USER GUIDE

Bridgetek

BRIDGING TECHNOLOGY

EVE Screen Designer 4.5

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Contents

I Preface

A. Purpose

This document describes the functionality and procedures involved in using the **E**VE **S**creen **D**esigner (ESD) 4.5.

B. Intended Audience

The intended audience shall be any GUI application developer working with EVE products.

C. Related Documents

Document Name	Document Type	Document Format
FT81x Series Programmers Guide	Programming Guide	PDF
FT81x Datasheet	Datasheet	PDF
FT9xx Toolchain Installation Guide	Installation Guide	PDF

D. Feedback

Every effort has been taken to ensure that the document is accurate and complete. However any feedback on the document may be emailed to docufeedback@brtchip.com. For any additional technical support, refer to http://brtchip.com/contact-us/.

II Overview

A. Introduction

EVE **S**creen **D**esigner (ESD) is the next generation of smart IDE for EVE, making EVE-based GUI development much easier to accomplish. This tool enables users to build one GUI application using a **visual programming**[1] method without needing to know any EVE-specific display list commands.

ESD provides a **WYSIWYG** ("**W**hat **Y**ou **S**ee **I**s **W**hat **Y**ou **G**et") environment for editing graphics, designing visual effects, and defining GUI application user logic, generating **ANSI C code** for the targeted hardware platform. Users can also choose to simulate the whole design to experience the UI before compiling and downloading the generated source code. Furthermore, ESD has the capability to work seamlessly with Bridgetek FT9XX tool chain. User can compile, link the generated source code with FT9XX tool chain and upload it to the targeted platform without leaving ESD.

ESD introduces layout mechanism to manage widgets and pages in a more generic way. The layout mechanism will enable users to create more dynamic UI much easier than before. In addition, ESD 4.X dramatically enhances the functionality of logic nodes editor, layout editor and project browser, for better user experience.

B. Key Features

The following are some of the key features of **E**VE **S**creen **D**esigner:

- **WYSIWYG** GUI
- High level widgets
- No EVE display list knowledge required
- Widget based GUI construction
- Drag and drop widget to create screen layout
- Inter widget communication
- Screen logic creation without coding
- Simulation of screen logic and user touch input using mouse
- Building and downloading the generated "C" code (if FT9XX Toolchain is installed)

[1] https://en.wikipedia.org/wiki/Visual_programming_language

C. ESD 4.X Features

What's new in ESD 4.5?

- Added new target platform support for VM816CU50A and VM816C50A boards.
- Added new widget : Circular gradient widget

ESD 4.0 Features:

- Introduced layout type widget to manage the widget's layout effectively
- Support for platform configuration when creating new project
- Switch platform when multiple platforms are supported in current project
- Added resource folder in project browser when adding images into project
- Enable creating subfolder in project browser for better resource management
- Added more built-in logic nodes to ease the logic creation
- Added default theme file in newly created project
- Added optimization in FT9XX tool chain configuration script to reduce code size
- Enable string find/replace functionality in the C file editor
- Support group selection and area selection in logic node editor and layout editor
- Support cut/copy/paste operation on nodes level
- Support screen resolution specific widget properties configuration
- Support PALETTED8,DXT1, PNG2, JPEG3 format in ESD Image widget
- Enabled log facility for debugging purpose

[2] PNG file shall conform to the requirement of EVE command CMD_LOADIMAGE
[3] JPEG file shall conform to the requirement of EVE command CMD_LOADIMAGE

D. Known Issues & Limitations

The following are some known issues and limitations of ESD:

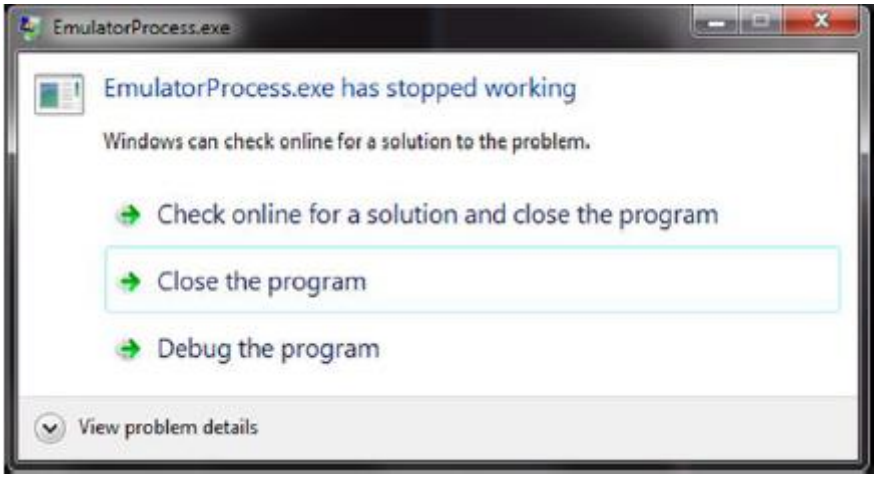
- Only the FT81X series EVE is supported. FT80X Series EVE is **NOT** supported
- The C code editor in ESD does not support all the features of a code editor.
- Video feature is not supported.
- If the project file path is too long (i.e. more than 512 bytes), ESD may have a problem opening it. The typical error message is shown below:

  "Unable to generate output files, check directory permission at: C:\Users\xxxx.xxxx\Project\ESD\....."

  Where

  "C:\Users\xxxx.xxxx\Project\ESD\....." refers to the project folder.

- Logic node editor background goes white after windows hibernates.
- In some unusual cases, users may encounter a dialog box (shown below) which will not affect the functionality. In this case, just ignore the dialog box by closing it.



- In few cases, users may need to click the "Recompile" button at the toolbar to update the frozen simulation result.

E. Terms & Description

Abbreviations/Term	Description
Actor	One type of logic node which is regularly updated but without visual appearance
DLL	Dynamic Link Library is a collection of small programs, any of which can be called when needed by a larger program that is running in the computer
ESD	EVE Screen Designer
EVE Emulator	Bridgetek behaviour-modelling software for EVE Series chip
HAL	Hardware Abstraction Layer is a software subsystem providing hardware abstraction.
IDE	Integrated Development Environment
Layout type widget	One type of widget which has no visual appearance rendered by EVE , but manage the associated widget
Logic Node	The node expressing certain logics.(Also referred to simply as "node" in this document)
Logic Node Editor	The place create logics by connecting the logic node
Page	One single screen in design
Simulation	Preview the project or page by running the generated C code on PC
Widget	One type of logic node which has visual appearance rendered by EVE

F. Credits

Open Source Software

- Qt: http://doc.qt.io/qt-5/licensing.html under LGPL.
- TinyCC: http://bellard.org/tcc/ and http://repo.or.cz/tinycc.git available under LGPL.
- Errorlist module: https://github.com/kaetemi/errorlist available under MIT license
- QScintilla: part of PyQt available under PyQt commercial license

  https://www.riverbankcomputing.com/commercial/license-faq

Icons Copyright

Some of the icons used in ESD 4.X are from:
http://p.yusukekamiyamane.com/icons/search/fugue/ used in compliance with the Creative Commons Attribution 3.0 License.

III Setup & Installation

A. System Requirements

To install ESD 4.5 application, ensure that your system meets the requirements recommended below:

- ✓ Ideally Windows 10; alternatively Windows 8 or 7 with the latest windows updates
- ✓ 1.6GHz or faster processor
- ✓ 1GB of RAM (1.5GB if running on a virtual machine)
- ✓ Multi-Core CPU is highly recommended
- ✓ At least 512MB hard disk space
- ✓ Display resolution 1080 x 800 pixels or higher
- ✓ "Write" permission to the installation folder

B. Hardware Requirements

The exported C source code from ESD 4.X is targeted at **FT90X MCU Module** and **EVE Module** platforms.

The supported platforms are listed as below:

Platform Name	Compatible EVE Module	Compatible FT90X Module Name	Compatible PC based Module
ME812A WH50R	ME810A-WH70R(800x480) ME811A-WH70R(800x480) ME812A-WH50R(800x480) ME813A-WH50C(800x480)	MM900EV-LITE MM900EV1A MM900EV2A MM900EV3A	NA
ME810A HV35R	ME810A-HV35R		NA
VM816CU50A	VM816C (800x400)	NA	FT4222 (libFT4222.dll)
VM816C50A	VM816C (800x400)	NA	MPSSE (libMPSSE.dll

For PanL35, PanL70 and PanL70Plus are not modular design, the EVE and FT90X modules are always together in the panel.

While working on hardware platform (FT90X MM modules), users must ensure that an SD card is inserted into the SD Slot since ESD 4.X will try to detect the presence of an SD card. If the SD card could not be detected, then the application may fail.

C. Dependencies / Pre-Requisites

- **Visual C++ Redistributable for Visual Studio 2015**

  If the PC does not have Microsoft Visual Studio 2015 installed, Visual C++ Redistributable is required. Users can download this from:

  https://www.microsoft.com/en-sg/download/details.aspx?id=48145

- **Windows 10 Universe C Runtime**

  ESD has run-time dependency on Windows 10 Universe C Runtime (CRT). You may download it from https://www.microsoft.com/en-us/download/details.aspx?id=48234 and install on your PC should the following problem be encountered:

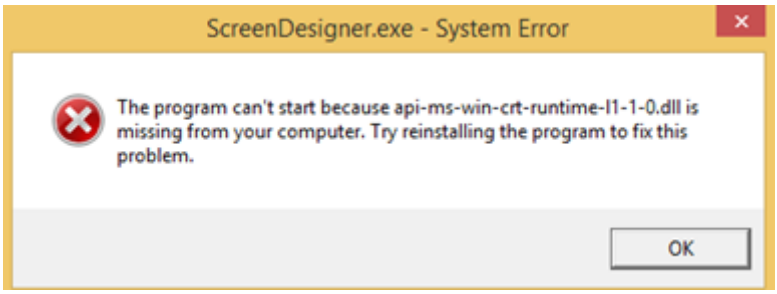


Figure 1 - Screen Designer - System Error

- **FT9XX Tool Chain Version 2.1.0 or later**

  To compile and build projects, the FT9XX Tool Chain 2.1.0 must be installed on the PC. It is downloadable from http://brtchip.com/ft90x-toolchain/.

  Please ensure that the Tool Chain executable path is defined by the system PATH environment variable.

  Users are advised to check the known issues and limitations (of FT9XX Toolchain) while building the ESD 4.X project with FT9XX Toolchain. The respective FT9XX Toolchain package version release note contains the list of known issues and limitations.

  For ESD 4.X, we recommend users to install FT9XX Tool Chain version 2.4.0 for best result.

D. Installing ESD 4.5

The following steps will guide you through the ESD 4.5 *Setup/Installation* process.

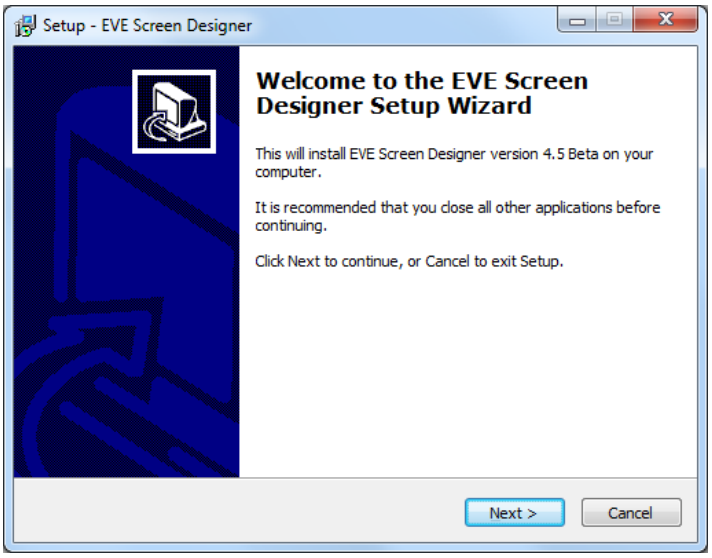
i. Download the package from www.brtchip.com.

ii. When prompted with a download dialog box. Click on **Save**.

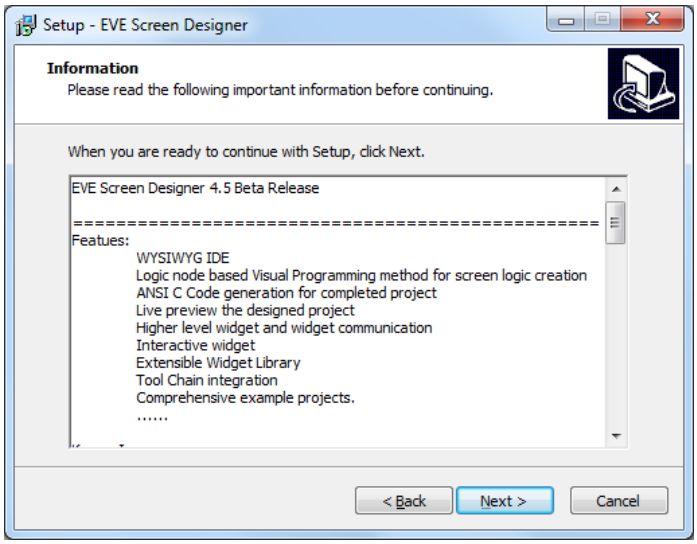
iii. Navigate to the folder under which the package files are downloaded.

iv. Extract the zip file contents. Double click on the executable file – **EVE Screen Designer 4.5.exe**

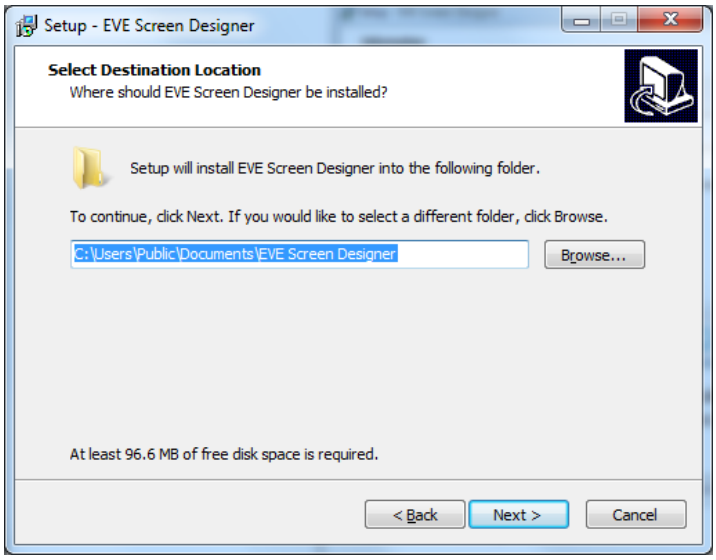
v. The EVE Screen Designer 4.X Setup Wizard is displayed along with a Welcome message.



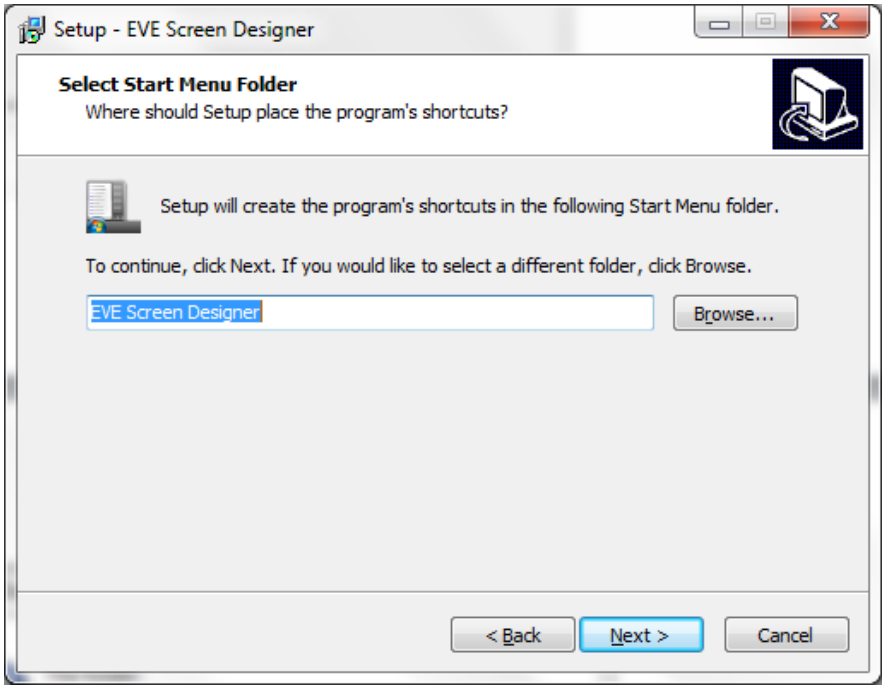
vi. Click **Next** to view the end user information window.



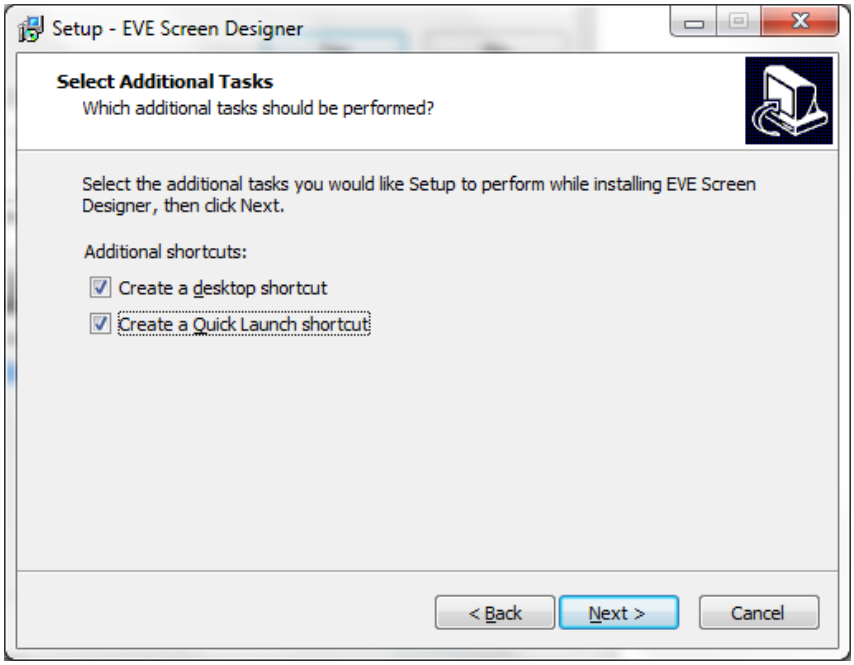
vii. Click **Next** to select a "Destination Folder" for installing the files. Accept the default folder or click **Browse** to specify a different location. Click **Next** to confirm the destination folder and continue.



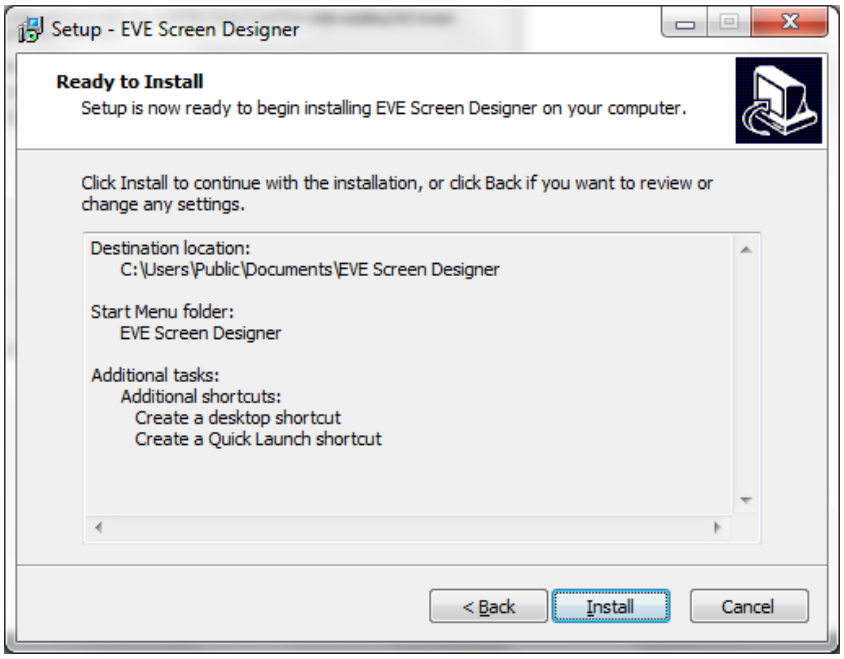
viii. Click **Next** to select a "folder" for creating the program shortcut. Accept the default folder or click **Browse**, to specify a different location. Click **Next** to confirm and continue.



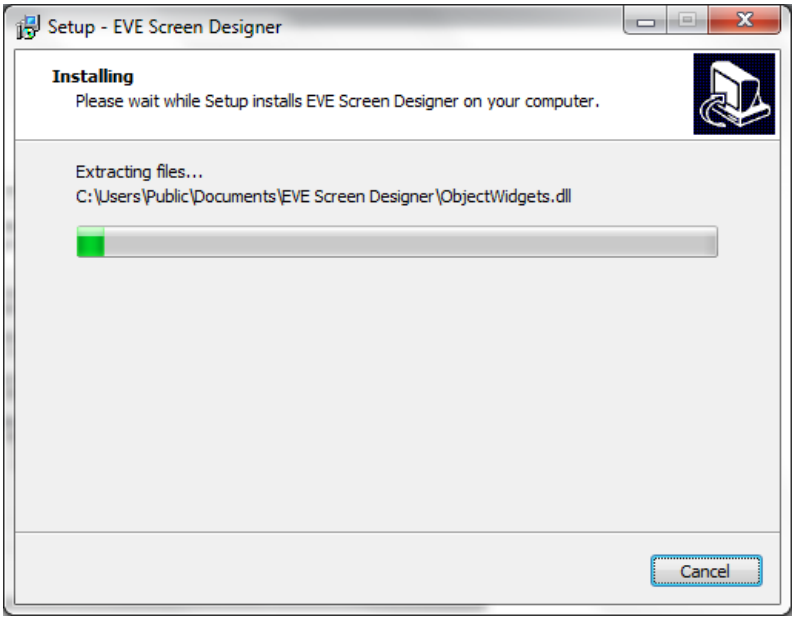
ix. In the **Select Additional Tasks** window, check **"Create a desktop / Create Quick Launch shortcut"** boxes, to have the ESD 4.5 icon and Quick Launch shortcut displayed on the desktop if required. Click **Next** to prepare for the installation.



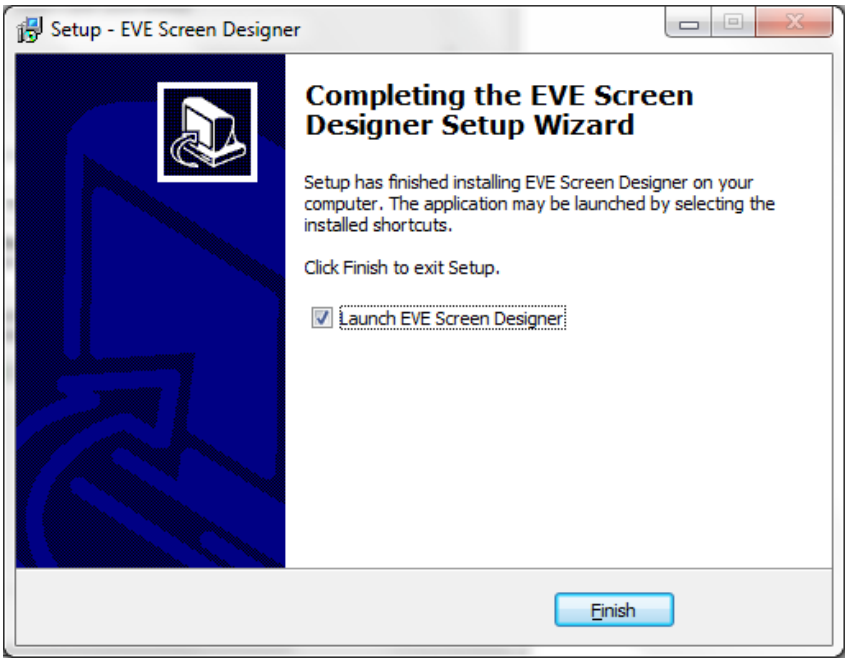
x. The initial setup is completed and the application is ready to be installed.



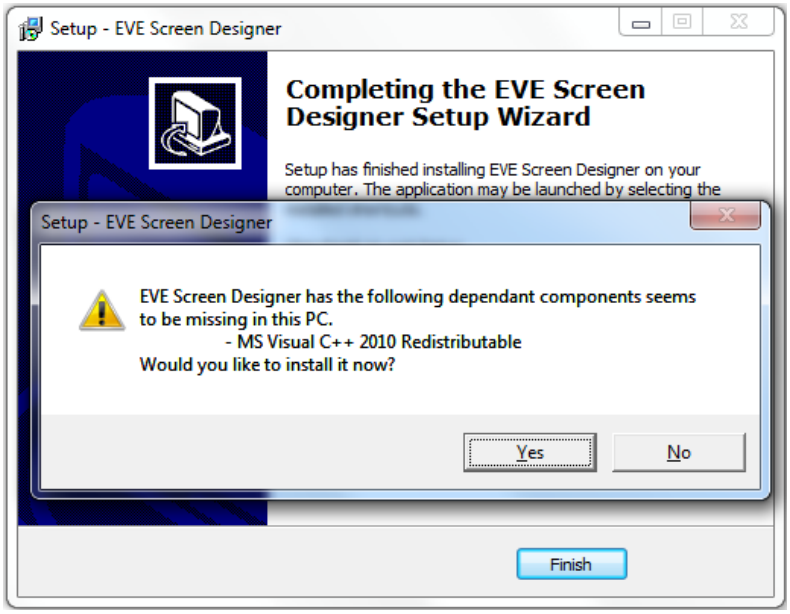
xi. Click **Install** to start the installation. A progress bar indicates that the installation is in progress.



xii. Upon successful installation, click **Finish**. The ESD 4.5 application UI is displayed.



xiii. Setup will check for availability of MS Visual 2010 redistributable and it will prompt the user to install it if it is not found in the system as given below prior to the last step of ESD 4.5 installation.



Upon clicking "Yes" from the above prompt dialog box, the Setup will open a browser and will redirect to the following webpage for installing MSVC 2010 redistributable.

https://www.microsoft.com/en-sg/download/details.aspx?id=26999

User may opt to choose "No", so that he can install it at any later point of time. Upon clicking "No", normal operation will continue.

E. Installation Folder

The following table provides a list of folders that can be found under the installation path upon successful installation of ESD 4.X.

Folder Name	Description	Permission
Examples	The example projects created by ESD 4.5	Read/Write
Imageformats	Qt run-time DLLs for image format supporting	Read-Only
Libraries	Widget library, application framework and Hardware abstraction layer	Read-Only
Log	Stores the runtime logs. For debug purpose.	Read/Write
Manual	Contains this document	Read-Only
platforms	Qt platform run-time DLLs.	Read-Only
Settings	Configuration files for third-party utilities and tool chains as well as ESD settings. The files are in XML format.	Read-Only. Reserved for advanced users to change.
Templates	The template files used by ESD	Read-Only
TinyCC	TinyCC run-time used for ESD simulation purpose.	Read-Only
Tools	The third-party utilities used in ESD4.5 for bitmap conversion purpose	Read-Only

Table 1 - Installation Folder

IV Working with ESD 4.X

The targeted audience of this chapter are mainly the existing ESD users. This chapter may help the existing users to get familiar with the new features of ESD 4.X.

A. What's new in ESD 4.5?

New platform

ESD 4.5 has a default support for "VM816CU50A" (FT4222) and "VM816C50A" (MPSSE) target platforms. In these new platforms, user is able to export ESD project as MS visual studio 2015 project. The output visual studio solution can be found in "Project" folder.

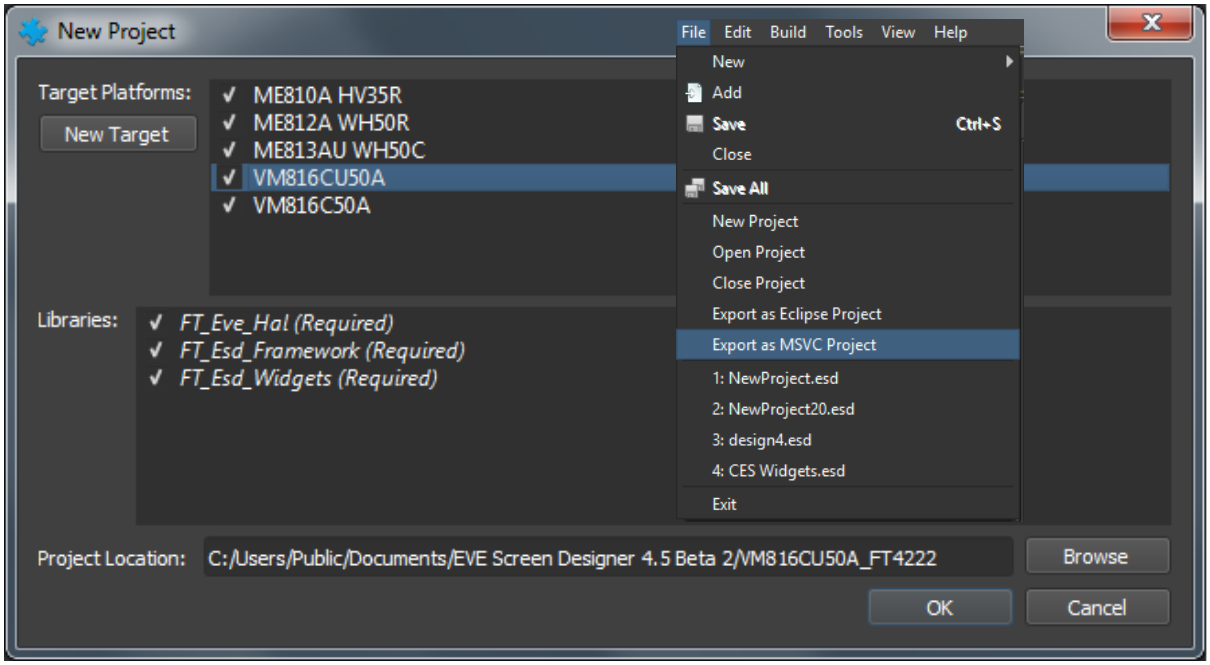


Figure 2 - VM816CU50A & VM816C50A Target Platforms

New widget

A new ESD widget named *Circular Gradient widget* is provided as part of the ESD widget library. Refer to Widget section for more details.

B. What's new in ESD 4.2?

New platform

ESD 4.2 has a default support for "ME813AU WH50C" target platform. In this new Platform, user is able to export ESD project as MS visual studio 2015 project. The output visual studio solution can be found in "Project" folder.

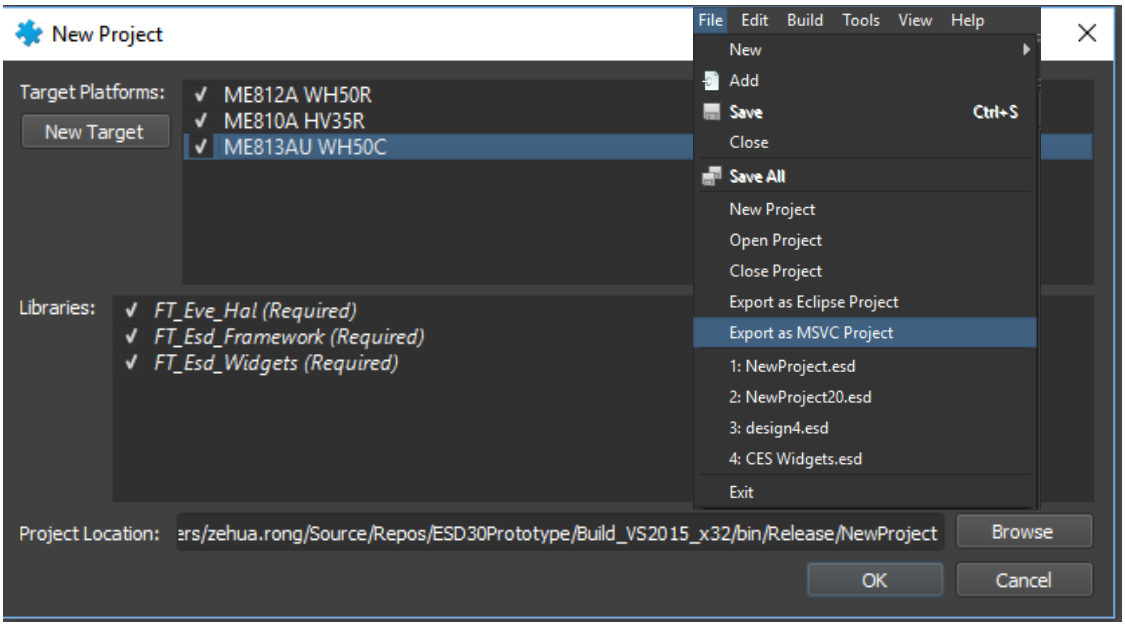


Figure 3 - ME813AU WH50C Target Platform

C. What's new in ESD 4.1?

New platforms

ESD 4.1 has a default support for "PanL35" and "PanL70" target platforms.

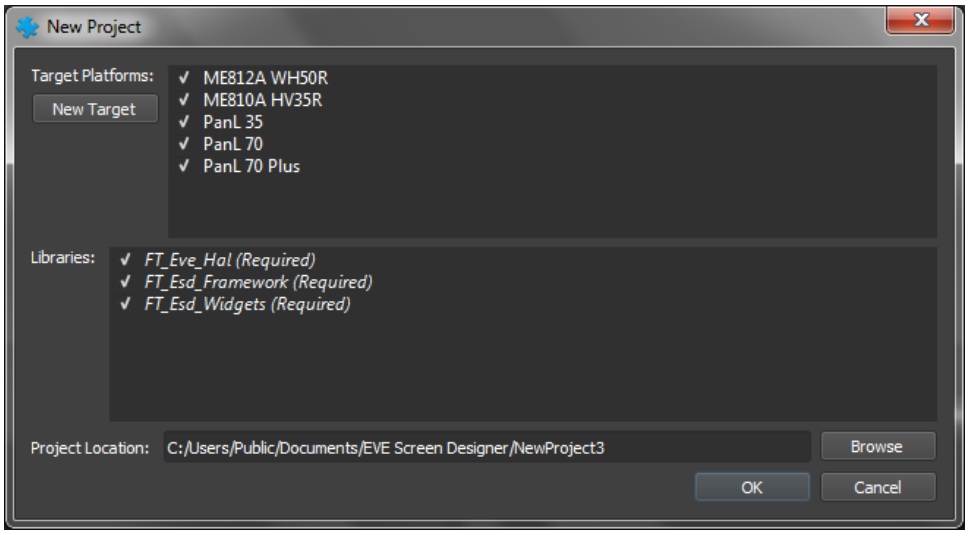


Figure 4 - PanL35 and PanL70 Target Platforms

New widgets

A list of new ESD widgets are provided as part of the ESD widget library. This includes: *Circle Line widget, Arc Line widget, Ring widget, Partial Ring widget, Linear Roller widget, Touch Panel widget, Scroll Switch layout* and *Idle Checker Actor*. Refer to Widget section for more details.

D. What's new in ESD 4.0?

Widget model

ESD 4.0 introduces a standard widget model, which applies to page, layout and widget. It provides a generic interface for these 3 kinds of nodes. With this feature, users can manage pages, widgets, and layouts in the same way. With widget model, the widget hierarchy is estimated. A child widget is managed by its parent widget. **Typically, the following properties of a child widget are decided by its parent widget**:

- X, Y coordinate
- Width, Height
- Depth sort property, which determines the rendering sequence of widgets, i.e. Z order
- Allocation mode, when the child widget is allocated/de-allocated.

This provides a different user experience from ESD 3.0. When a user decides to drag a widget into the screen, it is better to select a parent widget for it. The picture below illustrates the widget hierarchy in ESD 4.0:

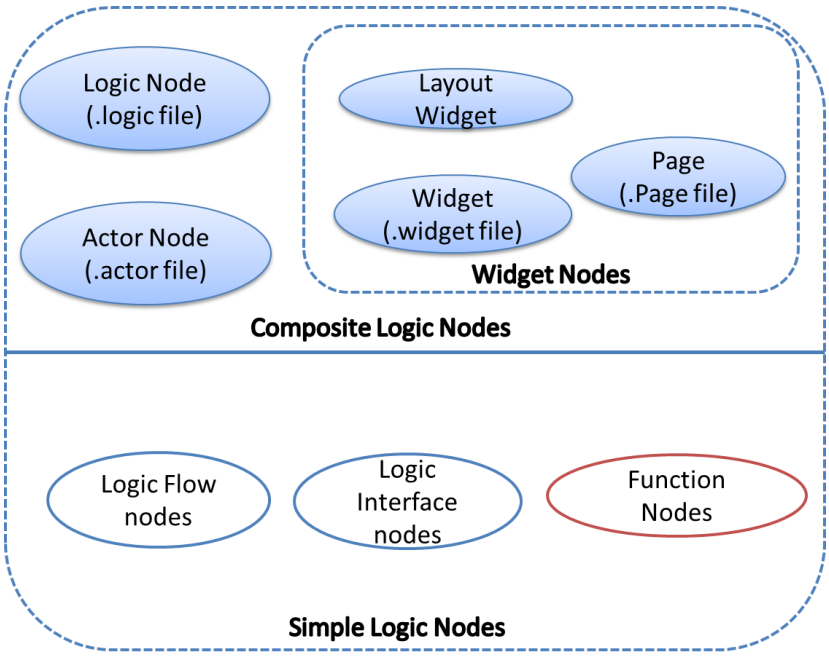
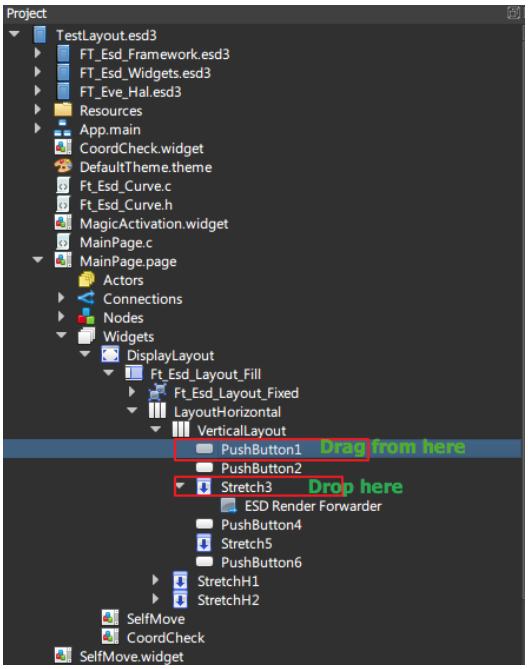


Figure 5 - ESD 4.0 Nodes Hierarchy

By default, a new page is created with a "Fixed Position" layout node as a root widget. Any other widgets are expected to be child widget of "Fixed Position". It enables all the child widgets to be placed with a fixed position within the screen. Users can work with this layout node the same way as before in ESD3.0.

However, a page is allowed to have multiple layouts to manage different zone of the screen. To adjust the widget hierarchy, users can drag and drop the widget through **"Project Browser"**. Here is an example:



The "Drag" and "Drop" action above will bring the following effect:

1. Widget object "PushButton1" is removed from its parent widget "VerticalLayout"
2. The widget "Stretch3" will take over the ownership of widget object "PushButton1".
3. "PushButton1"s position and dimension will be re-calculated and assigned by "Stretch3" widget.

Layout Feature

Based on the generic widget model, ESD 4.0 is able to support the layout feature by introducing a set of layout widgets and the relevant utility functions into built-in library. Users can make use of the layout widgets to manage the widgets and pages. The layout widget normally has no appearance when rendering and it works like a container of widgets.

For instance, when a label widget is added into a "linear layout" widget, its position and size is determined by a "linear layout" widget in order to place other widgets of "linear layout" widget with horizontally or vertically aligned style.

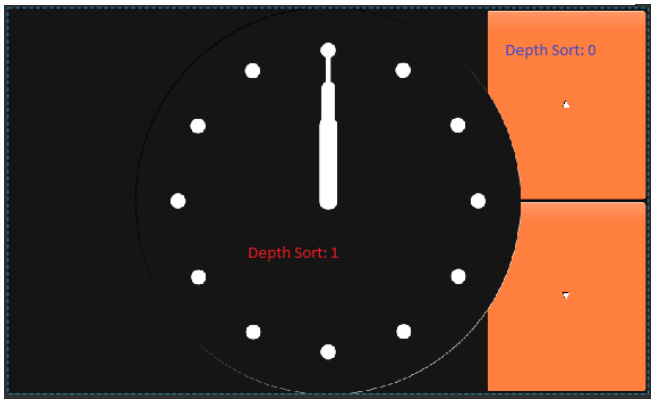
Project Extension Name (*.esd)

Upon installing ESD 4.0, the previous project file extension name ".esd3" will become obsolete and the new project extension name ".esd" will be enforced. Thus, all the projects will have the **".esd"** extension name.

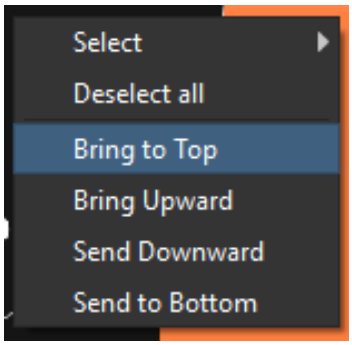
Depth Sort Property

In ESD4.0, the depth sort value of widgets serves multiple purposes.

Depth Sort as rendering order



Similar to ESD 3.0, the depth sort still serves as a rendering order in ESD4.0 if the parent widget is a *fixed positioning layout, a fill layout, a stretch layout, a scroll layout, a page* or *a widget*. The owner widget that has the larger integer of the depth sort value will promote the widget to be rendered on top of the other widgets which have relatively lower values within the same layout/widget. In this case, the depth sort value is equivalent to z-axis value in 3-D context. However, this does not apply when its parent layout is a linear layout or a switch page layout. The sample picture demonstrates how a clock widget and a spin box widget are rendered in a page when the clock widget has higher depth sort value.

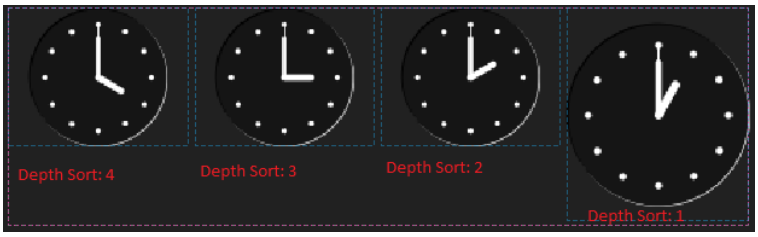


User can right click on the widget from the screen layout designer and use the context menu to adjust the depth sort as z-order value in design time.

