Crystalfontz America, Incorporated

GRAPHIC LCD MODULE SPECIFICATIONS

Preliminary

Crystalfontz Model Number	**CFAX12864U-TFH-TS**
Hardware Version	**Revision v0, July 2009**
Data Sheet Version	**Revision v0.2 Preliminary, April 2011**
Product Pages	http://www.crystalfontz.com/product/CFAX12864UTFHTS.html

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REVISION HISTORY

HARDWARE	
2011/03/28	Current hardware version: **v0** New module

DATA SHEET	
2011/04/20	Current Data Sheet version: **v0.2, Preliminary** Since last Data Sheet (no version number, Preliminary): ● Moved specifications into standard graphics Data Sheet template and added more information. ● Improved module outline illustrations. See Module Outline Drawings (Pg. 7). ● In LED Backlight Characteristics (Pg. 21), corrected Forward Voltage from maximum of “+5v” to “+3.6v”. Module has not changed.
2009/07/02	Data Sheet version: Preliminary, no version number New Data Sheet.

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MAIN FEATURES

This module is engineered for high volume production. It uses a "TAB" (tape automated bonding) or "COF" (chip on flex) style flex tail. The TAB connector is soldered directly to corresponding pads on your PCB using a hot-bar soldering machine. High volume contract manufacturers will be familiar with this type of construction and its assembly methods. The TAB style connection requires no separate connector, so the cost is very low, and the ultra thin profile of the display is maintained. For more information, see Tab Soldering (Pg. 23).

DEVELOPMENT KIT / DEMONSTRATION BOARD

This module is available installed on the Crystalfontz CFA-10021 demonstration board. The DMOX12864U-TFH-TS Development Kit / Demonstration Board kit has everything you need to easily demonstrate and experiment with the module. The kit can also be used as a reference for your designs. The *CFA10021 User Guide* can be found at the end of this Data Sheet.

FEATURES

- ❑ 128 pixels by 64 pixels graphic tab type LCD has a large display area in a compact 68.80 (W) x 63.10 (H) x 6.35 (D) millimeter package. FPC for panel and FFC for touch screen *unfolded*.
- ❑ White LED backlight with FSTN, positive, white transflective mode LCD. Displays dark pixels on light background.)
- ❑ +3.3v operation.
- ❑ A typical touch screen connector is Molex 52207-0485 / DigiKey WM7675CT-ND.
- ❑ 8-bit parallel (6800 or 8080) and SPI interface.
- ❑ Built-in Novatek NT7534 or compatible controller.
- ❑ 6:00 o'clock viewing angle.
- ❑ Wide temperature operation: -20°C to +70°C.
- ❑ Sunlight readable.
- ❑ RoHS compliant.
- ❑ Factories have ISO certification.
- ❑ Product materials are in compliance with the regulations related to the EU Directive 2006/121/EC for Registration, Evaluation, Authorization and Restriction of Chemicals (REACH).

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MODULE CLASSIFICATION INFORMATION

CFA ❶ X ❷ 128 ❸ 64 ❹ U ❺ - T ❻ F ❼ H ❽ - TS ❾

❶	Brand	Crystalfontz America, Inc.
❷	Display Type	X – Graphic, tab type
❸	Number of Pixels (Width)	128 pixels
❹	Number of Pixels (Height)	64 pixels
❺	Model Identifier	U
❻	Backlight Type & Color	T – LED, white
❼	Fluid Type, Image (Positive or Negative), & LCD Glass Color	F – FSTN, positive, white
❽	Polarizer Film Type, Wide (WT) Temperature Range, & Viewing Angle (O'clock)	H – Transflective, WT, 6:00[1]
❾	Special Code 1	TS – Touch Screen

[1] *Note: For more information on Viewing Angle, see* *Definition of 6 O'Clock and 12:00 O'Clock Viewing Angles (Pg. 20)*.

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MECHANICAL SPECIFICATIONS

PHYSICAL CHARACTERISTICS

ITEM	SIZE
Pixels	
Number of Pixels	128 (W) x 64 (H) pixels = 8,192 pixels
Pixel Size	0.35 (W) x 0.40 (H) mm
Pixel Pitch	0.37 (W) x 0.42 (H) mm
Viewing Area Width and Height	Millimeters: 52.00 (W) x 33.50 (H) mm Inches: 2.05" (W) x 1.32" (H)
Active Area Width and Height	*Without top row of icons:* Millimeters: 47.34 (W) x 26.86 (H) mm Inches: 1.86" (W) x 1.06" (H) *Including top row of icons:* Millimeters: 47.76 (W) x 30.29 (H) mm Inches: 1.88" (W) x 1.19" (H)
Overall Module Outline Width and Height Dimensions	*FPC for panel and FFC for touch screen unfolded:* Millimeters: 68.80 (W) x 63.10 (H) mm Inches: 2.7" (W) x 2.48" (H) *Height with FPC for panel folded:* Millimeters:44.70 (H) mm Inches: 1.75" (H)
Module Depth	*Maximum*: Millimeters: 6.35 mm Inches: 0.25" *Nominal*: Millimeters: 6.20 mm Inches: 0.24"
Module Connector Pitch	0.6 mm
Touch Screen FFC	19.00 mm length
Touch Screen Connector Pitch	1.0 mm
A typical touch screen connector is Molex 52207-0485 / DigiKey WM7675CT-ND.	
Weight	23 grams (typical)

