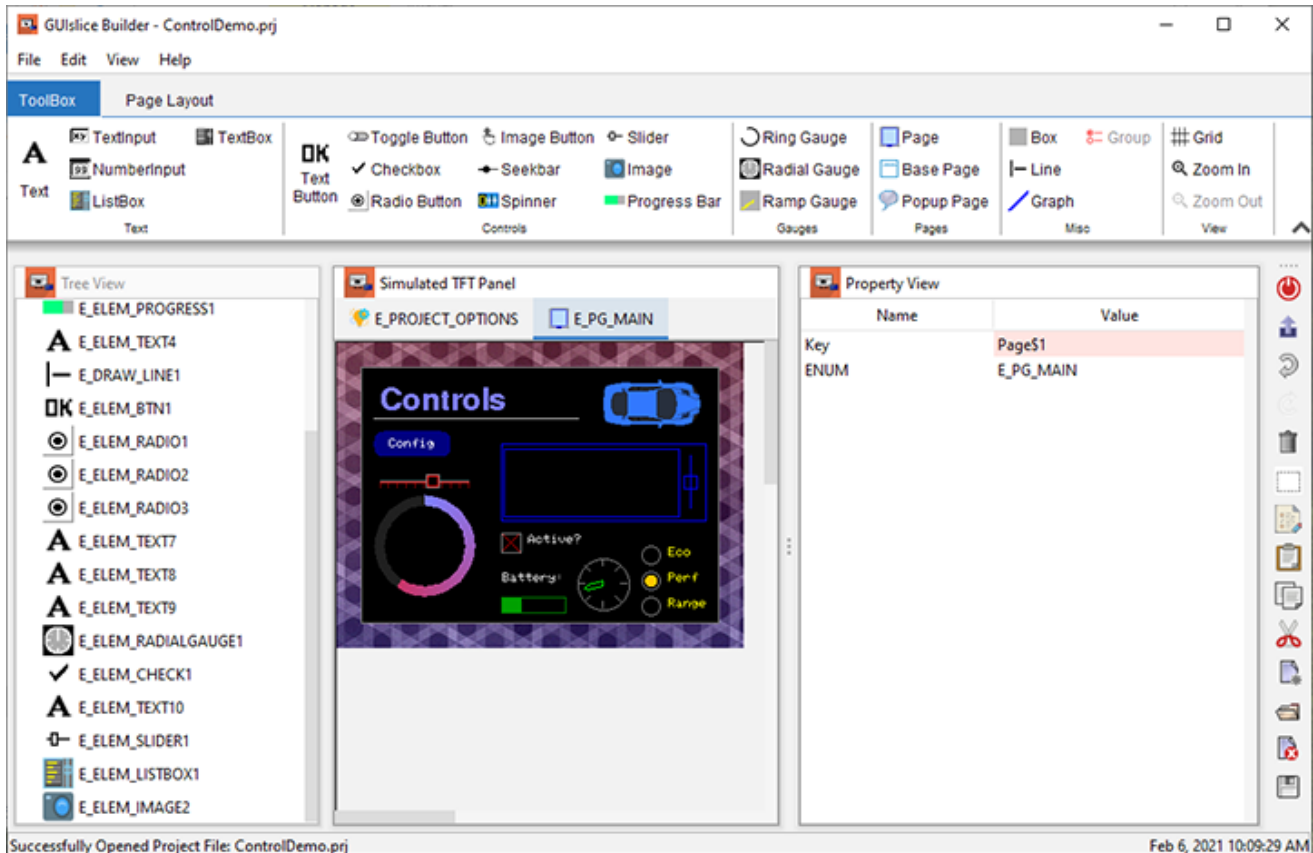


GUIslice Builder

User Guide

Ver: 0.17.b12



Publication date and software version

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1.0 Introduction

GUISlice library is a lightweight platform-independent GUI designed for embedded displays. While it can support other systems it started with support for use with Raspberry Pi and Arduino. It's written and supported by Calvin Hass. You can download the library and example files from github. See the wiki pages for more details.

GUISlice Wiki: <https://github.com/ImpulseAdventure/GUISlice/wiki>

It's a nice package but the embedded design choice to eliminate dynamic memory allocation does mean additional care must be taken in the user code to manage the data structures.

The GUISlice Builder creates a cross-platform desktop application that automates the boilerplate code generation and tracking of the UI pieces. For example, the Builder helps manage:

- Defines, enums, UI storage declarations
- Coordinates and dimensions of UI elements can be visually created
- Colors and fonts can also be modelled within the Builder

The net result is that the Builder allows users to layout their UI visually and enables boilerplate GUI code to be generated quickly with a drag-and-drop desktop application and save the user from some of the bookkeeping and potential errors that might otherwise come up.

It generate a skeleton file for your Graphics Library, either 'project.ino' for Arduino IDE, or main.cpp for PlatformIO, or 'project.c' for Linux. A 'project_GSLC.h' header file will also be created for Arduino IDE and PlatformIO IDE projects but generally, you won't need to view or edit this file.

Graphics packages are defined inside builder_fonts.json file since your chosen package mostly affects font handling. Refer to Appendix B Font File Format for more details.

Currently we ship with support for these Graphic Packages.

- Adafruit_GFX
- M5Stack
- ILI9341_t3
- TFT_eSPI
- UTFT
- Linux SDL1, SDL2 and TSLIB

You switch to these using the E_PROJECT_OPTIONS's property view. You can set the default value for new projects inside User Preferences General Tab. This is available by selecting Edit menu and then Options.

The Builder supports the Arduino IDE and PlatformIO IDE. You may choose this inside General Tab mentioned above or on a per project basis using the E_PROJECT_OPTIONS tab that appears next to the E_PG_MAIN tab. For more details about PlatformIO support see Chapter 6 - PlatformIO Configuration.

Both the User Preference General Tab and E_PROJECT_OPTIONS Tab support Users selecting a Color Scheme for your projects. See Chapter 7 for your choices.

Note it is also possible to add your own fonts by simply dropping them into the correct Builder's font folder. However, Smooth fonts (*.vfw") and Linux fonts would also require you to edit builder_fonts.json file. See section 5.6 Fonts and Appendix B Font File Format for more details.

Some MicroControllers like Arduino support UI Elements that are Flash based versions that reduce RAM requirements. See section 4.0 for details.

It should be noted that the Builder makes no attempt to support all GUIslice API calls or UI Elements. Simply a rich enough set to do useful work.

An important design goal was to allow for incremental (round-trip) revisions between user code updates and Builder visual element adjustments.

You will notice in the generated C code various tags inserted by the builder such as:

```
//<Save_References !Start!>  
//<Save_References !End!>
```

As long as you refrain from adding or modifying code between these auto-generated tags you can continue to add additional elements to your project and not lose any other edits you make.

The only exception is the button callbacks:

```
//<Button Enums !Start!>  
//<Button Enums !End!>
```

Here the builder will attempt to intelligently edit the callbacks to allow you to add or subtract options to your buttons like:

- Jump Page ENUM
- Popup Page Enum
- Hide Popup Page? See Section 4.19 Text Button for details of your button options and Appendix E Case Statement Generation for detailed examples of callback edits.

Remember, if you need to use any unsupported API calls or UI elements just keep them outside of the tags. This would be one reason why you would need to edit the 'project_GSLC.h' file so you can increase the storage for any unsupported UI elements.

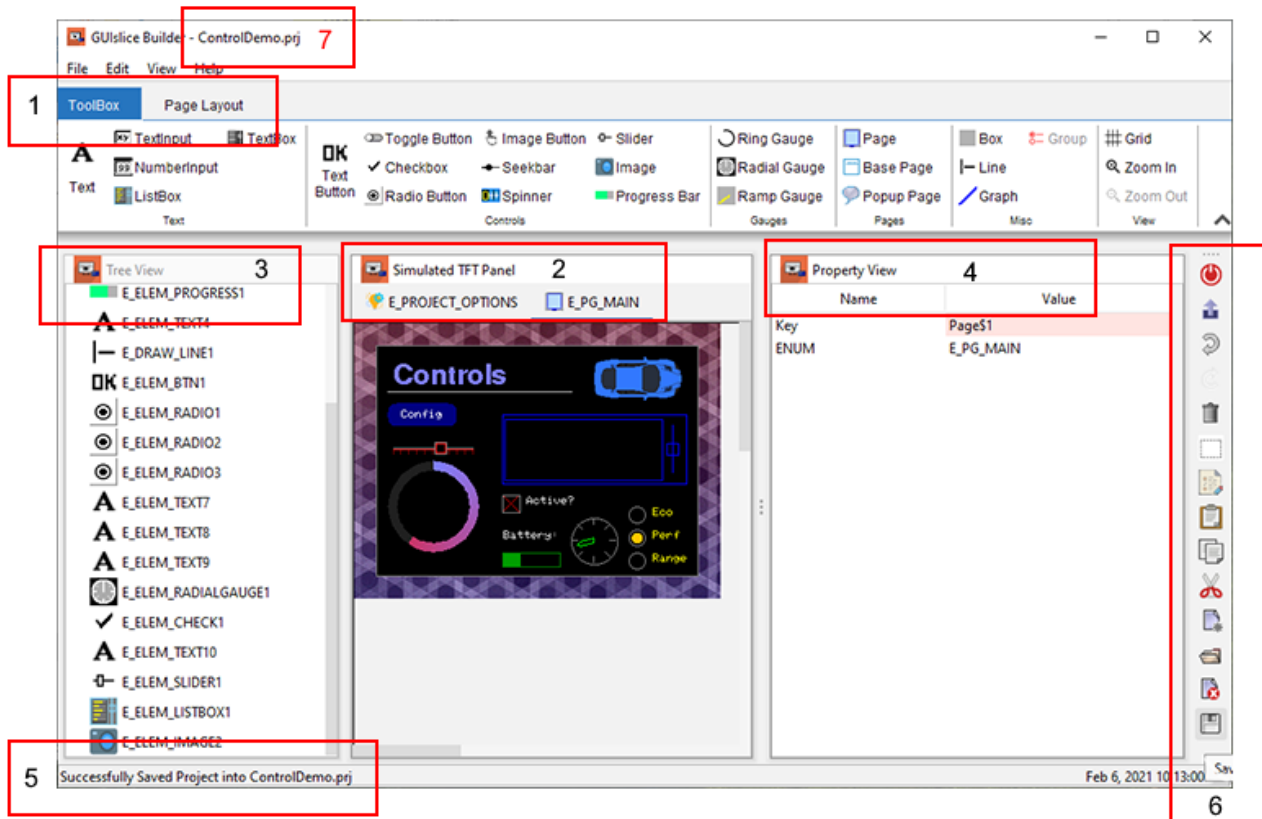
The Code Templates the Builder uses are exposed inside GUIsliceBuilder/templates. The two files are arduino.t and linux.t. Some documentation is included in Appendix D in case you need to make edits.

2.0 Getting Started

See the Builder's wiki for installation instructions:

Install: <https://github.com/ImpulseAdventure/GUIslice/wiki/GUIslice-Builder>

2.1 Builder Screen Layout



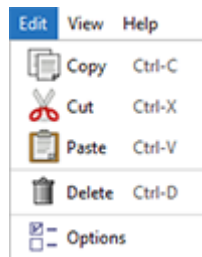
1. Tabs for Ribbon and Page Layout. Ribbon is where you select the UI Elements to drop on the TFT Simulation. Page Layout tab has icon buttons for aligning UI Elements on a page.
2. TFT Simulation is where you create your UI.
3. Treeview displays all elements you have selected in z-order of display.
4. Property View allows you to view and change various properties of the selected UI Element.
5. Status Bar will give confirmation messages, like your project has been saved.
6. Taskbar has the globally available buttons.
7. Displays the current project name.

2.2 Setting Screen parameters

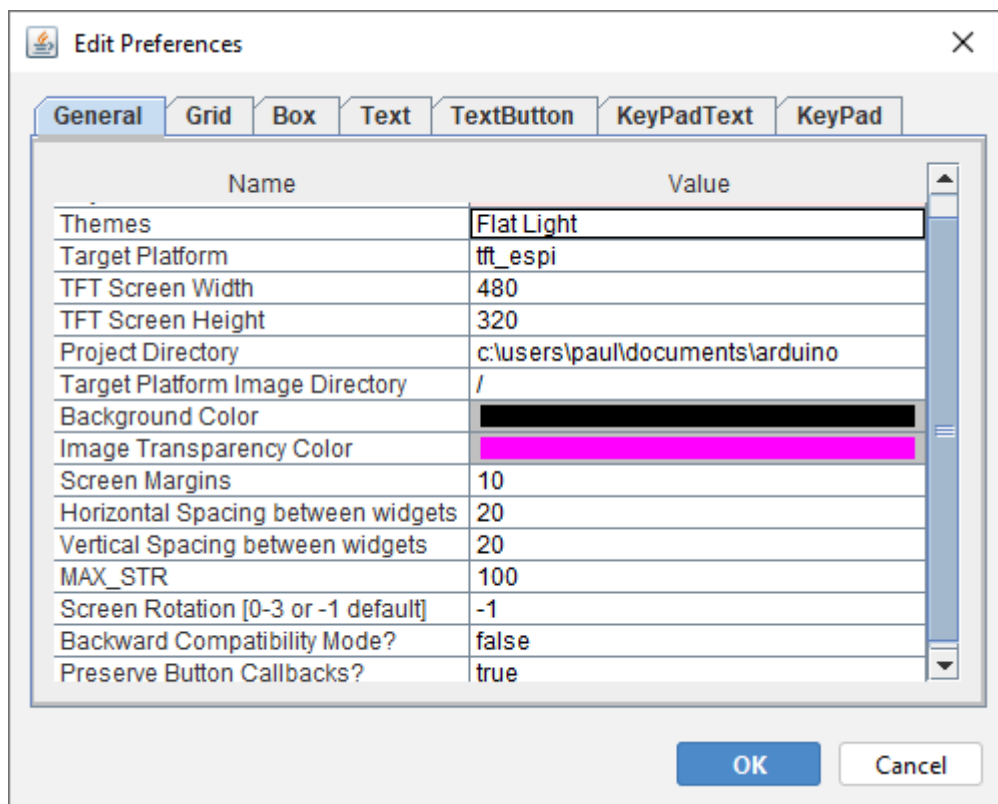
2.2.1 User Preferences

You must setup the builder for your target platform, screen's width and height; if its different than the default. You have two places where you can make changes.

Your User Preferences for All Projects are accessed by the menubar `select edit->options`:



You can set your target platform, your display's width and height, and point the project directory to where you will be storing output files. The directory must already exist. For Arduino users I suggest pointing to your sketchbook folder.



