio | C/R | 400 | 500 | - | |
| *1) Response Time | Tr+Tf | - | 35 | 50 | msec |
| *2) CIE Color Coordinate | Rx | 0.640 | 0.660 | 0.680 | |
| | Ry | 0.297 | 0.317 | 0.337 | |
| | Gx | 0.240 | 0.260 | 0.280 | |
| | Gy | 0.555 | 0.575 | 0.595 | |
| | Bx | 0.121 | 0.141 | 0.161 | |
| | By | 0.055 | 0.075 | 0.095 | |
| | Wx | 0.275 | 0.295 | 0.315 | |
| | Wy | 0.297 | 0.317 | 0.337 | |
| *1) Viewing Angle | Θl | - | 80 | - | Degree |
| | Θr | - | 80 | - | |
| | Θu | - | 80 | - | |
| | Θd | - | 80 | - | |

Preliminary

## Definition of Response Time (Tr, Tf)

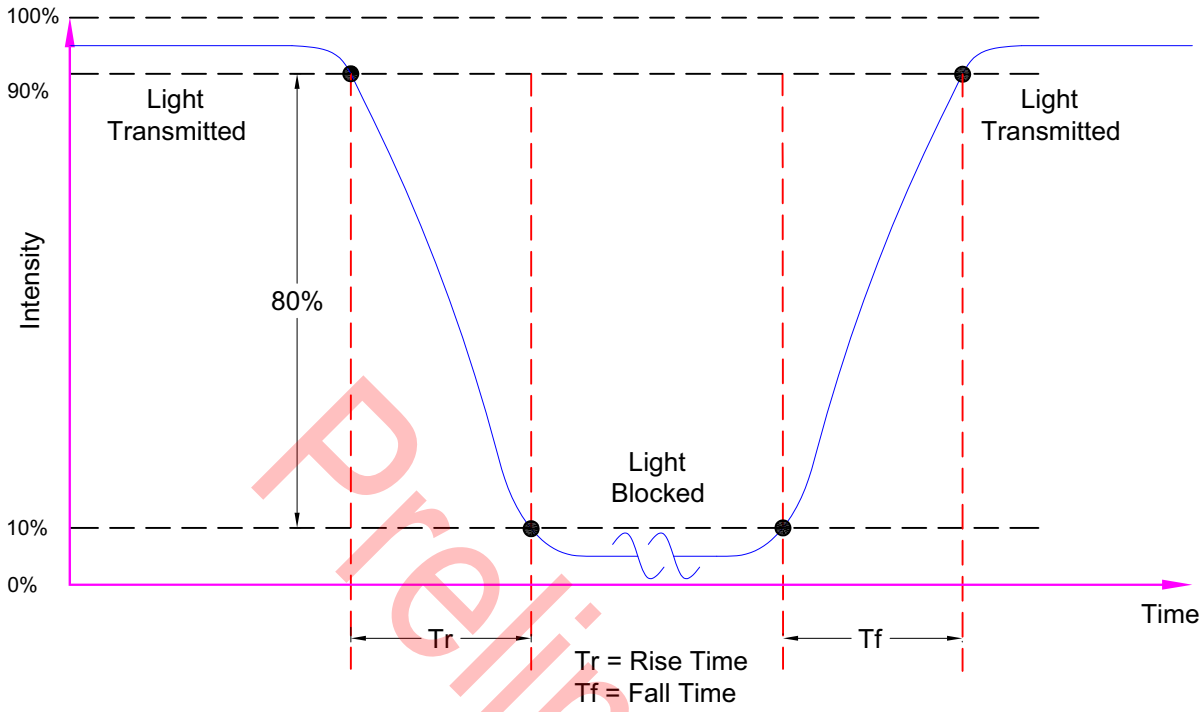



Figure 2. Definition of Response Time (Tr, Tf)

