arLCD Manual

Last Updated: September 25, 2013

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Before you begin

The EarthMake arLCD contains both an Arduino and an EarthLCD ezLCD-303 display on the same PCB. The arLCD also uses the ezLCD-303 to program the Atmel processor. No other boards are required to build many projects.

Therefore when connected to the USB and during configuration you will see references to the ezLCD-303. When you are upgrading firmware you will be upgrading the GPU on the ezLCD-303.

When downloading sketches it will be to the Atmel processor on the arLCD.

Getting Started

Downloading files & Installing the drivers

In order to write code and upload it to your arLCD, make sure you have the latest Arduino IDE installed and became familiar with it.

- **Download** the Arduino IDE from the Arduino website: http://arduino.cc/en/Main/Software

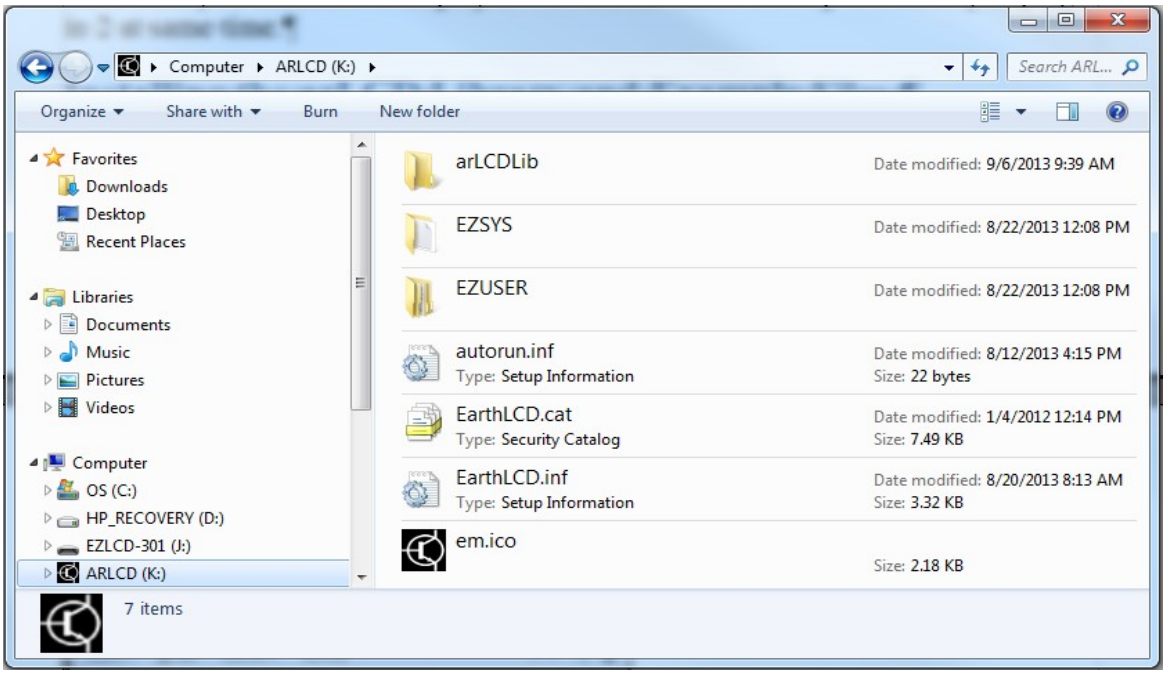
- Before connecting your arLCD **go to**: http://www.earthlcd.com/Downloads/arLCD_Software

And **download the latest zip files**:

arLCD_2pxx.zip
ezLCD-3xx-Firmware-Loader.zip

Now, **unzip the files**, and plug in the **arLCD** into a free USB port and wait a few seconds. Although the arLCD does not require any additional drivers, the system still needs to know what kind of hardware it is and how to configure it. The EarthLCD.inf included on the internal flash drive provides that information.

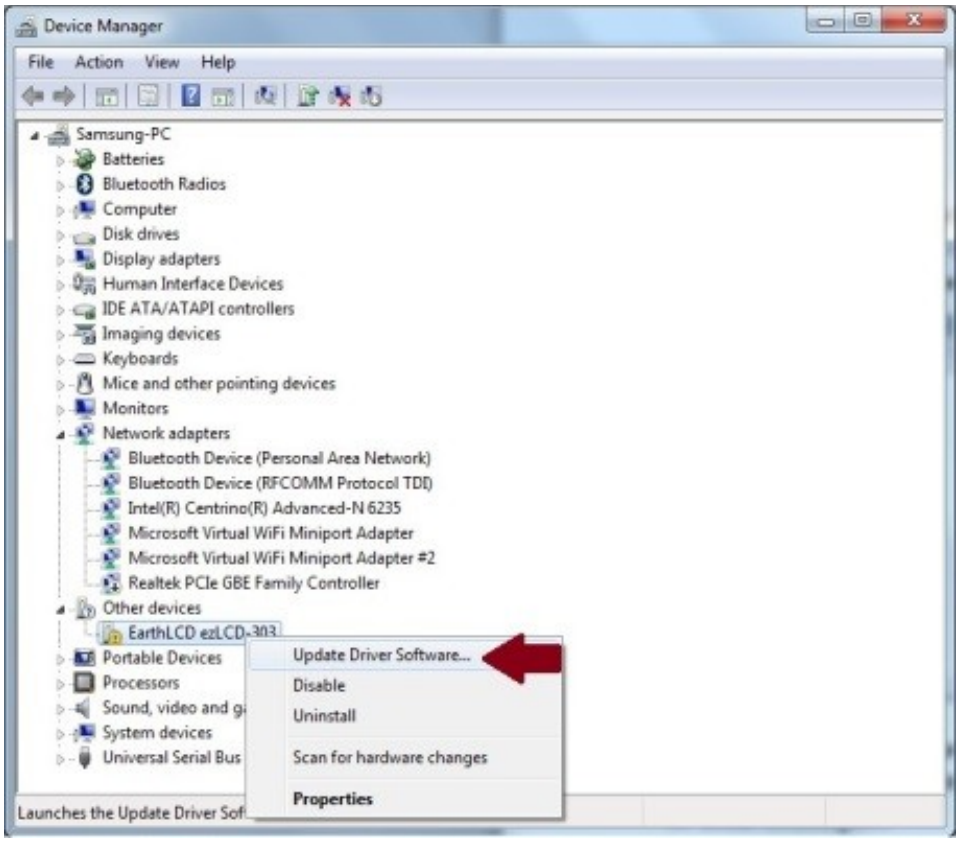
Windows will recognize the new hardware and show the “new hardware found” guide.



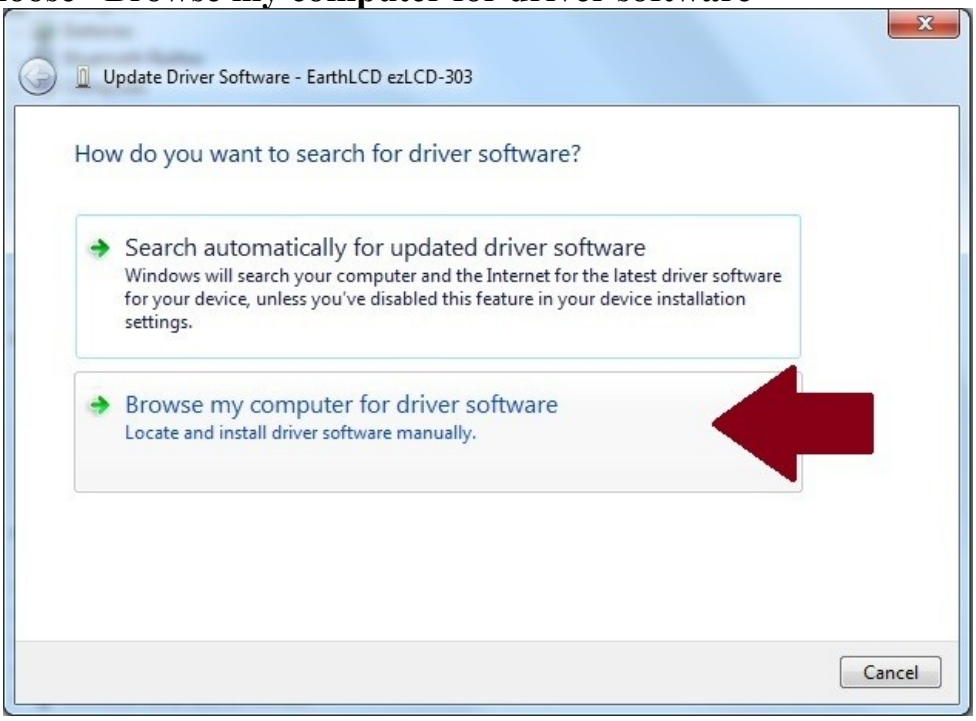
Any drivers should now be installed and ready to use. You can proceed to Installing the arLCD Library and Example Files. In most cases a reboot isn't necessary but it´s recommended.

Installing Device Driver

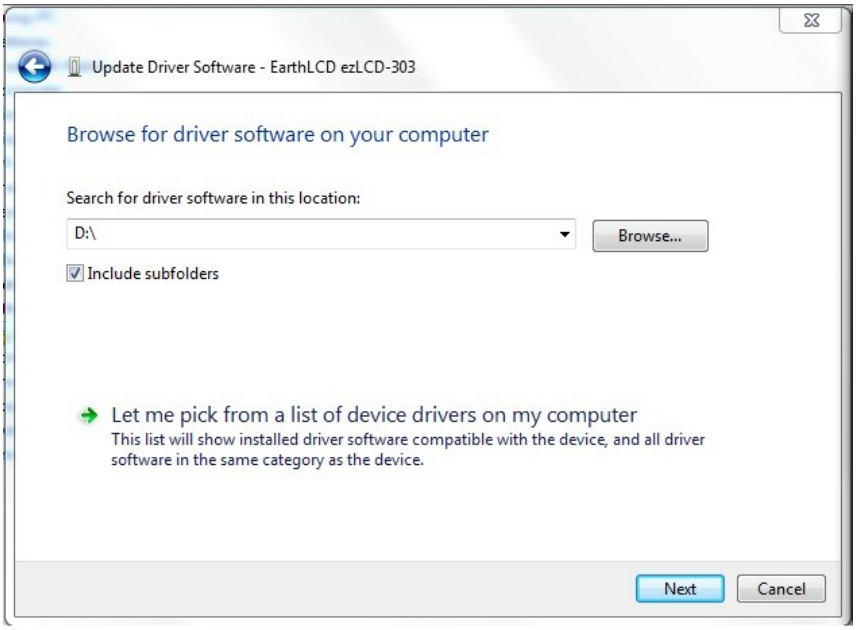
- Now **go to "Device Manager"** which you can find through the search bar in the "Start Menu".
- Then **right click on the EarthLCD device** and **select "Update Driver Software"** as shown in the picture below.

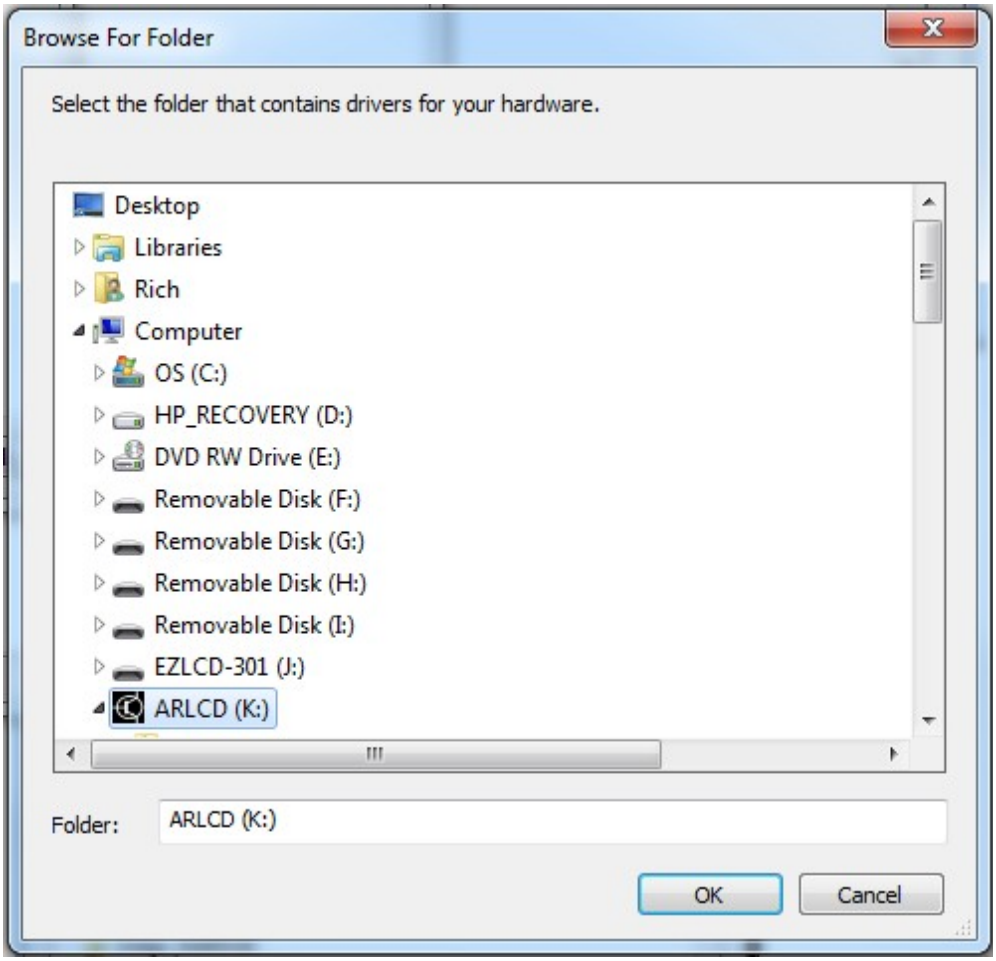


- **Choose “Browse my computer for driver software”**

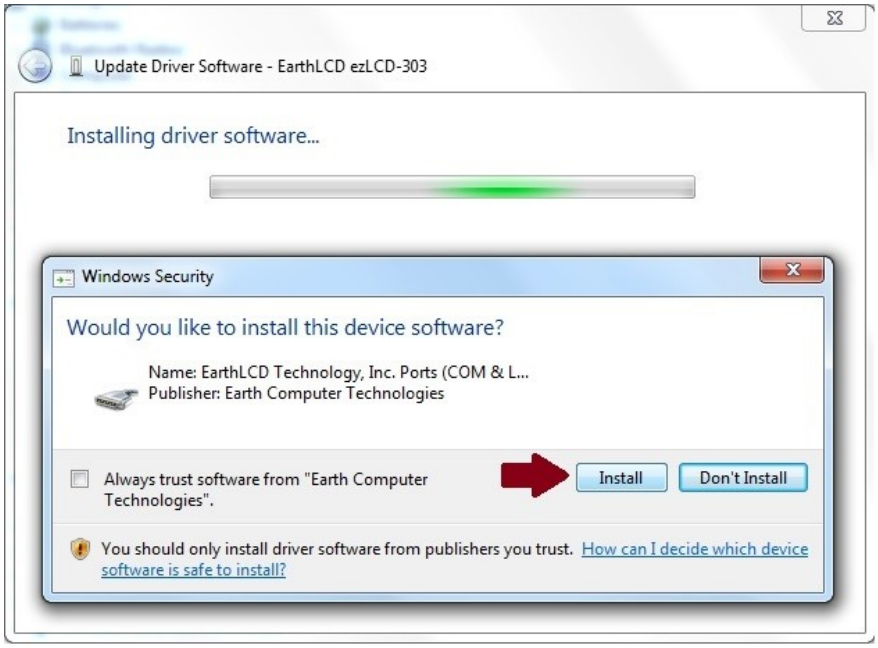


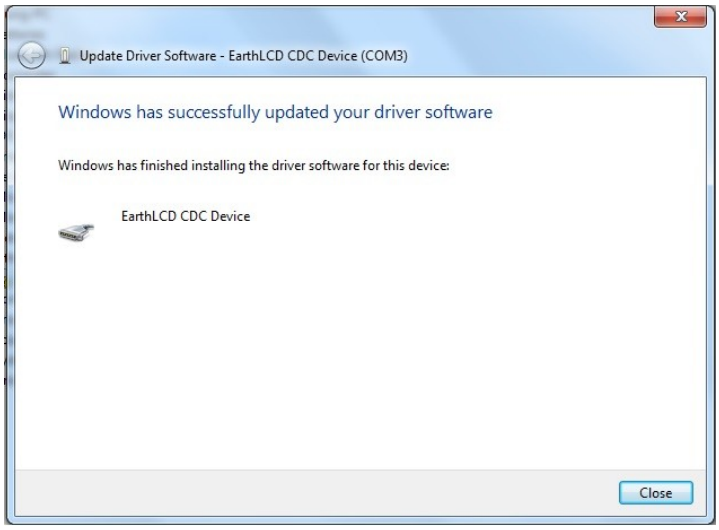
- **Click browse** and **select the ARLCD** and **click OK**.