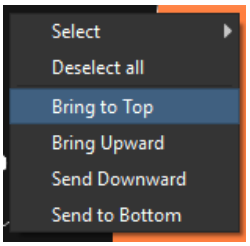
- **Bring to Top:** The selected widget's *depth sort = max(all widgets' depth sort) + 1*. This sets the selected widget on top of all other widgets.
- **Bring Upward:** The selected widget's *depth sort = max(the next higher depth sort from all widgets, its current depth sort) + 1*. This increases the selected widget's depth sort on top of the next higher value.
- **Send Downward:** The selected widget's *depth sort = min(the next lower depth sort from all widgets, its current depth sort) – 1*. This decreases the selected widget's depth sort below the next lower value.
- **Send to Bottom:** The selected widget's *depth sort = min(all widgets' depth sort) – 1.* This sets the selected widget below all the other widgets.

All widgets are referring to the sibling widgets within the same hierarchy. In other words, they are within the same widget container such as the same layout, same page or the same widget.

Depth Sort as layout sequencing control



When the parent widget is a linear layout, the depth sort value serves as layout sequencing control. In the case of within a horizontal linear layout, the depth sort value serves as horizontal ordering along the x-axis. The depth sort with a higher value will be rendered first in the linear layout. Such that, the widget with the highest depth sort value will be placed at the left most in the horizontal layout; similarly, the widget with the highest depth sort value will be placed at the top most in the vertical layout. Refer to Linear Layout for more details.



User can right click on the widget from the screen layout designer, uses the context menu to adjust the depth sort as x-order/y-order value in design time.

- **Bring to Top:** The selected widget's *depth sort = max(all widgets' depth sort) + 1.* This moves the selected widget to the left most in horizontal linear layout; it moves the selected widget to the top most in vertical linear layout;
- **Bring Upward:** The selected widget's *depth sort = max(the next higher depth sort from all widgets, its current depth sort) + 1*. This moves the selected widget to one step to the left in horizontal layout or one step to the top in vertical layout.
- **Send Downward:** The selected widget's *depth sort = min(the next lower depth sort from all widgets, its current depth sort) – 1*. This moves the selected widget to one step to the right in horizontal layout or one step to the bottom in vertical layout.
- **Send to Bottom:** The selected widget's *depth sort = min(all widgets' depth sort) – 1*. This moves the selected widget to the right most in horizontal linear layout; it moves the selected widget to the bottom most in vertical linear layout;

All widgets are referring to the sibling widgets within the same hierarchy. In other words, they are within the same widget container such as the same layout, same page or the same widget.

Depth Sort as page sequencing in "Switch Page"

When the parent widget is a switch page widget, the depth sort value serves as page indexing in switch page container. Changing the depth sort value of the pages will only affect the index of the pages in the switch page container. The page with the highest index value will be listed first. However, if all the pages in the container are active, then the last page will be shown and the rest of pages will be hidden or closed based on the allocation setting. Users can right click on the widget from the screen layout designer and use the context menu to adjust the page indexing in design time. Users can only see the index from project browser. Please refer to **Switch Page** for further details.

E. Impacts of ESD 4.5 from ESD 4.2

New target platforms have been added in ESD 4.5. There are no impacts for existing feature in ESD 4.2.

F. Impacts of ESD 4.2 from ESD 4.1

A new target platform has been added in ESD 4.2. There are no impact for existing feature in ESD 4.1.

G. Impacts of ESD 4.1 from ESD 4.0

Some of the minor bugs of ESD 4.0 have been fixed in ESD 4.1. There are no significant changes in API. Hence, it has minimum impact from ESD 4.0 except for the updated widgets.

H. Impacts of ESD 4.0 Updated Features

Since the new/updated features of ESD 4.0 may cause API changes, the existing ESD 3.0 project is not fully compatible with ESD 4.0. Although ESD 4.0 has the utility inside to detect and migrate opening ESD 3.0 project, it may still fail working as expected.

- ESD Layouts: A new category of widgets "ESD Layout" are introduced into the Library Browser, which enables the layout feature.

- ESD Widgets: A new set of widgets are introduced into "ESD Widgets" category in the library. These set widgets are to be used in constructing the pages. The nodes under the "ESD Render Functions" are not supposed to construct page as it has no widget interface and the layout widget is unable to manage them.

- ESD Sketch
- ESD Numeric Label
- ESD Fixed Point Label
- ESD Scroll Image
- ESD Image
- ESD Scroll Panel

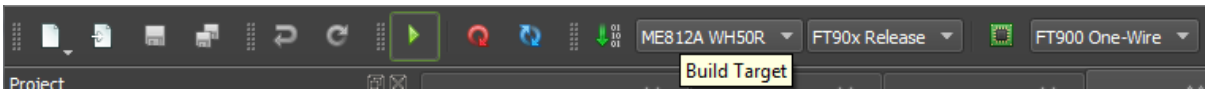
I. Migrating from ESD 3.0 to ESD 4.X project

When ESD 4.X opens an existing ESD 3.0 project, it will prompt users to migrate it. If user chooses not to migrate, ESD 4.X will not open ESD3.0 project.

MIGRATION NOTES

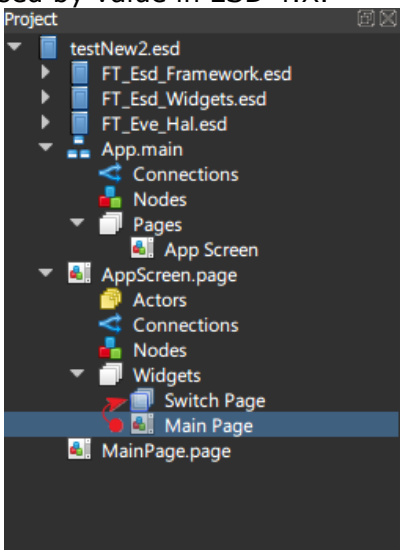
1. Please back up your project if you are not sure about the migration. The migration process will **overwrite the project and it cannot be reversed**.
2. The migrated project file will be renamed from **"*.esd3"** to **"*.esd"**.

3. The target module of the opened project will be redirected to two built-in platforms after migration. So if the target module is in 320 x 480 resolutions, users may select the platform **"ME810A HV35R"** from "Build Target" combo box from the toolbar and make a platform switch.



In some cases, if an existing ESD 3.0 project cannot be migrated to ESD 3.0, then users are required to migrate manually.

- The variable *"Parent"* of logic is renamed to *"Owner"* in ESD 4.X.
- *X, Y, Width, Height* properties in widgets is now accessible through the widget variable.
- Instead of pointer, struct *"Ft_Esd_BitmapCell"* shall be used by value in ESD 4.X.
- In order to restore the default behaviour of application logic *"App.main"*, users may need to manually move the existing pages into layout widget *"Switch Page"* in the Project Browser.



J. Setting Platform Specific Properties

In ESD 4.X, users are able to create one project supporting multiple platforms with various screen size. Therefore, at different platform, the same widget may have different property value. For instance, for a platform with screen size 480 x 320, the button size may shrink to a smaller size from the original value for a platform with screen size 800 x 480.

Users can make a property value specific to the current target through the context menu of the property browser. It can be done by right clicking the selected property of the current widget. This is illustrated in the picture given below.

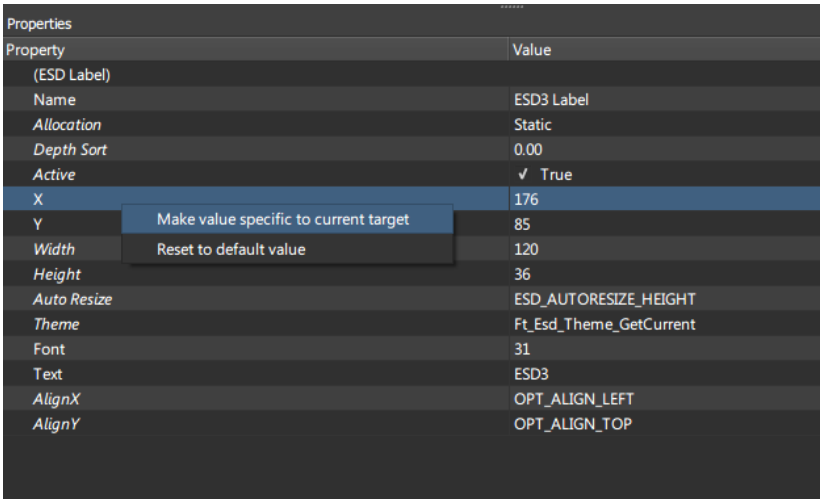


Figure 6 - Making Value Specific to Current Target

User can remove value specific to current target through context menu in property browser by right clicking the selected property of current widget. This is illustrated in the picture given below.

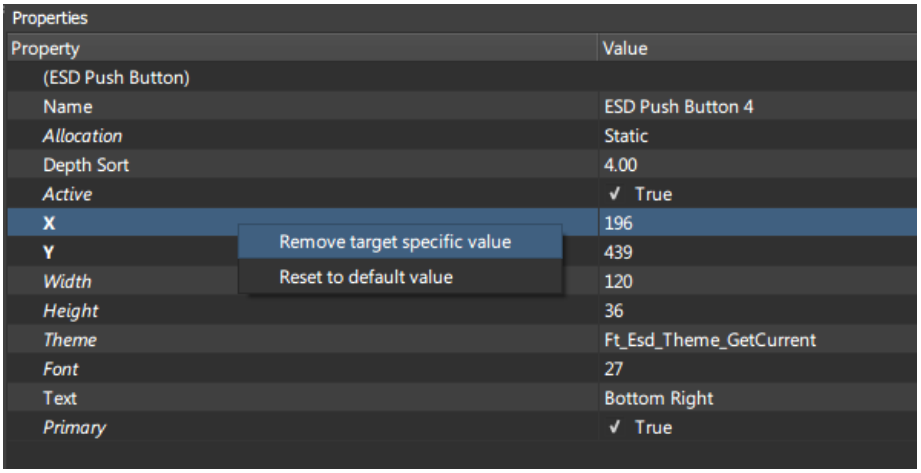


Figure 7 - Removing Target Specific Value

Users can refer to the **"ScreenResolution"** project under the **"Installation\Example"** folder.

V Getting Started

A. The Graphical User Interface

ESD 4.X user interface has the following components:

1 *Menu Bar*
2 *Toolbar*
3 *Project Explorer*
4 *Screen Layout Editor*
5 *Logic Node Editor*
6 *Library Browser*
7 *Error List/Inspector*
8 *Output* window
9 *Property Editor*
10 *Status Bar*

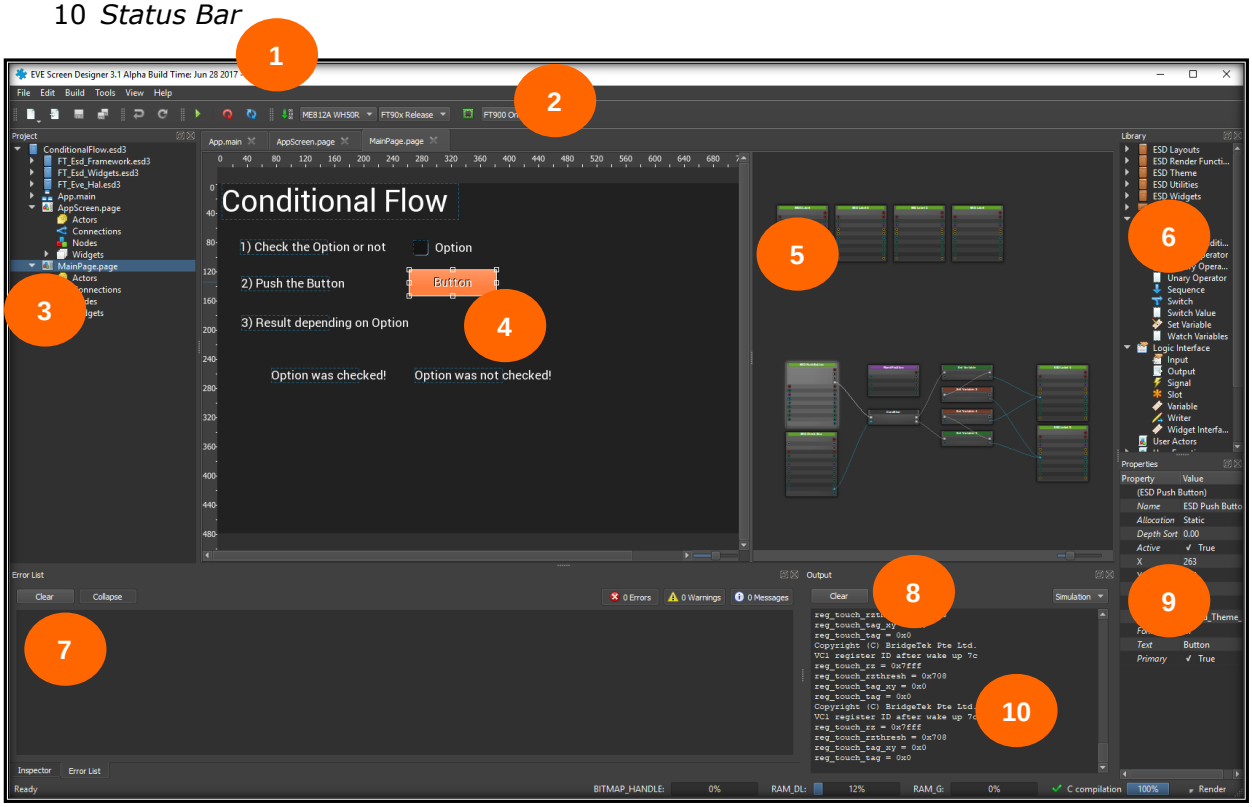


Figure 8 - EVE Screen Designer 4.X User Interface Components

1 Menu bar

The ESD 4.X *Menu bar* displays the headings for each drop-down menu. According to the function, the commands are grouped under each of these menu headings.

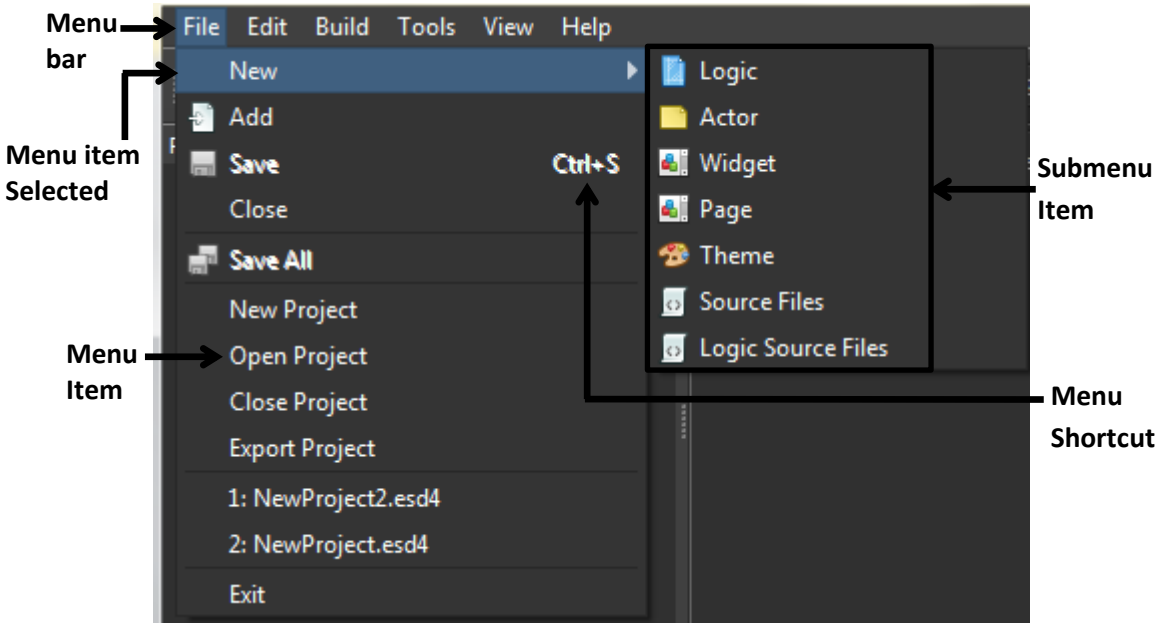
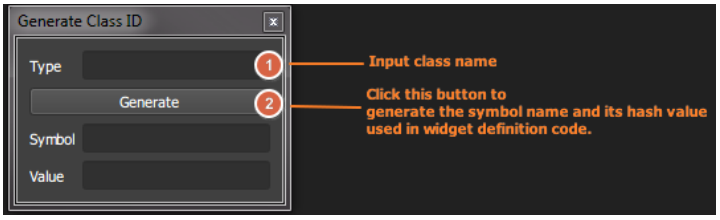


Figure 9 – Menu bar

The following table provides the list of Menu/Submenu and its description -

Menu	Submenu		Description
File	New	Logic	Creates new file for the current project
		Actor	
		Widget	
		Page	
		Theme	
		Source Files	
		Logic Source Files	
	Add		To add existing file(s)/resource (such as bitmap, C source file etc.) to the project
	Save		To save the current file

	Close		To close the current file
	Save All		To save all the files in the current project
	New Project		To open a new project
	Open Project		To open an existing project
	Close Project		To close a current project
	Export Project		To export eclipse project file
	Exit		To close the ESD 3.1 application
Edit	Undo		To reverse the action of an recently performed action
	Redo		To revert the effects of the undo action
	Cut		Cut the selected node(s) to clipboard
	Copy		Copy the selected node(s) to clipboard
	Paste		Paste the node(s) from clipboard
	Find		Find a specific text string in source editor
	Replace		Replace a specific text string in source editor
Build	Build Executable		To generate a executable file
	Build and Upload to Hardware		To generate a executable file and upload to hardware
	Browse to Executable		To navigate to the folder under which the executable file is located
Tools	Generate Class ID		To generate a Class ID for user widget or layout. It is a hash from the widget name and generally useful when user prefers to write code in "C" language. 
View	Project		To display or hide a component view. By default all the

	Library		components are displayed.
	Properties		
	Inspector		
	Error List		
	Output		
Help	User Guide		Opens the ESD 4.X User Guide with respect to current version
	About		Displays the version details
	3rd Party		Displays the copyright, disclaimer and license information of the 3rd party software

Table 2 - Menu & Description

2 Toolbar

The *Toolbar* provides an easy access to common functions (in the form of icons) such as new file, save file, undo, redo etc.

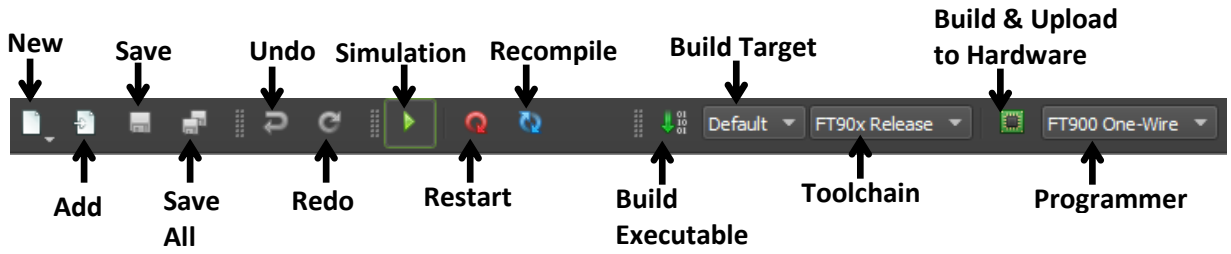


Figure 10 - Toolbar

The following table provides the list of toolbar functions and its description –

Toolbar Function	Description
New	To open new *Logic/Actor/Widget/Page/Theme/Source Files/Logic Source Files*
Add	To add existing resource (such as bitmap, C source file etc.) to the project
Save	To save the currently open file
Save All	To save all the files in the current project
Undo	To reverse the action of a recently performed action
Redo	To revert the effects of the undo action

Simulation	A toggle button which starts or stops the simulation mode.  - This state indicates that the ESD 4.X is in simulation mode. Clicking this button stops the simulation.  - This state indicates that the ESD 4.X is out of simulation mode. Users can drag/drop widgets or edit them safely.
Restart	To automatically restart the EVE emulator. Clicking this button will force the simulated screens to be re-drawn.
Recompile	To recompile the whole project's source code using ESD built-in TinyCC compiler. It is a mandatory procedure for simulation.
Build Executable	To build the project and generate the executable file
Build Target	Select the hardware platform as source code building target
Toolchain	Select the building configuration when tool chain is invoked to build
Build and Upload to Hardware	To build the project; generate executable file and upload it into the selected hardware (e.g. MM900EV2A)
Programmer	Defaults to FT900 One-Wire programmer.

Table 3 - Toolbar & Description

3 Project Explorer

The *Project Explorer* window organizes all the files used in the project in a tree view. It also lists out all the resources used by each file. Project explorer allows users to navigate each page of the project.

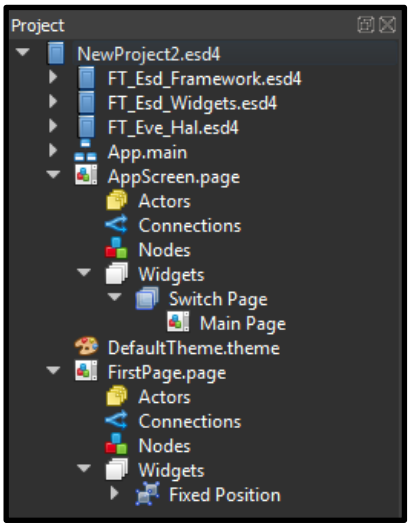


Figure 11 - Project Explorer window

4 Screen Layout Editor

The *Screen Layout Editor* displays the rendering output of EVE and allows users to edit C source code. The page/widget/main files can be opened and edited in this editor.

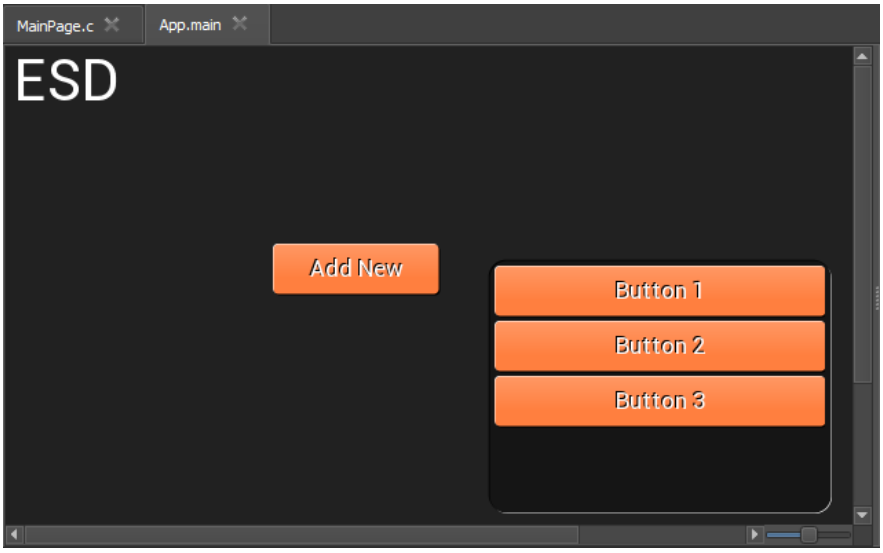


Figure 12 - Screen Layout Editor – App.main

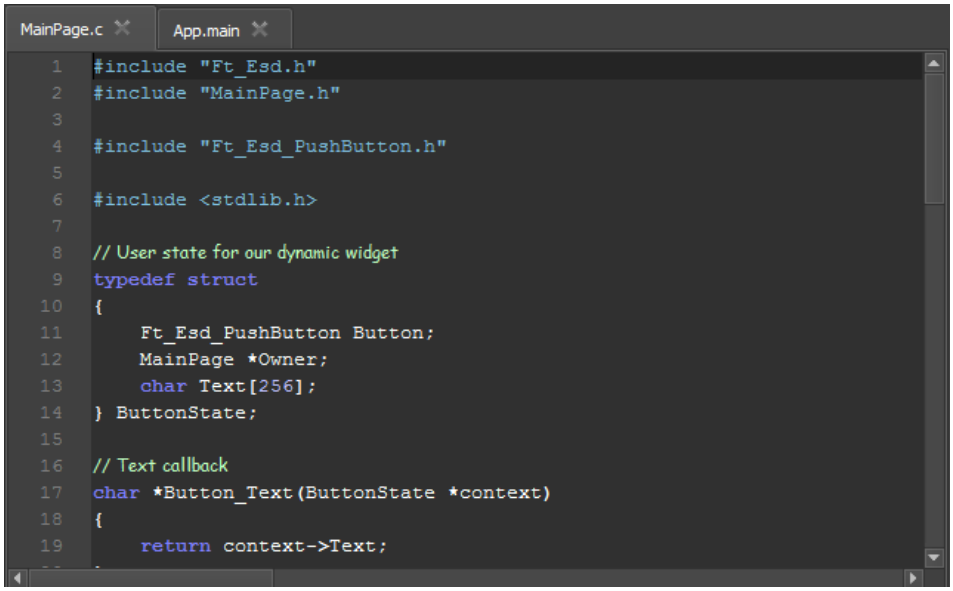


Figure 13 - Screen Layout Editor - MainPage.c (C Source Code)

It shares one view port with the logic node editor. Users can adjust the size of the screen layout editor by dragging the splitter handle.

Users can drag and drop the widgets from the library browser to form the layout when simulation mode is *"off"*. For the other kind of logic nodes, if the EVE rendering process not defined, screen layout editor does not allow them to be dropped in.

5 Logic Node Editor

The *Logic Note Editor* allows users to layout logic nodes and to establish connections to create logic maps. Users can drag and drop a logic node from the Library Browser component to the Logic Note Editor in order to create connections.

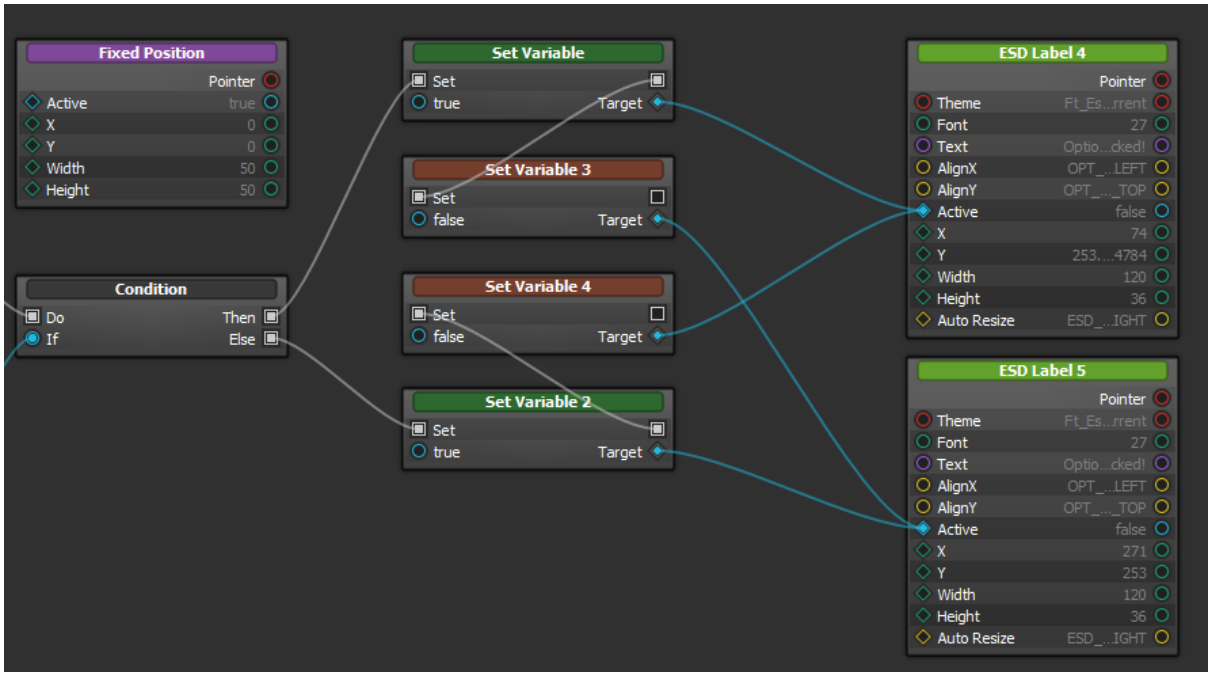


Figure 14 - Logic Node Editor

6 Library Browser

The *Library Browser* allows storing all the available logic nodes and resources in ESD 4.X that includes both built-in and user-defined ones. Users can view these logic nodes by category and select one for their project.

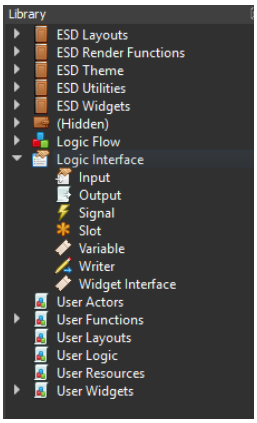


Figure 15 - Library Browser

The following table provides the ESD library name and its description –

Library Name	Description
ESD Layouts	ESD built-in layout widgets and relevant utilities
ESD Render Functions	ESD built-in Render functions
ESD Theme	ESD built-in basic theme manipulation functions
ESD Utilities	ESD built-in utilities
ESD Widgets	ESD built-in widgets
Logic Flow	ESD built-in logic node for control flow
Logic Interface	ESD built-in logic node for interface
User Actors	User defined actor logic node. It is empty by default.
User Functions	User defined functions. It is empty by default.
User Layouts	User defined layouts. It is empty by default.
User Logic	User defined logics. It is empty by default.
User Pages	Pages added by user. It is empty by default if no page is created.
User Resources	Resources added by users (For example: bitmap). It is empty by default.
User Widgets	Widgets created and added by users. It is empty by default.

Table 4 - ESD 4.X Libraries

7 Error List

The *Error List* is a dock window which shows the message output from ESD 4.X, while saving and recompiling the project files. Any error message displayed in this window indicates that the generated source code for the current project is unable to be executed successfully. Users need to double check the logic defined in *logic node editor* or the user-defined source code in the project.

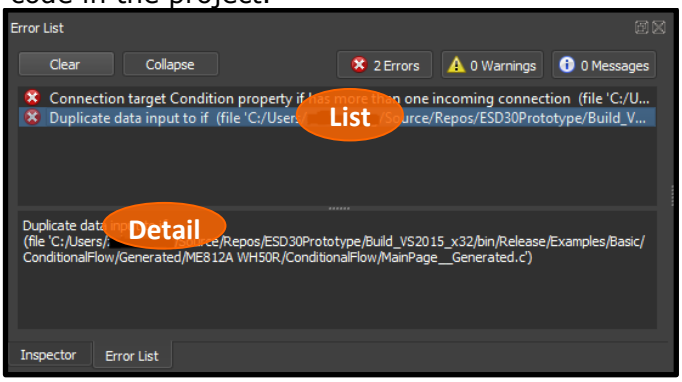


Figure 16 - Error List Window

8 Output

The *Output* component is a docked window which shows the message output from the EVE emulator and Toolchain.

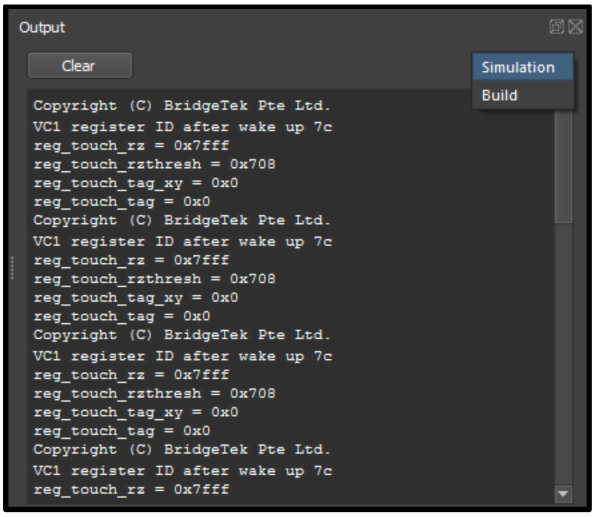


Figure 17 - Output Window

To check a message from the EVE emulator, click **"Simulation"** from the drop down list. To check a message from the EVE Toolchain while building generated source code, click **"Build"** from the drop down list. This window is automatically updated during simulation or building.

9 Property Editor

The *Property Editor* allows user to edit the properties of selected logic nodes. The sample screenshot given below shows the property editor of an ESD Push button.

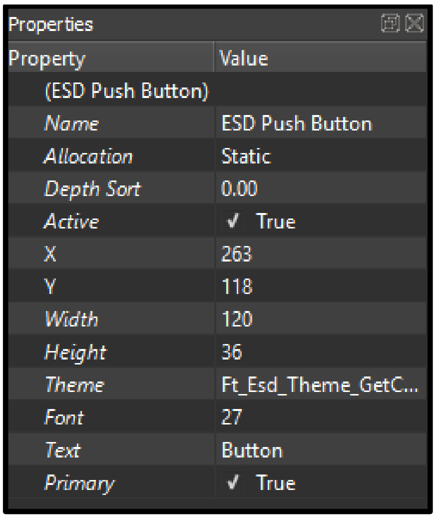


Figure 18 - Property Editor (ESD Push Button)

10 Status bar

The *Status bar* is found at the bottom of the user interface. It primarily displays the current status of any of process or job that is being handled by the application. For example, if the user is performing a C compilation, then the compilation status of the generated C code is displayed.

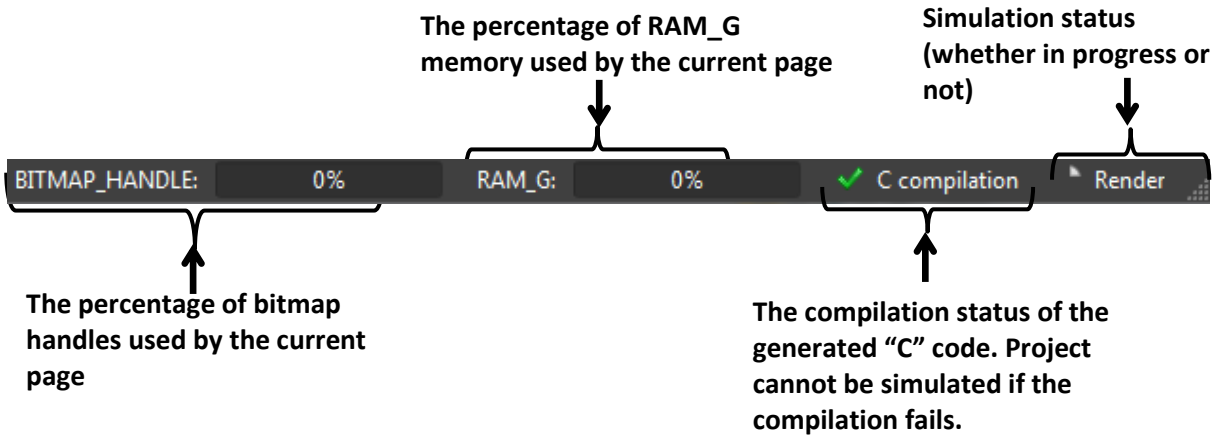


Figure 19 - Status bar

B. Application Project Structure

An Application consists of one or more pages. Each page in turn may contain one or more widgets. Widgets and pages are connected via connection lines so that the screen logic is defined.

The application model follows a strict hierarchical structure where all the pages are owned and managed by the application, and all the widgets are owned by their respective pages. The visibility and memory lifetime of the widgets are thus managed on a page-by-page basis.

By design, all widgets and pages are generated to be entirely modular and self-sufficient. Any interaction between the widgets and pages is therefore required to be routed through the hierarchical chain. (Only node connections exist between the directly connected nodes in the hierarchy.)

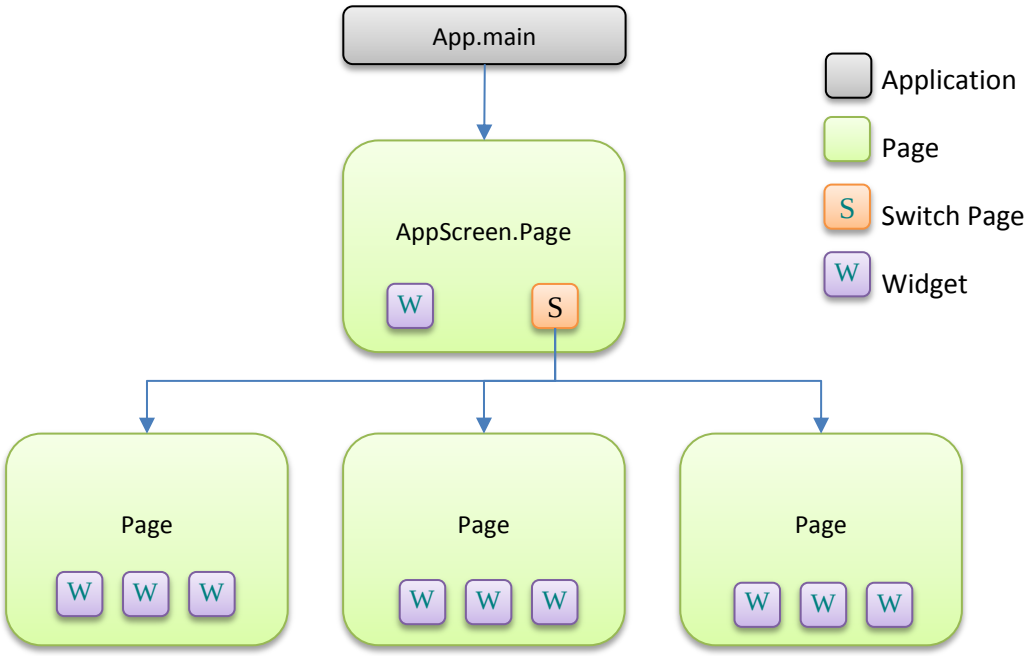


Figure 20 - Application Project Structure

File Name	Description
*.esd	Project file - This XML file describes what files are included in this project. This file is unique for the whole project.
*.main	Logic file - This XML file describes the application level logic. By default, it is named as "App.main" and is unique project wide.
*.page	Page Node Definition file - This XML file describes what widgets are contained and connected in each page. By default: "AppScreen.Page" is added, where a switch page may be included for control on page transition. A page can contain other pages, but switch page is required for page transition control.
*.widget	Widget Node Definition file. This XML file describes a widget detail. A widget can contain other nodes, which may include widget node, actor node and logic node.
*.actor	Actor Node Definition file. This XML file describes the actor node detail.

*.logic	Logic Object Definition file. This XML file describes the logic node details.
*.theme	Application Theme Definition file. This XML file describes a theme detail.
*.h	C language source header file
*.c	C language source body file
*.png, *.jpg, *.jpeg	Image resource files

C. ESD Workflow

The workflow given below illustrates how to create an EVE based GUI application using ESD.

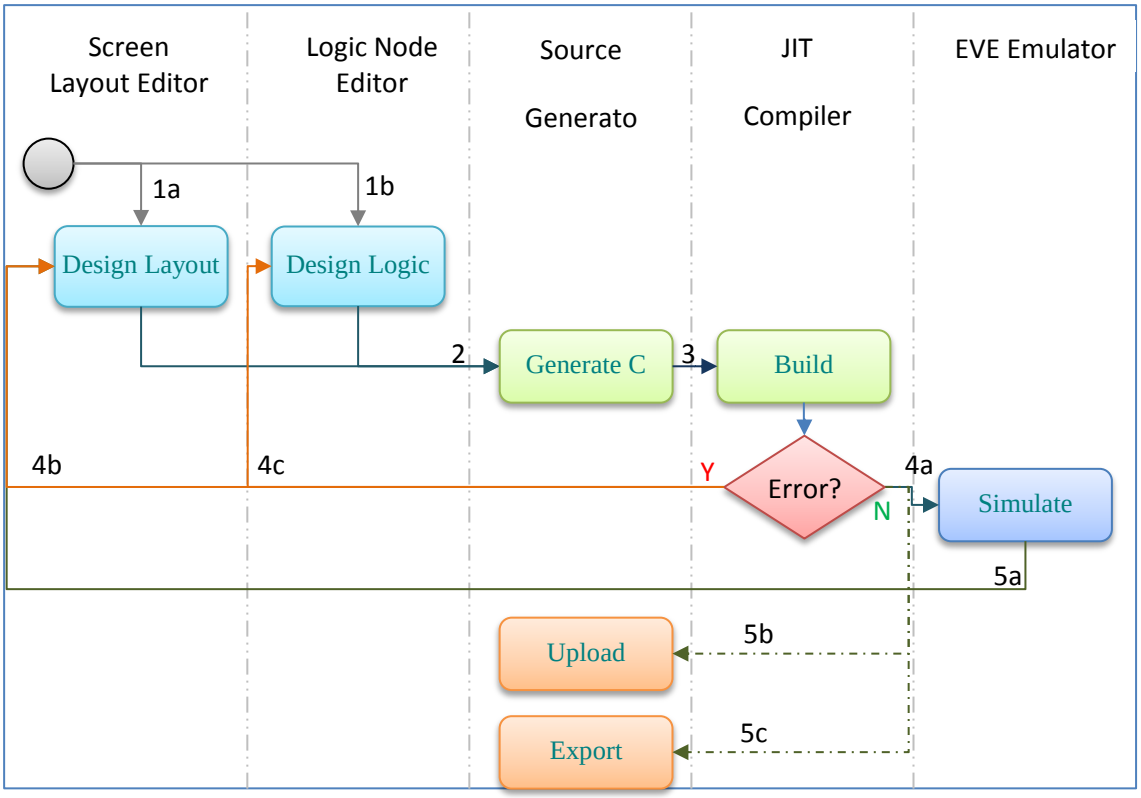


Figure 21 - Application Workflow

The 5 main modules that comprises the application workflow are the *Screen Layout Editor, Logic Node Editor, Source Generator, JIT Compiler* and *EVE Emulator*. Among these, *Source Generator*, *JIT Compiler* and *EVE Emulator* are the back-end modules which have no UI exposed to end user. The compiler is a JIT style C compiler, i.e. TinyCC compiler, which compiles and links the generated code into executable. The executable is invoked by emulator module for simulation.