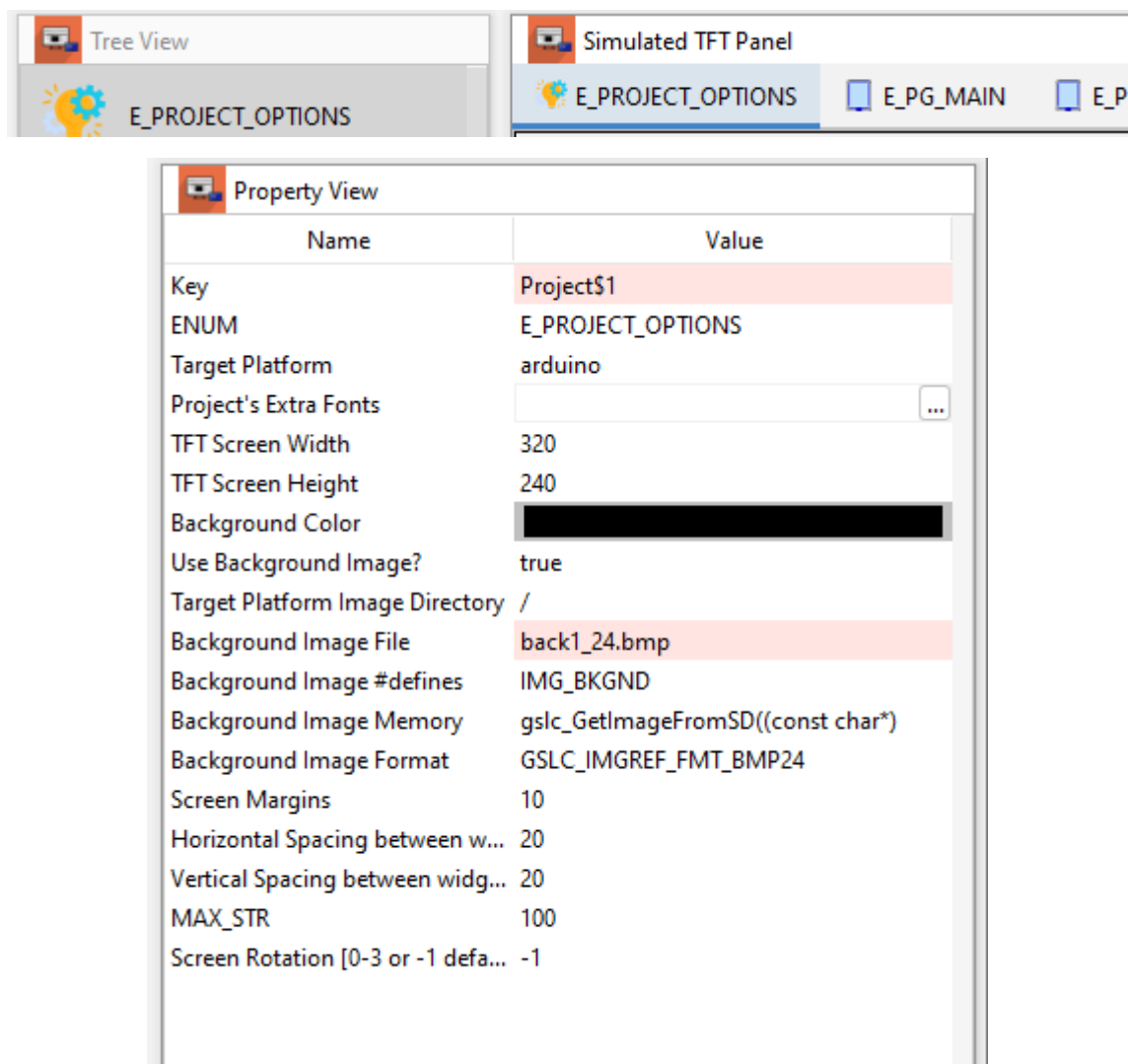
Any changes to your User Preferences will be used as defaults for any new projects you create.

The builder is initially setup for Adafruit's TFT 2.8 Display. It's display is 320px wide and 240px height.

See Section 5.2 General Preferences for details of the various settings.

2.2.2 Project Tab

You may also override your User Preferences on a per project basis by selecting the Project Tab or selecting E_PROJECT_OPTIONS in the TreeView. Any changes made here apply only to your currently open project and will be stored with your project UI Elements.




See 5.1 Project Options for details of the various settings.

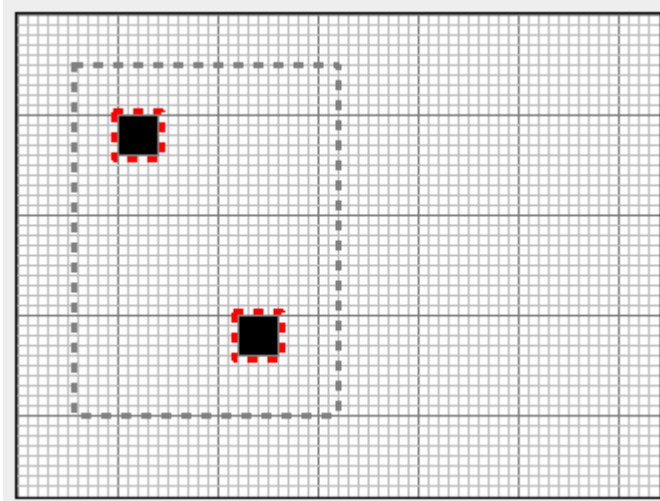
2.3 Creating your UI

Now that you have your builder setup you can start creating your UI.

Before beginning lets go over over the mouse selecting rules for the TFT Simulation:

- Left-click on an object deselects any existing selection and selects the object.
- Control Left-click on an object toggles its selection without affecting the selection of any other objects.
- Shift Left-click on an object selects it without deselecting any other objects.
- Right-click on a "Text" or "Label" property will bring up a mini-popup that lets you choose either to clear the text field or invoke the CharacterMap Dialog.
- Using the Rectangle Selection Tool  on the Page Layout tab will allow you to create a rubber band

by pressing down the left mouse button and keeping it down while you move the band over the a group of objects and will select them all. For Example:



UI elements can be moved by placing the cursor over a selected object and pressing and holding down left mouse button while dragging the object or group of objects to a new location. If you don't like the new location you can press the UNDO button.

For finer control over moving selected objects you can use the arrow keys pressing Alt-up arrow, Alt-down arrow, Alt-left arrow and Alt-right arrow to move one pixel at a time.

Now start by picking your first UI piece on the Toolbox. I suggest you first turn on the GRID using Ctrl-L. I also suggest not starting with a box that takes up your whole screen or the grid lines will be useless. Besides setting the background color has the same effect without interfering with UI design. If you want a preview of the UI without grid lines simply use Cntl-L again or the Page Layout tab's Grid control to toggle the grid on/off.

Say you start with a Text Button, you will notice its been randomly placed on the canvas. Using your mouse select this Text Button by moving the mouse pointer over the Text Button and clicking the left key. It will now have a dashed red rectangle around it to indicate its been selected. Now press and hold the mouse left key and drag the Button approximately where you want it. You can refer to section 3.4 Layout Band for using the various alignment controls for further alignment.

Off to the right of the TFT Simulation screen you will see all of the properties for this element. Anything with a rose color is something you can't edit. When you were dragging your button you might have noticed the x and y coordinates changing dynamically. Then when you released the mouse a slight jump occurred snapping the UI Button to the grid's snapTo points. Instead of dragging the Text Button around you could also have simply typed in the new x and y positions within the properties table. Modifying the x or y coordinates directly will also override the Grid's SnapTo and its Margin setting.

One thing you should consider as you add UI elements is changing the ENUM names for Button and any other element. It will make your life a lot easier if they have meaningful names.

For example, this new Text Button might be your QUIT button.













So change the ENUM from its default to E_ELEM_BTNQUIT, while also changing Text to Quit.

Also, any element you plan on directly accessing at runtime should have a meaningful element reference name. Like in example ex04_bld_ctrls where the text counter's reference is named m_pElemCount. By the way the 'm_' signifies a global variable and the lowercase 'p' means a pointer.

3.0 Using UI

3.1 Main Parts

Taskbar

This will open an existing project.	
Saves current project button.	
Undo will recover from any recent changes to your project.	
Redo will allow a replay of your previous undo(s).	
Delete allows removal of a element. You can only select a page for deletion by selecting it inside the treeview or on the page tabs. You must, however, have removed all elements from the page before attempting a deletion. Furthermore you are never allowed to delete the first or main page.	
Rectangular Selection creates a rubber band that you can drag over UI elements to select them. You start by pressing and holding the left mouse button then dragging the rubber band over yourUI Elements. Once you release the left mouse button the transaction ends.	
Copy Properties to other UI Elements	
Copy will copy selected UI Elements to the clipboard.	
Cut will copy selected UI Elements to the clipboard and delete them from the current page.	
Paste will copy UI Elements from the clipboard to the current page. You may use that Page tabs to move to a new page. The copied Elements will be slightly offset from the original copied positions. This is to avoid placing them directly on top of the original Elements.	
Export the generate code skeleton for the current project.	
Exit the builder.	

Toolbox Tab

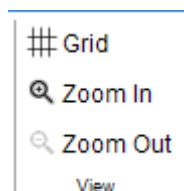
ToolBox

Page Layout

This is broken into bands Text, Controls, Gauges, Misc and View.

For Bands Text, Controls, Gauges and Misc See Section 4.0 for details of each UI Element.

View Band



The Grid button allows you to turn on/off the grid.

The Zoom In button will enlarge the size of the TFT Simulation.

The Zoom Out button will reduce your view of the TFT Simulation. Note: You can't make it smaller than your Target Platform's Screen Dimensions.

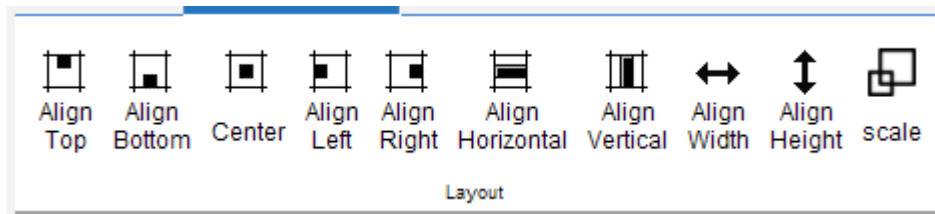
Page Layout Tab

ToolBox

Page Layout

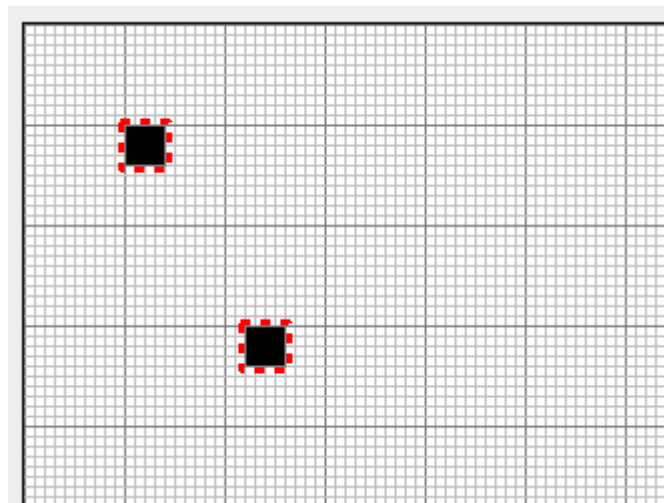
Contains Layout Band

Layout Band



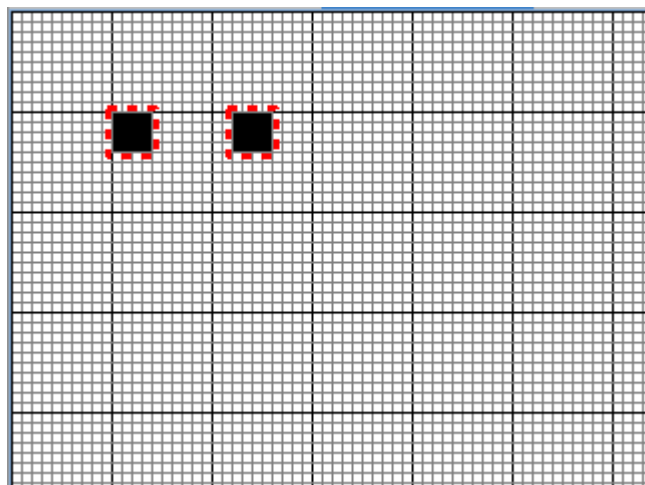
Align Top

The easiest way I can think of to show how to use the alignment buttons is with a couple of checkboxes. Go ahead and create two boxes it doesn't matter where they end up on the TFT Simulation.

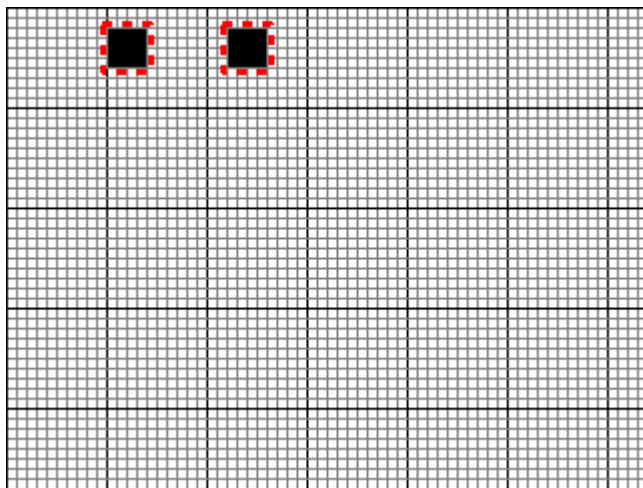


Now click the Align Top button.

This gives you:

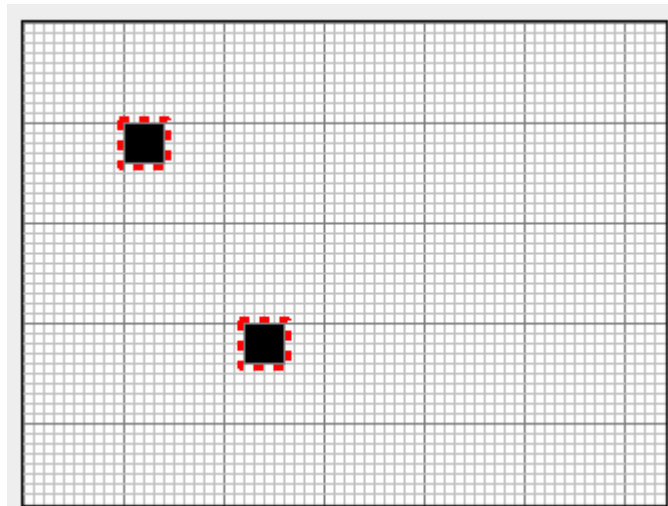


If you click it a second time the elements move to the top margin (set as a default of 10). You can change the size of margins in the General tab. You can click the UNDO button to get back to the original position and test the other alignment buttons.



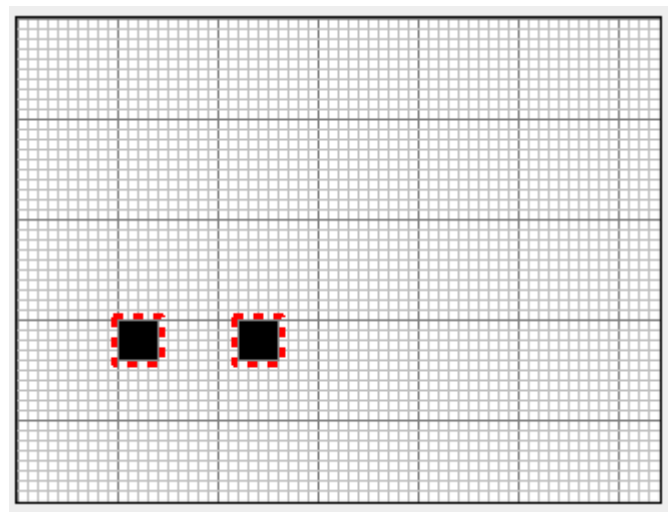
Align Bottom

Before:



Now click the Align Bottom button.

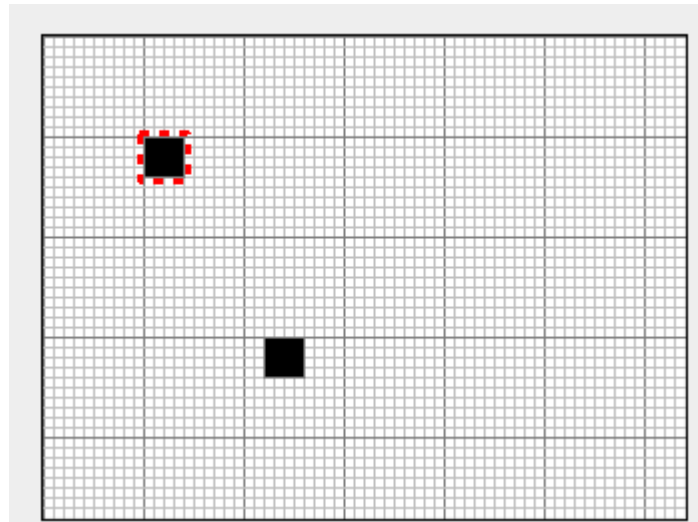
This gives you:



If you click it a second time the elements move to the bottom margin.