- **Click "Next"** and the window below should appear. **Select "Always trust software from "Earth Computer Technologies""** and **click "Install"**.



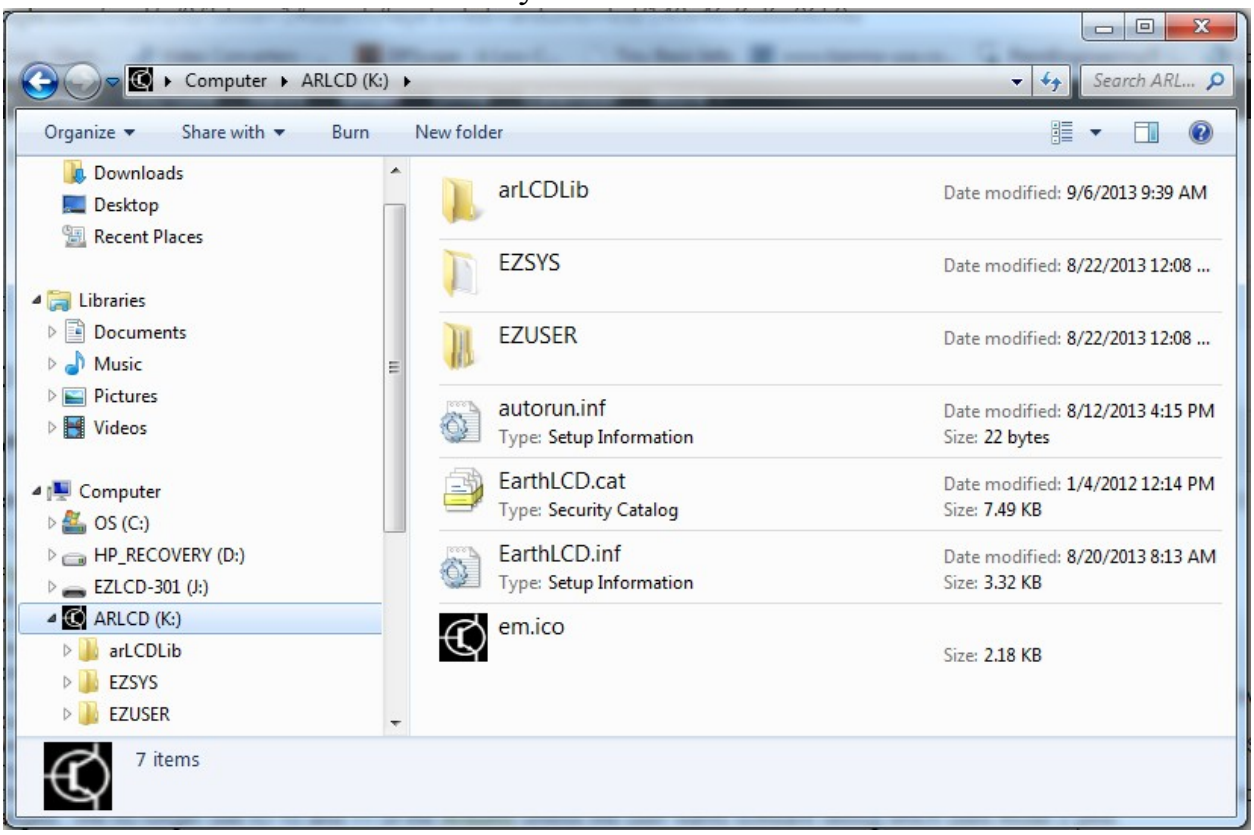


The driver is now installed. The window that appears will show you the COM port the device is using. **Remember the COM port** for later.

In this case we will use **COM3**.
Each time you connect the display it will use the same COM port unless you plug in 2 at same time.

Installing the arLCD Library and Example Files

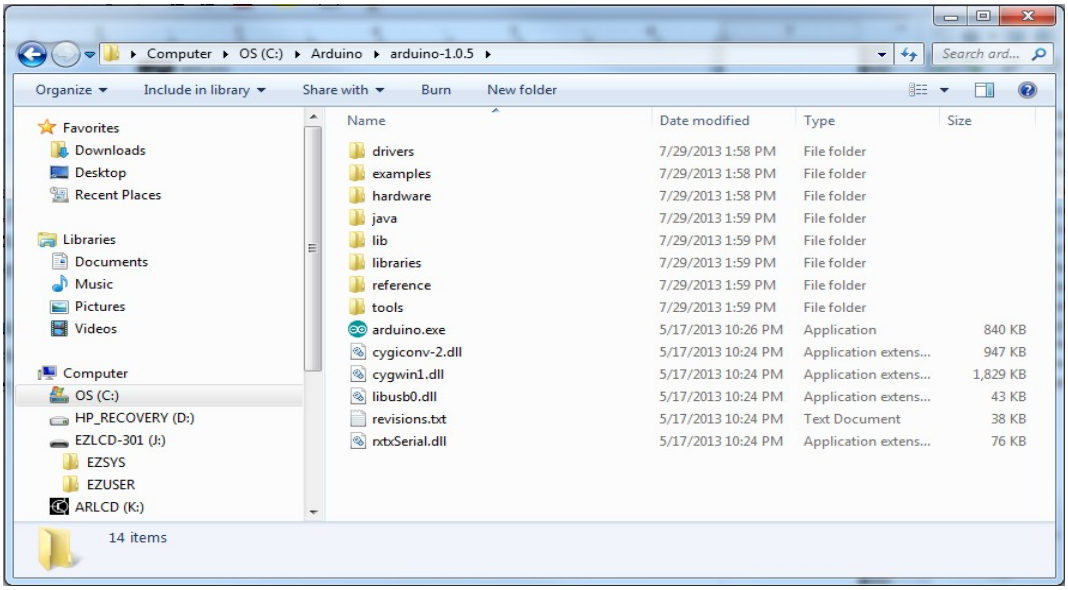
The arLCD comes with a library to be used with the Arduino IDE.



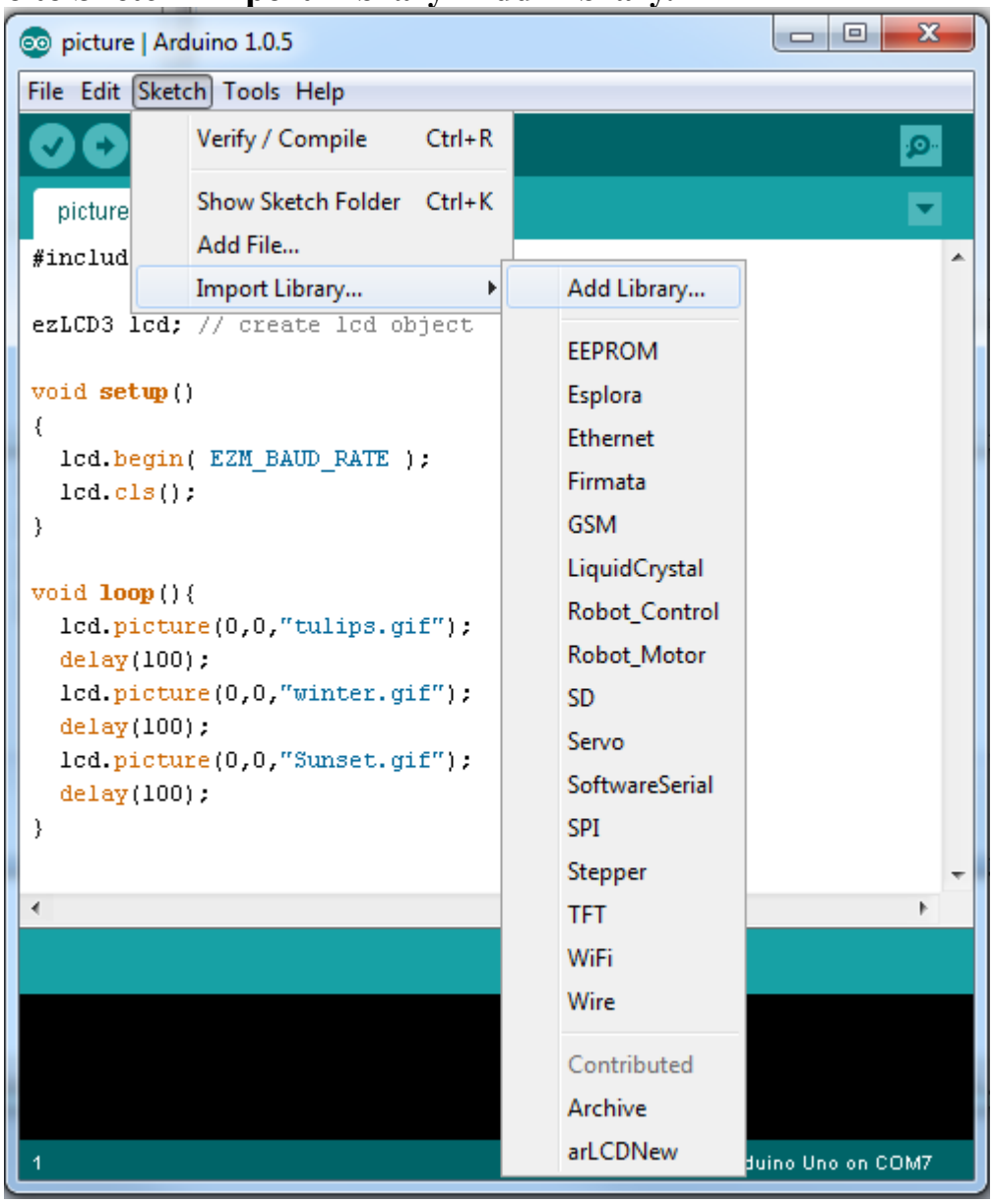
Select the arLCDLib as shown from your arLCD. This directory contains both the library and example files to be used with the arLCD.

To use the libraries and example files they must be installed into the Arduino IDE.

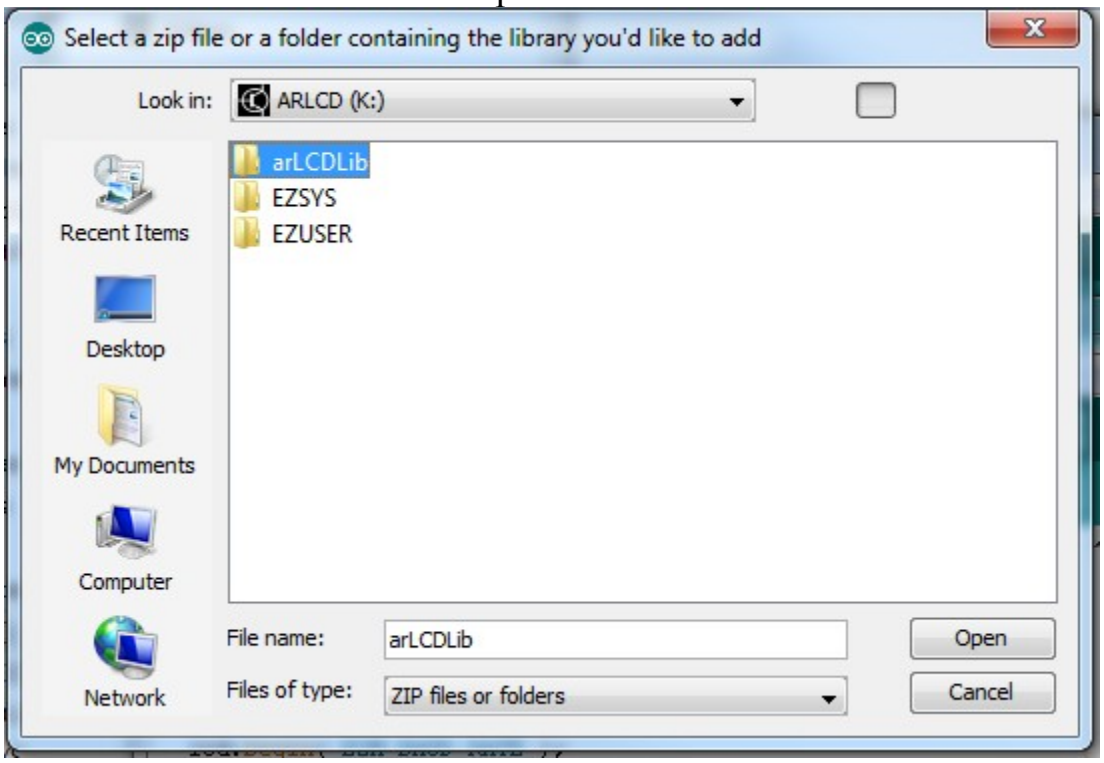
- **Open the Arduino IDE** on your computer


Computer ▸ OS (C:) ▸ Arduino ▸ arduino-1.0.5 ▸
Search ard...
Organize
Include in library
Share with
Burn
New folder
Favorites
Downloads
Desktop
Recent Places
Libraries
Documents
Music
Pictures
Videos
Computer
OS (C:)
HP_RECOVERY (D:)
EZLCD-301 (J:)
EZSYS
EZUSER
ARLCD (K:)
Name
Date modified
Type
Size
drivers 7/29/2013 1:58 PM File folder
examples 7/29/2013 1:58 PM File folder
hardware 7/29/2013 1:58 PM File folder
java 7/29/2013 1:59 PM File folder
lib 7/29/2013 1:59 PM File folder
libraries 7/29/2013 1:59 PM File folder
reference 7/29/2013 1:59 PM File folder
tools 7/29/2013 1:59 PM File folder
arduino.exe 5/17/2013 10:26 PM Application 840 KB
cygiconv-2.dll 5/17/2013 10:24 PM Application extens... 947 KB
cygwin1.dll 5/17/2013 10:24 PM Application extens... 1,829 KB
libusb0.dll 5/17/2013 10:24 PM Application extens... 43 KB
revisions.txt 5/17/2013 10:24 PM Text Document 38 KB
rxtxSerial.dll 5/17/2013 10:24 PM Application extens... 76 KB
14 items

- **Go to Sketch>Import Library>Add Library.**



Now select the arLCDLib and click Open.

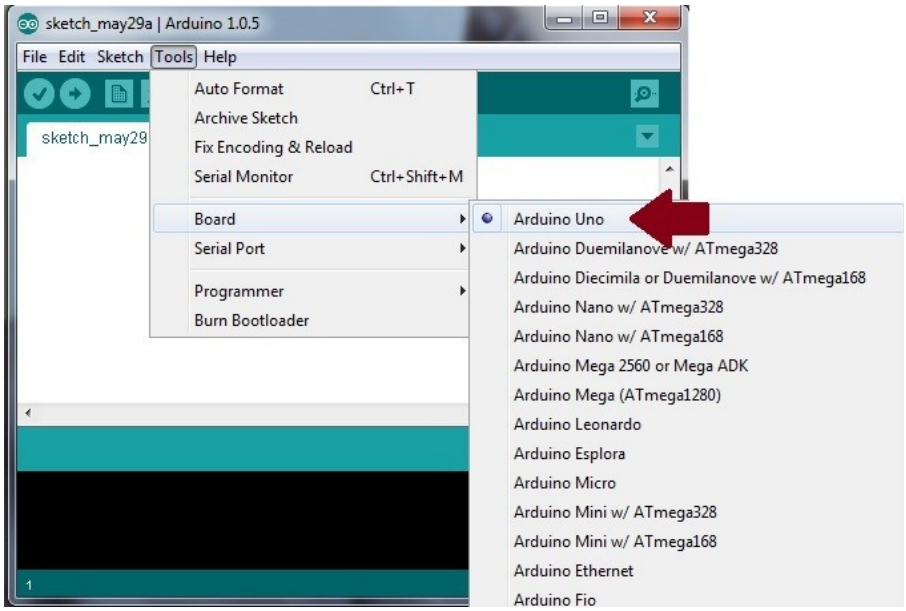


Now the arLCD Library is installed.

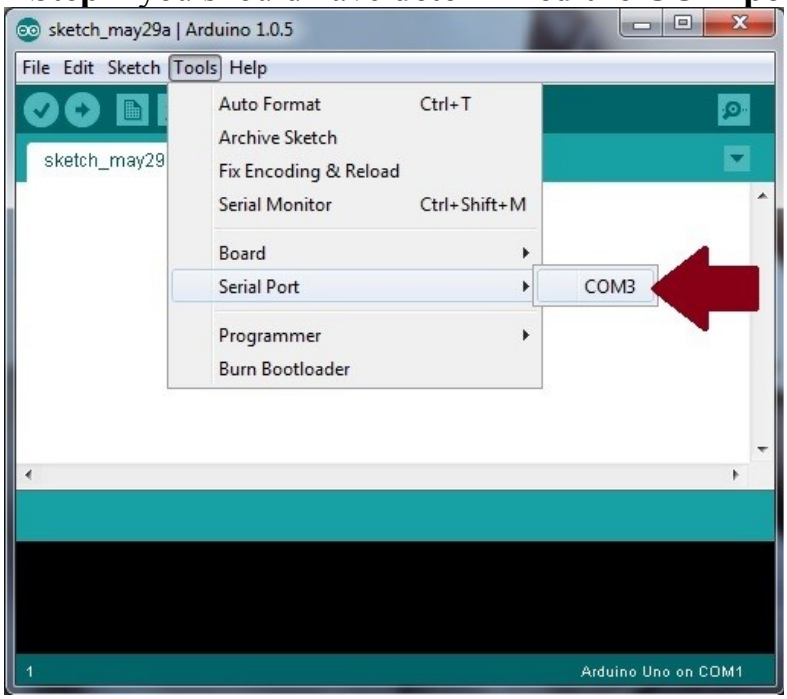
Loading an example sketch into your arLCD

You are almost ready to load the sketch onto your arLCD. You just need to set your Arduino IDE to the correct type of hardware and COM port.

