Crystalfontz America, Incorporated

INTELLIGENT USB
LCD MODULE SPECIFICATIONS

Crystalfontz Model Number	**XE634BK-YFH-KU**
Hardware Version	**v2.4, February 2011**
Firmware Version	**v2.4, February 2011**
Data Sheet Version	**v1.0, February 2011**
Product Pages	http://www.crystalfontz.com/product/XE634BKYFHKU.html

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REVISION HISTORY

HARDWARE **XE634BK-YFH-KU LCD MODULE** XE634BK-YFH-KU v2.4 is an CFA634-YFH-KU v2.4 module encapsulated in a resilient black case with a permanently attached USB "A" cable.	
2011/02/01	Current hardware version: **v2.4** Previous revision: 2.3 (no units shipped for this version with this part number) This new display module is a replacement for the obsolete CFA632-YFB-KU. It is available by special order only. The only hardware changes are these improvements: ● Wide temperature range (operation -20°C to +70°C and storage 30°C to +80°C) replaces normal temperature range (operation 0°C to +50°C and storage -10°C to +60°C) . For more information, see Part Change Notification (PCN) 10318.

FIRMWARE	
2011/02/01	Current firmware version: **v2.4** Firmware version displayed on the boot screen reflects hardware version v2.4.

DATA SHEET	
2011/02/18	Data Sheet version: **v1.0** First Data Sheet.

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The Fine Print

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MAIN FEATURES

XE634BK-YFH-KU is a Crystalfontz CFA634-YFH-KU module encapsulated in a black case. The case is compact – only slightly larger than the bare module. The approximately 9.0-foot black low-drop USB "A" cable supplies both power and data. The cable is permanently attached. It is easy to position the module at eye level on a work surface or mount it to a wall.

FEATURES

❑ 20x4 LCD module has a large display area encapsulated in a 144.00 wide x 69.00 high x 26.4 depth millimeter (5.67" x 2.71" x 1.04") case.

❑ Large, easy-to-read characters: 7.3 mm (0.287") character height.

❑ Yellow-green array LED backlight with FSTN positive mode LCD. Displays dark characters (near-black) on yellow-green background.

❑ Sunlight readable.

❑ Software controlled contrast.

❑ The CGROM is an enhanced version with many useful characters: numeric superscripts, icons, mathematical symbols, some fractions, a great variety of arrows, many currency symbols, and more.

❑ LCD characters are contiguous horizontally to allow the host software to display "gapless" bar graphs in horizontal direction.

❑ Software controlled terminal style automatic scrolling and line wrapping.

❑ Unique scrolling marquee feature continuously scrolls a message across the display without host intervention.

❑ Buffered communication.

❑ Optional 5.25" half-height drive-bay CFA634 PC Mounting Bracket available.

❑ Nonvolatile memory capability (EEPROM) to customize the "power-on" display settings. All features of the display are controlled: characters displayed, user-definable characters, backlight setting, contrast setting, cursor position, cursor style, "wrap" setting, "scroll" setting, and even the scrolling marquee.

❑ Extended voltage (9-15 volts) and 5 volts power inputs standard on all modules for the controller. Backlight is 5 volts only.

❑ RoHS compliant.

❑ Factories have ISO certification.

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MODULE CLASSIFICATION SYSTEM

XE 634 - Y F H - K U
❶   ❷   ❸ ❹ ❺   ❻ ❼

❶	Brand	XES– e**X**ternal **E**nclosure
❷	Model Identifier	634
❸	Backlight Type & Color	Y – LED, yellow-green
❹	Fluid Type, Image (positive or negative), & LCD Glass Color	F – FSTN, negative neutral
❺	Polarizer Film Type, Temperature Range, & View Angle (O 'Clock)	Transflective, Wide Temperature Range[1], 6:00
❻	Special Code 1	K – manufacturer's code
❼	Special Code 2	U – USB interface
[1]*Wide Temperature Range is -20°C minimum to +70°C maximum*		

MECHANICAL SPECIFICATIONS

PHYSICAL CHARACTERISTICS

ITEM	SIZE (mm)
Overall Size	144.00 (W) x 69.00 (H) millimeters
Viewing Area	102.00 (W) x 41.50 (H) millimeters
Active Area	93.54 (W) x 34.00 (H) millimeters
Character Size	3.84 (W) x 8.90 (H) millimeters
Dot Size	0.72 (W) x 0.86 (H) millimeters
Dot Pitch	0.78 (W) x 0.92 (H) millimeters
Depth	25.9 millimeters
Weight	415 grams, including cable (typical)

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TEMPERATURE AND HUMIDITY RATINGS