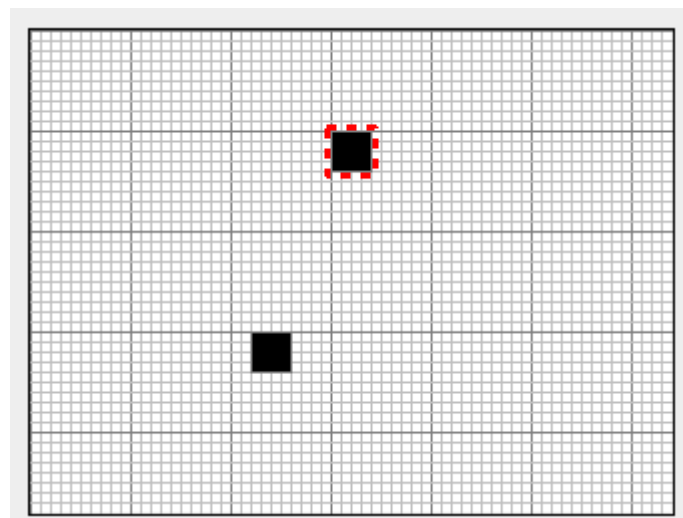
Align Center

You can only center one element at a time.



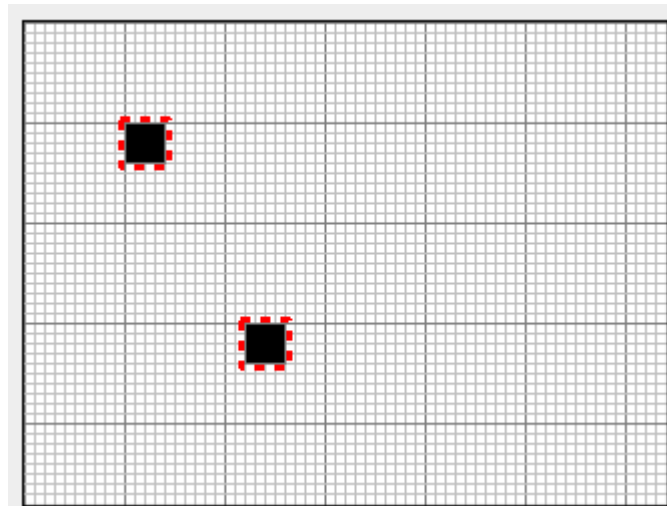
Now click the Align Center button.

This gives you:



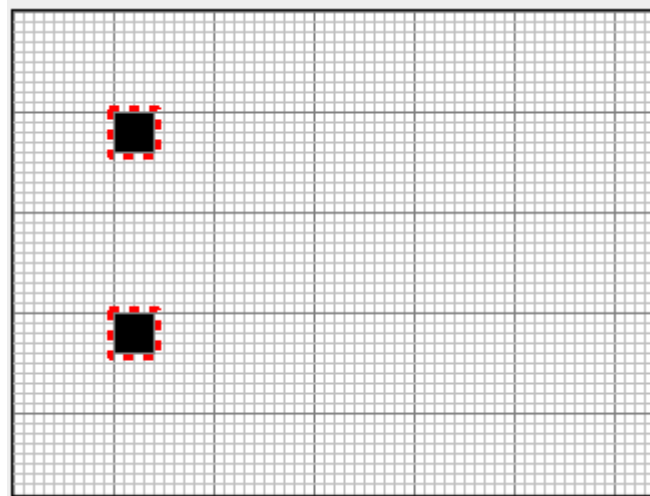
Align Left

Before:



Now click the Align Left button.

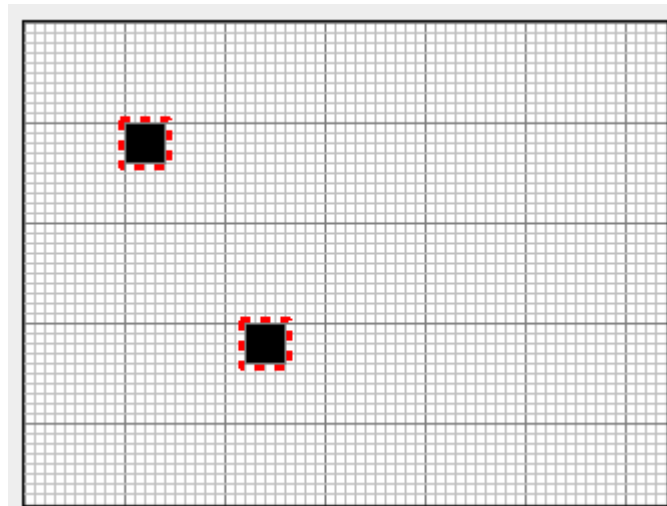
This gives you:



If you click it a second time the elements move to the left margin.

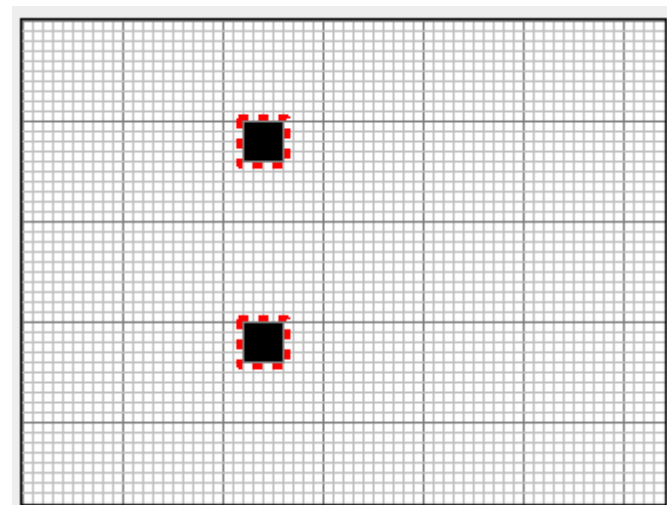
Align Right

Before:



Now click the Align Right button.

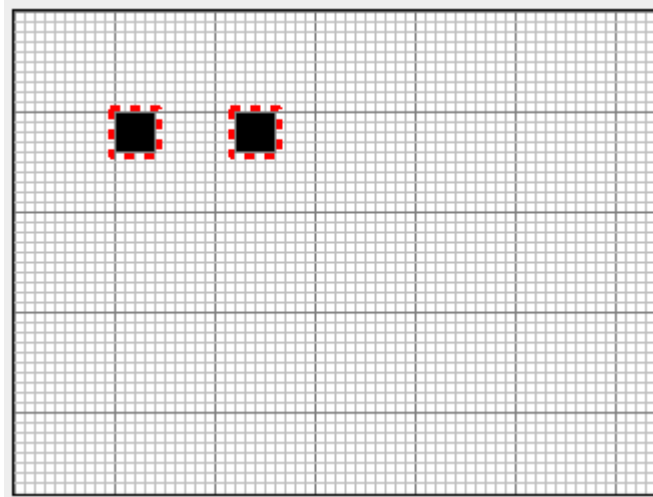
This gives you:



If you click it a second time the elements move to the right margin.

Align Horizontal Spacing

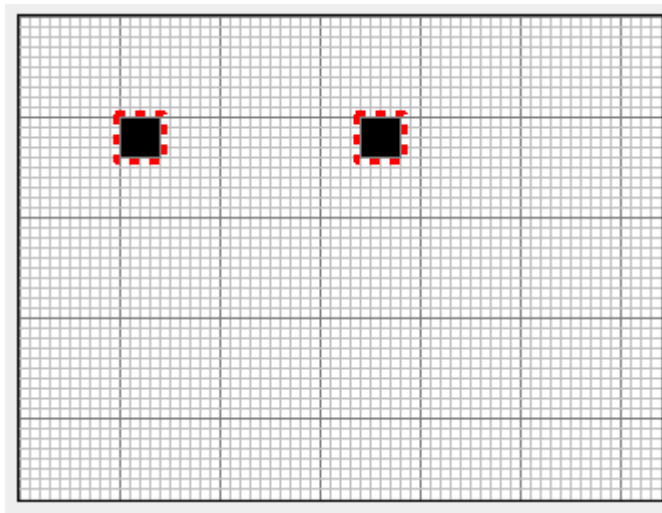
Before:



Now click the Align Horizontal Spacing button.

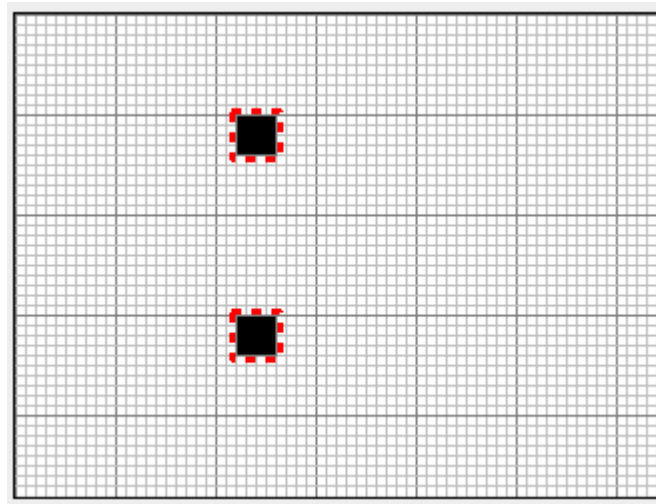
With:

This gives you:



Align Vertical Spacing

Before:



Now click the Align Vertical Spacing button.

With:

Enter spacing

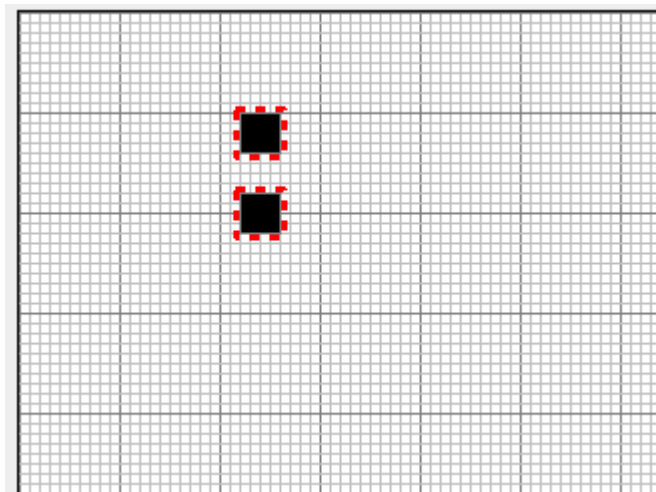
Enter vertical spacing in pixels

20

OK

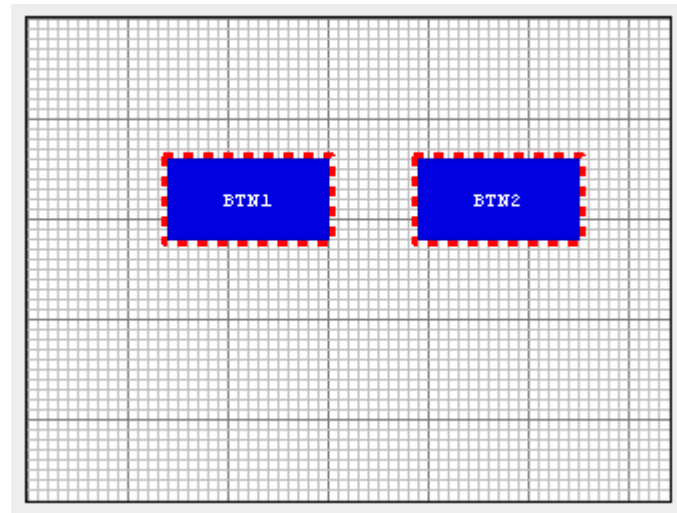
Cancel

This gives you:



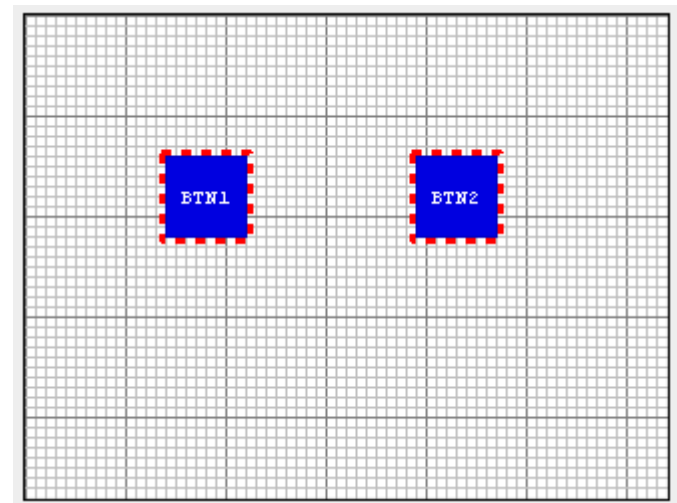
Align Width ↔

Before:



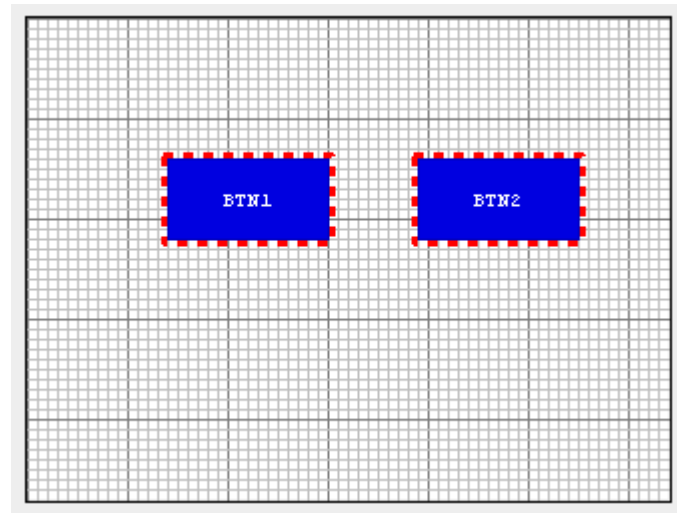
Now click the Align Width button.

This gives you:



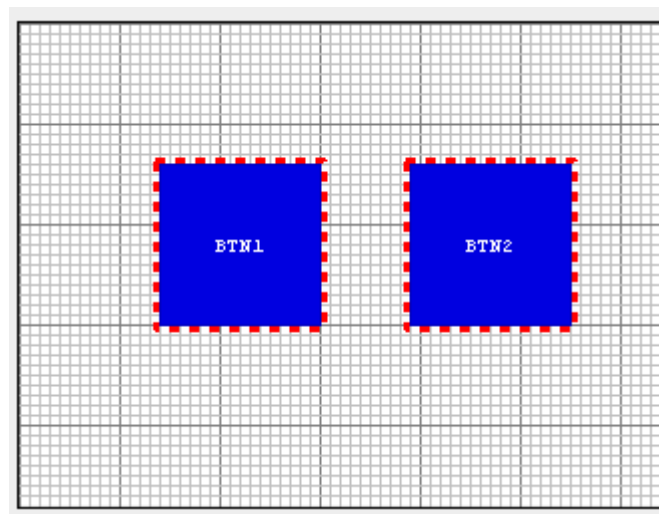
Align Height ↕

Before:



Now click the Align Height button.