- From the Arduino IDE toolbar select **Tools -> Board -> Arduino Uno**.

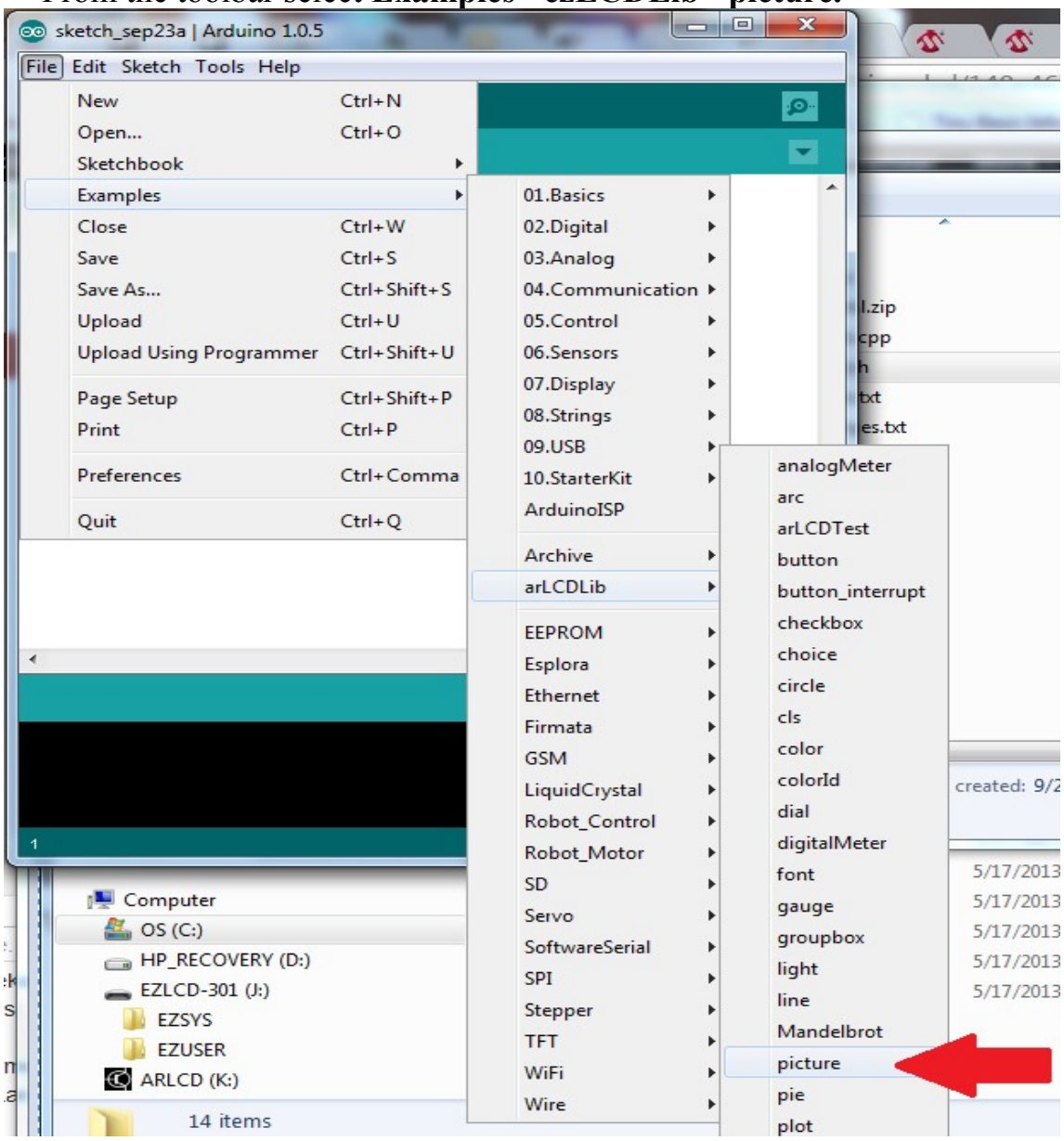


- Now from **Step 2** you should have **determined the COM port**.

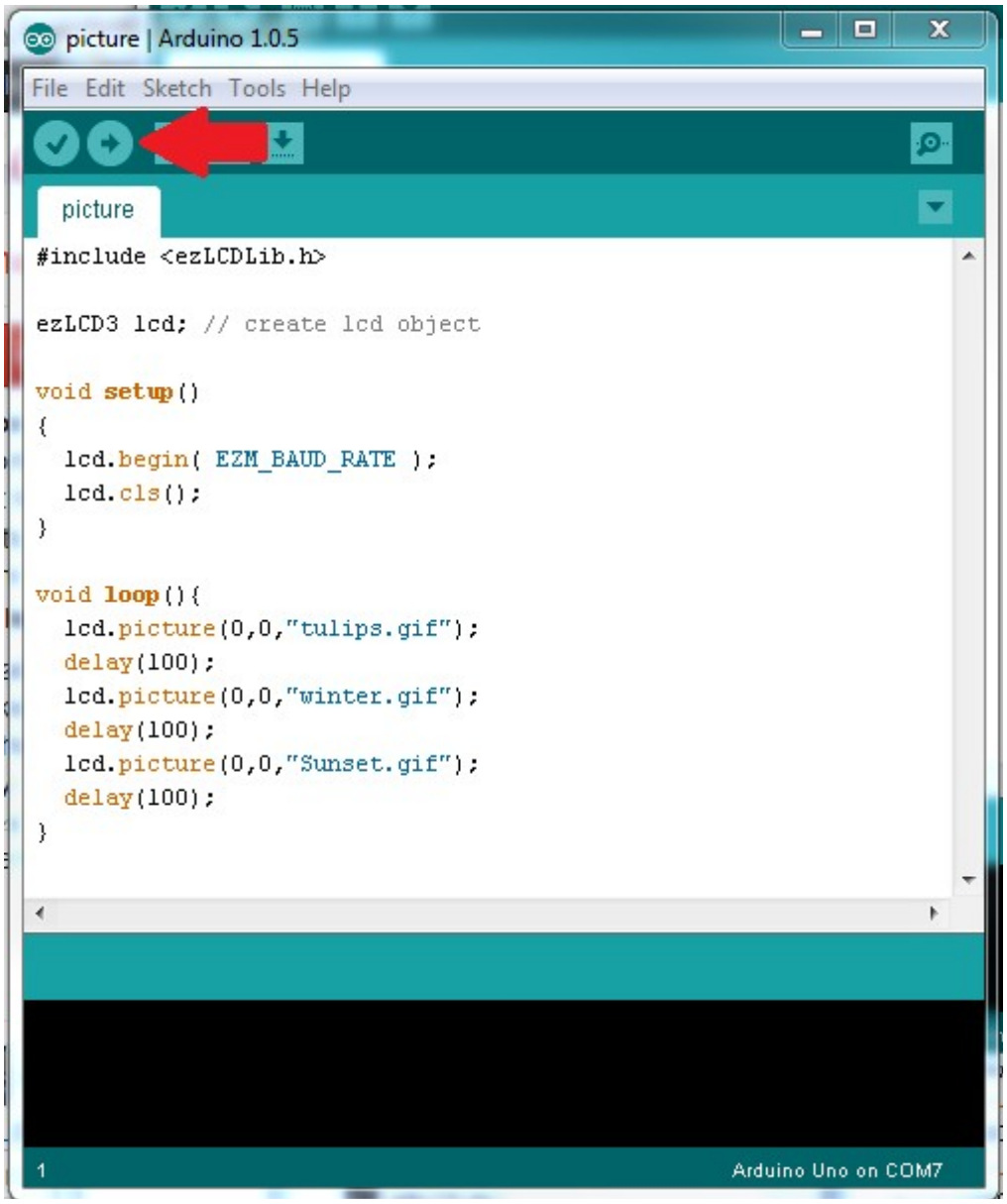


Go to **Tools -> Serial Port -> COM3** (This will vary on your computer)

- From the toolbar select **Examples> ezLCDLib> picture.**



- Now compile and upload the “picture” example to the arLCD by pressing the right arrow button.



The picture example should take a few seconds to compile and be downloaded into the arLCD. You should see 3 GIF files sequentially displayed on the screen. If not make sure the three GIF images are in the EZSYS/IMAGE/ directory.

Recap and more information

Now that you are up and running you can try selecting some of the other 25+ examples from the library and explore how they work. Make some code changes and see how it affects the display. Don't be afraid to try things. If you don't understand lines in the sketch, make some changes and see what happens.

Remember to select each sketch from the File menu.

File > Examples > arLCDLib > selected *sketch*

and then upload

File > Upload

for each sketch you want to try. You can modify and re-upload it as many times as you want. If you want to save it, we recommend you save it with another name you can remember so you can go back and look at the original.

On RESET the ezLCD GPU will check the touchscreen to see if during reset the user wants to bypass the normal startup.ezm. The user can supply alternative startup files or none at all.

Note: Without one startup the COM ports are not setup and communication with the Arduino cannot happen. The startup.ezm files are changed by direct access to the flash drive on your PC.

Keep in mind, in order to communicate with your arLCD, the startup.ezm file must be setup correctly. If a startup.ezm is in the \EZUSER\MACROS\ then it will be used. If not it will use the startup.ezm in the \EZSYS\MACROS\ directory which is already in use.

The normal STARTUP.ezm is used without touching the screen on reset. You can use different startup files by holding a certain sections of the screen while resetting the arLCD (reset button on the back). The Upper left is STARTUP1.ezm, upper right is STARTUP2.ezm. Lower right is STARTUP3.ezm and lower left is STARTUP4.ezm. STARTUP5.ezm is executed if the screen is pressed but not inside the 50 x 50 pixel corners. If the startup.ezm file is not found, it is simply skipped. The other startup files can be found in our recent file systems online.

The latest filesystem includes;

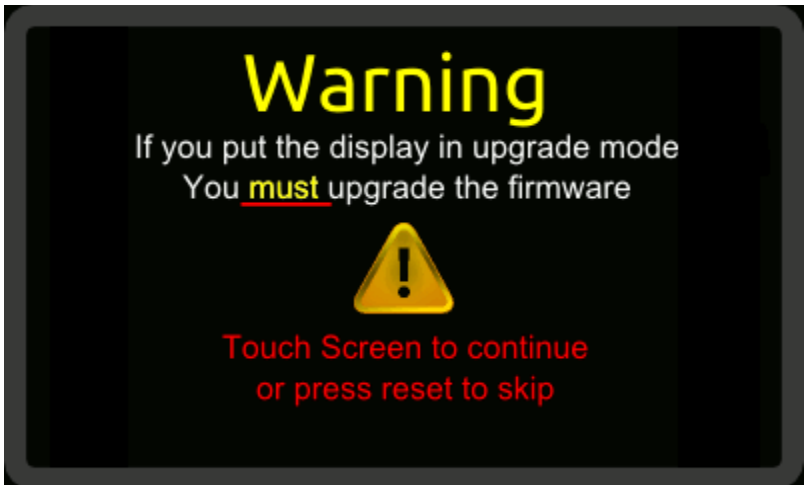
startup.ezm 'Configures the arLCD for normal use and programming.

Startup1.ezm 'Safemode. Disables the arLCD from receiving commands from the user. Use safemode if the user programs a sketch into the arLCD which disables or otherwise causes the GPU into an unwanted state and no longer can update new sketches.

Startup2.ezm 'configures the arLCD for firmware upgrade.

If the user wants to upgrade the firmware they simply touch the screen again and release. If the user did not want to upgrade the firmware, simply press the reset again before touching the screen.

If the user does put the firmware into upgrade mode, reset will not recover. The firmware must be upgraded. See the upgrading firmware section.



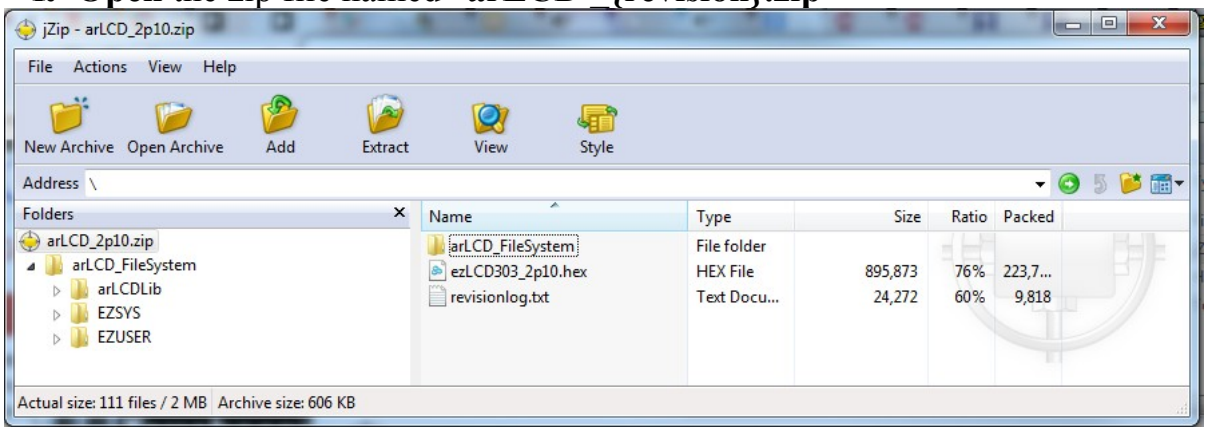
Visit our website or link below for more documentation and et al.

EarthLCD Downloads page:
http://www.earthlcd.com/Downloads/arLCD_Downloads

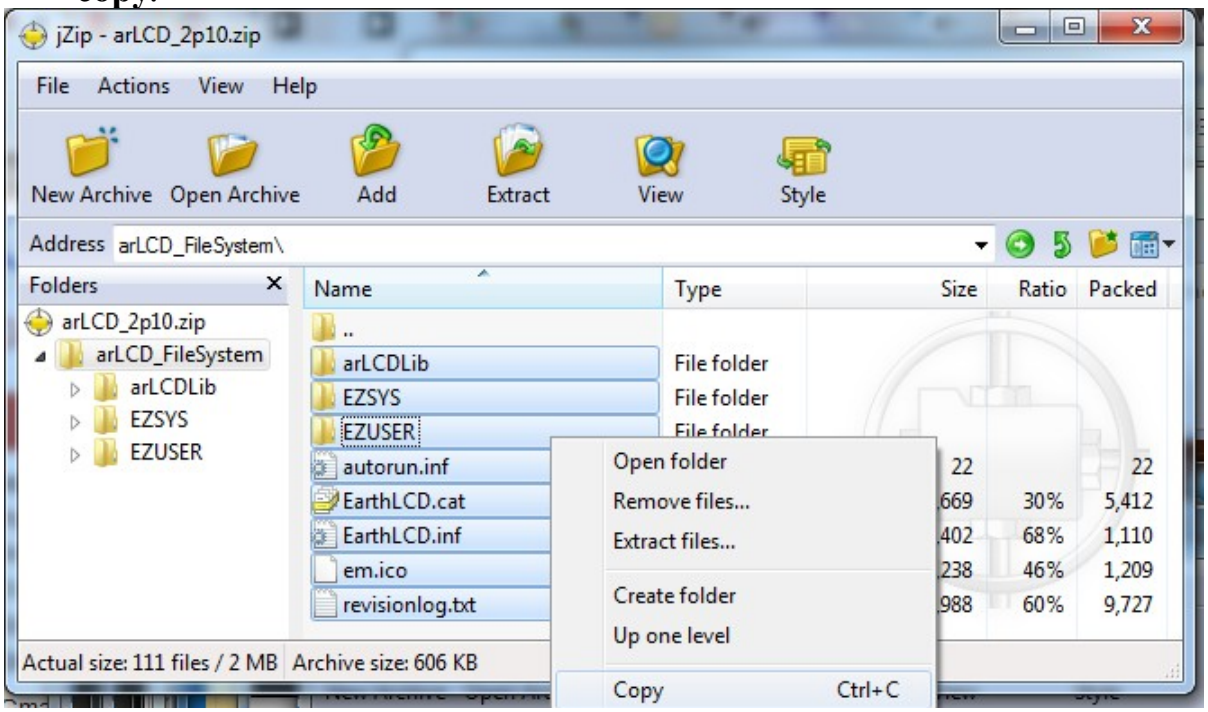
Updating the Filesystem

In order to get the most out of your arLCD, it is recommended to update the filesystem to the latest version, which you downloaded in Getting Started .