The application workflow starts by design layout (1a) or design logic (1b); upon user saving the changes, it will trigger C code generation (2); then the compiler will try to build the generated c code; if any error encountered during building, then user needs to continue on design layout (4b) or design logic (4c); or if no error found, then the

emulator will start simulating (4a) the project. Users will be able to upload (5b) the binary to the EVE chips or export (5c) the project as eclipse C project.

Design Layout using Layout Editor

Users need to determine how many pages are included in the project and what widgets are to be contained in each page. After a page is created, users can drag and drop the widgets to design the appearance of the page in the screen layout editor. This process determines how many screens are shown in the project and how they look like together.

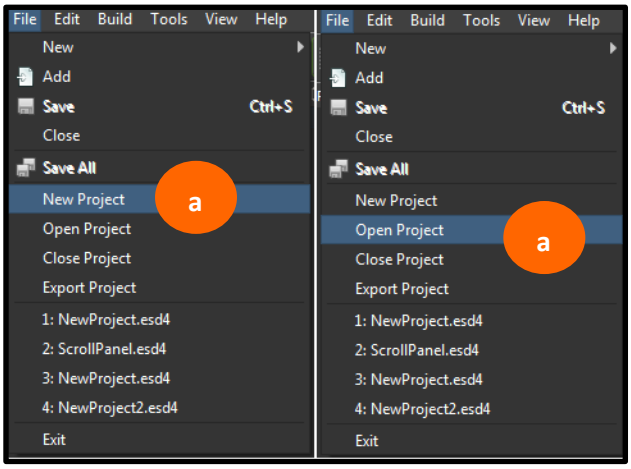
Custom Widget

ESD 4.X provides a set of built-in widgets for users to construct screen layouts. Additionally, if the built-in widgets do not meet the design requirement, users may define and design custom widgets.

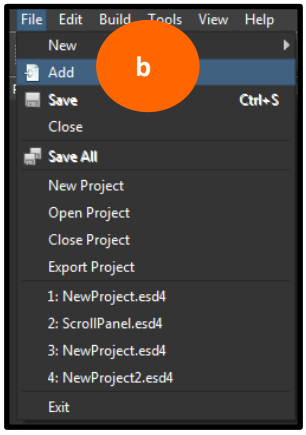
Add Bitmap Resource

To display a bitmap on the page, users need to add a bitmap resource into the project. The following steps will provide guidance on how to add a bitmap resource:

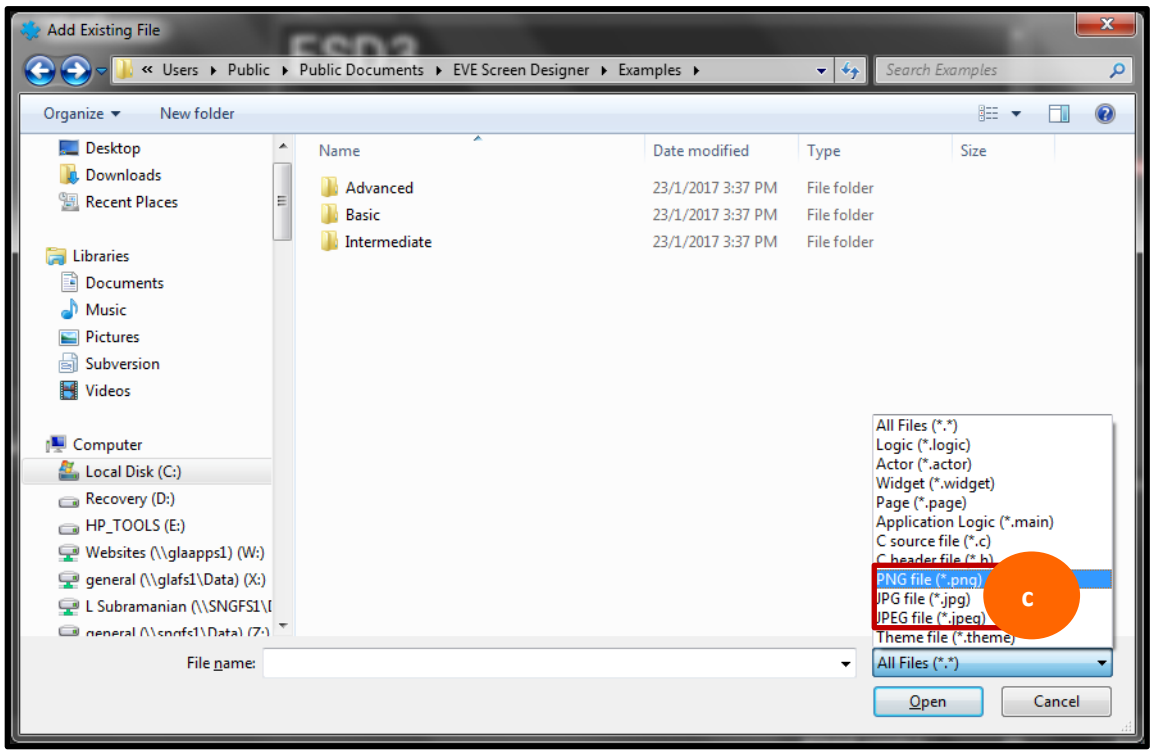
a. Create a New Project (*File → New Project*) or Open an existing Project *(File → Open Project)*.



b. Click **File → Add** from the menu.



c. Browse and select the image file(s) from the file explorer window.



Upon adding the file, users can drag and drop the ESD Image widget to the desired page and select the bitmap cell (which is default at cell 0) accordingly.

Configure Bitmap Resource

Users can configure a bitmap resource via the Property Editor. Select the image file from the project browser and check the Property Editor.

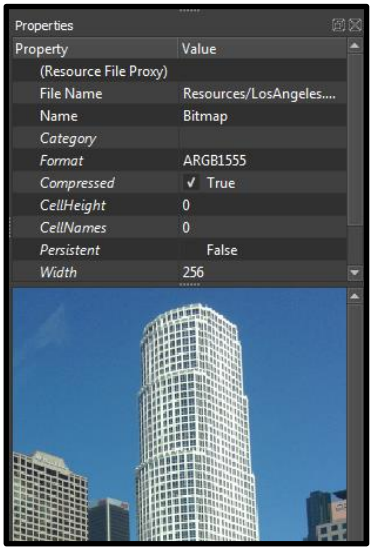


Figure 22 - Property Editor

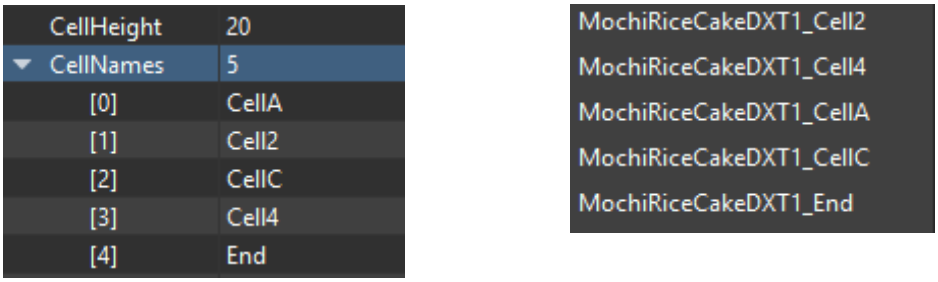
Property	Value/Description
File Name	Name of the image file
Name	Resource Type Name. In this case, the selected resource type is Bitmap.
Category	Category of the selected object
Format	Image Format – The target format of bitmap can be – • L1/L2/L4/L8 • RGB332/RGB565 • ARGB1555/ARGB2/ARGB4 • PALETTED4444/PALETTED565/PALETTED8 • DXT1 • JPEG (decompressed into RGB565 format only) • PNG (decompressed into RGB565 format only)
Compressed	Set bitmap compression on/off
CellHeight	The pixel number of one cell. For example, if the bitmap width is 240 and height is 240, then it can be defined as two cells with "CellHeight" - 120 or four cells with "CellHeight" – 60. Cell Height default at 0 which mean there will be only one cell no matter how large the bitmap it is.
CellNames	This field will enable system to create a list of n number of user defined cell names instead system generated which is suffixed with "_x". 
Persistent	Keeps the memory persistent even if the bitmap is not displayed when it is true.
Width	The width of bitmap image in pixels
Height	The height of bitmap image in pixels

Table 5 - Bitmap Resource Properties

Design Screen Logic using Logic Node Editor

Users can define the dynamic behaviour of an application in this phase. The Logic Node Editor employs the innovative visual programming idea to help users define logic flows without coding.

During this phase, users can decide the behaviour mode of both inner- and inter-pages. For inner-page behaviour, users can connect the widgets on the page via the logic node editor adding more logic nodes from the library browser, if necessary.

Inter-page logic behaviour is captured in the application logic, which is normally named as "AppScreen.page". Users are required to drag and drop the predefined pages into the logic node editor and connect these pages via the logic interface. This will define the inter-pages behaviour like screen logic.

Simulate

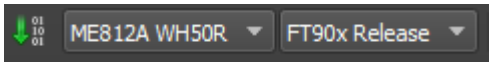
To validate the behaviour of the screen logic, users may need to simulate the project on the PC before compiling and downloading the generated C code into the target device. When application logic is selected, users can simulate the whole project by clicking the **"Simulation"** button on the toolbar. When the application is in simulation mode, users cannot drag and drop the widgets into the layout editor. The PC mouse will act as a touch stylus on the touch panel to interact with application directly.

Before performing a simulation, it is strongly recommended to save the current project by clicking the **"Save all"** button. Once the simulation is completed, ensure to switch off the simulation mode by clicking the **"Simulation"** button again.

Simulation State	Description
	ON State - Indicates that the simulation is in progress. Clicking on it will switch off the simulation. In this state, users will not be able to edit the page or project.
	OFF State - Indicates that currently simulation is not in progress. Clicking on it will switch on the simulation.

Build & Upload

Upon installing the FT90x Toolchain, the application will invoke its compiler and programmer so that the current project can be built and uploaded successfully into the target hardware.



Click on the **"Build Target"** button to build a project

Click on the **"Build and Upload to Hardware"** button to build the program and upload it to the target device

On ESD 4.5, new build targets "VM816CU50A" and "VM816C50A" have been added to the build target list. The new targets support only x86 toolchain. Hence the output will be .exe which can be executed in the target hardware.

On ESD 4.2, new build target "ME813AU WH50C" had been added to the build target list. The new target does not support FT90x toolchain, however, it support x86 toolchain. Hence, in "ME813Au WH50C", "Build Executable" will build and '.exe' application which is runnable on PC. "Build and Upload to hardware" will build and run the output '.exe' on PC.

Build Targets	Toolchains	Output files
ME812A WH50R	FT90x Debug, FT90x Release	*.bin; *.elf
ME810A HV35R	FT90x Debug, FT90x Release	*.bin; *.elf
PanL 35/70/70 Plus	FT90x Debug, FT90x Release	*.bin; *.elf
ME813AU WH50C	X86 Release	*.exe
VM816CU50A	X86 Release	*.exe; *.dll
VM816C50A	X86 Release	*.exe; *.dll

Export

Upon completing the screen design, it's time to move the project to the next phase of the workflow – export project. There are two ways of exporting project. They are **"Export as Eclipse Project" and "Export as MSVC Project"**. This function is used to prepare all the necessary files for the MCU tool chain so that users can make further enhancements such as connecting sensors or external hardware to a full HMI solution.

Once the export is completed, the application copies all the generated "C" source code and necessary bitmap resources into a user defined folder. In addition, the respective project files are generated in the output folders. The eclipse project files *".cproject"* and *".project"* files are also generated so that the users can open the project in the FT90X eclipse IDE[4]. All the generated files are named as "*_*generated.c"*. On the other hand, in build target "ME813AU WH50C" which supports to export as MSVC project since ESD 4.2. The output MSVC project can be found in "Project" folder, and the project is compatible with Visual studio 2015.

Build Targets	Export Project
ME812A WH50R	Eclipse Project
ME810A HV35R	Eclipse Project
PanL 35/70/70 Plus	Eclipse Project
ME813AU WH50C	MSVC Project
VM816CU50A	MSVC Project
VM816C50A	MSVC Project

Exported Folder Structure

The following table provides the list folders and files that are created upon exporting the project –

Folder / Files	Description
.cproject	Eclipse project file
.project	Eclipse project file
Project/$(ProjectName)_MSVC/ $(ProjectName)_MSVC.sln	MSVC project solution file
Project/$(ProjectName)_MSVC/ $(ProjectName)_MSVC /$(ProjectName)_MSVC.vcxproj	MSVC visual studio c++ project file
FT_Esd_Framework	Contains the application framework files. **It is recommended not to make any changes to this folder/ files**
FT_Esd_Widgets	Contains the widget files **It is recommended not to make any changes to this folder/ files**

[4] http://brtchip.com/ft9xx-toolchain/

FT_Esd_Hal	Contains the hardware abstraction layer files. These files may be changed to support a different MCU.
Data	Contains the converted bitmap resource data which is used by the current project
$(ProjectName)	Contains the application specific source code

Bitmap Resource

If a *bitmap resource* is used in the project, users are required to download the converted bitmap resource into an SD card **root** directory and insert the SD card into the hardware module.

The converted bitmap resource is located at:

$(ProjectFolder)\build\$(PlatformName)\data

Or

$(ExportFolder)\data

The bitmap resource file with .bin extension is called to decompress using the EVE engine command *CMD_INFLATE*.

As per the Hardware Platform requirements, the SD card must be formatted as a FAT32 file system.

D. Layout Editor

The *Layout Editor* allows users to preview a single page as well as the whole project. ESD employs the EVE emulator to render an EVE display onto the layout editor. It provides users the interface to view the result of the screen design and its logic.

The following file types are displayed in ESD layout editor:

- *Application logic file* - generally with ".main" extension
- *Page file* - generally with ".page" extension

Page File

Page stands for a single screen which will be rendered. One application consists of at least one page. Page may have its own life cycle and manages all the widgets on it. Only widgets can be dragged and dropped into pages at Page layout editor. However, all the nodes from a library can be dragged and dropped into the logic node editor.

"Active" Property

The *"Active" property* is a Boolean value to control the page, and is created or released while the application is updating the pages. By default, the "Active" property is true. The page is created and shown, unless "Switch" end is connected.

Switch Page

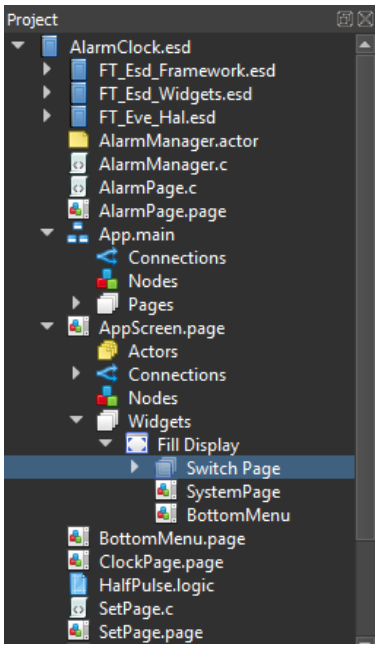


Figure 23 – Switch Page

Users can define multiple pages within the project. *"Switch Page"* ESD layout should add to manage the pages. User can drag and drop the pages into this switch page from project browser. The picture below displays how the logic editor view looks like for the switch page logic.

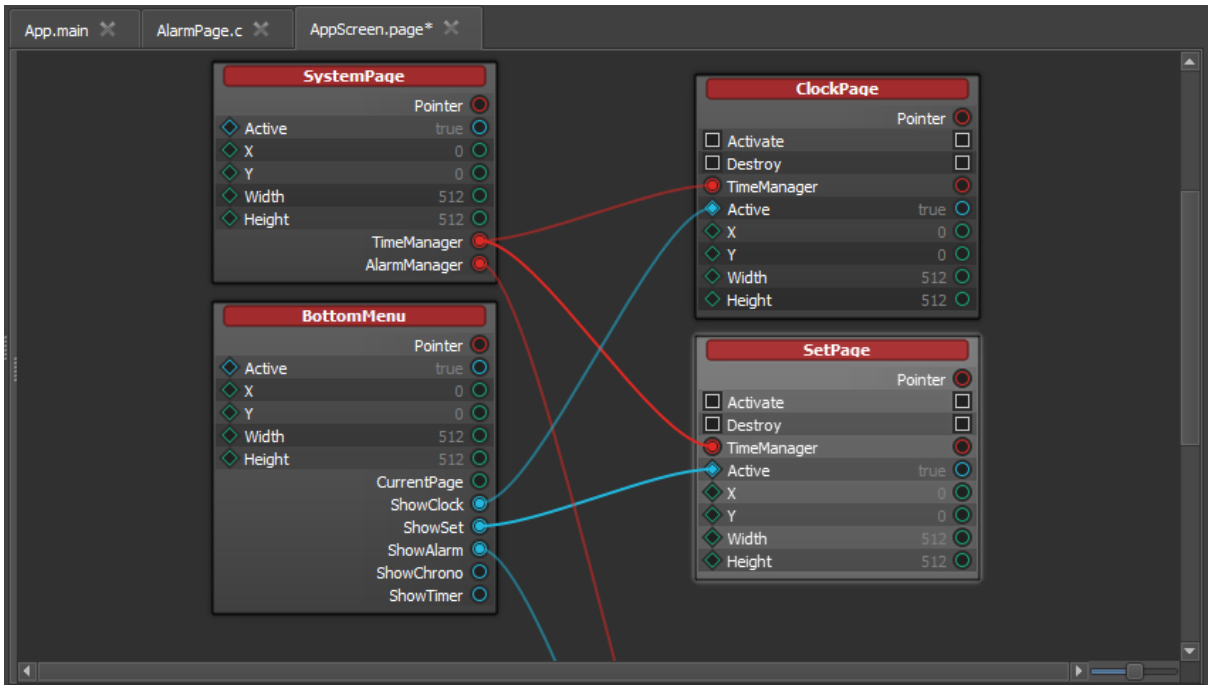


Figure 24 - Sample Switch Page UI

Page Persistence

To allow a page to remain in memory with its current state even when it is made inactive, set the allocation mode to "Lazy Persistent" or "Static" from the application logic in the page's Properties. This feature can help users to reserve the information of a page even when it is not visible.

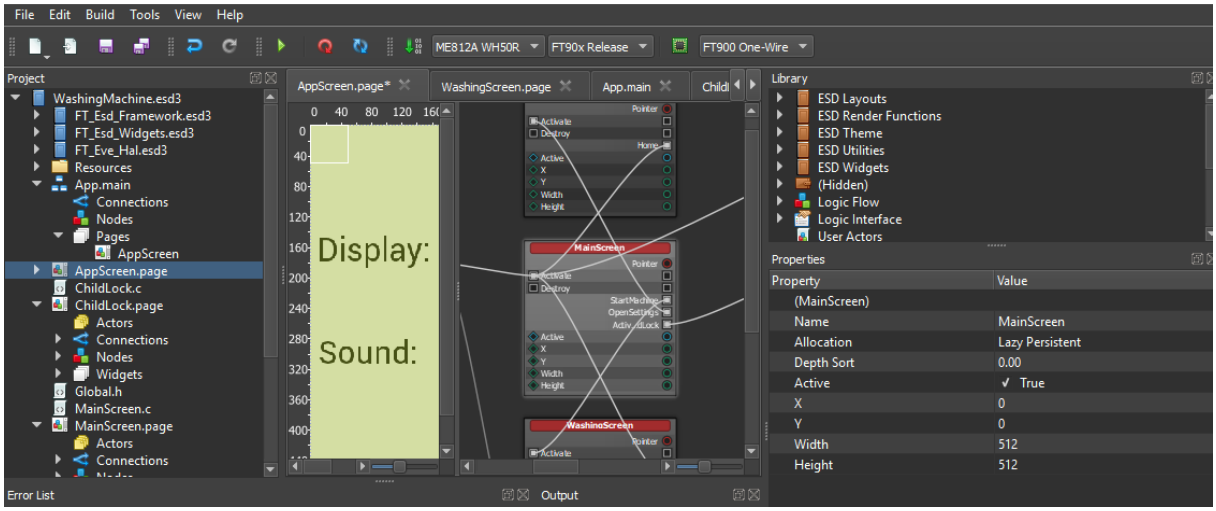


Figure 25 - Properties Editor – Page Allocation

The page allocation modes supported in ESD 4.X are listed in the table given below:

Allocation Mode	Description
Static	Page is always persistent in memory after application starts
Lazy	Page is created when it is in active state and destroyed when it is inactive
Lazy Persistent	Page is created when it is in active state but persistent in memory when it is inactive until application is closed.

User Defined Function for Page File

Users can write their own code to handle the "Pushed" signal of the "ESD Push Button" widget. Users are required to select the "ESD Push Button" widget in the logic node editor and double click it. A function will be generated to replace the user defined function.

```
ESD_METHOD(MainPage_ESD_Push_Button_Pushed, Context = MainPage)
void MainPage_ESD_Push_Button_Pushed(MainPage *context)
{
        // Users can write their code here
}
```

The code can be located at ***$(PageFileName).c*** file.

MainPage.page* | App.main | MainPage.c

```
1  #include "Ft_Esd.h"
2  #include "MainPage.h"
3
4  ESD_METHOD(MainPage_ESD_Push_Button_Pushed, Context = MainPage)
5  void MainPage_ESD_Push_Button_Pushed(MainPage *context)
6  {
7      // …
8      printf("This push button is pushed\n");
9  }
10
```

Figure 26 - Sample Source File

Zoom In & Out

The visual area of the screen layout editor can be zoomed when the current file is a page file, i.e., *".page"* file. The mouse wheel button provides *zoom-in* and *zoom-out* functionality, allowing users to view more details about the screen design. Refer to the below sample picture.

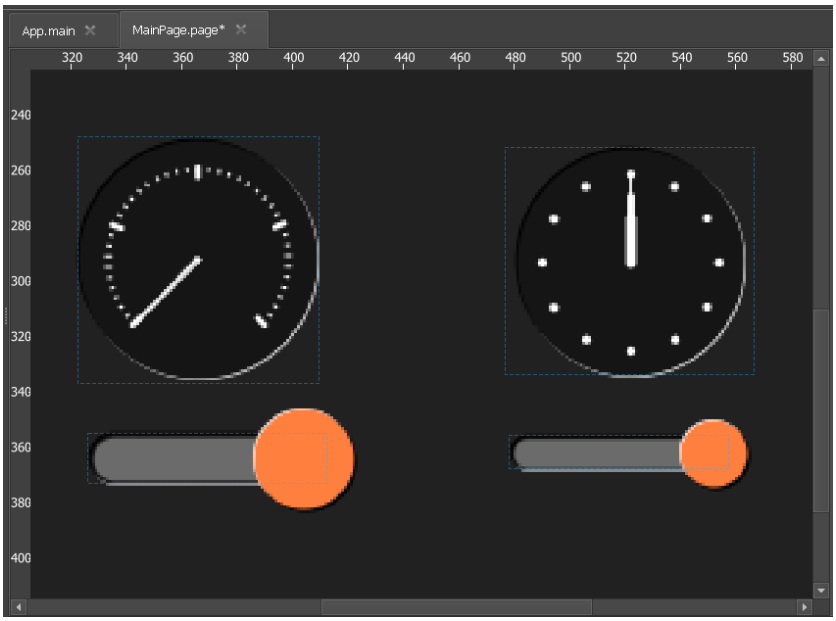


Figure 27 - Zoom In & Out

Main File

To view the application logic file (*.main) file, double click the file within the project explorer. The screen layout editor will show the first page defined in the logic node editor. To view how the application logic is defined, click the **"Simulation"** button and check it in the screen layout editor.

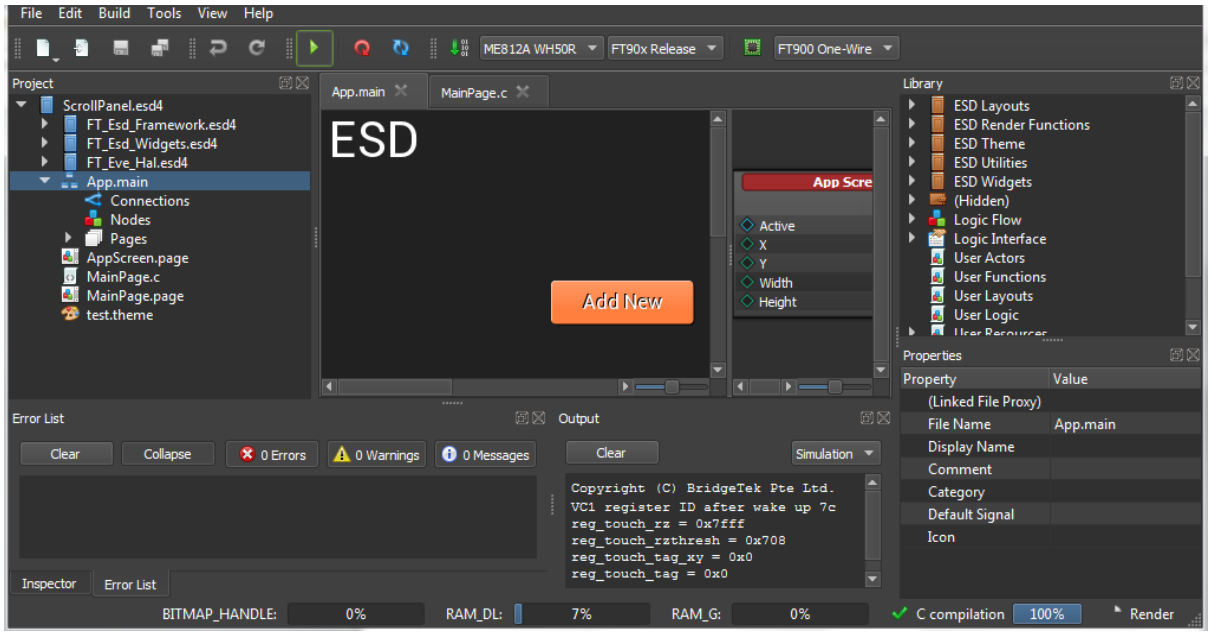


Figure 28 - Main File

Logic File

The logic file contains certain logic that is used to encapsulate the user defined logic. It works similar to a C function. A logic file does not render any user interface.

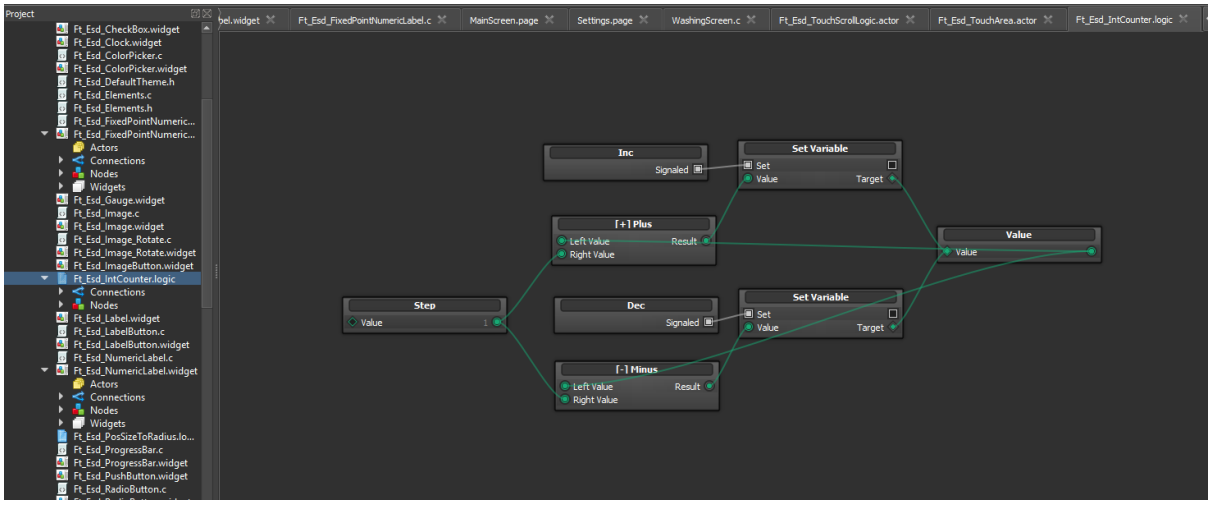


Figure 29 – Sample Logic File

C File

The screen layout editor provides a simple C editor when users double click a ".c" file in the project browser. Note that it is not a full-fledged C editor and many features may be implemented in the future.

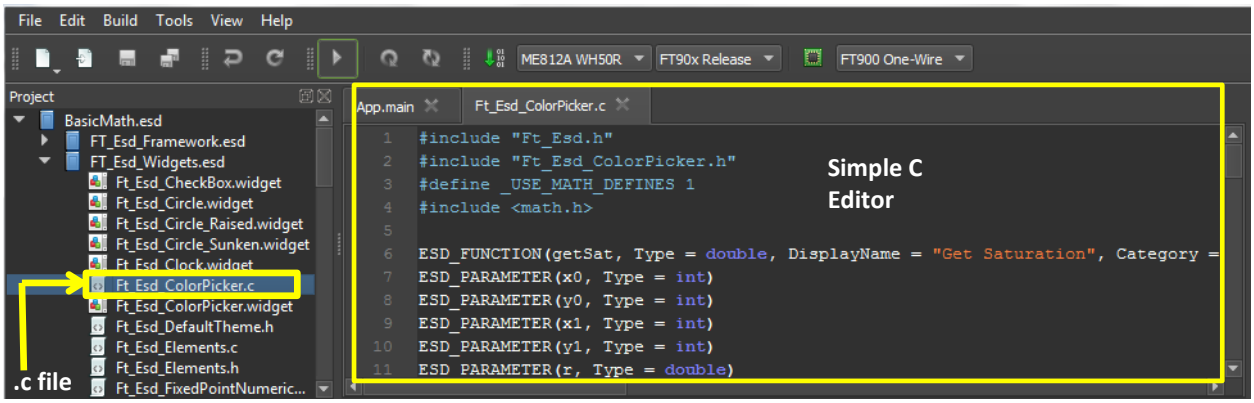


Figure 30 - C File / C Editor

To effect the changes made, ensure that all the changes are saved to the project by clicking **"File → Save All"** from the menu or from the toolbar.

E. Logic Note Editor

Using the *Logic Node Editor* (LNE), users compose screen logic by connecting logic nodes. The Logic Note Editor is designed to open the following file formats:

- Application logic file , *.main file
- Screen logic file, *.page file
- Widget file, *.widget
- Actor file, *.actor
- User defined logic file, *.logic file

Basic Logic Node

ESD 4.X has some built-in predefined *basic logic nodes*. These basic logic nodes provide basic control flow and logic interfaces as well as basic functions. A typical basic logic node is represented in the logic node editor as below, the name of which is shown in white.

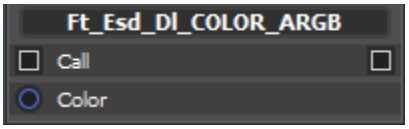
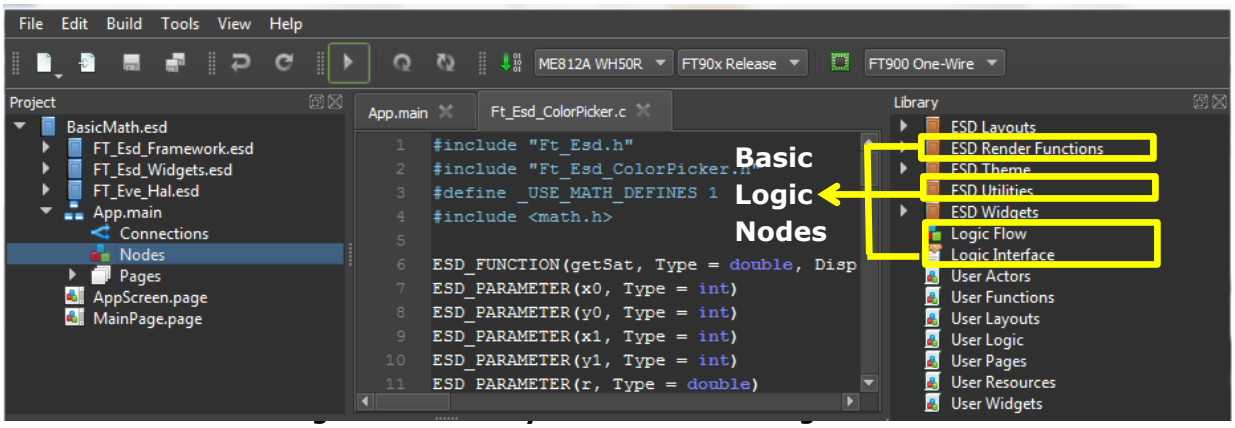


Figure 31 – Logic Node Editor - Basic Logic Node

Within the library browser, the basic logic nodes are located at *"Logic Flow"*, *"Logic Interface"*, *"ESD Utilities"* and *"EVE Render Functions"*.



Composite Logic Node

A *Composite Logic Node* is made up by connecting multiple basic logic nodes. A typical composite logic node is defined in a standalone document in XML format and is shown in the logic node (refer to Figure 28).

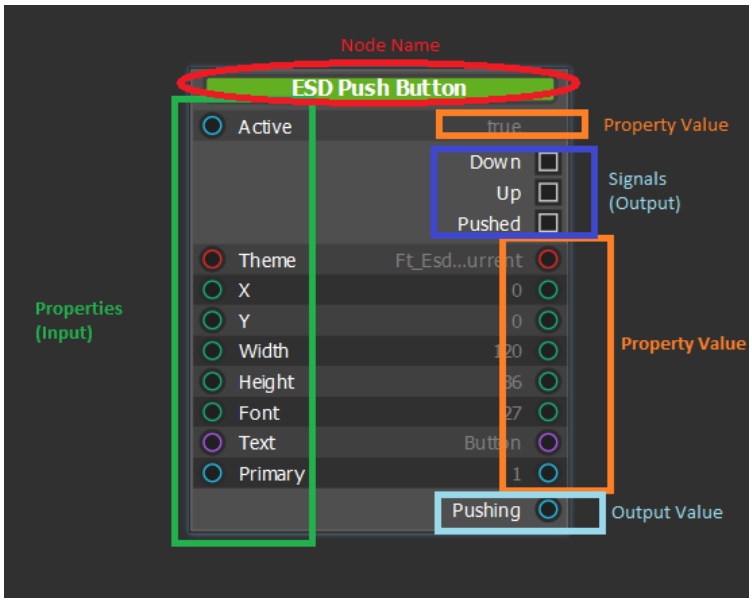


Figure 33 - Composite Logic Node

The following are the different types of composite logic nodes defined in ESD 4.X–

- *Page Node*
- *Widget Node*
- *Layout Widget*
- *Actor Node*
- *Logic Object*

Page Node

When users create a single page, it is represented by a logic node under the "User Page" category in the library browser. Users can connect one page node to another within the logic node editor. It has its own property and defined output.

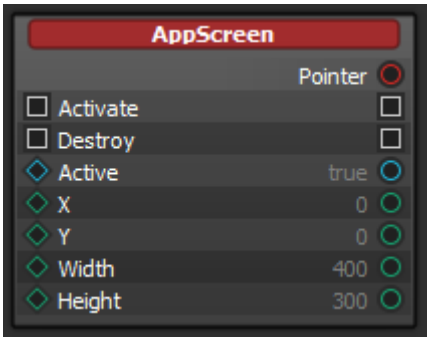


Figure 34 - Composite Logic Node - Page Node

Widget Node

The *Widget Node* is one type of logic node which has visual appearance and is able to handle user input. It has the built-in *Start*, *Update*, *Idle*, *Render* and *End slots*.

For more information on built-in slots, please refer to Built-in Slot.

Within the logic node editor, the widget name is highlighted with the green colour title as shown in the sample picture below -

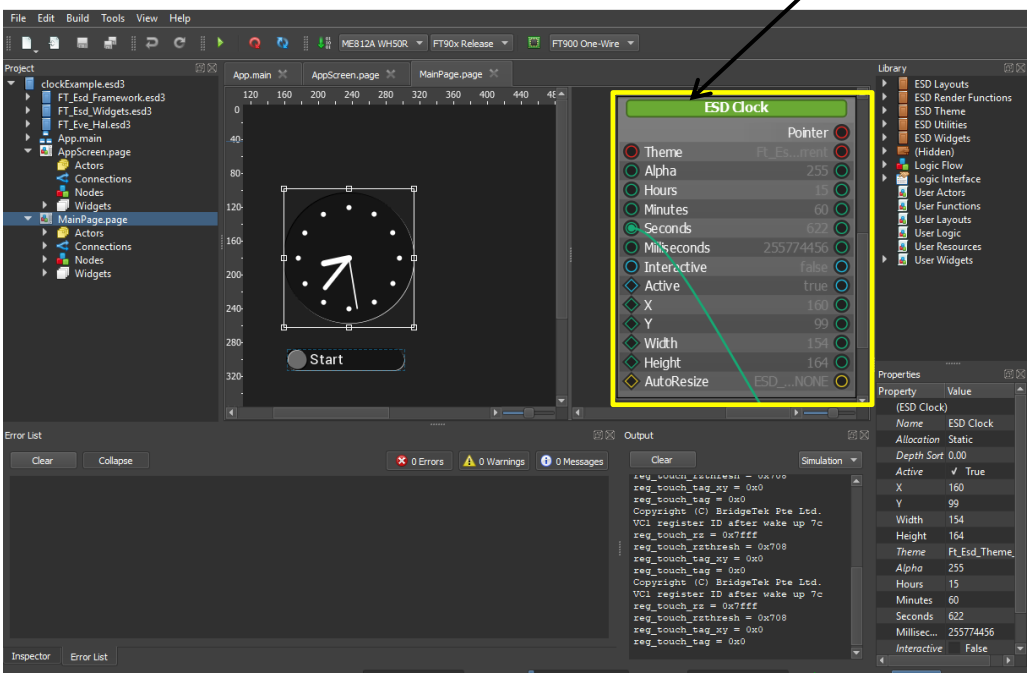
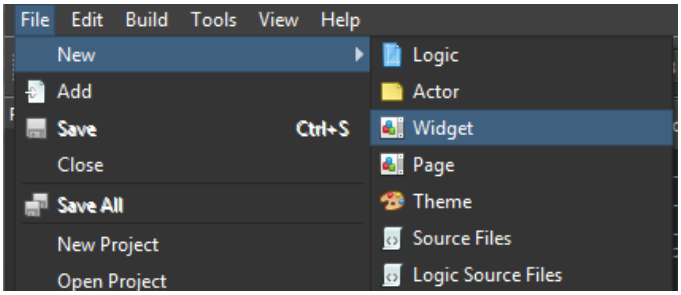


Figure 35 - Logic Node Editor – Widget Node

The highlighted sections provide information on adding user widgets; the position and size properties; rendering the widget and widget theme.

Adding User Widgets

A *User Widget*, also called as *custom widget* is a reusable user interface element created by a user. To create a widget, from the menu, click and select **"File → New → Widget"**.



In order to make use of these slots, users need to drag the slots from the library browser and drop them into the logic node editor. By renaming it to the slot defined above, users can connect widget control flow to application control flow.

Position & Size Properties

As a user interface element, widgets have at least position and size properties so that users can control them using a visible handle. Position property is defined by an "Input" node with "ft_int16_t" type named as "X" or "Y". Size property is defined by an "Input" node with "ft_int16_t" type named as "Width" or "Height". A sample picture of the "X" property is given below –

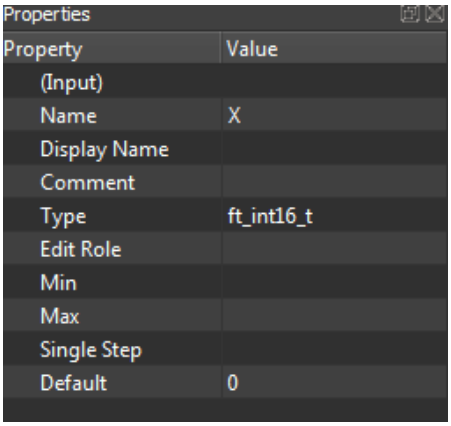


Figure 36 - User Widget - Position & Size Properties

Rendering a widget

Rendering of a widget may be implemented fully in the logic editor, or directly in the code using the logic editor to glue together the code with the generated structures. To create the render function, simply add a *Slot* from the Logic Interface category of the library browser, name it "Render" and double click to create the user method for handling the rendering. The widget is expected to restore any graphics state it changes, with the exception of the state values specified below.

Preferably use the Ft_Esd_Dl_ utility functions for displaying list drawing when available. Several state parameters which may be expected to be changed often to the same value implement de-duplication here to shorten the display list. The de-duplicated values are: *Palette source, Color RGB, Color A, Handle, Cell,* and *Vertex Format*. These graphic state values are not required to be restored to their original values when the Ft_Esd_Dl_ functions are used. These values should be expected to be any undefined value at the start of the Rendering function.

Access the value of the X input property as given below:

```
int x = context->X(context->Owner);
```

This calls the `get()` function assigned by the parent to the X property, passing the owner's context to the function to handle it there.

Theme

Widgets should provide property input to override the default application theme. An input property with type *Ft_Esd_Theme* * should be added by dragging one input node from the "Logic Interface" category of the library browser.

Colours from the theme may be accessed from the logic editor using the utility functions under the ESD Theme category, or from the user code as given below –

```
Ft_Esd_Theme *theme = context->Theme(context->Owner);
if (theme == NULL) theme = Ft_Esd_Theme_GetCurrent();
ft_rgb32_t primaryColor = theme->PrimaryColor;
```

Touch Input

In order to handle the *touch input*, add a Touch Tag node from *"ESD Utilities"* category of the library browser to the logic editor, and either handle the signals or access its state through the Touch Tag interface. Users need to make use of the "Tag" value provided by the "Touch Tag" node during the Render function, and restore the "Tag" to value 0 after the relevant portion of the rendering.

To handle any of the signals from Touch Tag in user code, simply create an ESD_METHOD style function in the same format as the Render user code function, and it will be available from the User Functions category in the library to drag into the logic editor and connect to any of the signals from the Touch Tag node.

Layout Type Widget

Layout widget is a layout container for widgets. Unlike widget nodes which have visual appearance, a layout widget manages the layout specification for its child widgets. Layout widgets are introduced since in ESD 4.0. Figure 34 & 35 displays the various layout widgets supported in ESD 4.X.