This gives you:



Scale

Scale each element according to the supplied ratios this will change each element's width, height, x, and y positions.

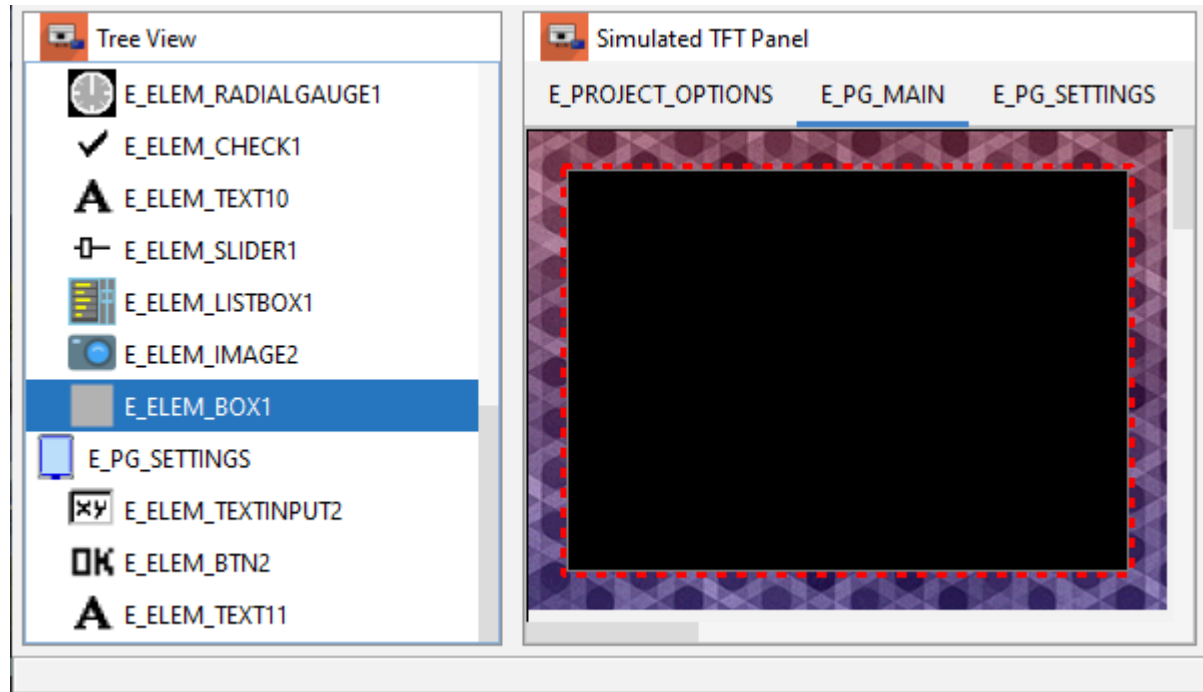
GLCD Fonts (BuiltIn) will be ignored since there is too much distance between them for scaling (8,16,24,32,40). However for other fonts an attempt is made to find a font that can scale to about the correct ratio or sometimes even an exact match. Nevertheless, Users may need to manually change fonts.

WARNING! If you are shrinking the screen size and you already have elements placed on page(s) you should not leave Project Options until you go to Tab Page Layout and use the Scale command. Otherwise, you may crash and burn showing pages since elements are likely to be placed beyond the screen size.

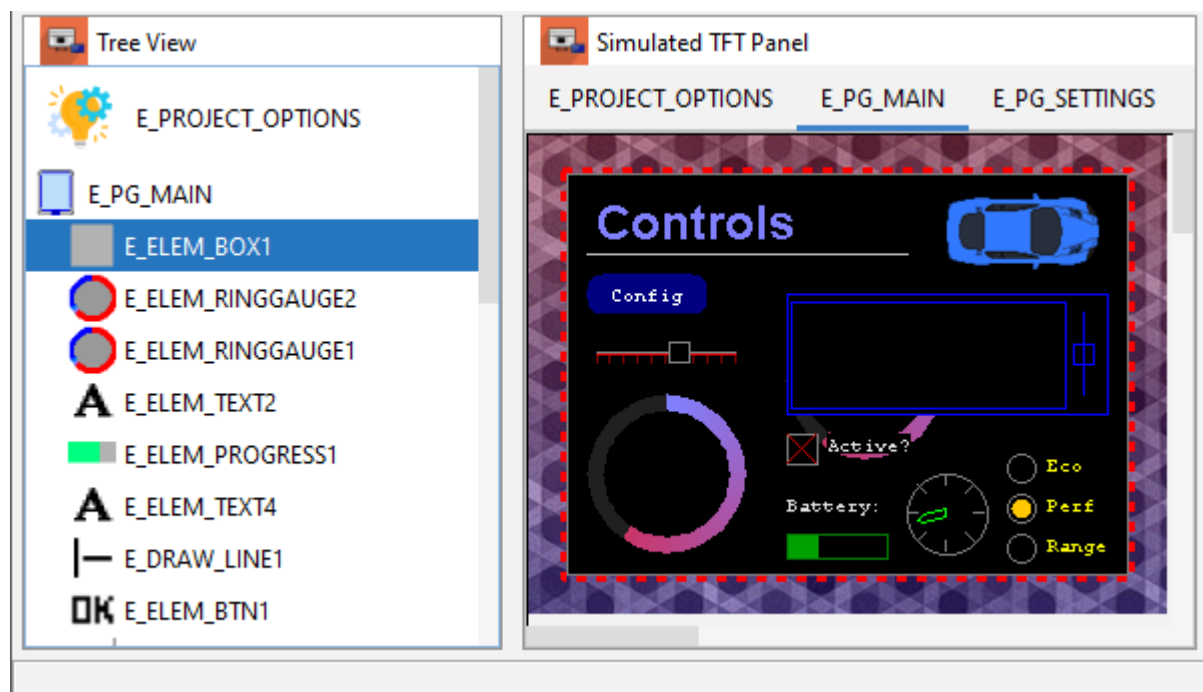
3.2 Z-Order

Images in GUIslice are placed one on top of the other. Drawing begins from the first UI element created to the last. This is referred to as Z-Order. This generally doesn't cause any issues but there are times you will need to change this Z-Order to avoid obstructing components.

For example, say you laid out most of you UI and then add a big box element on top of them like so:



Now the solution to this issue is to select the Box element in the Treeview and drag it up to the top just under the Page element. Now you will see this:



4.0 UI Elements

This section outlines the various properties you can set and their usage for each type of element. Images are discussed in section 5.4. During run-time any properties shown in a rose color are read-only.

Most of the UI elements also support a Flash version to minimize RAM usage. These UI Elements will have a 'Use Flash API?' property you can set equal to 'true'.

4.1 Common Properties

These are the basic common properties for all elements with the exception of Page.

NAME	VALUE
Key	Used Internally as an index key
Enum	Used by GUIslice API as a identifier. The Builder
	will create one for you but you should modify it to
	be meaningful for your program.
X	element X, Y Coordinates
Y	You can edit X,Y in place for precise positioning.
Width	element width in pixels
Height	element height in pixels
ElementRef	Allows runtime access to this element, if set,
	and like Enum should be set to something meaningful.

NOTE: Width and Height are system set to default values when placed on the TFT Simulation.

When you first create a UI Element you will be shown its set of Default Colors. GUIslice API has a different set of colors for each UI Element but you can override them and set to your preferences.

4.2 BOX

See example ex02_bld_btn_txt for a simple example. A more advanced example using draw and tick callbacks is ex06_bld_callback. If 'Touch Enabled' = true a button callback will be generated to detect users clicking on the box element.

```
// Common Button callback
bool CbBtnCommon(void* pvGui,void *pvElemRef,gslc_teTouch eTouch,int16_t nx,int16_t ny)
{
    gslc_tsElemRef* pElemRef = (gslc_tsElemRef*)(pvElemRef);
    gslc_tsElem* pElem = pElemRef->pElem;

    if ( eTouch == GSLC_TOUCH_UP_IN ) {
        // From the element's ID we can determine which button was pressed.
        switch (pElem->nId) {
//<Button Enums !Start!>
            case E_ELEM_BOX1:
                //TODO- Replace with button handling code
                break;
        }
    }
}
```

If the Draw Function is set to true a callback for drawing will be auto-generated for you and will look like:

```
bool CbDrawScanner(void* pvGui,void* pvElemRef,gslc_teRedrawType eRedraw)
{
    ...
    //TODO - Add your drawing graphic primitives
    ...
    return true;
}
```

You will need to add your custom drawing code in place of the TODO statement. For a timer interrupt enable the Tick Function. Here a Tick callback will be generated that looks like:

```
bool CbTickScanner(void* pvGui,void* pvScope)
{
    ...
    //TODO add your custom code here
    ...
    return true;
}
```

NAME	VALUE
Key	Box\$1
ENUM	E_ELEM_BOX1

NAME	VALUE
X	
Y	
Width	300
Height	150
ElementRef	
Corners Rounded?	false
Touch Enabled?	false
Draw Function	false, Set true Creates a CbDrawScanner callback
Tick Function	false, Set true Creates a CbTickScanner callback
Use Flash API?	false. set to true if you need to save ram

4.3 Checkbox ✓

You may have the Builder generated a callback by setting 'Callback Enabled?=true'. Then you will be notified when users mark or unmark checkboxes. It will look like:

```
bool CbCheckbox(void* pvGui, void* pvElemRef, int16_t nSelId, bool bState)
{
    ...
    switch (pElem->nId) {
        //<Checkbox Enums !Start!>
        case E_ELEM_CHECK1:
            Serial.print("Callback: Check[ID="); Serial.print(pElem->nId); Serial.print("]
state=");
            if(bChecked)
                Serial.println("true");
            else
                Serial.println("false");
            break;
        ...
    }
    return 1;
}
```

See example ex04_bld_ctrls.

NAME	VALUE
Key	CheckBox\$1
ENUM	E_ELEM_CHECK1
X	
Y	
Width	20
Height	20
ElementRef	
Checked?	false, Set true initial state as 'checked'
Check Mark Style	GSLCX_CHECKBOX_STYLE_X (default)
	GSLCX_CHECKBOX_STYLE_BOX
	GSLCX_CHECKBOX_STYLE_ROUND
Check Mark Color	Color.ORANGE Determines the color of check mark
Callback Enabled?	false
Use Flash API?	false. set to true if you need to save ram

4.4 Graph

See example ex11_bld_graph.

NAME	VALUE
Key	Graph\$1
ENUM	E_ELEM_GRAPH1
X	
Y	
Width	180
Height	120
ElementRef	m_pElemGraph1
Font	BuiltIn->5x8pt7b - Font to use for graph area
Maximum Points	0 Maximum number of points in buffer
Graph Style	GSLCX_GRAPH_STYLE_DOT - Dot, Line or Fill.
Color of Graph	Color.ORANGE Set color of graph dots or fill.

4.5 Line |—

See examples `ex07_bld_slider` and `ex24_bld_tabs` for using lines as dividers.

NAME	VALUE
Key	Line\$1
ENUM	E_DRAW_LINE1
X Start Point	
Y Start Point	
Line Length	50
Vertical?	false
Fill Color	GSLC_COL_GRAY_LT2

4.6 Image

See example `ex06_bld_callback`. Also `ex32_bld_spinner` for usage of a background image.

NAME	VALUE
Key	Image\$1
ENUM	E_ELEM_IMAGE1
X	
Y	
Width	
Height	
ElementRef	
Image	(ex: logo1_24.bmp)
Image defines	(ex: IMG_LOGO1_24)
Image Extern	used only for RAM based images
Image Memory	<code>gslc_GetImageFromSD((const char*)</code>
	<code>gslc_GetImageFromFile(</code>
	<code>gslc_GetImageFromProg((const unsigned char*)</code>
	<code>gslc_GetImageFromRam((unsigned char*)</code>
Image Format	GSLC_IMGREF_FMT_BMP24
	GSLC_IMGREF_FMT_BMP16
	GSLC_IMGREF_FMT_JPG
	GSLC_IMGREF_FMT_RAW
Transparent?	false, if true, support transparency provided
Touch Enabled?	false, If true a button callback will be created
Frame Enabled?	false
Frame Color	Frame color with this color

4.7 Image Button

See examples ex03_bld_btn_img and ex28_bld_btn_img_flash. For full details on your options see section 4.19 Text Button and Appendix E. The button callback will look like:

```
// Common Button callback
bool CbBtnCommon(void* pVGui,void *pvElemRef,gs1c_teTouch eTouch,int16_t nX,int16_t nY)
{
    gs1c_tsElemRef* pElemRef = (gs1c_tsElemRef*)(pvElemRef);
    gs1c_tsElem* pElem = pElemRef->pElem;

    if ( eTouch == GSLC_TOUCH_UP_IN ) {
        // From the element's ID we can determine which button was pressed.
        switch (pElem->nId) {
//<Button Enums !Start!>
            case E_ELEM_IBTN1:
                //TODO- Replace with button handling code
                break;
```

NAME	VALUE
Key	ImageButton\$1
ENUM	E_ELEM_IBTN1
X	
Y	
Width	
Height	
ElementRef	
Image	(ex: exit_n24.bmp)
Image defines	(ex: IMG_EXIT_N24)
Image Extern	
Image Memory	(ex: gs1c_GetImageFromSD((const char*))

NAME	VALUE
Image When Selected	(ex: exit_g24.bmp)
Image Select defines	(ex: IMG_BTN_EXIT_G24_SEL)
Image Select Extern	
Image Select Memory	
Image Format	GSLC_IMGREF_FMT_BMP24
Transparent?	false
Custom Code (optional)	Press button [...] to enter code (See section
	4.19 Text Button for Custom Code details)
Jump Page Enum	PAGE ENUM used for gslc_SetPageCur call
Popup Page ENUM	PAGE ENUM used for gslc_PopupShow call
Hide Popup Page?	false, set=true->gslc_PopupHide() current page
Frame Enabled?	false
Frame Color	Frame color with this color

4.8 Listbox

Displays a set of items (string values) and allows the user to select an item. See examples ex30_bld_listbox for a multi-column list and ex31_bld_listbox for a scrolling list of rows.

NAME	VALUE
Key	ListBox\$1
ENUM	E_ELEM_LISTBOX1
X	
Y	
Width	200
Height	100
ElementRef	m_pElemListbox1
Font	BuiltIn(1x)->5x8pt7b
List of Items	Press button [...] to enter list.
Storage Size	0 Auto set to correct size using the entered list
Selected Item	0
Items per Row	1
Display Rows	5
Item Gap	0
Text Margin Width	5
Text Margin Height	0
Text Alignment	GSLC_ALIGN_MID_LEFT

NAME	VALUE
Frame Color	Color.BLUE
Fill Color	Color.BLACK
Selected Color	Color.BLACK
Add Scrollbar?	true, false no scrollbar
Scrollbar Width	20
Scrollbar Thumb Size	5
Scrollbar ENUM	E_LISTSCROLL1
Scrollbar EREF	m_pListSlider1
Scrollbar Max Value	100
Frame Enabled?	true
Text Color	Color.WHITE

4.9 Progress Bar

Draws a progress bar element that represents a proportion value (nVal) between nMin and nMax. See examples ex04_bld_ctrls, ex05_bld_pages, ex06_bld_callback, ex24_bld_tabs, ex25_bld_popup, and ex32_bld_spinner.

NAME	VALUE
Key	ProgressBar\$1
ENUM	E_ELEM_PROGRESS1
X	
Y	
Width	50
Height	10
ElementRef	m_pElemProgress1
Vertical?	false, true its vertical bar
Minimum Value	0
Maximum Value	100
Starting Value	0
Gauge Indicator Color	Color.GREEN
Use Flash API?	false. set to true if you need to save ram

4.10 Radial Gauge

A circular gauge that can be used to show direction or other rotational values.