## Definition of Vertical and Horizontal Viewing Angles (CR≥2)

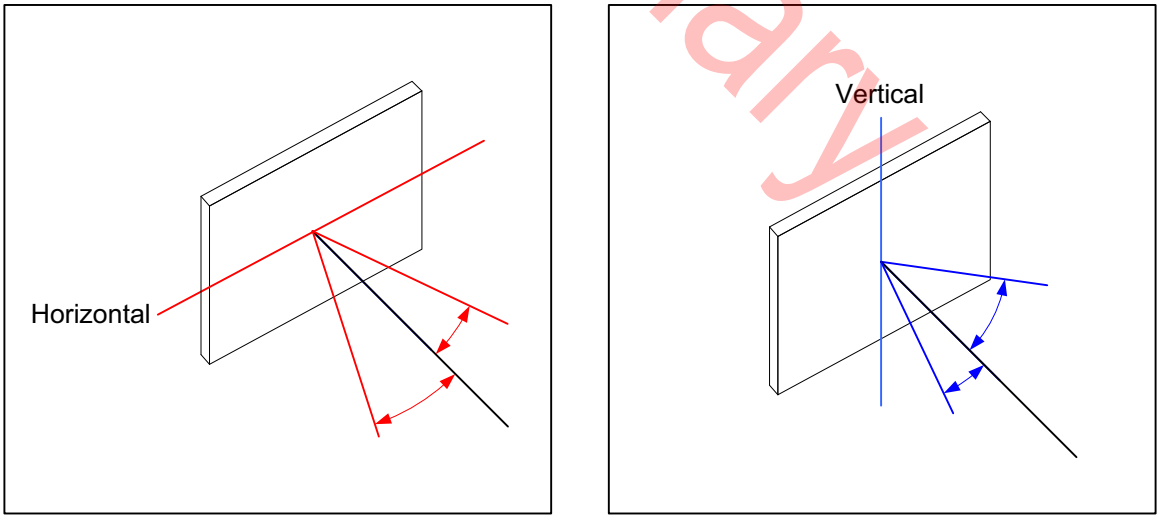



Figure 3. Definition of Horizontal and Vertical Viewing Angles (CR>2)

Preliminary

### Definition of 6 O'Clock and 12:00 O'Clock Viewing Angles

This module has a 12:00 o'clock viewing angle.

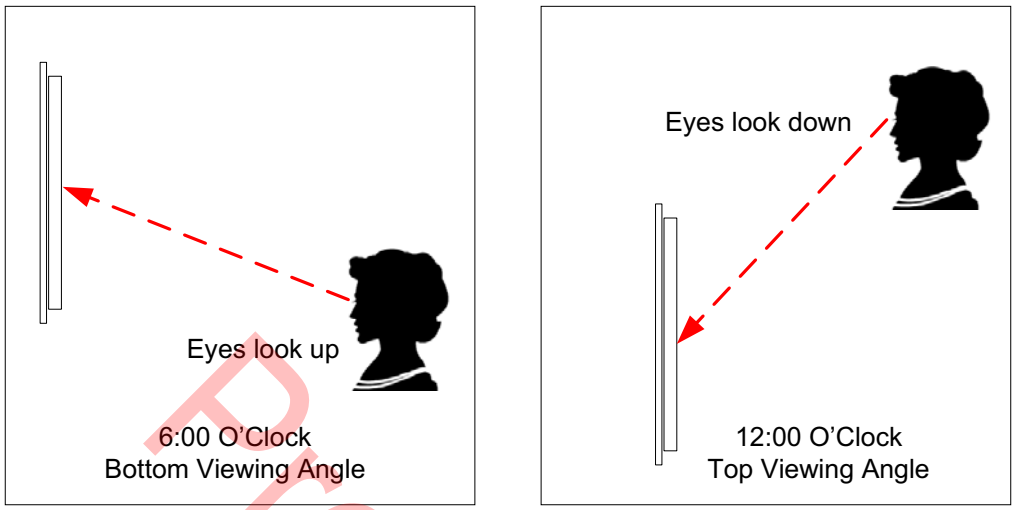
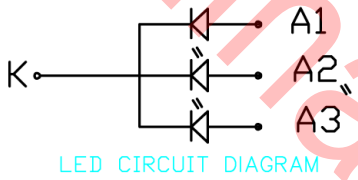



Figure 4. Definition of 6:00 O'Clock and 12:00 O'clock Viewing Angles

Preliminary

# LED BACKLIGHT CHARACTERISTICS




The back-light system is edge-lighting type with 3 chips White LED

| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Forward Current | $I_F$ | 18 | 60 | - | mA | |
| Forward Voltage | $V_F$ | | 3.3 | | V | - |
| LCM Luminance | $L_V$ | -- | -- | -- | cd/m2 | |
| Uniformity | AVg | 80 | - | - | % | - |

# MODULE RELIABILITY AND LONGEVITY

## MODULE RELIABILITY

| PART NUMBER | SPECIFICATION |
|---|---|
| CFAF240320H-022TT | Brightness will be >50% of a new module's initial brightness<br>for at least 50,000 hours of operation when supply to each LED is below TBD mA. |