1. **Open** the zip file named "**arLCD _{revision}.zip**"

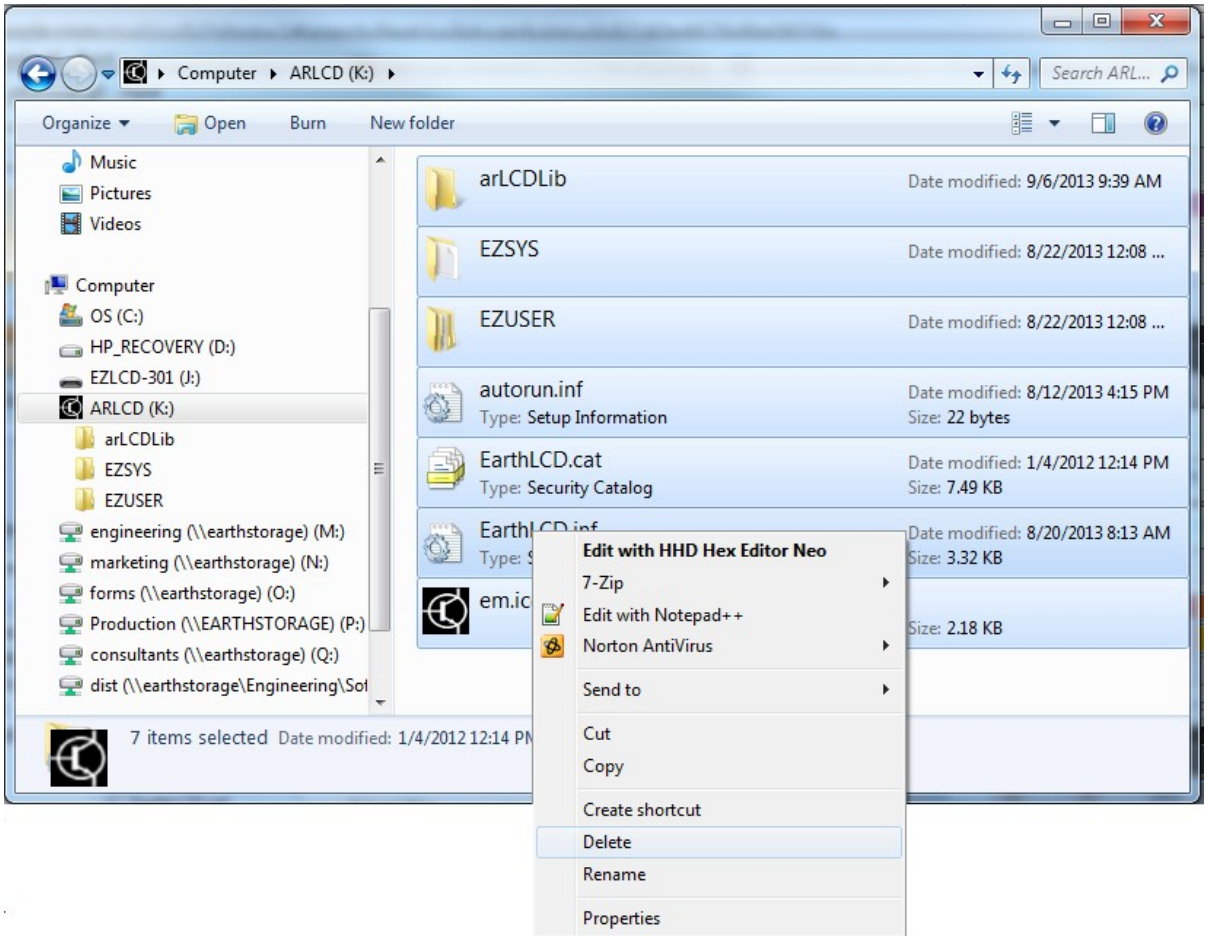


2. Like the pictures below, **select all files in the arLCD_FileSystem and copy**.



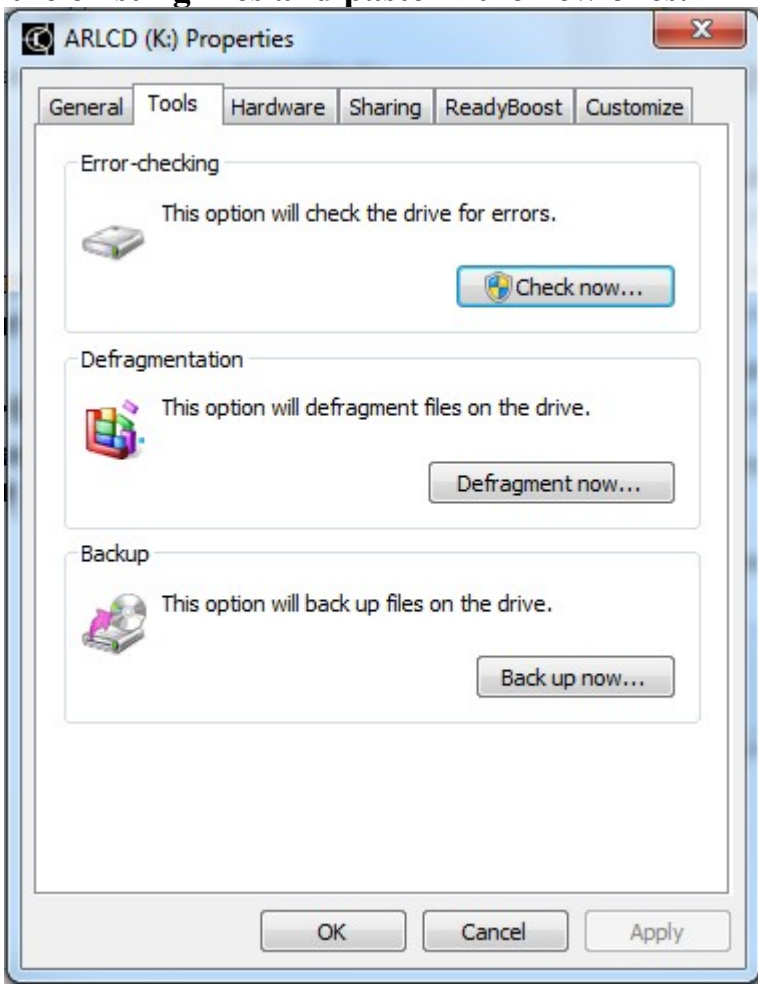
3. Go **to My Computer>ARLCD**

4. **Select all the files on the arLCD flash drive and delete them.**



5. Now **replace all the files** with the new ones with a simple paste command.
6. **Restart the arLCD** by pressing the reset button on the back of the display.

Note: Do not reformat the flash drive unless instructed so by a support engineer. Just delete the existing files and paste in the new ones.



You can run the Error checking and Defragmentation prior to upgrading the filesystem to clear out any problems that you created.

Upgrading the arLCD Firmware

A Windows PC is required to upgrade the firmware on an arLCD.

IMPORTANT: Never use any upgrade firmware that is not designed for the display you have.
Only arLCD firmware (arLCD_2pxx.hex or ezLCD-303_2pxx.hex) should be installed. Using the wrong firmware could make your unit inoperable and leave no way to install the correct firmware.

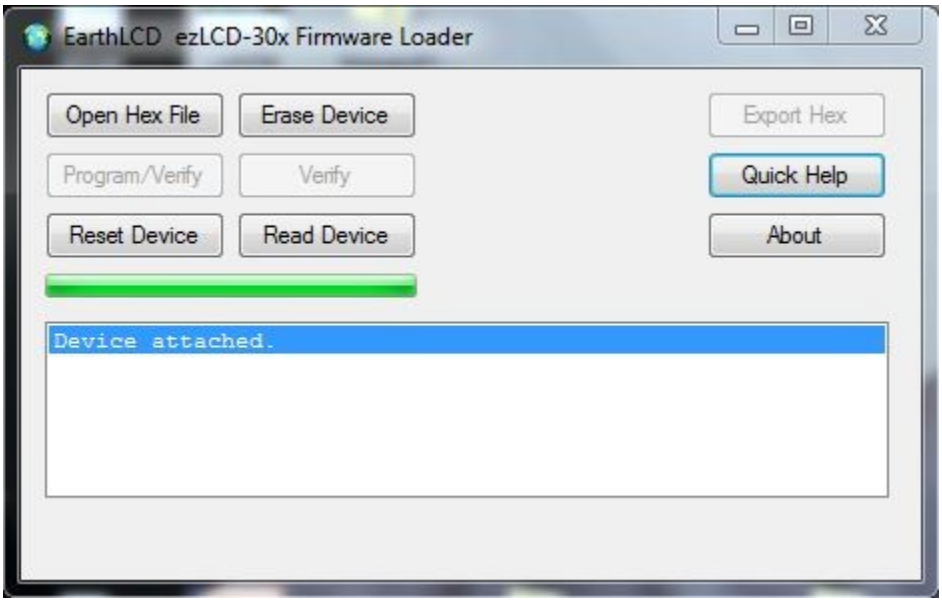
Before upgrading your arLCD firmware you should backup any macros or fonts you have created by copying them from the arLCD flash drive to your computer.

To put the arLCD in upgrade mode hold the top right corner of the screen and press the reset button. Then follow the onscreen instructions.

Once you put the arLCD in firmware upgrade mode, it cannot come out of this state until new firmware is programmed using the provided program even if you unplug it or reset!

1. Have the **Firmware Loader downloaded and installed and running**.
2. Download the most **recent firmware**, which you did in **Getting Started**.
3. **Plug in your arLCD to a USB port**.

4. **The arLCD should attach to the Firmware Loader as shown below**.



5. Click "**Open Hex File**" and locate where you downloaded the firmware. (ezLCD-303_2pxx.hex)

6. Click "**Program/Verify**"

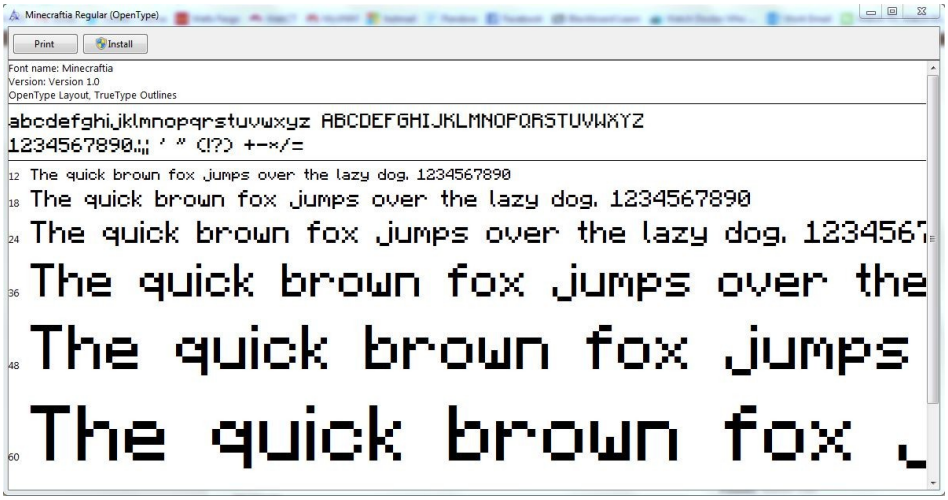
7. When the programming and verification is complete click "**Reset Device**"

8. **You are done!**

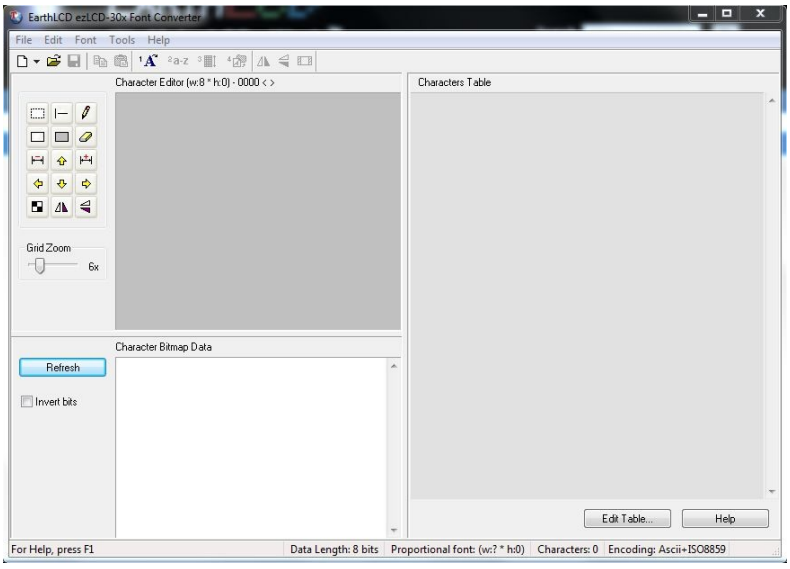
Font Converter

The ezLCD-3xx Font Converter is a great way to customize your own fonts, resize fonts or upload different fonts onto your arLCD. Make your own fonts, edit fonts, or upload pre-made ones to create a spectacular display!

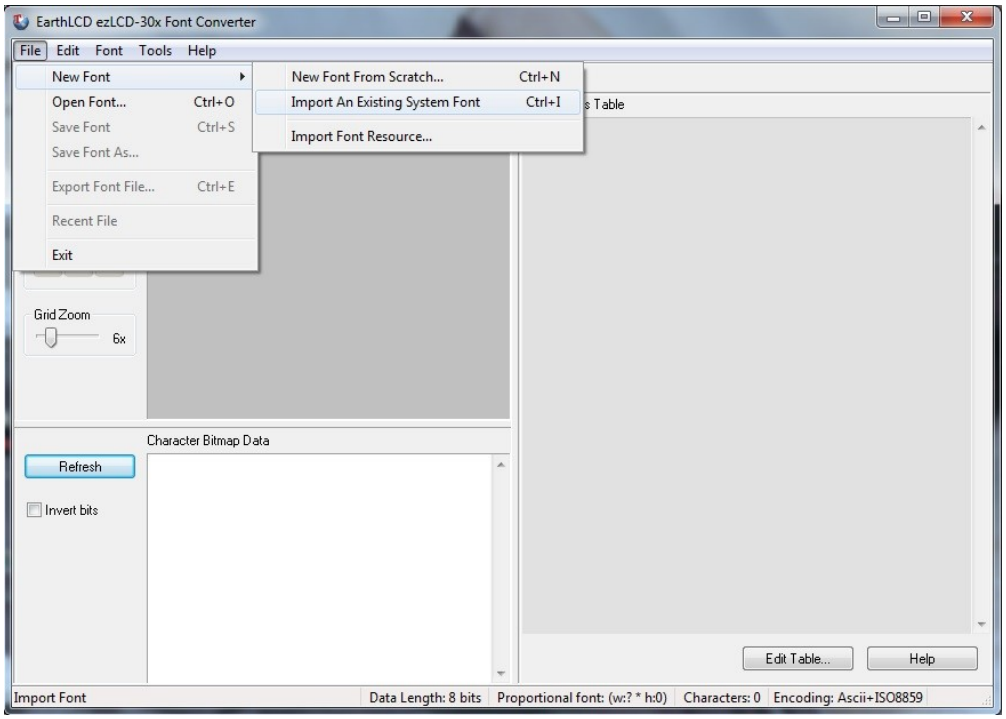
1. **Download & Install** the ezLCD-3xx Font Converter.
2. **Download & Install** a font of your choice



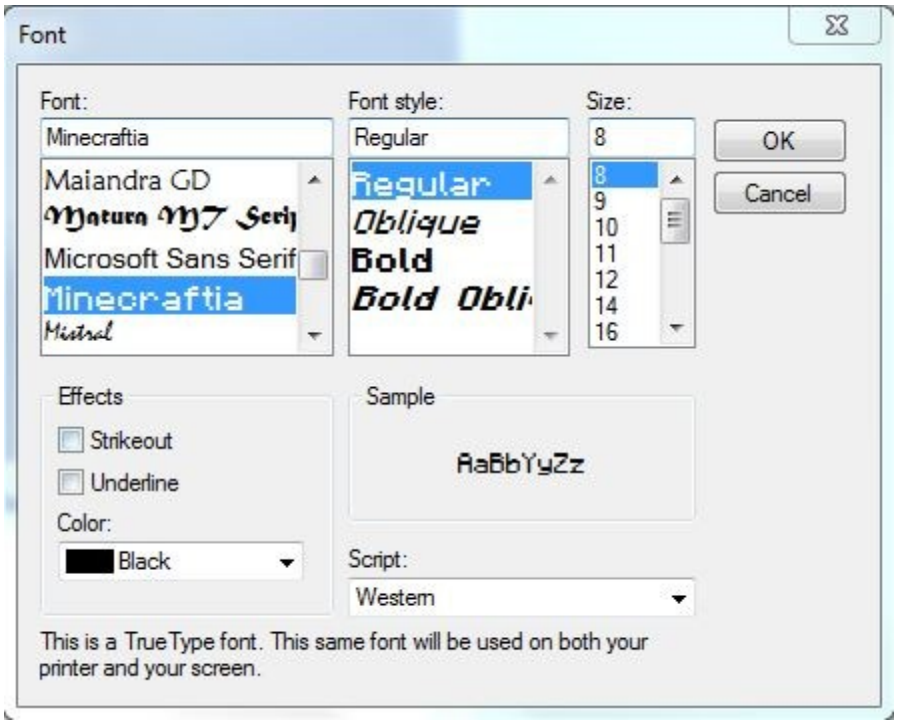
3. **Open** the Font Converter.