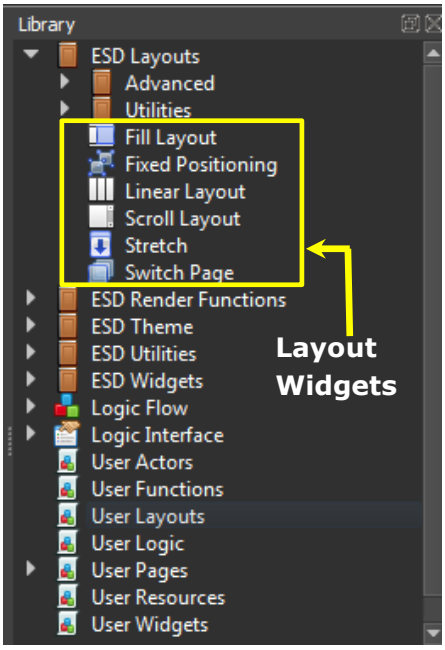


Figure 37 - Layout Widgets

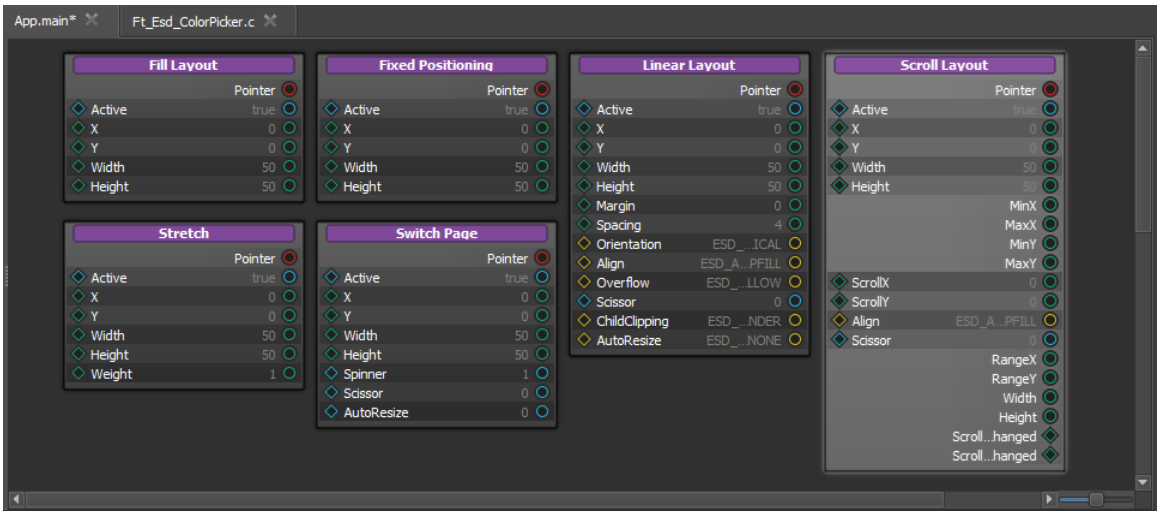


Figure 38 - Layout Widgets

Actor Node

Actor type is an extended type of logic node which functions similar to the widget node, but without the *Render* slot. Therefore, it has no visual appearance. When users create a new actor node, it does not show in the layout editor. It has the built-in *Start, Update, Idle* and *End* slots which are not available in a regular logic node.

For more information about built-in slots, please refer to Built-in Slot.

An Actor node is useful for implementing both continuous and background running behaviours, such as animations, timers, and input data polling. The actor node name is highlighted with the yellow colour within the logic node editor.

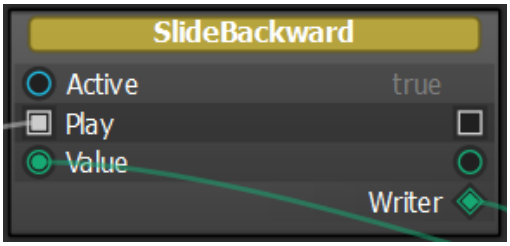
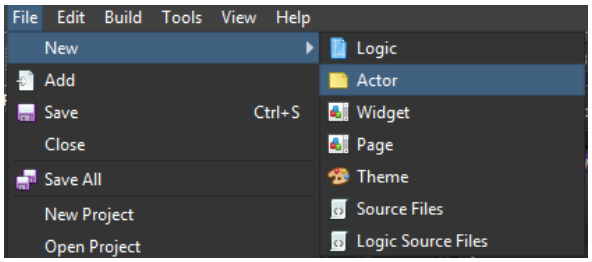


Figure 39 - Actor Node

To create an actor, from the menu, click and select **"File → New → Actor"**.



Refer to the example project **"ActorAnimator.esd"** under the **"EVE Screen Designer → Examples → Basic → ActorAnimators"** folder for adding and using actor node.

Logic Object

A *Logic Object* is a basic logic block designed to express certain logic which has NO built-in slot. Hence, it is not possible to invoke it through the built-in render slot or update slot. However, it may have its own private or public property and output, signal and slot, depending on the users' implementation.

A logic object is generally used to simplify complex logic by splitting it into multiple smaller and simpler logic objects. It is defined and saved in a "*.logic" file.

Within the logic node editor, the logic object name is highlighted with the grey colour.

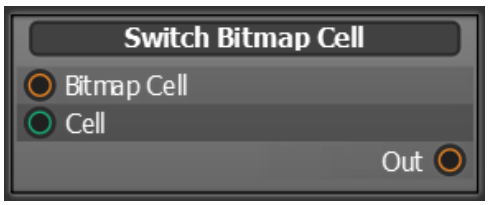


Figure 40 - Logic Object

To add a logic object, from the menu, click and select **"File → New → Logic"**.

Connections

Connections are lines between two nodes. The connection line's colour is determined by the ends. The following table provides the different types of ends and their description.

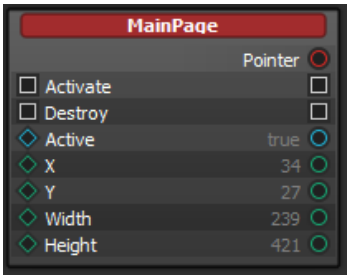
Connection Line End Type	Description
Event slots and Signals 	Event slots and signals are implemented as functions which only take a pointer to the node context as a parameter. The node context contains the state of the node as well as a pointer to the parent node to signal back.
Data property bindings 	Data property input and output bindings are implemented as get-functions which only take a pointer to the node context as a parameter and return a value. This means that these connections are completely evaluated every time the property is read, and consequently the property always reads as the latest value. A buffer variable can be used to cache values if necessary. The different colours denote the different data types.
Variable write 	The write interface is translated into a function pointer during the code generation. Variables are plain variables, which can be written using the Set Variable node. They may also be set through the Writer interface which is implemented using a pointer to a set-function.

Table 6 - Connection End Types

In general, all of the input properties that can be connected can also be specified from the property editor when they are constant values; this is sometimes referred to as the "Default" value. In addition, it is possible to specify the Minimum and Maximum values for the input bindings and variables.

Rendering Order

In the application logic file "app.main", the pages added on the logic node editor are to be represented with the symbols shown in the sample picture.



When there are more than two pages, the order in which the pages were created determines the rendering order.

The following implicit rule of the logic node editor is worthy to be noted, since this rule applies to all the logic nodes.

"Depth Sort" is used to determine the rendering order of the logic nodes. The greater the value of "Depth Sort", the later the logic node is rendered and higher the layer in which it is shown. When logic nodes have the same "Depth Sort" value, the logic node's "X"/"Y" coordinate (within layout widget) determines the rendering order. The page node with the lowest value of the "X"/"Y" coordinate is rendered first (as lower depth value).

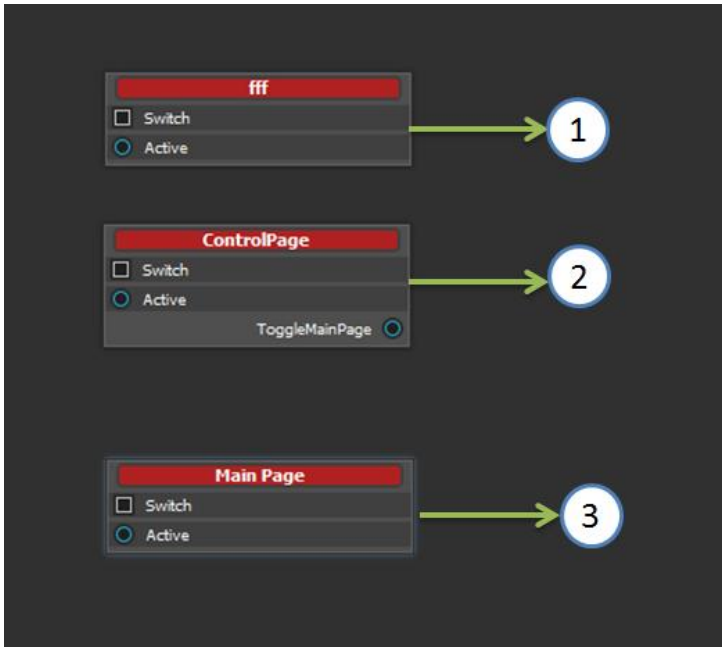
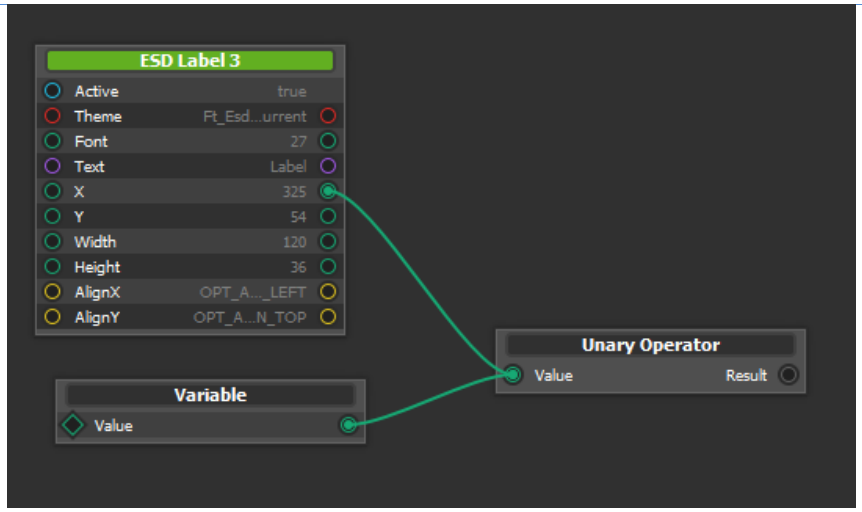


Figure 41 - Rendering Order Example

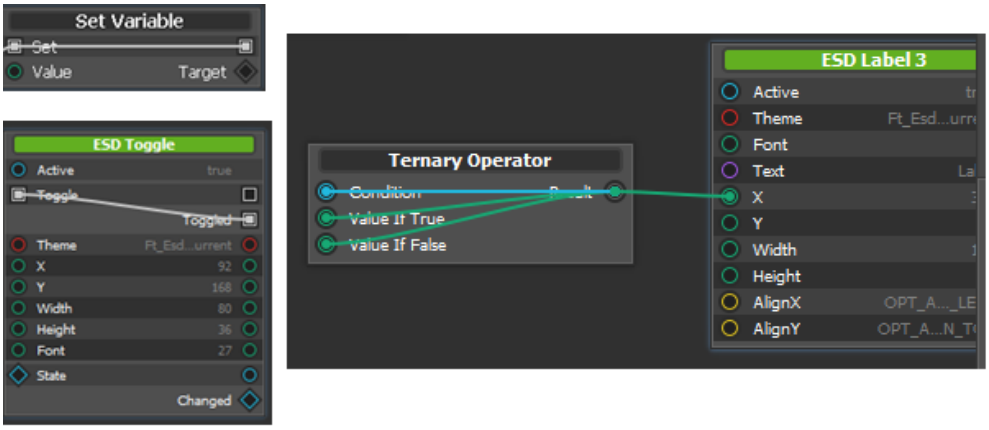
Logic Note Editor - Zoom In & Zoom Out

The Logic Node Editor enables *Zoom-in* and *Zoom-out* functionality. Users can make use of the mouse wheel button to zoom in and zoom out.

DON'TS	**Avoid two connections connecting to the same port. Refer to the sample picture given below.**



Avoid endless dead loops caused by connecting the input and output of the same object. It will cause an unexpected error. Refer to the sample pictures given below.



To effect the changes made to the logic note editor, ensure that all the changes are saved to the project, by clicking **"File → Save All"** from the menu or toolbar. In some cases, click the **"Recompile"** button to recompile the source code generated by ESD.

F. Library Browser

The *Library Browser* consists of the basic components which are predefined and built in as part of ESD 4.X, as well as user defined components and/or resources. The components in the library include *Theme*, *Primitive, Widgets*, *Logic Flow* and *Logic Interface*. Users can select the appropriate components and drag them into the logic node editor or layout editor.

The library view depends on the currently selected node. The library browser will only show the contents which applies to the currently opened node.

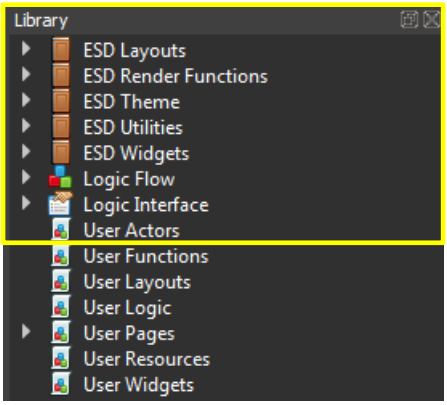
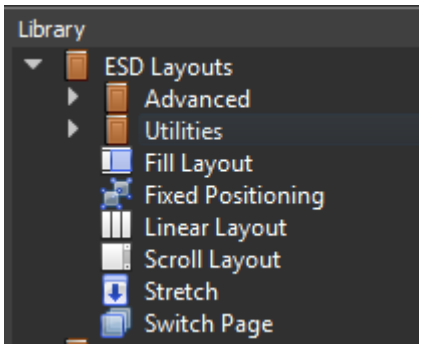


Figure 42 - Library Browser

The forthcoming sections provide information about the different components of the library browser.

ESD Layouts

ESD Layouts contains the collection of ESD 4.X layout widgets and layout utilities functions.

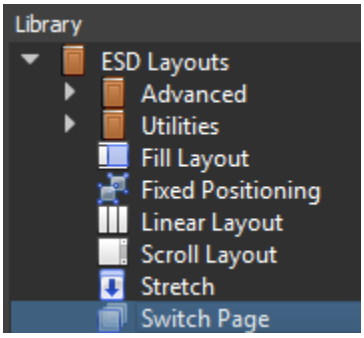


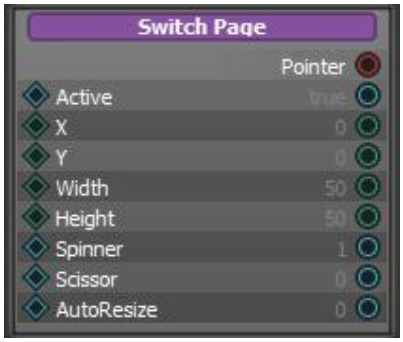
Layout	Description
Fill Layout	This layout is used to fill up the whole widget display region
Fixed Positioning	This layout is for fixed coordinate layouts
Linear Layout	This layout supports both horizontal and vertical layouts
Scroll Layout	Specific layout for scrollable panel
Stretch	This layout supports both horizontal and vertical layouts
Switch Page	To manage page switching logic

There are also layout utilities and advanced layout features provided in ESD Layouts collection. These sections are for advanced user only.

Switch Page

The *Switch Page* is a special layout which focuses on page/widget transitions. By default, there will be only one Switch Page layout in "AppScreen.Page" in every ESD project. However, this is optional and the users can remove or change the switch page layout in the project. Refer to the example project **"EVE Screen Designer ->Examples ->Basic -> MenuPage ->MenuPage.esd->AppScreen.page"** for a switch page demo.

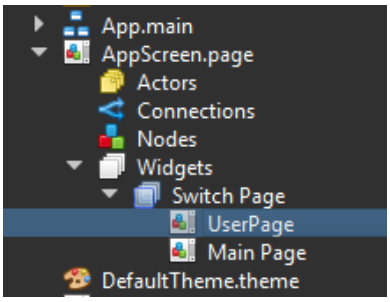




Property Name	Description
Pointer	The pointer reference of the widget object
Active	Enable or disable displaying this widget
X	x coordinate of the top-left of the widget, in pixels
Y	Y coordinate of the top-left of the widget, in pixels
Width	Widget width
Height	Widget Height
Spinner	Set true to show spinner/loading icon when switching page. This is useful user indication when a page has heavy resource.
Scissor	Set true, to trim off any content is drawn outside the layout region.
AutoResize	Set true, to enable auto resize for this layout.

Table 7 – Switch Page Layout Properties

Switch Page Implementation



1. Set page/widget into Switch Page

Unlike widgets, Switch Page cannot be dragged on Screen Layout Editor or Logic Editor. In order to put a page under the control of the switch page layout, the user has to use Project Browser instead, drag the widget into the switch page layout.

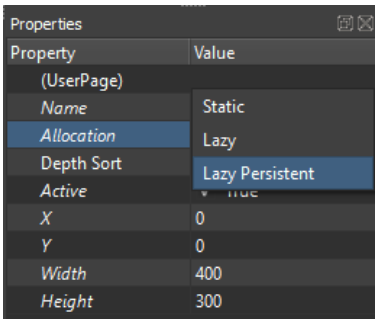
2. Page Resource

Since ESD 4.0, a page resource allocation can be:

- Static – always load at the start
- Lazy – allocate when it is active, and free it when it is inactive.

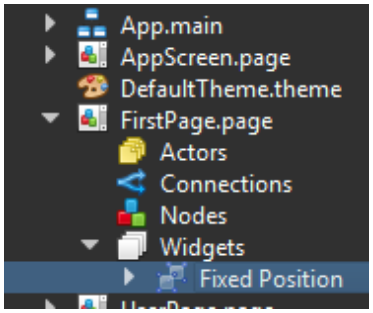
- Lazy persistent – allocate when it is first time active, and it will remain in system until reset.

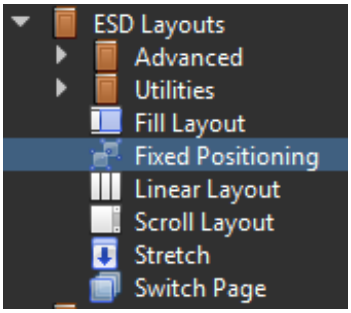
When a new page is activated, its parent object, the Switch Page will also mark the current page as inactive and free it from memory when it has "Lazy" mode of allocation.



Fixed Positioning

The *Fixed Positioning* is a layout widget which allows its child widgets to be fixed at design time. By default, every page starts with one fixed positioning layout, such that all widgets under the page are placed at design time. Fixed Positioning layout does not update its child widget's dimensions on runtime. Users should get what they see on design time, on runtime as well.





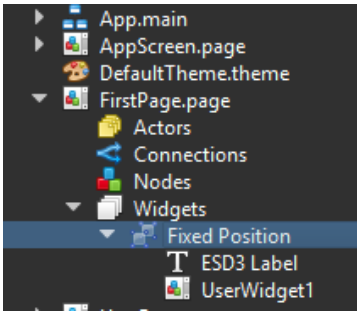
Property Name	Description
Pointer	The pointer reference of the widget object
Active	Enable or disable displaying this widget
X	x coordinate of the top-left of the widget, in pixels
Y	Y coordinate of the top-left of the widget, in pixels
Width	Widget width
Height	Widget Height

Table 8 – Fixed Positioning Layout Properties

Fixed Positioning Implementation

1. Set page/widget into Fixed Positioning Layout

Drag and drop a new widget into the Screen Layout Editor will be the highest depth sort widget in the layout by default. However, the depth sort values are configurable by the users. If a widget is not in fixed positioning layout, the Screen layout editor will not able to change it is position as it desired. Always check on project browser as picture on the right.

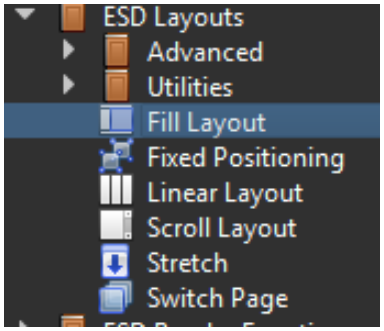


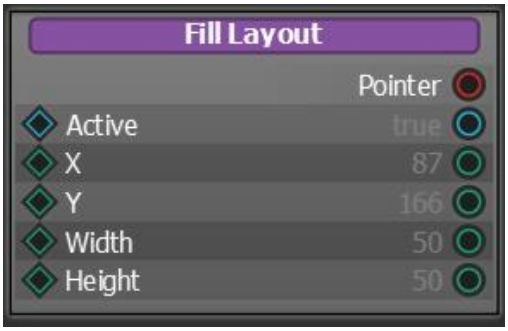
2. Change Child Widgets' depth sort

Changing the depth sort value of child widgets will affect their rendering sequence. This functionality is same as in ESD 3.0.

Fill Layout

The *Fill Layout* is the base layout for every widget/page since in ESD 4.X. A widget always comes with a Fill Layout in it. However, a fill layout in a page has a fixed size due to the screen size defined from the hardware. All widgets in the Fill Layout will auto resize to fit the whole layout area.





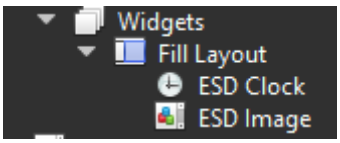
Property Name	Description
Pointer	The pointer reference of the widget object
Active	Enable or disable displaying this widget
X	x coordinate of the top-left of the widget, in pixels
Y	Y coordinate of the top-left of the widget, in pixels
Width	Widget width
Height	Widget Height

Table 9 – Fill Layout Properties

Fill Layout Implementation

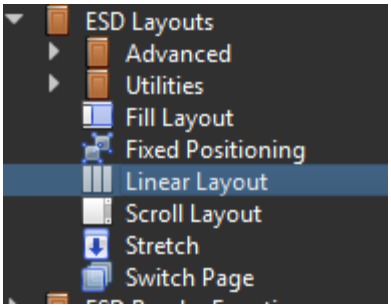
1. Change Widget sequence

The fill layout sequence is ordered in the sequence of widgets' depth sort. Changing a particular widget to a higher depth sort value, will increase the priority widget's rendering. The example below shows a clock widget and an image widget under the same Fill Layout. Both widgets are filling up the full "Fill Layout" area. However, by setting the depth value of clock widget bigger than the image widget's depth sort, the clock widget will be rendered on top of the image widget.



Linear Layout

The *Linear Layout* supports both horizontal and vertical alignment in ESD 4.X. All child widgets will be distributed in the selected orientation. Users cannot change the sequence of widgets in the linear layout from Screen Layout Designer in ESD 4.X. However, changing their depth sort value from the property browser will change the sequence.



Property Name	Description
Pointer	The pointer reference of the widget object
Active	Enable or disable displaying this widget
X	x coordinate of the top-left of the widget, in pixels
Y	Y coordinate of the top-left of the widget, in pixels
Width	Widget width
Height	Widget Height
Spacing	Set the spacing gay between adjacent child widgets.
Orientation	Set Linear Layout orientation. It supports: • ESD_ORIENTATION_HORIZONTAL • ESD_ORIENTATION_VERTICAL
Alignment	Set the alignment setting for the child widgets in the layout
Overflow	Set child widget overflow mode. It supports: • ESD_OVERFLOW_ALLOW • ESD_OVERFLOW_CLIP • ESD_OVERFLOW_FILL
Scissor	Set true to enable scissor to clip off overflow
ChildClipping	Set the flags when child clipping should check. It supports: • ESD_CLIP_RENDER • ESD_CLIP_UPDATE • ESD_CLIP_IDLE
AutoResize	Set auto resize mode for this layout.

Table 10 – Linear Layout Properties

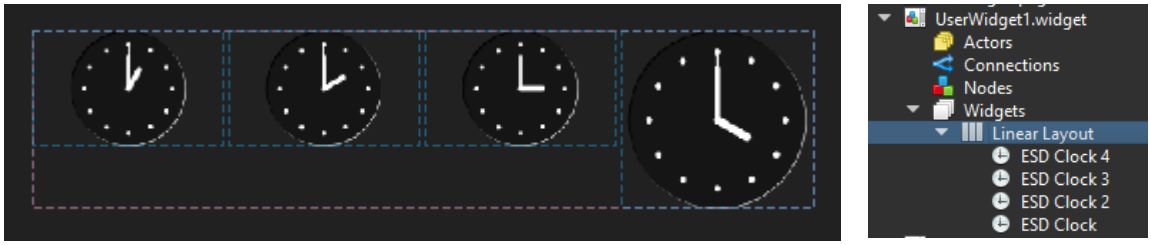
Linear Layout Implementation

1. Horizontal Layout

All child widgets of a linear layout with its orientation are set to "ESD_ORIENTATION_HORIZONTAL". They will be distributed horizontally with some

spacing in between adjacent widgets. The layout used as in the example here has parameters:

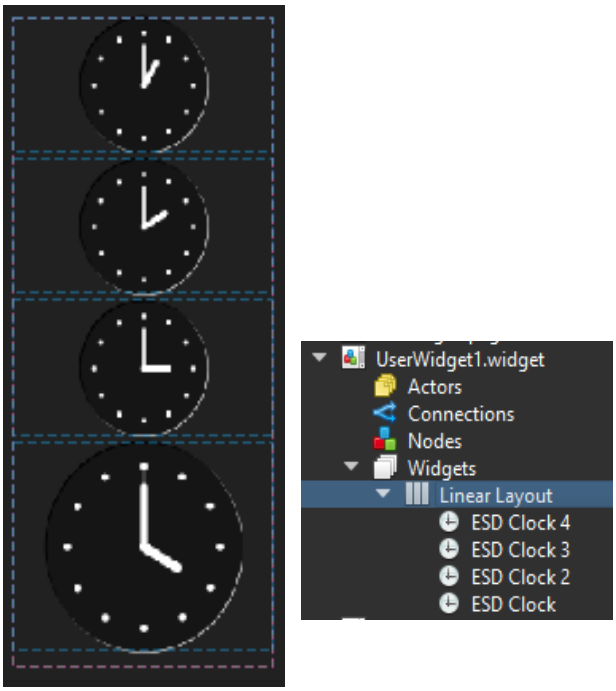
- Orientation = ESD_ORIENTATION_HORIZONTAL
- Spacing = 4
- Align = ESD_ALIGN_TOPFILL
- Overflow = ESD_OVERFLOW_ALLOW



2. Vertical Layout

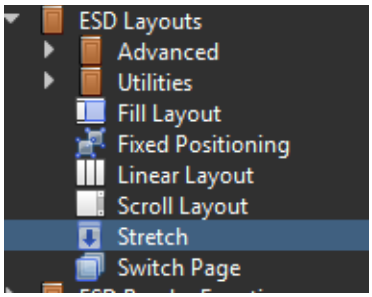
All child widgets of a linear layout with its orientation set to "ESD_ORIENTATION_VERTICAL". They will be distributed vertically with some spacing in between adjacent widgets. The layout used as in the example here has parameters:

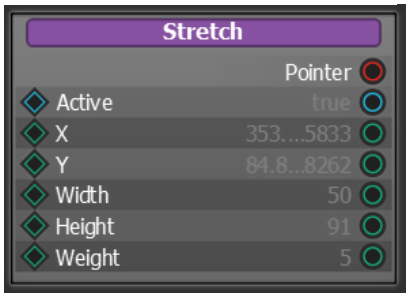
- Orientation = ESD_ORIENTATION_VERTICAL
- Spacing = 4
- Align = ESD_ALIGN_TOPFILL
- Overflow = ESD_OVERFLOW_ALLOW



Stretch

The *Stretch Layout* is designed to work together with the linear layout. In the event some widgets need to have higher weightage in the layout, Stretch Layouts are used.





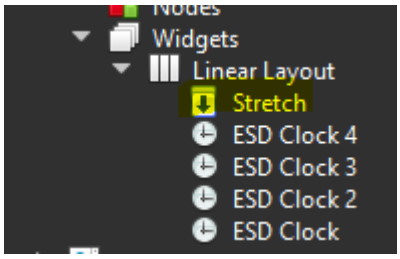
Property Name	Description
Pointer	The pointer reference of the widget object
Active	Enable or disable displaying this widget
X	x coordinate of the top-left of the widget, in pixels
Y	Y coordinate of the top-left of the widget, in pixels
Width	Widget width
Height	Widget Height
Weight	The weight factor when determine the stretch scale in the selected orientation

Table 11 – Stretch Layout Properties

Stretch Layout Implementation

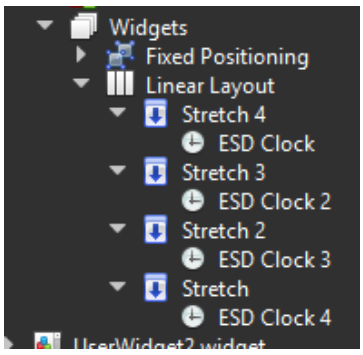
1. Space Stretching

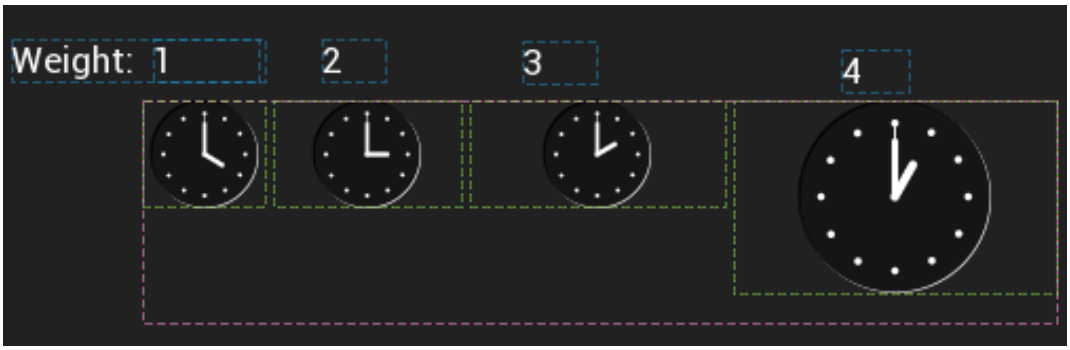
The example here demonstrates how to stretch unused space horizontally. A stretch layout has been added into the Linear Layout. The weight factor used here is 1.



2. Widget Weight Stretching

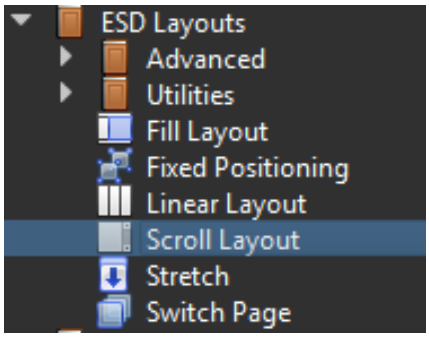
The example here demonstrates widget stretching. In this example, every clock widget has different stretch weight values. The result every widget gains their proportion of width as shown below.





Scroll Layout

The *Scroll Layout* is a support runtime resizable and scrollable layout in ESD 4.X.



Property Name	Description
Pointer	The pointer reference of the widget object
Active	Enable or disable displaying this widget
X	x coordinate of the top-left of the widget, in pixels
Y	Y coordinate of the top-left of the widget, in pixels
Width	Widget width
Height	Widget Height
ScrollX	Getter and Setter for scroll value along X-axis
ScrollY	Getter and Setter for scroll value along Y-axis
Align	Set alignment for its child widgets
Scrollbars	Set when scrollbar should be visible
TouchScroll	Set true to enable touch scroll
Scroll Bar Size	To set scroll bar size when it is visible

Table 12 – Scroll Layout Properties

Scroll Layout Implementation

For the implementation of scroll layout, refer to the example project - **"EVE Screen Designer ->Examples ->Intermediate -> ScrollPanel.**

Scroll Switch Page Layout

The *Scroll Switch Page Layout* consists of a switch page manager and a scroll panel for runtime scrollable support.

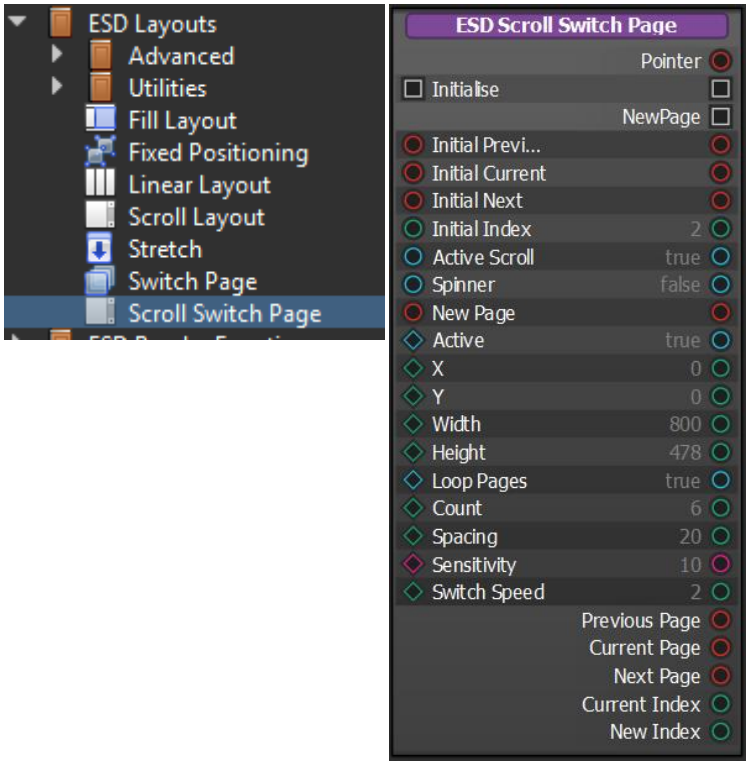


Figure 43 - Scroll Switch Page Layout

Scroll Switch Page layout requires 3 lazy page instances and a current index to start with, namely - the previous page instance, the current page instance and the next page instance.

Upon user touch swipe event, the page will switch according to the swipe direction. The behaviour of this scroll switch page layout are as below:

- On non-swiping runtime, it only renders the current page, but runs the update logic of all the 3 pages.
- On swiping event, it displays both the current page and the swiping to page (can be previous and next page instance).
- On touch up event, it will either recover to the original position if the swiped range has not reached the minimum threshold or switch to the new page. The touch scroll will be temporally disabled until it has recovered or switched to the target page.
- Upon switching page complete, the scroll switch page will fire "NewPage" event and requests a new page instance to be allocated and assigns it as the "New Page" input.

Property Name	Description
Pointer	The pointer reference of the widget object
Initialise	The "initialise" slot for initialling the scroll switch page layout
Initial Previous	Initial Previous page instance at start
Initial Current	Initial Current page instance at start
Initial Next	Initial Next page instance at start
Initial Index	Initial Current page index at start
Active Scroll	Set true to override child widgets touch tag event where tag is default(255)
Spinner	Set true to show spinner upon loading the new page instance.
New Page	New page instance input
Active	Enable or disable displaying this widget
X	x coordinate of the top-left of the widget, in pixels

Y	Y coordinate of the top-left of the widget, in pixels
Width	Widget width
Height	Widget Height
Loop Pages	Set true to loop the pages
Count	Set pages count/limit
Spacing	Defines the spacing between pages
Sensitivity	Define the scroll switch sensitivity, range from: 0.05 to 20.00
Switch Speed	Define the switch speed during page transition
Previous Page	The output of previous page instance
Current Page	The output of current page instance
Next Page	The output of next page instance
Current Index	The output of current index
New Index	The output of new index

Table 13 – Scroll Switch Page Layout Properties

Scroll Layout Implementation

In typical configuration for a scroll switch page layout, the figure below demonstrates a sample setup. It should have the following rules:

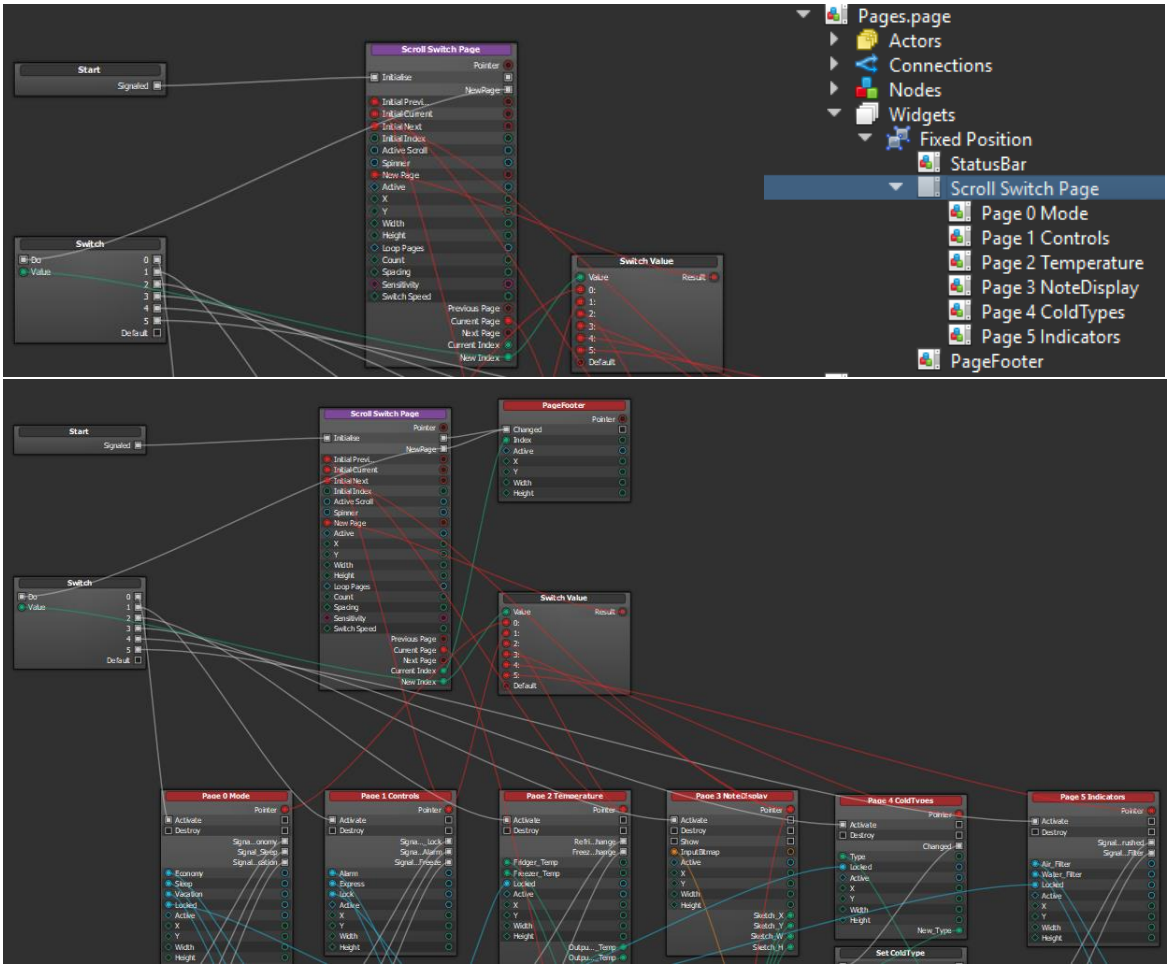


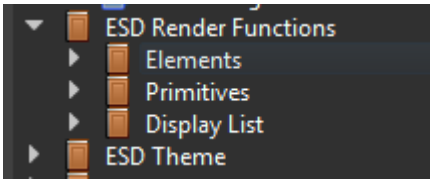
Figure 44 - Sample Scroll Switch Page Implementation

- Connect start slot to the "Initialise" slot of scroll switch page layout instance.
- All switching pages should be configured as child widgets of Scroll Switch Page.

- All child page widgets should be lazy allocation and has same width as the Scroll Switch Page.
- Initial Previous Page, Initial Current Page and the Initial Next Page should be active by default while the rest of child pages should be inactive.
- Initial index should be the index of initial current page.
- Recommend using the "Switch" node to trigger the specific "Activate" signal of the target page.
- Recommend using the "Switch Value" node to get the specific target page instances from all the pages.
- Recommend adding header and footer pages which are Sibling widgets of the Scroll Switch Page Layout instance.

ESD Render Functions

All render functions are non-widget. They are not managed by layout in ESD 4.X. Non-widget functions are to be used only within a widget. These functions are provided as utilities for user to make their own custom widgets.
Note: In order to preview the render functions result in design time, render slot in the custom widget is required.



Elements

The *Elements* are both simple and basic widgets, usually used to construct higher level and more complex widgets. Normally, they do not handle any touch input.

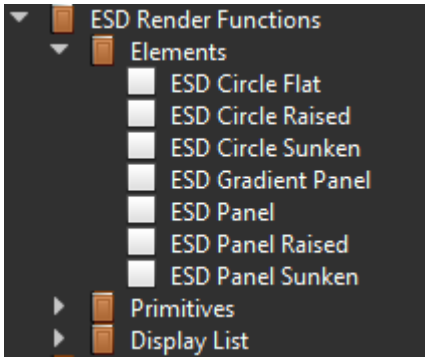


Figure 45 - ESD Elements

ESD Circle

The *ESD Circle* allows the user to draw circles on the screen. The following styles are available – *ESD Circle Flat; ESD Circle Raised* and *ESD Circle Sunken*.

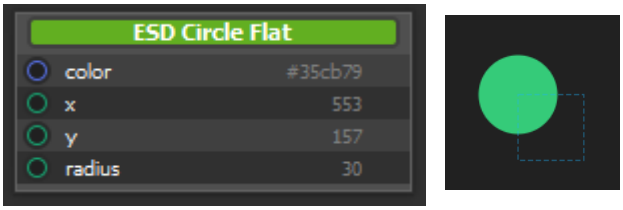


Figure 46 - ESD Circle Element

Property Name	Description
color	RGB value to be rendered inside the circle
x	x coordinate of central point, in pixels
y	Y coordinate of central point, in pixels
radius	radius of the point

Table 14 - ESD Circle Element Properties

ESD Panel

The *ESD Panel* is an adjustable rectangular widget that defines a coloured area. The colour can be specified by a theme or user's selection. Internally, it is constructed by EVE primitives RECTS and SCISSORS. Two styles of ESD Panel are available namely – *ESD Panel Raised* and *ESD Panel Sunken*.

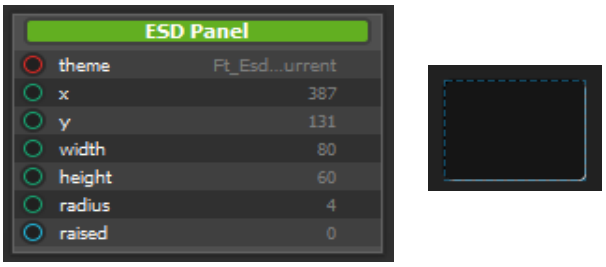


Figure 47 - ESD Panel Element

Property Name	Description
Theme	Theme to be applied on the panel
x	x coordinate of the top-left point, in pixels
y	Y coordinate of the top-left point, in pixels
width	Panel width
height	Panel Height
radius	radius of the corners
raised	Set to true to make panel in raised style

Table 15 - ESD Panel Element Properties

ESD Gradient Panel

The *ESD Gradient Panel* is an adjustable rectangular widget that defines a gradient coloured area. The gradient colour can be specified by two colours (one at start and one at the end). The gradient direction is adjustable by changing the direction.

