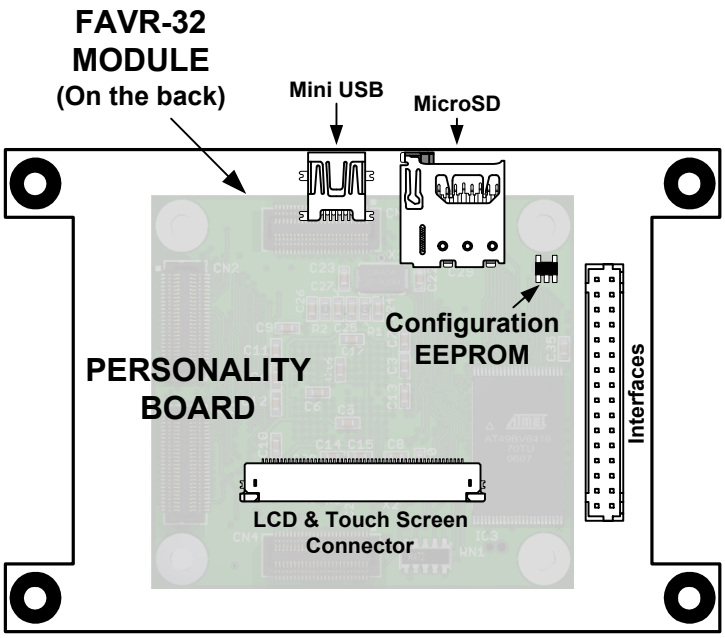
ezLCD+

ezLCD+103 Product Manual



ezLCD+ Documentation Overview

The ezLCD+ documentation consists of:

"ezLCD+10x Manual"

Specific for each ezLCD+ device (ezLCD+101, ezLCD+102, .. etc.).

- *Provides "Quick Start" instructions.*
- *Describes the hardware of the particular device.*
- *Describes how to load a new firmware and how to customize your ezLCD+ device.*

"ezLCD+ External Commands Manual"

Common for all ezLCD+ products.

- *Describes the set of commands, which can be sent to the ezLCD+ through any of the implemented interfaces (USB, RS232, SPI, etc.). Those commands may be sent by an external host (PC or microcontroller).*
- *Describes the API of the ezLCD+ Windows USB driver.*

"ezLCD+ Lua API Manual"

Common for all ezLCD+ products.

All ezLCD+ products have an embedded Lua interpreter. The ezLCD+ Lua API has been developed to access all graphic and I/O capabilities of the ezLCD+ device using the Lua language.

* **Programming in Lua (second edition) By Roberto Lerusalimschy**

Common for all ezLCD+ products.

The official book about the Lua programming language. It is available at:
http://www.amazon.com/exec/obidos/ASIN/8590379825/lua-docs-20
More information about Lua can be found at:
http://www.lua.org/

* Not included. Must be downloaded or purchased seperately.

Table of Contents

ezLCD-103 Product Manual

ezLCD-103 Product Manual

1 Overview

Congratulations on your purchase of ezLCD+103!

The ezLCD+103 is an all-in-one programmable color LCD panel which includes:

- 320x240 pixel, 262144 color, 3.5" TFT LCD
- Embedded 32bit processor (Atmel AT32AP7000) with LCD Controller
- 4 Mega Bytes of embedded flash for storing custom fonts and bitmaps
- MicroSD Card slot for storing bitmap, fonts and other user data up to 2 Giga Bytes
- Power supply, which generates all the voltages needed by the logic and the display itself
- Touch screen
- Interface drivers and other circuitry

The ezLCD+103 communicates with the outside world through several interfaces:

- RS232 TTL
- USB
- I2C
- SPI
- SD/MMC

The ezLCD+103 firmware is in-field updatable and contains an extensive command set:

- Graphic commands
- Double buffering
- True Type and Open Type font rendering
- Bitmap font rendering
- Unicode support
- SD file I/O (FAT12, FAT16, and FAT32)
- Touch Screen commands

The ezLCD+103 firmware is in-field updatable and contains an extensive command set:

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- True Type and Open Type font rendering
- Bitmap font rendering
- Unicode support
- SD file I/O (FAT12, FAT16, and FAT32)
- Touch Screen commands

The ezLCD+103 may be in-field customized by:

- Adding custom fonts
- Adding custom bitmaps
- Customizing startup screen
- Modifying interface parameters like RS232 baudrate, Ethernet MAC and IP address, etc.
- Modifying pin functions

The ezLCD+103 belongs to the ezLCD+ family of intelligent displays.
All ezLCD+ devices (including ezLCD+103) have two distinctive user interfaces:

1. The ezLCD+ External Commands.The ezLCD+ is driven by a set of commands, which can be fed through any of the implemented interfaces apart from I2C. The *ezLCD+ External Commands Manual*

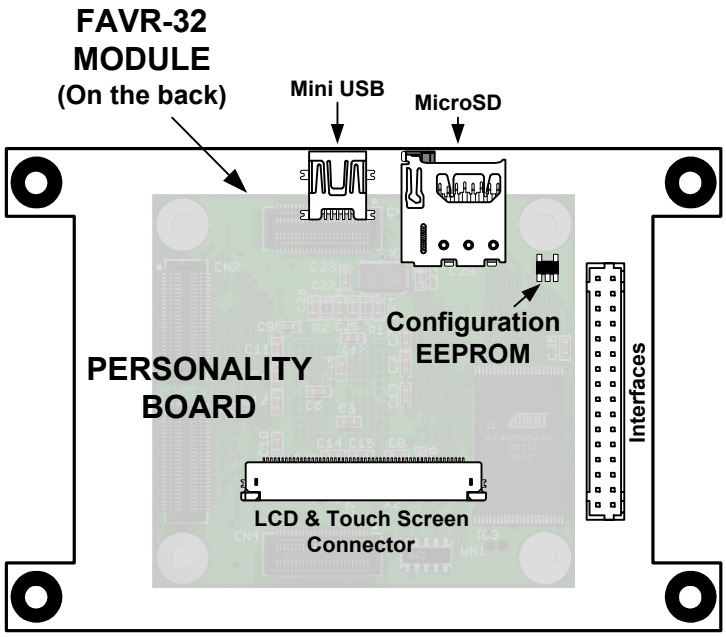
describes in detail those commands.

2. Lua programming language interpreter. The ezLCD+ contains an embedded Lua programming language interpreter. The ezLCD+ Lua library is described in the *ezLCD+ Lua API Manual*.

The ezLCD+103 may be used as an "intelligent" display, or as a stand alone device. There is enough flash memory left to incorporate additional graphical instructions, or to customize the software for particular tasks. Possible applications include automotive, avionics, nautical, industrial control, hobby, etc.

2 Design Concept

The ezLCD+103 board



The ezLCD+103 consists of:

- **FAVR-32 Module**. Stores and executes the firmware. Contains 32AP7000 32-bit microcontroller with LCD controller, RAM, ROM, Clocks and a local voltage regulator.
- **Personality Board**. Interfaces the FAVR-32 module with the outside world. Contains several I/O connectors, DC/DC voltage regulator, and **Configuration EEPROM**.
- LCD Panel
- LCD Backlight Inverter

The Configuration EEPROM stores information about all the hardware outside the AVR-32 Module:
- LCD parameters (resolution, number of colors, size, voltages, timings, etc.)
- Connectors and drivers aboard the Personality Board
- Touch Screen type and parameters
- etc.

FAVR-32 module is connected to the Personality Board by three 1.5 mm height 50-pin connectors. Upon power-up, FAVR-32 Module reads the LCD parameters and other configuration data from the Configuration EEPROM. The read parameters and data is used to configure firmware for driving the particular LCD display and peripherals.

The design concept described above enables the Firmware and FAVR-32 Module to be identical for several types of LCD graphic displays available on the market today. The LCD controller embedded in the FAVR-32 module is capable of driving TFT, STN, Color, or Monochrome LCD displays with the resolution of up to 2048x2048. The small size of the FAVR-32 Module enables it to fit on the back of an LCD panel starting with the size of 2.7".

Incorporating a new LCD panel would require the following:
1. Design a Personality Board for the particular LCD panel
2. Program the Configuration EEPROM with the parameters of the required LCD panel

3 Quick Start

Quick Start Requirements:

- PC Computer with at least 1 USB 2.0 port
- Windows XP SP2, or Windows Server 2003, or any Windows Vista or Windows Server 2008

Note: *The ezLCD+ products do not need a PC computer to work. The above requirements are for the "Quick Start" only.*

Quick Start

1. Download the latest USB FAVR-32 driver from http://www.ezlcd.com/support/

2. Run the downloaded driver installation executable before connecting ezLCD+103 to the USB of your computer.

3. Connect ezLCD+103 USB to your computer and turn the ezLCD+103 power on by sliding the PWR switch into "ON" position. "New Hardware Found" wizard should appear. Select automatic driver installation. Turn-off ezLCD+103 after the driver have successfully been installed.