*Under operating and storage temperature specification limitations, humidity noncondensing) RH up to 65%, and no exposure to direct sunlight. Value listed above is approximate and represents typical lifetime.*

*The white LEDs dim over time, especially if driven with high currents. The dimming may not be noticeable when a single display is installed. However, if a new display is installed next to a display that has been on continuously for a very long time, you will see the difference. To preserve the lifetime of white LEDs, we recommend that white LED backlights are dimmed or turned off when not needed. Also, please do not use more current than you need to achieve your brightness requirements.*

Preliminary

## MODULE LONGEVITY (EOL/REPLACEMENT POLICY)

Crystalfontz is committed to making all of our modules available for as long as possible. For each module we introduce, we intend to offer it indefinitely. We do not preplan a module's obsolescence. The majority of modules we have introduced are still available.

We recognize that discontinuing a module may cause problems for some customers. However, rapidly changing technologies, component availability, or low customer order levels may force us to discontinue ("End of Life" EOL) a module. For example, we must occasionally discontinue a module when a supplier discontinues a component or a manufacturing process becomes obsolete. When we discontinue a module, we will do our best to find an acceptable replacement module with the same fit, form, and function.

In most situations, you will not notice a difference when comparing a "fit, form, and function" replacement module to the discontinued module. However, sometimes a change in component or process for the replacement module results in a slight variation, perhaps an improvement, over the previous design.

Although the replacement module is still within the stated Data Sheet specifications and tolerances of the discontinued module, changes may require modification to your circuit and/or firmware. Possible changes include:

- *Backlight LEDs.* Brightness may be affected (perhaps the new LEDs have better efficiency) or the current they draw may change (new LEDs may have a different VF).
- *Controller.* A new controller may require minor changes in your code.
- *Component tolerances.* Module components have manufacturing tolerances. In extreme cases, the tolerance stack can change the visual or operating characteristics.

Please understand that we avoid changing a module whenever possible; we only discontinue a module if we have no other option. We will post Part Change Notices on the product's web page as soon as possible. If interested, you can subscribe to future part change notifications.

# CARE AND HANDLING PRECAUTIONS

For optimum operation of the module and to prolong its life, please follow the precautions below.

Excessive voltage will shorten the life of the module. You must drive the display within the specified voltage limit.

## HANDLING CAUTION FOR MODULES SHIPPED IN TRAYS

If you receive modules packed in trays, handle trays carefully by supporting the entire tray. Trays were made to immobilize the modules inside their packing carton. Trays are not designed to be rigid. Do not carry trays by their edges; trays and modules may be damaged.

## ESD (ELECTRO-STATIC DISCHARGE)

The circuitry is industry standard CMOS logic and is susceptible to ESD damage. Please use industry standard antistatic precautions as you would for any other static sensitive devices such as expansion cards, motherboards, or integrated circuits. Ground your body, work surfaces, and equipment.

## DESIGN AND MOUNTING

- The exposed surface of the “glass” is actually a polarizer laminated on top of the glass.To protect the soft plastic polarizer from damage, the module ships with a protective film over the polarizer. Please peel off the protective film slowly. Peeling off the protective film abruptly may generate static electricity.
- The polarizer is made out of soft plastic and is easily scratched or damaged. When handling the module, avoid touching the polarizer. Finger oils are difficult to remove.
- To protect the soft plastic polarizer from damage, place a transparent plate (for example, acrylic, polycarbonate, or glass) in front of the module, leaving a small gap between the plate and the display surface. We use GE HP-92 Lexan, which is readily available and works well.
- Do not disassemble or modify the module.
- The display can be mounted vertically onto a front panel using a variety of methods. If the enclosure is plastic, it can be molded to have the display snap into place. A metal enclosure can use a milled faceplate with mounting tabs to secure the module. Adhesives can be used, as long as they are not similar to “super-glue” because these emit vapors that can damage the display over time.
- Do not reverse polarity to the power supply connections. Reversing polarity will immediately ruin the module.
- Use care to keep the exposed terminals clean. Contamination, including fingerprints may make soldering difficult, and the reliability of the soldered connection poor.
- Sharp bends can damage the panel and FFC (Flat Flex Cable). Do not crease the cables. Do not bend the cables tightly against the edge of the LCD panel. Do not repeatedly bend the cable beyond its elastic region. Limit bend radius to at least R5.00 mm.