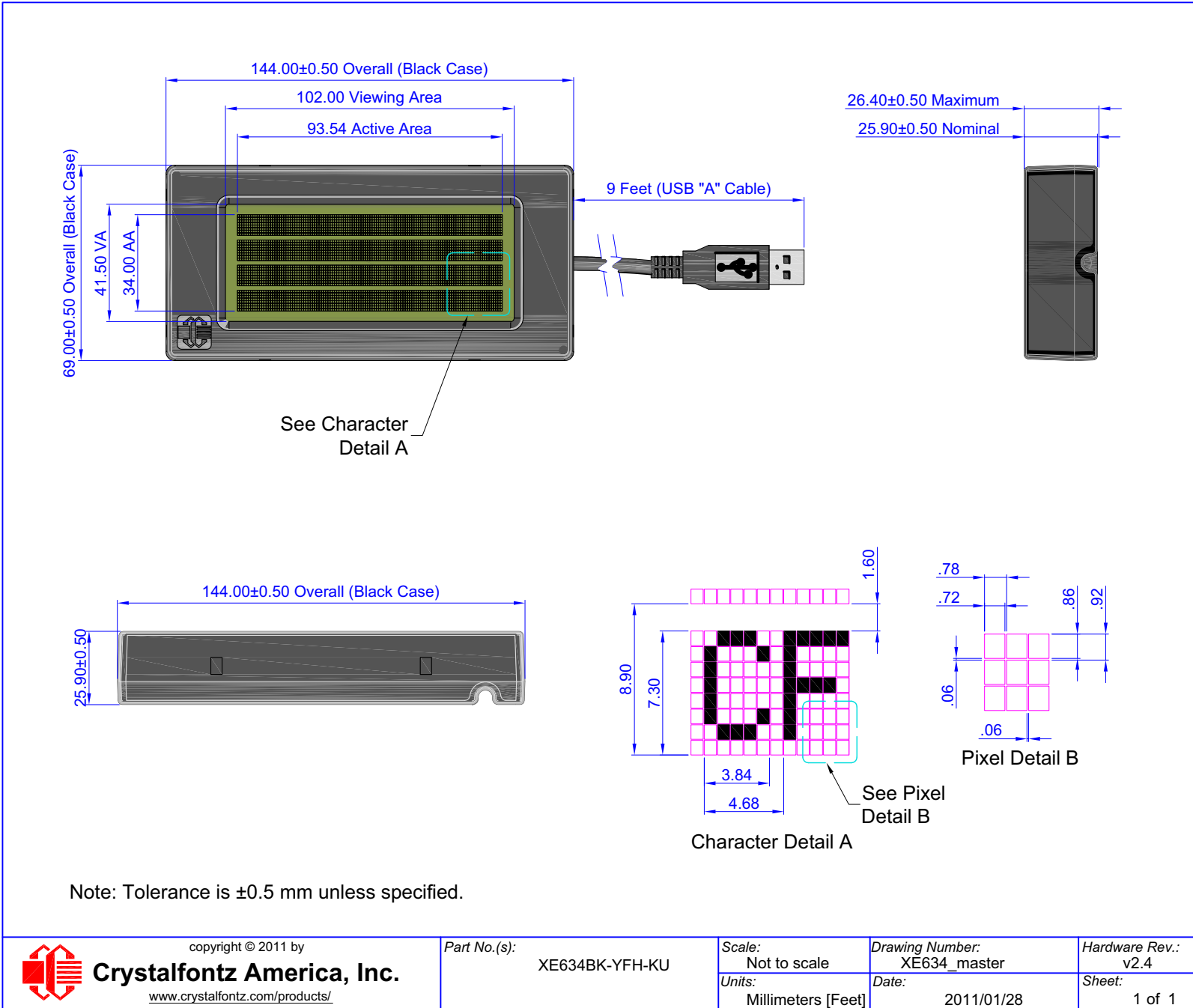| ABSOLUTE MAXIMUM RATINGS	SYMBOL	MINIMUM	MAXIMUM
Operating Temperature	T_{OP}	20°C	+70°C
Storage Temperature	T_{ST}	-30°C	+80°C
Humidity Range (noncondensing)	RH	10%	90%

144.00±0.50 Overall (Black Case)

102.00 Viewing Area

93.54 Active Area

69.00±0.50 Overall (Black Case)

41.50 VA

34.00 AA

26.40±0.50 Maximum

25.90±0.50 Nominal

9 Feet (USB "A" Cable)

See Character Detail A

144.00±0.50 Overall (Black Case)

25.90±0.50

1.60

8.90

7.30

3.84

4.68

See Pixel Detail B

Character Detail A

.78

.72

.86

.92

.06

.06

Pixel Detail B

Figure 1. Outline Drawing

Note: Tolerance is ±0.5 mm unless specified.

Part No.(s): XE634BK-YFH-KU	Scale: Not to scale	Drawing Number: XE634_master	Hardware Rev.: v2.4
	Units: Millimeters [Feet]	Date: 2011/01/28	Sheet: 1 of 1

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OPTICAL CHARACTERISTICS

Viewing Direction	6 o'clock

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

This LCD 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.
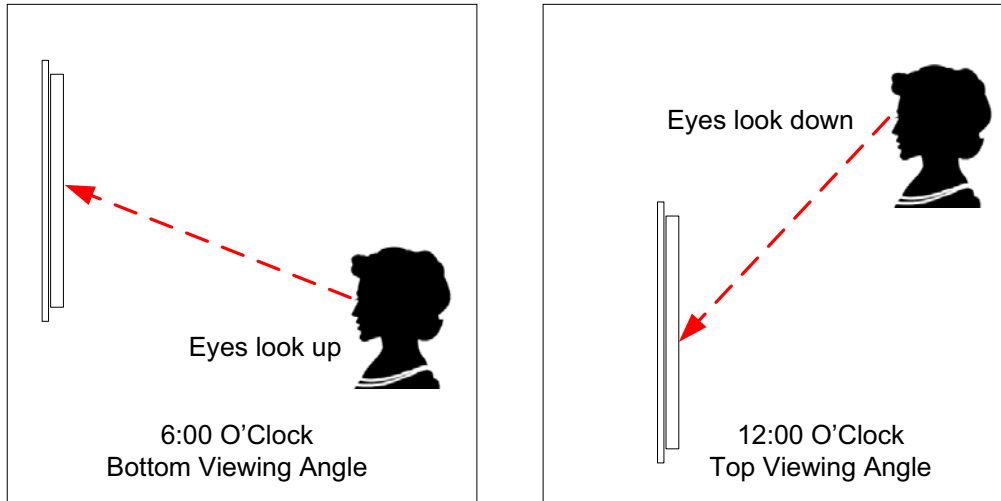