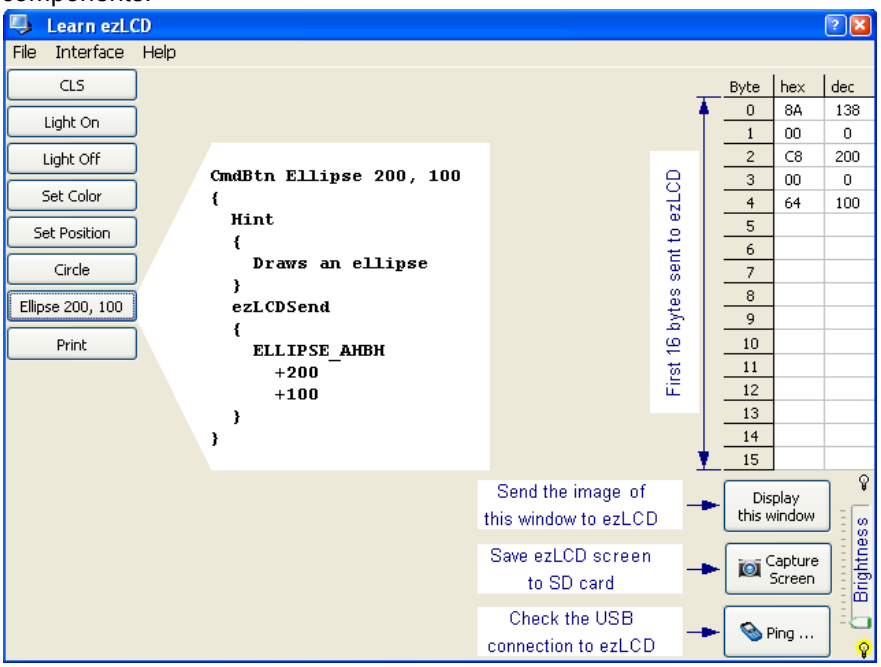
4. Go to chapter: "Quick Start: External Commands" or "Quick Start: Lua".

3.1 Quick Start: External Commands

1. Make sure, that USB FAVR-32 driver is installed on your PC
2. Download the setup of "Learn_ezLCD" utility from http://www.ezlcd.com/support/
3. Install "Learn_ezLCD" utility by running the downloaded setup
4. Turn-on ezLCD+103 and make sure that it is connected to your computer through USB.
5. Run "Learn_ezLCD" utility. Press "Display this window" button. "Learn_ezLCD" utility window should appear on the ezLCD.
6. Read "Learn_ezLCD" Help and experiment with ezLCD commands and "Learn_ezLCD" buttons

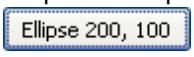
About Learn_ezLCD

"Learn_ezLCD" is a simple utility, designed to help beginners learn how to use ezLCD commands. The picture, below, shows the main window of "Learn_ezLCD", with some short descriptions of it's components.



Upon start, "Learn_ezLCD" dynamically generates Command Buttons, based on the data read from the file: Buttons.txt. File Buttons.txt contains the button definitions. It resides in the same folder as Learn_ezLCD.exe (application executable).
Besides that, the button definitions can be loaded from any other Button Definition File by selecting File->Open from the menu.

Generated buttons are shown in the upper-left part of the picture above.

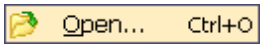
As an example, the script defining button:  is shown to the right of it.

Permanent components of "Learn_ezLCD" are located in the right part of it's window: They include:

- The Data Sent Table, which shows the first 16 bytes of the data sent to the ezLCD upon pressing the button
- Three Utility Buttons: 'Display this window', 'Capture Screen' and 'Ping ...'
- ezLCD Backlight Control Slider

For more information about ezLCD+ External Commands, please refer to the *"ezLCD+ External Commands Manual"*.

3.2 Quick Start: Lua

1. Make sure, that USB FAVR-32 driver is installed on your PC
2. Download the setup of "ezLuaIDE" from http://www.ezlcd.com/support/
3. Install "ezLuaIDE" by running the downloaded setup
4. Turn-on ezLCD+103 and make sure that it is connected to your computer through USB.
5. Run "ezLuaIDE". From the Menu, select "File" - "Open" 

6. Select HelloWorld.lua file from the folder "Program Files\ezLuaIDE\Examples".

HelloWorld.lua

```
1   -- Select Display & Draw Frames
.   ez.SetDispFrame(0)
.   ez.SetDrawFrame(0)
.   -- Fill screen with navy color
-   ez.Cls(ez.RGB(0, 0, 128))
.   -- Select True Type font no 6, height = 64 pixels, Width = Automatic
.   ez.SetFtFont(6, 64, 0)
.   -- Set golden color for drawing
.   ez.SetColor(ez.RGB(255, 215, 0))
10  -- Set screen position for drawing
.   ez.SetXY(10, 10)
.   -- Print Hello World !
.   print("Hello World !")
```

7. Press 

button. The ezLCD+103 should display "Hello World !" in golden color over navy background:

For more information about Lua on ezLCD+ and ezLuaIDE, please refer to the "ezLCD+ Lua API Manual".

4 Hardware & Interfaces

4.1 Specifications

Electrical and Environmental Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Power Supply Voltage	Vcc	4.5	5.0	6.0	V	
Power Supply Current	Icc		360	420	mA	Vcc = 5V, maximum backlight
Hi Level Discrete Input Voltage	V_{IH}	2.2	3.3	3.6	V	**Note:** Discrete signals are not +5V tolerant. This includes SPI, I2C, SD and RS232 TTL interfaces.
Lo Level Discrete Input Voltage	V_{IL}	-0.3	0	1	V	
Operating Temperature	Topa	-20		70	°C	Max. storage time at -30°C: 48hrs Max. storage time at 80°C: 120hrs Background color changes slightly depending on ambient temperature. This phenomenon is reversible.
Storage Temperature	Tstg	-30		80	°C	
Operating Ambient Humidity	H_{OP}			75	%RH	
Storage Humidity	H_{ST}			75	%RH	

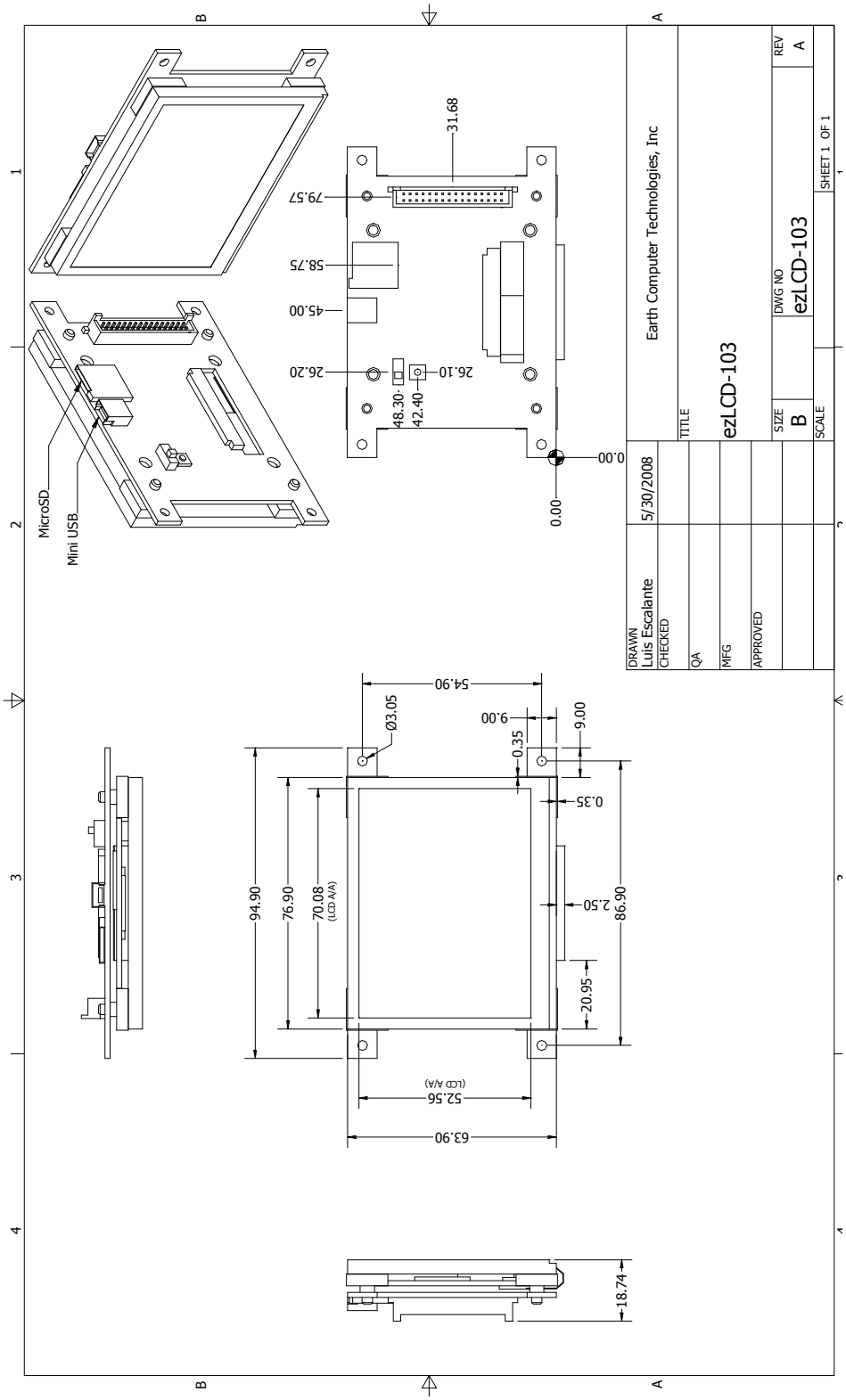
Display Specifications

Parameter	Specification	Unit
Display Resolution	320(W) x 240(H)	pixel
Color Depth	8-bit, 16,777,216 colors	
Active Screen Size	3.5(Diagonal)	inch
Contrast Ratio	300:1	
Pixel Pitch	0.219(W) x 0.219(H) mm	mm
Luminance	350	Cd/m^2
Operating Mode	Transmissive, normally white	

