Virtual Breadboard

Prototype Virtually, Make for Real

www.virtualbreadboard.com

Date	*Description*	*VBB Version*
16 Oct 2012	*First Draft Created*	V 4.19
21 Nov 2012	*Enhanced Nets which were broken* • *Nets are now components* • *Nets have properties which can be edited* • *Net dropdown list has accelerator features* • *Some components V18'O, Arduino etc have default Nets which match up to their pin names, D0,D1.. A0,A1..* • *Show Nets toolbar button show the 'rats' nest of selected nets* *Windows 8 Compatibility* • *Removed Xenocode sandbox* • *Moved 'Built-in' examples into AppData/Virtual Breadboard directory* *Kits* • *Added 1st example Kit 'Christmas Tree Kit'*	*V 4.20*
24 Nov 2012	*Fix for Language Issue*	*V 4.21*
30 Nov 2012	*Fix for components broken in window 8 changes. Specifically code components such as TTL74XX*	*V 4.22*

22 Aug 2013	*Clean up*	*V 4.33*

Introduction

Virtual Breadboard is a software platform designing ‘Breadboard’ form-factor electronic circuits and developing the microcontroller firmware that drive them. You can use Virtual Breadboard to:

- Develop and debug microcontroller based applications
- Program microcontrollers directly
- Develop Control Panels for Embedded Applications
- Act as a guide for assembling solderless Breadboard circuits
- For documentation of circuits to share
- To use with ICEShield for testing microcontroller software

Circuit Emulation

Virtual Breadboard can be used as a Circuit Emulator for some types of Circuits. In particular VBB is not a SPICE simulation and does not resolve circuit current so you cannot use it for circuit-analysis. However for a wide variety of ‘physical computing’ circuits VBB emulations work just fine.

Whats the difference between a Simulation and an Emulation?

Emulation models behaviour whereas simulation emerges behaviour. A behaviour might be to turn on a LED connected via a resistor to a microcontroller pin. A simulation might compute the circuit resistance and equivalent resistance of the power driver of the pin along with the voltage curve and forward voltage of the diode to resolve the instantaneous current and then lookup the luminosity curve of the diode to render a faithful representation of the color and intensity of the LED the user might expect to see. An emulation on the other hand just draws a LED as on when the PIN is HIGH and off when the PIN is LOW. The resulting behaviour from the user and microcontroller are the same. A LED is *on* when the pin is *HIGH* and the LED is *off* when the pin is *LOW*. Naturally emulations are faster to calculate and easier to implement. VBB is a circuit *emulator* and SPICE is a circuit *simulator*.
Its important to understand this difference when using VBB because you cannot place capacitors and resistors and expect for example behaviours such as filters to emerge. There are however common work arounds to achieve common behaviours using properties of the discrete components.

System Requirements

Virtual Breadboard is only compatible with the Windows Operating System.

Linux and Mac users can achieve many of the same results using VBBExpress which is Mono compatible and cross platform.

Installation

Virtual Breadboard ships as a windows installer packaged in a ZIP file.
Unzip and run the setup.exe
If you are updating VBB make sure you uninstall first.

Dependencies

VBB is a .NET application and has the following dependency

- Microsoft .NET 2.0
- Microsoft JSharp

Microsoft .NET 2.0

Microsoft .NET 2.0 or greater shipped standard on every version of Windows since Vista. If you are using Windows XP you will also most likely already have .NET installed. If not you can download the redistributable from Microsoft here :

http://www.microsoft.com/download/en/details.aspx?id=19

Or from VirtualBreadboard.com here

http://www.virtualbreadboard.com/download/dependencies/dotnetfx/dotnetfx.exe

Microsoft JSharp Runtime

The Microsoft J# Runtime is also required. You may not have this installed on your computer because Microsoft stopped installing it by default.

Download vjredist.exe from Microsoft here:
http://www.microsoft.com/en-us/download/details.aspx?id=4712

Download Or from VirtualBreadboard.com here

http://www.virtualbreadboard.com/download/dependencies/VJSharpRDP/vjredist.exe

Administrator Permissions

When you first run VBB you need to use the Administrator account to give VBB permission to install its configuration files in the AppData.