- Tick marks can be optionally drawn around the gauge.
- Size, color and fill of the needle can be configured. See example `ex09_bld_radial`.

NAME	VALUE
Key	RadialGauge\$1
ENUM	E_ELEM_RADIALGAUGE1
X	
Y	
Width	80
Height	80
ElementRef	m_pElemRadial1
Minimum Value	0
Maximum Value	100
Starting Value	0
Rotation Clockwise?	true
Tick Divisions	Default 8
Tick Size	Default 5
Tick Color	Default GRAY
Indicator Length	Default 20
Indicator Tipe Size	Default 3
Indicator File?	Default false
Gauge Indicator Color	Color.GREEN

4.11 Radio Button

You may have the Builder generated a callback by setting 'Callback Enabled?=true'. Then you will be notified when users mark or unmark radio buttons. It will look like:

```
bool CbCheckbox(void* pvGui, void* pvElemRef, int16_t nSelId, bool bState)
{
    ...
    switch (pElem->nId) {
        //<Checkbox Enums !Start!>
        case E_ELEM_RADIO1:
            // For the radio buttons, determine which ID is currently selected (nSelId)
            // - Note that this may not always be the same as the element that
            //   issued the callback (pElem->nId)
            // - A return value of GSLC_ID_NONE indicates that no radio buttons
            //   in the group are currently selected
            if (nSelId == GSLC_ID_NONE) {
                Serial.println("Callback: Radio[ID=NONE] selected");
            } else {
                Serial.print("Callback: Radio[ID="); Serial.print(nSelId); Serial.println("]
selected");
            }
            break;
        ...
    }
```

If you select multiple radio buttons you can use the 'Group' Control Tool to assign a unique GROUPID. The GUIslice API will then only allow one of the buttons to be checked. See example ex04_bld_ctrls.

NAME	VALUE
Key	RadioButton\$1
ENUM	E_ELEM_RADIO1
X	
Y	
Width	20
Height	20
ElementRef	
Checked?	false, Set true initial state as 'checked'
Check Mark Style	GSLCX_CHECKBOX_STYLE_ROUND (default)
	GSLCX_CHECKBOX_STYLE_BOX
	GSLCX_CHECKBOX_STYLE_X
Check Mark Color	Color.ORANGE Determines the color of check mark
Callback Enabled?	false
Use Flash API?	false. set to true if you need to save ram
Group ID	GSLC_GROUP_ID_NONE

4.12 Ramp Gauge

A gradient ramp (green-yellow-red) visual control similar to certain linear tachometers. See example `ex09_bld_radial`.

NAME	VALUE
Key	RadialGauge\$1
ENUM	E_ELEM_RAMPGAUGE1
X	
Y	
Width	100
Height	80
ElementRef	m_pElemRamp1
Minimum Value	0
Maximum Value	100
Starting Value	0
Tick Divisions	Default 8
Tick Size	Default 5
Tick Color	Default GRAY
Indicator Length	Default 20
Indicator Tipe Size	Default 3
Indicator File?	Default false
Fill Color	Color.BLACK

4.13 RingGauge

RingGauge creates display element similar to a donut-chart.

- The element has an outer and inner radius to create a ring appearance.
- The ring has an angular range defined by 'Angular Range°', which means that the ring can be configured to cover a full circle or just a portion of a circle.
- 'Starting Angle°' defines the starting angle and direction of fill.
- When drawing the ring within the angular range, it is composed of an active region (the angular region from the start to the current position value) and an inactive region (from the current value to the end of the angular range). The inactive region can be hidden (by setting it to the fill color).
- A text value can be drawn in the center of the ring, typically to show the current value. See example ex42_bld_ring.

NAME	VALUE
Key	RingGauge\$1
ENUM	E_ELEM_RINGGAUGE1
X	
Y	
Width	100
Height	100
ElementRef	m_pElemXRingGauge1
Font	BuiltIn(1x)->5x8pt7b
Field Size	10
Starting Angle°	0
Angular Range°	360
Clockwise Direction?	true

NAME	VALUE
Minimum Value	0
Maximum Value	100
Starting Value	0
Number of Segments	72
Line Thickness	10
Use Gradient Colors?	false
Flat Color	Color.RED
Gradient Start Color	Color.RED
Gradient End Color	Color.BLUE
Inactive Color	GSLC_COL_GRAY_DK2
Text Color	Color.YELLOW
Fill Color	Color.BLACK

4.14 Seekbar

The Seekbar is a modern Slider Control modelled after the Android version. It works the same as the Slider in Section 4.15 but with a different visual appearance. They're interchangeable.

See example `ex47_ard_seekbar` for the visual options and look over the examples for the Slider.

NAME	VALUE
Key	SeekBar\$1
ENUM	E_ELEM_SEEKBAR1
X	
Y	
Width	80
Height	30
ElementRef	m_pElemSeekBar1
Minimum Value	0
Maximum Value	100
Starting Value	0
Thumb Size	8
Thumb Color	GSLC_COL_BLUE_DK2
Add Trim?	true
Trim Color	GSLC_COL_BLUE_LT4
Add Frame to Thumb?	false
Thumb Frame Color	GSLC_COL_GRAY
Progress Bar Width	4
Progress Bar Color	GSLC_COL_BLUE
Remaining Bar Width	2
Remaining Bar Color	GSLC_COL_GRAY
Vertical?	false

NAME	VALUE
Tick Divisions	0
Tick Size	10
Tick Color	GSLC_COL_GRAY
Use Flash API?	false. set to true if you need to save ram.

4.15 Slider

The Slider allows the user to select a value by sliding the knob within the bounded value. The slider can show tick marks. When the Slider's callback is tied to a Listbox or Textbox it provides a scrollable view of the contents of these elements. See examples ex04_bld_ctrls, ex07_bld_slider, ex09_bld_radial, ex10_bld_textbox, ex31_bld_listbox, and ex42_bld_ring.

The Builder will generate a callback for when users move the thumb control. This will allow you to retrieve its position. It looks like:

```
bool CbSlidePos(void* pGui,void* pvElemRef,int16_t nPos)
{
    ...
    switch (pElem->nId) {
//<Slider Enums !Start!>
        case E_SLIDER_R:
            // Fetch the slider position
            m_nPosR = gslc_ElemXSliderGetPos(pGui,m_pElemSlider1);
            //TODO- Replace with slider handling code
            break;
        ...
    }
    return 1;
}
```

NAME	VALUE
Key	Slider\$1
ENUM	E_ELEM_SLIDER1
X	
Y	
Width	80
Height	20
ElementRef	m_pElemSlider1
Minimum Value	0
Maximum Value	100
Starting Value	0
Thumb Size	5
Vertical?	false

NAME	VALUE
Tick Divisions	10
Tick Size	5
Tick Color	Color.BLUE
Trim Style?	false
Trim Color	Color.BLUE
Frame Color	Color.GRAY
Fill Color	Color.BLACK
Selected Color	Color.BLACK

4.16 Spinner

A Spinner consists of

- a numeric counter text field
- increment and decrement button. See example ex32_bld_spinner. A callback will be generated so you can retrieve the counter value when it changes. The callback looks like:

```
bool CbSpinner(void* pvGui, void *pvElemRef, int16_t nState, void* pvData)
{
    ...
    if (nState == XSPINNER_CB_STATE_UPDATE) {
        // From the element's ID we can determine which input field is ready.
        switch (pElem->nId) {
//<Spinner Enums !Start!>
            case E_ELEM_COMP1:
                //TODO- Add Spinner handling code
                // using gslc_ElemXSpinnerGetCounter(&m_gui, &m_sXSpinner1);
                break;
            ...
        }
    }
}
```

So you can plug in your custom handling code in place of the TODO comment.

NAME	VALUE
Key	Spinner\$1
ENUM	E_ELEM_SPINNER1
X	
Y	
Width	64
Height	17
ElementRef	m_pElemSpinner1
Font	BuiltIn(1x)->5x8pt7b
Minimum Value	0
Maximum Value	99
Starting Value	0

NAME	VALUE
Increment by	1
Button Size	20
Increment Label	Up Arrow. Right-click to invoke CharacterMap Dialog
Decrement Label	Down Arrow.

You must have the following set inside your GUIslice/config/ard_XXXX.h file to use this control.

```
#define GSLC_FEATURE_COMPOUND    1
```

4.17 Text A

Most of the builder examples use text fields as labels while some use them to display runtime counts. See `ex04_bld_ctrls` for display of a runtime counter example.

NAME	VALUE
Key	Text\$1 unique key assigned for internal use
ENUM	E_ELEM_TEXT1 system assigned enum.
Width	60 Width and Height will adjust themselves
Height	12 based upon the text entered
ElementRef	Allows runtime access to this element if set
Font	Name of your chosen font
Text	The text to display. Right click this field
	will bring up a popup that can either clear the
	field or invoke CharacterMap dialog.
UTF-8?	Only ascii characters unless checked.
	NOTE: Only Target Platform Linux supports UTF-8
External Storage Size	Setting to 0 makes text read-only.
Text Alignment	GSLC_ALIGN_MID_LEFT (can be RIGHT or CENTERED)
Fill Enabled?	true
Frame Enabled?	false
Use Flash API?	false. set to true if you need to save ram

4.18 Text Box

A Textbox is a multi-line area that displays scrolling text. It can be tied to a Slider Element to allow a user to control scrolling. Optionally, it can handle embedded color codes for text. See example ex10_bld_textbox.

NAME	VALUE
Key	TextBox\$1
ENUM	E_ELEM_TEXTBOX1
X	
Y	
Width	201
Height	63
ElementRef	m_pElemTextbox1
Font	BuiltIn(1x)->5x8pt7b
Wrap Text	false, Set=true, if text is to wrap across lines
Display Rows	6
Characters per Row	28
Add Scrollbar?	true
Scrollbar Width	20
Scrollbar Thumb Size	5
Scrollbar ENUM	E_TEXTSCROLL1
Scrollbar EREF	m_pTextSlider1
Scrollbar Max Valu	100
Text Color	Color.YELLOW
Frame Color	Color.GRAY
Fill Color	Color.BLACK
Selected Color	Color.BLACK

NOTE: Text rows and columns are only an approximation. Embedding colors will require extra space. See the GUIslice API for further details.

You must have the following set inside your GUIslice_config_<ard,linux>.h file to use embed colors:

```
#define GSLC_FEATURE_XTEXTBOX_EMBED    1
```

4.19 Text Button

Most of the Builder examples use Text Buttons even if only for the Quit button. The Builder will generate most of the code for some of the more simple cases.

Options available

- Add your own custom code
- If you just want the button to jump to a new page set the 'Jump Page ENUM' equal to the target Page ENUM, `eex05_bld_pages`.
- To start a Popup Dialog Page set 'Popup Page ENUM' to the Page ENUM that you desire, `ex25_bld_popup`.
- To return from a Popup Dialog set 'Hide Popup Page?' = true.
- To save SRAM on an Arduino you can use the flash version by setting 'Use Flash?' = true.

The normal button callback will look like:

```
// Common Button callback
bool CbBtnCommon(void* pVGui,void *pVElemRef,gs1c_teTouch eTouch,int16_t nx,int16_t ny)
{
    gs1c_tsElemRef* pElemRef = (gs1c_tsElemRef*)(pVElemRef);
    gs1c_tsElem* pElem = pElemRef->pElem;

    if ( eTouch == GSLC_TOUCH_UP_IN ) {
        // From the element's ID we can determine which button was pressed.
        switch (pElem->nId) {
//<Button Enums !Start!>
            case E_ELEM_BTN1:
                //TODO- Replace with button handling code
                break;
```

You can add your own custom code. Say, you want to backtrack page jumps easily. Create a subroutine inside your *.ino file called `setNewPage`.

```
// -----
// Program Globals
// -----
int m_lastPage;

void setNewPage(int pageId)
{
    m_lastPage = gs1c_GetPageCur(&m_gui);
    gs1c_SetPageCur(&m_gui,pageId);
}
```

Then inside any button callback that you create that is a jump to another page (say `E_PG_EXTRA`) instead of using `Jump Page ENUM` property you use the `Custom Code` property and insert:

```
setNewPage(E_PG_EXTRA);
```

The generated code will be:

```
//<Button Enums !Start!>
    case E_ELEM_BTN1:
        setNewPage(E_PG_EXTRA);

        break;
```

Now for any button that wants to return from whence it came use the custom code option by adding:

```
setNewPage(m_lastPage);
```

Note that when entering code inside the dialog box you can drag code lines up or down or use the arrow buttons on the bottom of the dialog. You can also double click on any line to edit it. The code lines will automatically have 8 spaces added to the beginning of them during code generation to avoid you needing to deal with indentation inside the case statement.

While using the `Jump Page ENUM` callback instead; The Auto-Generated code will look like:

```
//<Button Enums !Start!>
    case E_ELEM_BTN1:
        //TODO- Check the code to see what else you may need to add
        gslc_SetPageCur(&m_gui, E_PG_EXTRA);
        break;
```

Using `Popup Page Enum` property generates:

```
//<Button Enums !Start!>
    case E_ELEM_BTN1:
        //TODO- Check the code to see what else you may need to add
        gslc_PopupShow(&m_gui, E_PG_POPUP, true);
        break;
```

And the return from a Popup uses `Hide Popup Page?` :

```
//<Button Enums !Start!>
    case E_ELEM_BTN1:
        //TODO- Check the code to see what else you may need to add
        gslc_PopupHide(&m_gui);
        break;
```

A fuller explanation of when the Builder will create, delete or modify a case statement will be found in Appendix E.

NAME	VALUE
Key	TextButton\$1
ENUM	E_ELEM_BTN1
X	
Y	
Width	80
Height	40
ElementRef	
Font	BuiltIn(1x)->5x8pt7b
Label	The text to display. Right click this field
	will bring up a popup that can either clear the
	field or invoke CharacterMap dialog.
UTF-8?	Only ascii characters unless checked.
	NOTE: Only Target Platform Linux supports UTF-8
Corners Rounded?	false
Fill Enabled?	false
Frame Enabled?	false
External Storage Size	Setting to 0 makes text label read-only.
Text Alignment	GSLC_ALIGN_MID_MID

NAME	VALUE
Custom Code (optional)	Press button [...] to enter code
Jump Page ENUM	PAGE ENUM used for gslc_SetPageCur call
Popup Page ENUM	PAGE ENUM used for gslc_PopupShow call
Hide Popup Page?	false, set=true->gslc_PopupHide() current page
Use Flash API?	false
Text Color	Color.WHITE
Frame Color	GSLC_COL_BLUE_DK2
Fill Color	GSLC_COL_BLUE_DK4
Selected Color	GSLC_COL_BLUE_DK1

4.20 Toggle Button

A simple On/Off button modelled after the Android Toggle button. The callback is the same as the Text and Image buttons.

See example `ex46_ard_togglebtn`.

NAME	VALUE
Key	ToggleButton\$1
X	
Y	
Width	35
Height	20
ElementRef	m_pElemToggle1
Checked?	false
Thumb Color	GSLC_COL_GRAY
On State Color	GSLC_COL_BLUE_DK1
Off State Color	GSLC_COL_GRAY_LT3
Circular?	true
Use Flash API?	false
Frame Enabled?	true
Frame Color	GSLC_COL_GRAY

4.21 Numeric Input

When a user presses on this UI Element a Popup Numeric Keypad will appear to take input. A callback is generated by the Builder for this field and will look like:

```
bool Cbkeypad(void* pvGui, void *pvElemRef, int16_t nState, void* pvData)
{
    gslc_tsElemRef* pElemRef = (gslc_tsElemRef*)(pvElemRef);
    gslc_tsElem* pElem = pElemRef->pElem;
    gslc_tsGui* pGui = (gslc_tsGui*)pvGui;

    // From the element's ID we can determine which element is ready.
    if (pElem->nId == E_ELEM_KEYPAD) {
        int16_t nTargetElemId = gslc_ElemXKeyPadDataTargetIdGet(pGui, pvData);
        if (nState == XKEYPAD_CB_STATE_DONE) {
            // User clicked on Enter to leave popup
            // - If we have a popup active, pass the return value directly to
            //   the corresponding value field
            switch (nTargetElemId) {
                //<Keypad Enums !Start!>
                case E_ELEM_NUMINPUT1:
                    //TODO- Update input handling code
                    // using gslc_ElemXKeyPadDataValGet(pGui, pvData)
                    gslc_PopupHide(&m_gui);
                    break;
            }
        }
    }
}
```

See ex26_bld_calc for an example of usage.