Backlight

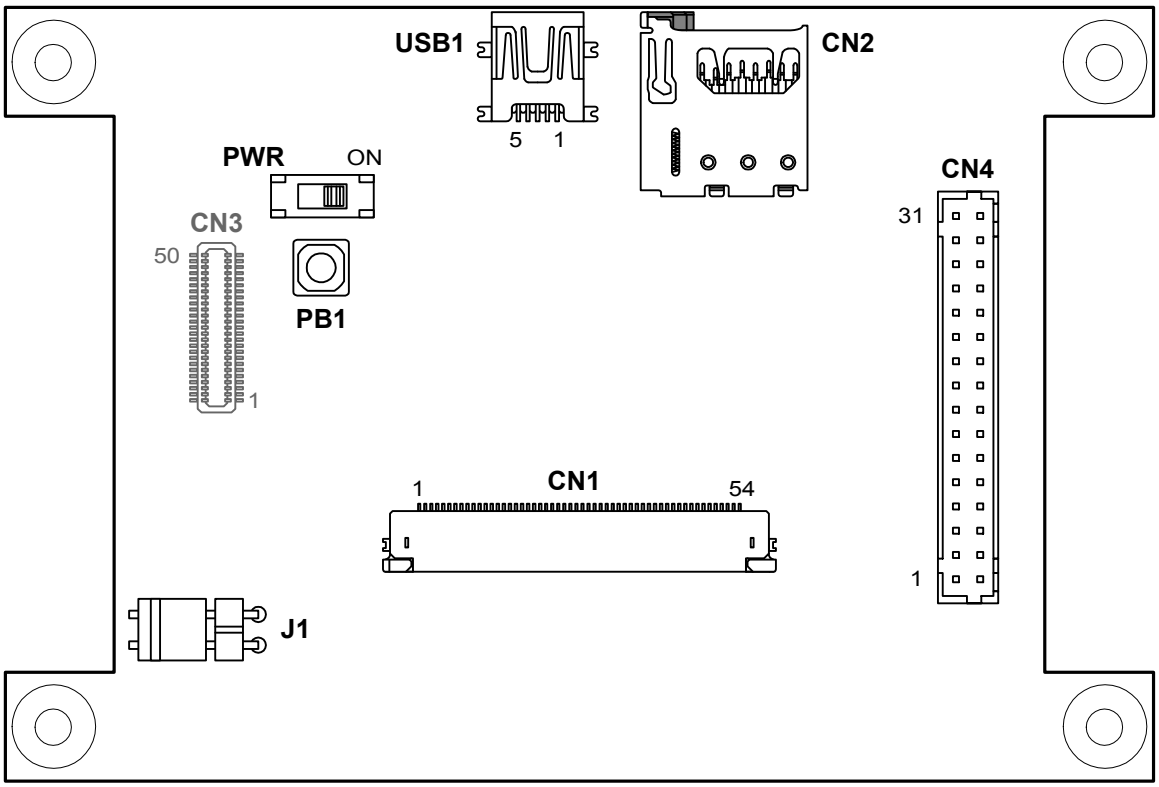
Backlight lamp life: 50000 hrs until brightness is at 70% of original brightness.

4.2 Dimensions



4.3 Connectors, Jumpers and Switches

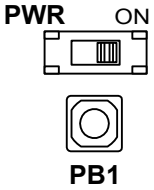
4.3.1 Assignments



ezLCD+103 Connectors, jumpers and Switches

Name	Function	Matching Connectors
CN1	LCD/Touchscreen Signals	Standard flex cable 54x0.5mm
CN2	MicroSD	Standard MicroSD Card
CN3	Ethernet MAC Signals (back of the board)	Hirose DF23C-50DS-0.5V
CN4	Power and Interfaces (I2C, SPI, RS232 TTL, SD, Audio, discrete)	Hirose DF11-32DS
USB1	USB	Standard Mini USB-B Plug
J1	USB Power Jumper	Standard 0.1" Jumper Block
PWR	Power On/Off Switch	N/A
PB1	Programming Button	N/A

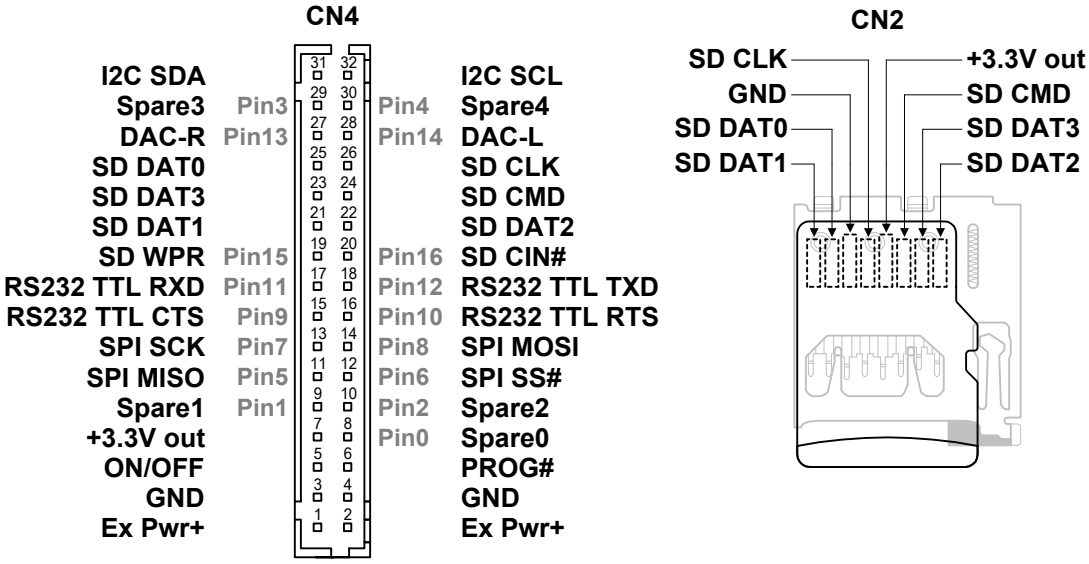
4.3.2 PWR and PB1



PWR: Low current, power On/Off switch. Sends the signal to the ezLCD+103 power supply to switch the power on or off. It has the same function as ON/OFF signal (CN4).

PB1: Programming button. Starts ezLCD+103 bootloader, when pressed during power-up. Starts touch screen calibration, when momentarily pressed. Starts Demo Mode when pressed for more than 2 seconds.It has the same function as PROG# signal (CN4).

4.3.3 CN4 and CN2

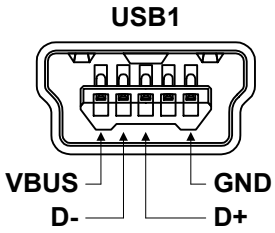


Connector CN2 is used as a slot for MicroSD card. CN2 signals are repeated on CN4.
Connector CN4 contains power and interface signals (I2C, SPI, RS232 TTL, SD, Audio and discrete).
Pin0 to Pin16 specify pins, which can be reconfigured by Lua applications.

Signal Name	Type	Description
Ext Pwr+	Ext. Power	External power voltage (Vcc) 4.5V to 6V
GND	Gnd	Common power return and signal gnd
ON/OFF	Input (0 or Opened, +2.2 to +6V)	ON/OFF signal. The same function as PWR (ON) switch. +2.2 to +6V turns the power ON. 0 to +0.8V turns the power OFF. Rin > 100 kOhm This signal is pulled to GND by an internal resistor
PROG#	Discrete Input (0 - 3.3V or Opened)	Firmware download signal. The same function as PB1 pushbutton. Starts ezLCD+103 bootloader, when connected to GND during power-up. Starts touch screen calibration, when momentary connected to GND. Starts Demo Mode when connected to GND for more than 2 seconds This signal is pulled to +3.3V by an internal resistor
+3.3V out	Pwr/Out	+3.3V/0.5A regulated voltage output. May be used as a power supply for external devices.
Spare0 to Spare4	Discrete I/O	Spare I/O discrete signals. May be used by Lua applications
SPI MISO	Discrete Output (0 - 3.3V)	SPI Master Input Slave Output signal
SPI SS#	Discrete Input (0 - 3.3V)	SPI Slave Select input
SPI SPCK	Discrete Input (0 - 3.3V)	SPI Clock input
SPI MOSI	Discrete Input	SPI Master Output Slave Input signal

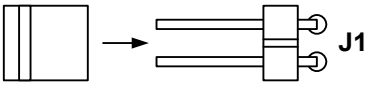
Signal Name	Type	Description
	(0 - 3.3V)	
RS232 TTL CTS	Discrete Input (0 - 3.3V, 1.5mA)	RS-232 TTL Clear To Send input **Note:** This signal has different voltage levels than RS-232 standard
RS232 TTL RTS	Discrete Output (0 - 3.3V)	RS-232 TTL Request To Send output **Note:** This signal has different voltage levels than RS-232 standard
RS232 TTL RXD	Discrete Input (0 - 3.3V, 1.5mA)	RS-232 TTL Received Data input **Note:** This signal has different voltage levels than RS-232 standard
RS232 TTL TXD	Discrete Output (0 - 3.3V)	RS-232 TTL Transmitted Data output **Note:** This signal has different voltage levels than RS-232 standard
SD WPR	Discrete Input (0 - 3.3V)	SD Write Protect This signal is not used by ezLCD+103
CD CIN#	Discrete Input (0 - 3.3V)	SD Card Inserted This signal is not used by ezLCD+103
SD DAT1	Discrete I/O (0 - 3.3V or Opened)	SD Data 1 signal This signal is pulled to +3.3V by an internal resistor
SD DAT2	Discrete I/O (0 - 3.3V or Opened)	SD Data 2 signal This signal is pulled to +3.3V by an internal resistor
SD DAT3	Discrete I/O (0 - 3.3V or Opened)	SD Data 3 signal This signal is pulled to +3.3V by an internal resistor
SD CMD	Discrete I/O (0 - 3.3V or Opened)	SD Command signal This signal is pulled to +3.3V by an internal resistor
SD DAT0	Discrete I/O (0 - 3.3V or Opened)	SD Data 0 signal This signal is pulled to +3.3V by an internal resistor
SD CLK	Discrete Output (0 - 3.3V)	SD Clock
I2C SDA	Discrete I/O (Open - Gnd)	I2C interface SDA (Serial Data) signal
I2C SCL	Discrete I/O (Open - Gnd)	I2C interface SCL (Serial Clock) signal
DAC-R	0 - 3.3V PWM Output	Audio Bitstream DAC Right
DAC-L	0 - 3.3V PWM Output	Audio Bitstream DAC Left

4.3.4 USB1



Connector USB1 is used for USB interface. For signal description, please refer to the USB 2.0 specification.