Figure 2. Definition of 6:00 O'clock and 12:00 O'clock Viewing Angles

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ELECTRICAL SPECIFICATIONS

SYSTEM BLOCK DIAGRAM
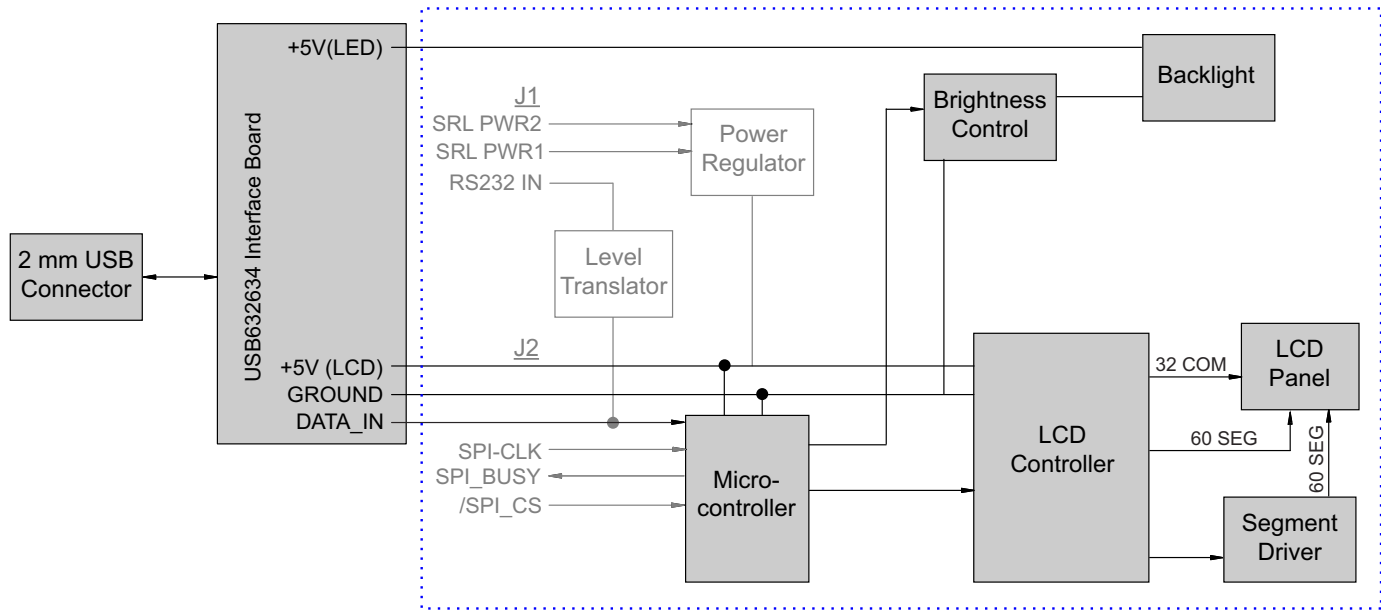
Figure 3. System Block Diagram

CRITERIA	SPECIFICATION
Backlight PWM Frequency	300 Hz nominal
Driving Method	1/ 32 Duty, 1/ 6.7 Bias

REQUIRED VOLTAGE

Logic (+5 volts): Supplied through J2: 4.75 volts minimum, 5.0 volts nominal, 5.25 volts maximum

Backlight: (+5 volts): 4.75 volts minimum, 5.0 volts nominal, 5.25 volts maximum

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CURRENT CONSUMPTION

LCD WITH BACKLIGHT AT 100%	LCD WITH BACKLIGHT AT 0%
450 mA	9 mA

HOST COMMUNICATIONS

CFA634 DEMONSTRATION AND TEST PROGRAMS

The following programs are available for free download on our website:

❑ WinTest Test and Demonstration Software for CFA632 and CFA634

This website page has a link to download a demonstration and test program, WinTest.exe. The C source code is included. The program demonstrates software techniques for displaying banners, graphs, large digits, spectrum, and oscilloscope. Example commands may be copied from the Control Codes listed below and pasted into WinTest. (See Description of Control Functions (Pg. 14).

❑ 632/634 BasicStamp2 Sample

This website page has a link to download a simple program that demonstrates communications from a Parallax Basic Stamp. BS2 source code is available.

❑ 632/634 Linux-Compatible Command-Line Demonstration Program

This is a link to a Linux-compatible demonstration program. The C source code is included.

ABOUT HANDSHAKING

❑ The display can generally execute commands faster than the interface can deliver them so no handshaking is necessary from the display's point of view.
❑ The few exceptions involve accessing the EEPROM (For example, see Control the Boot Screen (\009, Control+I) (Pg. 14)).

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CONTROL CODES AND FUNCTIONS

The CFA634 will accept plain ASCII characters and display them on the screen at the current cursor position. For example, if you send "Hello World", the display shows "Hello World". The display also supports a set of control characters that access other features of the display. Some of these commands require one or more parameters. In general, the parameters are "binary" characters, meaning that any value between 0 and 255 may be required.

The notation "\xxx" is used for "binary" data, where "xxx" is the decimal representation of the number. Use the codes \000 to \255 to include all possible values for a character. This notation is supported by the WinTest Test and Demonstration Software. We recommend you try this utility by using the examples listed under Description of Control Functions (Pg. 14). Select a line of text by highlighting it, copy it, then paste it into the WinTest edit box with a right-click "Paste". Be sure *not* to highlight the invisible carriage return at the end of the line.

Below is a list of the control codes. Click on the links under the ASCII column to jump to an explanation of the code.