VBB will install its examples etc in the

<User>AppData\Local\Virtual Breadboard\VBB <version> directory

Internet Activation

VBB uses internet activation to manage the pay-for-feature extensions.

Version Check

When VBB starts up it checks the version online and offers to automatically update.

When you agree to AutoUpdate VBB,.exe writes a new file VBBUpdate.exe on the same directory as the VBB.exe is executing, launches it and then shuts down. VBBUpdate.exe then downloads the new VBB.exe replacing the old copy and then restarts VBB.exe and closes down. When VBB.exe starts if it finds a file named VBBUpdate.exe it deletes it automatically.

If you have security which detects the above activity as suspicious please download the VBB.exe file manually.

Pay for Features

When VBB starts it checks which features have been licensed and activates them. Some features actually are hosted online and some features download content on demand. Hence a full time internet connection is required for extended Pay-For-Features to operate correctly. If the internet is not available VBB will continue to operate in standard mode

Internet Access

Internet Access is made via standard Http WebServices on Port 80. This looks just like Browser Access and should have no problems with firewalls.

However, the #1 problem people have with VBB is with their Antivirus or Internet Security

Antivirus

Antivirus applications regularly have a problem with the Spoon Sandbox detecting it as suspicious and blocking it in some way. This happens when an Antivirus company makes a new release and then usually goes away as they patch the false positive. This is happening less and less but you might have to add VBB.exe to the exception list of the your AntiVirus application

Internet Security / Firewall

Applications such as Norton Internet security block internet access preventing authentication and pay-for-feature useage. You might have to add VBB.exe to the exception list of your Internet monitor and/or Firewall in order for Activation to function correctly.

VBB Application

VBB is an Integrated Development Environment for the purpose of designing, simulating and building microcontroller based electronics hardware systems.

The fundamental concept is the DesignSheet, VBB manages a collection of DesignSheets which can link together to perform various tasks.

VBB has two phases, design-time and run-time. Each DesignSheet has a design-time view and may have a run-time view.

Solution contains a collection of Projects
Project contain a collection of Design Sheets

Solution

- Project(s)
    - DesignSheet(s)

Solution (*.VSM)

The VBB VSM '*Virtual System Model*' Solution file is the root file for VBB. It contains references to a collection of Projects and contains global settings for the solution.

Project (*.PRJ)

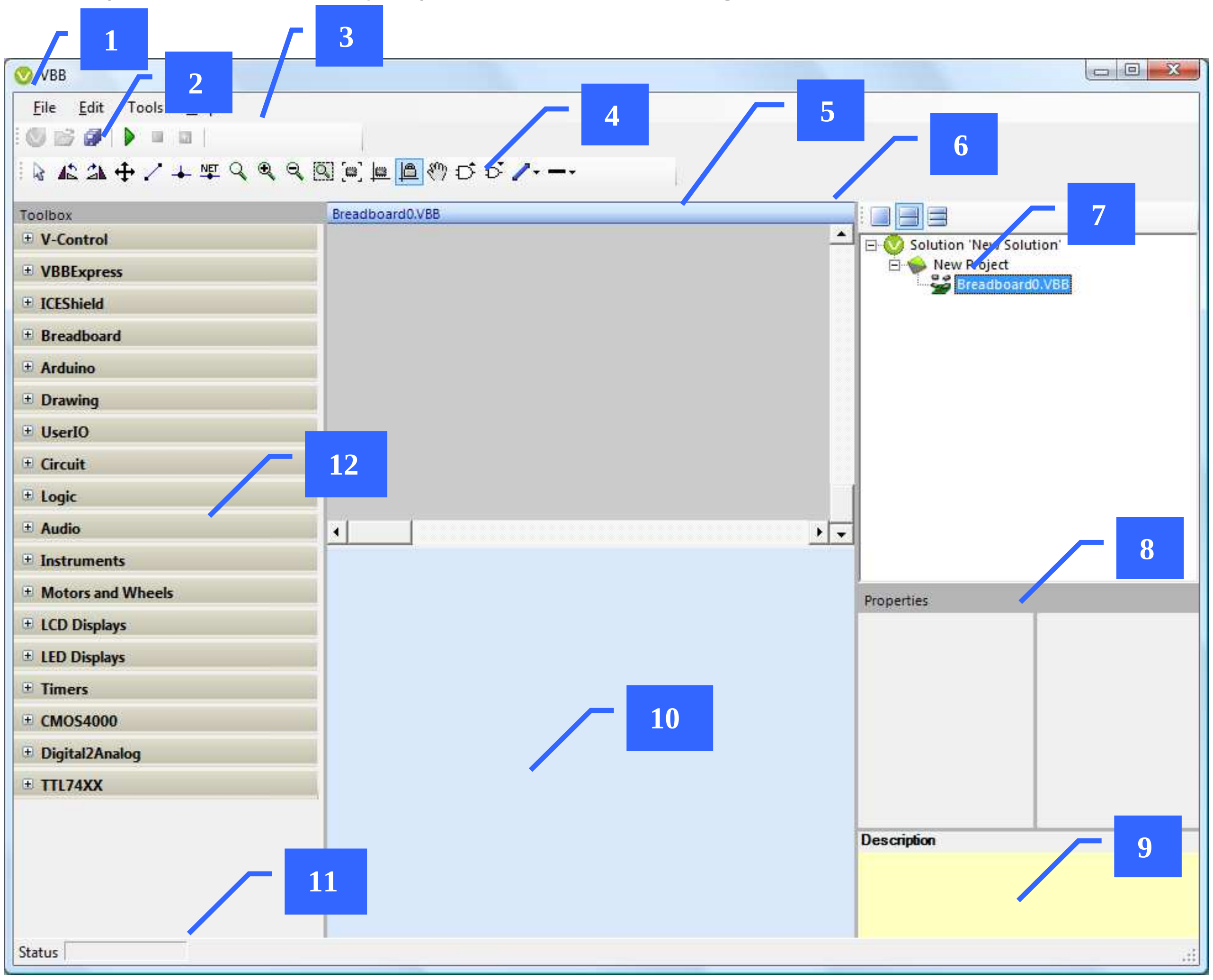
A project contains a collection of DesignSheets and project specific configuration settings