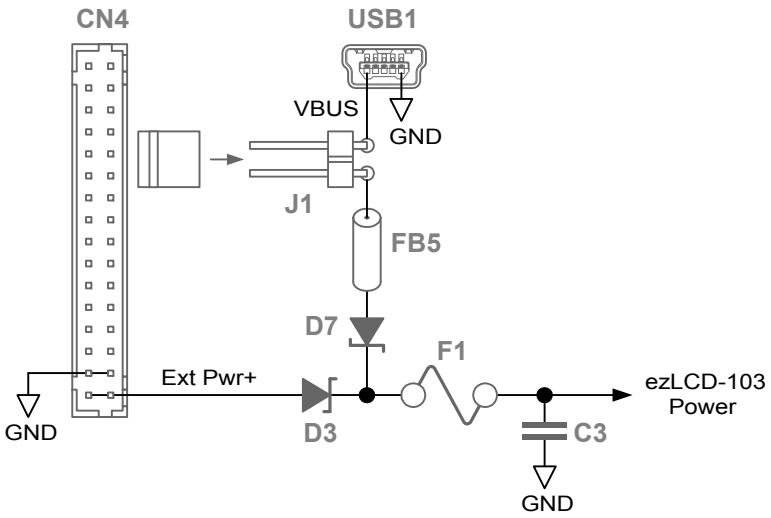
4.3.5 J1



Jumper J1 is used to power ezLCD+103 from the USB.

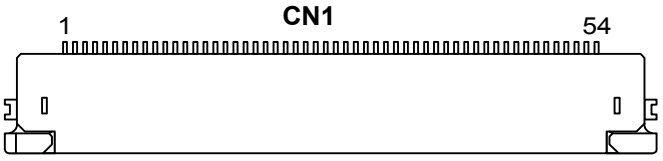
When J1 is **opened**:  , ezLCD+103 is powered from the voltage between CN4 pins: Ext_Pwr+ and GND

When J1 is **closed**:  , ezLCD+103 is powered from the voltage between USB1 pins: VBUS and GND,
or between
CN4 pins: Ext_Pwr+ and GND,
whichever voltage is greater.



ezLCD+103 Input Power Circuitry

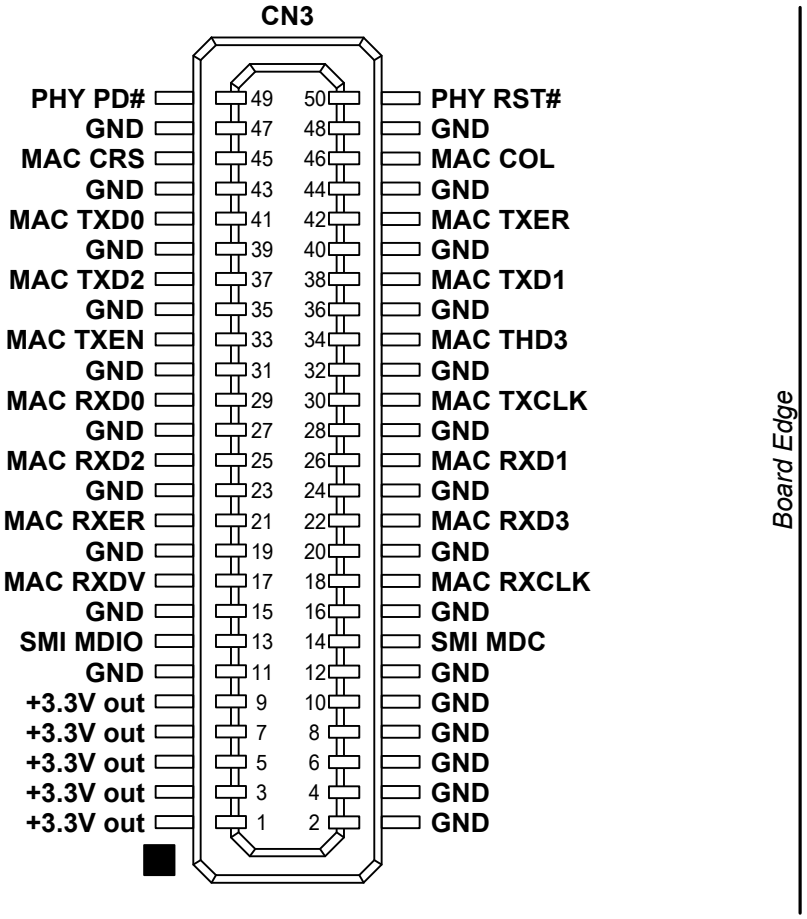
4.3.6 CN1



Connector CN1 is used for LCD and Touchscreen signals. The pin assignments fit the EarthLCD display ECT-TG320240S03E only. The information below is provided for reference only.

Pin No	Name	Type	Description
1,2	LED-	20mA current source	Backlight current source
3,4	LED+		
5,6,7	N/C		Not connected
8	Ty-	Resistance	Touch screen y- input
9	Tx+	Resistance	Touch screen x+ input
10	Ty+	Resistance	Touch screen y+ input
11	Tx-	Resistance	Touch screen x- input
12 to 19	B0 to B7	Discrete Output (0 - 3.3V)	8 bits of RGB Blue component
20 to 27	G0 to G7	Discrete Output (0 - 3.3V)	8 bits of RGB Green component
28 to 35	R0 to R7	Discrete Output (0 - 3.3V)	8 bits of RGB Red component
36	HSYNC	Discrete Output (0 - 3.3V)	Horizontal Synchronization
37	VSYNC	Discrete Output (0 - 3.3V)	Vertical Synchronization
38	DCLK	Discrete Output (0 - 3.3V)	Data Clock
39,40	N/C		Not connected
41, 42	+3.3V Out	Pwr/Out	+3.3V/0.5A regulated voltage output
44 to 47	N/C		Not connected
48	GND	Gnd	Common power return and signal gnd
49,50,51	N/C		Not connected
52	ENB	Discrete Output (0 - 3.3V)	Data enable
53,54	GND	Gnd	Common power return and signal gnd

4.3.7 CN3



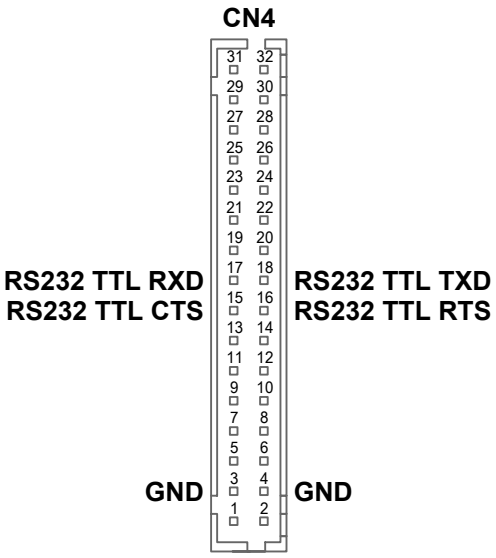
Connectors CN3 is used to connect ezLCD+103 to ethernet network through the 10/100 Mb/s Ethernet Physical Layer Transceiver (PHY)

MAC Signals
Standard Media Access Control (MAC) Data Interface signals. For more information, please refer to IEEE 802.3 specification.

SMI Signals
Standard Serial Management Interface signals. For more information, please refer to IEEE 802.3 specification.

Signal Name	Type	Description
PHY PD#	Discrete Output (0 - 3.3V or Opened)	PHY Power Down signal. Active Lo.
PHY RST#	Discrete Output (0 - 3.3V or Opened)	PHY Reset signal. Active Lo.
+3.3V out	Pwr/Out	+3.3V/0.5A regulated voltage output.
GND	Gnd	Common power return and signal gnd

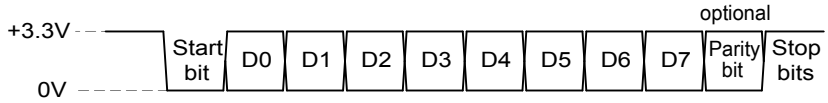
4.4 RS232



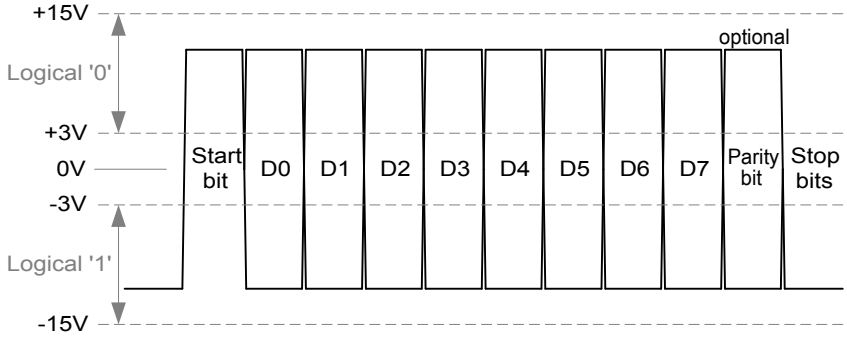
Warning: RS232 TTL uses logic level signals: Min = 0V, Max = +3.3V. Connecting RS232 TTL to "standard" RS232 interface with the bipolar signal levels of (±3 V, ±5 V, etc.) may damage the ezLCD+103 and void the warranty.