ASCII	*KEYSTROKES*	*CONTROL CODE FUNCTION*
\000	Control+@	Reserved
\001	Control+A	Cursor Home
\002	Control+B	Hide Display
\003	Control+C	Restore Display
\004	Control+D	Hide Cursor
\005	Control+E	Show Underline Cursor
\006	Control+F	Show Blinking Block Cursor with Underscore
\007	Control+G	Show Inverting Blinking Block Cursor with Underscore
\008	Control+H	Backspace (Destructive)
\009	Control+I	Control the Boot Screen
\010	Control +J or Control +Enter	Line Feed
\011	Control+K	Delete In Place
\012	Control+L	Form Feed (Clear Display)
\013	Control+M	Carriage Return
\014	Control+N	Backlight Control
\015	Control+O	Contrast Control
\016	Control+P	(Reserved)
\017	Control+Q	Set Cursor Position (Column and Row)
\018	Control+R	Horizontal Bar Graph

ASCII	*KEYSTROKES*	*CONTROL CODE FUNCTION*
\019	Control+S	Scroll ON
\020	Control+T	Scroll OFF
\021	Control+U	Set Scrolling Marquee Characters
\022	Control+V	Enable Scrolling Marquee
\023	Control+W	Wrap ON
\024	Control+X	Wrap OFF
\025	Control+Y	Set Custom Character Bitmap
\026	Control Z	Reboot
\027	Escape	Escape Sequence Prefix
\028	Control+ Backslash	Large Block Number
\029	Control+Quote	(Reserved)
\030	Control+Equal	Send Data Directly to LCD Controller
\031	Control+Minus	Show Information Screen
\128		Custom Character 0
\129		Custom Character 1
\130		Custom Character 2
\131		Custom Character 3
\132		Custom Character 4
\133		Custom Character 5
\134		Custom Character 6
\135		Custom Character 7

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DESCRIPTION OF CONTROL FUNCTIONS

Cursor Home (\001, Control+A)

Moves cursor to the top left character position. No data is changed. Identical to Control+Q,0,0.

Hide Display (\002, Control+B)

Display is blanked, no data is changed.

Restore Display (\003, Control+C)

Restores blanked display; nothing else is changed.

Hide Cursor (\004, Control+D)

Cursor is not shown; nothing else is changed.

Show Underline Cursor (\005, Control+E)

Shows a nonblinking underline cursor at the printing location.

Show Blinking Block Cursor with Underscore (\006, Control+F)

Shows a blinking block cursor at the printing location.

Show Inverting Blinking Block Cursor with Underscore (\007, Control+G)

Shows a blinking block cursor at the printing location. This cursor inverts the character rather than replacing the character with a block. This cursor style is the default cursor at power-up.

Backspace (\008, Control+H)

Moves the cursor back one space and erases the character in that space. Will wrap from the left-most column to the right-most column of the line above. Will wrap from the left-most column of the top row to the right-most column of the bottom row.

Control the Boot Screen (\009, Control+I)

This command allows the current state of the display to be stored in the display's EEPROM, recalling of the EEPROM contents to the display, and controlling the boot behavior.

All features of the display are controlled: the characters displayed, the bitmaps of the user-definable characters, the backlight setting, the contrast setting, the cursor position, the cursor style, the wrap setting, the scroll setting, and even the scrolling marquee's data and state.

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NOTE

Since writing and reading the EEPROM takes quite a bit time, it is possible to overflow the display's input buffer if data is continuously sent while the display is busy executing these commands. The display will still buffer data while these commands are being executed. However, the buffer is 64 bytes long and can be overflowed. You must take care to not overflow the input buffer while the EEPROM commands are executing.

Send "Control+I" followed by the command.

\009 \000 Set boot to "backward compatibility mode"

Execution time: 5.1 mS

If JPK is open: Crystalfontz boot screen is displayed. The boot screen will clear automatically after about 5 seconds. If a character is received during that 5 seconds, the boot screen will be cleared immediately, then that character will be processed.

If JPK is closed: No logo is shown.

\009 \001 Set boot to show Crystalfontz logo until a character arrives

Execution time: 5.1 mS

The Crystalfontz boot screen is displayed. When a character is received, the boot screen will be cleared immediately and the character will be processed.

\009 \002 Set boot to show User Boot Screen for 5 seconds

Execution time: 5.1 mS

The User Boot Screen is recalled from the EEPROM and shown on the display. The boot screen will clear automatically after about 5 seconds. If a character is received during that 5 seconds, the boot screen will be cleared immediately, then that character will be processed.

\009 \003 Set boot to show User Boot Screen until a character arrives

Execution time: 5.1 mS

The User Boot Screen is recalled from the EEPROM and shown on the display. When a character is received, the boot screen will be cleared immediately, then that character will be processed.

\009 \004 Set boot to show User Boot Screen and leave it displayed

Execution time: 5.1 mS

The User Boot Screen is recalled from the EEPROM and shown on the display. Incoming characters are processed normally without the screen being cleared. Settings for display blank, cursor style and position, WRAP, SCROLL are maintained.

\009 \005 Save current display state to EEPROM

Execution time: 800 mS

The entire display state is saved to the EEPROM.

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\009 \006 Recall current display state from EEPROM

Execution time: 91 mS

The entire display state is recalled from the EEPROM

Line Feed (\010, Control+J or Control+Enter)

Moves the cursor down one row.
- If SCROLL is *on* and the cursor is at the bottom row, the display will scroll up one row and the bottom row will be cleared. I
- If SCROLL is *off*, and the cursor is at the bottom row, it will wrap up to the same character position on the top row.

NOTE

If SCROLL is set, the cursor is placed on the bottom line, several Line Feed characters are sent (forcing the display to scroll), and these Line Feeds characters are immediately followed by a burst of more than 64 additional characters—it is possible to overflow the display's input buffer. Don't do this. Contrary to design standards for internet server software from our favorite software monopoly, the display will not start executing the input buffer data as if it were code. The display will simply overwrite the oldest data in the input buffer with the most recently received data.

Delete In Place (\011, Control+K)

Deletes the character at the current cursor position. Cursor is not moved.

Form Feed (\012, Control+L)

Clears the display and returns cursor to Home position (upper left). All data is erased.

Carriage Return (\013, Control+M)

Moves cursor to the left-most column of the current row.

Backlight Control (\014, Control+N)

Send "Control+N", followed by a byte from 0-100 for the backlight brightness. 0=OFF, 100=ON, intermediate values will vary the brightness.