NAME	VALUE
Key	NumberInput\$1
ENUM	E_ELEM_NUMINPUT1
X	
Y	
Width	40
Height	12
ElementRef	m_pElemVal1
Font	BuiltIn(1x)->5x8pt7b
UTF-8?	Only ascii characters unless checked.
	NOTE: Only Target Platform Linux supports UTF-8

NAME	VALUE
Field Size	6
Text Alignment	GSLC_ALIGN_MID_LEFT
Fill Enabled?	true
Use Flash API?	false set to true if you need to save ram
Text Color	Color.YELLOW
Frame Color	Color.GRAY
Fill Color	Color.BLACK
Selected Color	Color.BLACK

4.22 Text Input

When a user presses on this UI Element a Popup Text-Only Keypad will appear to take input. A callback is generated by the Builder for this field and will look like:

```
bool CbKeypad(void* pGui, void *pvElemRef, int16_t nState, void* pvData)
{
    gslc_tsElemRef* pElemRef = (gslc_tsElemRef*)(pvElemRef);
    gslc_tsElem* pElem = pElemRef->pElem;
    gslc_tsGui* pGui = (gslc_tsGui*)pGui;

    // From the element's ID we can determine which element is ready.
    if (pElem->nId == E_ELEM_KEYPAD) {
        int16_t nTargetElemId = gslc_ElemXKeyPadDataTargetIdGet(pGui, pvData);
        if (nState == XKEYPAD_CB_STATE_DONE) {
            // User clicked on Enter to leave popup
            // - If we have a popup active, pass the return value directly to
            //   the corresponding value field
            switch (nTargetElemId) {
                //<Keypad Enums !Start!>
                case E_ELEM_TEXTINPUT1:
                    //TODO- Update input handling code
                    // using gslc_ElemXKeyPadDataValGet(pGui, pvData)
                    gslc_ElemSetTxtStr(pGui, m_pElemInTxt1, gslc_ElemXKeyPadDataValGet(pGui,
pvData));
                    gslc_PopupHide(&m_gui);
                    break;
            }
        }
    }
}
```

See ex26_bld_alpha for an example.

NAME	VALUE
Key	TextInput\$1
ENUM	E_ELEM_TEXTINPUT1
X	
Y	
Width	65
Height	10
ElementRef	m_pElemInTxt1
Font	BuiltIn(1x)->5x8pt7b
Text	The text to display. Right click this field
	will bring up a popup that can either clear the
	field or invoke CharacterMap dialog.

NAME	VALUE
UTF-8?	Only ascii characters unless checked.
	NOTE: Only Target Platform Linux supports UTF-8
Field Size	10
Text Alignment	GSLC_ALIGN_MID_LEFT
Fill Enabled?	true
Use Flash API?	false set to true if you need to save ram
Text Color	Color.YELLOW
Frame Color	Color.GRAY
Fill Color	Color.BLACK
Selected Color	Color.BLACK

4.23 Page

A Page is simply a full screen menu. You may have as many as you want given enough memory.

4.24 Base Page

You can have optionally one base page. This is where you place any elements you want to show on all menus. Say a status line on the bottom of the display.

4.25 Popup Page

A popup page is one that will overlay the current page still showing whatever is not covered up by the popup. The keypad is an example. Use as many popup pages as needed.

5.0 Customizing

There are a few ways of customizing your experience with the builder. You can modify your UI preferences by the editing your Project Options Property View.

Some of the UI Elements also have a tab in the menubar `Edit->options` dialog allowing you to set size, color, font, and some other options depending upon the element in question.

5.1 Project Options

When you first create a new project these values are filled in with values from the General Preferences tab (Section 5.2) available by edit->options menu item.

NAME	VALUE
Key	Project\$1
ENUM	E_PROJECT_OPTIONS
Target Platform	arduino,m5stack,teensy,tft_espi,linux
Project's Extra Fonts	List of optional Fonts that can be used by custom code
TFT Screen Width	320
TFT Screen Height	240
Background Color	Black is default
Use Background Image?	default is false
Target Platform Image Directory	/ (Value prepended to image file name to create path)
Background Image File	Ex: back1_24.bmp Name of Bitmap file or blank
Background Image defines	Ex: IMG_BKGND Auto-generated name for image <code>#define</code>
Background Image Memory	gslc_GetImageFromSD((const char*)
	gslc_GetImageFromFile(
	gslc_GetImageFromProg((const unsigned char*)
	gslc_GetImageFromRam((unsigned char*)
Background Image Format	GSLC_IMGREF_FMT_BMP24
	GSLC_IMGREF_FMT_BMP16
	GSLC_IMGREF_FMT_RAW

NAME	VALUE
Screen Margins	10 pixels top, bottom, right and left
Horizontal Spacing between elements	20 Used by alignment commands as the default value
Vertical Spacing between elements	20 Used by alignment commands as the default value
MAX_STR	100
Screen Rotation [0-3 or -1 default]	-1 Otherwise, forces gslc_GuiRotate() call with this value

5.1.1 General Preferences

NAME	VALUE
Themes	FlatLaf or Java Built-In Themes like: Windows or Metal
Target Platform	arduino,arduino minimum, linux
TFT Screen Width	320
TFT Screen Height	240
Project Directory	c:\users[username]\documents\arduino
Target Platform Image Directory	/
Background Color	Black is default
Image Transparency Color	For transparent images GSLC_COL_MAGENTA (r=255,g=0,b=255)
Screen Margins	10 pixels top, bottom, right and left
Horizontal Spacing between elements	20 Used by alignment commands as the default value
Vertical Spacing between elements	20 Used by alignment commands as the default value
MAX_STR	100
Screen Rotation [0-3 or -1 default]	-1 Otherwise, forces gslc_GuiRotate() call with this value
Backward Compatibility Mode?	false is default. If true Builder will not create _GSLC.h
Preserve Button Callbacks?	If true callback code is only changed if model changed
	Otherwise button callbacks deleted each code generation.

The FlatLaf project provides the support for non built-in themes: <https://github.com/JFormDesigner/FlatLaf>
The full Copyright is included in Appendix C.

5.1.2 Grid Preferences

NAME	VALUE
Grid SnapTo	true
Grid Minor Width	10
Grid Minor Height	10
Grid Major Width	50
Grid Major Height	50
Grid Minor Color	Color.BLACK
Grid Major Color	Color.BLACK
Grid Background Color	Color.WHITE

5.1.3 KeyPadAlpha

You can customize your keypad's position, X and Y. Change it's font, button sizes, use rounded corners, and modify the gap between buttons.

NAME	VALUE
Key	KeyPadAlpha
ENUM	E_POP_KEYPAD_ALPHA
X	65
Y	80
ElementRef	m_pElemKeyPadAlpha
Font	BuiltIn(1x)->5x8pt7b
Corners Rounded?	false
Use Default Button Sizes?	true
Button Width	12
Button Height	25
Button Gap X	0
Button Gap Y	0

5.1.4 KeyPadNum

The numeric keypad besides supporting the same features as the alphabetic keypad can also support integer only input by setting `Enable Floating Point? = false`, and only allowing positive numbers by setting `Enable Minus Sign? = false`.

NAME	VALUE
Key	KeyPadNum
ENUM	E_POP_KEYPAD_NUM
X	65
Y	80
ElementRef	m_pElemKeyPadNum
Font	BuiltIn(1x)->5x8pt7b
Corners Rounded?	false
Enable Floating Point?	true
Enable Minus Sign?	true
Use Default Button Sizes?	true
Button Width	25
Button Height	25
Button Gap X	0
Button Gap Y	0

5.2 UI Element Customizing

A few elements allow you to change their default properties on a global basis. Going into the Options tabbed dialog there are tabs for Box, Text, TextButton, Checkbox, and RadioButton. If you modify any properties on these tabs when you drop the modified elements onto the TFT Simulation the values will be set according to your new settings. The property values will also be set on any further projects you create or edit. They will not modify any elements previously used in your projects.

5.3 Program skeleton

One of the directories created and populated by the builder is called templates.

Files are created here:

- **ino2.t** Template for Arduino IDE `*.ino` and PlatformIO IDE `main.cpp`
- **hdr.t** Template for `*_GSLC.h`
- **c.t** Linux Template
- **graphics.t** Non Linux code blocks
- **linux.t** linux code blocks
- **default_colors.csv**
- **builder_fonts.json**
- **ino.t** Template used when in General preferences a user has set `Backward Compatibility Mode? = true` to avoid a `*_GSLC.h` being created.

See Appendix B for format of the json font file.

The files **ino2.t**, **hdr.t**, **ino.t** and **c.t** are the skeleton programs for the supported platforms. You can edit them to include your name, copyright, and whatever else you need. Just be careful of the code generation tags. If you delete or modify them the builder will fail to work correctly.

5.4 default_colors.cvs

This file lists the mapping of colors in RGB format to the GUIslice API names. For example, rgb (0,0,0) is GSLC_COL_BLACK. The top 7 rows are the default values the library uses, although these are spread about in the code base. If you don't like the default color scheme you can use the builder to override them on an individual element basis. Inside the Properties View will be "Use Default Colors?=true". You simply click the property value to change it to false and you can then edit the Frame, Fill, and Select colors.

5.5 Images

Many UI's, if not most, will require images and icons. You can place them inside the directories GUIsliceBuilder/arduino_res or linux_res depending upon your target platform. You can, of course, create your own folder. The arduino_res and linux_res simply exist to provide you with some samples. Once you travel to another folder to find your images the system will remember your last accessed folder and always return to it.

The only formats currently supported by the GUIslice API library are:

- GSLC_IMGREF_FMT_BMP16
- GSLC_IMGREF_FMT_BMP24
- GSLC_IMGREF_FMT_JPG
- GSLC_IMGREF_FMT_RAW

The GUIslice C Library only supports what the chosen driver implements on the Target Platform. Standard Arduino only supports BMP24 files either from SD card or embedded C files and Mono (RAW) BMP bitmaps in C files. The arduino TFT_eSPI supports BMP24 Bitmaps loaded from SD card or as an embedded C File and JPG loaded from SPIFFS file system on a ESP8366 or ESP32. Linux on a RaspberryPI using SDL supports BMP16 Bitmaps from the file system and may support others.

Since drivers come and go the Builder isn't going to do much checking. So do your research and choose wisely.

Now displaying images on the TFT Simulation is one issue, finding them on the target platform is another. The builder defaults to root '/' on the SD card for Arduino appended to the image's location. You can change the target's image directory from '/' for arduino by modifying:

```
edit->options->General->Target's Platform Image Directory
```

The code generator will append whatever string you include so be sure to add folder separators. The default value is "/".

5.6 Adding Fonts

The font implementation is somewhat challenging.

The builder uses one file inside GUIsliceBuilder/templates to define available fonts with their GUIslice API font parameters:

- **builder_fonts.json**

The builder can now actually run the target graphics package fonts at the actual size as they will appear on your Target TFT Display Screen. For this support the actual font C Headers and C files are stored inside the Builder's fonts folder, organized by driver.

A partial Example:

```
| GUIsliceBuilder
|- fonts
  |- gfx
    |- FreeMono
      |- BOLD
      |- BOLD_ITALIC
      |- ITALIC
      |- PLAIN
  |- glcd
  |- ili9341_t3
    |- Arial
      |- BOLD
      |- PLAIN
  |- m5stack
    |- gfx
      |- FreeMono
        |- BOLD
        |- BOLD_ITALIC
        |- ITALIC
        |- PLAIN
  |- ttf (Place linux true type font files here and add the names to
builder_fonts.json)
  |- utft
    |- BigFont.c
    |- SmallFont.c
    |- SevenSegNumFont.c
  |- v1w smooth fonts created by Processing IDE for TFT_eSPI driver
```

The Builder ships with FreeFonts, Google's Dosis and Noto(tm) fonts pre-built for Adafruit's GFX format. You can use them by copying the headers files from GUIsliceBuilder/fonts/gfx to either libraries Adafruit_GFX/Fonts or TFT_eSPI/Fonts/GFXFF depending upon your target platform.

You may add additional Adafruit compatible fonts, Teensy ILI9341_T3 fonts or UTFT fonts by copying them into the Builder's font folder, GUIsliceBuilder/fonts under the driver folder. GFX and T3 font support require you to create a folder that can be used by the Builder as the Font's Family name ie: 'FreeMono'. Under this new folder you must create Font Style sub-folders, any combination of BOLD, BOLD_ITALIC, ITALIC, or PLAIN depending upon what fonts you have decided to add.

For Teensy fonts don't forget to copy both the Headers and C files.

The Builder also supports UTFT fonts that you download from [UTFT Fonts](#).

You do not need to edit the builder_fonts.json file for these new Adafruit GFX, UTFT or T3 fonts, just drop them into the correct existing folders or create new folders and restart the Builder.

You **DON'T need** to also copy them to a folder your C++ IDE can find them in!*

The builder is aware of fonts that come standard with your target graphics package and if a font doesn't come with it the Builder will copy the correct files to your project folder. If you change fonts between code generation it will also cleanup and remove un-referenced font files it had previously copied.

For example, Adafruit ships Free fonts but only in 9,12,18 and 24 sizes. If you chose say FreeSans size 14 the builder will copy FreeSans14pt7b.h to your project sketch folder and if it becomes un-referenced in your project it will be deleted during a new code generation.

While *.vlw smoothfonts do need edits to the builder_fonts.json file to add them. Google's Noto Bold is already supported so you can use its entries as a guide. Note that you don't place the actual *.vlw fonts in the Builders folders. You place the *.ttf file that you used as input to Processing IDE that created your *.vlw fonts. The Builder currently can't read the *.vlw files only the TrueType fonts. You will however notice a sub folder called data where the NotoBold vlw files have been placed as a convenience so you don't need to generate them, just copy to your Arduino project `data` folder and upload them to your SPIFFS file system.

As an example, say you need to support a chinese font called "wqyMicroHei.ttf" and the size 16. You first copy this font to GUIsliceBuilder/fonts/vlw.

You follow Appendix G for instructions to create your size 16 vlw font, "wqyMicroHei16.vlw". This file is the one you copy to your project's subfolder named data. This then needs to be uploaded to your MicroController.

Then you edit the GUIsliceBuilder/templates/builder_fonts.json file as so:

```
{
  "categoryName": "FONT_VLW",
  "fonts": [
    {
      "familyName": "wqyMicroHei.vlw",
      "displayName": "wqyMicroHei16V",
      "defineFile": "wqyMicroHei16",
      "eFontRefType": "GSLC_FONTREF_FNAME",
      "pvFontRef": "WQYMICROHEI16_VLW",
      "nFontSz": "16",
      "logicalName": "wqyMicroHei.ttf",
      "logicalSize": "16",
      "logicalStyle": "Bold",
      "fontRefMode": "GSLC_FONTREF_MODE_1"
    },
    {
      "familyName": "NotoSansBold.vlw",
      "displayName": "NotoSansBold16V",
```


If you need to use a font that doesn't fall into the above categories then you will need to tell the Builder to simulate it, "categoryName": "FONT_SIM". This is fairly easy to do but can be a bit fussy. There isn't much error handling so be careful with edits. You will need to study Appendix B to be successful. If you need help or advice simply post to the Builder Github repository's issues section.