4. Go to **File > New Font > Import An Existing System Font**



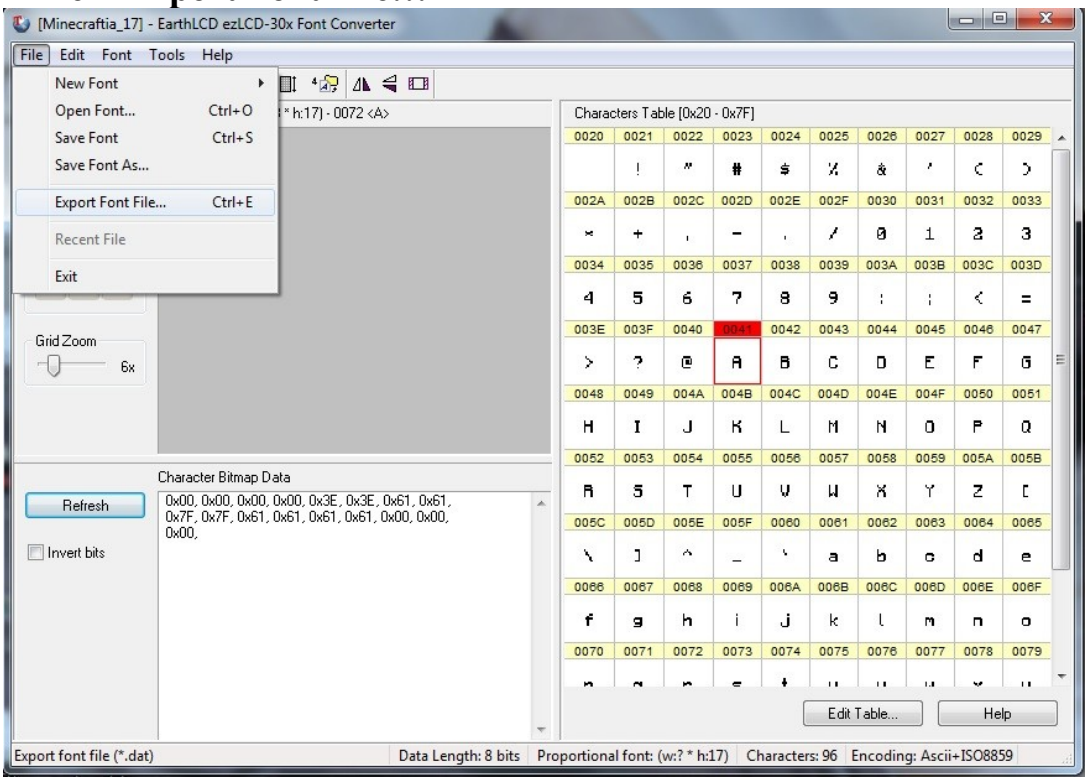
5. **Find** the font you installed & **Select** the settings you want. Click **ok.**

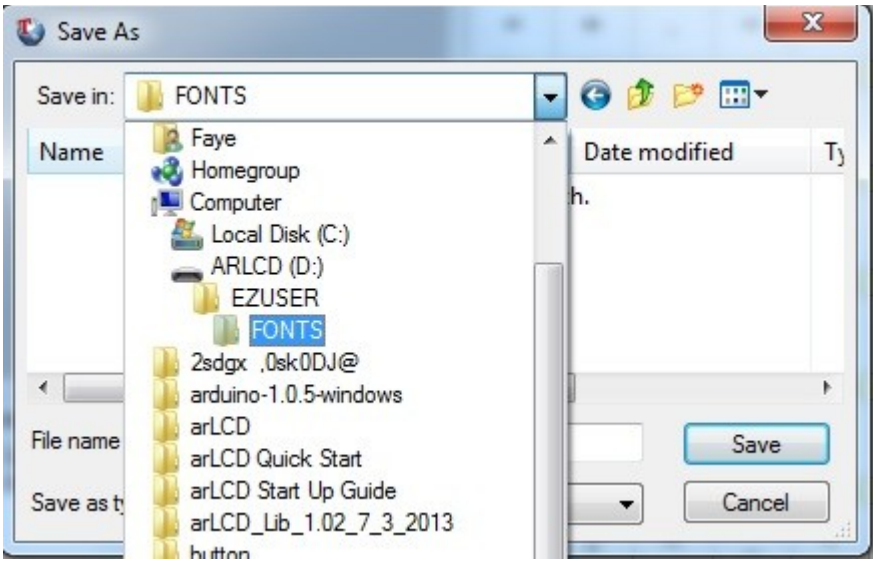


6. Edit it however you want. Play around with the options.
   NOTE: Below the options bar, you will see “Character Editor”. “w” means width and “h” means height in pixels of the font box.

Hint: The font will take up less space on the screen if you remove all the excess blank pixels above and below the selected font.

7. When you are ready to upload the font onto you arLCD, go to
   File > Export Font File…





8. **Save** your font in **ARLCD > EZUSER > FONTS**

Hint: The file name must be only 8 characters or less with a 3 character extension (myfont.ezf).

9. Your font is now ready to use! Create a sketch to test it out!
   NOTE: Make sure the font name has double quotations around it.
   lcd.font("myfont");

Basic Commands

To use the arLCD library some global storage is used.

```
volatile unsigned int timedOut;
volatile unsigned int error;
volatile unsigned long timeOutCount;
volatile unsigned long timeOut;
```

timedOut indicates the communication between the GPU and the Atmel has retried and timedout.

Error indicates an error has happened on the previous command. Like trying to open a picture that is not there.

TimeOutCount and timeOut are used to determine if a time exists.

CLS

The CLS command will clear the screen to black. It will also remove all widgets and clear any previous widget IDs being used.

The user has the option of specifying the clear screen background color (bcolor). The user also has the option of specifying the foreground color which will be used for text following the command.

Command:

lcd.cls( );

lcd.cls(bcolor);

lcd.cls(bcolor, fcolor);

Parameters:

bcolor is the background color used for clearing the screen
fcolor is the foreground color. Same as lcd.color fcolor.

COLOR

The COLOR command sets the foreground color which will be used for text. Line and other primitive commands.

Command:

lcd.color(fcolor);

Parameters:

fcolor is the foreground color used follow on commands.

XY

The XY command sets the position pointer (sometimes called cursor) for follow on print commands.

Command:xy x, y

lcd.xy(**x**, **y**);

Parameters:

x is the pixel position from left (0) to right (319).
y is the pixel position from top (0) to bottom (219).

The XY command can also be used to get the current position.

lcd.xy( );

These other commands do the same thing.

lcd.getX( );

lcd.getY( );

The X and Y are also returned to two global variables X and Y.

```
volatile unsigned int X;
volatile unsigned int Y;
```

LIGHT

The LIGHT command sets current backlight level of the display with optional timeout and timeout brightness. If timeout is not specified, no timeout will happen. Setting timeout to zero will terminate timeout.

After **timeout** in seconds the backlight brightness will be changed from the active brightness (**level**) to the inactive brightness (**timeoutbrightness**). Touching the screen will resume the brightness back to active brightness.

Command:light level

lcd.light(**level**);

lcd.light(**level, timeout, timeOutBrightness**);

Parameters:

level is the active brightness level of the backlight from 0 to 100.
timeout is active timeout in seconds before the backlight is changed.
timeoutbrightness is the inactive backlight level.

The light command can also be used to get the current level. A value form 0 to 100 will be returned.

lcd.light( );

GETXMAX and GETYMAX

The GETXMAX and GETYMAX commands return the max width and height of the display screen.

Command: light level

lcd.getXmax( ); get the X max value of display (319)

lcd.getYmax( ); get the Y max value of display (239)

Parameters:

None

TOUCHX, TOUCHY and TOUCHS

The TOUCHX, TOUCHY and TOUCHS commands return the max width and height of the display screen.

Command: touchX, touchY or touchS

lcd.touchX( ); get the X value last location touched on the display (0-319).
lcd.touchY( ); get the Y value last location touched on the display (0-239).

lcd.touchS( ); get the status of the last touch event on the display.

This can return

0=No press
1=Moved
2=Pressed
3=Stillpressed
4=Released

STRING

The STRING command is used to set a string of a stringID. Most strings are set prior to use by follow on commands. Strings can be upto 64 characters long.

Command: string

lcd.string(ID, “string”); set the string for ID.

lcd.getStringID(ID, pointer); get the string for ID and put it in pointer.

Parameters:

ID is the ID to use to reference the string.

string can be any ascii string up to 64 characters

```
lcd.string( 1, "ALOG" ); // stringId 1

char temp[64];//setup string
lcd.getStringID( 1, temp ); // stringId 1
lcd.printString( temp );
```

PRINTSTRING

The PRINTSTRING command is used to print a string to the display. The command will use the current color and font. Strings can be upto 64 characters long.

Command: printString

lcd.printString(“Hello World”); //prints the string “Hello World”.

lcd.print(“Hello World”); // works too

lcd.printStringID(ID); //prints the string in ID.

```
lcd.printString( “Hello World” );  //print the text to the display
lcd.string( 1, "Hello World” ); // stringId 1
lcd.printStringID( 1 );
```

PRINT Escape Sequences

When printing a string, various escape sequences can be used to modify the output without additional commands. Things that can be changed are color, font orientation and XY location.

COLOR: \[xxxm
\[dddm where ddd can be any of the colors in the colorID table.

FONT ORIENTATION:
\[dr where d can be **0** = 0°, 1 = 90°. 2 = 180° and 3 = 270°

XY LOCATION:
\n cause the position to go down one line (Y+1)
\r cause the position to go to the left side (X = 0)
\[dddx where ddd can be any valid X location (0-319)
\[dddy where ddd can be any valid Y location (0-239)
Note: One line is defined as the height of the current font.

```
//note the use of escape sequences below allow 1 line to replace 9 lines of code
//  lcd.xy(55,0);
//  lcd.color(RED);
//  lcd.printString("L");
//  lcd.color(GREEN);
//  lcd.printString("C");
//  lcd.color(BLUE);
//  lcd.printString("D");
//  lcd.color(WHITE);
//  lcd.printString(" Hardware Test V1.0");
  lcd.printString("\\[55x\\[0yar\\[4mL\\[9mC\\[12mD\\[3m Hardware Test V1.0");
```

CLIPPING

The CLIPPING command sets an area of the screen which is protected from change by primitive commands. First a clipping area is defined. Second clipping is enabled or disabled. When enabled primitives only work inside the clipping area.

is used to print a string to the display. The command will use the current color and font. Strings can be upto 64 characters long.

Command:

lcd.clipArea(L, T, R, B); //define the area with left top and right bottom
lcd.clipEnable(TRUE/FALSE); // turn it on or off

Parameters:

L is the left x position.
T is the top y position.
R is the right x position.
B is the bottom y position.

lcd.clipArea(50, 50, 200, 150); // define the area
lcd.clipEnable(TRUE); // turn clipping on
any attempt to write outside the window will be ignored

DRAWLED

The DRAWLED command draws a simple LED on the display to replace any physical LED that might otherwise be needed. This allows a larger number of possible LEDs and requires no pins to drive the LEDs. LEDs can be any color defined. The size of the LED be assigned as your needs dictate.

Command:

lcd.drawLed(dim, x, y, colorLed, colorHigh);

Parameters:

dim is the radius of the LED outer circle.
x is the x position of the LED.
y is the y position of the LED.
colorLed is the color of the LED. Used colorID or names (RED).
colorHigh is the color of the LED highlight. Typically WHITE.

lcd.drawLed(12, 160, 50, BLACK, WHITE);
draws an LED with radius of 12 pixels at X=160 and Y=50. Black is used for the color to show its OFF. White is used as the highlight colors.

lcd.drawLed(12, 160, 50, RED, WHITE);
draws an LED with radius of 12 pixels at X=160 and Y=50. RED is used for the color to show its ON. White is used as the highlight colors.

lcd.drawLed(12, 160, 50, LIME, WHITE);
draws an LED with radius of 12 pixels at X=160 and Y=50. LIME is used for the color to show its ON. White is used as the highlight colors.

WSTACK

The WSTACK command is used to see what widget touch commands have happened. It is a 32 deep stack to prevent missing any screen presses when the user is processing other things. It can be used with interrupts or not.

Three global variables are updated each time this command is called.

currentWidget gets the ID of the event
currentInfo gets the info about the event. 0=nothing to report.
currentData gets the Data related to the event.

By monitoring the currentInfo and currentWidget the user can track touch events without missing any.

Info and Data vary between widgets. See explanation below.

```
volatile unsigned int currentWidget;
volatile unsigned int currentInfo;
volatile unsigned int currentData;
```

Command:

lcd.wstack(cmd);

Parameters:

cmd is the command requested of the wstack.

0 = read data from FIFO	(FIFO)
1 = read data from LIFO	(LIFO)
2 = clear all data in the FIFO	(CLEAR)
3 = read data nondestuctive from FIFO	(PEEK)

Example:

```
cls black                  'clears the screen to black
string 1 "testing"         'the word will appear on the button
fontw 0 sans24             'widget font needs to be set before the theme
theme 2 5 20 2 2 2 4 4 0 0 0    'colors are to distinguish different parts of widget
button 1 165 86 150 100 1 0 0 2 1 'simple button
WSTACK 0
```

You can keep reading the stack to see all the presses you made to any of the current widgets. When you read 0 0 0 the FIFO is empty. The stack is currently 32 deep.

You can also look at the last FIFO entry with LIFO option.

FIFO and LIFO Methods

FIFO stands for *first-in, first-out*, meaning the data is pushed into the bottom of the stack and removed from the top of the stack. Therefore oldest data is returned first.

LIFO stands for *last-in, first-out*, meaning the data is still pushed into the bottom of the stack but removed rom the bottom of the stack. Therefore newest data is returned first.

Typically the user would turn ON WQUIET to suppress any touch events if using the widget stack. See WQUIET below.

Note: Default startup file has WQUIET enabled.

INFO and DATA vary from widget to widget

For the button, Touchzone:

4 = widget pressed
2 = widget canceled
1 = widget released
DATA = State

For the checkbox:

4 = widget checked
1 = widget unchecked
DATA = State

For the radio button:

4 = widget pressed
DATA = State

For the slider:

2 = widget decremented
1 = widget incremented
DATA = Value

For the dial:

2 = widget counter clockwise
1 = widget clockwise
DATA = Value

CALIBRATE

The CALIBRATE command is used to calibrate the touchscreen. It is typically not used but once or the screen goes out of calibration. Once executed the user presses three spots on the display as indicated. The display calculates and stores calibration data on the flash drive.

Do not put this command in a setup block of your sketch. Calibration blocks flash and USB access and makes upgrading sketches impossible.

Command:

lcd.calibrate( );

Parameters:

None

```
lcd.calibrate( );
```

WVALUE

The WVALUE command is used to get and set values from any active widget. When setting a value of a widget it will be redrawn. When getting a value from widgets, different widget types return different meaning

When getting value:

Button return 1 if pressed, 0 otherwise.
Slider returns Position.
Digital Meter returns Value
ProgressBar returns position.
Gauge returns position.
Dial returns Value.
StaticText cannot return string data.
Checkbox returns 1 if checked, 0 otherwise.
RadioButton returns 1 if checked, 0 otherwise.

Do not put this in a setup block of your sketch. Calibration blocks flash and USB access and makes upgrading sketches impossible. When used always make it conditional.

Command:

```
lcd.wvalue( ID, value );        //updates widget ID with value

lcd.wvalue( ID );               //gets the widget value
```

Parameters:

ID is the widget ID to reference by.
Value is the value to send to the widget.

Updating an Analog meter

```
int value = analogRead(0);      //read analog pin voltage
lcd.wvalue( 1, value );         //update widget with value

int value=lcd.wvalue(1);        //read widget 1 value
```

WSTATE

The WSTATE command is used to get and set state from any active widget. When getting state from widgets, different widget types return different meaning

Command:

lcd.wstate(ID, state); //updates widget ID with state

lcd.wstate(ID); //gets the widget state

Parameters:

[ID] must be the same as the **ID** of the widget you want to change.

[Options] are: **0 = delete, 1 = enable, 2 = disable, 3 = redraw**

0 = Delete the widget. This option redraws the widget to the common background color and then unlinks the widget ID from further processing. Once a widget is deleted its state can no longer be modified.

1 = Enable the widget. This option will enable a previously created widget that has been disabled. The Widget is redrawn with the enable colors in the Theme.

2 = Disable the widget. This option will disable a previously created widget that is enabled. The Widget is redrawn with the disable colors in the Theme.

3 = Redraw the widget. This option will redraw a previously created widget. This is useful if the widget has been overwritten by other text or if the string has been modified and needs to be redrawn on the widget.

Values over 3 use the definitions in table below.