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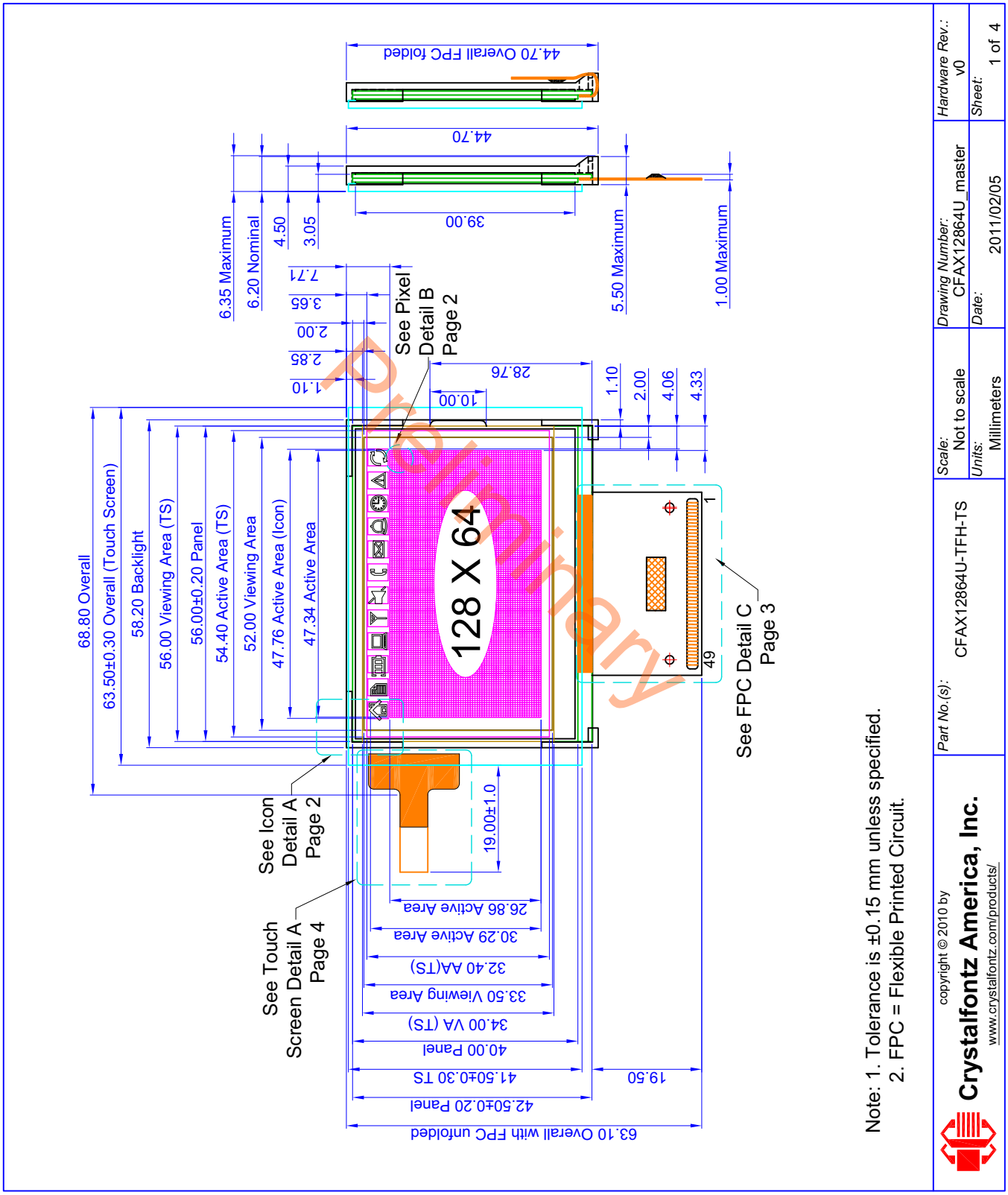
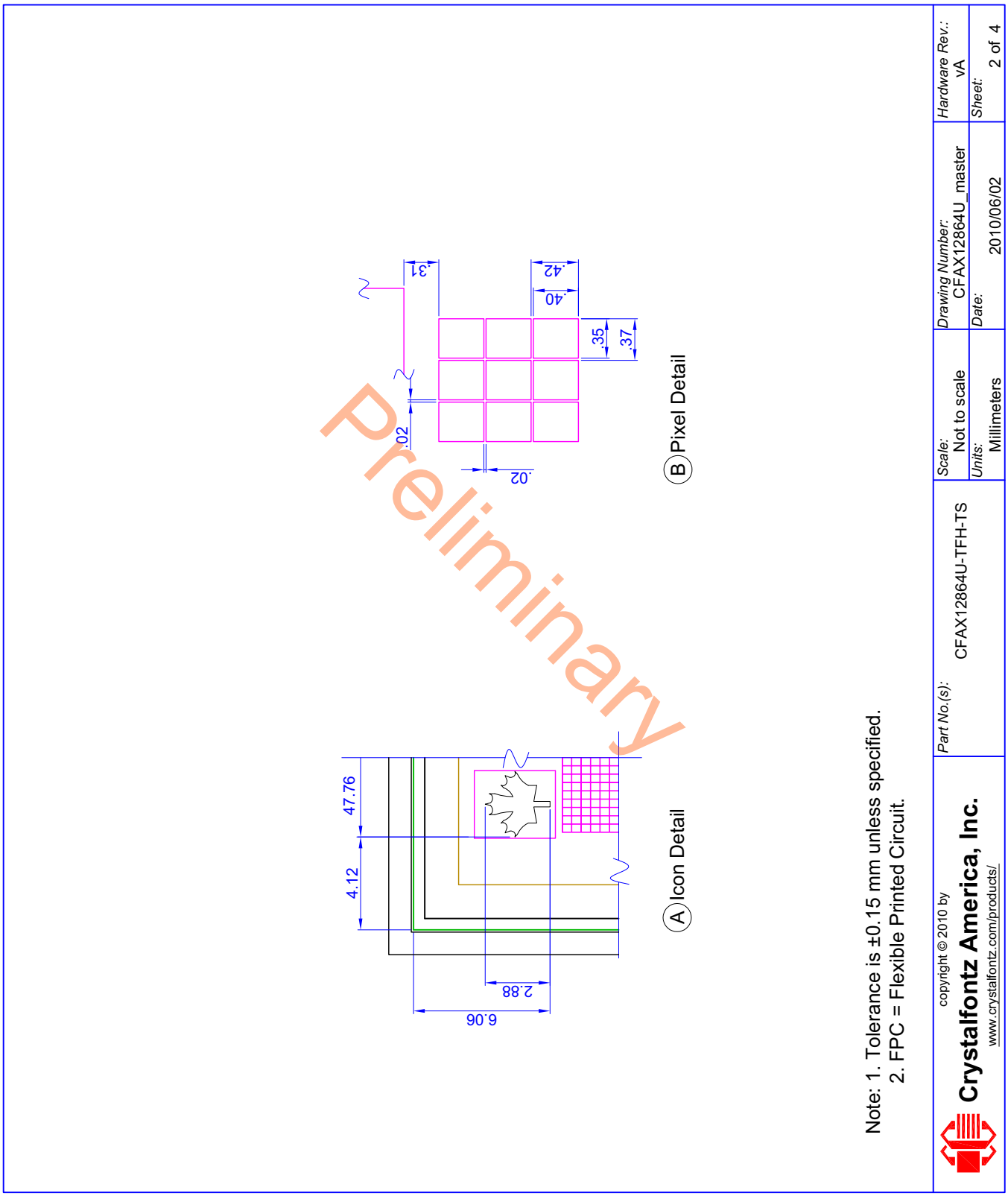
MODULE OUTLINE DRAWINGS

Figure 1. Module Outline Drawings (four pages below)




Preliminary
Note: 1. Tolerance is ±0.15 mm unless specified.
2. FPC = Flexible Printed Circuit.
Ⓑ Pixel Detail
Ⓐ Icon Detail
.31
.42
.40
.35
.37
.02
.02
47.76
4.12
2.88
6.06
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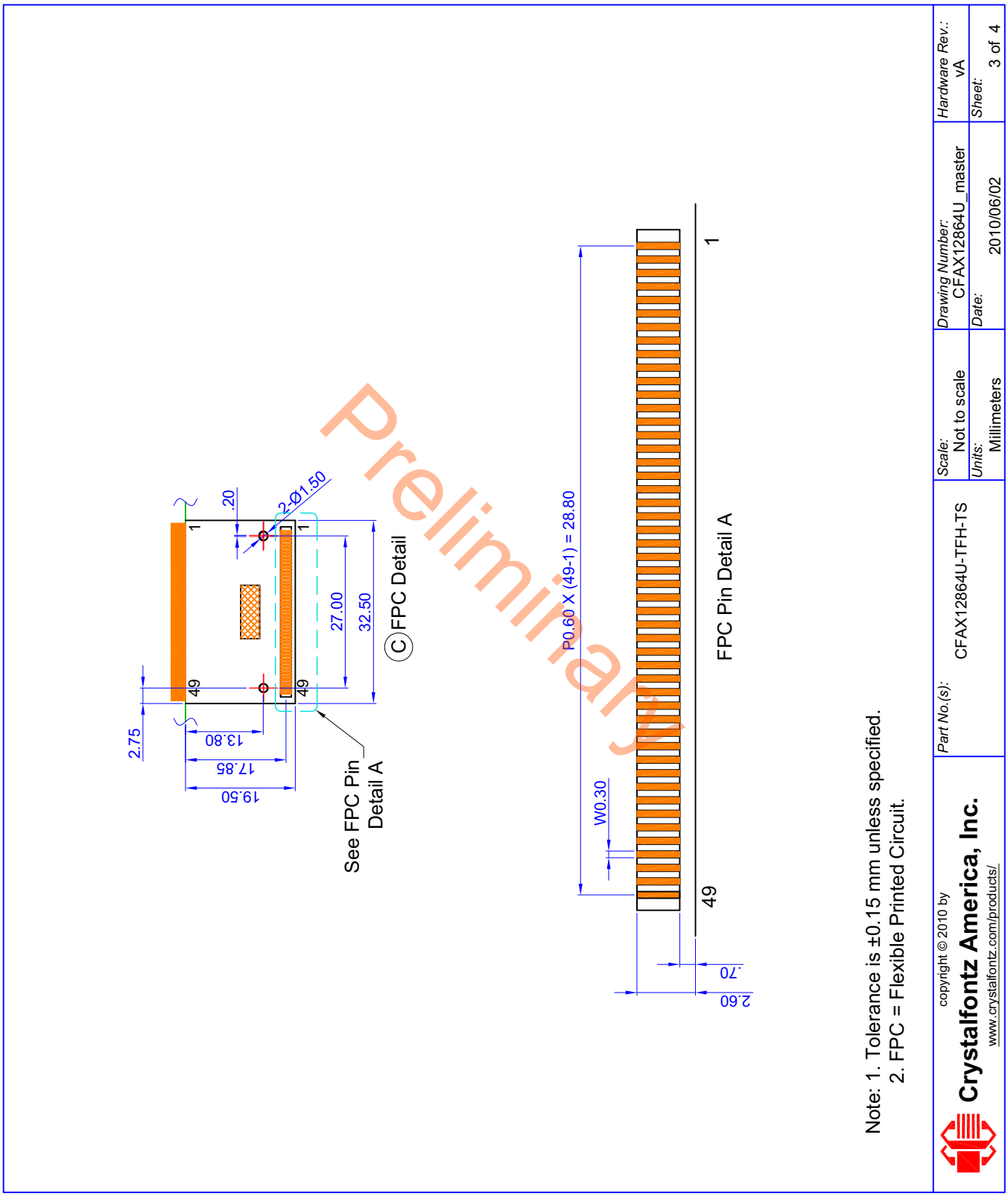
Part No.(s):
CFAX12864U-TFH-TS
Scale: Not to scale
Units: Millimeters
Drawing Number: CFAX12864U_master
Date: 2010/06/02
Hardware Rev.: vA
Sheet: 2 of 4