If an error is detected processing builder_fonts.json it will be reported inside GUIsliceBuilder/logs/builder.log or a crash *.txt file. You should get a line number and most likely a cryptic message. For example: saying a name was expected. Look for extra or missing commas ',', brackets ']' or curly braces '}'.

The builder_fonts.json file format is documented in Appendix B.

If you edit this file you must restart the Builder it will then use the new font file.

6.0 PlatformIO Configuration

Users selecting PlatformIO IDE may either choose one of the pre-configured options provided by GUIsliceBuilder or provide their own platformio.ini file.

GUIslice API distribution has inside its GUIslice folder a sample platformio.ini that you can use as a starting point for edits. Once you have completed them you simply copy it to the Builder's template folder and it will be copied over to your PlatformIO/Projects/appname folder with each code generation.

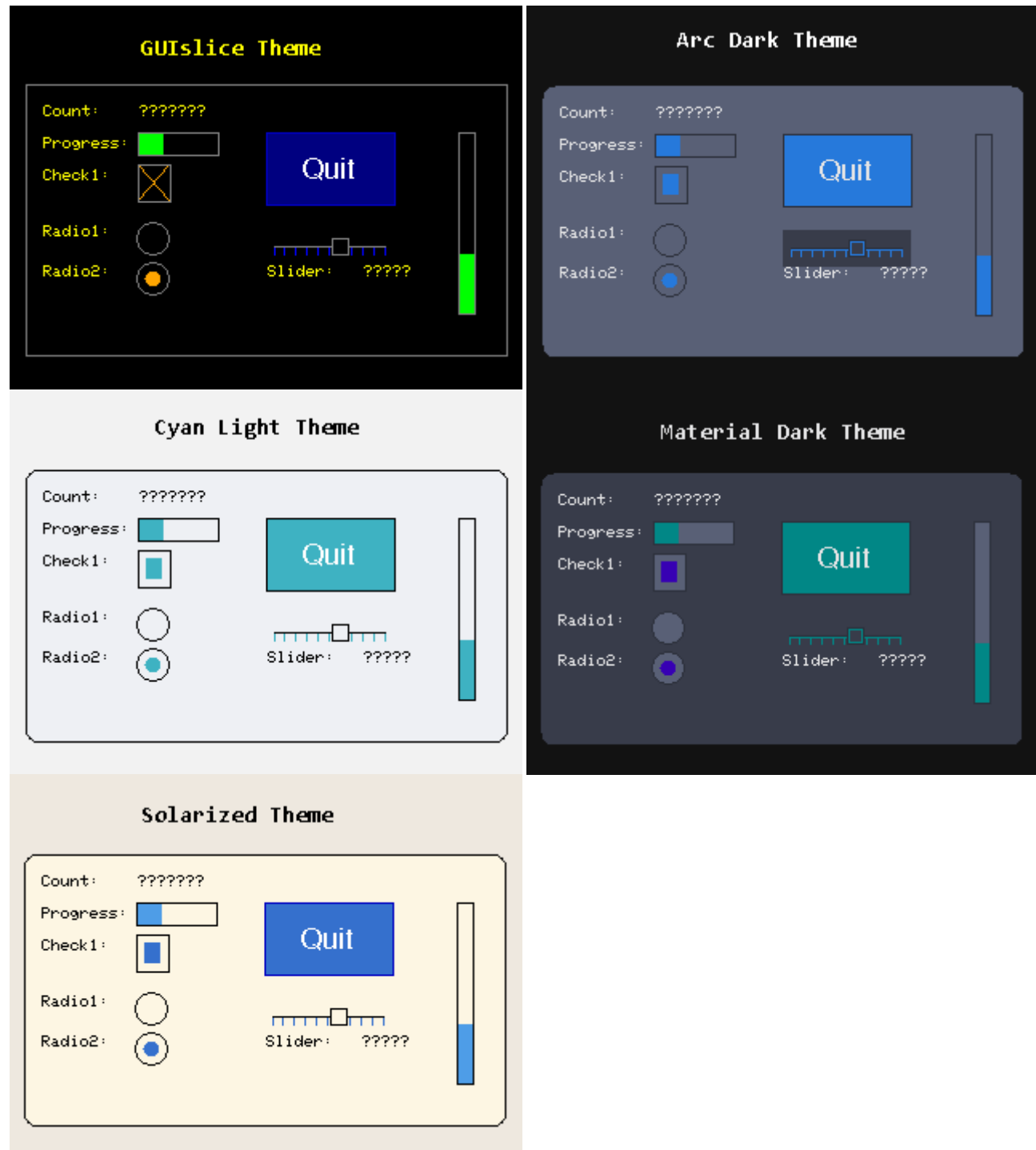
The Builder does provide pre-configured options inside PlatformIO_Config. If the Builder doesn't find a platformio.ini file inside its templates folder these options will be presented to you in your Project Options Tab within the `PlatformIO default_envs` property. The Builder will use your choice to create a platformio.ini dynamically for you and copy this to your PlatformIO/Projects/appname folder. Each of your GUIslice projects may have a different environment in this manner. So one project might be for an Arduino Mega while another might be a esp32.

If you need to edit any files found in PlatformIO_Config I suggest you first copy it to templates/PlatformIO_Custom folder first. In this way when you later update GUIsliceBuilder to a newer version your configuration files won't be overwritten.

7.0 GUIslice API Themes

The User Preference General Tab for setting defaults for all new projects and E_PROJECT_OPTIONS Tab for a particular project support Users selecting a Color Scheme for your GUIslice API UI Elements. Use the `GUIslice API Theme` property combobox pull-down to make your selection.

You may choose between GUIslice, Arc Dark, Cyan Light, Material Dark, or Solarized themes.



The Themes are defined in the file templates/guislice_themes.json which you may edit using a text editor. You can make changes or add new themes to this file. An example below for Cyan Light **Box** element is:

```
{
  "themeName": "Cyan Light",
  "uiElements":
  [{
    "uiElemName": "Page",
    "fill_col": "0xf2f2f2"    // light gray (242,242,242)
  },
  {
    "uiElemName": "Box",
    "corners_rounded": true,
    "frame_en": true,
    "fill_en": true,
    "glow_en": false,
    "frame_col": "0x000000", // black (0,0,0)
    "glow_col": "0xeef0f4",  // light gray (238,240,244)
    "fill_col": "0xeef0f4"   // light gray (238,240,244)
  },
  ],
```

Appendix A - Acknowledgements

All Copyright Notices are included in Appendix C

JRibbonBar Project

The GUIsliceBuilder's Ribbon code is provided by the JRibbonBar project written by Csekme Krisztián, Software Engineer at CalTec.

- **RibbonMenu-1.0.6.jar**

The JRibbonBar project is on GitHub: <https://github.com/csekme/JRibbonMenu>

FlatLaf Project

The Non-Built IN Java Themes are supported by the FlatLaf project. The jar file is:

- **flatlaf-1.0-rc1.jar**

The FlatLaf project is on GitHub: <https://github.com/JFormDesigner/FlatLaf>

Google JSON Support

reading of our json files is provided by Google's GSON project.

- **gson-2.8.6.jar**

Apache Logging

Tracing of our runtime is provided by the apache library.

- **log4j-api-2.8.jar**
- **log4j-core-2.8.jar**

bobbylight/RSyntaxTextArea provides Code editing support

<https://github.com/bobbylight/RSyntaxTextArea>

Icon Attribution

Virtually all icon's used by the Builder were created by Paul Conti. However, a small set have been made by other people.

The "Project" (Light Bulb with gears) icon



used in the TreeView was created by

Icons made by [dDara](#) from www.flaticon.com

The "Copy Properties" (exam) icon



was created by

Icons made by [Zlatko Najdenovski](https://www.flaticon.com) from www.flaticon.com

The "Page" (Tablet)  and "Image" (Camera)  and "Widget" (Puzzle) icons were provided by:

<https://github.com/icons8/flat-color-icons>

The "Scale"



[Photoshop icons created by Freepik - Flaticon](https://www.freepik.com/free-vector/flat-color-icons)

Appendix B - Font File Format

You can add or remove fonts from `builder_font.json` to support any font that exists on your target platform. Even add your own platform.

The file is in JSON Format - See RFC 8259. We use Google's GSON to read this file and it is a superset of the json standard. The most useful of which is that it will take C style comments and ignore them.

The JSON objects that are in this file starts with `allFonts` which is an array of `graphicPackage` objects that itself contains an array of categories. Each category contains a set of font definitions.

```
allFonts
|- graphicPackage
  |- categories
    |-fonts
      -font definition
      -font definition
    |- categories
      |-fonts
        -font definition
        -font definition
  |- graphicPackage
    |- categories
      |-fonts
```

Please note that object and fields names must match the case shown inside our json file or they will be ignored!

`graphicPackage` names are mostly used to identify font handling for code generation. The current list of `graphicPackage` supported are:

- Adafruit_GFX
- M5Stack
- ILI9341_t3 (Teensy)
- TFT_eSPI
- UTFT
- Linux

Within the `graphicPackage` object you may have optionally a set of warning messages to output during code generation. This can be useful if you accidentally choose an incorrect GUIslice configuration file inside `GUIslice_config.h`. For example is say you chose platform `Adafruit_GFX` but you used a `TFT_eSPI` driver these warning messages would give you a compile time error.

```
#if defined(DRV_DISP_TFT_ESPI)
  #error Project tab->Target Platform should be tft_espi
#endif
```

You simply add them to the `warnings` array of `graphicPackage` object like so:

```
{
  "allFonts": [
    {
      "graphicPackage": "Adafruit_GFX",
      "warnings": [
        "#if defined(DRV_DISP_TFT_ESPI)",
        "  #error Project tab->Target Platform should be tft_espi",
        "#endif"
      ],
    },
  ],
}
```

You may also supply a "dpi": field if you are simulating a font. Usually this is set to 72 but Adafruit uses 141. The Builder doesn't need this field for the supported Native fonts.

Example:

```
"Adafruit_GFX": "Linux",
"dpi": "72",
"categories": [
```

The Categories supported are:

- FONT_GFX which are Adafruit's GFX compatible fonts.
- FONT_GLCD which are Adafruit's classic built-in fonts
- FONT_T3 which are Teensy's ili9341_t3 fonts
- FONT_SIM which are any fonts that the Builder needs to simulate using Java's built-in fonts which limits you to using "logicalName": "Monospaced" or "SansSerif" or "Serif". It limits you to 255 characters in your character set maximum.
- FONT_TTF which are TrueType fonts used by Linux
- FONT_UTFT which are for the UTFT driver supplied by [UTFT Library](#)
- FONT_VLW which are smoothfonts supported by TFT_eSPI driver.

The FONT_GFX, FONT_GLCD, FONT_UTFT and FONT_T3 fonts are supported as native fonts. That is the Builder actually reads and parses the C `*.h` headers and/or C `*c` files that define the font. It uses that information and bitmaps to render the fonts in the TFT Simulation area.

The graphicPackage object supports adding extra include files.

Just like coding in C or C++ keep your curly braces `{}` and brackets `[]` balanced and keep note of your commas placements. JSON doesn't give much in the way of error checking feedback.

The Fonts object holds an array of font definitions. Most of these Fields are required by GUIslice API to use Fonts and therefore we use the same names so you can match them to the required fields. The rest allow the Builder to either give you helpful information within the Font Chooser Dialog or to simply be able to display the font within your UI Elements on the TFT Simulation Panel.

The fields are:

- **fontName** - No Default refers to the font family, ex: Dosis SansSerif, FreeFont Sans, Noto Mono, etc...
- **displayName** - No Default refers to the actual font on the target platform, Ex: 'FreeSans12pt7b'.
- **externName** - Default: "NULL" Ex: UTFT package it points to the font storage name "BigFont". Code Generation will then create `extern uint8_t BigFont[];`.
- **includeFile** - Default: "NULL" Ex: "FreeSansBold12pt7b.h". This name will have category object parameter includePath added to it during code generation.
Ex: categoryName=FONT_GFX has "includePath": "Fonts/" giving: `#include "Fonts/FreeSansBo1d12pt7b.h";`.
- **defineFile** - Default: "NULL" On linux platform it points to the font in linux filesystem, Ex: '/usr/share/fonts/truetype/droid/DroidSans.ttf'
- **headerName** - Default: "NULL" Optional. Simple name of header. Ex: "BigFont.h". Note that BigFont file contains multiple font sizes and entries must be made for each font.
- **srcName** - Default: "NULL" c source file name, Ex: "BigFont.c". Note that BigFont file contains multiple font sizes and entries must be made for each font.
- **eFontRefType** - Default: GSLC_FONTREF_PTR GUIslice API parameter Font reference type (eg. filename "GSLC_FONTREF_FNAME" or pointer "GSLC_FONTREF_PTR")
- **pvFontRef** - No Default GUIslice API parameter Reference pointer to identify the font. Example: Adafruit FreeFonts would be GSLC_FONTREF_PTR it's "&displayName" like "&FreeMono9pt7b" which must be a pointer value to the font bitmap array. TFT_eSPI Smooth Fonts stored in Flash would also be defined this way. In the case of SDL mode or TFT_eSPI Smooth Fonts, it is a filepath to the font file.
- **nFontSz** - Default: 1 GUIslice API parameter Typeface size to use. For Arduino built-in fonts a number from 1 to 5, Most fonts will set this to 1, while in SDL mode its actual logical size of font.
- **logicalFont** - Default: NULL Used only when font type is FONT_SIM. It's the name java needs to use when accessing this font. Java ships with five platform independent fonts: Dialog, DialogInput, SansSerif, Serif, and Monospaced. It doesn't have to be a Java builtin font but must be whatever name the operating system uses.
- **logicalFontSize** - No Default The size of the Font.
- **logicalFontStyle** - No Default The font style, PLAIN, BOLD, ITALIC, BOLD_ITALIC
- **fontRefMode** - Default: GSLC_FONTREF_MODE_DEFAULT This is for drivers that need special handling within GUIslice API.

If the default value of a font field is satisfactory for your font you can simply skip the field.

Further details concerning fontRefMode

In many graphics libraries styled after the Adafruit-GFX APIs, all it takes to select a font within the graphics library is a call to `setFont()` with a pointer to the GFX font structure.

However, certain graphics libraries have provided support for additional font types and modes of operation. In order to enable these additional features, GUIslice has created a mode selector called `FontRefMode`. The `FontRefMode` signals to GUIslice what special font APIs should be called within the graphics library.

Configuring a font for use in GUIslice generally only requires a single call to `gslc_FontSet()`. If the graphics library supports additional font types or modes, `gslc_FontSetMode()` can be called, which takes as a parameter enabling one to select a different `FontRefMode`.

By default, most graphics libraries use the `FontRefMode` `GSLC_FONTREF_MODE_DEFAULT`. Additional font modes are defined (eg. `GSLC_FONTREF_MODE_1`, `GSLC_FONTREF_MODE_2` and `GSLC_FONTREF_MODE_3`), with the definition of each specific to the particular graphics library in use.

For example:

- The RA8876 display driver uses `FONTREF_MODE_DEFAULT` to select the internal ROM fonts, whereas other modes are used to select fonts from external ROM chips.
 - The RA8875_SUMO display driver uses `FONTREF_MODE_DEFAULT` to select the Adafruit-GFX fonts, whereas `GSLC_FONTREF_MODE_1` is used to select an `ILI9341_t3_font`.
 - The ILI9341_t3 display driver uses `FONTREF_MODE_DEFAULT` to select the Adafruit-GFX fonts, whereas `GSLC_FONTREF_MODE_1` is used to select an `ILI9341_t3_font`.
-

Appendix C - CopyRight Notices

Apache Logging, FlatLaf project, Google's gson, and J.RibbonBar CopyRights are based upon Apache License version 2.0.