Example:

```
lcd.cls( WHITE ); //clears the screen to white
lcd.string( 1, "testing"); //the word will appear at the bottom of the widget
lcd.fontw( 0, “sans24”); //widget font needs to be set before the theme
lcd.theme( 0, 0, 1, 2, 3, 4, 5, 6, 7, 8, 0 );//
lcd.staticText( 1, 10, 25, 220, 25, 5, 0, 1 );     'draws a static widget
delay(5000);//wait 5 seconds
```

You could use this

```
lcd.string( 1, “tested”);    //change the string to “tested”
lcd.wstate( 1, 3 );          //changes the string to “tested”
```

Note: Gauge and progress bar use the same wstate definitions.

Static Text	Hide	Draw	Update	~	~	~	~	~	~	~	~	Frame	Center	Right	Disabled	~	
Progress Bar	Hide	Draw	Redraw	~	~	~	~	~	~	~	~	~	~	Vertical	Disabled	~	
Slider	Hide	Draw	Draw Focus	Draw Thumb	~	~	~	~	~	~	~	~	Scroll Bar	Vertical	Disabled	~	
Rotary Dial	Hide	Draw	~	~	~	~	~	~	~	~	~	~	CCW	CW	Disabled	~	
Analog Meter	Hide	Draw	Redraw	Update	~	~	~	~	~	~	~	~	Accuracy	Ring	Disabled	~	
Digital Meter	Hide	Draw	Update Text	~	~	~	~	~	~	~	~	Frame	Center	Right	Disabled	~	
Radio Button	Hide	Draw	Draw Focus	Draw Check	~	~	~	~	~	~	~	~	First	Checked	Disabled	~	
Group Box	Hide	Draw	~	~	~	~	~	~	~	~	~	~	Center	Right	Disabled	~	
Check Box	Hide	Draw	Draw Focus	Draw Check	~	~	~	~	~	~	~	~	~	Checked	Disabled	~	
Touch Zone	Hide	Draw	Draw Focus	~	~	~	~	~	~	~	~	~	~	Pressed	Disabled	~	
Button	Hide	Draw	Draw Focus	~	~	~	No Panel	Two Tone	Top	Bot	Left	Right	Toggle	Pressed	Disabled	~	
Data Bit	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
Defaults	**Hide**	**Draw**	**Draw Focus**	**Redraw**											**Disabled**		

Drawing Shapes

Arc (Pie)

This command allows you to draw an arc which is a segment of a circle. To better understand this command, imagine a circle that will not appear on your arLCD screen. Like the picture below, think of the light blue circle to be invisible and the arc, shown black, is what will appear on the screen. The arc can also be filled which gives a pie command.

Command:

lcd.arc(radius, start, end, fill);

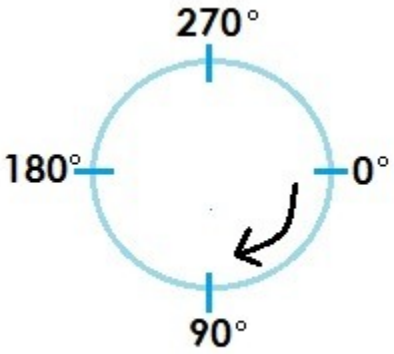
Parameters:

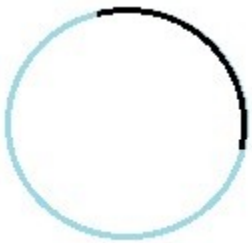
radius is the length in pixels from the center of your imaginary circle to its perimeter or edge

start is the angle in degrees the arc will begin drawing **clockwise**

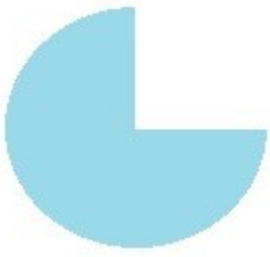
end is the angle in degrees the arc will stop (angles range from 0-359)

Fill by default is set to 0. **0 = no fill, 1 = fill**





ARC



PIE

Box (Rectangle)

This command draws a box starting at the current xy position.

Command:

lcd.box(width, height, fill);

lcd.rect(x, y, width, height, fill);

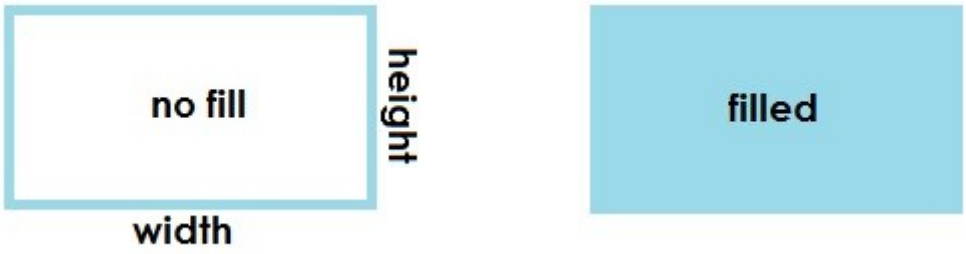
Parameters:

x and **y** are the points on the screen the box will be drawn from if used.

Width is the horizontal length of the box in pixels

Height is the vertical length of the box in pixels

Fill by default is set to 0. **0 = no fill, 1 = fill**



Circle

This command draws a circle at the current xy position or the specified position.

Command:

lcd.circle(radius, fill); 'circle from current xy with radius and fill options

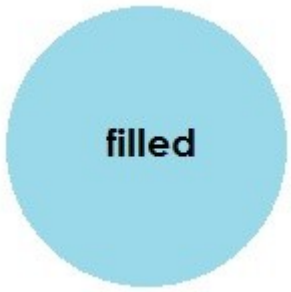
lcd.circle(x, y, radius, fill); 'circle from specified xy with radius and fill options

Parameters:

x and **y** are the points on the screen the box will be drawn from if used.

Radius is the length in pixels from the center of the circle to its perimeter or edge

Fill by default is set to 0. **0 = no fill, 1 = fill**



Line

The line command draws a straight line on the screen.

Command:

lcd.line(x, y);

Parameters:

x and **y** are points on the screen the line will be drawn to from the current position.

Line Type

This command allows you to change the line style you want to draw in.

Command:

lcd.lineType(option);

Parameters:

options is the number value set to the different type of lines.

0=solid line, _____

1=dotted line, ...

2=dashed line, - - - - - - - - - - - -

Line Width

This command allows you to change the thickness of the line you are drawing.

Command:

lcd.lineWidth(width);

Parameters:

width is the thickness of the line. 1 = thin, 3 = thick

Plot (Point)

Plotting a point means to designate a location on the screen where you would like to start drawing. A plot coordinate is one pixel size. The arLCD has a resolution of 320x240. So think of the x coordinate as the horizontal axis of the screen (0-319) and the y coordinate as the vertical axis of the screen (0-239). The origin of the (0,0) coordinate is at the top left the screen.
The current color (fcolor) is used.

Command:

```
lcd.plot( );              'plot to current x, y

lcd.plot( x, y );         'plot to specified x, y

lcd.point( );             'plot to current x, y

lcd.point( x, y );        'plot to specified x, y
```

Parameters:

x and **y** are the coordinates to which a pixel is placed.

Picture

The picture command displays a picture on the screen a the specified location. The picture can be GIF, BMP or JPEG. GIF is the smallest and fastest format. The picture should be resized to fit the screen properly. Sending huge files that don't match the screen size can crash the GPU.

Command:

lcd.picture(x, y, picture); 'image.gif, image.jpg, image.bmp

lcd.picture(x, y, options, picture);

Parameters:

x and **y** is point on the screen the picture will start being drawn.
Options are 0=none, 1=centered, 2=downscaled, 3=both.

Fonts

To be able to print text on to the display screen a reference must be made to a FONT. There are internal fonts and external fonts. Internal are very fast but only come in 2 sizes (1=Small and 2=Medium)

Fonts are set with the Font command.
Internal Font:
lcd.font(1); //internal small
lcd.font(2); //internal medium (also default which is 0)

External Font: (in directory \EZSYS\FONTS)
lcd.font(“Serif24”); //external font Serif24 point font

Widgets that have text require a font to be defined prior to being created. Since there can be a lot of widget there can be 16 widget fonts defined. They have an ID included in the definition.
Widget Fonts use the FONTW command.
Internal Font:
lcd.fontw(1, 1); //widget font 1 is set to internal small font
lcd.fontw(7, 2); //widget font 7 is set to internal medium font

External Font: (in directory \EZSYS\FONTS)
lcd.fontw(2, “Serif24”); //widget font 2 is set to external font Serif24 point font

Font orientation is set with fonto. Setting it to 1 would rotate the text.
lcd.fonto(0);
We recommend to leave it set to 0.

Theme

Themes are color schemes of your widget. Without a good theme, your widgets will not appear as what they are supposed to be on the screen. Manipulating the colors in the theme command will give your button more dimension to make it seem more realistic. To better understand this, download the Theme Generator BETA and play around with the different options.

Note: Not all of the parameters in the theme command effect every widget the same way. Some widgets use only a few theme parameters while others utilize all of them.

Command:

lcd.theme(ID, DE, LE, TC0 , TC1, TCD, C0, C1, CD, BKC, FontW);

Parameters:

ID this is the theme ID number. This needs to be a unique number from all other Theme IDs.

DE – Dark Emboss Color This is the part of you widget where you would imagine the shadow will fall if there was a light hitting it.

LE – Light Emboss Color This is where you can imagine where the light would hit your widget

TC0 – Text Color 0 Color of the text

TC1 – Text Color 1 Color of the text

TCD – Text Color Disabled Color of the text when the widget is disabled

C0 – Color 0 The color for a general part of the widget

C1 – Color1 The color for a general part of the widget

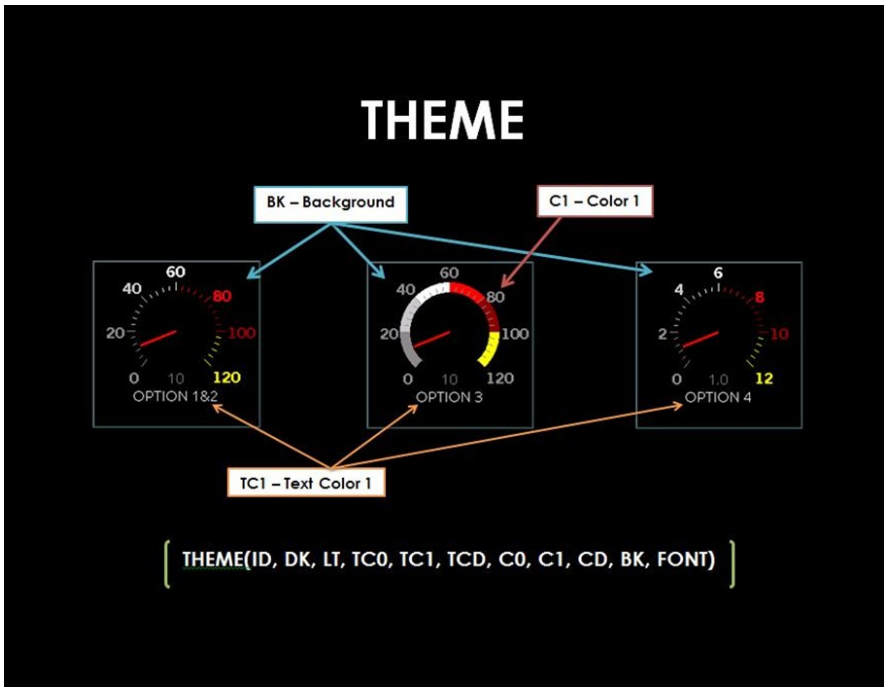
CD – Color Disabled The color of the widget when it is disabled

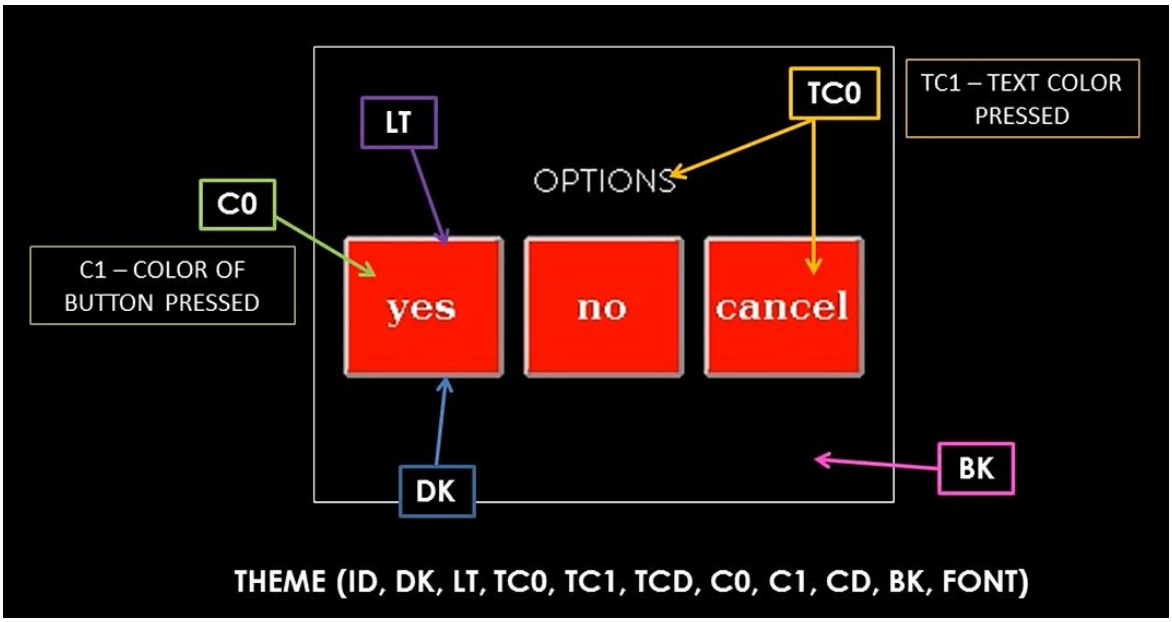
BKC – Background Color

FontW – Font ID. The font you want to use for the widget. Font IDs must be established before the theme command.

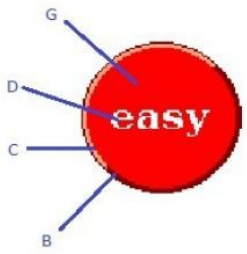
WIDGET	ID A	Emboss Dark Color B	Emboss Light Color C	Text Color 0 D	Text Color 1 E	Text Color Disabled F	Color 0 G	Color 1 H	Color Disabled I	Common Background Color J	K=Font
AMETER		x	x	x	Label	x	Back	Top Text Option 3	x	x	
BUTTON		bot	top	up	down	disabled	up	down	disabled	x	
CHECKBOX		top	bot	check/text	x	disabled	box	x	box	back	
RADIO		top	bot	check/text	x	disabled	circle	x	circle	back	
DIAL		bot/button	top	x	x	x	dial	x	dial	x	
CHOICE		bot	top	x	text	x	button	x	x		
SLIDER		bot	top	x	x	x	slider	handle	slider	x	
PROGRESS		top	bot	text	x	x	Back	foreground	x	x	
STATIC		x	x	x	text	text	frame	x	x	back	
DMETER		x	x	text	x	x	x	frame	x	back	
GBOX		x	frame	text	x	disabled	x	x	x	back/text	