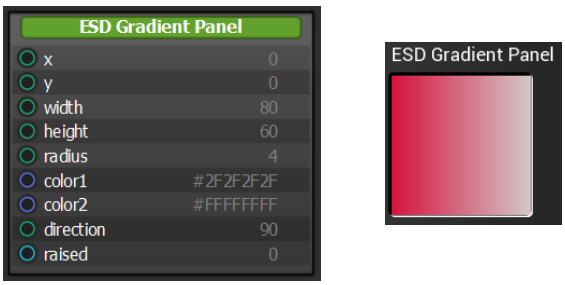


Figure 48 - ESD Gradient Panel Element

Property Name	Description
x	x coordinate of the top-left point, in pixels
y	Y coordinate of the top-left point, in pixels
width	Panel width
height	Panel Height

radius	radius of the corners
color1	Start colour for gradient effect
color2	End colour for gradient effect
direction	Gradient effect direction
raised	Set to true to make panel in raised style

Table 16 - ESD Gradient Panel Element Properties

Primitives

A *Primitive* is a special type of logic node which is a wrapper for a rendering function called by Render slot. It has no return value and its properties cannot be output to other logic nodes. Similar to widgets, it appears on the screen, but is unable to handle user input.

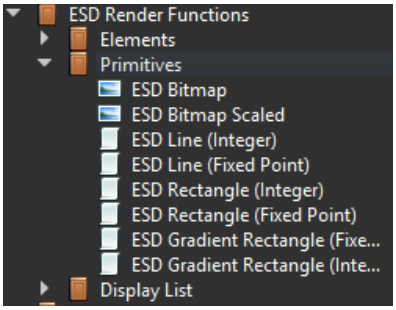
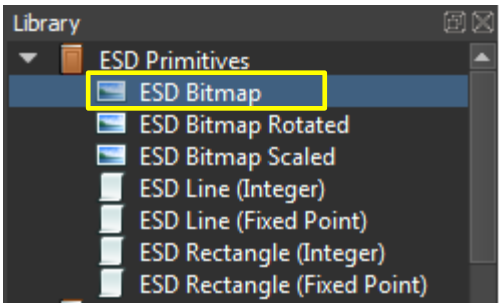


Figure 49 - ESD 4.X Primitives

ESD Bitmap

The *ESD Bitmap* object allows users to display a bitmap resource. A bitmap resource is generated from an image file by adding it into a project. A bitmap resource is treated as a single bitmap cell by default with the name "(Bitmap Resource)_0".

For example, if the bitmap resource is named "photo.jpg", the default bitmap resource will be named as "photo_0". Users can define how many bitmap cells they want by specifying the *"CellHeight"* property.



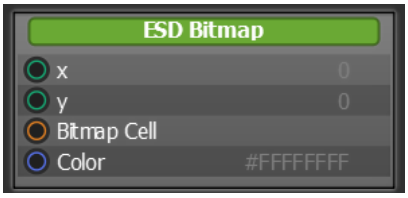
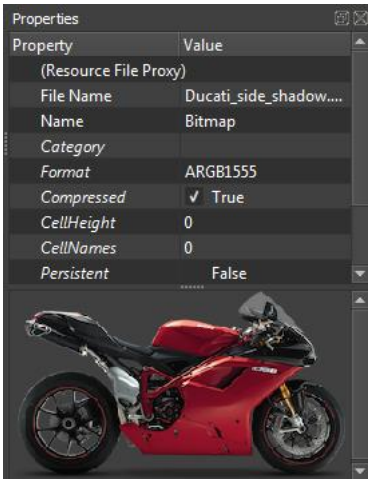


Figure 50 - ESD Bitmap Primitive

Property Name	Description
x	x coordinate of Bitmap, top-left, in pixels
y	Y coordinate of Bitmap, top-left, in pixels
Bitmap Cell	Bitmap cell to display
Color	Color to be applied to bitmap

Table 17 - ESD Bitmap Properties

To add a bitmap

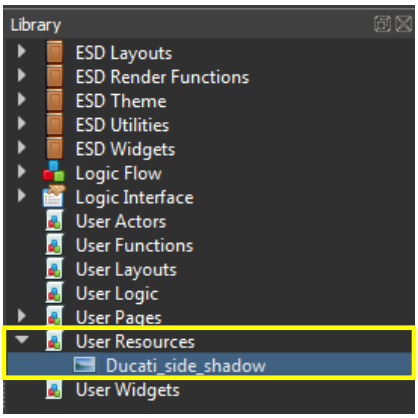


Click and select **"File → Add"** or click  from the toolbar. A bitmap cell is then assigned. ESD 4.X supports the following image file formats as input – *".png", ".jpg"* and *".jpeg"*. Bitmap resources can contain a single or multiple cells based on the *CellHeight* value.

If the value of the *"CellHeight"* is zero, then the number of cells is one.

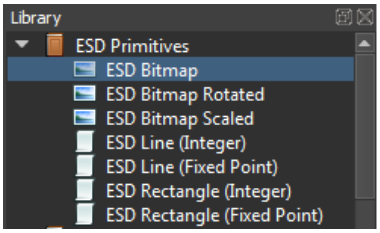
If the value of the *"CellHeight"* is non-zero, then the number of cells value is calculated as shown below –

```
Number of Cell = Bitmap Height / CellHeight
```

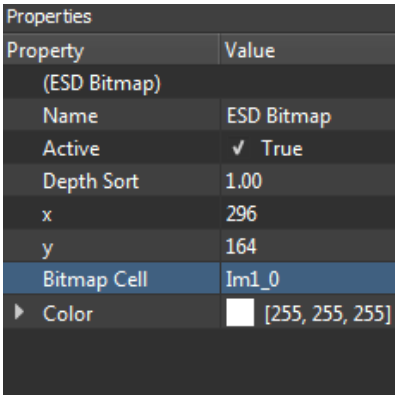


Upon adding a Bitmap, the new bitmap resource will be added into the Library under the category – *"User Resources"*.

To use an *ESD Bitmap*, drag and drop the ESD Bitmap Node into the *Layout Editor* or *Logic Node Editor*.



Choose a Bitmap Cell to display from the dropdown list.



The list of Bitmap Cell values is updated automatically after a new image file is added into a project.

Use ESD Image to display bitmap as ESD bitmap is non-widget, and used only as a rendering function in ESD 4.X. Users are required to upgrade ESD Bitmap to ESD Image from ESD 3.X.

ESD Line

The *ESD Line* allows users to draw lines on the screen.

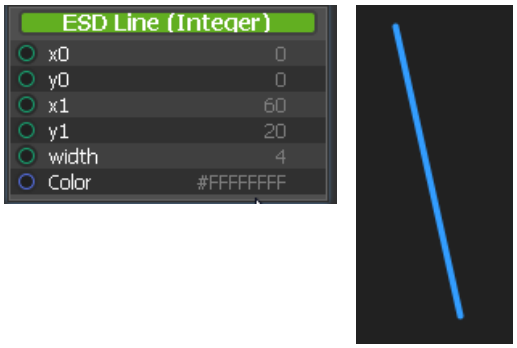


Figure 51 - ESD Line

Use ESD Widgets – Line Widget to display line as ESD line is non-widget, and used only as a rendering function in ESD 4.X. Users are required to upgrade ESD Line to Line Widget.

Property Name	Description
x0	x – coordinate of the start point, in pixels
y0	y – coordinate of the start point, in pixels
x1	x – coordinate of the end point, in pixels
y1	y – coordinate of the end point, in pixels
width	Line width, in pixel
Color	Line color, in RGBA format

Table 18 - ESD Line Properties

Fixed Point Variant

ESD Line (Fixed point) expresses the properties with pixel attribute in fixed point format. It provides more control to lines.

ESD Rectangle

The *ESD Rectangle* allows users to draw rectangle on the screen.

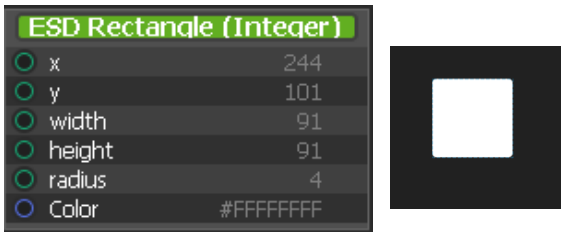


Figure 52 - ESD Rectangle

Property Name	Description
x	x coordinate of Bitmap, top-left, in pixels
y	Y coordinate of Bitmap, top-left, in pixels
width	width, in pixels
height	height, in pixels
radius	radius of the round corner, in pixels
Color	color of the rectangle

Table 19 - ESD Rectangle Properties

Fixed Point Variant

ESD Rectangle (Fixed point) expresses the properties with pixel attribute in fixed point format. It provides more control to rectangles.

Display List

The Display List provides a collection of utilities functions related to EVE Display List.

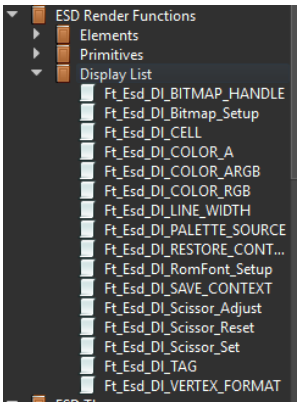


Figure 53 - ESD Display List

ESD Theme

A *Theme* is a collection of colours which can be used across the application in order to maintain a consistent style. The library browser provides the necessary logic nodes to make most use of the theme function.

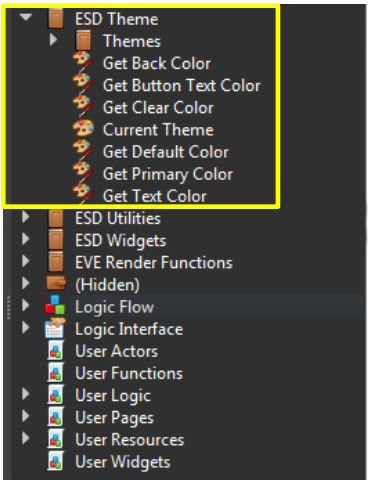


Figure 54 - Library Browser - ESD Theme

Built In Themes

ESD 4.X provides two *Built-in Themes* for users to configure the colour scheme of project. They are: *Ft_Esd_Theme_LightBlue* theme and *Ft_Esd_Theme_DarkOrange* theme.

Property	Value
(Linked File Proxy)	
File Name	Ft_Esd_Theme_LightBlue.theme
Name	Theme
Category	EsdTheme_Themes
ClearColor	[235, 235, 235] (255)
BackColor	[255, 255, 255] (255)
TextColor	[0, 0, 0] (255)
ButtonTextColor	[250, 250, 250] (255)
DefaultColor	[113, 113, 113] (255)
PrimaryColor	[34, 119, 199] (255)

Property	Value
(Linked File Proxy)	
File Name	Ft_Esd_Theme_DarkOrange.theme
Name	Theme
Category	EsdTheme_Themes
ClearColor	[33, 33, 33] (255)
BackColor	[21, 21, 21] (255)
TextColor	[255, 255, 255] (255)
ButtonTextColor	[255, 255, 255] (255)
DefaultColor	[107, 107, 107] (255)
PrimaryColor	[255, 127, 63] (255)

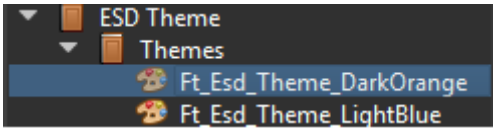


Figure 55 - ESD 4.X Built-in Themes

Table 19 and 20 provides information about the built-in themes property -

Property Name	Type	Value (Default)	Description
Name	String	Theme	Ft_Esd_Theme_LightBlue
ClearColor	RGBA	235,235,235(255)	Clear Color
BackColor	RGBA	255,255,255(255)	Background Color
TextColor	RGBA	0,0,0(255)	Text Color
ButtonTextColor	RGBA	250,250,250(255)	Button Text Color
DefaultColor	RGBA	113,113,113(255)	Default Color
PrimaryColor	RGBA	34,119,199(255)	Primary Color

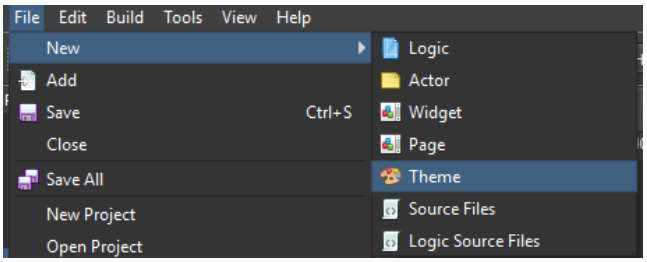
Table 20 - Ft_Esd_Theme_LightBlue Theme

Property Name	Type	Value (Default)	Description
Name	String	Theme	Ft_Esd_Theme_DarkOrange
ClearColor	RGBA	33,33,33(255)	Clear Color
BackColor	RGBA	21,21,21(255)	Background Color
TextColor	RGBA	255,255,255(255)	Text Color
ButtonTextColor	RGBA	255,255,255(255)	Button Text Color
DefaultColor	RGBA	107,107,107(255)	Default Color
PrimaryColor	RGBA	255,127,63(255)	Primary Color

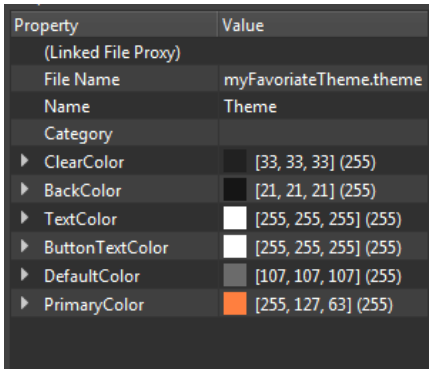
Table 21 - Ft_Esd_Theme_DarkOrange Theme

To create a new theme –

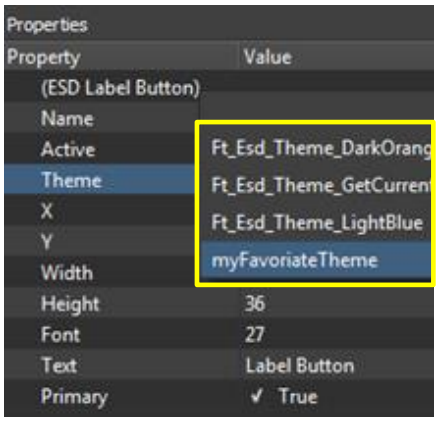
1. Click and select **"File → New → Theme"**.



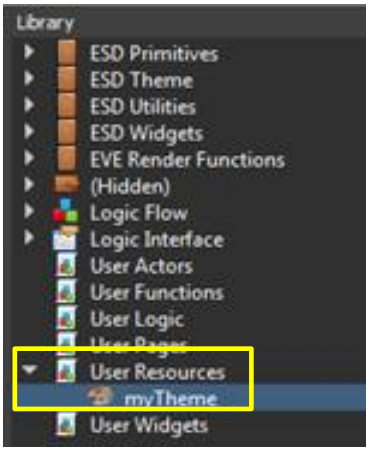
2. A new *"*.theme"* file is created within the Project folder. Using the Property Editor, users can configure it as per their requirement.



3. The newly-created theme will be available across the project and may be applied it to other widgets with the theme property.

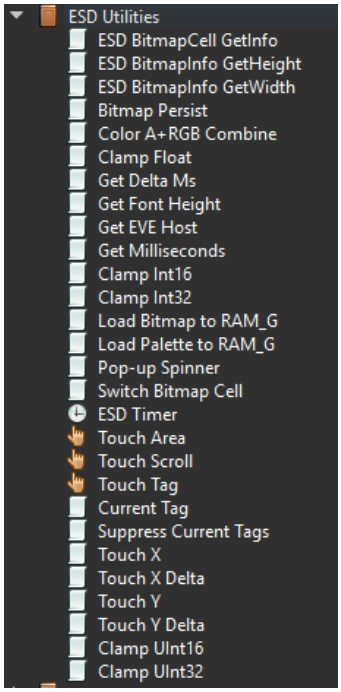


4. The newly created theme will also be available under **User Resources** in the *Library Browser*. Users can drag and drop the theme to the logic editor.



ESD Utilities

ESD Utilities contains the collection ESD utilities functions. The following table provides the list of ESD Utilities and its functionality.

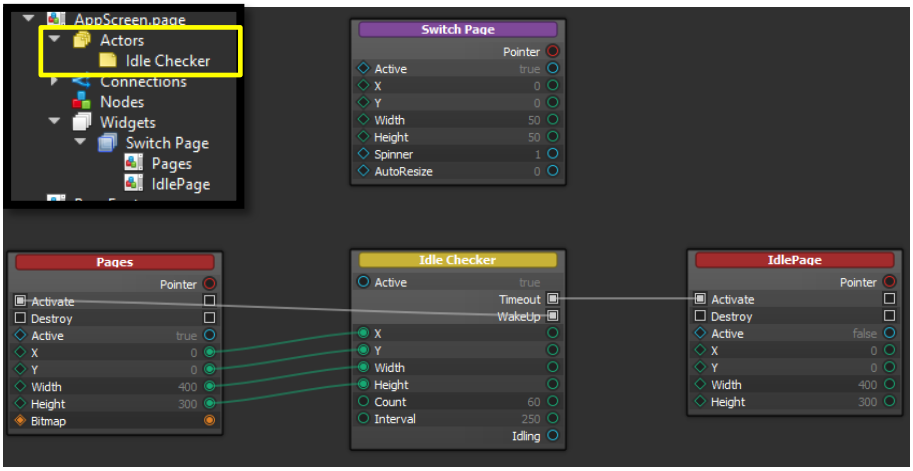


ESD Utility	Description
ESD BitmapCell GetInfo	Retrieves the BitmapCell information with given bitmap reference.
ESD BitmapInfo GetHeight	Returns the BitmapCell Height of given bitmap reference.
ESD BitmapInfo GetWidth	Retrieves the BitmapCell Width of given bitmap reference.
Bitmap Persist	To persist the given bitmap object
Color A+RGB Combine	Merge Alpha to RGB, to become RGBA colour
Clamp Float	Clamp float value with min and max limits
Get Delta Ms	Get Delta time difference in milliseconds since last frame update called
Get Font Height	Return Font Height
Get EVE Host	Get EVE Host
Get Milliseconds	Get time in milli-seconds for current frame
ESD Idle Checker	ESD Idle Checker Actor to check when to sleep and wake up based on the touch events.
Clamp Int16/UInt16	Clamp Int16/UInt16 value with min and max limits
Clamp Int32/UInt32	Clamp Int32/UInt32 value with min and max limits
Load Bitmap to RAM_G	Load Bitmap to RAM_G
Load Palette to RAM_G	Load Palette to RAM_G
Pop-up Spinner	Pop-up Spinner when the frame is rendered
Switch Bitmap Cell	Switch Bitmap Cell
ESD Timer	ESD Timer Actor
Touch Area	Touch Area Actor
Touch Scroll	Touch Scroll Actor
Touch Tag	Touch Tag Actor
Current Tag	Current Touch Tag
Suppress Current Tags	Suppress Current Tags
Touch X/Y	Touch X/Y coordinate
Touch X/Y Delta	Touch X/Y Delta

Table 22 – ESD Utilities & Description

ESD Idle Checker *new*

ESD Idle Checker Actor provides an actor to check when the application should go to sleep mode or wake up from sleep mode. One of the main use case of the idle checker actor is to check for idling and wake up event for displaying the screen saver page. The picture on the right demonstrated in "AppScreen.page" uses Idle Checker to switch between application pages and the idle page. The idle checker has an interval of 250 ms and count of 60 intervals. In other words, it may timeout when there is no touch event for 15 secs (60 * 250 = 15000 ms).



ESD Widgets

A *widget* is a kind of logic node which has a visual appearance rendered by the Embedded Video Engine (EVE). The widgets can be found in the library browser area. There are two types of widgets – *ESD Widgets* (built-in widgets provided by ESD 3.x) and *User Widgets* (defined by users). Advanced users may also create custom widget using the c source files directly. However, users must ensure that the first member in the custom widget should always be ESD_Widget. This is required for ESD Widget framework to work correctly.

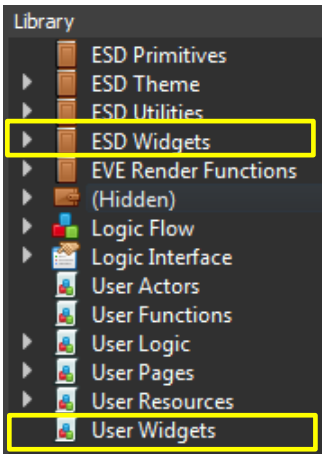


Figure 56 – Widgets

Basic Widgets

ESD Basic widgets are introduced in ESD 4.0. These widgets are the widget wrappers for the Elemental and Primitive Rendering functions which include drawing line, paint rectangle, paint circle and paint bitmap.

ESD Line Widget

The *ESD Line* Widget allows the user to display line as widget instead of a render function on the screen.

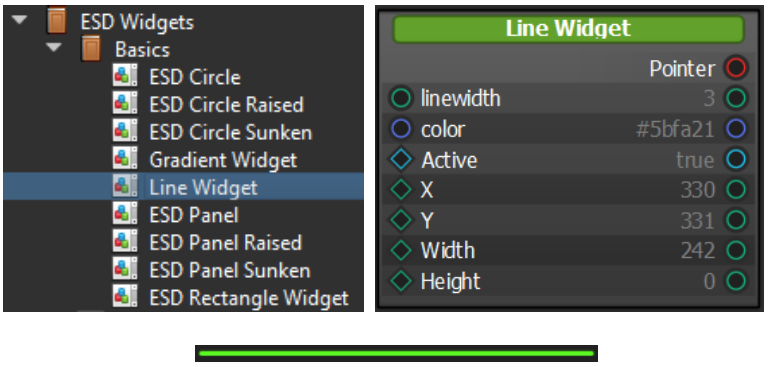


Figure 57 - ESD Line Widget

Property Name	Description
Pointer	The pointer reference of the widget object
color	Select background colour
Active	Set true to activate this widget
x	x coordinate of central point, in pixels
y	Y coordinate of central point, in pixels
Width	Width of the widget
Height	Height of the widget

Table 23 - ESD Line Widget Properties

ESD Circle Widgets

The *ESD Circle* Widgets allow the user to display circle as widget instead of a render function on the screen. ESD Circle will display a flat circle; while ESD Circle Raised has raised border and ESD Circle Sunken has sunken border.

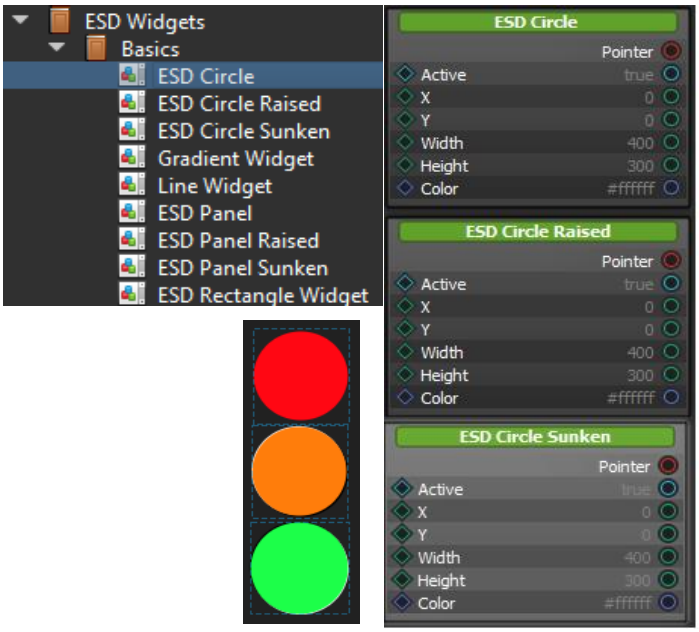


Figure 58 - ESD Circle Widgets

Property Name	Description
Pointer	The pointer reference of the widget object
Active	Set true if this widget is active.
color	RGB value to be rendered inside the circle
x	x coordinate of central point, in pixels
y	Y coordinate of central point, in pixels
radius	Radius of the point

Table 24 - ESD Circle Element Properties

ESD Circle Line Widgets new

The *ESD Circle Line* Widgets allow the user to display circle line with hollow in centre. ESD Circle Line has configurable border and colour.

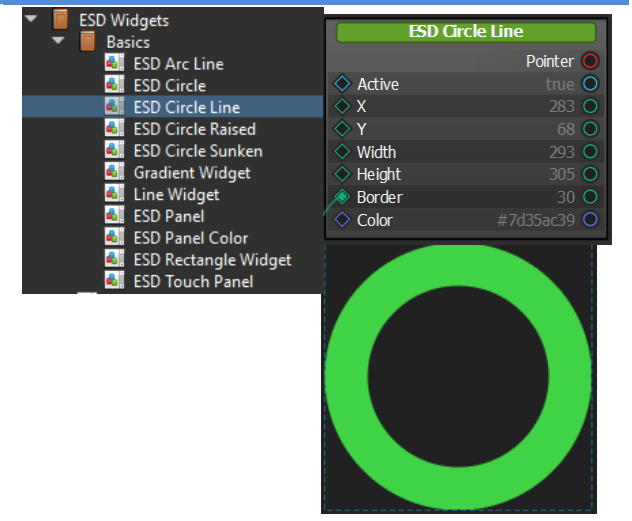


Figure 59 - ESD Circle Line Widgets

Property Name	Description
Pointer	The pointer reference of the widget object
Active	Set true if this widget is active.
x	x coordinate of central point, in pixels
y	Y coordinate of central point, in pixels
Border	The border of the circle line widget
Color	ARGB value to be rendered as the circle line widget

Table 25 - ESD Circle Line Element Properties

ESD Arc Line Widgets new

The *ESD Arc Line* Widgets allow the user to display arc line which can cover 0 to 360 degrees of arc segment. ESD Arc Line has configurable border, colour, and origin of arc direction, value of arc segment in degree, clockwise directional flag, start point and end point settings.

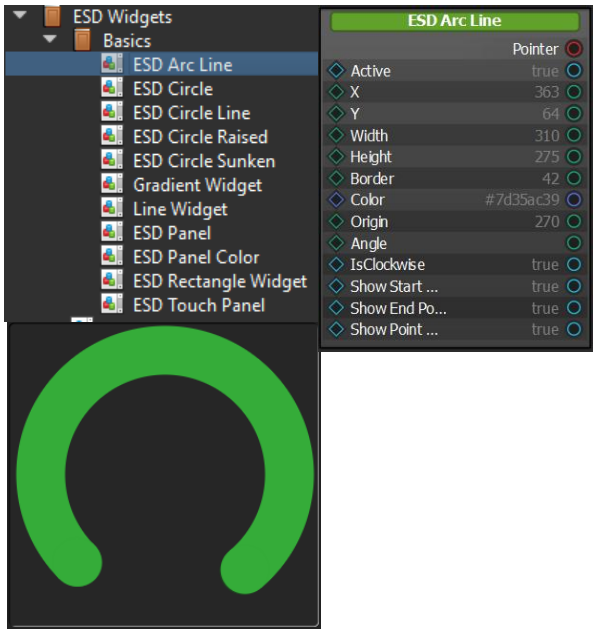


Figure 60 - ESD Arc Line Widgets

Property Name	Description
Pointer	The pointer reference of the widget object
Active	Set true if this widget is active.
x	x coordinate of central point, in pixels
y	Y coordinate of central point, in pixels
Border	The border of the arc line widget
Color	ARGB value to be rendered as the arc line widget
Origin	The origin of the arc direction, range from 0 to 360
Angle	The arc segment angle value, range from 0 to 360
IsClockwise	The Boolean to set if the arc's direction. Set true as clockwise direction.
Show Start Point	The Boolean to enable rendering start point
Show End Point	The Boolean to enable rendering end point
Show Point Shadow	The Boolean to enable rendering point shadow on start and end points

Table 26 - ESD Arc Line Element Properties

ESD Panel Widgets

The *ESD Panel* Widgets allow the user to display panel as widget instead of a render function on the screen. ESD Panel will display a configurable raised/sunken panel; while ESD Panel Raised has raised border and ESD Panel Sunken has sunken border. Both ESD Panel Raised and ESD Panel Sunken can set the background colour.

Figure 61 - ESD Panel Widgets

Property Name	Description
Pointer	The pointer reference of the widget object
theme	Select the theme which affect the background colour
raised	Set true for raised border, else it will be sunken border
x	x coordinate of central point, in pixels
y	Y coordinate of central point, in pixels
radius	radius of the point

Table 27 - ESD Panel Widget Properties

Property Name	Description
Pointer	The pointer reference of the widget object
color	Select background colour
Active	Set true to activate this widget
x	x coordinate of central point, in pixels
y	Y coordinate of central point, in pixels
radius	radius of the point

Table 28 - ESD Panel Raised and Sunken Widget Properties

ESD Touch Panel Widgets new

The *ESD Touch Panel* Widgets allow the user to display panel as widget with touch event handler together. It consists of one ESD Panel, one touch tag and one touch area when it is applicable.

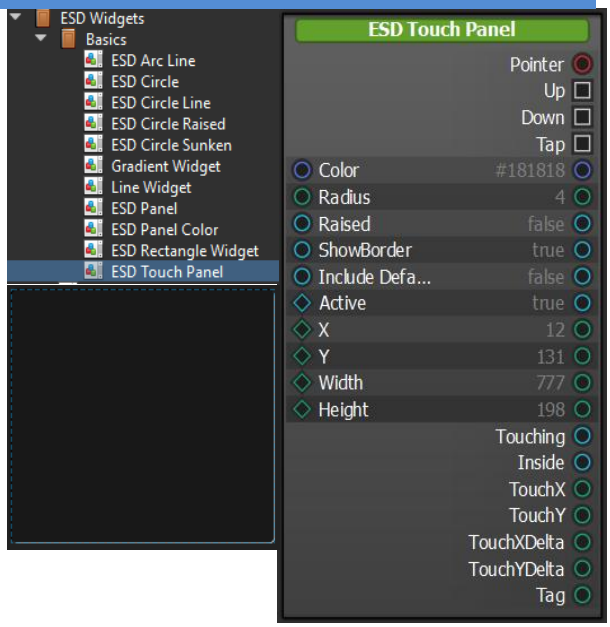


Figure 62 – ESD Touch Panel Widgets

Property Name	Description
color	Select the background colour
raised	Set true for raised border, else it will be sunken border
radius	radius of the point
x	x coordinate of central point, in pixels
y	Y coordinate of central point, in pixels
Width	Widget Width
Height	Widget Height

Table 29 - ESD Touch Panel Widget Properties

Output / Signal	Description
Pointer	The pointer reference of the widget object
Up	Touch Up event signal
Down	Touch Down event signal
Tap	Touch Tap event signal
Touching	The output of touching status
Inside	The output of touch inside status
TouchX	The output of X coordinate of the touch point
TouchY	The output of Y coordinate of the touch point
TouchXDelta	The output of X difference between last two touch points
TouchYDelta	The output of Y difference between last two touch points
Tag	The output of touch tag Id.

Table 30 - ESD Touch Panel Widget Output/Signal

ESD Gradient Widget

The *ESD Gradient Widget* allows the user to display gradient rectangle as widget instead of a render function on the screen.

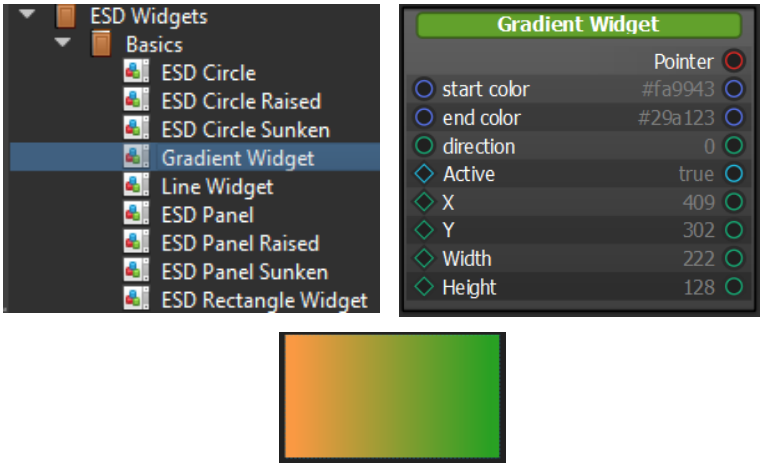


Figure 63 - ESD Gradient Widget

Property Name	Description
Pointer	The pointer reference of the widget object
Start color	Select the starting colour of the gradient effect
End color	Select the ending colour of the gradient effect
direction	Set the gradient effect direction in degree. The degree and value range is from 0 to 359
Active	Set true to activate this widget
x	x coordinate of central point, in pixels
y	Y coordinate of central point, in pixels
Width	Width of the widget
Height	Height of the widget

Table 31 - ESD Gradient Widget Properties

ESD Circular Gradient Widget

The *ESD Circular Gradient Widget* allows the user to display a circular gradient in two different styles. User can able to select any gradient style by choosing it from the gradient type property as mentioned in the table below.

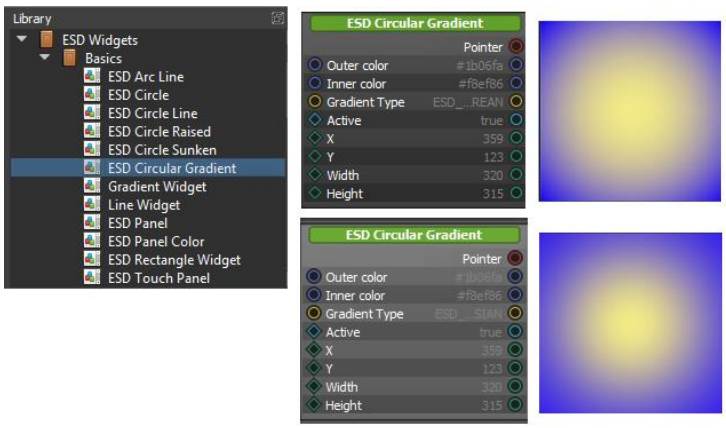


Figure 64 - ESD Circular Gradient Widget

Property Name	Description
Pointer	The pointer reference of the widget object
Outer color	Select the outer colour of the gradient effect
Inner color	Select the inner colour of the gradient effect
Gradient Type	Set the gradient style to either ESD_PYTHAGOREAN to get Pythagorean Style or ESD_GAUSSIAN to get Gaussian style
Active	Set true to activate this widget
x	x coordinate of central point, in pixels
y	Y coordinate of central point, in pixels
Width	Width of the widget
Height	Height of the widget

Table 32 - ESD Circular Gradient Widget Properties

ESD Check Box

The *ESD Check Box* is a widget which has two states and toggles its own state based on user touch input.

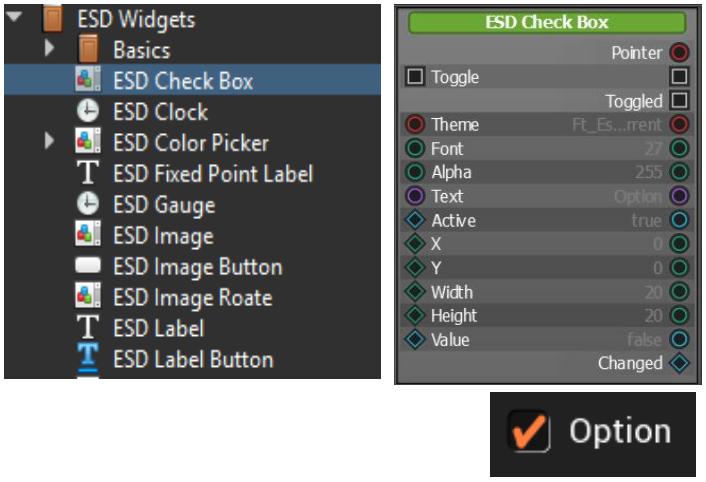


Figure 65 - ESD Check Box Widget

Property Name	Description
Pointer	The pointer reference of the widget object
Theme	Get theme (background/text/default/…color)
X	Absolution position of the horizon
Y	Absolution position of the vertical
Width	Widget width
Height	Widget Height
Alpha	Adjust the transparency
Text	The display label behind the check box
Value	Checked/Unchecked

Table 33 - ESD Check Box Widget Properties

Users can connect the *ESD Check Box* with other widgets in order to get user's input via a signal mechanism.

ESD Clock

The *ESD Clock* is a basic widget based on an EVE built-in widget. It can be accessed from the library browser under the ESD Widgets folder.

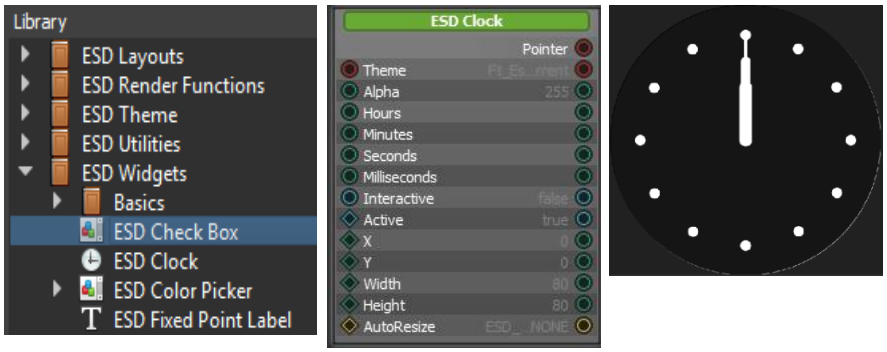
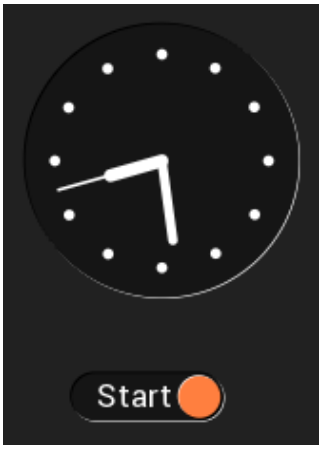


Figure 66 - ESD Clock Widget

Property Name	Description
Pointer	The pointer reference of the widget object
Theme	Theme to be applied on the widget
Alpha	Adjust the transparency
Hours	The hour hand position
Minutes	The minute hand position
Seconds	The seconds hand position
Milliseconds	The time expressed in milliseconds unit
Interactive	Currently not in use
X	x coordinate of the top-left of the widget, in pixels
Y	Y coordinate of the top-left of the widget, in pixels
Width	Widget width
Height	Widget Height

Table 34 - ESD Clock Widget Properties

Users can connect the ESD clock with other widgets, such as ESD toggle or ESD timer via hours/minutes/seconds or milliseconds property. Figure 59 shows how a clock is started or stopped by an ESD Toggle Widget and the corresponding logic node connection.



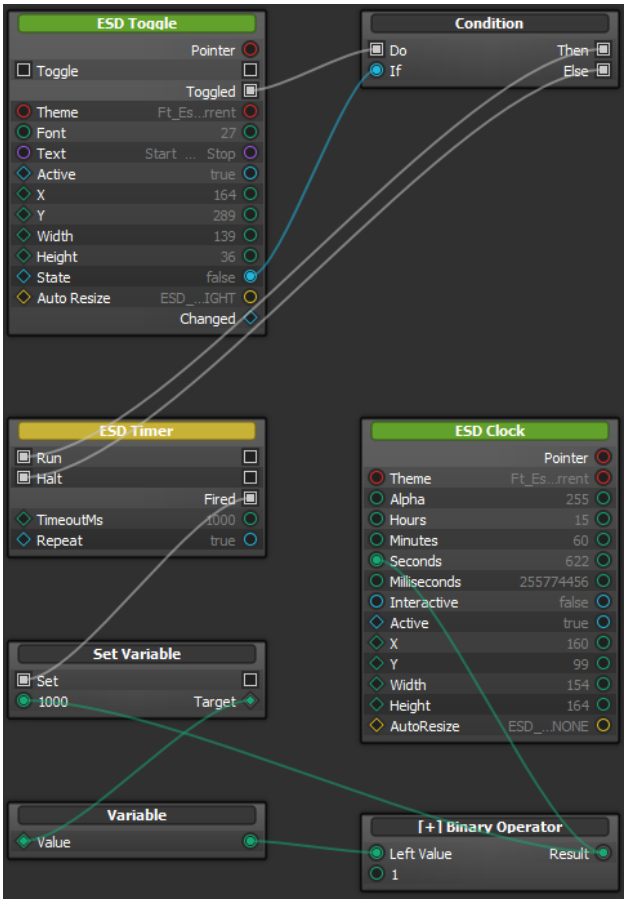


Figure 67 - ESD Clock Widget Example

ESD Color Picker

ESD Color Picker provides a circle style Colour picker which is associated with a circle bitmap. It handles user touch and translates the touch point into a corresponding RGB Colour value as an output. Users can connect this widget with the bitmap *"circular_colorwheel.png"* under *"$(LIBRARY)\Ft_Esd_Widget"* after adding it into the current project. The bitmap can be changed but it needs to be in the same style, only with a different radius value, which can be adjusted in the Property Editor.

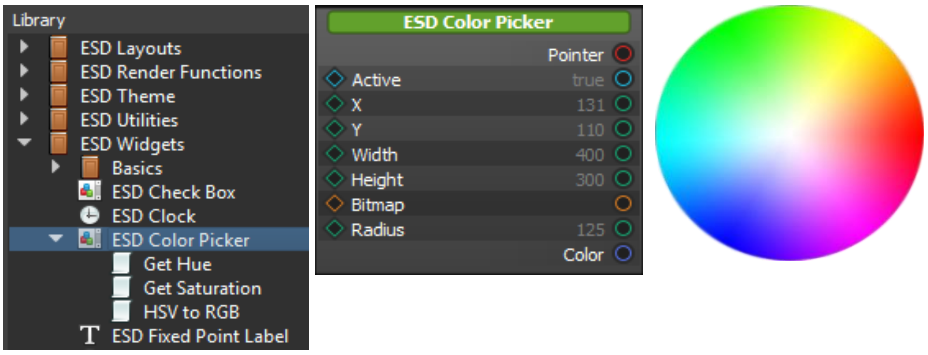


Figure 68 - ESD Color Picker Widget

Property Name	Description
Pointer	The pointer reference of the widget object
X	X coordinate of the top-left, in pixels
Y	Y coordinate of the top-left, in pixels
Width	Widget width
Height	Widget Height
Bitmap	The bitmap cell used in the colour picker
Radius	The radius of the circular image (in pixel)

Table 35 - ESD Color Picker Widget Properties

Output / Signal	Description
Color	The current colour based on the user's touch and selected bitmap

Table 36 - ESD Color Picker Widget Output/Signal

The logic node connection in the figure 60 shows connecting the output of the ESD Color Picker widget with the colour property of the other widget.