Examples:
```
\014\000
\014\050
\014\100
```

Contrast Control (\015, Control+O)

Send "Control+O", followed by a byte from 0-100 for the contrast setting of the displayed characters.
   0 = very light   50 is typical   100 = very dark

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Examples:
```
\015\050
\015\060
\015\070
```

Reserved (\16, Control+P)

Set Cursor Position (Column and Row) (\017, Control+Q)

Send "Control+Q" followed by one byte for the column (0-19) and a second byte for the row (0-3). The upper-left position is 0,0. The lower-right position is 19,3.

For example, to move the cursor to column 11 of the second line:
```
\017\010\001
```

Horizontal Bar Graph (\018, Control+R)

Send "Control+R" followed by the following bytes:
graph_index
style
start_column
end_column
length
row

graph_index determines which custom characters are used.

graph_index	CUSTOM CHARACTERS USED
\000	0,1
\001	2,3
\002	4,5
\003	6,7

style is the bit pattern to use in drawing the graph.

style	PATTERN	DESCRIPTION
\255	(11111111b)	thick bar
\000	(00000000b)	not visible (all pixels are off)
\085	(01010101b)	striped bar
\060	(00111100b)	medium width bar, centered
\015	(00001111b)	medium width bar, low in the row

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style	PATTERN	DESCRIPTION
\240	(11110000b)	medium width bar, high in the row

Any value is valid between \000 and \255. The MSB (Most Significant Bit) is at the top of the row, the LSB (Least Significant Bit) is at the bottom of the row.

start_column and *end_column* are the character X coordinates of the graph area. Each must be between \000 and \019. *start_column* must be less than or equal to *end_column*.

length is the length in pixels of the graph. Positive values will graph from the left edge of *start_column*, negative values will graph from the right edge of *end_column*. There are six pixels per character, so the maximum value of *length* is 20 x 6 = \120.

row is the character Y coordinate. \000-\003 is valid.

Examples:
```
\018\000\255\000\014\010\001
\018\000\015\000\014\236\001
```

> **NOTE**
>
> The entire graph area is completely rewritten by each graph command, so there is no need to clear the area between successive updates of the same graph. If a length of \000 is written, the entire graph area is cleared to spaces. Negative values can be calculated as 256 - value. For instance, if you want a graph to extend 20 pixels towards the left, from the right most column of the graph area, send 236 (256 - 20 = 236). No additional graph "setup" command is needed.

> **NOTE**
>
> The graphs use some of the custom characters and may corrupt the display contents if there are user-defined custom characters or large numbers shown.

Scroll ON (\019, Control+S)

Turns scroll feature on. Then a Line Feed (Control+J) command from the bottom row will scroll the display up by one row, independent of Wrap. If Wrap is also on (Control+W), a wrap occurring on the bottom row will cause the display to scroll up one row. Scroll is on at power-up.

Scroll OFF (\020, Control+T)

Turns scroll feature off. Then a Line Feed (Control+J) command from the bottom row will move the cursor to the top row of the same column, independent of wrap (Control+W for Wrap ON, Control+X for Wrap OFF). If wrap is on, a wrap occurring on the bottom row will also wrap vertically to the top row. Scroll is on at power-up.

Set Scrolling Marquee Characters (\021, Control+U)

Send "Control+U" followed by the following bytes:
index
character

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index determines which of the 20 scrolling marquee characters gets set (\000 to \019 are valid).

character is the value that this position in the scrolling marquee will be set to.

The examples below will set the first 12 characters to "Crystalfontz", put another message on the display, and enable the scrolling marquee. Please note that the second line ends in a space.

Examples:

```
\004\022\255\001\005\012\017\000\001Scrolling Marquee
\021\000C\021\001r\021\002y\021\003s\021\004t\021
\005a\021\006l\021\007f\021\008o\021\009n\021\010t
\021\011z\021\012 \021\013 \021\014 \021\015 \021
\016 \021\017 \021\018 \021\019 \022\001\001\016
```

> **NOTE**
>
> A section of memory holds 20 hidden characters. These 20 characters, along with the contents of one line of the display, can be rotated pixel by pixel across the display in a circular fashion. Use this command multiple times to set the 20 hidden characters. Use the normal display functions to set the other characters in the line you want to rotate and then enable rotation with Enable Scrolling Marquee command. The hidden characters are set to blanks at power-up, or loaded from the User Boot Screen.
>
> You will probably want to disable the scrolling marquee movement while you are setting the scrolling marquee characters or modifying characters on the rotating line. You will probably also want to move the cursor off the line or hide it.
>
> WinTest, available at WinTest Test and Demonstration Software easily allows setting up the scrolling marquee and adjusting the parameters, so you can find a setting you like in a minimum amount of time.

> **NOTE**
>
> If the first character of the line above the scrolling line on the CFA634 display has any pixels on its bottom row set, they will appear as "ghost" pixels in the upper right of the last character of the scrolling line. This will only happen on the first line or if the cursor or a custom character with its bottom row of pixels set is in the leftmost position of the line directly above the scrolling marquee line. These pixels are an artifact of the display controller's memory architecture.

Enable Scrolling Marquee (\022, Control+V)

Send "Control+V" followed by the following bytes:
line
scroll_step_size
update_speed

line determines which line will scroll with the scrolling marquee or if the scrolling marquee is disabled.

line	FUNCTION
\000	enable scrolling marquee on line 1
\001	enable scrolling marquee on line 2
\002	enable scrolling marquee on line 3

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line	*FUNCTION*
\003	enable scrolling marquee on line 4
\255	disable scrolling marquee (valid values for *scroll_step_size* and *update_speed* must still be sent)

scroll_step_size controls the number of pixels that the message is shifted by at each update:

scroll_step_size	*RESULT*
\001	shift by one pixel, smooth but slow
\002	shift by two pixels
\003	shift by three pixels
\004	shift by four pixels
\005	shift by five pixels
\006	shift by six pixels (equal to shifting by one character, fast)

update_speed determines how often updates will occur. The units are 1/96 of a second (about 10 mS). The valid range is \005 (52 mS) to \100 (1.042 S).