Preliminary
.20
2-Ø1.50
1
49
27.00
32.50
2.75
13.80
17.85
19.50
See FPC Pin Detail A
C FPC Detail
P0.60 X (49-1) = 28.80
W0.30
FPC Pin Detail A
.70
2.60
Note: 1. Tolerance is ±0.15 mm unless specified.
2. FPC = Flexible Printed Circuit.
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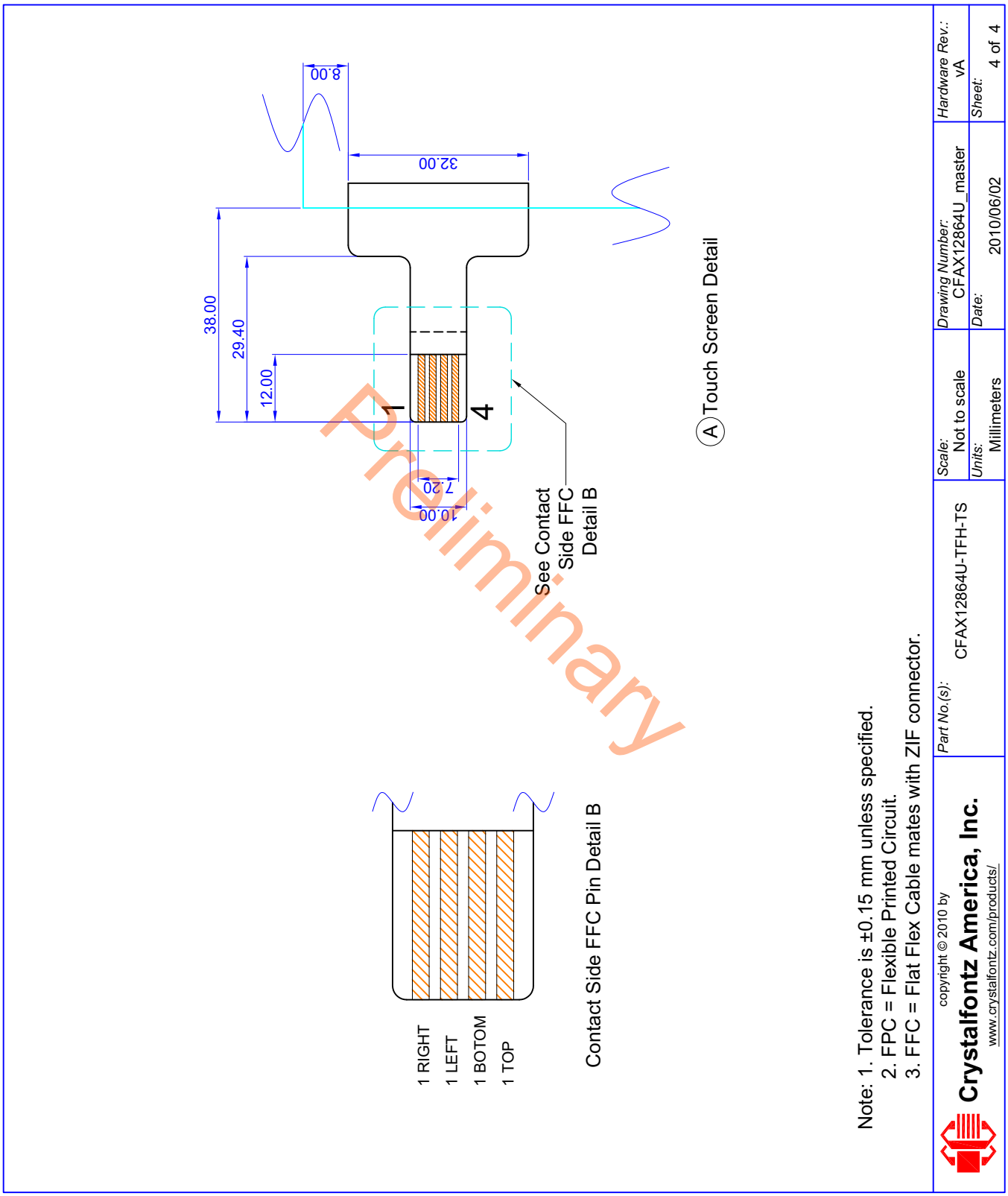
Part No.(s):
CFAX12864U-TFH-TS
Scale: Not to scale
Units: Millimeters
Drawing Number: CFAX12864U_master
Date: 2010/06/02
Hardware Rev.: vA
Sheet: 3 of 4


8.00
32.00
38.00
29.40
12.00
1
4
7.20
10.00
See Contact Side FFC Detail B
A Touch Screen Detail
1 RIGHT
1 LEFT
1 BOTOM
1 TOP
Contact Side FFC Pin Detail B
Note: 1. Tolerance is ±0.15 mm unless specified.
2. FPC = Flexible Printed Circuit.
3. FFC = Flat Flex Cable mates with ZIF connector.
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Part No.(s):
CFAX12864U-TFH-TS
Scale: Not to scale
Units: Millimeters
Drawing Number: CFAX12864U_master
Date: 2010/06/02
Hardware Rev.: vA
Sheet: 4 of 4

TOUCH SCREEN PINOUT DETAILS

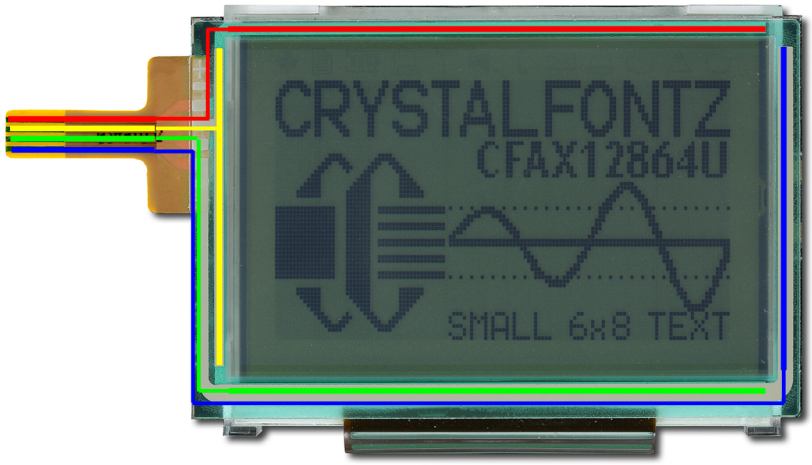

Figure 2. Touch Screen Pinout Details

Preliminary

ELECTRICAL SPECIFICATIONS

DRIVING METHOD

DRIVING METHOD	SPECIFICATION
Duty	1/64
Bias	1/9

ABSOLUTE MAXIMUM RATINGS

ABSOLUTE MAXIMUM RATINGS	SYMBOL	MINIMUM	MAXIMUM
Operating Temperature*	T_{OP}	-20°C	+70°C
Storage Temperature*	T_{ST}	-30°C	+80°C
Humidity	RH	0%	90%
Input Voltage	V_I		V_{DD}
Supply Voltage for Logic	V_{DD}	+1.8v	+3.6v
Supply Voltage for LCD	V_O-V_{SS}	+6.0v	+14.2v
**Prolonged exposure at temperatures outside of this range may cause permanent damage to the module.*			

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DC CHARACTERISTICS

This is a summary of the module's major operating parameters. For detailed information, see the controller Novatek NT7534 Data Sheet.