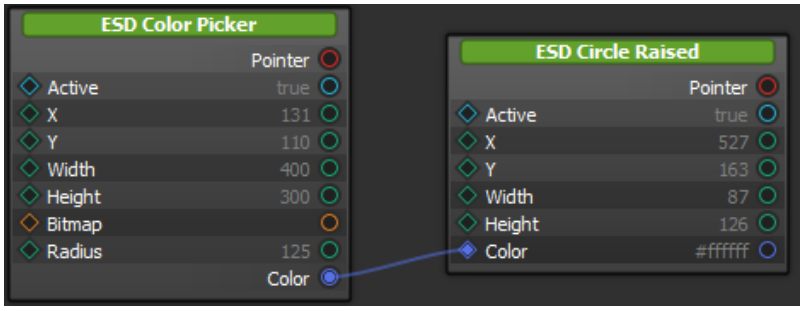


Figure 69 - ESD Color Picker Widget Example

ESD Gauge

The *ESD Gauge* is a circular widget which is based on the EVE built-in widget. It can be connected with other widgets to display the value by needle. This widget does not have the capability of interacting with the user's touch input.

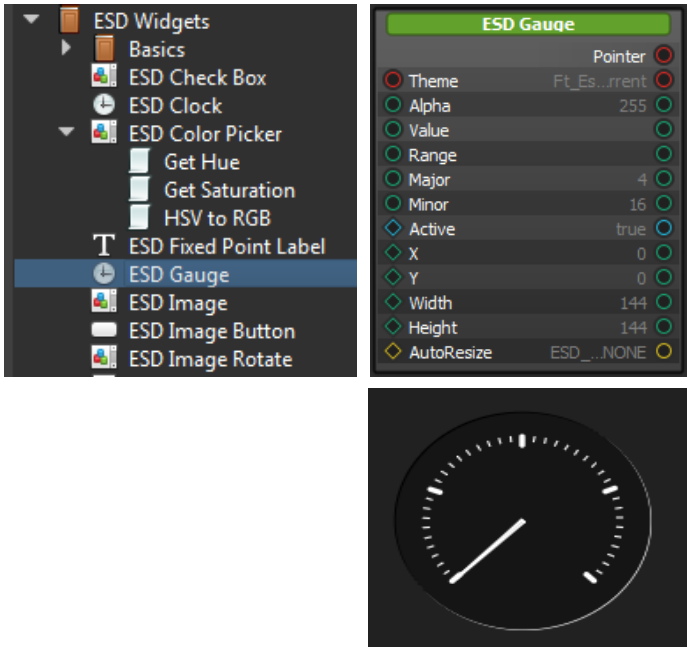


Figure 70 - ESD Gauge Widget

Property Name	Description
Pointer	The pointer reference of the widget object
Theme	Theme to be applied to this widget
Alpha	Adjust the transparency
Value	Current value that the needle is pointing to
Range	Value range
Major	Major Division
Minor	Minor Division
X	Absolution position of the horizon
Y	Absolution position of the vertical
Width	Widget width
Height	Widget Height

Table 37 - ESD Gauge Widget Properties

An ESD Gauge can display the temperature, speed, pressure etc. Figure 62 – ESD Gauge Example displays the current pressure inside a tire. Users can control a pump by increasing/decreasing pressure on the screen.

Figure 71 - ESD Gauge Example

The corresponding logic node connection in the logic note editor is shown in Figure 63.

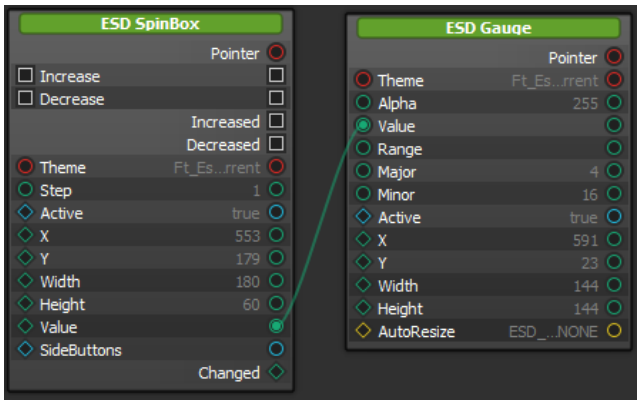


Figure 72 - ESD Gauge Logic Node Connection Example

ESD Image

The *ESD Image* is the standard image widget that allows users to display a bitmap resource. To rotate an image, use the ESD Image Rotate widget.

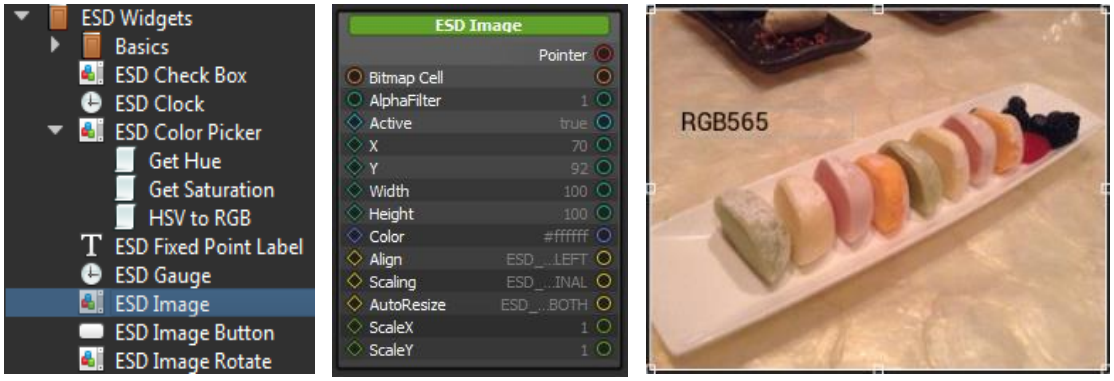


Figure 73 - ESD Image Widget

Property Name	Description
Pointer	The pointer reference of the widget object
Bitmap Cell	The bitmap cell to be display on the widget
Alpha Filter	Alpha Filter setting, set 0 to disable it, or 1-255 for alpha function filtering
Active	Set true if this widget is active.
X	X coordinate of the image button, top-left, in pixels
Y	Y coordinate of the image button, top-left, in pixels
Width	Image button width, in pixels
Height	Image button height, in pixels
Color	Default colour
Align	Set Image alignment mode
Scaling	Set Image scaling mode
AutoResize	Set Widget Auto resize mode
ScaleX	X Scale value for the image
ScaleY	Y Scale value for the image

Table 38 - ESD Image Properties

ESD Image Button

The *ESD Image Button* allows the users to add a button in the form of a bitmap.

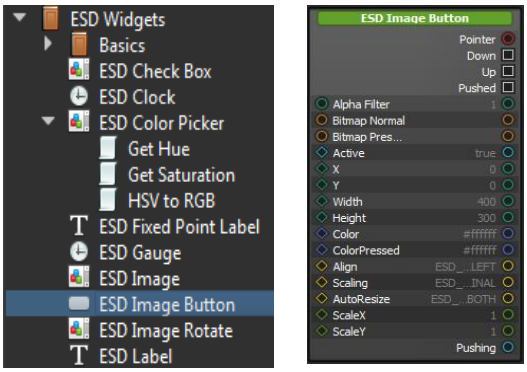


Figure 74 - ESD Image Button

Property Name	Description
Pointer	The pointer reference of the widget object
Alpha Filter	Alpha Filter setting, set 0 to disable it, or 1-255 for alpha function filtering
Bitmap Normal	Bitmap cell to display in the normal state
Bitmap Pressed	Bitmap cell to display in the pressed state
Active	Active state of the image button, set to true to appear on the screen
X	X coordinate of the image button, top-left, in pixels
Y	Y coordinate of the image button, top-left, in pixels
Width	Image button width, in pixels
Height	Image button height, in pixels
Color	Default colour
Align	Set Image alignment mode
Scaling	Set Image scaling mode
AutoResize	Set Widget Auto resize mode
ScaleX	X Scale value for the image
ScaleY	Y Scale value for the image

Table 39 - ESD Image Button Properties

Output / Signal	Description
Down / Up / Pushed	Output signal when image button is Down/Up or Pushed state
Pushing	Output value indicated (true) if the image button is in pressed state

Table 40 - ESD Image Button Output/Signal

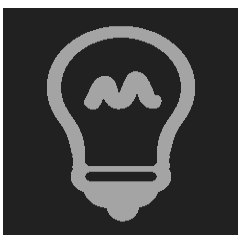
The following example illustrates how to add / use an image button –

Add new image buttons and assign the bitmaps - *Bulb Off Image* and *Bulb On Image* (refer to the bitmap pictures) to *Bitmap Normal* and *Bitmap Pressed*.

Bulb Off image (bitmap cell name is bulbOff1_0)

Bulb On image (bitmap cell name is bulb1On_0)

Property	Value
(ESD Image Button)	
Name	ESD Image Button
Active	✓ True
Theme	Ft_Esd_Theme_GetCurrent
X	400
Y	200
Bitmap Normal	bulb1Off_0
Bitmap Pressed	bulb1On_0



Normal State

Pressed State

Figure 75 - ESD Image Button Example

If the bitmap resource consists of transparent area which are clickable by users, then set Alpha Filter=0 to disable alpha function filtering.

ESD Image Rotate

The *ESD Image Rotate* is similar to the ESD Image widget that allows users to display a bitmap resource with the rotation angle.

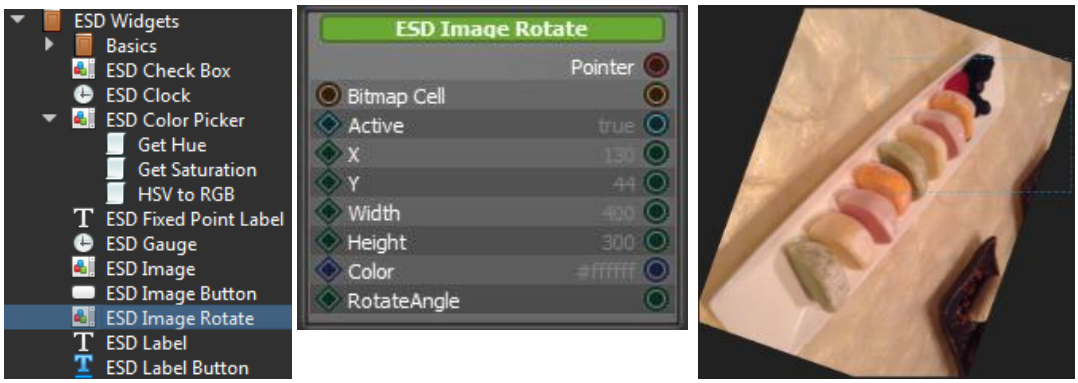


Figure 76 - ESD Image Widget

Property Name	Description
Pointer	The pointer reference of the widget object
Bitmap Cell	The bitmap cell to be display on the widget
Active	Set true if this widget is active.
X	X coordinate of the image button, top-left, in pixels
Y	Y coordinate of the image button, top-left, in pixels
Width	Image button width, in pixels
Height	Image button height, in pixels
Colour	Default colour
Rotate Angle	The Rotation Angle range: 0 to 65535

Table 41 - ESD Image Properties

ESD Label

The *ESD Label* allows the users to add a Text Label with customized size and text.

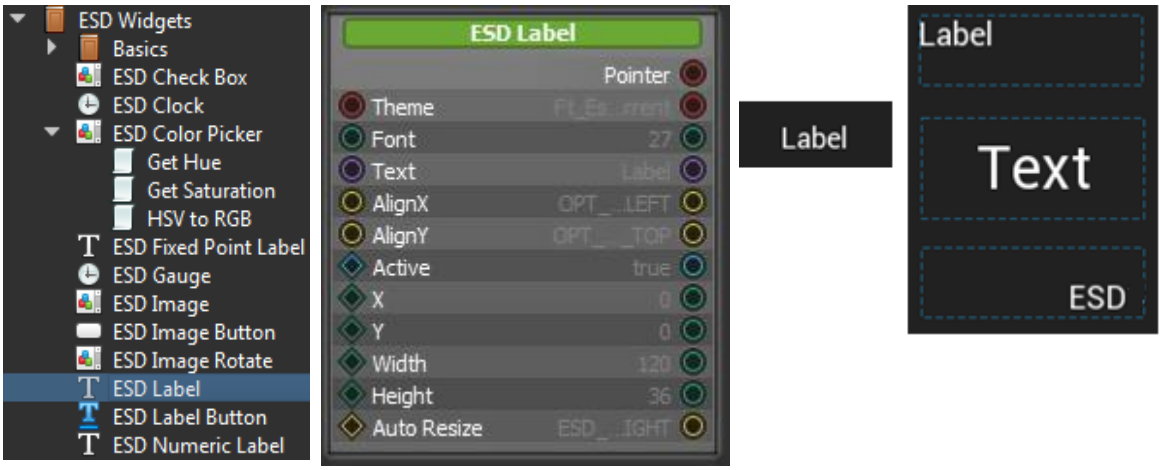


Figure 77 - ESD Label

Property Name	Description
Pointer	The pointer reference of the widget object
Theme	Theme applied for the label
Font	Fonts used in the label. Same as bitmap handle defined in EVE
Text	The text content of the label. By default, "Label"
AlignX	Horizontal alignment of text *OPT_ALIGN_LEFT: Left,* *OPT_ALIGN_CENTER: Center,* *OPT_ALIGN_RIGHT: RIGHT*
AlignY	Vertical alignment of text *OPT_ALIGN_TOP: Top,* *OPT_ALIGN_CENTER: Center,* *OPT_ALIGN_BOTTOM: Bottom*
Active	Active state of the label, set to true to appear on the screen
X	X coordinate of label, top-left, in pixels
Y	Y coordinate of label, top-left, in pixels
Width	Label width, in pixels
Height	Label height, in pixels

Table 42 - ESD Label Properties

ESD Numeric Label

The *ESD Numeric Label* allows the users to add a numeric Label with value in integer. ESD Numeric Label outputs are similar to c function printf("%d") and printf("%x").

Figure 78 - ESD Numeric Label

Property Name	Description
Pointer	The pointer reference of the widget object
Theme	Theme applied for the label
Font	Fonts used in the label. Same as bitmap handle defined in EVE
AlignX	Horizontal alignment of text *OPT_ALIGN_LEFT: Left,* *OPT_ALIGN_CENTER: Center,* *OPT_ALIGN_RIGHT: RIGHT*
AlignY	Vertical alignment of text *OPT_ALIGN_TOP: Top,* *OPT_ALIGN_CENTER: Center,* *OPT_ALIGN_BOTTOM: Bottom*
AutoResize	Set Widget Auto resize mode
Integer Value	The integer value of the numeric label.
EnablePadding	Set true to enable padding
No Of Digits	Number of digits, padding will be applied when the number of digits is less.
IsZeroLeading	Set true to enable '0' leading as padding
IsHexDisplay	Set true to enable Hexadecimal display format
Active	Active state of the label, set to true to appear on the screen
X	X coordinate of label, top-left, in pixels
Y	Y coordinate of label, top-left, in pixels
Width	Label width, in pixels
Height	Label height, in pixels

Table 43 - ESD Numeric Label Properties

ESD Fixed Point Label

The *ESD Fixed Point Label* allows the users to add a fixed point Label with value in fixed point. ESD Fixed Point Label outputs are similar to c function printf("%f").

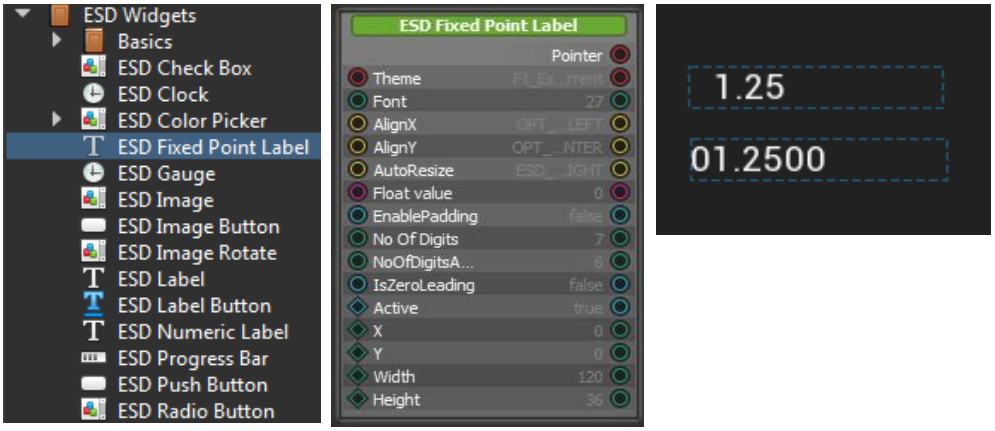


Figure 79 - ESD Fixed Point Label

Property Name	Description
Pointer	The pointer reference of the widget object
Theme	Theme applied for the label
Font	Fonts used in the label. Same as bitmap handle defined in EVE
Align X	Horizontal alignment of text *OPT_ALIGN_LEFT: Left,* *OPT_ALIGN_CENTER: Center,* *OPT_ALIGN_RIGHT: RIGHT*
Align Y	Vertical alignment of text *OPT_ALIGN_TOP: Top,* *OPT_ALIGN_CENTER: Center,* *OPT_ALIGN_BOTTOM: Bottom*
AutoResize	Set Widget Auto resize mode
Float Value	The float value of the fixed point label.
EnablePadding	Set true to enable padding
No Of Digits	Number of digits, padding will be applied when the number of digits is less.
NoOfDigitsAfterDot	Number of digits after the dot.
IsZeroLeading	Set true to enable '0' leading as padding
Active	Active state of the label, set to true to appear on the screen
X	X coordinate of label, top-left, in pixels
Y	Y coordinate of label, top-left, in pixels
Width	Label width, in pixels
Height	Label height, in pixels

Table 44 - ESD Fixed Point Label Properties

ESD Label Button

The *ESD Label Button* allows the users to add a button in the form of a label.

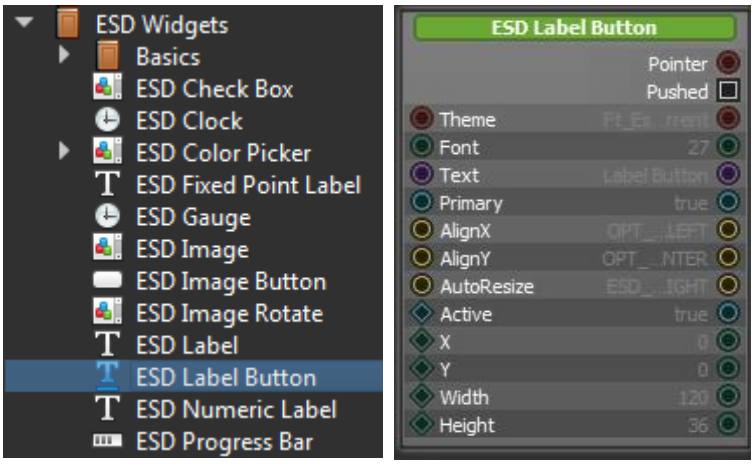


Figure 80 - ESD Label Button

Property Name	Description
Pointer	The pointer reference of the widget object
Theme	Theme applied for the label button
Font	Font used in the label button. Same as bitmap handle defined in EVE
Text	The text content of the label button. By default, "Label"
Primary	Primary state of the label button – Set to True to use the Primary colour from theme Set to False to use the default colour from theme
AlignX	Horizontal alignment of text *OPT_ALIGN_LEFT: Left,* *OPT_ALIGN_CENTER: Center,* *OPT_ALIGN_RIGHT: RIGHT*
AlignY	Vertical alignment of text *OPT_ALIGN_TOP: Top,* *OPT_ALIGN_CENTER: Center,* *OPT_ALIGN_BOTTOM: Bottom*
AutoResize	Set auto resize mode: *ESD_AUTORESIZE_NONE* *ESD_AUTORESIZE_WIDTH* *ESD_AUTORESIZE_HEIGHT* *ESD_AUTORESIZE_BOTH*
X	X coordinate of label button, top-left, in pixels
Y	Y coordinate of label button, top-left, in pixels
Width	Label button width, in pixels
Height	Label button height, in pixels

Table 45 - ESD Label Button Properties

The logic node connection in Figure 72 shows how a toggle changes the state upon pushing the label button. When label button is pushed, the corresponding output signal is **"Pushed"**.

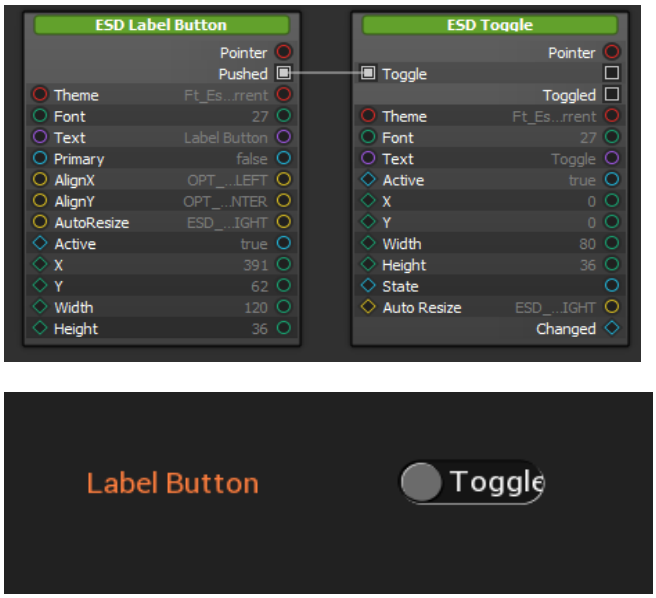


Figure 81 - ESD Label Button Example

ESD Radio Button and ESD Radio Group

The *ESD Radio Button* is used to choose options. The *ESD Radio Button Group* is a utility widget which is not rendered to display. It enables multiple radio buttons to form a single group; only one radio button can be selected at a time.

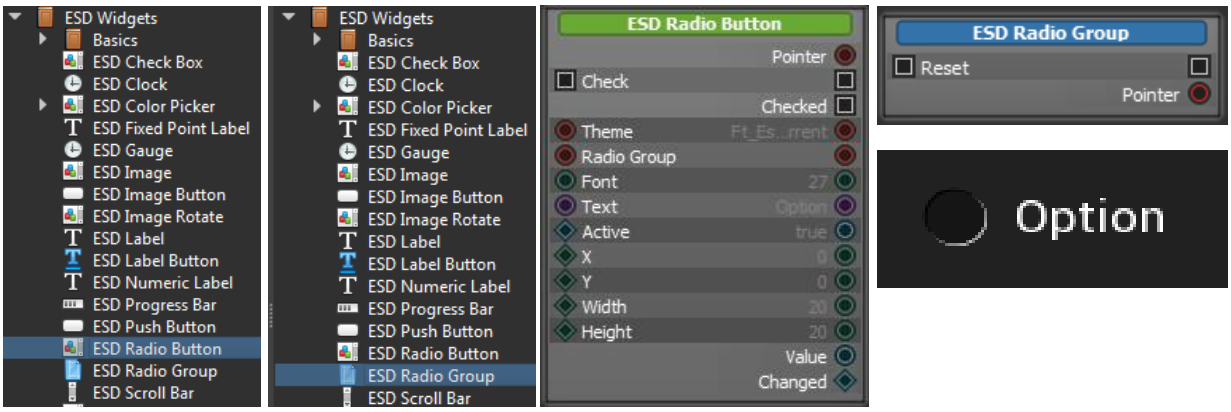
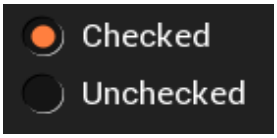


Figure 82 - ESD Radio Button & ESD Radio Group

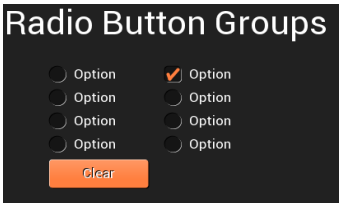
Property Name	Description
Pointer	The pointer reference of the widget object
Check	Selected or not selected
Theme	Theme to be applied to this widget
Radio Group	Pointer to a radio group
Font	Font Size
Text	The display label beside the radio button
Active	Enable or disable displaying this widget
X	Absolute position of the horizon

Y	Absolute position of the vertical
Width	Widget width
Height	Widget Height

Table 46 - ESD Radio Button Properties



An ESD Radio Button has 2 states: *Checked* or *Unchecked*. *Checked* state is selected by clicking on an empty box, or by an external signal from other sources (Push Button, Image Button, Checkbox, etc.).



Each Radio Button has a pointer to an ESD Radio Group; it shares the same context. Only one Radio Button can be checked at a time. When an ESD Radio Group receives a Reset signal, it will reset all states of its children Radio Buttons. Refer to Figure 74.

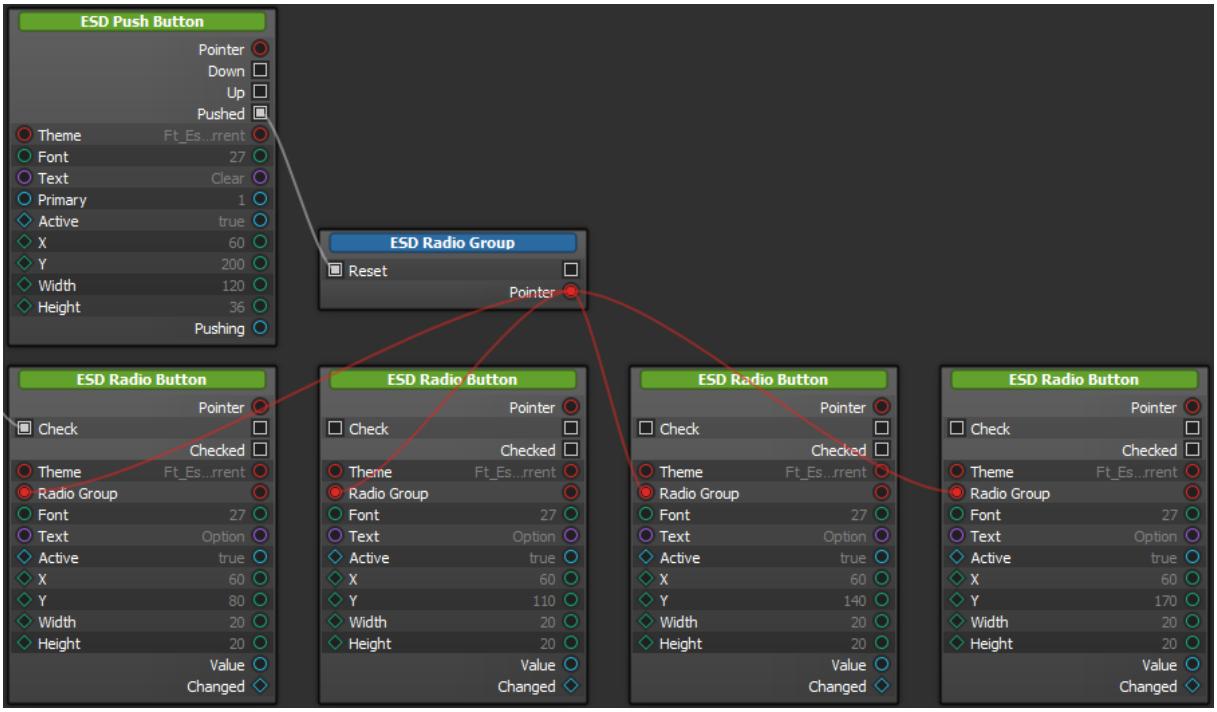


Figure 83 - ESD Radio Button & ESD Radio Group Example

ESD Push Button

The *ESD Push Button* allows the users to add a 3D effect rectangle button with customized size and text label.

Figure 84 - ESD Push Button

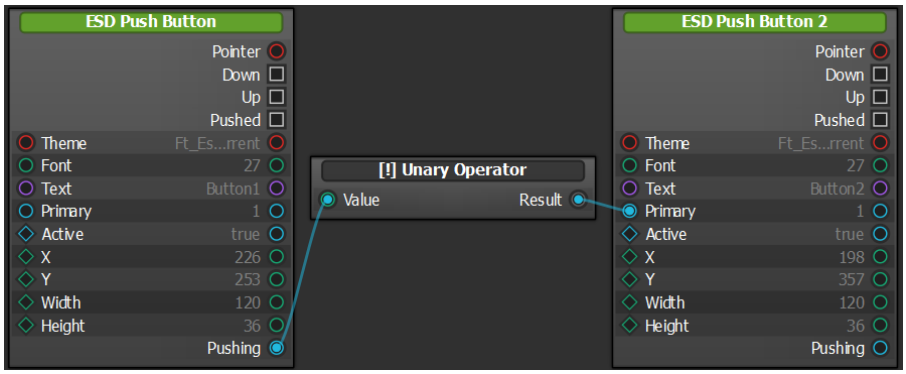
Property Name	Description
Pointer	The pointer reference of the widget object
Theme	Theme applied for the button
Font	Fonts used in the label
Text	The label displayed on the button
Primary	Primary state of the button – Set to True to use the Primary color from theme Set to False to use the default color from theme
Active	Active state of the button, set to true to appear on the screen
X	Coordinate of button, top-left, in pixels
Y	Coordinate of button, top-left, in pixels
Width	Button width, in pixels
Height	Button height, in pixels

Table 47 - ESD Push Button Properties

Output / Signal	Description
Down / Up / Pushed	Output signal when the push button is Down/Up or Pushed state
Pushed	Output signal when the push button is in pushed state

Table 48 - ESD Push Button Output/Signal

The logic node connection in Figure 76 shows how a Push Button ("Button1") is created to toggle the primary state of another Push Button ("Button 2").



Here is the output –

Normal State Pushing State

Figure 85 - ESD Push Button Example

ESD Progress Bar

The *ESD Progress Bar* widget allows the users to add and use a progress bar.

Figure 86 - ESD Progress Bar

Property Name	Description
Pointer	The pointer reference of the widget object
Theme	Theme to be applied on the progress bar
Value	Indicates the progress level and displayed as the filled portion of the progress bar
Range	Progress bar values range

Active	Active state of the progress bar, set to true to appear on the screen
X	X coordinate of the progress bar, top-left, in pixels
Y	Y coordinate of the progress bar, top-left, in pixels
Width	Progress bar width, in pixels
Height	Progress bar height, in pixels

Table 49 - ESD Progress Bar Properties

The logic node connection in figure 78 shows the creation of a continuous progress bar with a range from 0 to 1000, taking its input from the built-in "GetMilliseconds" function node.

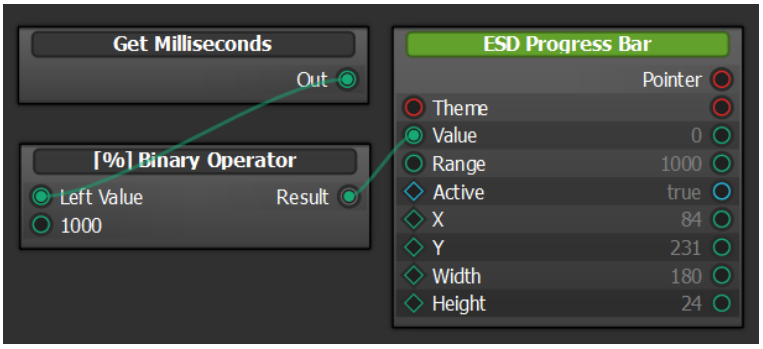


Figure 87 - ESD Progress Bar Example

ESD Slider

The *ESD Slider* is used to adjust the values by dragging a slider.

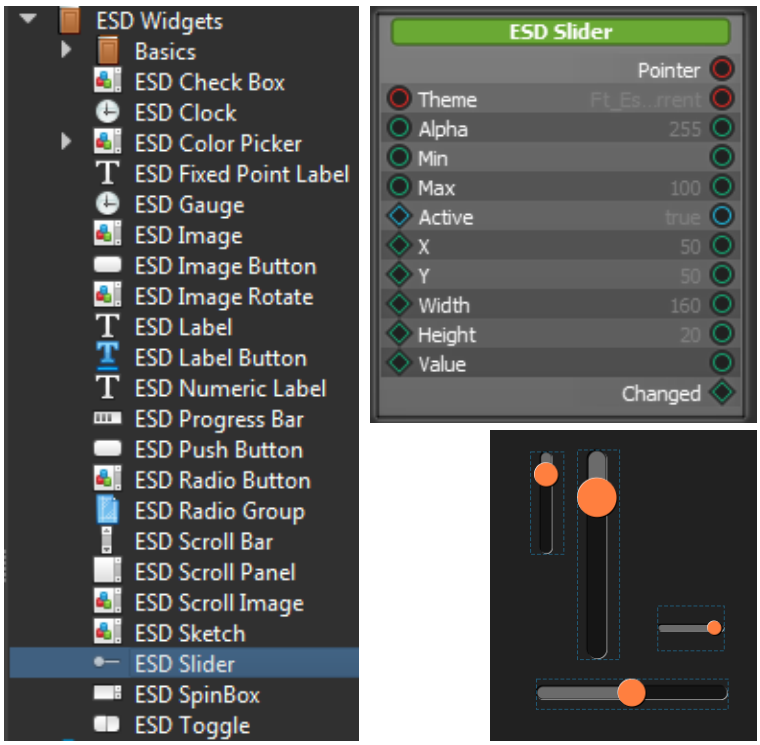


Figure 88 - ESD Slider Widget

Property Name	Description
Pointer	The pointer reference of the widget object
Theme	Theme to be applied to this widget
Alpha	Adjust the transparency
Min	Minimum Value of the slider
Max	Maximum Value of the slider
Active	Enable or disable displaying this widget
X	x coordinate of the top-left of the widget, in pixels
Y	Y coordinate of the top-left of the widget, in pixels
Width	Widget width
Height	Widget Height

Table 50 - ESD Slider Widget Properties

Output / Signal	Description
Changed	Output signal when the slider has changed

Table 51 - ESD Slider Output/Signal

The slider modifies the alpha value and combines it with the RGB color. The combined value creates the ESD Rectangle colour. It will set the connected variable to the new value once the value is changed. This is illustrated in the pictures given below –

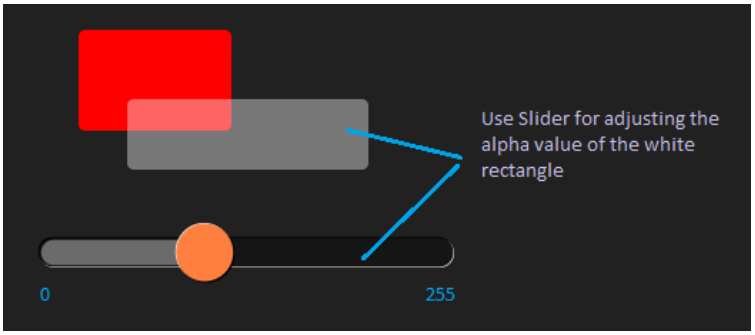


Figure 89 - ESD Slider Example

Figure 81 shows the logic node connection in the logic note editor –

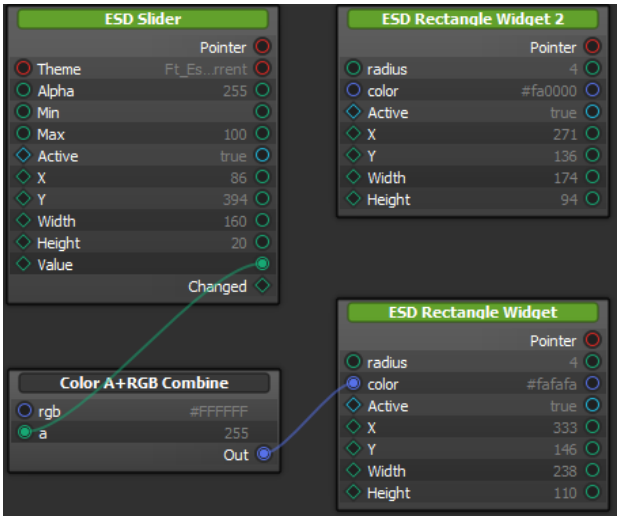


Figure 90 - ESD Slider Logic Node Connection Example

ESD Scroll Bar

The *ESD Scroll Bar* is used to scroll value between minimum and maximum which often used together with a panel forming as scrollable panel.

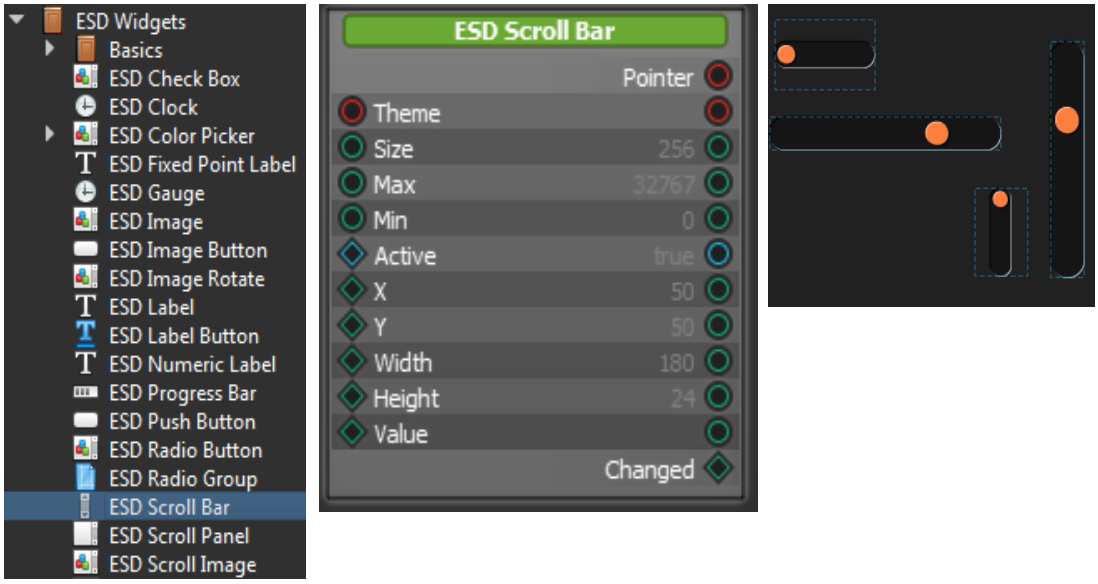


Figure 91 - ESD Scroll Bar Widget

Property Name	Description
Pointer	The pointer reference of the widget object
Theme	Theme to be applied to this widget
Max	Maximum Value of the slider
Min	Minimum Value of the slider
Active	Enable or disable displaying this widget
X	x coordinate of the top-left of the widget, in pixels
Y	Y coordinate of the top-left of the widget, in pixels
Width	Widget width
Height	Widget Height

Table 52 - ESD Scroll Bar Widget Properties

Output / Signal	Description
Changed	Output signal when the scroll bar has changed

Table 53 - ESD Scroll Bar Output/Signal

ESD Scroll Panel

The *ESD Scroll Panel* widget is scrollable panel, a linear layout is required to work together. Refer to "ScrollPanel" example project for detail.

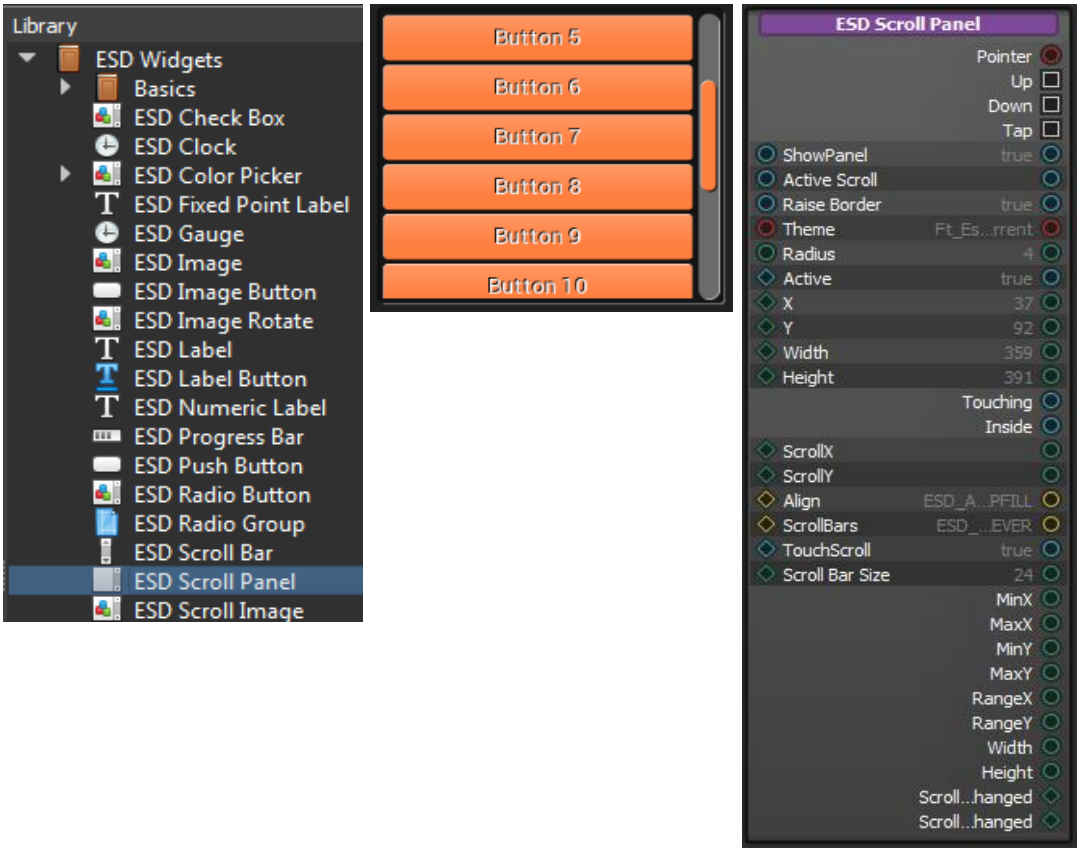


Figure 92 - ESD Scroll Panel

Property Name	Description
Pointer	The pointer reference of the widget object
Up	Touch up event
Down	Touch down event
Tap	Touch tap event
ShowPanel	Set true to display background panel
Active Scroll	Set true to override default touch tag (255)
Raise Border	Set background panel with raise border
Touching	Boolean for Touching status
Inside	Boolean for Touch inside status
Theme	Theme to be applied to this widget
Active	Enable or disable displaying this widget
X	x coordinate of the top-left of the widget, in pixels
Y	Y coordinate of the top-left of the widget, in pixels
Width	Widget width
Height	Widget Height
ScrollX	Scroll to x coordinate in pixels
ScrollY	Scroll to Y coordinate in pixels

Align	Set alignment mode
ScrollBars	Set scroll bar mode: ESD_VISIBLE_NEVER ESD_VISIBLE_WHENNEEDED ESD_VISIBLE_ALWAYS
TouchScroll	Set true to enable touch scroll
Scroll Bar size	Set the size of scroll bar if it is applicable

Table 54 - ESD Scroll Panel Widget Properties

Output / Signal	Description
MinX	Minimum X for local X coordinate in scroll panel
MinY	Minimum Y for local Y coordinate in scroll panel
MaxX	Maximum X for local X coordinate in scroll panel
MaxY	Maximum Y for local Y coordinate in scroll panel
RangeX	X Range for local X coordinate in scroll panel
RangeY	Y Range for local Y coordinate in scroll panel
Width	Local width of scroll panel
Height	Local height of scroll panel
ScrollXChanged	Signal when X has changed
ScrollYChanged	Signal when Y has changed

Table 55 - ESD Scroll Panel Output/Signal

ESD Scrollable Image

The *ESD Scrollable image* supports scrollable image effect by both touch and slider controls. Refer to the example project **"ScrollImageWidget"** under the **"EVE Screen Designer -> Examples -> Intermediate"** folder.