Signal Name	Type	Description
GND	Gnd	signal gnd
RS232 TTL CTS	Discrete Input (0 - 3.3V, 1.5mA)	RS-232 TTL Clear To Send input
RS232 TTL RTS	Discrete Output (0 - 3.3V)	RS-232 TTL Request To Send output
RS232 TTL RXD	Discrete Input (0 - 3.3V, 1.5mA)	RS-232 TTL Received Data input
RS232 TTL TXD	Discrete Output (0 - 3.3V)	RS-232 TTL Transmitted Data output

The ezLCD+103 uses "RS232 TTL" signals, which have different logic voltage levels than "standard" RS232. The drawings below show the differences between both RS232 signals:



RS232 TTL Signal



RS232 Standard Signal

Default Communication Parameters

Baudrate: 115200 bps
No of Data Bits: 8
No of Stop Bits: 1
Parity: None
Handshake: None

Most of the above parameters can be permanently modified by changing User Configuration. See Chapter ezLCD+ Customization / User Configuration.

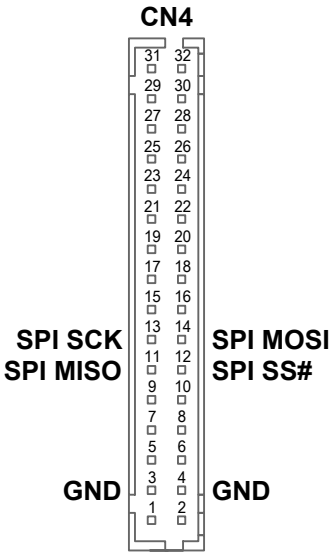
ezLCD+103 Power-Up Ready Transmission

If the RS232 is set as the "Default Transmitter", it is used by ezLCD to send EZLCD_READY byte (**EA** hex, **234**dec). The EZLCD_READY byte is sent one time only, upon the power-up when the ezLCD+103 RS232 interface is ready to receive the commands.
The "Default Transmitter" can be set by changing User Configuration. See Chapter ezLCD+ Customization / User Configuration.

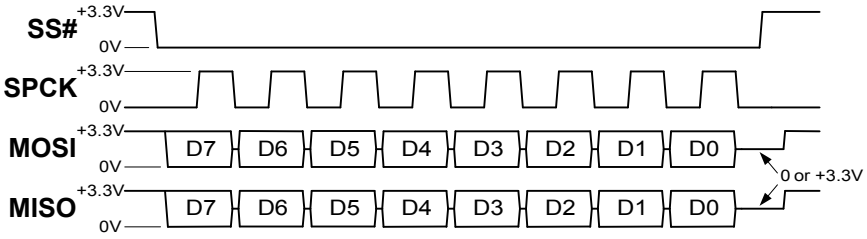
4.5 SPI

Communication Parameters

Max f_{SPCK}: 4MHz
SPCK Idle: Low
No of Data Bits: 8
Bit Order: MSB goes first
Data sampled on: Leading edge of the SPCK (rising edge)
ezLCD+103 is: SPI Slave



Signal Name	Type	Description
Gnd	Gnd	Common power return and signal gnd
SPI MISO	Discrete Output (0 - 3.3V)	SPI Master Input Slave Output signal
SPI SS#	Discrete Input (0 - 3.3V)	SPI Slave Select input
SPI SPCK	Discrete Input (0 - 3.3V)	SPI Clock input
SPI MOSI	Discrete Input (0 - 3.3V)	SPI Master Output Slave Input signal



Receiving the data from the ezLCD+103

Since:

- The ezLCD+103 is configured as an SPI Slave and
- All transmissions through the SPI interface have to be initiated by the Master,

it is the user's responsibility to query the ezLCD for any new data, for example: touch screen coordinates.
Each time, the byte is sent through the SPI interface to the ezLCD+103, the unit responds on the MISO pin. if you want to query the ezLCD without sending any command: send 0 to the ezLCD.

ezLCD+103 Power-Up Ready Transmission

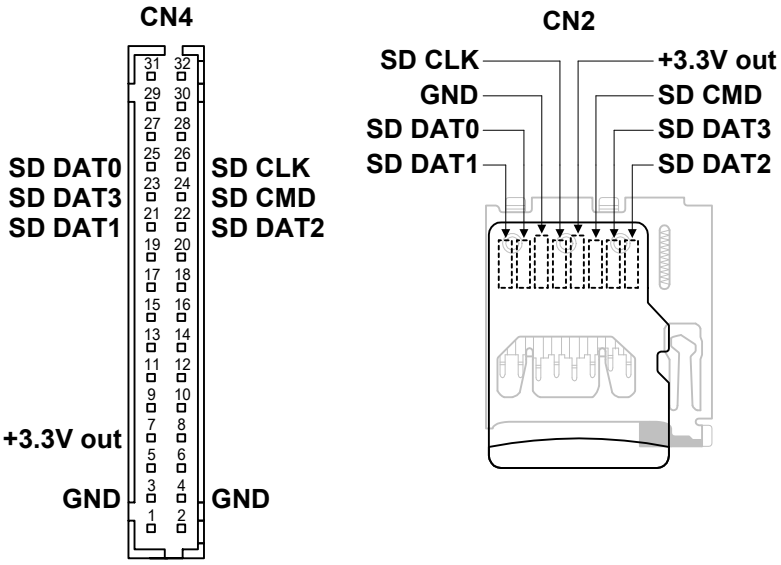
If the SPI is set as the "Default Transmitter", it is used by ezLCD+103 to send EZLCD_READY byte (**EA**hex, **234**dec). The EZLCD_READY byte is sent one time only, upon the power-up when the ezLCD +103 SPI interface is ready to receive the commands.
The "Default Transmitter" can be set by changing User Configuration. See Chapter ezLCD+ Customization / User Configuration.

4.6 SD

The SD Interface hardware supports the SD Memory Card Specification V1.0. SD Memory Card operations are supported by the firmware.

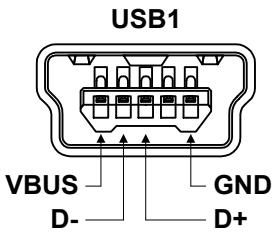
The ezLCD+103 firmware automatically adjusts the baudrate and other timing parameters by reading the SD Card parameters in the slow clock mode.

Max Available Baudrate: 96 Mbps (read from the SD Card)
24 Mbps (write to the SD Card)



Signal Name	Type	Description
GND	Gnd	Common power return and signal gnd
+3.3V out	Pwr/Out	+3.3V/0.5A regulated voltage output.
SD DAT1	Discrete I/O (0 - 3.3V or Opened)	SD Data 1 signal This signal is pulled to +3.3V by an internal resistor
SD DAT2	Discrete I/O (0 - 3.3V or Opened)	SD Data 2 signal This signal is pulled to +3.3V by an internal resistor
SD DAT3	Discrete I/O (0 - 3.3V or Opened)	SD Data 3 signal This signal is pulled to +3.3V by an internal resistor
SD CMD	Discrete I/O (0 - 3.3V or Opened)	SD Command signal This signal is pulled to +3.3V by an internal resistor
SD DAT0	Discrete I/O (0 - 3.3V or Opened)	SD Data 0 signal This signal is pulled to +3.3V by an internal resistor
SD CLK	Discrete Output (0 - 3.3V)	SD Clock

4.7 USB



For the detailed description of the USB signals, please refer to the USB 2.0 specification.

The ezLCD+103 USB interface is compatible with the USB 2.0 specification and supports Hi speed (240Mbps) communication.

USB Drivers

The drivers for PC are compatible with Windows XP, Server 2003, Vista and Server 2008. Both, 32 and 64 bit (ia64 and amd64) platforms are supported. The drivers are available in the "Drivers" directory of the ezLCD+103 CD and in the support section of the ezLCD web site:
http://www.ezlcd.com/support/

Drivers are distributed in the form of windows applications:

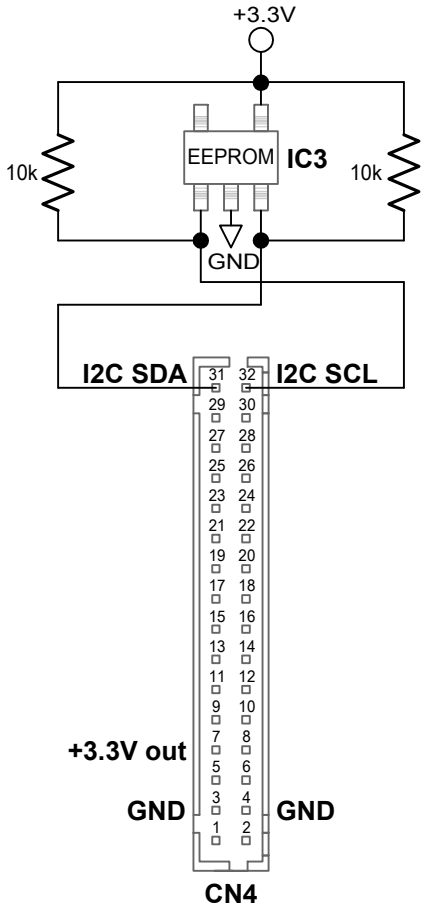
Favr32_USB_x86.exe	-	32-bit Windows (all processors)
Favr32_USB_amd64.exe	-	64-bit Windows run by amd64 processor
Favr32_USB_ia64.exe	-	64-bit Windows run by ia64 processor

Note: Please, run the driver installation executable before connecting ezLCD+103 to the USB of your computer

ezLCD+103 Power-Up Ready Transmission

If the USB is set as the "Default Transmitter", it is used by ezLCD+103 to send EZLCD_READY byte (**EA**hex, **234**dec). The EZLCD_READY byte is sent one time only, upon power-up, when ezLCD+103 USB interface is ready to receive commands.
The "Default Transmitter" can be set by changing User Configuration. See Chapter ezLCD+ Customization / User Configuration.