NOTE
Do not mix Logic and Supply Voltages.

PART	DC CHARACTERISTICS	TEST CONDITION	SYMBOL	MINIMUM	TYPICAL	MAXIMUM
Controller and Board	Supply Voltage for Logic		V_{DD} - V_{SS}	+3.0v	+3.3v	+3.6v
	Input High Voltage	V_{DD}	V_{IH}	0.8V_{DD}		V_{DD}
	Input Low Voltage		V_{IL}	V_{SS}		+0.2V_{DD}
	Output High Voltage	V_{DD}	V_{OH}	+0.8v		
	Output Low Voltage		V_{OL}			+0.2v
	Supply Current	without backlight	I_{DD}	0.18 mA	0.18 mA	0.18 mA
LCD Glass	Supply Voltage for Driving LCD	TA = -20ºC	V_O - V_{SS}			
		TA = +25ºC			+8.8v	
		TA = +70ºC				

Generated using step-up voltage circuit. See page 21 of the controller Novatek NT7534 Data Sheet.

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DETAILS OF INTERFACE PIN FUNCTIONS

<table>
<tr><th>PIN</th><th>SIGNAL</th><th>I/O</th><th>DESCRIPTION</th></tr>
<tr><td>1</td><td>NC</td><td></td><td>No Connection.</td></tr>
<tr><td>2</td><td>IRS</td><td>I</td><td>This terminal selects the resistors for the V0 voltage level adjustment.

High: Use the internal resistors.
Low: Do not use the internal resistors.

The V0 voltage level is regulated by an external resistive voltage divider attached to the VR terminal. This pad is enabled only when the master operation mode is selected. It is fixed to either High or Low when the slave operation mode is selected.</td></tr>
<tr><td>3</td><td>$\overline{\text{HPM}}$</td><td>I</td><td>This is the power control terminal for the power supply circuit for the liquid crystal drive.

High: Normal power mode.
Low: High power mode.

This pad is enabled only when the master operation mode is selected and it is fixed to either High or Low when the slave operation mode is selected.</td></tr>
<tr><td>4</td><td>P/S</td><td>I</td><td>This is the parallel data input/serial data input switch terminal.

High: Parallel data input.
Low: Serial data input.

The following applies depending on the P/S status:

<table>
<tr><td>P/S</td><td>Data/Command</td><td>Data</td><td>Read/Write</td><td>Serial Clock</td></tr>
<tr><td>“H”</td><td>A0</td><td>D0 to D7</td><td>/RD, /WR</td><td>-</td></tr>
<tr><td>“L”</td><td>A0</td><td>SI (D7)</td><td>Write only</td><td>SCL (D6)</td></tr>
</table>

Low: Fix D0~D5 pads to V_{DD} or V_{SS} level. $\overline{\text{RD}}$(E) and $\overline{\text{WR}}$ (R/W) are fixed to either High or Low. With serial data input, RAM display data reading is not supported.</td></tr>
<tr><td>5</td><td>C86</td><td>I</td><td>This is the host interface switch terminal.

High: 6800 series host interface.
Low: 8080 series host interface.</td></tr>
<tr><td>6</td><td>CLS</td><td>I</td><td>Terminal to select whether enable or disable the display clock internal oscillator circuit.

High: Internal oscillator circuit for display is enabled.
Low: Internal oscillator circuit for display is enabled (requires external input).

When Low, input the display clock through the CL pad.</td></tr>
</table>

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PIN	SIGNAL	I/O	DESCRIPTION
7	M/S	I	This terminal selects the master/slave operation for the Novatek NT7534 chips. Master operation outputs the timing signals that required for LCD display, while slave operation inputs the timing signals required for the liquid crystal display, synchronizing the liquid crystal display system.
8	VR	I	Voltage adjustment pad. Applies voltage between V0 and V_{SS} using a resistive divider.
9	V0	I/O	LCD driver supplies voltages. The voltage determined by the LCD cell is impedance converted by a resistive driver or an operation amplifier for application. Voltages should be according to the following relationship: V0≥V1≥V2≥V3≥V4≥VSS2 When the on-chip operating power circuit is on, the following voltages are supplied to V1 to V4 by the on-chip power circuit. Voltages selection is performed by the LCD Bias Set command.
10	V4		
11	V3		
12	V2		
13	V1		
14	NC		No Connection.
15	NC		No Connection.
16	C2-	O	Capacitor 2-pad for internal DC/DC voltage converter.
17	C2+	O	Capacitor 2+pad for internal DC/DC voltage converter.
18	C1+		Capacitor 1+pad for internal DC/DC voltage converter.
19	C1-		Capacitor 1-pad for internal DC/DC voltage converter.
20	C3+		Capacitor 3+pad for internal DC/DC voltage converter.
21	NC		No Connection.
22	V_{OUT}	I/O	DC/DC voltage converter output.
23	V_{SS}		Ground. Must be connected to an external ground.
24	V_{DD2}	supply	These are the power supply pads for the step-up voltage circuit for the LCD. These pads must be connected to each other.
25	V_{DD}	O	Power supply output for pad option.
26	DUTY1	I	Select the maximum LCD driver duty.
27	DUTY2		

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PIN	SIGNAL	I/O	DESCRIPTION
28-35	DB0-DB07	I/O	This is an 8-bit bidirectional data bus that connects to an 8-bit or 16-bit standard host databus. When the serial interface is selected (P/S = Low), then D7 serves as the serial data input terminal (SI) and D6 serves as the serial clock input terminal (SCL). When the serial interface is selected , fix D0~D5 pads to V_{DD} or V_{SS} level. When the chip select is inactive, D0 to D7 are set to High impedance.
36	$\overline{RD}$	I	*8080 series host* = active *Low*. This pad is connected to the $\overline{RD}$ signal of the 8080 host. The Novatek NT7534 databus is in an output status. *6800 series host* = active *High*. This is used as an enable clock input of the 6800 series host.
37	$\overline{WR}$	I	When connected to an 8080 host, this is active Low . This terminal connects to the 8080 host. The Novatek NT7534 databus are latched at rising edge of the $\overline{WR}$ signal. When connected to an 8080 host, this is the read/write control signal input terminal. When R/W = *High*: Read. When R/W = *Low:* Write.
38	A0	I	This is connected to the least significant bit of the normal host address bus, and it determines whether the data bits are data or a command. *High*: D0 to D7 = Display data. *Low*: D0 to D7 = Control data.
39	$\overline{RES}$	I	*Low:* The settings are initialized. The reset operation is performed by the $\overline{RES}$ signal level.
40	CS2	I	This is the chip select signal.
41	$\overline{CS1}$		This is the chip select signal.
42	NC		No Connection.

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PIN	SIGNAL	I/O	DESCRIPTION
43	$\overline{DOF}$	I/)	This is the liquid crystal display blanking control terminal. M/S= *High*: Output. M/S= *Low*: Input. When the Novatek NT7534 chip is used in master/slave mode, the various DOF terminals must be connected.
44	CL		This is the display clock input terminal. When the Novatek NT7534 chips are used in master/slave mode, the various CL terminals must be connected.
45	FR	I/O	This is the liquid crystal alternating current signal I/O terminal. *High*: Output. *Low:* Input. When the Novatek NT7534 chip is used in master/slave mode, the various FR terminals must be connected.
46-49	NC		No Connection.
For backlight connections, please refer to LED Backlight Characteristics (Pg. 21).			

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ESD (ELECTRO-STATIC DISCHARGE) SPECIFICATIONS

The circuitry is industry standard CMOS logic and 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.