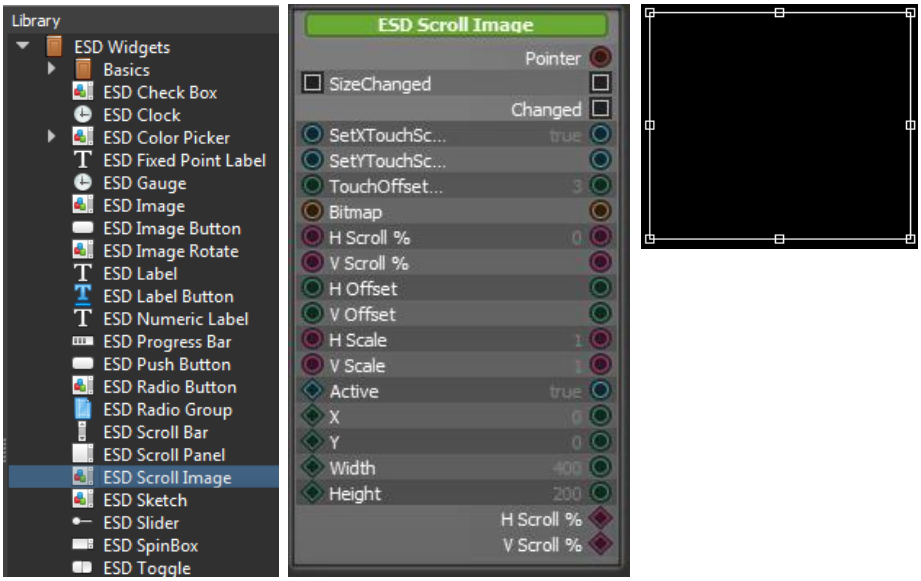


Figure 93 - ESD Scrollable Image

Property Name	Description
Pointer	The pointer reference of the widget object
SetXTouchScroll	Set true to enable X axis touch scroll
SetYTouchScroll	Set true to enable Y axis touch scroll
TouchOffsetThreshold	The offset threshold for activating and touch scroll. This is use to stabilize the noise in touch input.
Bitmap	Image object reference for display
H Scroll %	Set horizontal scroll initial value in percentage
V Scroll %	Set vertical scroll initial value in percentage
H Offset	Set image horizontal offset
V Offset	Set image vertical offset
H Scale	Set image horizontal scale
V Scale	Set image vertical scale
Active	Enable or disable displaying this widget
X	x coordinate of the top-left of the widget, in pixels
Y	Y coordinate of the top-left of the widget, in pixels
Width	Widget width
Height	Widget Height

Table 56 - ESD Scroll Panel Widget Properties

Output / Signal	Description
SizeChanged	Trigger to update scrollable image touch area after size changed by its parent widget
Changed	Signal for scroll value changes from the scrollable image widget
H Scroll %	Horizontal scroll percentage value writer, uses to update external scroll bar if there is
V Scroll %	Vertical scroll percentage value writer, uses to update external scroll bar if there is

Table 57 - ESD Scrollable Image Output/Signal

Touch Control Mode

The ESD scrollable image supports touch input control. Refer to the example project **"ScrollImageWidget -> "FirstPage.Page** under the **"EVE Screen Designer -> Examples -> Intermediate"** folder.

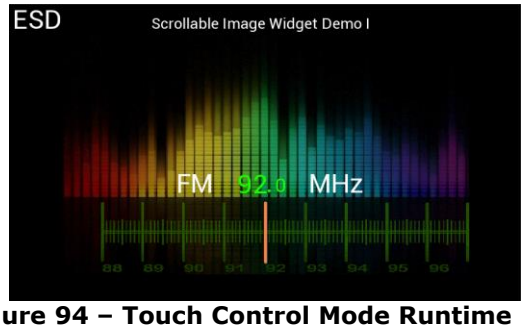


Figure 94 – Touch Control Mode Runtime

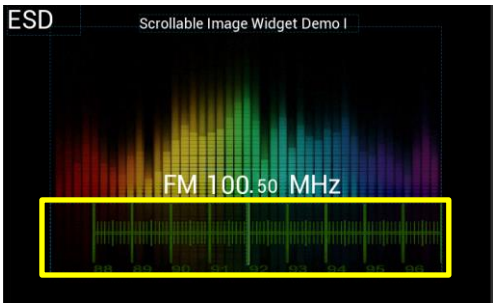


Figure 95 – Touch Control Mode Design

- SetXTouchScroll = true, enable X-axis touch scroll.
- SetXTouchScroll = false, since Y-axis touch is not required.
- TouchOffset = 4, there is some noise in touch input.
- Bitmap = FMScale_0, refer to Bitmap resource "FMScale", first cell.
- H Offset = 510, to right shift the image. When at 0%, the image starts at centre. 100% Width Scrollable Range = image width * H Scale + offset.
- H Scale = 1.6, set horizontal scale of the image. The scrollable image width = image original width x scale.
- Output Changed is signalled whenever there is a touch scroll event.
- Output writer "H Scroll %" is connected to synchronize the scrolled value from scrollable image.

Slide Control Mode

The ESD scrollable image also supports slider control. Refer to the example project **"ScrollImageWidget-> "SecondPage.Page** under the **"EVE Screen Designer-> Examples -> Intermediate"** folder.

Figure 96 - Slide Control Mode Runtime

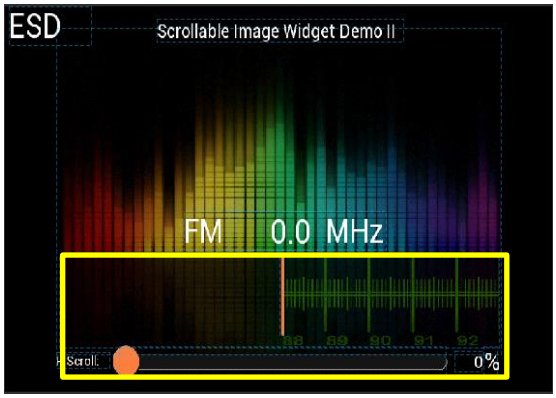
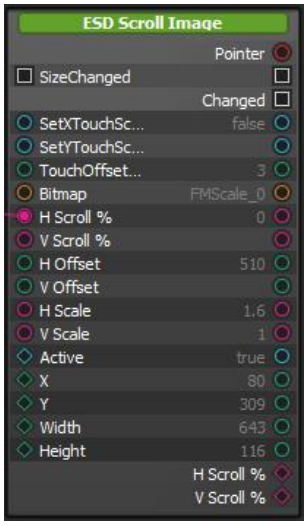


Figure 97 – Slide Control Mode Design



- SetXTouchScroll = false, no touch scroll required.
- SetXTouchScroll = false, no touch scroll required.
- Bitmap = FMScale_0, refer to Bitmap resource "FMScale", first cell.
- H Offset = 510, to right shift the image. When at 0%, the image starts at centre. 100% Width Scrollable Range = image width * H Scale + offset.
- H Scale = 1.6, set horizontal scale of the image. The scrollable image width = image original width x scale.
- Connect "H Scroll %" from slider value output, this will set the scroll value of the scrollable image.

ESD Sketch

The *ESD Sketch* widget provides a canvas area for use to do free sketch by touch.

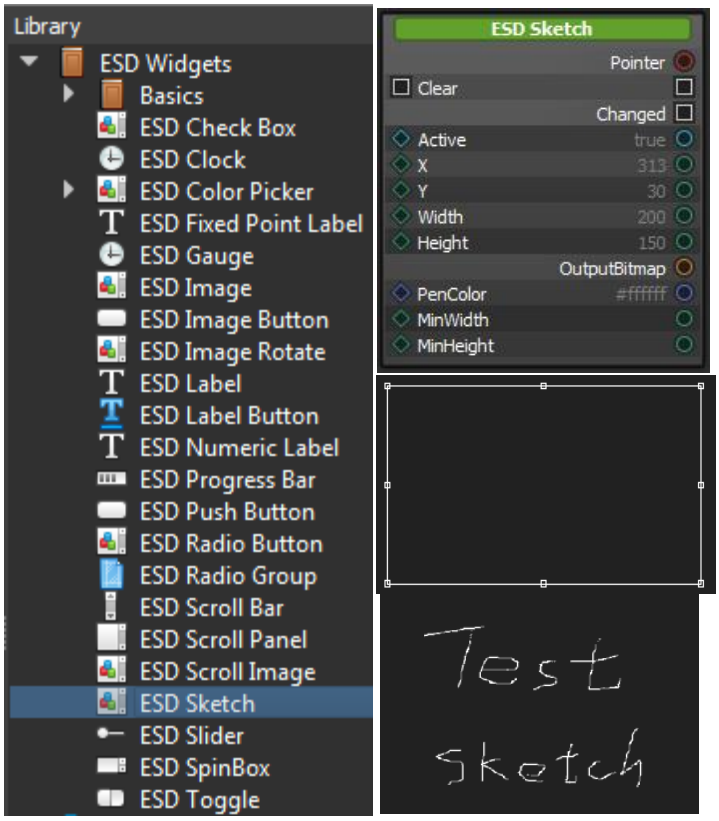


Figure 98 - ESD Sketch Widget

Property Name	Description
Active	Enable or disable displaying this widget
X	x coordinate of the top-left of the widget, in pixels
Y	Y coordinate of the top-left of the widget, in pixels

Width	Widget width
Height	Widget Height
PenColor	Color that is used to draw the trace
MinWidth	Minimum Widget width when resizing the bitmap
MinHeight	Minimum Widget height when resizing the bitmap

Table 58 - ESD Sketch Widget Properties

Output / Signal	Description
Pointer	The pointer reference of the widget object
Bitmap Cell	Output the drawing as bitmap cell
Changed	Signal for change event

Table 59 - ESD Sketch Widget Output/Signal

ESD Spin Box

The *ESD Spin Box* Widget allows the users to create a spin box with customized style and size.

Figure 99 - ESD Spin Box

Property Name	Description
Pointer	The pointer reference of the widget object
Increase	Input slot to trigger the increase (up) event
Decrease	Input slot to trigger the decrease (down) event
Theme	Theme to be applied on the spin box
Step	When arrows are used to change the spin box's value, the value will be incremented/decremented by the amount of step
Active	Active state of the spin box, set to true to appear on the screen

X	X coordinate of the spin box, top-left, in pixels
Y	Y coordinate of the spin box, top-left, in pixels
Width	Spin box width, in pixels
Height	Spin box height, in pixels
Value	Value of the spin box
SideButtons	Denotes the Spin box style  False (Default)  True

Table 60 - ESD Spin Box Properties

Output / Signal	Description
Increased/Decreased	Output signal when the spin box is in Up (Increased)/ Down (Decreased) state
Changed	Output signal, the changed value of spin box is written out

Table 61 - ESD Spin Box Output/Signal

The logic node connection in figure 91 shows the interconnection of two different styles of ESD Spin box widgets that will increase or decrease simultaneously.

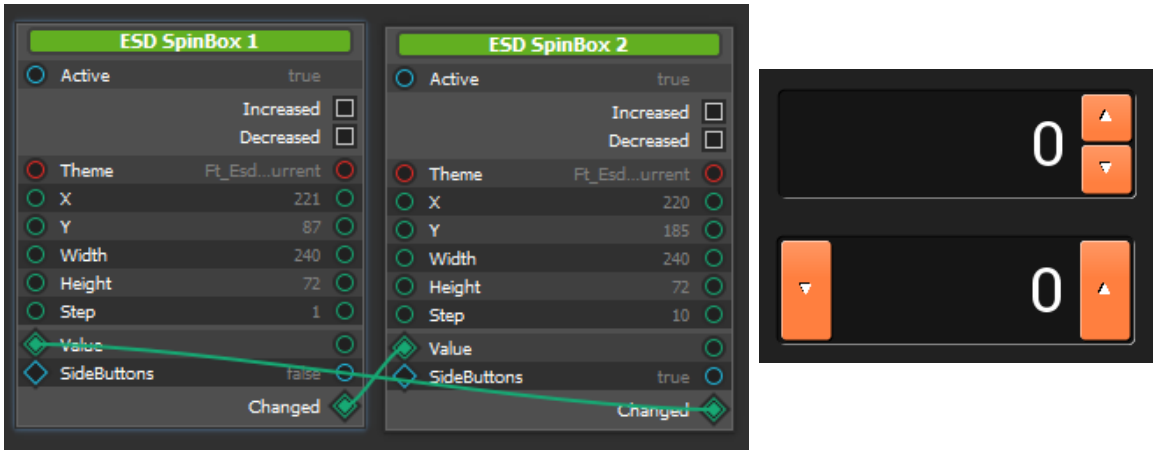


Figure 100 - ESD Spin Box Example

ESD Toggle

The *ESD Toggle* widget provides the toggle switch functionality with user touch enabled.

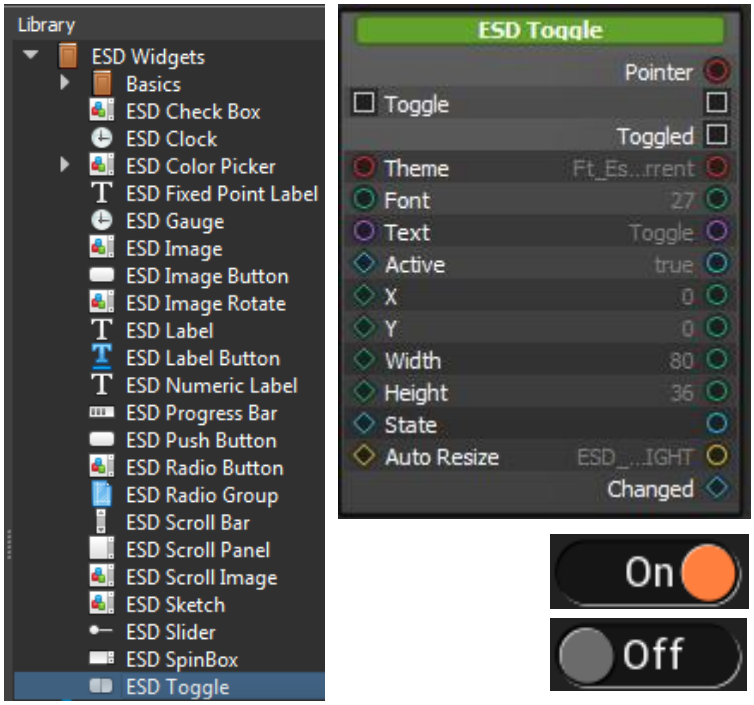


Figure 101 - ESD Toggle

Property Name	Description
Theme	Theme to be applied to this widget
Font	The font handle used by label inside the widget
Text	Toggle label
Active	Enable or disable displaying this widget
X	X coordinate of the top-left, in pixels
Y	Y coordinate of the top-left, in pixels
Width	Toggle widget width
Height	Toggle widget height
State	The current state of the toggle widget
AutoResize	Set true to enable auto resize the toggle widget

Table 62 - ESD Toggle Widget Properties

Output / Signal	Description
Pointer	The pointer reference of the widget object
Toggled	Output signal triggered by toggle action
Changed	Output value of the changed state

Table 63 - ESD Toggle Widget Output/Signal

Figure 93 displays the creation of two toggle widgets, *"Toggle1"* and *"Toggle2"* which is connected with the same state.

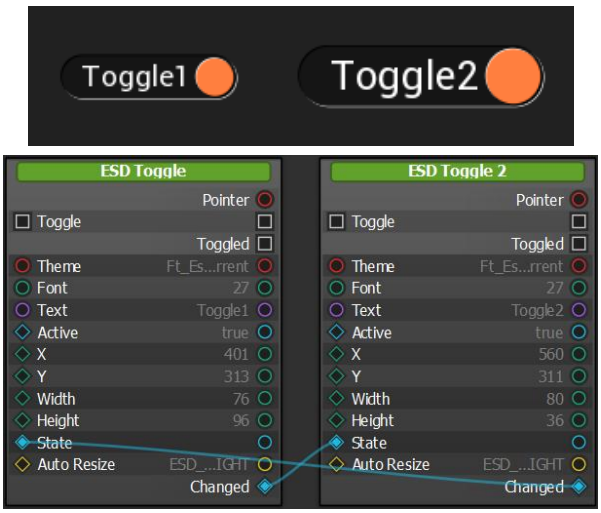


Figure 102 - ESD Toggle Widget Example

ESD Ring Widget *new*

In ESD 4.1, the *ESD Ring* widget provides user to display a ring widget. It is useful for displaying circular widgets such as circular progress bar.

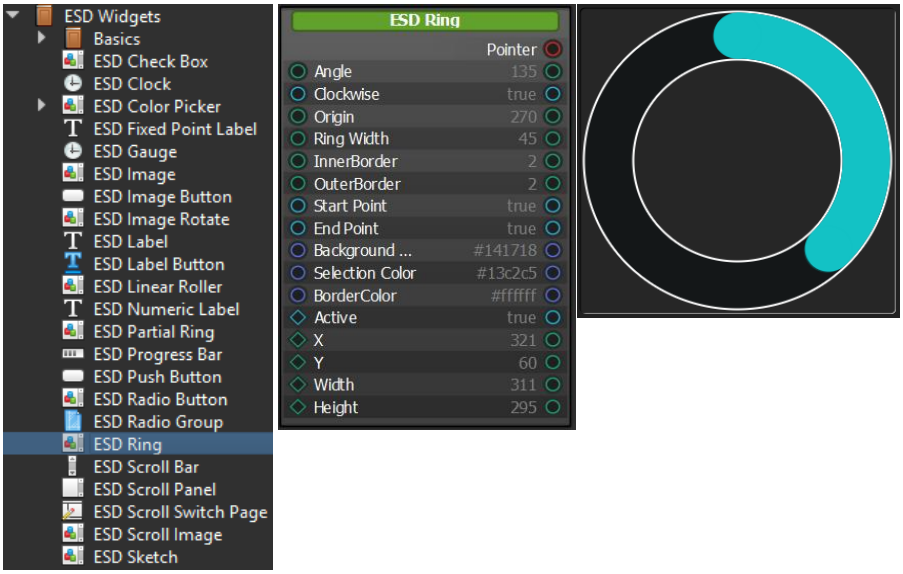


Figure 103 - ESD Ring Widget

Property Name	Description
Pointer	The pointer reference of the widget object
Angle	The angle value of the ring is displaying, range from 0 to 360.
Clockwise	The Boolean flag to set as clockwise direction.
Origin	The origin direction of the ring, range from 0 to 360.
Ring width	Defines the ring width
Inner border	Defines the inner border width, set -1 to disable it.
Outer border	Defines the outer border width, set -1 to disable it.
Start point	The Boolean flag to set if to display start point
End point	The Boolean flag to set if to display end point
Background Color	Set the ring's background color in RGB

Selection Color	Set the ring's selection color in RGB
Border Color	Set the ring's inner and outer border color in RGB
Active	Enable or disable displaying this widget
X	X coordinate of the top-left, in pixels
Y	Y coordinate of the top-left, in pixels
Width	Toggle widget width
Height	Toggle widget height

Table 64 - ESD Ring Widget Properties

ESD Partial Ring Widget *new*

In ESD 4.1, the *ESD Partial Ring* widget provides user to display a partial ring widget. It is similar to ESD Ring widget except it does not require the angle range to be 360 degree.

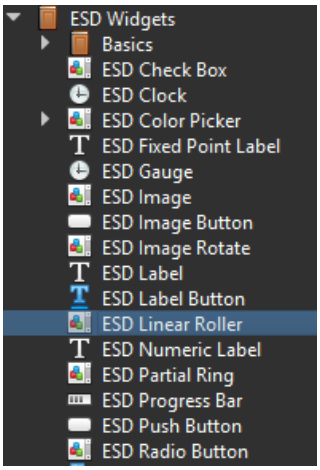
Figure 104 – ESD Partial Ring Widget

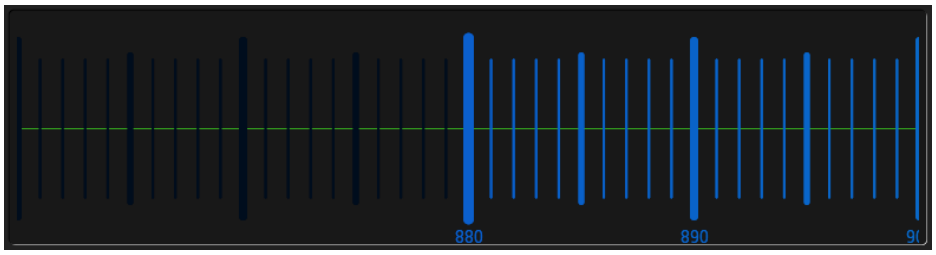
Property Name	Description
Pointer	The pointer reference of the widget object
Angle	The angle value of the ring is displaying, range from 0 to 360.
Max Angle	Defines the max angle of the selection, range from 1 to 360.
Clockwise	The Boolean flag to set as clockwise direction.
Origin	The origin direction of the ring, range from 0 to 360.
Ring width	Defines the ring width
Inner border	Defines the inner border width, set -1 to disable it.
Outer border	Defines the outer border width, set -1 to disable it.
Start point	The Boolean flag to set if to display start point
End point	The Boolean flag to set if to display end point
Background Color	Set the ring's background color in RGB
Selection Color	Set the ring's selection color in RGB
Border Color	Set the ring's inner and outer border color in RGB
Active	Enable or disable displaying this widget
X	X coordinate of the top-left, in pixels
Y	Y coordinate of the top-left, in pixels
Width	Toggle widget width
Height	Toggle widget height

Table 65 - ESD Partial Ring Widget Properties

ESD Linear Roller Widget *new*

In ESD 4.1, the *ESD Linear Roller* widget provides user to display linear roller. This is useful for roller style of control widgets.





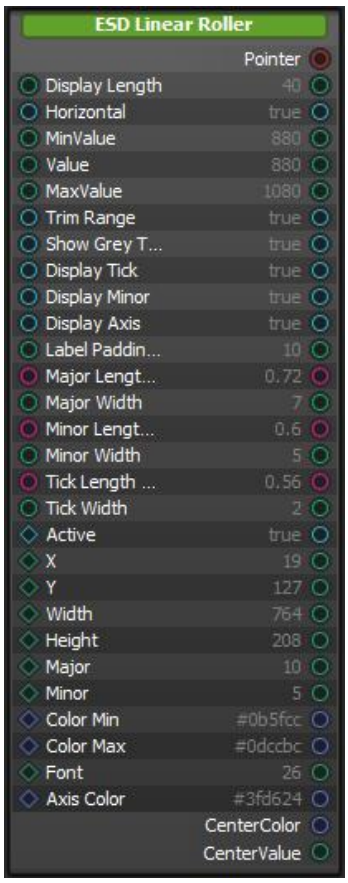


Figure 105 – ESD Linear Roller Widget

Property Name	Description
Display Length	The display length in ticks for the displaying window
Horizontal	The Boolean flag to set the orientation of the roller. Set true as horizontal roller.
MinValue	The minimum value of the roller
Value	The current value of the roller
MaxValue	The maximum value of the roller
Trim Range	The Boolean flag for trimming according to the range.
Show Grey Trim Range	The Boolean flag for showing the trimmed range as grey scales.
Display Tick	The Boolean flag for displaying the tick scale.
Display Minor	The Boolean flag for displaying the minor scale.
Display Axis	The Boolean flag for displaying the axis of the roller.
Label Padding	Defines the label padding for displaying the major label.
Major Length	Defines the length of the major scale, range from 0.0 to 1.0
Major Width	Defines the line width of the major scale in pixels
Minor Length	Defines the length of the minor scale, range from 0.0 to 1.0
Minor Width	Defines the line width of the minor scale in pixels
Tick Length	Defines the length of the tick scale, range from 0.0 to 1.0
Tick Width	Defines the line width of the tick scale in pixels
Active	Enable or disable displaying this widget
X	X coordinate of the top-left, in pixels

Y	Y coordinate of the top-left, in pixels
Width	Toggle widget width
Height	Toggle widget height
Major	Defines major count in ticks
Minor	Defines minor count in ticks
Color Min	The minimum color for minimum value of the roller
Color Max	The maximum color for maximum value of the roller
Font	Defines the font for the label
Axis Color	The Boolean flag to check if the display axis line

Table 66 - ESD Linear Roller Widget Properties

Output / Signal	Description
Pointer	The pointer reference of the widget object
CenterColor	Output the value of the centre color
CenterValue	Output the current value at the centre of the roller

Table 67 - ESD Linear Roller Widget Output/Signal

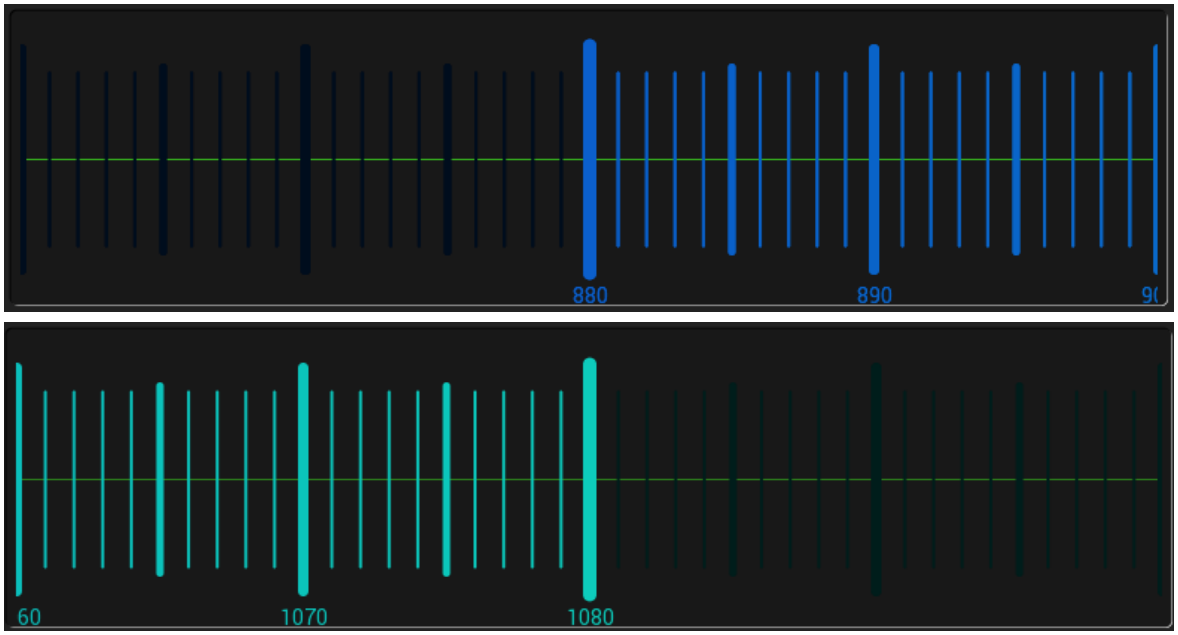


Figure 106 - Sample of Linear Roller Widget

In the above figure, the roller has minimum value = 880, maximum value = 1080, display length = 40 ticks, major = 10 ticks, minor = 5 ticks. It displays major scales, minor scales and tick scales, while each type of them has different widths and lengths. It also displays roller axis line, display trimmed range as grey scales. Lastly, there are gradient color effects in the scales, both minimum and maximum colors are configured (from blue to cyan).

Logic Flow

A *Logic Flow* is an ESD built-in logic node. It is used to define the logic or control flow and contains the following nodes:

- *Condition*
- *Binary Condition*
- *Binary Operator*
- *Ternary Operator*
- *Unary Operator*
- *Sequence*
- *Switch*
- *Switch Value*
- *Set Variable*
- *Watch Variables*

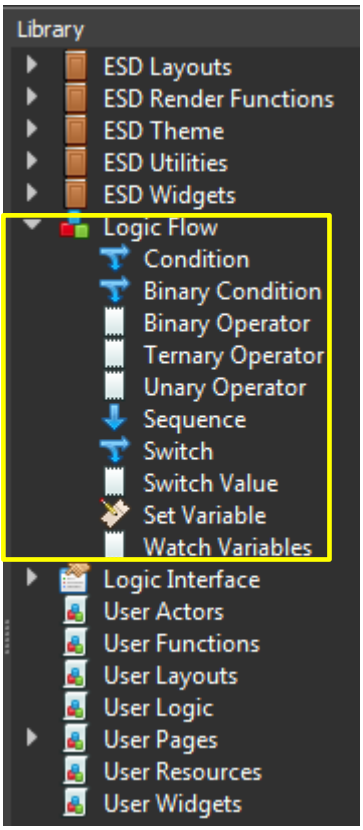


Figure 107 - Logic Flow

Condition

Condition node provides a set of rules to be performed if a certain condition is met. In other words, it allows applying decision points.

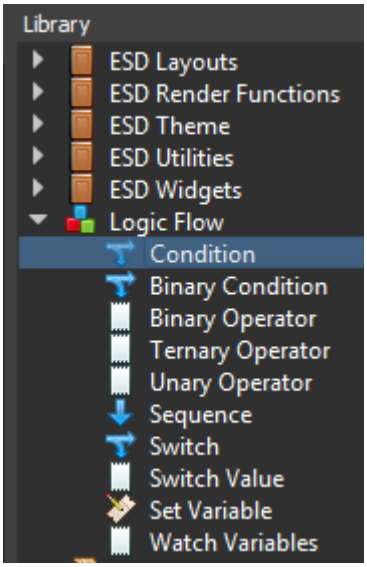


Figure 108 - Logic Flow – Condition Node

Whenever a condition node is called, a *"Then"* condition will be called when the *"If"* expression is True, otherwise an *"Else"* condition will be called.

Ensure that the input for the "If" connection is a Boolean variable (i.e. *True* or *False*).

Binary Condition

Binary Condition node provides a set of rules to be performed based on the result of a binary operator on two input values. In other words, it allows applying decision points.

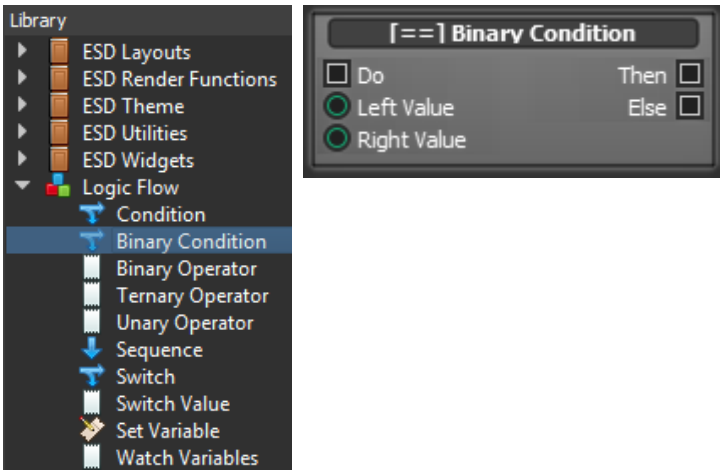


Figure 109 - Logic Flow – Binary Condition Node

Whenever a binary condition node is called, a *"Then"* condition will be called when the result of binary operator on left and right value is True, otherwise an *"Else"* condition will be called.

The binary operator is specified by user and it will be evaluated when the node is called through "*Do*" input call.

Binary Operator

This node contains *Binary Operator* that operates on two operands (inputs) and manipulates them to return an output. For example: *Result=Left Value * Right Value*.

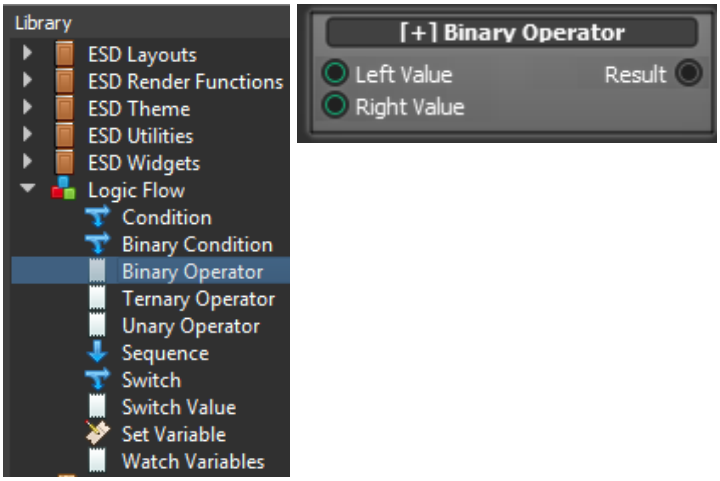


Figure 110 - Logic Flow - Binary Operator Node

The following table provides a list of binary operators supported by ESD 4.0.

Binary Operator	Description
==	Equal to comparison operator
!=	Not Equal to comparison operator
&&	Logical AND operator
&	Binary AND operator
||	Logical OR operator
|	Logical OR operator
*	Multiplication operator
/	Division operator
%	Modulus operator
^	Binary XOR operator
+	Addition operator
-	Subtraction operator
,	Comma operator
>	Greater than operator
<	Less than operator
>=	Greater than or equal to
<=	Less than or equal to
<<	Binary Left Shift Operator
>>	Binary Right Shift Operator

Table 68 - Binary Operators Supported by ESD 4.0

Ternary Operator

This node contains *Ternary Operator* that operates on three arguments. First is the comparison argument; second is the result upon a true comparison and the third is the result upon a false comparison.

For example: *Result= condition ? "Value if true": "Value if false".*

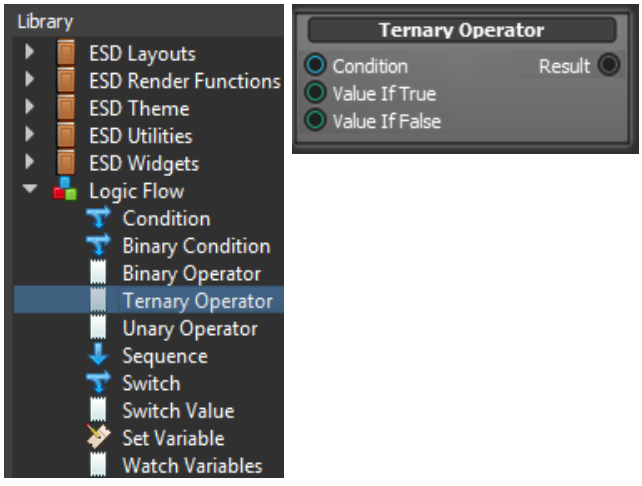


Figure 111 - Logic Flow - Ternary Operator Node

Unary Operator

This node contains *Unary Operator* that operates on a single operand (input). For example: ~.

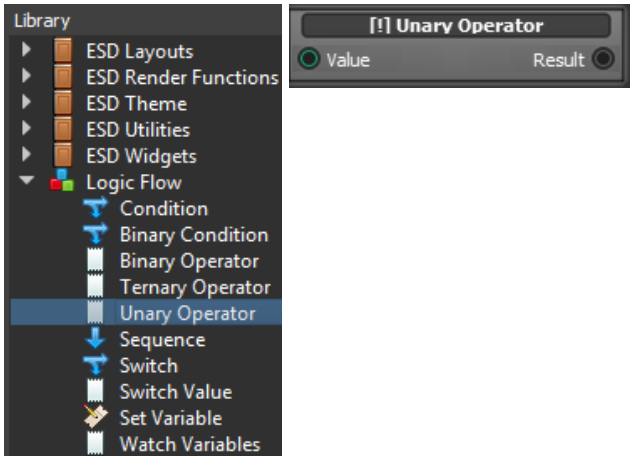


Figure 112 - Logic Flow - Unary Operator Node

The following table provides a list of unary operators supported by ESD 4.0.

Unary Operator	Description
!	Logic Negation
&	Address of
*	De-reference
+	Positive operator
-	Negative operator
~	One's complement
!!	Non-zero value converts to 1and other values converts to 0.

Table 69 – Unary Operators Supported by ESD 4.0

Sequence

"*Sequence*" node allows users to define a series of calling actions. When the "Do" input call is invoked, the calls will be triggered sequentially. The number of calls is specified by users in property "Count".

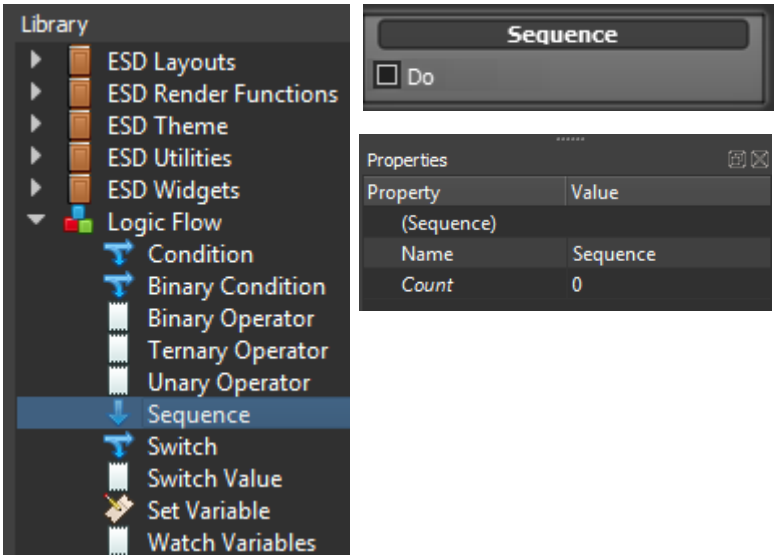


Figure 113 - Logic Flow – Sequence Node

Switch Node

"*Switch*" node will call different branches based on the input value, like a "Switch-Case" statement in C language. Users can define any number of branches and the values to be compared with input value through "Cases" property. Figure 101 shows an example of 3 branches defined and called respectively if input value is equal to 1 or 2 or 3. Since, the input value is pre-set to 4; the default branch is called if no connection is made on it.

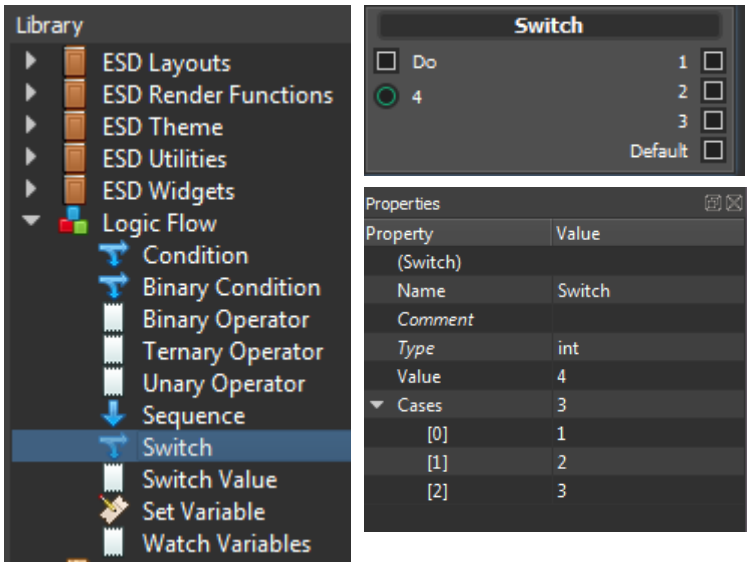


Figure 114 - Logic Flow – Switch Node

Switch Value

"*Switch Value*" is a node to select one output value from multiple predefined values in "Cases" property based on input value. The example in Figure 102 shows 2 "*Cases*" branch and property "*Cases*" 0 defines such logic: The "*Result*" value is 4 if input value is 1. Therefore, the result value is 5 when the input value is 3.

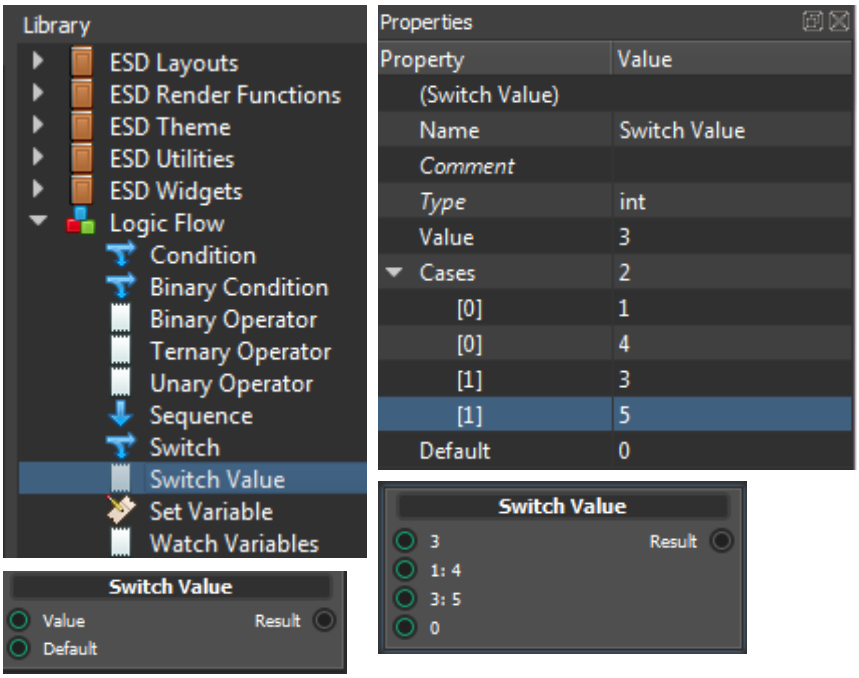


Figure 115 - Logic Flow – Switch Value

Set Variable

The *Set Variable* node is used to set the values of a variable. It links an event call with a data binding to a Writer (output a functional call through "writer") or a Variable (sets a variable to the value).