NOTE

Since the liquid crystal fluid in the display takes some time to react, the minimum usable value is about 16 or 167 mS. The Enable Scrolling Marquee command supports a large range of speeds to accommodate future displays and user preference.

The following equations will allow you to determine the speed at which the message scrolls:

Update Frequency = *update_speed* / 96 Hz
Update Period = 96 / *update_speed* Seconds

New Character Frequency = (*scroll_step_size x update_speed*) / (96 x 6) Hz
New Character Period = (96 x 6) / (*scroll_step_size x update_speed*) Seconds

Message Repeat Period = (40 x 96 x 6) / *(scroll_step_size x update_speed*) Seconds

See the example in Set Scrolling Marquee Characters (\021, Control+U) (Pg. 18). WinTest Test and Demonstration Software, easily allows you to set up a scrolling marquee and adjust the parameters. You can find a setting you like in a minimum amount of time.

Wrap ON (\023, Control+W)

Turns wrap feature on. When wrap is on, a printable character received when the cursor is at the right-most column will cause the cursor to move down one row to the left-most column. If the cursor is already at the right-most column of the bottom row, it will wrap to the top row if Scroll is off, or the display will scroll up one row if Scroll is on.

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Wrap OFF (\024, Control+X)

Turns wrap feature off. When wrap is off, a printable character received when the cursor is at the right-most column will cause the cursor to disappear (as it will be off the right edge of the screen) and any subsequent characters will be ignored until some other command moves the cursor back onto the display. This function is independent of Scroll.

Set Custom Character Bitmap (\025, Control+Y)

The custom characters are mapped at \128 through \135 corresponding to character 0 to character 7.

Send "Control+Y" followed by the following bytes:
character
data0
data1
data2
data3
data4
data5
data6
data7

character determines which of the eight custom characters is modified. 0-7 is valid. The custom characters are displayed by sending \128 to \135:

character	*CUSTOM CHARACTER MODIFIED*
\128	0
\129	1
\130	2
\131	3
\132	4
\133	5
\134	6
\135	7

data0-data7 are the bitmap information for this character. Any value is valid between 0 and 63. The MSB is at the left of the character cell of the row and the LSB is at the right of the character cell. data0 is at the top of the cell, *data7* is at the bottom of the cell.

> **NOTE**
>
> The large digits use all of the custom characters. If you modify the custom characters when large digits are displayed, the display will probably become corrupted. The bar graphs also use some of the custom characters.

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Examples:

```
\012\001\128\129\130\131\017\000\001\132\133\134\135
\025\000\000\000\001\003\000\031\031\031
\025\001\028\054\032\001\003\051\051\051
\025\002\014\027\049\032\032\047\032\047
\025\003\000\000\032\048\000\062\000\062
\025\004\031\031\031\000\003\001\000\000
\025\005\051\051\051\003\001\032\054\028
\025\006\047\032\047\032\032\049\027\014
\025\007\062\000\062\000\048\032\000\000
```

Reboot (\026, Control+Z)

CFA634 firmware is very stable and robust. It is unlikely that you will ever need a "reboot" command. If the firmware did crash, the command processor would most likely be inoperable and unable to detect the reboot command. However, you may have certain situations where it is nice to have a command that will return the display to a known state. For instance, if the baud rate on the host is set to an incorrect speed, the data is interpreted as meaningless garbage which the display firmware tries to interpret. Some data may set the contrast to an unusable value; some data may program the LCD controller to an indeterminate state. Or perhaps you always want the display to wake up in a given state when your program starts, without going through all the commands that affect the way the display interprets commands (such as the state of Scroll or Wrap).

Send one "Control+Z" followed by another "Control+Z" to reboot the display. If you are not sure of the display state, it may be necessary to send up to 9 characters to satisfy the parameters of some previous command. For example, if the Set Custom Character Bitmap command (See Set Custom Character Bitmap (\025, Control+Y) (Pg. 21)) has just been received by the display when an application crashes, the display will interpret the next 9 bytes as the parameters to the command, then wait for more commands. If you are not sure what the status of the display is, send 9 blanks (\032) followed by two "Control+Z"s (\026).

Escape Sequence Prefix (\027, Escape)

Four escape sequences are supported. These correspond to the escape sequences that are sent for the four arrows keys in HyperTerminal with an ANSI terminal selected (and also our WinTest). These sequences move the cursor only and do not wrap.

ESCAPE SEQUENCE	ARROW KEY
ESC [A (equivalent to \027\091\065)	UP arrow
ESC [B (equivalent to \027\091\066)	DOWN arrow
ESC [C (equivalent to \027\091\067)	RIGHT arrow
ESC [D (equivalent to \027\091\068)	LEFT arrow

Large Block Number (\028, Control Backslash)

Send "Control+Backslash" followed by the following bytes:
   style
   column
   number

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style determines if a large number (3x4 or a 4x4) is displayed:

style	FUNCTION
\000	3X4 large number
\001	4x4 large number
\002-\255	invalid

column is the starting column of the number.
  \000-\017 are valid for a style of \000 (3x4)
    \000-\016 are valid for a style of \001 (4x4).

number is the number to display. \048 to \057 ('0' to '9') are valid.

NOTE

The large numbers use all the custom characters. There will be some corruption if they are used at the same time as graphs or user defined custom characters. No large number initialization command is needed.