OPTICAL SPECIFICATIONS

OPTICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	MINIMUM	TYPICAL	MAXIMUM
Viewing Angle (6 o'clock) (Vertical, Horizontal)	(V)θ	CR≥2	30°		60°
	(H)φ	CR≥2	-45°		45°
Contrast Ratio[1]	CR			5	
LCD Response Time[2]	T rise	Ta = 25°C		110 ms	220 ms
	T fall	Ta = 25°C		260 ms	520 ms

[1]*Contrast Ratio = (brightness with pixels light)/(brightness with pixels dark).*
[2]*Response Time: The amount of time it takes a liquid crystal cell to go from active to inactive or back again.*

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OPTICAL DEFINITIONS

- Operating Voltage (V_{LCD}): V_{OP}
- Viewing Angle
  - Vertical (V)θ: 0°
  - Horizontal (H)φ: 0°
- Frame Frequency: 64 Hz
- Driving Waveform: 1/16 Duty, 1/5 Bias
- Ambient Temperature (Ta): 25°C

Definition of Operation Voltage (Vop)

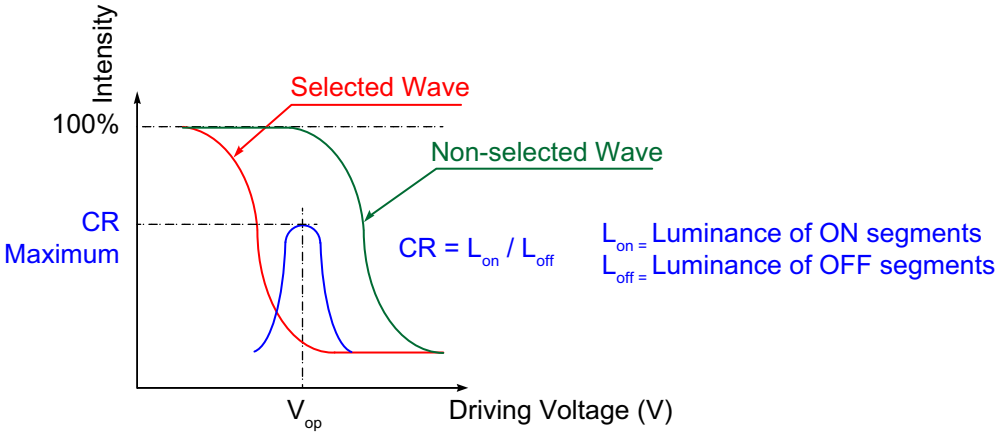

Figure 3. Definition of Operation Voltage (V_{OP}) (Positive)

Definition of Response Time (Tr, Tf)

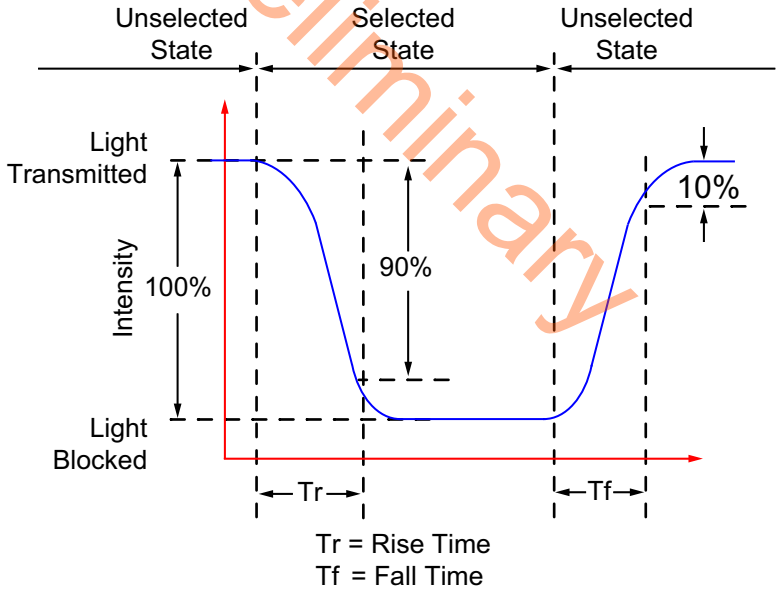

Figure 4. Definition of Response Time (Tr, Tf) (Positive)

Preliminary

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

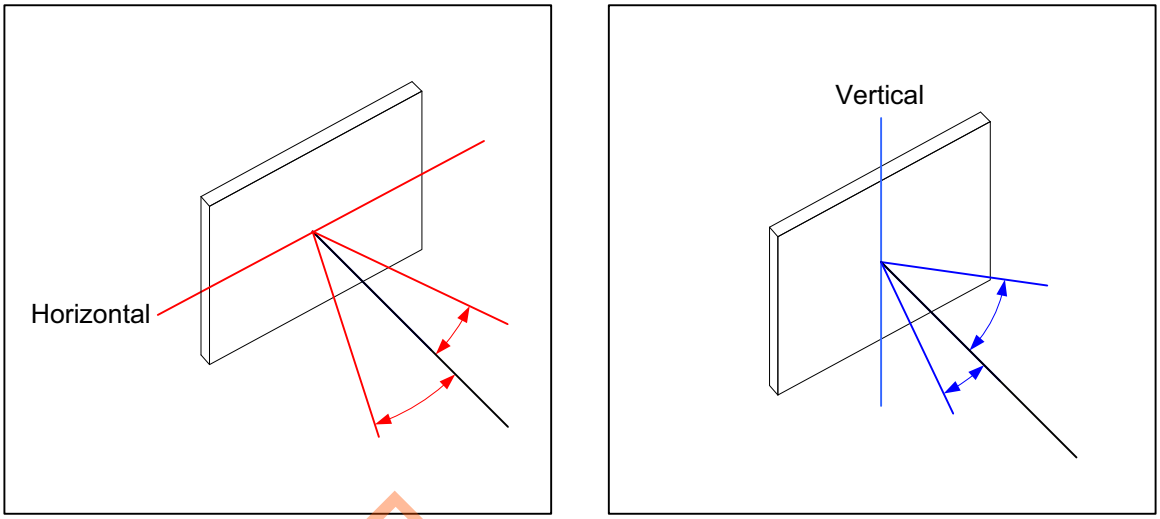

Figure 5. Definition of Horizontal and Vertical Viewing Angles (CR>2)

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

This module has a 6:00 o'clock viewing angle. A 6:00 o'clock viewing angle is a bottom viewing angle like what you would see when you look at a cell phone or calculator. A 12:00 o'clock viewing angle is a top viewing angle like what you would see when you look at the gauges in a golf cart or airplane.

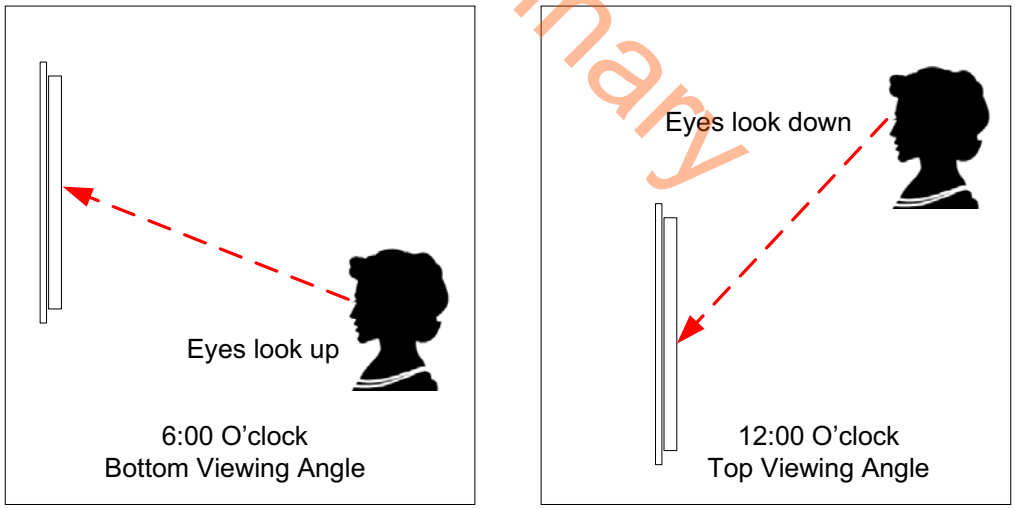

Figure 6. Definition of 6:00 O'Clock and 12:00 O'Clock Viewing Angles

LED BACKLIGHT CHARACTERISTICS

This module uses an LED backlight. LED backlights are easy to use, but they are also easily damaged by abuse.