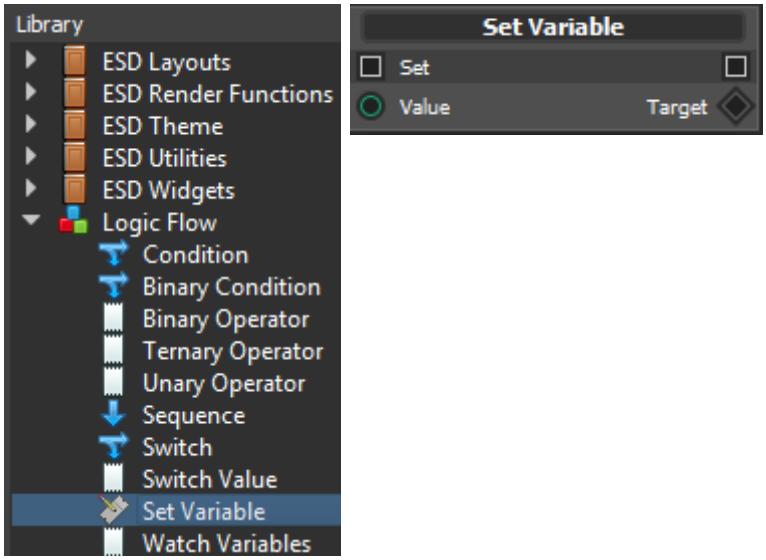
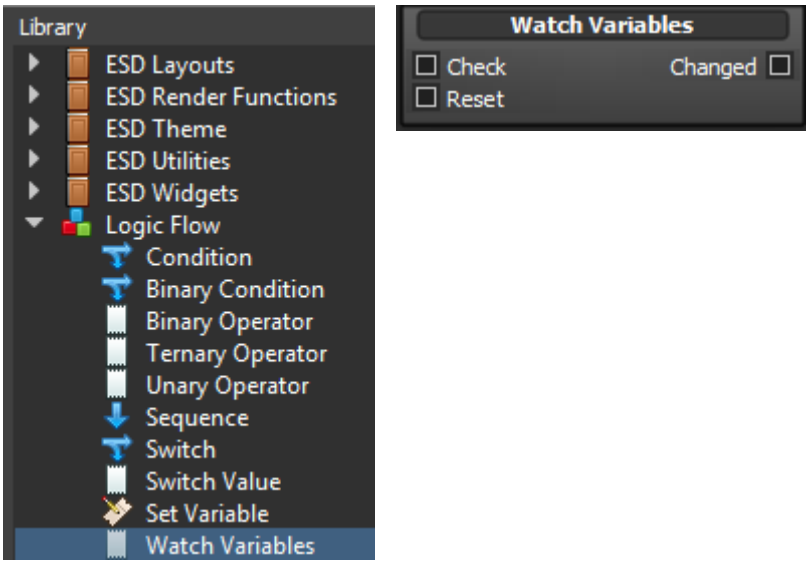


Figure 116 - Logic Flow - Set Variable Node

Watch Variables

The Watch variables node is used to monitor a set of variable updates. A single watch variable node can monitor 'n' number of variables which can be different (primitive) types. However, the more the input variables have connected, the more frequent the output "Changed" will be triggered. User can also connect input slots:



- "Check" – used to trigger an immediate check for the input variables against previously checked values.
- "Reset" – set base values as current input values, and monitors changes from there.

This watch variable could be very useful during the debugging, or multiple input trigger events. It simplifies nested if conditional flows.

Logic Interface

A *Logic Interface* is an ESD built-in logic node. It is used to define an interface and contains the following nodes:

- *Input*
- *Output*
- *Signal*
- *Slot*
- *Variable*
- *Writer*
- *Widget Interface*

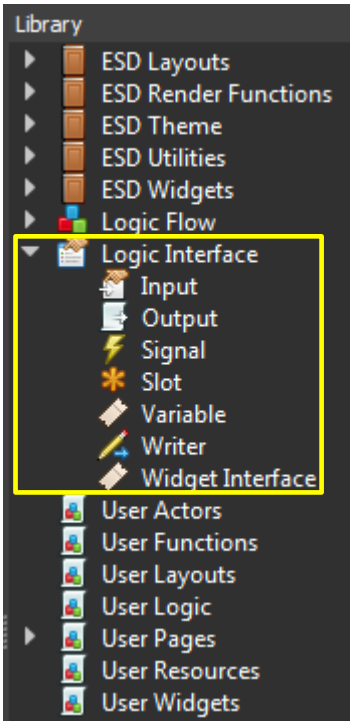


Figure 117 - Logic Interface

Input

The *Input* node is used to create an input interface for its parent logic node to bind incoming data. For instance, while creating a widget, an input node will define a property for the widget whose value depends on the connection. Users can configure its property through the Property Editor.

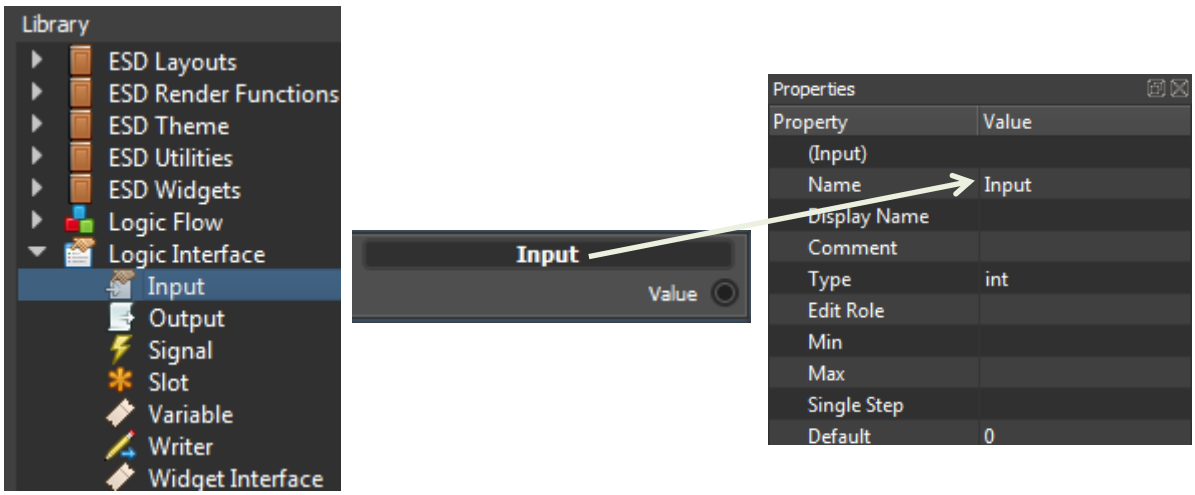


Figure 118 - Logic Interface - Input Node

Output

The *Output* node is used to create an output interface for its parent logic to bind the outgoing data. For instance, while creating a widget, an output node will define an interface for the widget to display values to the users. Users can configure its property through the Property Editor.

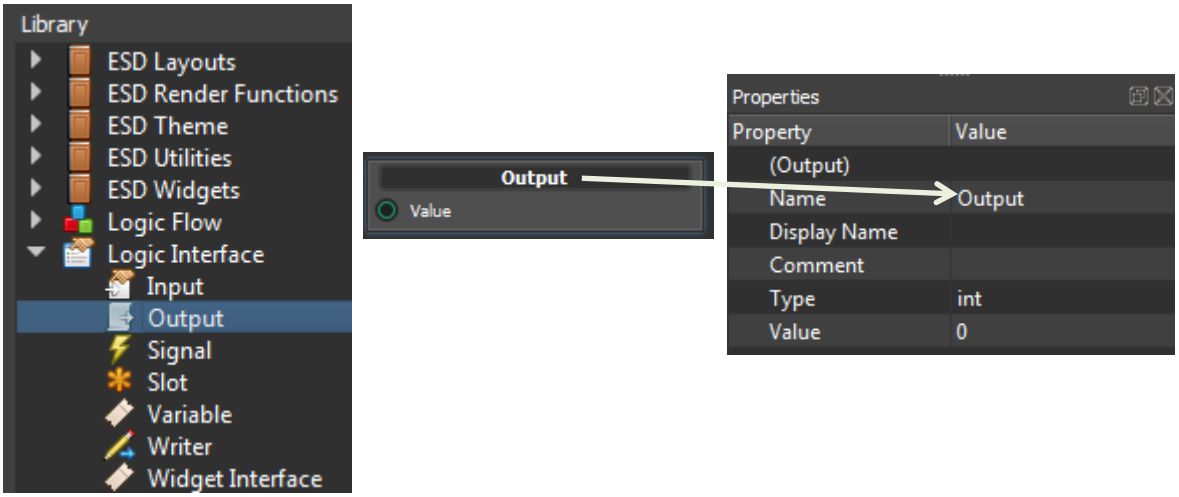


Figure 119 - Logic Interface - Output Node

Signal

The *Signal* node is used to create an outgoing event function call. Users can configure its property through the Property Editor.

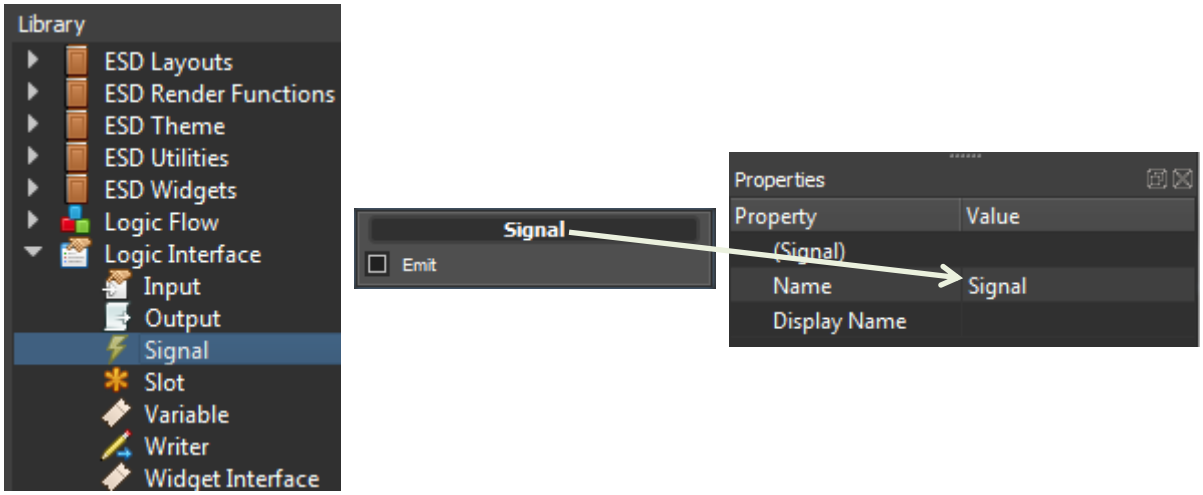


Figure 120 - Logic Interface - Signal Node

Slot

The *Slot* node is used to create an incoming event function call.

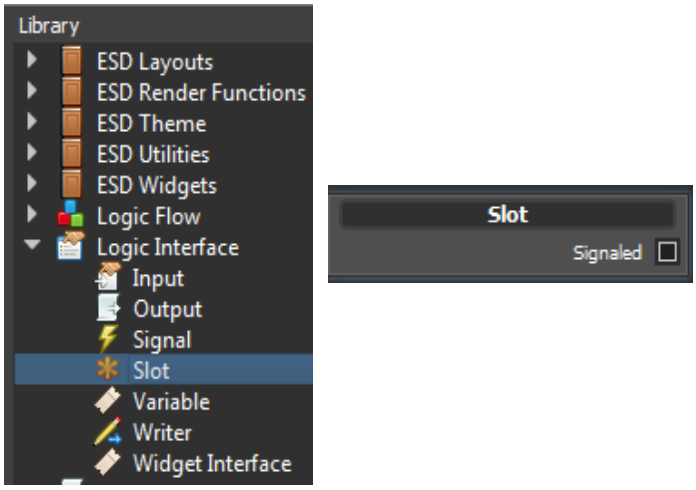


Figure 121 - Logic Interface - Slot Node

Built-in Slot

There are a number of *built-in slots* available for Widgets, Pages and Applications which are automatically called through the node hierarchy. The following table provides the list of built-in slots.

Built-in Slot	Description
Start	Called when the node is created in memory
Render	Writing rendering calls to the co-processor command buffer. It is repeatedly called.
Update	Called once before the frame render. It is called frequently.
Idle	Called repeatedly while waiting for the frame to flip
End	Called when the node is removed from the memory

Table 70 - Built-in Slots

The following pseudo-code may help you understand how these slots are invoked:

```
//Application is booting up and started
Start()

//Now UI is launched
while(UI is running)
{
    Update();
    Render();
    Idle();
}

//Application is ending
End()
```

Variable

The *Variable* node is used to define a plain C variable. Users can drag and drop the Variable from the Library browser to the logic node editor and configure its property through the Property Editor.

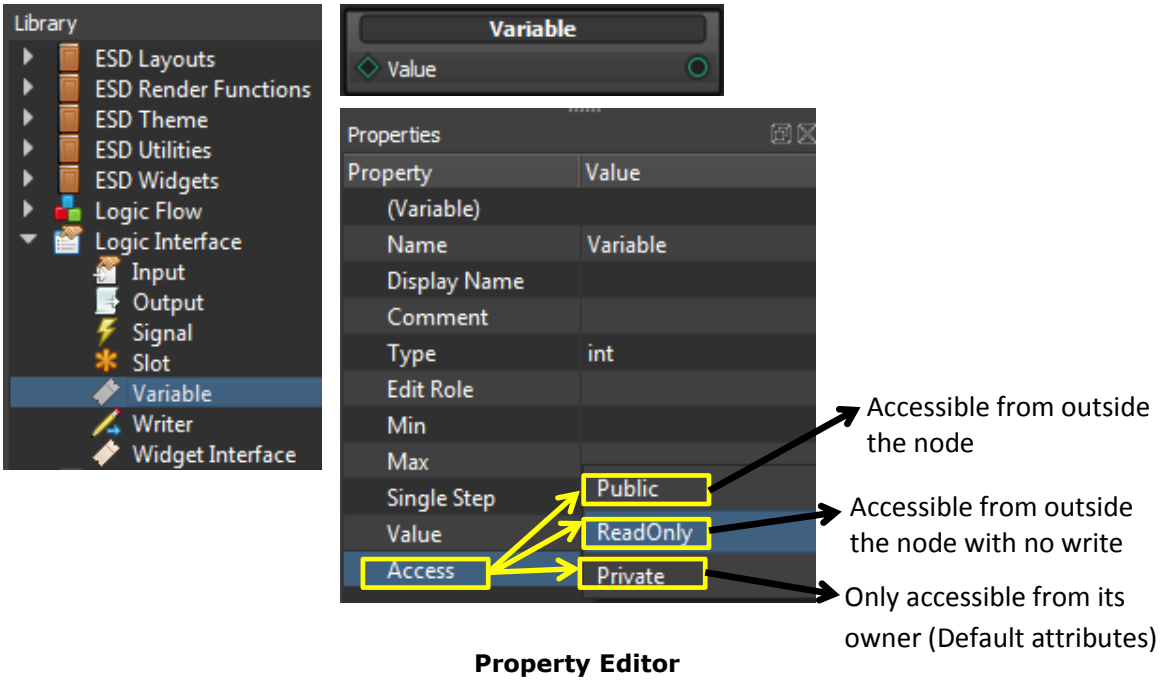


Figure 122 - Logic Interface - Variable Node

Writer

The *Writer* node is used to define a value writing interface for its parent node. Generally, it is used to setup the value for the external variable. For instance, while creating the ESD Spinbox widget, the "Changed" writer is defined to update the connected external variables of Spinbox widget once Spinbox value is changed.

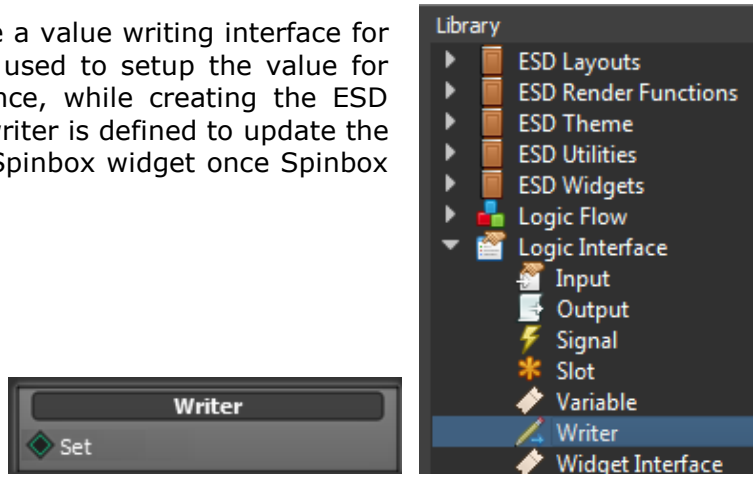
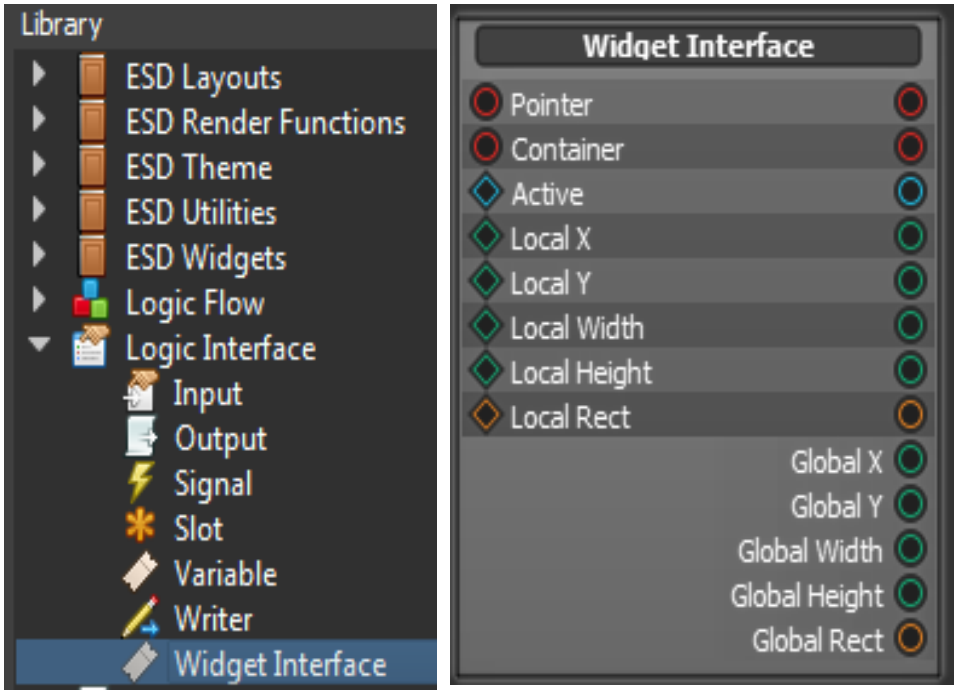


Figure 123 - Logic Interface - Writer Node

Widget Interface

The *Widget Interface* node shows the interface of base widget interface. Since ESD 4.0, all layouts, pages and widgets have been implemented from this widget interface. For advanced users, this widget interface node could be useful for designing user customized widget in order to use its base interface for accessing information from ESD widget framework.



Property Name	Description
Pointer	Provides the pointer of this widget, allow other widget/layout/page to refer
Container	Provides the pointer of this widget's immediate container. Normally, a widget's immediate container is a layout
Active	Set and get the current widget active
Local X	Set and get the current widget local X. Local X refers to the local x-coordinate with reference to its container
Local Y	Set and get the current widget local Y. Local Y refers to the local y-coordinate with reference to its container
Local Width	Set and get the current widget local width. Local width refers to the designed width with reference to its container
Local Height	Set and get the current widget local height. Local height refers to the designed height with reference to its container
Local Rect	Set and get the current widget local dimension with reference to its container
Global X	Set and get the current widget global X. Global X refers to the global x-coordinate with reference to screen
Global Y	Set and get the current widget global Y. Global Y refers to the global y-coordinate with reference to screen
Global Width	Set and get the current widget global width. Global width refers to the designed width with reference to screen

Global Height	Set and get the current widget global height. Global height refers to the designed height with reference to screen
Global Rect	Set and get the current widget global dimension with reference to its screen

Table 71 – Widget Interface Properties

Advanced users are encouraged to refer the example project **"WindowLayout"** for details.

- **All Local properties are subjected to difference from the respective Global properties. As the global values are determined by the layers of the layouts as containers.**
- **Global properties are the values determined at the runtime. While Local properties are values determined at design time.**
- **Global properties are eventually stable in runtime, as layers of layouts may require multiple rendering cycle to stabilize.**

G. Property Editor

The *Property Editor* provides user a unified interface to edit properties. Each logic node in ESD 3.0, including a widget, has its own predefined properties. Users can edit the property values using the Property Editor to customize logic nodes.

The sample picture below shows an example of the ESD 4.0 widget "ESD Radio Button".

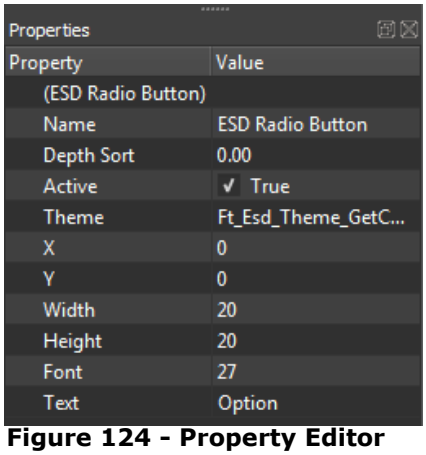


Figure 124 - Property Editor

Common Properties

While each widget has its own properties defined for its own specific features, the following are some of the properties that are commonly found in all the widgets of ESD 4.0application -

- *Name*
- *Depth Sort*
- *Active*

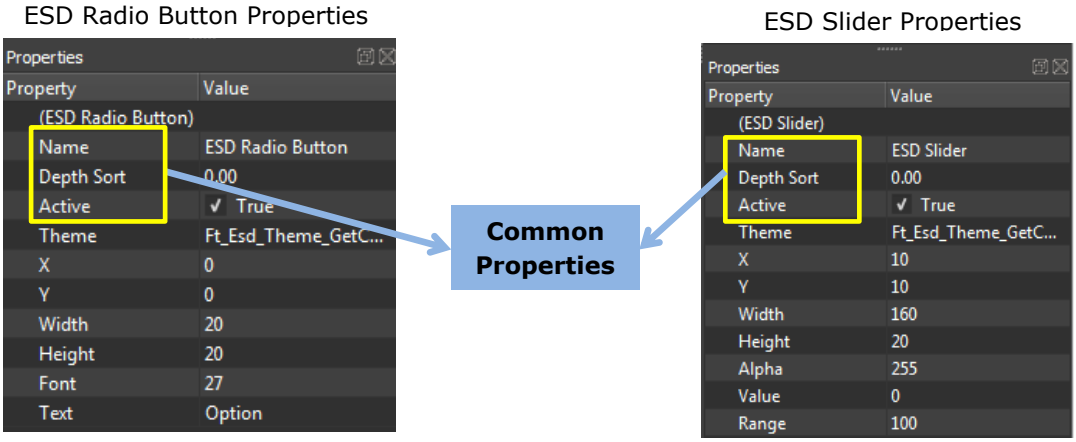


Figure 125 - ESD Common Properties

Name

Each node must have one unique *name* as an identifier. Users are required to define a name that is valid C identifier, since these names will be used by ESD 3.0 for generating the source code.

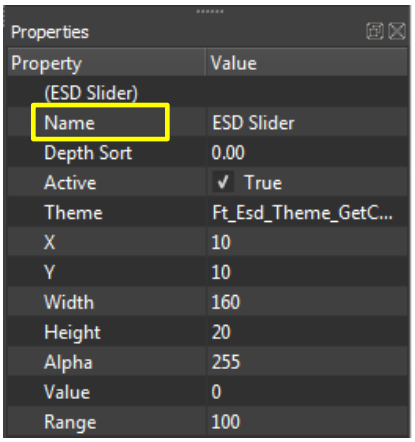


Figure 126 – Name Property

Depth Sort

Each widget and page has one common property called *Depth Sort*. It is of floating point type, and defines the sequence of rendering. The default value is "0.00" and users may change it accordingly to adjust the sequence of the rendering process.

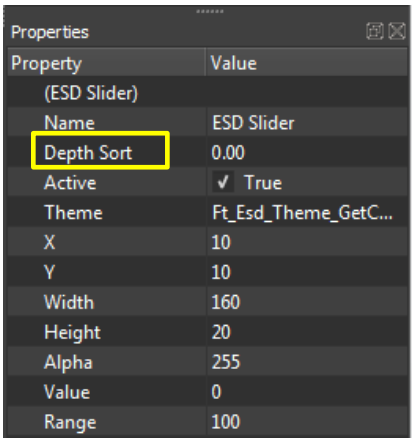


Figure 127 – Depth Sort Property

The context menu helps users adjust the rendering sequence without dealing with the values and can be accessed within the layout editor by selecting the widget or page and right-clicking it.

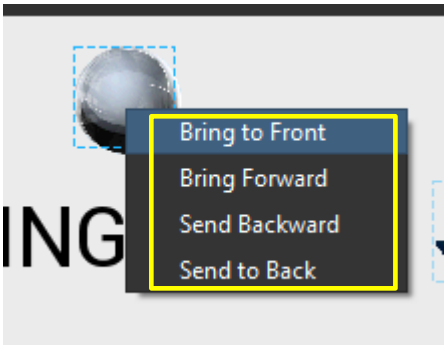


Figure 128 – Right Click Menu

The widget or page with the **greatest** positive "Depth Sort" value will be rendered **last** and appear on the **topmost** layer.

Active

Each widget has one *Active* property of Boolean type which controls whether or not it is rendered on the screen. Active property in false state does not mean that the widget is released from the memory. Instead, it means that the widget is not rendered on the screen, but still is part of the memory.

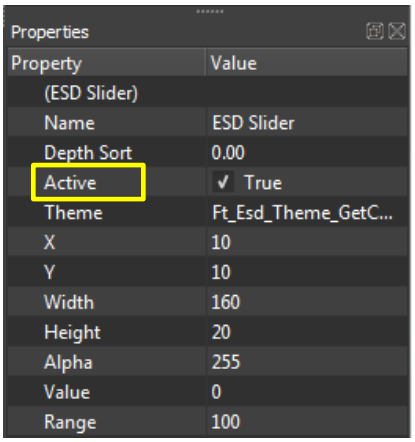


Figure 129 – Active Property

Users must ensure that the NAME property follows the standard **C identifier** syntax in order to make the generated source code more readable.

H. Programming Features

This section explains about the programming features. ESD 4.0 enables users to write C code and make this code available in the form of logic nodes so that the code can be re-used across multiple projects.

Macros

In order to provide the development environment with necessary information about the available functionality in a user's code, ESD 4.0provides a set of macros. These macros are necessary and useful when users add their own code that needs to be used from the *logic node editor* or *layout designer*.

These macros are generally used together with the source code.

ESD_TYPE

ESD_TYPE provides information about a primitive type. All types are assumed to have a default value of 0.

Syntax Example:

```
ESD_TYPE(ft_uint32_t, Native = UInt32, Edit = Int)
ESD_TYPE(char *, Native = Latin1, Edit = String)
ESD_TYPE(Esd_BitmapCell *, Native = Pointer, Edit = Library)
```

Parameter Type	Parameters	Description
Native		Type used internally for formatting C literals and binary representations
	Void	Not a type (default)
	Int64, Int32, Int16, Int8,Int Ptr	Signed integer
	UInt64, UInt32, UInt16, UInt8, UIntPtr	Unsigned integer
	Double	64bit floating point
	Float	32bit floating point
	Char	An 8bit text character
	Bool	C99 Bool
	Utf8	String with UTF-8 encoding
	Latin1	String with Latin 1 (ISO8859-1) encoding
	Pointer	Pointer type
	Struct	Struct type (not fully supported yet)
Edit		Used by the Properties Editor to specify the control to edit the value and by code generation when using the fixed point formats
	None	No editor control (default)
	Int	Integer, spin-box integer control
	Real	Floating point, spin-box floating point control

	Boolean	One or Zero, checkbox
	String	Text, single-line entry
	Fixed1, Fixed2, ..., Fixed32	Fixed point, spin-box floating point control
	ColorARGB	Color, rgb with alpha
	ColorRGB	Color, rgb without alpha
	Library	Select a function specified with ESD_FUNCTION to provide the value (useful for pointer values)

Table 72 - Macros – ESD_TYPE - Parameters

ESD_ENUM

Enumeration types are usable as types from the logic editor. It will use the specified Type in the generated code. Internally, only the enumeration identifiers are parsed; values are ignored. Enumerations used in the properties are serialized as their identifier string. Enumerations are edited using a drop-down control in the *Properties Editor*.

Syntax Example:

Using pre-processor definitions, the symbol right after each *#define* statement is used.

```
ESD_ENUM(Ft_BitmapFormat, Type = ft_uint32_t)
#define PALETTED              8UL
#define PALETTED4444          15UL
#define PALETTED565           14UL
#define PALETTED8             16UL
ESD_END()
```

Parsing from an enum requires the identifiers to be on separate lines, the first identifier of each line is used.

```
ESD_ENUM(Ft_BitmapFormat)
enum Ft_BitmapFormat
{
    PALETTED,
    PALETTED565,
    PALETTED8
};
ESD_END()
```

In case the enumeration is defined in another file, a macro is available to manually specify the identifiers.

```
ESD_ENUM(Ft_BitmapFormat, Type = ft_uint32_t)
ESD_IDENTIFIER(PALETTED)
ESD_IDENTIFIER(PALETTED565)
ESD_END()
```

When the Flag value is specified, the enumeration can combine multiple values, and will show as a series of check-boxes in the Properties Editor instead of a drop-down menu.

```
ESD_ENUM(Ft_CoPro_Opt, Type = ft_uint16_t, Flags)
#define OPT_CENTERX           512UL
ESD_END()
```

To allow users to select 0 as a valid value, the Zero flag can be set. This flag has no effect when the Flag value is specified.

ESD_FUNCTION

ESD_FUNCTION is a macro to register a user defined function to ESD 4.0, so that the application can add that function into the *User Functions* category node which is located in the Library browser.

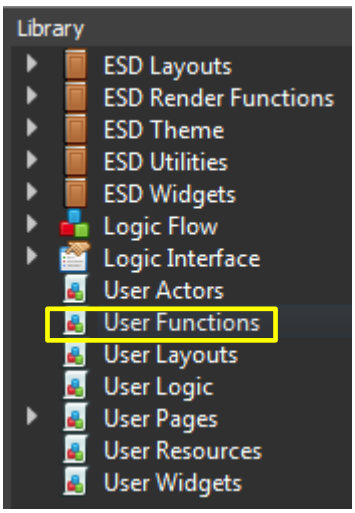


Figure 130 – User Functions Example

Syntax Example:

The following syntax example is to register a function called *"hsvToRgb"* to ESD 4.0.

```
ESD_FUNCTION(hsvToRgb, Type = ft_argb32_t )
ESD_PARAMETER(h, Type = double)
ESD_PARAMETER(s, Type = double)
ESD_PARAMETER(v, Type = double)
```

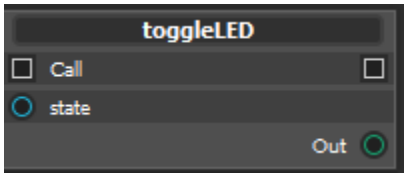
Upon registering the function, it is added to the *User Functions* category.

Parameters	Description
Type	The function's return value type

Table 73 - Macros – ESD_FUNCTION - Parameters

NOTE

- **Each ESD_PARAMETER defines only one function parameter. It must be kept in a single line for each parameter.**
- **"Buffered" flag can be attached after "Type". It will create the output of the function stored in a member variable, whenever the function is called. Without the Buffered flag, you'll have a function with just one output value which is called whenever the output value is used. Here is an example:**




```
ESD_FUNCTION(toggleLED, Type=int,Buffered)
ESD_PARAMETER(state,Type=ft_bool_t)
```

ESD_METHOD

ESD_METHOD works similar to ESD_FUNCTION with an enhanced feature. It takes a logic/actor/widget/page/app context pointer as first parameter. It can be used only within the logic editor of that logic/actor/widget/page/app.

Syntax Example:

The following syntax example defines one method to handle "Pushed" event for an ESD Push Button widget contained in "MainPage.page".

```
ESD_METHOD(MainPage_ESD_Push_Button_Pushed, Context = MainPage)
void MainPage_ESD_Push_Button_Pushed(MainPage *context)
{
        // ...
}
```

The logic node connection and the corresponding output is shown in the sample picture below –

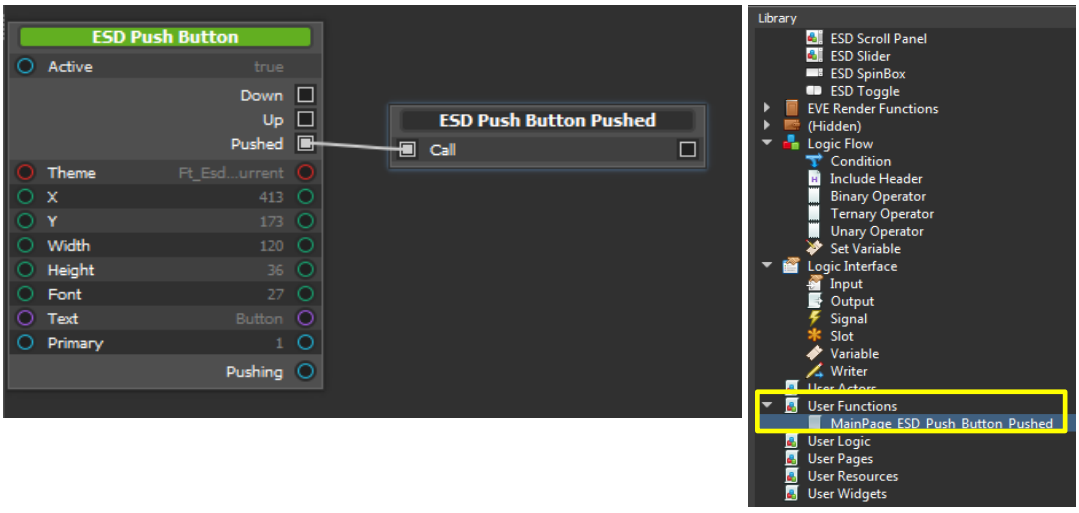


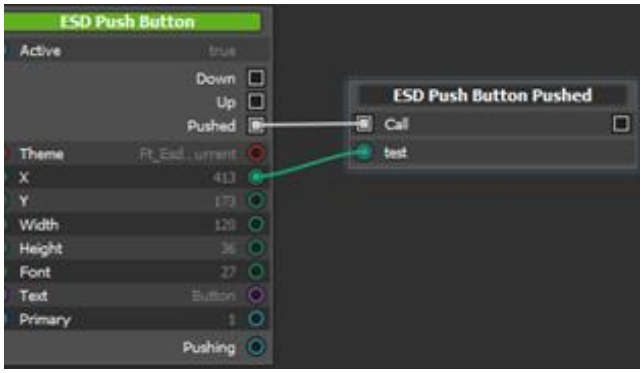
Figure 131 – ESD_METHOD Example

Parameters	Description
Context	Pointing to the caller's context

Table 74 - Meta Macros – ESD_METHOD - Parameters


NOTE

- **Additional parameters can be defined similar to ESD_FUNCTION. But these parameters must be added only after the Context parameter. Here is an example:**




```
ESD_METHOD(MainPage_ESD_Push_Button_Pushed, Context =
MainPage)
ESD_PARAMETER(test,Type = ft_bool_t)
void MainPage_ESD_Push_Button_Pushed(MainPage
*context,ft_bool_t test)
{
     // ...
}
```


NOTE

- **If the return value of method function is to be defined, "Buffered" keyword needs to be added after the "Type" definition. Refer to the syntax example -**

```
ESD_METHOD(MainPage_ESD_Push_Button_Pushed, Context =
MainPage,Type=int,Buffered)
ESD_PARAMETER(test,Type = ft_bool_t)
int MainPage_ESD_Push_Button_Pushed(MainPage
*context,ft_bool_t test)
{
     // ...
}
```

ESD_INPUT

ESD_INPUT is a built-in macro used to define an input variable of an ESD 4.0logic node.

Syntax Example:

```
ESD_INPUT(Margin, Type = int, Default = 4)
```

ESD_OUTPUT

ESD_INPUT is a built-in macro used to define an output variable of an ESD 4.0logic node.

Syntax Example:

```
ESD_OUTPUT(FirstPos, Type = int)
```

ESD_UPDATE

ESD_INPUT macro is used to register a function that is called repeatedly by built-in "Update" slot. This function shall not have any return value.

Syntax Example:

```
ESD_UPDATE(Ft_Esd_BitmapPersist)
ESD_PARAMETER(bitmapCell, Type = Ft_Esd_BitmapCell *)
void Ft_Esd_BitmapPersist(Ft_Esd_BitmapCell *bitmapCell);
```

Parameters:

Users can define their own parameter used by the registered function by using the ESD_PARAMETER.

Pre-compiler options

Within the ESD 4.0C code simulation engine, the following macros are predefined in generated source code:

- *ESD_SIMULATION*
- *FT900_PLATFORM*

ESD_SIMULATION

ESD_SIMULATION macro is defined when the code is running through the ESD simulation engine. If some part of the user's C source code is not supposed to be run under the ESD simulation engine, for example, accessing some hardware specific registers, users may choose to skip the code by using this macro.

FT900_PLATFORM

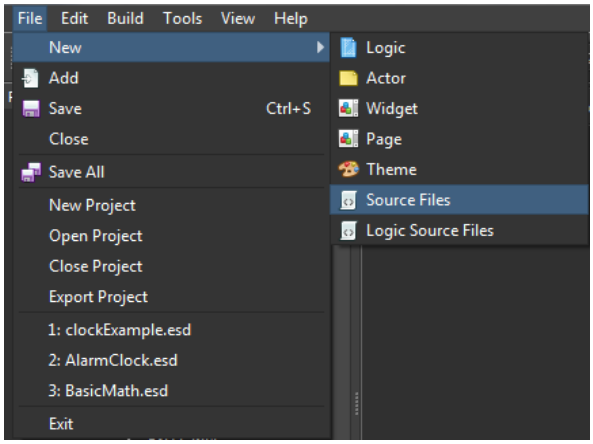
FT900_PLATFORM macro is defined when the target platform is FT90X based. It can be set when the ESD_SIMULATION macro is defined.

Add User Functions

Users can define their own functions by writing the C source code directly. If these functions are defined by using the predefined "ESD_FUNCTION", they will be shown under the "User Functions" category in the library browser. Users can drag and drop these nodes into the logic node editor to use them.

Creating Source File

To add user functions, users need to create a C source file by clicking **File → New → Source Files**.



Upon adding the source file, include the following header **(mandatory)** in the source file.

```
#include "Ft_Esd.h"
```

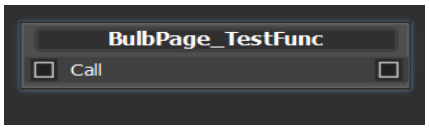
Editing the Source File

To make ESD 4.0responsive of the user functions, the ESD 3.0 specific macro *"ESD_FUNCTION or ESD_METHOD"* need to be added before the function definition. Refer to the examples given below –

Syntax Example:

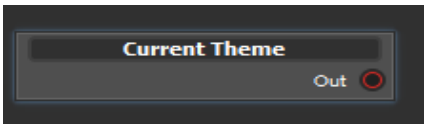
- Without parameter input and return value

```
ESD_FUNCTION(BulbPage_TestFunc)
void BulbPage_TestFunc(){}
```



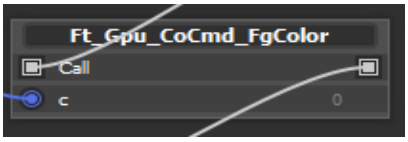
- Without parameter input, but with the return value

```
ESD_FUNCTION(Ft_Esd_Theme_GetCurrent, Type = Ft_Esd_Theme *)
Ft_Esd_Theme *Ft_Esd_Theme_GetCurrent();
```



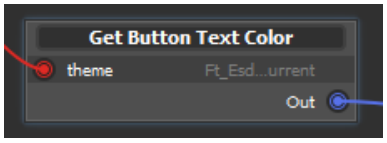
- Without return value defined, but with the parameter input

```
ESD_FUNCTION(Ft_Esd_Theme_GetButtonTextColor, Type = ft_rgb32_t)
ESD_PARAMETER(theme, Type = Ft_Esd_Theme *)
ft_rgb32_t Ft_Esd_Theme_GetButtonTextColor(Ft_Esd_Theme *theme) { //.. }
```



- Without return value and parameter input

```
ESD_FUNCTION(Ft_Esd_Theme_GetButtonTextColor, Type = ft_rgb32_t)
ESD_PARAMETER(theme, Type = Ft_Esd_Theme *)
ft_rgb32_t Ft_Esd_Theme_GetButtonTextColor(Ft_Esd_Theme *theme)
{
    //..
}
```



Appendix A – List of Figures

Appendix B – List of Tables

Appendix C – Revision History

Document Title	:	BRT_AN_029 EVE Screen Designer 4.5 User Guide
Document Reference No.	:	BRT_000218
Clearance No.	:	BRTXXX
Product Page	:	http://brtchip.com/esd-4-0/
Document Feedback	:	Send Feedback

Revision	Changes	Date
Version Draft 0.1	Initial Release	2017-12-21
Version Draft 0.2	ESD 4.5 Release	2018-05-31
Version Draft 0.3	ESD 4.5 Release (Minor modifications)	2018-06-22

Revision History

Revision history (internal use only, please clearly state all changes here before saving the file)

Revision	Date YYYY-MM-DD	Changes	Editor
Draft 0.1	2017-12-13	Initial Draft	Paul Jiao Shouwu/Zehua
Draft 0.1	2017-12-21	Reviewed and updated as required	L Subramanian
Draft 0.2	2018-05-31	Second Draft	Mohamed Fysal
Draft 0.3	2018-06-22	Third Draft – Target platform name changes	Mohamed Fysal