Standard Design Sheets

- Java Source Code Project
- Breadboard Graphical Layout
- Logic Trace
- Logic Analyser

VBB Solution Orientation

When you create a New Project you will see the following screen.



1. VBB Application Window
2. VBB Application Menu
3. The VBB application Toolbar
4. The current DesignSheet Toolbar
5. The current DesignSheet highlighted by blue header
6. The layout toolbar
7. The solution Explorer
8. The properties panel
9. The property description panel
10. Empty panel
11. Status Toolbar
12. Toolbox of currently select DesignSheet

VBB is context sensitive to the current DesignSheet, the toolbox and toolbar changes when the currently selected DesignSheet changes.

1. VBB Application Window

The VBB Application is a MIDI (Multiple Document Interface) style application where the document being managed is the DesignSheet

2. VBB Application Menus

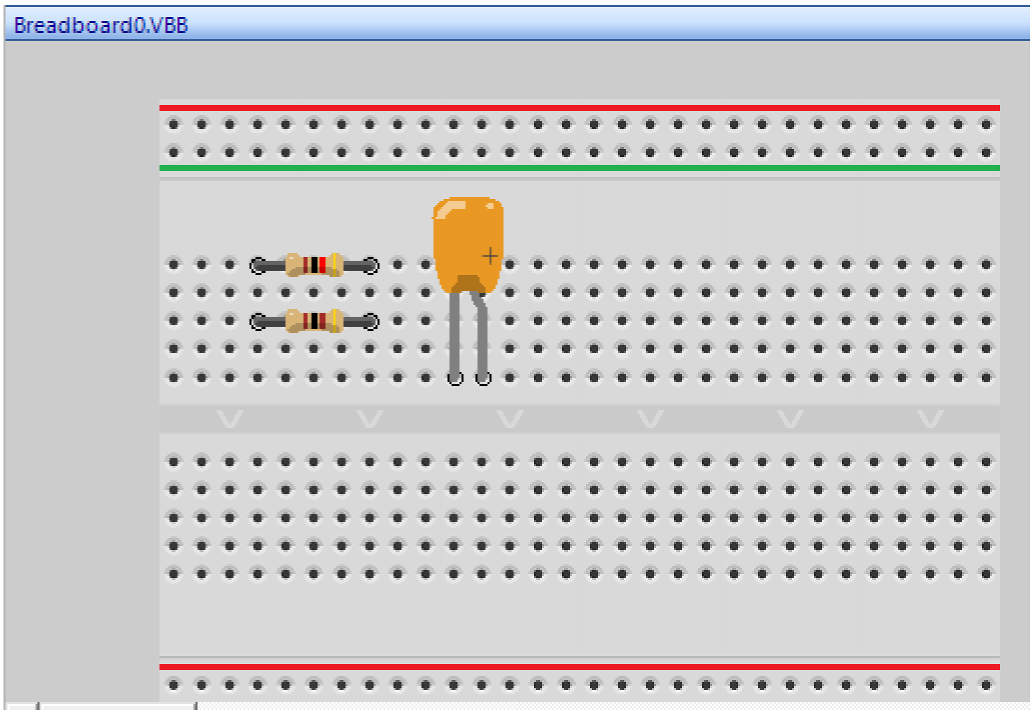
File

Name	ShortCut	Description
New	Ctrl + N	Opens the New Project Dialog with the New Tab selected. Only available when no solution is loaded.
Open	Ctrl + O	Opens the New Project Dialog with the Existing Tab selected. Only available when no solution is loaded.
Close Solution		Closes the current solution and returns to the closed solution state. Only available when a solution is loaded.
Save	Ctrl + S	Saves the current solution
Save As		Opens the Save Dialog prompting for the new project name. Only available when a solution is loaded.
Export BOM		Exports the BOM
Exit		Shut down VBB Only available when no solution is loaded.

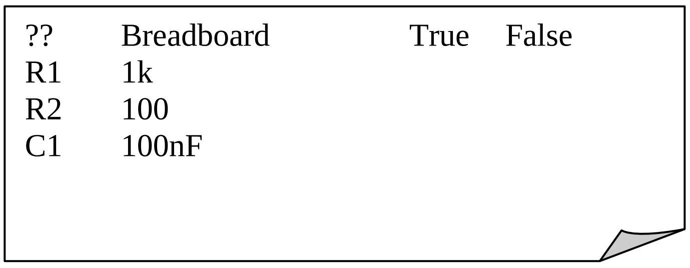
BOM Export