NOTE

Do not connect +5v directly to the backlight terminals. This will ruin the backlight.

NOTE

We recommend that the white LED backlight be dimmed or turned off during periods of inactivity to conserve the LEDs' lifetime.

LEDs are "current" devices. The important aspect of driving an LED is the current flowing through it, not the voltage across it. Ideally, a current source would be used to drive the LEDs. In practice, a simple current limiting resistor in line from a voltage source will work well in most applications and is much less complex than a current source.

Backlight Characteristics

dark pixels on light background

PARAMETER	MINIMUM	TYPICAL	MAXIMUM
Forward Current (I_{LED}) V = 3.5v	43.2 mA	48 mA	60 mA
Forward Voltage (V_{LED})	+3.0	+3.3v	+3.6v
Reverse Voltage (V_R)	+3.4v	+3.5v	+3.6v
Luminous Intensity* (I_V) I_{LED} = 48 mA	120 cd/m2	150 cd/m2	
**Direct measurement of backlight–the backlight is not measured through the LCD.*			

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MODULE RELIABILITY AND LONGEVITY

MODULE RELIABILITY

ITEM	SPECIFICATION	
LCD excluding LED backlight	50,000 to 100,000 hours (typical)	
White LED Backlight ($I_{LED} \leq 82$ mA)* ** We recommend that the backlight of the white LED backlit modules be dimmed or turned off during periods of inactivity to conserve the white LED backlight lifetime.*	*Power-On Hours*	*% of Initial Brightness (New Module)*
	<10,000	>90%
	<50,000	>50%

White LEDs do not have the extremely long lifetime typical of red or green LEDs. 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 be dimmed or turned off when not needed. Also, please do not use more current than you need to achieve your brightness requirements.

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MODULE LONGEVITY (EOL / REPLACEMENT POLICY)

Crystalfontz is committed to making all of our LCD 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 it replaces. 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:

- *LCD fluid, polarizers, or the LCD manufacturing process.* These items may change the appearance of the display, requiring an adjustment to V_O.
- *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 webpage 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.

ESD (ELECTRO-STATIC DISCHARGE)

The circuitry is industry standard CMOS logic and 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

Preliminary

- Do not disassemble or modify the module.
- Do not modify the tab of the metal holder or make connections to it.
- 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 touch screen's FPC. Do not crease FPC. Do not bend FPC tightly against the edge of the OLED panel.
- Do not repeatedly bend the touch screen FPC beyond its elastic region.
- To protect the touch screen from damage, the module ships with a protective film over the touch screen. Please peel off the protective film slowly. Peeling off the protective film abruptly may generate static electricity.
- The touch screen is made out of soft plastic and is easily scratched or damaged. Please handle carefully.
- To avoid damage, your bezel must be smooth where it touches the touch screen. Your bezel should not apply undue force to the touch screen.
- To avoid shorting, your mounting bezel should be at least 3 mm from the Active Area of the touch screen.
- Sharp bends can damage the panel's FPC (Flexible Printed Circuit) and the touch screen FFC (Flat Flex Cable). Limit bend radius to at least R5.

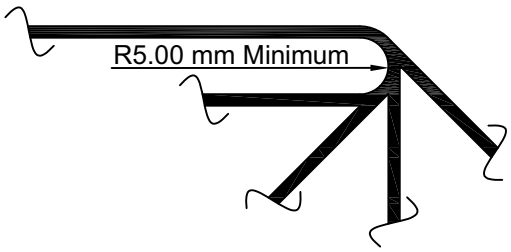

Figure 7. Limit Bend Radius of Touch Screen FFC

TAB SOLDERING

This module uses a "TAB" (tape automated bonding) or "COF" (chip on flex) style flex tail mated with a "COG" (chip on glass) display controller. The TAB is soldered directly to corresponding pads on your PCB by using a hot-bar soldering machine. High volume contract manufacturers will be familiar with this type of construction and its assembly methods.

Hot-bar soldering machines designed for prototype, rework, or repair of TAB connections are available from equipment suppliers at reasonable cost. The TAB style connection requires no separate connector so the cost is very low and the ultrathin profile of the display is maintained.

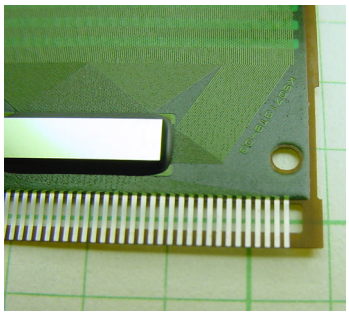

Figure 8. Typical Tab Solder Tail Construction

Hot Bar Soldering Machine

We have had good experiences with the APE Bondmaster and their price is reasonable (US $4,250 in July 2010). Other possible solutions are:

http://www.fancort.com/hotbar/hotbar.html
https://www.manncorp.com/hot-bar-soldering/pbs-series/index.php?auto=done
http://www.cherusal.com/tm-111mkiii.htm

The process is:

1. Pads on the PCB are tinned.
2. Tail is visually aligned to the PCB or by using the alignment holes.
3. Tail is held in place relative to the PCB with Kapton® tape.
4. Bondmaster head is lowered, applying pressure between the tail and the PCB.
5. Bondmaster is "cycled", which means it heats up to the point of melting the solder and then cools down.
6. Bondmaster head is raised.

Hand Soldering

For prototype work, hand soldering may be acceptable. Preset soldering iron to <260°C. Do not apply heat for more than 3 to 4 seconds. The FPC is quite fragile; use extreme care when soldering by hand. Great care must be taken since the conductors of the tail are completely exposed in the area where they are soldered. Solder only to the exposed terminals of the FPC connector. The use of Kapton® tape to help locate and secure the FPC may be useful.

AVOID SHOCK, IMPACT, TORQUE, AND TENSION

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

IF LCD PANEL BREAKS

- If the LCD panel breaks, be careful not to get the liquid crystal fluid in your mouth or eyes.
- If the liquid crystal fluid touches your skin, clothes, or work surface, wash it off immediately using soap and plenty of water.

Preliminary

- Do not eat the LCD panel.

CLEANING

The polarizer (laminated to the glass) is soft plastic. The soft plastic is easily scratched or damaged. Be very careful when you clean the polarizer.

- Do not clean the polarizer with liquids. Do not wipe the polarizer with any type of cloth or swab (for example, Q-tips).
- 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”). If the polarizer is dusty, you may carefully blow it off with clean, dry, oil-free compressed air.

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 them 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: from -20°C minimum to +70°C maximum with minimal fluctuations. Operation outside of these limits may shorten the life and/or harm the display.
  - 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.
- Adjust backlight brightness so the display is readable but not too bright. Dim or turn off the backlight during periods of inactivity to conserve the white LED backlight lifetime.

STORAGE AND RECYCLING

- Store in an ESD-approved container away from dust, moisture, and direct sunlight.
- Observe the storage temperature limitations: from -30°C minimum to +80°C maximum with minimal fluctuations. 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 LCD modules at an approved facility.

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APPENDIX A: QUALITY ASSURANCE STANDARDS

INSPECTION CONDITIONS

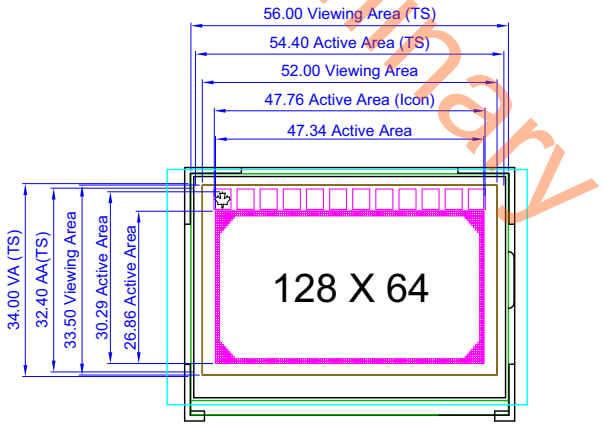
- Environment
  - Temperature: 25±5°C
  - Humidity: 30~85% RH (noncondensing)
- For visual inspection of active display area
  - Source lighting: two 20-Watt or one 40-Watt fluorescent light
  - Display adjusted for best contrast
  - Viewing distance: 30±5 cm (about 12 inches)
  - Viewing angle: inspect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

COLOR DEFINITIONS

We try to describe the appearance of our LCD modules as accurately as possible. For the photos, we adjust the backlight (if any) and contrast 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.