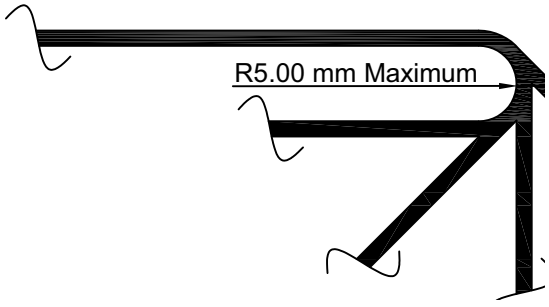



Figure 5. Limit Bend Radius of FFC cable.

Preliminary

- Do not repeatedly bend the FFC beyond its elastic region.

## AVOID SHOCK, IMPACT, TORQUE, OR TENSION

- Do not expose the module to strong mechanical shock, impact, torque, or tension.
- Do not drop, toss, bend, or twist the module.
- Do not place weight or pressure on the module.

## IF TFT PANEL BREAKS

All electronics may contain harmful substances. Avoid contamination by using care to avoid damage during handling. If any residues, gases, powders, liquids, or broken fragments come in contact with your skin, eyes, mouth, or lungs, immediately contact your local poison control or emergency medical center.

## HOW TO CLEAN

1. Turn display off.
2. Use the removable protective film to remove smudges (for example, fingerprints) and any foreign matter. If you no longer have the protective film, use standard transparent office tape (for example, Scotch® brand “Crystal Clear Tape”).
3. If the polarizer is dusty, you may carefully blow it off with clean, dry, oil-free compressed air.
4. If you must clean with a liquid, never use glass cleaners, as they may contain ammonia or alcohol that will damage the polarizer over time. Never apply liquids directly on the polarizer. Long contact with moisture may permanently spot or stain the polarizer. Use filtered water to slightly moisten a clean lint-free microfiber cloth designed for cleaning optics. (For example, use a cloth sold for cleaning plastic eyeglasses.)
5. The plastic is easily scratched or damaged. Use a light touch as you clean the polarizer. Wipe gently.
6. Use a dry microfiber cloth to remove any trace of moisture before turning on the TFT.
7. Gently wash the microfiber cloths in warm, soapy water and air dry before reuse.

## OPERATION

- We do not recommend connecting this module to a PC's parallel port as an end product. This module is not “user friendly” and connecting it to a PC's parallel port is often difficult, frustrating, and can result in a “dead” display due to mishandling. For more information, see our forum thread at http://www.crystalfontz.com/forum/showthread.php?s=&threadid=3257.
- Your circuit should be designed to protect the module from ESD and power supply transients.
- Observe the operating temperature limitations. Operation outside of these limits may shorten life and/or harm display. Changes in temperature can result in changes in contrast.
  - At lower temperatures of this range, response time is delayed.
  - At higher temperatures of this range, display becomes dark. (You may need to adjust the contrast.)
- Operate away from dust, moisture, and direct sunlight.

## STORAGE AND RECYCLING

- Store in an ESD-approved container away from dust, moisture, and direct sunlight, fluorescent lamps, or any ultraviolet ray.
- Observe the storage temperature limitations. Rapid temperature changes can cause moisture to form, resulting in permanent damage.
- Do not allow weight to be placed on the modules while they are in storage.
- Please recycle your outdated Crystalfontz modules at an approved facility.

Preliminary

# APPENDIX A: QUALITY ASSURANCE STANDARDS

## INSPECTION CONDITIONS

- Environment
  - Temperature: 25±5°C
  - Humidity: 30~85% RH (noncondensing)
- For visual inspection of active display area
  - Source lighting: two 20-Watt or one 40-Watt fluorescent light
  - Display adjusted for best contrast
  - Viewing distance: 30±5 cm (about 12 inches)
  - Viewing angle: inspect at 45° angle of vertical line right and left, top and bottom

## COLOR DEFINITIONS

We try to describe the appearance of our modules as accurately as possible. For the photos, we adjust for optimal appearance. Actual display appearance may vary due to (1) different operating conditions, (2) small variations of component tolerances, (3) inaccuracies of our camera, (4) color interpretation of the photos on your monitor, and/or (5) personal differences in the perception of color.