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Appendix D - Theme Support

FlatLaf is a modern **open-source** cross-platform Look and Feel for Java Swing desktop applications.

It looks almost flat (no shadows or gradients), clean, simple and elegant. FlatLaf comes with **Light**, **Dark**, **IntelliJ** and **Darcula** themes, scales on **HiDPI** displays and runs on Java 8 or newer.

The look is heavily inspired by **Darcula** and **IntelliJ** themes from IntelliJ IDEA 2019.2+ and uses almost the same colors and icons.

FlatLaf can use 3rd party themes created for IntelliJ Platform.

The Builder will look inside the folder `GUIsliceBuilder/templates/intellijthemes` and scan for any files that end with `".theme.json"`.

You can add you own themes simply by loading into the `intellijthemes` folder. The Builder will make them available upon the next startup.

Appendix E - Case Statement Generation

The Builder supports a richer set of functions for Button callbacks like Jump to Page, Show Popup page and Hide Popup Page and since users can set these values on/off in many different editing sessions the Builder attempts to do a more intelligent update for the Button callbacks.

The rules here apply only to the Button callbacks. All other callbacks simply look for existing case statement with ENUM and if it finds it within your *.ino file the code is left unchanged. If a UI Element is deleted the code generator will remove it's case statement.

Example One

You create a simple button in the Builder with no Jump, Popup, or Hide Page like the Quit button used in the examples and do a code generation.

```
case E_ELEM_BTN_QUIT:
    //TODO- Check the code to see what else you may need to add
    break;
```

What if you delete this button?

The case statement will be removed.

What if you rename the Button's ENUM, say from E_ELEM_BTN_QUIT to E_QUIT?

It will detect that E_ELEM_BTN_QUIT is no longer in your project so it will Delete it. It will then find what it believes is a new button and create a new case statement.

Unfortunately the Code Generator doesn't have any semantic information to identify a relationship of E_QUIT to E_ELEM_BTN_QUIT so this is the best it can do.

Example Two

Once again we start with Example's One simple button and now we edit the case statement:

```
case E_ELEM_BTN_QUIT:
    // Output a message when the button is pressed
    Serial.println("Quit button pressed");
    // Set a variable flag that we can use elsewhere
    m_bQuit = true;
    break;
```

You go back into the builder and set "Jump Page ENUM = E_PG2_MainMenu".

Here it will simply place the gslc_SetPageCur call before the break and leave everything else alone.

```

case E_ELEM_BTN_QUIT:
    // Output a message when the button is pressed
    Serial.println("Quit button pressed");
    // Set a variable flag that we can use elsewhere
    m_bQuit = true;
    gslc_SetPageCur(&m_gui, E_PG2_MainMenu);
    break;

```

Time passes and you now want a jump to E_PG4_Schedule instead so you edit the E_ELEM_BTN_QUIT Jump Page ENUM property and replace E_PG2_MainMenu with E_PG4_Schedule.

During a new code generation the Builder checks the existing case statement and sees E_PG2_MainMenu so it deletes just the gslc_SetPageCur statement and replaces it with the new value.

```

case E_ELEM_BTN_QUIT:
    Serial.println("E_ELEM_BTN_QUIT touched");
    // Set a variable flag that we can use elsewhere
    m_bQuit = true;
    gslc_SetPageCur(&m_gui, E_PG4_Schedule);
    break;

```

Example Three

Now what if instead you made so many edits to this case statement you don't want the Builder to look at it any more.

```

case E_IMGBTN_SETTINGS:
    if (!isGrinding)
    {
        SetMode(CliveNormal);
        setNewPage(E_PG_SETTINGS);
        BluetoothStartSettings();
        UpdateSettingsText();
        hideSetPositionPanel();
        needSensorRepaint = false;
    }
    break;

```

Just clear out "Jump Page ENUM = " and the Builder will leave it alone.

Example Four

I love cutting and pasting code any way to maximize my work?

Seriously though, lets say these rules are just too hard for you to work with or you really do love to cut and paste code. Yes, there is an option for you. On the User Preferences "General" tab there is an option "Preserve Button Callbacks?". Just set this to false and the Builder will start fresh for Button callbacks during code generation wiping out all code inside the Builder's "</Button Enums" tags.

Appendix F - Code Templates

There are two platform specific templates for code generation inside GUIsliceBuilder/templates. They are "arduino.t" for Arduino and compatibles and "linux.t" for RaspberryPI.

The templates are used for creating the various sections of your application. They start with a name enclosed with angle brackets `<>` and end with a `<STOP>`.

In between is the actual code to be output. Now most code will require properties from the specific UI Element you created for your User Interface. These properties are not referred by the user exposed names since they may change or get translated some day to another language. Instead, we use meta-ids which are documented below inside a meta-id table mapping.

The Java UI Element Models use these meta-ids to replace macros within the code blocks with actual property values.

The macros are identified by starting with a `$<` and ending with a bracket `>`. In between is the meta-id to be replaced.

Now there are some common properties to all UI Elements like ENUM meta-id "COM-002", and X + Y Positions meta-ids "COM-003", "COM-004".

While many UI Elements have at least some properties unique to them; Like the Progress Bar which has a property "is Vertical?" meta-is "BAR-100". Of course, without looking at source code you are not likely to identify or make use of such things.

Nevertheless, they may be cases where simple edits will allow you some degree of customization. Say you have replaced Adafruit's GFX fonts and you don't want code to generated with `#include <Adafruit_GFX.h>`. You find the code segment:

```
<FONT_ADAFRUIT>
#if defined(DRV_DISP_TFT_ESPI)
    #error Builder config "Edit->Options->General->Target Platform" should be "arduino
    TFT_eSPI"
#endif
#include <Adafruit_GFX.h>
// Note that these files are located within the Adafruit-GFX library folder:
<STOP>
```

and you can edit it so no mention of GFX is made like so:

```
<FONT_ADAFRUIT>
#if defined(DRV_DISP_TFT_ESPI)
    #error Builder config "Edit->Options->General->Target Platform" should be "arduino
    TFT_eSPI"
#endif
<STOP>
```

There are some cases where meta-id is not used and a few places where templates are also not used in code generation. This is due mostly to older beta code and my general lazyness and lack of motivation.

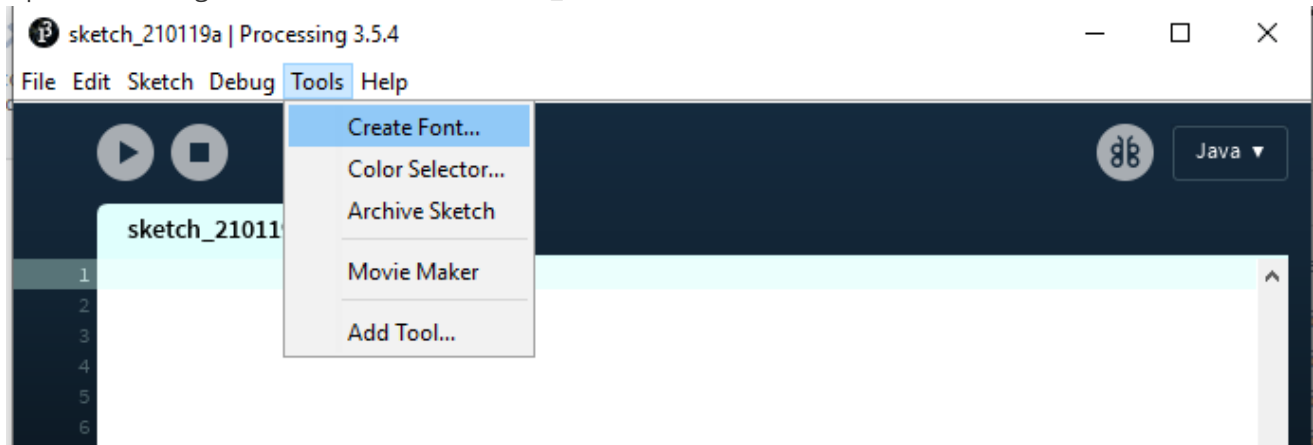
The most current and complete list of lds is inside the source code

```
builder/src/main/java/resources/templates/meta_ids.csv
```

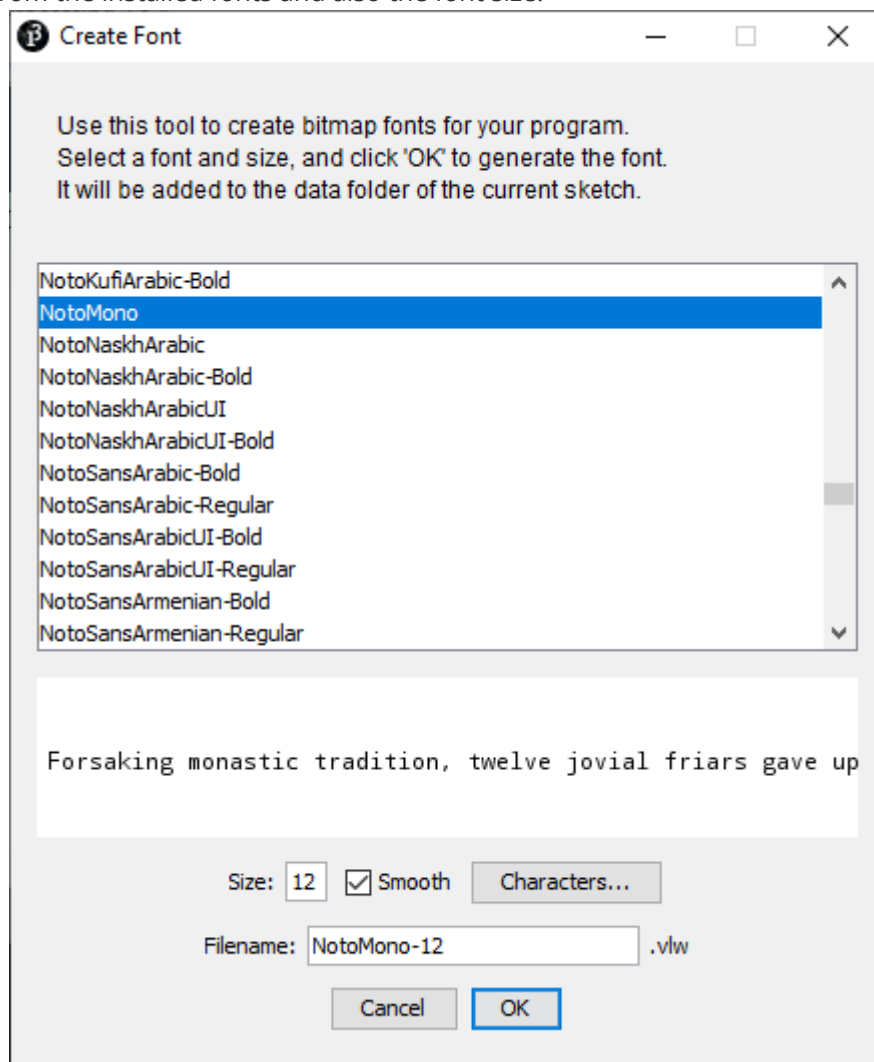
Appendix G - Creating VLW Fonts

Begin by downloading the Processing IDE from [Download Processing](#)

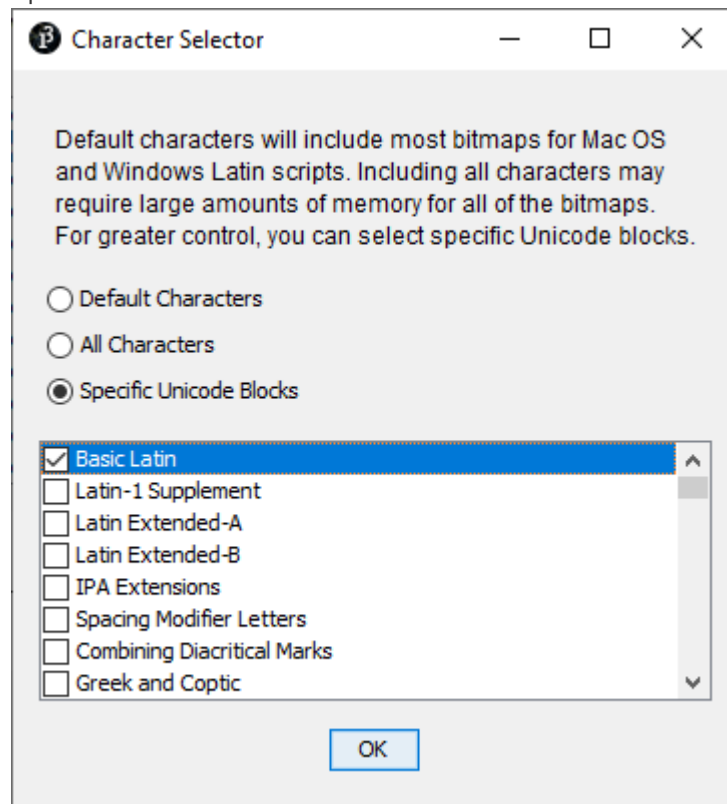
Open Processing IDE and select tools->create_font



Select your font from the installed fonts and also the font size:

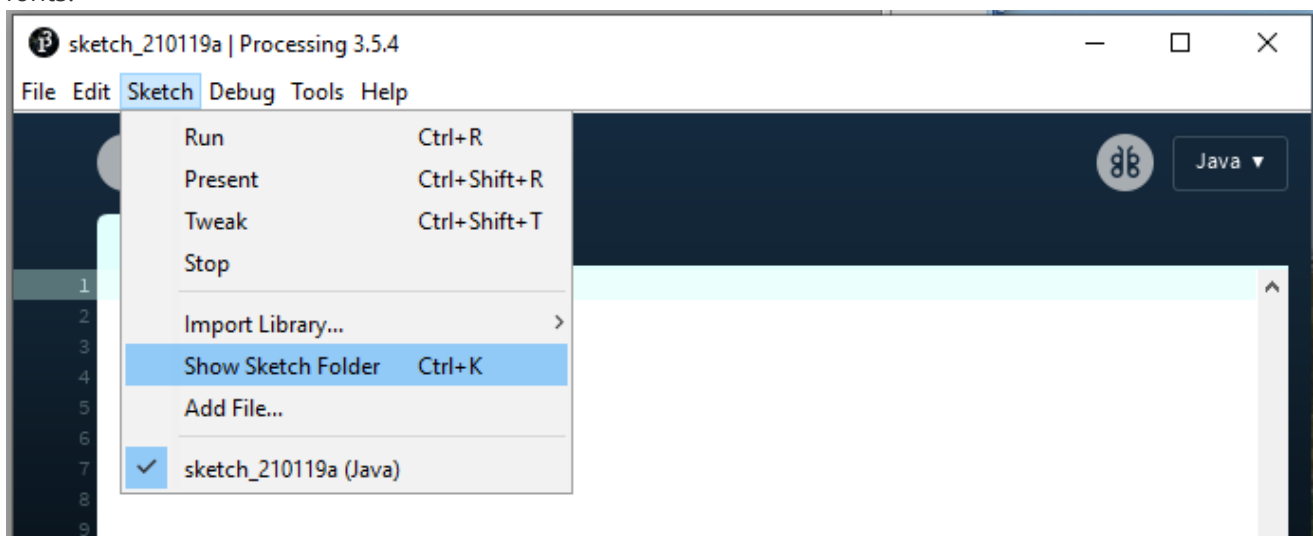


Optionally you can make your font use less memory by selecting character selector and picking your unicode code blocks for specific characters:



You may repeat this process as often as required.

Once you have converted all the fonts and sizes needed you need then open your sketch to find these new fonts:



Your new fonts will be inside the data sub folder. Copy them to your project's data folder.