Preliminary

DEFINITION OF ACTIVE AREA AND VIEWING AREA



ACCEPTANCE SAMPLING

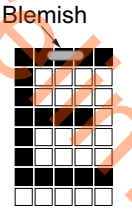
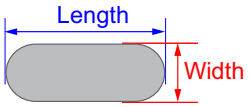
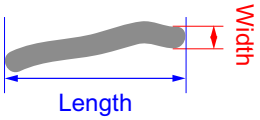
DEFECT TYPE	AQL*
Major	≤.65%
Minor	<1.0%
* Acceptable Quality Level: maximum allowable error rate or variation from standard	

DEFECTS CLASSIFICATION

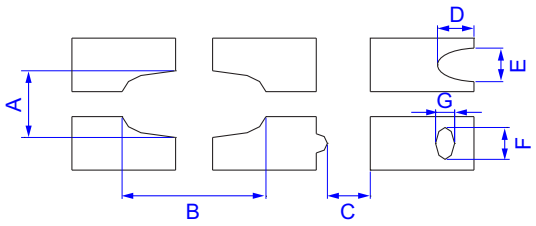
Defects are defined as:

- 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

ACCEPTANCE STANDARDS

#	DEFECT TYPE	CRITERIA			MAJOR / MINOR
1	Electrical defects	1. No display, display malfunctions, or shorted segments. 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*	*Acceptable Qty*	Minor
			≤0.30 mm	3	
			≤2 defects within 10 mm of each other		
5	Blemishes or foreign matter outside of display segments	Defect Size = (Width + Length)/2 	*Defect Size*	*Acceptable Qty*	Minor
			≤0.15 mm	Ignore	
			0.15 to 0.20 mm	3	
			0.20 to 0.25 mm	2	
			> 0.30 mm	1	
6	Dark lines or scratches in display area 	*Defect Width*	*Defect Length*	*Acceptable Qty*	Minor
		≤0.03 mm	≤3.0 mm	3	
		0.03 to 0.05	≤2.0 mm	2	
		0.05 to 0.08	≤2.0 mm	1	
		0.08 to 0.10	≤3.0 mm	0	
		≥0.10	>3.0 mm	0	

Preliminary

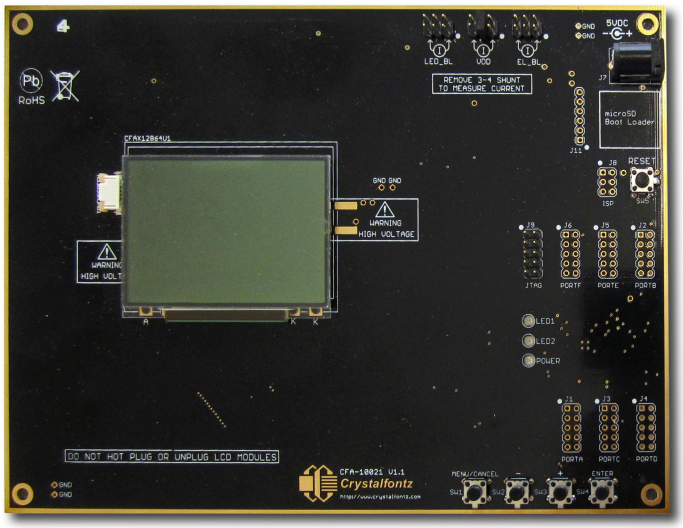
<table>
<tr><th>#</th><th>DEFECT TYPE</th><th colspan="3">CRITERIA</th><th>MAJOR / MINOR</th></tr>
<tr><td rowspan="5">7</td><td rowspan="5">Bubbles between polarizer film and glass</td><td colspan="2">Defect Size</td><td>Acceptable Qty</td><td rowspan="5">Minor</td></tr>
<tr><td colspan="2">≤0.20 mm</td><td>Ignore</td></tr>
<tr><td colspan="2">0.20 to 0.40 mm</td><td>3</td></tr>
<tr><td colspan="2">0.40 to 0.60 mm</td><td>2</td></tr>
<tr><td colspan="2">≥0.60 mm</td><td>0</td></tr>
<tr><td>8</td><td>Display pattern defect</td><td colspan="3"> 

<table>
<tr><th>Dot Size</th><th>Acceptable Qty</th></tr>
<tr><td>((A+B)/2)≤0.20 mm</td><td rowspan="4">≤3 total defects
≤2 pinholes per digit</td></tr>
<tr><td>C>0 mm</td></tr>
<tr><td>((D+E)/2)≤0.25 mm</td></tr>
<tr><td>((F+G)/2)≤0.25 mm</td></tr>
</table></td><td>Minor</td></tr>
<tr><td>9</td><td>Backlight defects</td><td colspan="3">1. Light fails or flickers.*
2. Color and luminance do not correspond to specifications.*
3. Exceeds standards for display's blemishes, foreign matter, dark lines or scratches.
*Minor if display functions correctly. Major if the display fails.</td><td>Minor</td></tr>
<tr><td>10</td><td>PCB defects (if module has PCB)</td><td colspan="3">1. Oxidation or contamination on connectors.*
2. Wrong parts, missing parts, or parts not in specification.*
3. Jumpers set incorrectly.
4. Solder (if any) on bezel, LED pad, zebra pad, or screw hole pad is not smooth.
*Minor if display functions correctly. Major if the display fails.</td><td>Minor</td></tr>
<tr><td>11</td><td>Soldering defects</td><td colspan="3">1. Unmelted solder paste.
2. Cold solder joints, missing solder connections, or oxidation.*
3. Solder bridges causing short circuits.*
4. Residue or solder balls.
5. Solder flux is black or brown.
*Minor if display functions correctly. Major if the display fails.</td><td>Minor</td></tr>
</table>

Preliminary

Crystalfontz America, Incorporated

CFA10021 Demonstration Board Kits
User Guide



Crystalfontz Model	**CFA10021 Demonstration Board Kits (for CFAX12864x-xxx families of graphic LCD modules)**
Hardware Version	**v1.1, February 2011**
Firmware Version	**v1.1, February 2011**
Data Sheet Version	**v1.0, February 2011**
Product Pages	http://www.crystalfontz.com/product/CFA10021.html

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REVISION HISTORY

CFA10021 DEMONSTRATION BOARD	
2011/02/11	Current demonstration board version: **v1.1** New demonstration board.

CFA10021 DEMONSTRATION BOARD FIRMWARE	
2011/02/11	Current firmware version: **v1.1** Initial release.

CFA10021 DEMONSTRATION BOARD KITS USER GUIDE	
2011/02/11	Data Sheet version: **v1.0** New Data Sheet.

The Fine Print

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.

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QUICK START

The CFA10021 demonstration board is shipped with a compatible module of your choice installed and tested. Simply plug the power supply (included) into an AC outlet. The CFA10021 will initialize and turn on the display, then run the demonstration script from the included microSD card.

INTRODUCTION

The CFA10021 Demonstration Board Kit has everything you need to easily demonstrate and experiment with one compatible Crystalfontz graphic LCD module. (A list of compatible modules is on the next page.) The kit can also be used as a reference for your designs that use one of these modules.

You can easily modify the miniBASIC scripts and bitmaps on the microSD card to make your own test screens and model user interface functions. All that is needed is the included microSD USB reader, a text editor (Notepad will do), an image editor (MS Paint will do), and Image2Code which is a free, simple, open-source format conversion utility.

An additional use is that the CFA10021 allows you to easily measure current of the different portions of the circuit under operation.

The schematic, bill of materials, and the PCB layout is available for download from our site. (As always, no registration is required.) Since the design materials are available before purchase, there is no risk of being "surprised" late in the design.