Exports a BOM (Bill of Materials) which is a list of the components in a Breadboard design as designated by the component ID and with a component descriptor

Clicking this menu option will open a file save dialog which can be used to name and locate the BOM text file.



For example the BOM text file for the about circuit might look



??	Breadboard	True	False
R1	1k		
R2	100		
C1	100nF		

BOM.txt

Edit

Name	ShortCut	Description
Cut	Ctrl + X	Copies the current selection to the clipboard and deletes the selection from the current DesignSheet. Only available when a DesignSheet is active and components have been selected.
Copy	Ctrl + N	Copies the current selection of the current DesignSheet to the clipboard Only available when a DesignSheet is active and components have been selected.
Paste	Ctrl + O	Pastes the components copied to the clipboard to the current DesignSheet. Only available when a DesignSheet is active and components have been copied to the clipboard.
Delete		Deletes the current selection from the current DesignSheet. Only available when a DesignSheet is active and components have been selected.

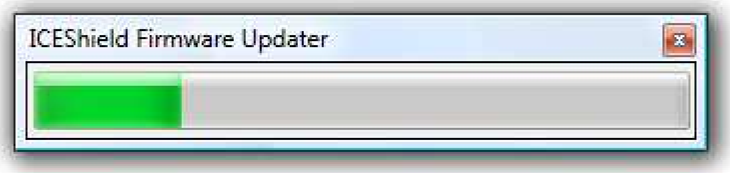
Help Menu

Name	ShortCut	Description
Update ICEShield Firmware		Starts the ICEShield firmware update dialog
About		Opens the About dialog

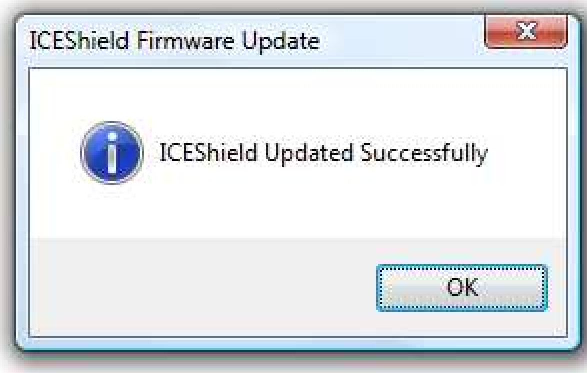
Update ICEShield Firmware
The ICEShield firmware is updateable and the firmware to match a specific release of VBBExpress is embedded in the VBBExpress.exe

To update the firmware
1) Make sure the ICEShield is connected to a USB port
2) Click the Update ICEShield Firmware menu option

An update dialog will appear showing the progress.