4.8 I2C



Since the ezLCD+103 is configured as I2C Master, the I2C interface cannot be used to receive ezLCD+ External Commands. On the other hand the I2C interface can be used by Lua to communicate with external devices like A/D converters, temperature sensors, serial memories, etc.

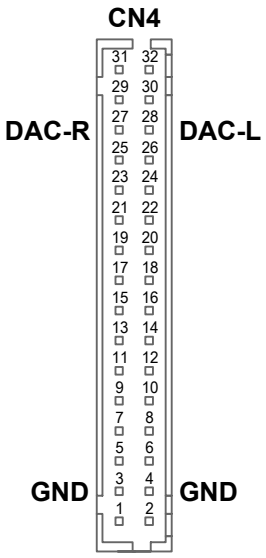
Internally, the I2C interface is used by ezLCD+103 to communicate with Configuration EEPROM as shown on the drawing to the left.

Signal Name	Type	Description
I2C SDA	Discrete I/O (Open - Gnd)*	I2C interface SDA (Serial Data) signal
I2C SCL	Discrete I/O (Open - Gnd)*	I2C interface SCL (Serial Clock) signal
+3.3V out	Pwr/Out	+3.3V/0.5A regulated voltage output. May be used as a power supply for external devices.
GND	Gnd	Common power return and signal gnd

* **Important**: Although I2C signals are of Open/Gnd type, their pins are internally connected to +3.3V through 10k pull-up resistors, as show on the drawing to the left.

For more information about I2C, please refer to the NXP (Philips) publication UM10204: "I2C-bus specification and user manual", now available at:
http://www.nxp.com/acrobat/usermanuals/UM10204_3.pdf.

4.9 Audio DAC



Signal Name	Type	Description
GND	Gnd	Common power return and signal gnd
DAC-R	0 - 3.3V PWM Output	Audio Bitstream DAC Right
DAC-L	0 - 3.3V PWM Output	Audio Bitstream DAC Left

For audio playback, the outputs DAC-R and DAC-L can be connected to a class D amplifier output stage, or they can be low pass filtered and connected to a high input impedance amplifier. A simple 1st order or higher low pass filter that filters all the frequencies above 50 kHz should be adequate.

5 Firmware

5.1 Firmware Upgrade

The firmware upload to the ezLCD+103 is performed through the SD card.

The ezLCD+103 firmwares are distributed as the ezLCD+ executable files. They have an extension .eze

To upgrade the ezLCD+103 firmware:

1. Make sure that the SD card is formatted in FAT-32, FAT-16 or FAT-12.
2. Copy the firmware file (.eze) to the SD card
3. Make sure that the firmware is the only file width the .eze extension on the SD root directory
4. Power off the ezLCD+103
5. Insert the SD card into the ezLCD SD slot
6. Hold down the PB1 button on the ezLCD+103 board (or connect the PROG# pin to the ground)
7. Power on the ezLCD+103
8. After 2-3 seconds release the PB1 button (or disconnect the PROG# pin from the ground)
9. Wait until the programming is finished and the ezLCD restarts. Note: this may take up to 2 minutes. Make sure that the PROG# is not active, otherwise the programming will be repeated.

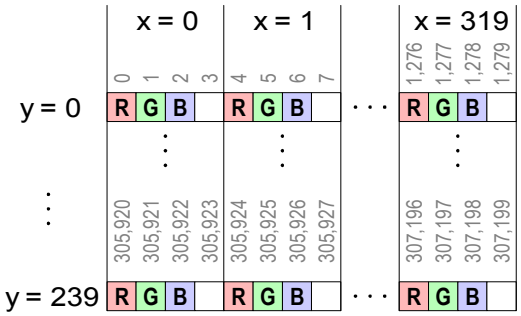
6 Display

6.1 Organization

The ezLCD+103 display frame is organized in 240 rows of 320 columns of pixels, as shown on the picture to the right. Each pixel of 4 bytes (32 bits): one byte for the red color, one for green, one for blue and one spare. The whole display frame takes 320*240*4 = 307,200 bytes.

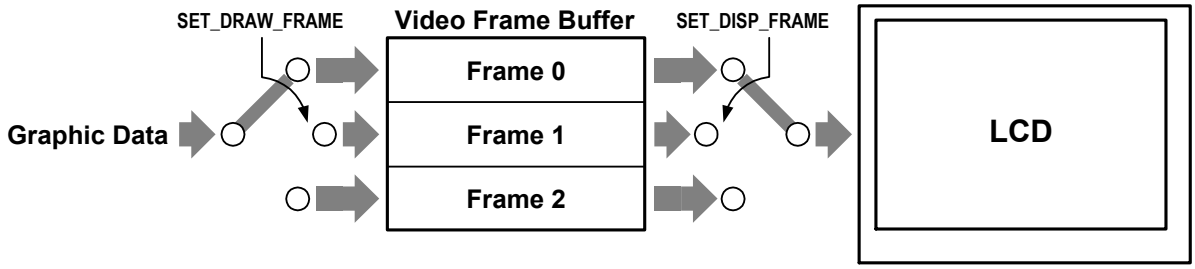
Since the last byte of the pixel is not used, this arrangement may seem like a waste of the memory, however 32 bits per pixel are processed faster by the 32 bit ezLCD CPU than 24 bits would do.

The drawing to the right shows the organization of the display frame memory. Rotated numbers show the byte offset from the beginning of the frame.



6.2 Frames

In order to support special effects (animation, double buffering, etc) the whole ezLCD video RAM is divided into the 20 separate frames. Each frame has the capacity of the full ezLCD screen: 320x240x32bits.



The ezLCD commands draw on the frame selected by the ezLCD+ Command: SET_DRAW_FRAME or ezLCD+ Lua instruction: **`SetDrawFrame`**

The screen displays image from the frame selected by the ezLCD+ Command: SET_DISP_FRAME or ezLCD+ Lua instruction: **`SetDispFrame`**.

The same frame can be used to draw in display data. Upon power-up both draw and display frames are set to the Frame 0.

The entire data from one frame can be copied to the another by using one of the ezLCD+ Commands:
COPY_FRAME
MERGE_FRAME
or equivalent ezLCD+ Lua instructions:
`CopyFrame`
`MergeFrame`

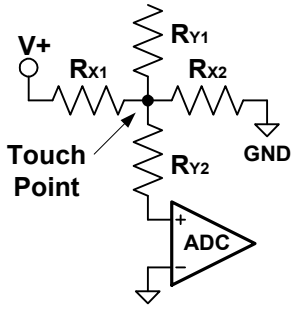
The portion of one frame can be copied to the another by using one of the ezLCD+ Commands:
COPY_RECT
MERGE_RECT
or equivalent ezLCD+ Lua instructions:
`CopyRect`
`MergeRect`

7 Touch Screen

7.1 Introduction

The ezLCD+103 has a 4-wire resistive analog touch screen. This touch screen consists of two layers of transparent resistive material with silver ink for electrodes. These two layers are stacked on an insulating layer of glass, separated by tiny spacer dots. They are interfaced electrically to the dedicated ezLCD +103 A/D converter. During measurement of a given coordinate, one of the resistive planes is powered along its axis and the other plane is used to sense the location of the coordinate on the powered plane.

For example, in case of the X coordinate measurement, the X plane is powered, as shown on the drawing below. The Y plane is used to sense where the pen is located on the powered plane as follows: At the location where the pen depresses the touch screen, the planes are shorted. The voltage measured on the sensed plane is proportional to the location of the touch on the powered plane. This voltage is then converted by the dedicated ezLCD+103 ADC as shown on the drawing below.



7.2 Calibration

The touch screen calibration starts upon pressing PB1 button (or connecting PROG# pin to ground) when the unit power is already on.

To calibrate the touch screen:

1. Power on the ezLCD+103.
2. Hold down PB1 button on the ezLCD+103 board (or connect the PROG# pin to the ground) for up to 2 seconds
3. Release the PB1 button (or disconnect the PROG# pin) as soon as the calibration page appears. The ezLCD+103 will switch to the Demo Mode if PB1 (or PROG#) is not deactivated in time.
4. Follow the instructions displayed on the ezLCD+103 screen

The calibration data is saved on the ezLCD+103 board Configuration EEPROM.

8 ezLCD+ Executable Files

The ezLCD+ executable files are the binary files, which can be directly executed by the ezLCD+ CPU (AT32AP7000) on the ezLCD+ platform.

The ezLCD+ executable files are used for special tasks, which cannot be performed by the ezLCD+ command set. Those include:

- Firmware upgrade
- ezLCD customization
- Loading special programs (Linux OS, etc.)
- etc.

The ezLCD+ executable files have the filename extension: ".eze". They can be executed only from the SD card during power-up when the PB1 button is pressed or PROG# input (CN4) is grounded. The .eze has to reside on the SD root directory. If the SD root directory contains more than one .eze file, only the first found is loaded and executed.

To execute the .eze file:

1. Make sure that the SD card is formatted in FAT-32, FAT-16 or FAT-12.
2. Copy the .eze file to the root directory of the SD card
2. Make sure that the copied file is the only file with the .eze extension on the SD root directory
4. Power Off the ezLCD+103
5. Insert the SD card into the ezLCD+103 SD slot
6. Press and hold down the PB1 button on the ezLCD board (or connect the PROG# pin to the ground)
7. Power On the ezLCD+103
8. After 2-3 seconds release the PB1 button (or disconnect the PROG# pin from the ground).