The CFA10021 is preprogrammed with a microSD boot loader. You can load our simple C example code, the miniBASIC interpreter, or build your own application for the CFA10021's versatile Atmel ATMEGA2561 microcontroller using AVR Studio and WinAVR (both free).

The board has a JTAG port for more advanced programming and debugging. All the ports are on 0.1" centers so you can connect them to anything you need. The CFA10021 is so versatile that you may want to use it as a base development platform for your projects.

The complete kit is RoHS compliant.

CFA10021 KIT CONFIGURATIONS

All of the modules listed below have a Novatek NT7534 controller.

If you want this display module	Which replaces obsolete	Order this demo kit	Mates with ZIF Connector	25.58 mm x 15.98 mm Active Area	47.34 mm x 26.86 mm Active Area	Touch Screen	No Backlight	White LED Backlight	White EL Backlight
CFAX12864T Product Family									
CFAX12864T-NFH	CFAX12864AP	DMOX12864T-NFH		X			X		
CFAX12864T-TFH		DMOX12864T-TFH		X				X	
CFAX12864T-WFH		DMOX12864T-WFH		X					X
CFAX12864T1 Product Family									
CFAX12864T1-NFH	CFAX12864AP1	DMOX12864T1-NFH	X	X			X		
CFAX12864T1-TFH		DMOX12864T1-TFH	X	X				X	
CFAX12864T1-WFH		DMOX12864T1-WFH	X	X					X
CFAX12864U Product Family									
CFAX12864U-NFH	CFAX12864C	DMOX12864U-NFH			X		X		
CFAX12864U-TFH		DMOX12864U-TFH			X			X	
CFAX12864U-TFH-TS		DMOX12864U-TFH-TS			X	X		X	
CFAX12864U-WFH		DMOX12864U-WFH			X				X
CFAX12864U1 Product Family									
CFAX12864U1-NFH	CFAX12864CP1	DMOX12864U1-NFH	X		X		X		
CFAX12864U1-TFH		DMOX12864U1-TFH	X		X			X	
CFAX12864U1-TFH-TS		DMOX12864U1-TFH-TS	X		X	X		X	
CFAX12864U1-WFH		DMOX12864U1-WFH	X		X				X

CONTENTS OF DEMONSTRATION BOARD KIT

- ❑ CFA10021 Demonstration Board (PCB).
- ❑ Mounted compatible graphic LCD module of your choice. (Selected at time of ordering. See choices in the table above.)
- ❑ 110 VAC Power adapter.
- ❑ MicroSD memory card loaded with BASIC demonstration program and bitmap images.
- ❑ USB reader for the microSD memory card.

In addition to the kit contents, a zipped folder of hardware design and program files is available at www.crystalfontz.com/products/product.phtml?product_id=1322#docs. (Free download.)

HOW TO MAKE A CUSTOM DEMONSTRATION

The CFA10021 is programmed with firmware that will read a BASIC program file from the microSD memory card. The BASIC program can read bitmap image files from the microSD memory card and display them on the graphic LCD module. The BASIC program can also read the four switches on the demonstration board and change the brightness settings.

By using the USB reader, a text editor, and a graphic conversion utility (provided), you can customize the demonstration to include your own bitmap images. The large capacity of the microSD card allows you to create complex demonstrations.

For the most recent version of the graphic conversion utility, sample scripts, and sample images for customizing the demonstration, download the zipped folder at www.crystalfontz.com/products/product.phtml?product_id=1322#docs.

LOADING A CUSTOM HEX FILE

The CFA10021 Demonstration Board Kit is shipped with the miniBasic-AVR interpreter loaded into the microcontroller Atmel ATMEGA2561's flash memory.

If you want to load our simple demonstration or your own program, simply name the hex file "cfa10021.hex" and copy it into the root the directory of the microSD card. When the CFA10021 boots, the boot loader will program the ATMEGA2561's flash with "cfa100021.hex" and then execute it.

Acknowledgement Note: The miniBASIC-AVR is a derivative of this (see http://www.personal.leeds.ac.uk/~bgy1mm/Minibasic/MiniBasicHome.html). The miniBASIC-AVR also includes the EFSL embedded filesystems library (see efsl.be).

HARDWARE DESIGN INFORMATION

BLOCK DIAGRAM

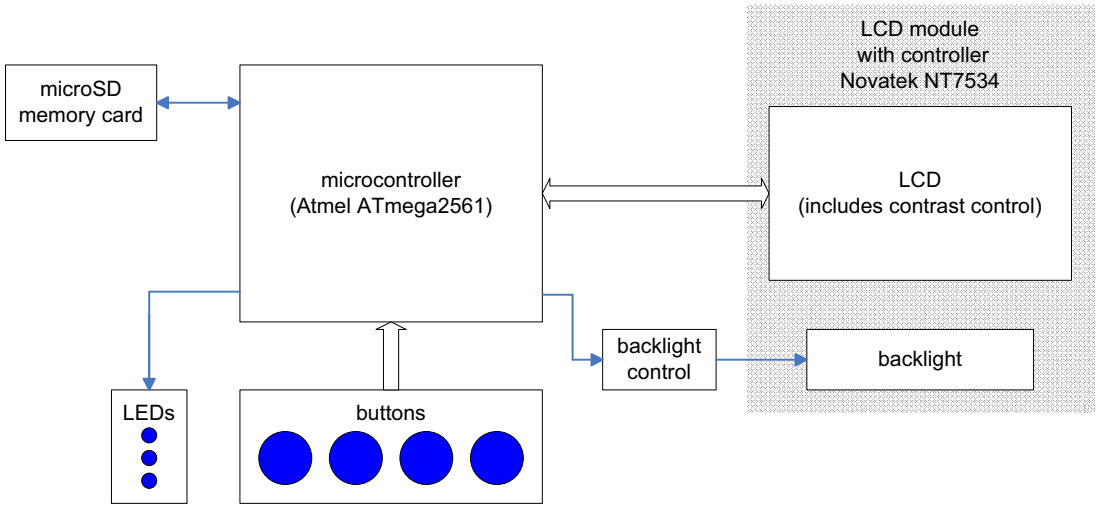

Figure 1. Block Diagram

CONTENTS OF HARDWARE DESIGN FOLDER

The zipped folder at www.crystalfontz.com/products/product.phtml?product_id=1322#docs includes the complete hardware design of the CFA10021 Demonstration Board.

- ❑ Schematic.
- ❑ PCB layout.
- ❑ Bill Of Materials (BOM) as an XLS spreadsheet.
- ❑ Simple OLED initialization code and bitmap display code.

The schematic and PCB layout were created with CadSoft EAGLE. EAGLE is a capable and low-cost electrical CAD system. You can download a freeware light edition of EAGLE from www.cadsoft.de/ to load, view, and print the schematic and layout files.

CARE AND HANDLING PRECAUTIONS

The kit is sold with a module mounted on it. If you attempt to modify the board to work with other modules, the warranty is void. Do not disassemble or modify the CFA10021 Demonstration Board Kit.

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

ESD (ELECTRO-STATIC DISCHARGE)

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

AVOID SHOCK, IMPACT, TORQUE, OR TENSION

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

OPERATION

- The module ships with a protective film over the display. Please peel off the protective film slowly. Peeling off the protective film abruptly may generate static electricity.
- Use only the included AC adapter to power the board.
- Observe the operating temperature limitations for the module: from -20°C minimum to +70°C maximum with minimal fluctuations. Operation outside of these limits may shorten the life and/or harm the display.
- Operate away from dust, moisture, and direct sunlight.

CLEANING

- The polarizer (laminated to the glass) is soft plastic. The soft plastic is easily scratched or damaged. Be very careful when you clean the polarizer.
- Do not clean the polarizer with liquids. Do not wipe the polarizer with any type of cloth or swab (for example, Q-tips).
- 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”). If the polarizer is dusty, you may carefully blow it off with clean, dry, oil-free compressed air.

STORAGE AND RECYCLING

- Store in an ESD-approved container away from dust, moisture, and direct sunlight.
- Observe the storage temperature limitations: from -30°C minimum to +80°C maximum with minimal fluctuations. 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 the demonstration board and module at an approved facility.