Examples:

```
\004\012\028\000\0010\028\000\0051\028\000\0092\028\000\0133\028\000\0174
\004\012\028\000\0005\028\000\0046\028\000\0087\028\000\0128\028\000\0169

\004\012\028\001\0000\028\001\0051\028\001\0102\028\001\0153
\004\012\028\001\0006\028\001\0057\028\001\0108\028\001\0159
```

Reserved (\029, Control+Quote)

Send Data Directly to the LCD Controller (\030, Control+Equal)

Send "Control+Equal" followed by the following bytes:
    location
    data

location is the destination register on the LCD controller:

location	REGISTER
\000	Control Register, (RS=0, RE=0)
\001	Data Memory, (RS=1, RE=x)
\002	Control Register, (RS=0, RE=1)

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data is the data to write to the controller.

NOTE

This command executes a low level write directly to the controller. Use this command at your own risk.
"Control+Z" followed by another "Control+Z" will reboot the display and recover from most mistakes.

Example:
```
\030\002\031\030\002\130
```

Show Information Screen (\031, Control+Minus)

This command will show the baud rate, version, and model number.

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CHARACTER GENERATOR ROM (CGROM)

Figure 4. Character Generator ROM (CGROM)

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HOW TO USE CGROM

The CGROM defines which characters are shown by the display for a given code received through the interface. The CFA634 firmware v2.0 has an enhanced CGROM that includes many useful special characters including numeric superscripts, icons, mathematical symbols, some fractions, a great variety of arrows, and many currency symbols.

Most of the characters can be accessed by sending the appropriate ASCII code to the display. For instance, the letter "A" can be shown by sending an "`A`" (which is the same as a "`decimal 65`", a "`hex 0x41`", or a "`\065`").

Some characters do not have an obvious match. For instance, the code to display a superscript "9" is "`decimal 137`", "`hex 0x89`", or "`\137`". The relationship between the codes and the characters are shown on in the Character Generator ROM (CGROM) (Pg. 25)

To find the code for a given character, add the two numbers that are shown in bold for its row and column. For example, the superscript "9" is in the column labeled "128d" and in the row labeled "9d". So you would add 128 + 9 to get 137. When you send a byte with the value of 137 to the display, then a superscript "9" will be shown at the current cursor position.

In the CFA634 v1.0, the CGROM table had several columns that did not have any characters assigned to the codes. The commands to control the display were mapped to some of those unused codes. These codes are shown in red in the table. Specifically, the first 32 codes (0 to 31) are reserved for the display's special functions (cursor positioning, contrast control, bar graphs. . .), and the codes from 128 to 135 are used to access the custom characters.

To access the characters shown in red, it is necessary to send some data directly to the LCD controller. Send Data Directly to the LCD Controller (\030, Control+Equal) (Pg. 23) allows any character in the CGROM to be displayed.

For example, if you want to display an arrow that points to the upper left, look at the table and note that it is in column "16d", and in row "6d", so its code is 22 (16 + 6 = 22). Use the following sequence to display the arrow that points to the upper left:

    \030\001\022

This sequence of three bytes must be used to display any of the characters shown in red in the table. It can also be used to access any character in the table.

MODULE RELIABILITY AND LONGEVITY

MODULE RELIABILITY

ITEM	*SPECIFICATION*
Yellow-green LED Backlight	50,000 to 100,000 hours (typical)

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.

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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:

- *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 (PCN) on the product's web page as soon as possible. If interested, you can subscribe to future part change notifications.

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CARE AND HANDLING INFORMATION

For optimum operation of the XE634BK-YFH-KU and to prolong its life, please follow the precautions below.

OPERATION AND STORAGE

- The case is not waterproof. To reduce the risk of fire, electric shock, or product damage, do not expose to drips or splashes.
- Do not use or store in a very dusty or high humidity area. Dust and moisture can enter inside the case and damage the components.
- Do not install near any heat sources such as radiators, heat registers, stoves, or other appliances that produce heat. Do not expose to direct sunlight for long periods of time.
- Storage temperature limitations: from -10°C minimum to +60°C maximum with minimal fluctuations. Rapid temperature changes can cause moisture to form inside the case, resulting in permanent damage.
- Operating temperature limitations: from 0°C minimum to a maximum of 50°C with minimal fluctuation. Operation outside of these limits may shorten life and/or harm 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.)
- Do not try to disassemble or modify the XE634BK-YFH-KU.
- Do not expose the module to strong mechanical shock, impact, torque, or tension.
- Do not drop, toss, bend, or twist the module.
- To avoid damage to the cable, do not tightly twist, pinch, or pull hard.
- Do not place weight or pressure on the XE634BK-YFH-KU.
- The XE634BK-YFH-KU is shipped with a protective plastic film over the display window. For best view, please remove the film.
- The case window is made out of plastic. It is "scratch resistant" polycarbonate but can be scratched or damaged by abuse.
- If you must discard the XE634BK-YFH-KU, please recycle at an approved facility.

IF LCD PANEL BREAKS

- If the XE634BK-YFH-KU is severely damaged and the LCD panel behind the polycarbonate breaks, be careful to not 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 with soap and plenty of water.

HOW TO CLEAN

- Do not spray any liquid directly on the module. The case is not waterproof.
- Clean the XE634BK-YFH-KU with a soft cloth slightly moistened with clear liquid glass cleaner (for example, Windex) and then wipe dry. Do not use chemical cleaners or solvents.
- The case window is polycarbonate. The polycarbonate may be scratched or damaged. Be gentle when you clean the case window.

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APPENDIX A: QUALITY ASSURANCE STANDARDS

INSPECTION CONDITIONS

- Environment
  - Temperature: 25±5°C
  - Humidity: 30~85% RH
- 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)
  - Viewable angle: inspect at 45° angle of vertical line right and left, top and bottom
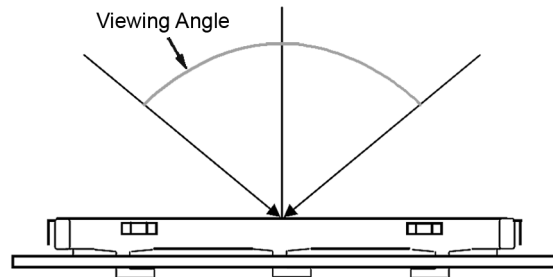
COLOR DEFINITIONS

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.