## ACCEPTANCE SAMPLING

| DEFECT TYPE | AQL* |
|---|---|
| Major | ≤.65% |
| Minor | <1.0% |
| * Acceptable Quality Level: maximum allowable error rate or variation from standard | |

## DEFECTS CLASSIFICATION

Defects are defined as:

- Major Defect: results in failure or substantially reduces usability of unit for its intended purpose.
- Minor Defect: deviates from standards but is not likely to reduce usability for its intended purpose.

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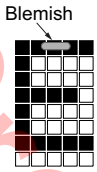
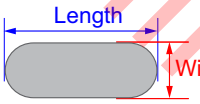
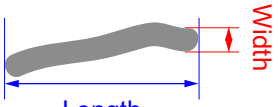
# ACCEPTANCE STANDARDS

| # | DEFECT TYPE | ACCEPTANCE STANDARDS CRITERIA | | | MAJOR / MINOR |
|---|---|---|---|---|---|
| 1 | Electrical defects | 1. No display, display malfunctions, or shorted segments.<br>2. Current consumption exceeds specifications. | | | Major |
| 2 | Viewing area defect | Viewing area does not meet specifications). | | | Major |
| 3 | Contrast adjustment defect | Contrast adjustment fails or malfunctions. | | | Major |
| 4 | Blemishes or foreign matter on display segments |  | *Defect Size (mm)* | *Acceptable Qty* | Minor |
| | | | ≤0.3 | 3 | |
| | | | ≤2 defects within 10 mm of each other | | |
| 5 | Other blemishes or foreign matter outside of display segments | Defect size = (A + B)/2<br>  | *Defect Size (mm)* | *Acceptable Qty* | Minor |
| | | | ≤0.15 | Ignore | |
| | | | 0.15 to 0.20 | 3 | |
| | | | 0.20 to 0.25 | 2 | |
| | | | 0.25 to 0.30 | 1 | |
| 6 | Dark lines or scratches in display area<br>  | *Defect Width (mm)* | *Defect Length (mm)* | *Acceptable Qty* | Minor |
| | | ≤0.03 | ≤3.0 | 3 | |
| | | 0.03 to 0.05 | ≤2.0 | 2 | |
| | | 0.05 to 0.08 | ≤2.0 | 1 | |
| | | 0.08 to 0.10 | ≤3.0 | 0 | |
| | | ≥0.10 | >3.0 | 0 | |
| 7 | Bubbles between polarizer film and glass | | *Defect Size (mm)* | *Acceptable Qty* | Minor |
| | | | ≤0.20 | Ignore | |
| | | | 0.20 to 0.40 | 3 | |
| | | | 0.40 to 0.60 | 2 | |
| | | | ≥0.60 | 0 | |

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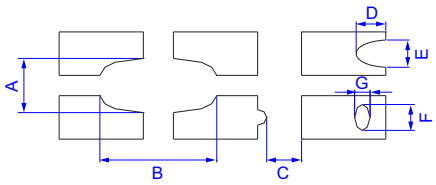
<table>
<tr><th>#</th><th>DEFECT TYPE</th><th>ACCEPTANCE STANDARDS CRITERIA (Continued)</th><th>MAJOR / MINOR</th></tr>
<tr><td>8</td><td>Display pattern defect</td><td> 

<table>
<tr><th>Dot Size (mm)</th><th>Acceptable Qty</th></tr>
<tr><td>((A+B)/2)≤0.2</td><td rowspan="4">≤3 total defects<br><br>≤2 pinholes per digit</td></tr>
<tr><td>C>0</td></tr>
<tr><td>((D+E)/2)≤0.25</td></tr>
<tr><td>((F+G)/2)≤0.25</td></tr>
</table></td><td>Minor</td></tr>
<tr><td>9</td><td>Backlight defects</td><td>1. Light fails or flickers.*<br>2. Color and luminance do not correspond to specifications.*<br>3. Exceeds standards for display’s blemishes or foreign matter (see test 5, Pg. 18), and dark lines or scratches (see test 6, Pg. 18).<br>*Minor if display functions correctly. Major if the display fails.</td><td>Minor</td></tr>
<tr><td>10</td><td>COB defects</td><td>1. Pinholes >0.2 mm.<br>2. Seal surface has pinholes through to the IC.<br>3. More than 3 locations of sealant beyond 2 mm of the sealed areas.</td><td>Minor</td></tr>
<tr><td>11</td><td>PCB defects</td><td>1. Oxidation or contamination on connectors.*<br>2. Wrong parts, missing parts, or parts not in specification.*<br>3. Jumpers set incorrectly.<br>4. Solder (if any) on bezel, LED pad, zebra pad, or screw hole pad is not smooth.<br>*Minor if display functions correctly. Major if the display fails.</td><td>Minor</td></tr>
<tr><td>12</td><td>Soldering defects</td><td>1. Unmelted solder paste.<br>2. Cold solder joints, missing solder connections, or oxidation.*<br>3. Solder bridges causing short circuits.*<br>4. Solder balls.<br>*Minor if display functions correctly. Major if the display fails.</td><td>Minor</td></tr>
</table>