Table 1: Widget Parameters

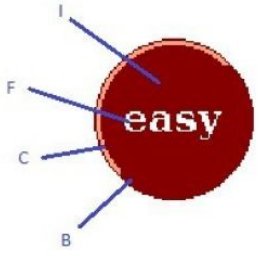




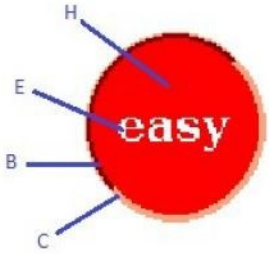
Choice



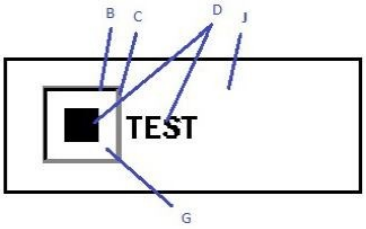
Unpressed



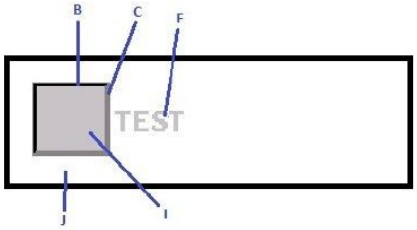
Disabled



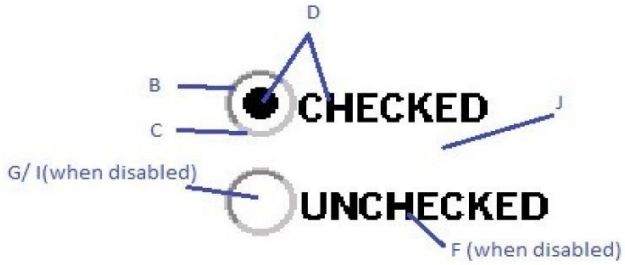
Pressed



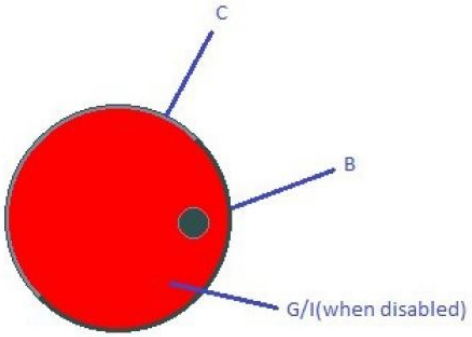
Checked



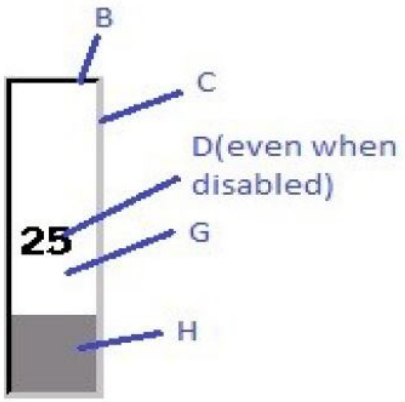
Unchecked



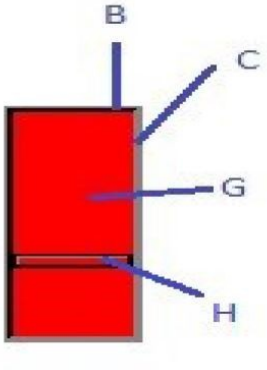
Radio Buttons



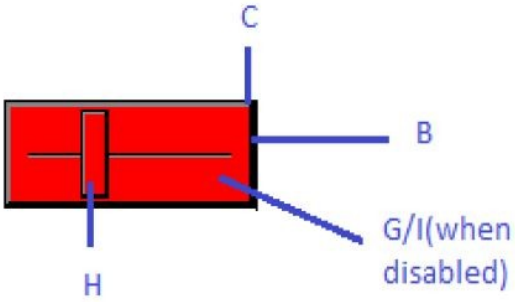
Dial



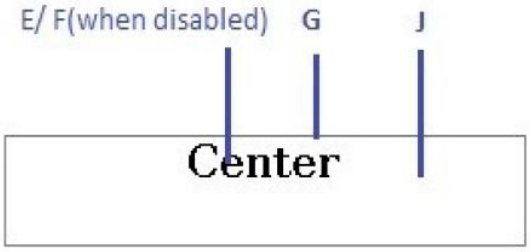
Progress Bar and Gauge



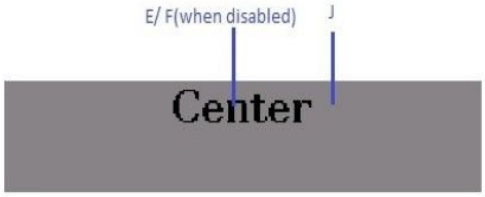
Scrollbar



Slider



Static Text (Active)



Static Text Disabled

Digital Meter

Widgets

Widgets are small components of an interface. On your computer, widgets are the calendar, clock and buttons on your display screen. Widgets have an ID to differentiate each of them. This is called the widget ID and can be from 1-99.

Only one widget can use an ID at a time. Clear screen will remove all widgets and clear all widget usage.

You can create many different kind of widgets as long as each ID is **unique** regardless of the widget type.
The ID of the widget is used to get responses about the widget or to change the widget after it is created.

Analog Meter

Analog meters are gauges, which you often see on weight scales or speedometers.

Command:

lcd.analogMeter(ID, x, y, width, height, options, initial, min, max, theme, stringID, type)

Parameters:

ID is an ID number, **1-99,** specified to a particular widget.

x & y values designate the location of the widget on the screen as the **XY** coordinate. Origin, (0,0), being the top left corner and (319,239) the bottom right.

width & height values designate the width and height of the widget in pixels.

options designates the DRAW options of the analog meter.

> **Option choices**: 1=draw, 2=disabled, 3=ring, 4=accuracy
> **Draw** prints the widget to screen.
> **Disabled** draws a widget that cannot be affected or changed by touch.
> **Ring** draws the widget with an arc'ed bar around numbers.
> **Accuracy** allows you to display numbers with a decimal point for more exact numbers. Uses 10 x times the actual value by the user because of integer math.

value designates the initial value setting of the needle on the meter.

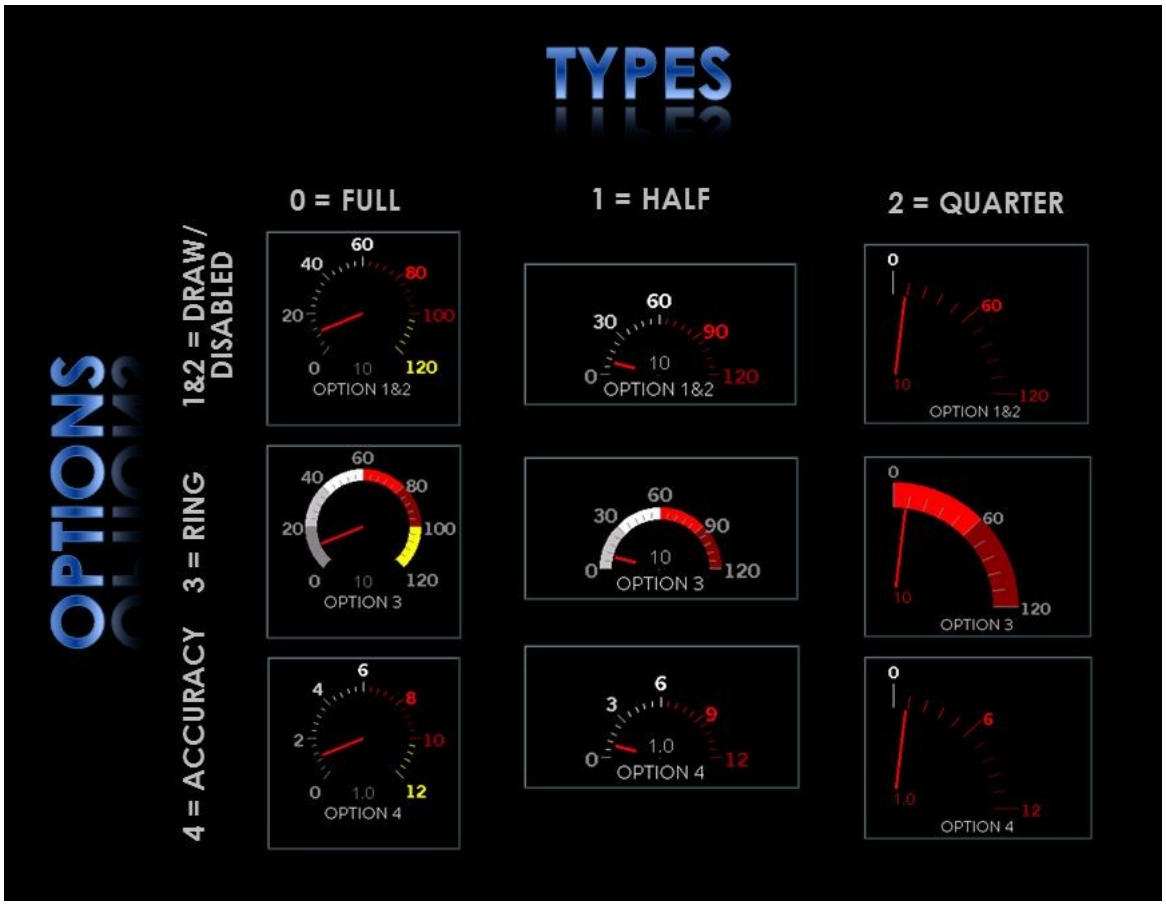
min designates the minimum value on the meter scale.

max designates the maximum value on the meter scale.

theme is the ID of the theme you want to use.

stringID designates the ID number of the text string that you'd like displayed below the meter.

type is the meter type/style you want to use. By default, the meter type is set to full. For the half size, you will need to adjust **width** to make the meter proportional. **Type choices**: **0=full, 1=half, 2=quarter.**


TYPES
OPTIONS
0 = FULL
1 = HALF
2 = QUARTER
1&2 = DRAW / DISABLED
3 = RING
4 = ACCURACY
OPTION 1&2
OPTION 3
OPTION 4

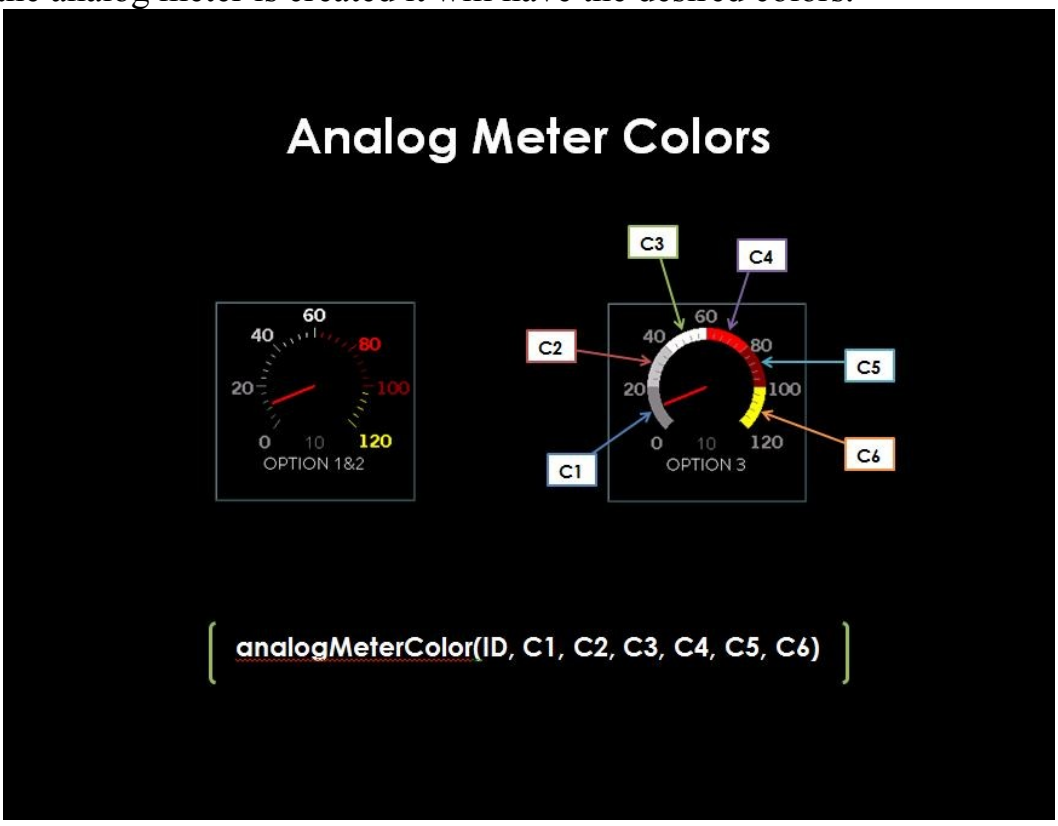
Analog Meter Color

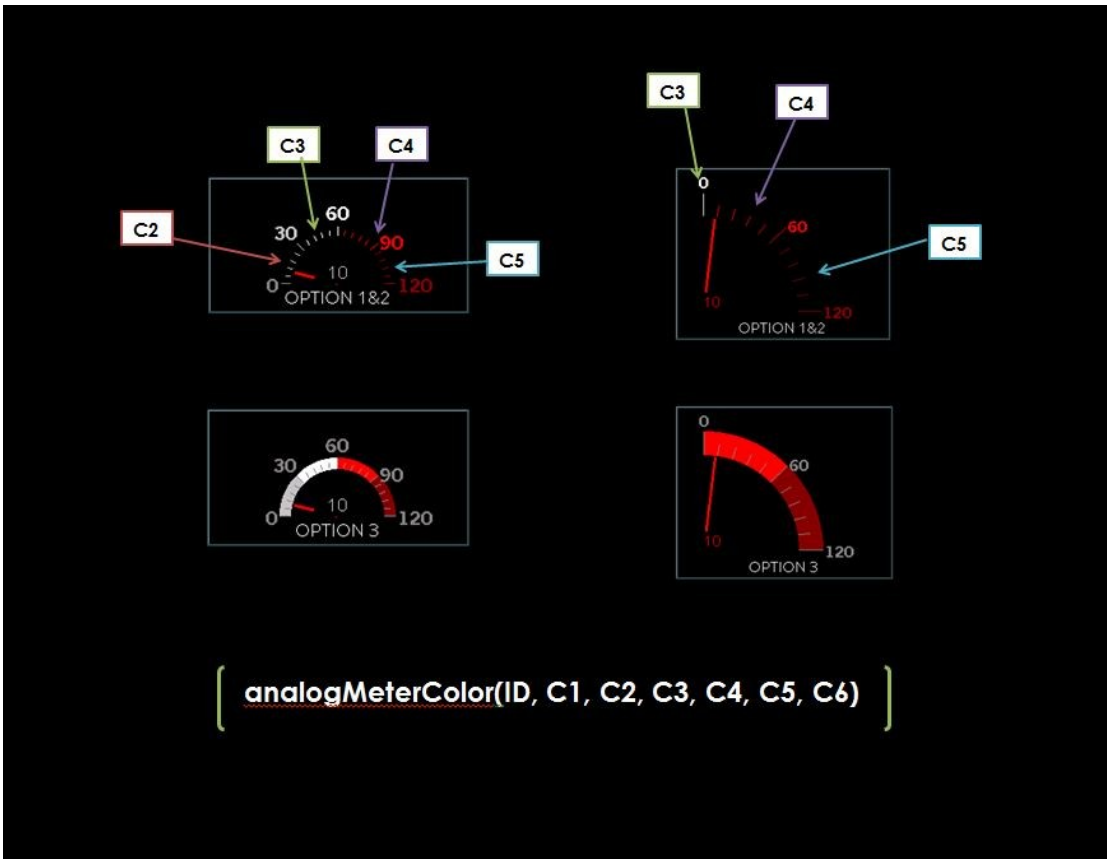
Analog Meter Color is a command that allows you to change the colors of the interval marks.

Command:
lcd.analogMeterColor(ID,color1,color2,color3,color4,color5,color6)

Parameters:
ID should be the ID of the analog meter you want to change.
color 1-6 changes the colors of the 6 "zones" of indicating lines and numbers of the meter arc. The zones start at **1** at the left end of the arc and **6** being the right end of the arc. For half meter type only *colors 3-5* are used. For quarter meter type only *colors 3-5* are used.

Hint: To change the color of an Analog Meter before its created use ID 101. Then when the analog meter is created it will have the desired colors.



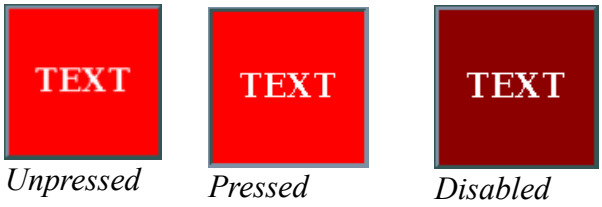

C3
C4
C2
C5
0
30
60
90
120
10
OPTION 1&2
C3
C4
C5
0
60
10
120
OPTION 1&2
0
30
60
90
120
10
OPTION 3
0
60
10
120
OPTION 3
analogMeterColor(ID, C1, C2, C3, C4, C5, C6)

Button

Button widget provides the user a simple way to trigger an event. You can use the button command to draw or make different size and shapes of buttons.

Command:
lcd.button(ID, x, y, width, height, options, align, radius, theme, string);

Parameters:
ID is an ID number, **1-99,** specified to a particular widget.
x and **y** values designate the location of the widget on the screen as the **XY** co-ordinate. Origin, (0,0), being the top left corner and (319,239) the bottom right.
width and **height** values designate the width and height of the button in pixels.
options designates the state of the button, whether it is pressed, disabled and etc. when its created
Option choices: 1=draw, 2=disabled, 3=toggle pressed, 4=toggle not pressed, 5=toggle pressed disabled, 6=toggle not pressed disabled.

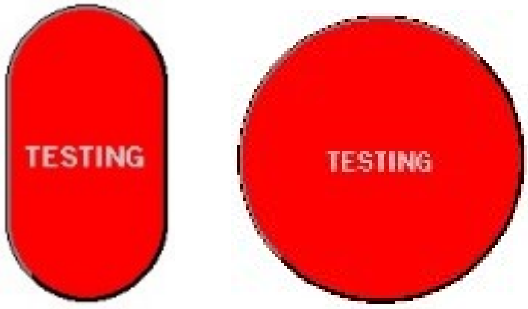


Unpressed *Pressed* *Disabled*

align value, designates the alignment of the text as it appears on the button.
Alignment choices: 0=centered, 1=right, 2=left, 3=bottom, 4=top.

Left *Center* *Right* *Top* *Bottom*

radius designates the radius of the button's corners in pixels. A value of 0 creates a square corner, while a value that is half the length of one side will give a round button. To see some different shapes for buttons, run demo buttons.ezm.



Tall Button *Round*

theme value designates the widget theme
stringID designates the ID number of the text string that you'd like displayed on the button.
Note: To create multi-line text on buttons, use \n in the string contents. Example: string 5 "Wrap\nText" will appear on 2 lines.