DEFINITION OF ACTIVE AREA AND VIEWABLE AREA

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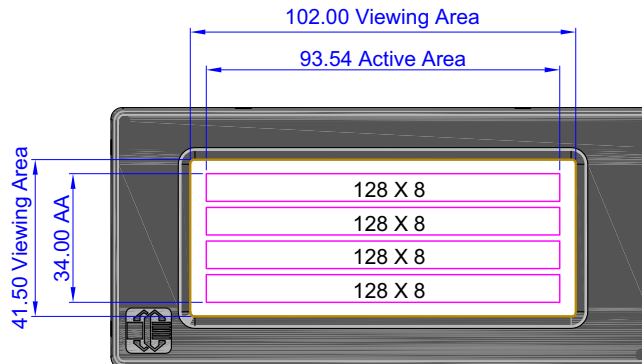
ACCEPTANCE SAMPLING
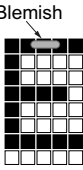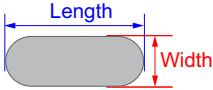
DEFECT TYPE	AQL*
Major	$\leq$0.65%
Minor	$\leq$1.00%
*Acceptable Quality Level: maximum allowable error rate or variation from standard	

DEFECTS CLASSIFICATION
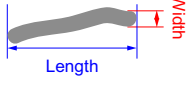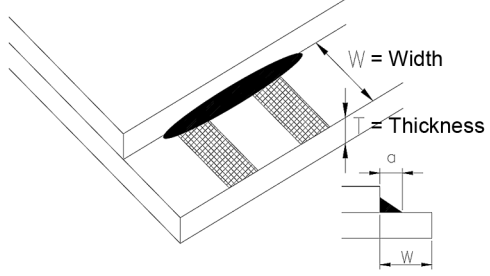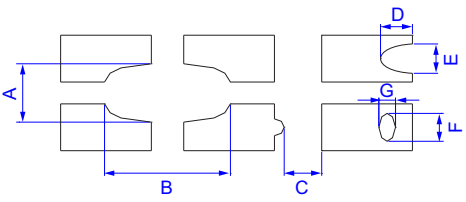
Defects are defined as:

- 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. (See Inspection Conditions (Pg. 29).			Major
3	Contrast adjustment defect	Contrast adjustment fails or malfunctions.			Major
4	Blemishes or foreign matter on display segments	Blemish	*Defect Size (mm)*	*Acceptable Qty*	Minor
			$\leq$0.3	3	
			$\leq$2 defects within 10 mm of each other		
5	Other blemishes or foreign matter outside of display segments	Defect size = (A + B)/2 Length Width	*Defect Size (mm)*	*Acceptable Qty*	Minor
			$\leq$0.15	Ignore	
			0.15 to 0.20	3	
			0.20 to 0.25	2	
			0.25 to 0.30	1	

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#	DEFECT TYPE	CRITERIA			MAJOR / MINOR
6	Dark lines or scratches in display area	*Defect Width (mm)*	*Defect Length (mm)*	*Acceptable Qty*	Minor
		$\leq$0.03	$\leq$3.0	3	
		0.03 to 0.05	$\leq$2.0	2	
		0.05 to 0.08	$\leq$2.0	1	
		0.08 to 0.10	$\leq$3.0	0	
		$\geq$0.10	>3.0	0	
7	Bubbles between polarizer film and glass	*Defect Size (mm)*		*Acceptable Qty*	Minor
		$\leq$0.20		Ignore	
		0.20 to 0.40		3	
		0.40 to 0.60		2	
		$\geq$0.60		0	
8	Glass rest defect	$a\leq1/4W$			Minor
9	Display pattern defect				Minor
		Dot Size (mm)	*Acceptable Qty*		
		$((A+B)/2)\leq0.2$	$\leq$3 total defects $\leq$2 pinholes per digit		
		C>0			
		$((D+E)/2)\leq0.25$			
		$((F+G)/2)\leq0.25$			

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#	DEFECT TYPE	CRITERIA				MAJOR / MINOR
10	Chip in corner					Minor
		a	*b*	*c*	*Acceptable Qty*	
		<4 mm	≤W	c≤T	3	
11	Chip on "non-contact" edge of LCD					Minor
		a	*b*	*c*		
		≤3 mm	≤1 mm	≤T		
		≤4 mm	≤1.5 mm	≤T		
12	Chip on "contact" edge of LCD, on the active side					Minor
		a	*b*	*c*	*Acceptable Qty*	
		≤2 mm	≤W/4	≤T	Ignore	
		≤3 mm	≤W/4	≤T	3	

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#	DEFECT TYPE	CRITERIA				MAJOR / MINOR
13	Chip on "contact" edge of LCD, on the inactive side					Minor
		a	*b*	*c*	*Acceptable Qty*	
		≤3 mm	≤1 mm	≤T	Ignore	
		≤4 mm	≤1.5 mm	≤T	3	
14	Chip in seal area					
		a	*b*	*c*	*Acceptable Qty*	
		<3 mm	≤1.5 mm	≤1/2 T	3	Minor
		Unacceptable if c>50% of glass thickness or if the seal area is damaged.				Major
15	Backlight defects	1. Light fails or flickers.* 2. Color and luminance do not correspond to specifications.* 3. Exceeds standards for display's blemishes or foreign matter (see test 5, Pg. 30), and dark lines or scratches (see test 6, Pg. 31). *Minor if display functions correctly. Major if the display fails.*				Minor
16	COB defects	1. Pinholes >0.2 mm. 2. Seal surface has pinholes through to the IC. 3. More than 3 locations of sealant beyond 2 mm of the sealed areas.				Minor
17	PCB defects	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.*				Minor

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#	DEFECT TYPE	CRITERIA	MAJOR / MINOR
18	Soldering defects	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.*	Minor