Preliminary

# APPENDIX B: TFT MODULE TERMS AND SYMBOLS

The first (top) term / symbol listed in this table is the term used by Crystalfontz.

| Term / Symbol | Description |
|---|---|
| A (LED +) | Supply pin for LED. “A” (anode) or “+” of LED backlight. If more than one, may be labeled as $A_1$, $A_2$, ... |
| cd/m$^2$<br>lumen<br>nits | Candela per square meter. A unit of measurement used to measure Luminous Intensity. cd/m$^2$ = 1 lumen. |
| $\overline{CS}$<br>CS#<br>CSX | Chip select input.<br>*Low:* Controller chip is selected. Communications with host are possible.<br>*High:* Controller chip is not selected. Host interface signals are ignored by the controller. |
| COF | Chip On Flex. Controller is on the FPC. Similar in appearance to “TAB”. The flex circuit on COF is typically much thinner than the flex of a “flex tail”. |
| COG | Chip On Glass. Controller is on the glass panel. |
| DB0 ~ DB*n*<br>D0 ~ D*n* | Parallel databus. |
| D/$\overline{C}$<br>RS<br>DCX<br>A0<br>CD<br>D/C# | Data/Command control. Determines whether data bits are data or command.<br>*1 – High:* Addresses the data register.<br>*0 – Low:* Addresses the command register. |
| DE<br>DEN | Data Enable signal for RGB / DPI mode. |
| DPI<br>DOTCLK<br>parallel | Displays Pixel Interface |
| DCLK | Dot-clock signal and oscillator source. A non-stop external clock must be provided to that pin even at front or back porch non-display period. RGB interface only. |
| ESD | Electro-Static Discharge. Sudden and brief electrical current that flows between two objects. ESD between a human and a TFT module can cause permanent damage. |
| FFC | Flat Flexible Cable. Also called “flex tail” or “pigtail”. Typically thinner than the “flex” film of COG (Chip On Glass). |
| FPC | Flexible Printed Circuit. Also called “flex tail”. Typically much thicker than the “flex” film of COF (Chip On Flex). |
| GND<br>$V_{SS}$ | Ground. Must be connected to an external ground. |
| $H_{SYNC}$ | Horizontal frame/RAM write synchronizing signal used for RGB mode only. |

Preliminary

| Term / Symbol | Description |
|---|---|
| $I_{DD}$ | Typical power supply current for TFT.<br>Total electrical current (I) in the Drains of a CMOS circuit |
| $I_{LED}$ | Current used by LED backlight. |
| IM*n* | Interface mode select pin where *n* is the corresponding number. |
| $I_{OP}$<br>$V_{CCI}$ | Current for normal OPeration, typically measured in milliamperes (mA).<br>1 mA = 0.001A (Ampere) |
| $I_{ST}$ | Current for STandby mode, typically measured in microampere (µA).<br>1 µA = 0.000001A (Ampere) |
| I/O<br>IO | Input/Output |
| K (LED -) | Supply pin for LED. “K” (cathode or kathode for German and original Greek spelling) or “-” of LED backlight. If more than one, may be labeled as $K_1$, $K_2$, ... |
| MIPI | Mobile Industry Processor Interface. See MIPI Alliance. |
| MISO<br>SDO<br>$D_{OUT}$ | Data output signal in serial SPI interface: Master In Slave Out. Serial Data Out. |
| MOSI<br>SDI<br>SI<br>DINI_SDA | Data output signal in serial SPI interface: Master Out Slave In. Serial Data In. |
| mm | Millimeter or millimetre. Unit of length equal to one thousandth of a meter.<br>1 millimeter = 0.0394 inches. |
| mW | Milliwatt is equal to one thousandth of a Watt.<br>Watts = Volts x Amps. |
| NC<br>nc | Make No Connection. |
| $P_{CLK}$ | Pixel clock signal for RGB / DPI mode. |
| PS*n*-PS0 | See table below |

| PS3 | PS2 | PS1 | PS0 | Interface Mode |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 16-bit 6800 parallel interface. (if available) |
| 0 | 0 | 0 | 1 | 8-bit 6800 parallel interface. (if available) |
| 0 | 0 | 1 | 0 | 16-bit 8080 parallel interface. |
| . . . . . | | | | |
| 0 | 0 | 1 | 1 | 8-bit 8080 parallel interface.<br>(if available) |