Checkbox

This widget allows you to display a check box with a string next to it.

Command:
lcd.checkbox(ID, x, y, width, height, option, theme, string);

Parameters:
ID is the widget ID number.
x and **y** values designate the location of the widget on the screen as the **XY** co-ordinate. Origin, (0,0), being the top left corner and (319,239) the bottom right.
width and **height** values designate the width and height of the widget in pixels.
option designates the initial state of the checkboxes.
Option choices: 1=draw unchecked, 2=draw disabled, 3=draw checked, 4=redraw
theme the theme ID you want to use in order to change the colors on the widget.
stringID designates the ID number of the text string that you'd like displayed next to the box that indicates checked or not.

Choice

The CHOICE widget allows you to print a string and display buttons for the user to choose a response. The default CHOICE reply buttons are “yes”, “no”, or “cancel”. This widget is useful for asking simple “yes or no” questions without having to figure out coordinates, sizes, and etc. for buttons and strings.

Command:

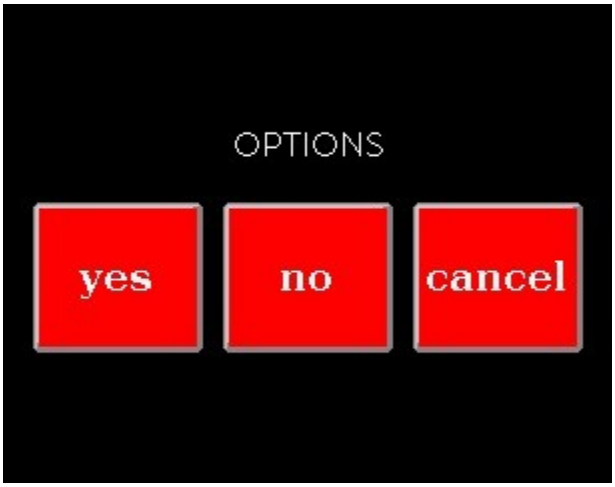
lcd.choice(string, theme, timeout);

Parameters:

string will be printed above the buttons. Please make sure to put the string in quotations marks. Also, the string cannot be substituted with a String ID.
Responses/Return Values: **0=no, 1=yes, -1=cancel**

theme only affects or will only change the colors for the buttons of the widget.

Timeout is time in milliseconds before giving up on waiting. Default is set for a long time.

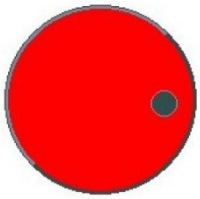


Dial

The DIAL widget allows you to display a dial that looks like an analog volume control found on stereo equipment.

Command:
lcd.dial(ID, x, y, radius, option, resolution, initial, max, theme);

Parameters:
ID is an ID number.
x and **y** values designate the location of the widget on the screen as the **XY** co-ordinate of the center of the dial.
radius values means that the radius of the dial is 75, which the diameter will be 150.
option designates the state of the dial. Option choices: **1=draw, 2=disabled.**
resolution designates the increments in the range. A resolution of 1 will be a value of every number, such as, 10,11,12,13,14,15.... has a resolution of **1**. A resolution of 3 for instance will show a value of 10,13,16,19.
value designates the initial dial value.
max value designates the largest value of the dial's input.
theme is the ID of the theme you want to use.



Digital Meter

The Digital Meter widget DMETER allows you to display a digital meter as in a panel meter.

Command:

lcd.digitalMeter(ID, x, y, width, height, option, initial, digits, dotpos, theme);

Parameters:

ID is an ID number

x and **y** values designate the location of the widget on the screen as the **XY** co-ordinate. Origin, (0,0), being the top left corner and (319,239) the bottom right.

width and **height** values designate the width and height of the widget in pixels.

option determines the alignment of the digits and whether the box is framed. Option choices: 1=left, 2=disabled, 3=right, 4=center, 11=left framed, 12=disable framed, 13=right framed, 14=center framed, 6=redraw.

value designates and displays the initial setting of the readout as it appears on the meter.

digits value designates the number of digits displayed on the meter.

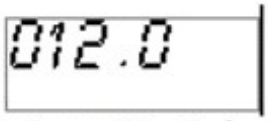
dp value designates the **dot position** of the decimal point from the 'right' most number.

theme is the theme ID you want to use (theme must be designated before the widget)

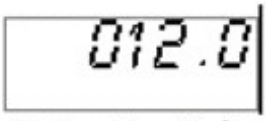
Option 1 = Left

Option 3 = Right

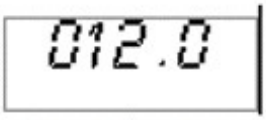
Option 4 = Center



Option 11 = Left Framed



Option 13 = Right Framed



Option 14 = Center Framed

Group Box

The groupbox widget generates a border/box and by changing the options positions the header text at different alignments. Group boxes help visually distinguish related items by framing them. The groupbox consists of a frame, title and a title background.

Command:

lcd.groupBox(ID, x, y, width, height, option, theme, string);

Parameters:

ID is an ID number.

x and **y** values designate the location of the widget on the screen as the **XY** coordinate. Origin, (0,0), being the top left corner and (320,240) the bottom right.

width and **height** values designate the width and height of the widget in pixels.

option determines the header alignments. (The options do not affect the contents' alignment) *Option choices:* 1=left,2=disabled,3=right,4=center

Option 1 = Left *Option 3 = Right* *Option 4 = Center*

theme is the theme ID you want to use (theme must be designated before the widget)

string is the ID number of the string you want as a header of the box.

Progress Bar

The PROGRESS widget allows you to display a progression bar at an initial state.

Command:

lcd.progressBar(ID, x, y, width,height, option, initial, range, theme, suffix);

Parameters:

ID is an ID number.

x and **y** values designate the location of the widget on the screen as the **XY** coordinate. Origin, (0,0), being the top left corner and (320,240) the bottom right.

width and **height** values designate the width and height of the widget in pixels.

option designates the option of the progress bar.

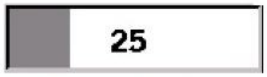
Option choices: 1=draw horizontal, 2=horizontal disabled, 3=vertical, 4=vertical disabled, 5=redraw horizontal, 6=redraw horizontal disabled, 7=redraw vertical, 8=redraw vertical disabled

value designates the initial value. By using the WVALUE command changes the initial value to a different one.

max value, 100, designates the maximum value that can be reached.

theme is the theme ID you want to use (theme must be designated before the widget)

string is the ID of the string you want to use.



Option 1 = Horizontal

Option 3 = Vertical

Gauge

The Gauge widget allows you to display a gauge at an initial state. It is similar to the progress bar but also allows negative numbers.

Command:

lcd.gauge(ID, x, y, width, height, option, value, min, max, theme, suffix);

Parameters:

ID is an ID number.

x and **y** values designate the location of the widget on the screen as the **XY** coordinate. Origin, (0,0), being the top left corner and (319,239) the bottom right.

width and **height** values designate the width and height of the widget in pixels.

option designates the option of the progress bar.

Option choices: 1=draw horiz, 2=horiz disabled, 3=vert, 4=vert disabled, 5=redraw horiz, 6=redraw horiz disabled, 7=redraw vert, 8=redraw vert disabled

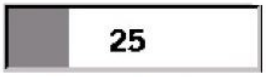
value designates the initial value.

min value, designates the minimum value that can be reached.

max value, designates the maximum value that can be reached.

theme is the theme ID you want to use (theme must be designated before the widget)

string is the ID of the string you want to use.



Option 1 = Horizontal

Option 3 = Vertical

Radio Button

The radio button widget allows you to display buttons for making a selection. Radio buttons differ from checkboxes in that only one button can be filled in at a time, while checkboxes can have many filled in at once. This makes radio buttons interconnected. If one button is checked then the others will go to or remain as an 'unchecked' state.

Command:

lcd.radioButton(ID, x, y, width, height, option, theme, string);

Parameters:

ID is an ID number.
Although radio buttons are connected as a group, each button still needs its own ID number.

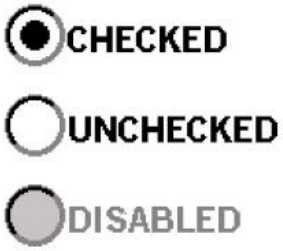
x and **y** values designate the location of the widget on the screen as the **XY** coordinate. Origin, (0,0), being the top left corner and (319,239) the bottom right.

width and **height** values designate the width and height of the entire widget in pixels which are the area that encompass the radio button and the string. The size of the radio button itself is defined by **height**.

option allow you to draw radio buttons checked, unchecked, or disabled. By disabling a button, the user will not be able to change its state. Options 4 (first checked) and Options 5(first unchecked) specify that it is the first button in a group. This allows you to have more than one group of buttons occupying the screen at the same time. When Options 4 or 5 are specified in a radio button command, the following buttons created will be in a group until another "first" button is defined. The buttons created after will be in the second group. If you make a button, "first unchecked", remember to draw one button in the group as "checked".
Option choices*:* 1=unchecked, 2=disabled, 3=checked, 4=FIRST unchecked, 5=FIRST checked

theme is the theme ID you want to use.

string designates the ID number of the text string that you want displayed on the button.


CHECKED
UNCHECKED
DISABLED

Slider

The slider widget allows you to display a vertical or horizontal slider or scroll bar that looks like a light dimmer. The slider widget components are the slider and a handle, also known as the thumb or indicator.

Command:

lcd.slider(ID, x, y, width, height, option, max, resolution, initial, theme);

Parameters:

ID is an ID number.

x and **y** values designate the location of the widget on the screen as the **XY** coordinate. Origin, (0,0), being the top left corner and (319,239) the bottom right.

width and **height** values designate the width and height of the widget in pixels.

option designates the options of the slider.

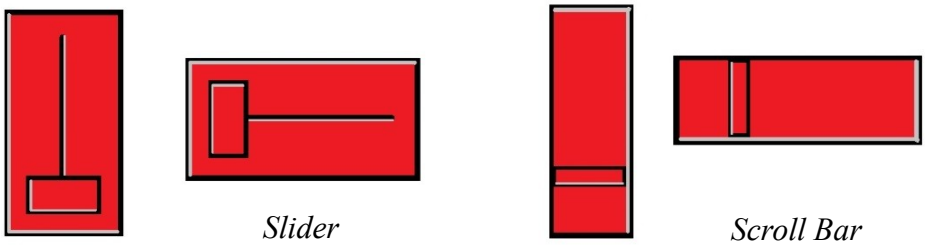
Option choices: 1=draw horizontal, 2=horizontal disabled, 3=vertical, 4=vertical disabled, 5=horizontal slider scrollbar, 6= disabled horizontal scrollbar, 7=vertical slider scrollbar, 8=disabled vertical scrollbar

max designates what the maximum value the slider can have

resolution is the increments or steps the indicator will move along the bar. ex. max = 10 & resolution = 5 then the only possible values are 0,5,10,

value designates the initial value of the indicator.

theme is the ID of the theme you want to use.



Slider *Scroll Bar*

Static Text Box

The static text box widget generates a framed text box with a string (or text) at different alignments. This command changes text within a box without having to overwrite its background.

Command:

lcd.staticText(ID, x, y, width, height, option, theme, string);

Parameters:

ID is an ID number.

x and **y** values designate the location of the widget on the screen as the **XY** coordinate. Origin, (0,0), being the top left corner and (319,239) the bottom right.

width and **height** values designate the width and height of the widget in pixels.

option designates the alignments of the static widget. Redraw clears the background of the assigned area then rewrites the text.

> *Option choices*: 1=left, 2=disabled, 3=right, 4=center, 5=left framed, 6=disabled framed, 7=right framed, 8=center framed, 9=redraw

theme is the ID of the theme you want to use.

string designates the ID number of the text string that you'd like displayed.

Touch Zone

Touchzone is similar to a button in action but without the button visualization. The user would typically place a graphic or text on the screen and create zones under specific parts of the graphic depending on what the function is. When the user touches these areas, the touchzone will indicate to the user that a touch has occurred and where.

Command:

lcd.touchZone(ID, x, y, width, height, option);

Note: There is no need for a theme or string as that would be user created without regard to the Touchzone widget.

Parameters:

ID is an ID number.

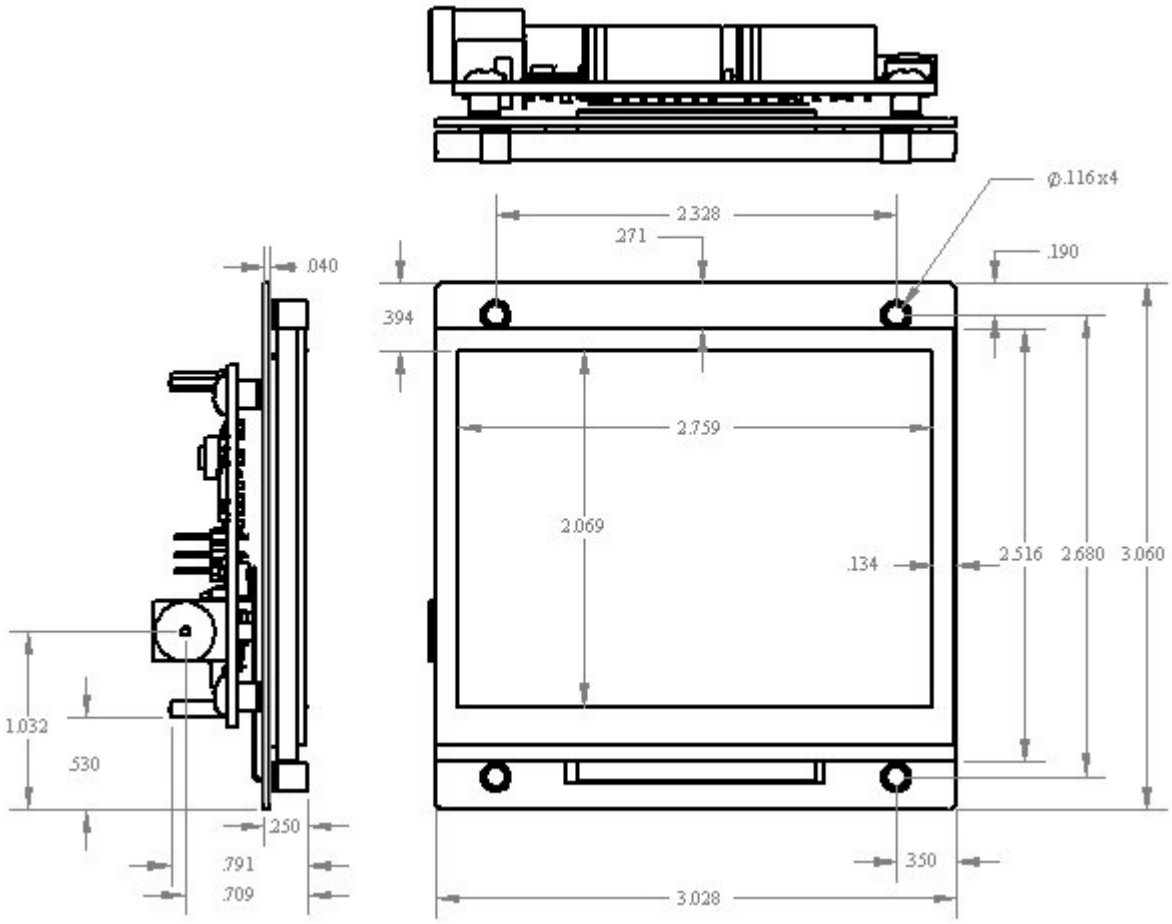
x and **y** values designate the location of the widget on the screen as the **XY** co-ordinate. Origin, (0,0), being the top left corner and (319,239) the bottom right.

width and **height** values designate the width and height of the widget in pixels.

option designates the "mode" of the touch zone being either enabled or disabled. When disabled, "touches" in the designated area on the screen, will do nothing.

Option choices: 1 = enable, 2 = disable

Mechanical Dimensions



Starting an arLCD Project

Starting your first, or any, project with your arLCD can seem daunting. Our goal was to make this easier, but here are a couple of pointers that will help you get set up quicker. Be sure to check out the Arduino website for tips and help on writing a sketch.

1) Search the web for examples of similar projects to yours. The Arduino community is vast and there is bound to be someone who had a similar idea to yours. Check out their code and tweak it to see how it works.
2) We have provided 25+ sample sketches. These should be a pretty good starting point for your project. Mix and match is how you learn new things.
3) Most devices require "power" and "ground" in order to function. The component's "power" and "ground" wires should correspondingly go into the arLCD's ground and power pins.
4) Writing a sketch may take a bit more time if you are not familiar with coding. However, don't fret, check out Examples and play around with them to see how it works. Also, Arduino has a page that helps with the basics on writing a sketch. Provided below, is a sketch template that has important code that you need to run a sketch on the arLCD.
5) Template

```
#include <ezLCDLib.h>

ezLCD3 lcd; // create lcd object

void setup(){//use the setup function to initialize the display
  lcd.begin( EZM_BAUD_RATE );
  lcd.cls();
  lcd.printString("\\[50x\\[50y\\[4mTemplate");
  //your setup code goes here
}

void loop(){//loop function is the main part of your program
//your project code goes here
}
```