9 ezLCD+ Customization

ezLCD+103 settings, bitmaps, fonts, protocols etc. may be modified by running from the SD the ezLCD executable file User.eze.

User.eze modifies the ezLCD defaults by reading the required changes from the following files:

UserRom.txt - Contains the SD paths to the files which are to be embedded into the ezLCD+103 ROM (fonts, bitmaps, scripts, etc.) The files are saved on the CPU ROM. There are 3.8 mega bytes available for the user files. The syntax of this file is described in the chapter: User ROM.

UserConf.txt - Contains the ezLCD+103 User Configuration (communication parameters, start-up screen, etc.) The syntax of this file is described in the chapter: User Configuration. The User Configuration is stored on the ezLCD+103 board Configuration EEPROM

User.eze, UserRom.txt and UserConf.txt should reside on the SD root directory. Both UserRom.txt and UserConf.txt are optional.

To customize ezLCD+103:

1. Edit UserRom.txt and UserConf.txt or only one of them as needed.
2. Make sure that the SD card is formatted in FAT-32, FAT-16 or FAT-12.
3. Copy the following files to the SD card:
   - User.eze
   - UserRom.txt and the files to be embedded into ezLCD ROM, if needed.
   - UserConf.txt, if needed
4. Make sure that the User.eze is the only file with the .eze extension on the SD root directory
5. Power off the ezLCD+103
6. Insert the SD card into the ezLCD SD slot (CN9)
7. Press and hold down the PB1 button on the ezLCD+103 board (or connect the PROG# pin to the ground)
8. Power on the ezLCD+103
9. After 2-3 seconds release the PB1 button (or disconnect the PROG# pin from the ground)
10. Wait until the programming is finished. Note: this may take up to 2 minutes.
11. Recycle the ezLCD+103 power. Make sure that the PROG# is not active, otherwise the programming will be repeated.

Warning: Do not turn off the power while programming of the User ROM is in progress.

The progress of the operation is displayed in form of messages on the ezLCD+103. Also, the messages are logged into User.log file, if the SD is not write-protected.

Example of the generated messages:

```
Opening File: UserConf.txt ... OK
Set SplashScreen to None
Set BackLight to 255
Set BacklightOn to True
Set TouchProtocol to None
Set Rs232Enabled to Yes
Set Rs232Baudrate to 115200
Set Rs232StopBits to 1
Set Rs232Parity to Even
```

```
Set Rs232Handshake to None
Set SpiEnabled to Yes
Set I2cEnabled to No

Opening File: UserRom.txt ... OK
Adding SD File: /Fonts/Arial_14.ezf
Added file type: Font Bitmap no: 0 size: 3560 bytes
Adding SD File: /Fonts/Arial_14_B.ezf
Adding SD File: /Fonts/DejaVuSans.ttf
Added file type: Font True Type no: 0 size: 568408 bytes
Adding SD File: /Fonts/DejaVuSans-Bold.ttf
Adding SD File: /Bitmaps/FAVR-32_Bottom.jpg
Added file type: Bitmap no: 0 size: 120112 bytes
Adding SD File: /Bitmaps/FAVR-32_Top.jpg
Added file type: Bitmap no: 1 size: 108481 bytes
Adding SD File: /Bitmaps/map1.jpg
Added file type: Bitmap no: 2 size: 120225 bytes

Saving User Configuration ... OK

Programming User ROM ... OK

No of Errors: 0
```

9.1 User ROM

The contents of the User ROM is specified by the UserROM.txt file, which contains the SD paths to the files which are to be saved on the CPU ROM. There are 3.8 mega bytes available for the user files.

Supported file types:

File Type	Supported Extensions
Bitmaps (Icons)	.bmp, .jpg, .ezp
Bitmap Fonts	.ezf
Free Type (True Type) Fonts	.ttf, .otf
Scripts	.lua

An index is automatically assigned to each of the embedded files of the particular type. This index is used as an argument in ezLCD+ Commands and Lua instructions. The indexes are assigned in the order the files of the particular type appear in UserRom.txt.

UserROM.txt is read by the ezLCD+ executable: User.eze. The whole procedure is described in the chapter: ezLCD+ Customization.

UserRom.txt Syntax

- UserRom.txt consists of a series of SD paths to the files.
- UserRom.txt is an ASCII text file.
- Each text line is terminated either with <CR><LF> (DOS, Windows, etc.) or the <LF> alone (Unix, Linux, MAC OS X, etc.).
- Comments start with '#' and end with the end of the line.
- Each text line can contain only one path to the SD file.

Example of the UserRom.txt file contents:

```
# +--------------+
# | BITMAP FONTS |
# +--------------+
/Fonts/Arial_14.ezf              # Bit Font 0
/Fonts/Arial_14_B.ezf            # Bit Font 1
/Fonts/Times New Roman_34_B.ezf  # Bit Font 2
/Fonts/Forte_26.ezf              # Bit Font 3
/Fonts/Script MT Bold_29_B.ezf   # Bit Font 4
/Fonts/ISO_6x10.ezf              # Bit Font 5
/Fonts/ISO_8x13.ezf              # Bit Font 6

# +-----------------+
# | FREE TYPE FONTS |
# +-----------------+
/Fonts/DejaVuSans.ttf            # FT Font 0
/Fonts/DejaVuSans-Bold.ttf       # FT Font 1
/Fonts/DejaVuSans-BoldOblique.ttf # FT Font 2
/Fonts/DejaVuSerif.ttf           # FT Font 3
```

```
/Fonts/DejaVuSerif-Bold.ttf      # FT Font 4
/Fonts/DejaVuSerif-Italic.ttf    # FT Font 5
/Fonts/Quig.ttf                  # FT Font 6

# +---------+
# | BITMAPS |
# +---------+
/Bitmaps/FAVR-32_Bottom.jpg      # Icon 0
/Bitmaps/FAVR-32_Top.jpg         # Icon 1
/Bitmaps/map1.bmp                # Icon 2
/Bitmaps/map2.ezp                # Icon 3
```

9.2 User Configuration

The User Configuration is used to modify some of the ezLCD+103 default parameters like:
- Communication parameters (RS232 baudrate, parity, IP address, etc.)
- Startup screen
- Startup backlight
- Pin functions

Upon power-up the ezLCD+103 CPU configures the ezLCD+103 according to the data read from the User Configuration. The User Configuration is stored on the ezLCD+103 board Configuration EEPROM.

The User Configuration can be modified, by editing the UserConf.txt file. The UserConf.txt file is read by the ezLCD+ executable: User.eze. The whole procedure is described in the chapter: ezLCD+ Customization.

UserConf.txt Syntax

The philosophy of UserConf.txt is similar to the one used in the Windows .ini files. It consists of the set of keys and values assigned to them. The keys are described in the section: User Configuration Keys.

- UserConf.txt is an ASCII text file.
- Each text line is terminated either with <CR><LF> (DOS, Windows, etc.) or the <LF> alone (Unix, Linux, MAC OS X, etc.).
- Comments start with '**#**' and end with the end of the line.
- Each text line can contain only one key assignment.
- Leading and trailing spaces are ignored.
- Keys and their values are separated by any combination of the following characters: '=', '**:**', <SPACE>, <TAB>.
- Keys and their values are case insensitive.
- Values maybe specified in the following formats:

  - decimal

  - hexadecimal: 0x followed by the number, for example: 0x2D0

  - binary: 0b followed by the number, for example: 0b00103103

  - boolean: True, False or Yes, No or On, Off or Enabled, Disabled

  - IP address: four decimal numbers (0 to 255) separated by dots, for example: 192.168.1.6

  - Special values: Even, Odd, hw, h/w, sw, s/w, Xon/Xoff, USB, Rs232, SPI, I2C, Net, Mac, Ethernet, Wnet, Wireless, Automatic, DHCP, ezButton, cuButton, CalibratedXY

Note: Only the key values specified in the UserConf.txt are modified. Others are left unchanged.

Examples of the correct key assignments:

```
Rs232Baudrate = 115200
Rs232Baudrate: 115200
Rs232Baudrate 115200
Rs232Baudrate=115200
Rs232Parity: None
Rs232Parity = Even
SpiEnabled = True
SpiEnabled Enabled
NetIpAddress = 192.168.1.6
NetIpAddress = DHCP
NetIpAddress = Automatic
StartupTxInterface = SPI
```

9.2.1 User Configuration Keys

Key: BackLight

Description: Power-up backlight brightness

Value Type: Number (decimal, hexadecimal, or binary)

Value Range: 0 to 255

Example:
```
BackLight = 255
```

Key: BacklightOn

Description: Power-up backlight state

Value Type: Boolean

Example:
```
BacklightOn = On
```

Key: DacEnabled

Description: Enable or disable stereo audio

Value Type: Boolean

Example:
```
DacEnabled = No
```

Key: DemoInterval

Description: Interval in seconds between screens, when the ezLCD is in the Demo Mode

Value Type: Number (decimal, hexadecimal, or binary)

Value Range: 0 to 4,294,967

Example:
```
DemoInterval = 2
```

Key: Demos

Description: Specifies which demos should be shown in the Demo Mode. Bits 0 to 4 of the key value specify, which demos should be shown:
Bit 0: System Info
Bit 1: SD slide demo
Bit 2: User ROM icons slide demo
Bit 3: Free Type (True Type) Font demo

Bit 4: Bitmap Font demo

Value Type: Number (decimal, hexadecimal, or binary)

Value Range: 0 to 31

Example:
```
Demos = 0b10111 # Show all of the demos except the Bitmap Font
```

Key: I2cEnabled

Description: Enable or disable I2C interface

Value Type: Boolean

Example:
```
I2cEnabled = No
```

Key: MacAddressHi

Description: The highest 16 bits of the 48 bit MAC Address (Ethernet Hardware Address)

Value Type: Number (decimal, hexadecimal, or binary)

Value Range: 0 to 0xFFFF

Example:
```
MacAddressHi = 0x181F
```

Key: MacAddressLo

Description: The lowest 32 bits of the 48 bit MAC Address (Ethernet Hardware Address)

Value Type: Number (decimal, hexadecimal, or binary)

Value Range: 0 to 0xFFFFFFFF

Example:
```
MacAddressLo = 0x008C0001
```

Key: MacEnabled

Description: Enable or disable Ethernet interface

Value Type: Boolean

Example:
```
MacEnabled = True
```

Key: NetAltDns

Description: IP Address of the Alternate DNS

Value Type: IP Address, or Special Value

Special Values: None, Automatic, DHCP. All of them are equivalent.