Preliminary

| Term / Symbol | Description |
|---|---|
| PWM | Pulse Width Modulation is a way to simulate intermediate levels by switching a level between full on and full off. PWM is typically used to control the brightness of LED backlights, relying on the natural averaging by the human eye. |
| $\overline{RD}_{8080}$ ($E_{6800}$)<br>$\overline{RD}$ (E)<br>E ($\overline{RD}$)<br>E<br>RDX | Host interface input.<br>*8080 Host:* Active low. Signal on the databus is latched at the rising edge of $\overline{RD}$.<br><br>*6800 Host (if available):* Enable control signal input active high.<br>E = *High:* Read or Write operation is active<br>E = *Low:* No operation |
| RGB | Typically used to indicate that Red, Green, and Blue are combined to produce a broad array of colors. |
| RH<br>Rh | Relative Humidity |
| RoHS | Restriction of Hazardous Substances Directive, an environmental standard. |
| $\overline{RST}$<br>$\overline{RES}$<br>RST#<br>RES#<br>RESET# | Reset signal.<br>*Low:* Display controller is reset. The $\overline{RST}$ pin should be pulsed low shortly after power is applied.<br>*High:* The $\overline{RST}$ pin should be brought high for normal operation. |
| SCK<br>SCL | Serial Clock |
| Ta<br>TA | “Ambient temperature” is the temperature of the air that surrounds a component. |
| Tf | Unit of measurement for TFT response time.<br>f = falling edge. See Definition of Response Time (Tr, Tf) (Pg. 12). |
| TFT | Thin-Film Transistor fabricated directly on the display substrate. |
| $T_{OP}$ | OPerating Temperature. |
| Tr | Unit of measurement for TFT response time.<br>r = rising edge. See Definition of Response Time (Tr, Tf) (Pg. 12). |
| $T_{ST}$<br>$T_{STG}$ | STorage Temperature. |
| $V_{ANALOG}$<br>$V_{CI}$ | Analog supply, |
| $V_{IH}$<br>$V_{ICH}$ | High level input voltage. |
| $V_{IL}$<br>$V_{LCH}$ | Low level input voltage. |

Preliminary

| Term / Symbol | Description |
|---|---|
| $V_{IN}$<br>$V_T$ | Input voltage |
| $V_{LED}$ | Forward voltage for LED backlight. |
| $V_{LOGIC}$<br>$V_{CC}$<br>$V_{DD}$<br>$V_{CI}$ | Power supply input. Must be connected to an external source. |
| $V_{LOGIC\ I/O}$<br>$V_{CCIO}$<br>$IO_{VCC}$ | Digital Logic Supply and Input/Output Supply |
| $V_O$<br>$V_{ADJ}$ | Supply voltage for driving LCD (contrast adjustment). |
| $V_{OH}$<br>$V_{OHC}$ | High level output voltage. |
| $V_{OL}$<br>$V_{OLC}$ | Low level output voltage. |
| $V_{SSD}$ | Digital ground. |
| $V_{SYNC}$ | Vertical frame/RAM write synchronizing signal used for RGB mode only. |
| $\overline{WR}_{8080}$<br>R/$\overline{W}$ ($\overline{WR}$)<br>$\overline{WR}$ (R/$\overline{W}$)<br>R/W# | Host interface input.<br>*8080 Host:* Active low. Signal on the databus is latched at the rising edge of $\overline{WR}$ signal.<br><br>*6800 Host (if available):* Read/Write control signal output.<br>*R/$\overline{W}$* = High: Read (Host←Module)<br>*R/$\overline{W}$* = Low: Write (Host→Module) |
| $\overline{WR}$_SCK | *DBI Type-B:* Serves as a write signal and write data at the low level.<br>*DBI Type-C:* it serves as SCK (Serial Clock).<br>If unused, tie to $V_{LOGIC\ I/O}$. |

Preliminary