Example: `NetAltDns = None`

Key: NetDns

Description: IP Address of the DNS

Value Type: IP Address, or Special Value

Special Values: None, Automatic, DHCP. All of them are equivalent.

Example: `NetDns = DHCP`

Key: NetGateway

Description: IP Address of the default Gateway

Value Type: IP Address, or Special Value

Special Values: None, Automatic, DHCP. All of them are equivalent.

Example: `NetGateway = 192.168.1.1`

Key: NetIpAddress

Description: IP Address of the ezLCD

Value Type: IP Address, or Special Value

Special Values: None, Automatic, DHCP. All of them are equivalent.

Example: `NetIpAddress = 192.168.1.6`

Key: NetSubnetMask

Description: Subnet Mask

Value Type: IP Address, or Special Value

Special Values: None, Automatic, DHCP. All of them are equivalent.

Example:
```
NetSubnetMask = 255.255.255.0
```

Key: ParEnabled

Description: Enable or disable Parallel Interface (provision)

Value Type: Boolean

Example:
```
ParEnabled = No
```

Keys: Pin_00_Funct
Pin_01_Funct
Pin_02_Funct
Pin_03_Funct
Pin_04_Funct
Pin_05_Funct
Pin_06_Funct
Pin_07_Funct
Pin_08_Funct
Pin_09_Funct
Pin_10_Funct

Description: Configurable pins functions

Value Type: Number (decimal, hexadecimal, or binary) or a Special Value

Value Range: TBD

Special Values: None

Example:
```
Pin_00_Funct: None
```

Key: Rs232Baudrate

Description: The baud rate in bit/s of the RS-232 interfaces

Value Type: Number (decimal, hexadecimal, or binary)

Value Range: 9,600 to 562,500

Example: `Rs232Baudrate = 115200`

Key: Rs232Enabled

Description: Enable or disable RS-232 interfaces

Value Type: Boolean

Example: `Rs232Enabled = Yes`

Key: Rs232Handshake

Description: Handshake specification of the RS-232 interfaces

Value Type: Special Value

Special Values: None - no handshake
hw, h/w - hardware handshake (RTS and CTS)
sw, s/w, Xon/Xoff - software handshake (xon/xoff)

Example: `Rs232Handshake = None`

Key: Rs232Parity

Description: The parity bit logic of the RS-232 interfaces

Value Type: Special Value

Special Values: None - no parity bit
Even - even parity bit
Odd - odd parity bit

Example: `Rs232Parity = None`

Key: Rs232StopBits

Description: Number of stop bits of the RS-232 interfaces

Value Type: Number (decimal, hexadecimal, or binary)

Value Range: 1 or 2

Example: `Rs232StopBits = 1`

Key: Rs232ReadyOn (available starting at firmware ver:2.20)

Description: Used only for RS232 handshake (if enabled). Specifies the number of bytes in the input data buffer, at which RTS is reset to Lo or Xon is sent by the ezLCD+.

Value Type: Number (decimal, hexadecimal, or binary) or Special Value

Special Values: None - use the default value (0)

Value Range: 0 to 983,040 (0xF0000) or None. Internally rounded down to the closest multiplication of 4. Should be lower than RS232ReadyOff. Otherwise the default value will be used

Example: `Rs232ReadyOn = 16`

Key: Rs232ReadyOff (available starting at firmware ver:2.20)

Description: Used only for RS232 handshake (if enabled). Specifies the number of bytes in the input data buffer, at which RTS is set to Hi or Xoff is sent by the ezLCD+.

Value Type: Number (decimal, hexadecimal, or binary) or Special Value

Special Values: None - use the default value (983,040)

Value Range: 0 to 983,040 (0xF0000) or None. Internally rounded down to the closest multiplication of 4. Should be higher than RS232ReadyOn. Otherwise the default value will be used

Example: `Rs232ReadyOff = 128`

Key: SerialNo

Description: User Device Serial Number

Value Type: Number (decimal, hexadecimal, or binary) or

Value Range: 0 to 4,294,96,294. Invalid Serial Number: 4,294,96,295 (FFFFFFFF$_{hex}$)

Example: SerialNo = 1234

Key: SpiEnabled

Description: Enable or disable SPI interface

Value Type: Boolean

Example: `SpiEnabled = Enabled`

Key: SplashScreen

Description: Power-up screen image. The value specifies the index of the User ROM bitmap to be displayed upon power-up

Value Type: Number (decimal, hexadecimal, or binary), or Special Value

Special Values: None - default screen with ezLCD info in the bottom

Value Range: 0 to 65535 or None

Example: `SplashScreen = None`

Key: StartupTxInterface

Description: Specifies through which interface the EZLCD_READY byte (0xEA) will be sent by the ezLCD when it is ready to process commands upon the power-up. The EZLCD_READY byte (0xEA) is sent only once and only after the power-up.
If the TouchProtocol key is set to cuButton or CalibratedXY, StartupTxInterface also specifies through which interface the touch screen data is sent upon the power-up.

Value Type: Special Value

Special Values: None - ezLCD will not transmit 0xEA upon the power-up
USB
RS232
SPI
I2C

Example: `StartupTxInterface = RS232`

Key: StartUpLua (available starting at firmware ver:2.20)

Description: Lua program executed at Power-up. The value specifies the index of the User ROM Lua program to be executed upon power-up

Value Type: Number (decimal, hexadecimal, or binary), or Special Value

Special Values: None - default screen with ezLCD info in the bottom

Value Range: 0 to 65535 or None

Example: `StartupLua = None`

Key: TouchProtocol

Description: Specifies the start-up touch protocol

Value Type: Special Value

Special Values: None - touch screen data is not sent
ezButton
cuButton
CalibratedXY

Example: `TouchProtocol = None`

Example of the UserConf.txt file contents:

```
SerialNo = 0x1234
SplashScreen = None
BackLight = 255
BacklightOn = True
TouchProtocol = None
StartupTxInterface = None
StartupLua = None
Rs232Enabled =   Yes
Rs232Baudrate =  115200
Rs232StopBits =  1
Rs232Parity =    None
Rs232Handshake = None
Rs232ReadyOn = None
Rs232ReadyOff = None
SpiEnabled = Yes
I2cEnabled = No
Demos =         0b11111
DemoInterval =  5
```

10 Demo Mode

While in Demo Mode, the ezLCD displays some demonstration screens.

The ezLCD+103 enters Demo Mode when:
1. The ezLCD+103 power is on, and
2. PB1 button is held down (or the PROG# pin is connected to ground) for more than 2 seconds

To exit Demo Mode:
1. Make sure that PROG# is deactivated
2. Double-tap on the touch screen

In Demo Mode each screen is displayed for at least 3 seconds. This can be changed by modifying the User Configuration Key: `DemoInterval`

Any of the displayed screens can be frozen on display by pressing the touch screen in any place. The screen will be displayed as long as the touch screen is held pressed.

The following demos can be shown:
- ezLCD+ System Info. Displays installed interfaces, communication parameters, User ROM summary, etc.
- Bitmap Font Demo. Displays Bitmap Fonts installed in the User ROM.
- Free Type (True Type) Font Demo. Displays True Type Fonts installed in the User ROM.
- SD Slide Demo. Displays .bmp, .jpg and .ezp pictures from the SD root directory.
- User ROM Slide Demo. Displays bitmaps installed in the User ROM.

The demos for display can be selected by modifying the User Configuration Key: `Demos`

11 GLOSSARY

Configuration Keys Part of ezLCD+ Customization. Set of text words and values assigned to them. They are specifying the *User Configuration*. Similar, in concept, to the keys used in Windows .ini files.
Described in the *"ezLCD+10x Manual"*.

ezLCD+ Customization Modification of the default power-up parameters. Addition of custom fonts, bitmaps, Lua programs, etc.
Described in the *"ezLCD+10x Manual"*.

Firmware Operating software of the ezLCD+103. Can be in-field upgraded.
Described in the *"ezLCD+10x Manual"*.

Lua Powerful, fast, light-weight, embeddable scripting language. By embedding Lua interpreter, the ezLCD+ become a true independent system (computer), which does not need any external host to drive it.
Described in the *"ezLCD+ Lua API Manual"*.

User Configuration Part of ezLCD+ Customization. Modifies some of the ezLCD+ default parameters like: communication parameters, start-up screen, etc. Upon the power-up the ezLCD+ CPU configures the ezLCD+ according to the data read from the User Configuration.
Described in the *"ezLCD+10x Manual"*.

User ROM Part of the ezLCD+ Customization. A place in the ezLCD+ flash, where user can store custom fonts, bitmaps, Lua programs, etc.
Described in the *"ezLCD+10x Manual"*.