It take about 20 seconds to complete at which time you will get a message to indicate the firmware has been successfully updated.


ICEShield Firmware Update

ICEShield Updated Successfully

About

Opens the About Dialog

The VBB application Toolbar

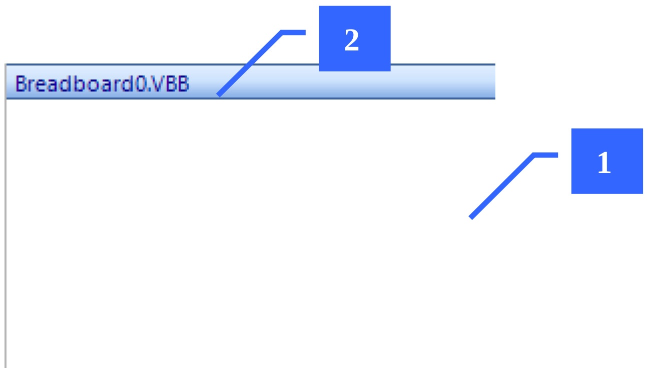
Name	Description
New	Opens the New Project Dialog with the New Tab selected. Only available when no solution is loaded.
Open	Opens the New Project Dialog with the Existing Tab selected. Only available when no solution is loaded.
SaveAll	Saves the current solution to disk. If this is the first time saved then the Save dialog is opened. Only available when a solution is loaded
Run	Runs the emulation for the current solution. Only available when in design mode.

DesignSheet Toolbar

The DesignSheet Toolbar contains tools for editing and navigating graphical DesignSheets. Like the Toolbox, the Toolbar is updated with the tools specific to the currently selected designer and updates when a new designer is selected.

Current DesignSheet

The current DesignSheet TitleBar is highlighted green



1. **<u>You can always click into the TitleBar to select the DesignSheet as the current DesignSheet</u>**
2. Some DesignSheets allow you click anywhere on the DesignSheet to select it

The layout toolbar

The design panel has up to three design panes. Each pane may contain a DesignSheet.

	One Panel	Show the design panel as a single design pane. Any selected DesignSheet is shown in the single pane
	Two Panel	Splits the design panel into two separate design panes
	Three Panel	Splits the design panel into three separate design panes.

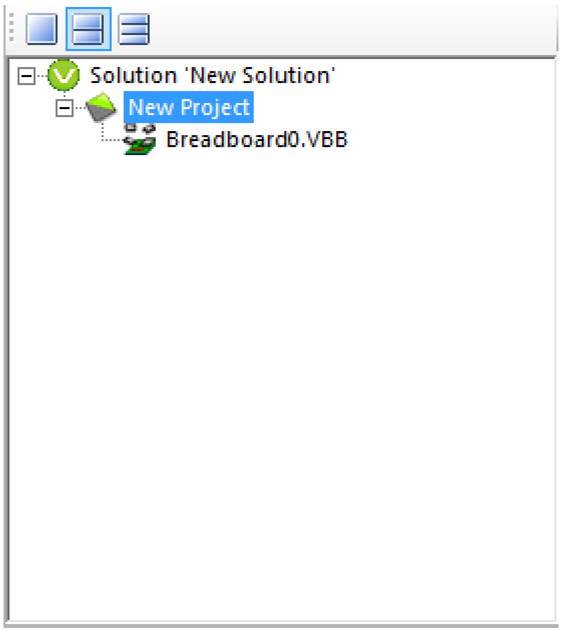
When you double click a DesignSheet in the navigation tree it is selected into one of the available panes according to its default viewing position.

<u>You can override the default location by dragging and dropping the design from the navigation tree to the desired panel.</u>

When switching between layouts the previous layout remembers which DesignSheets are in which panel.

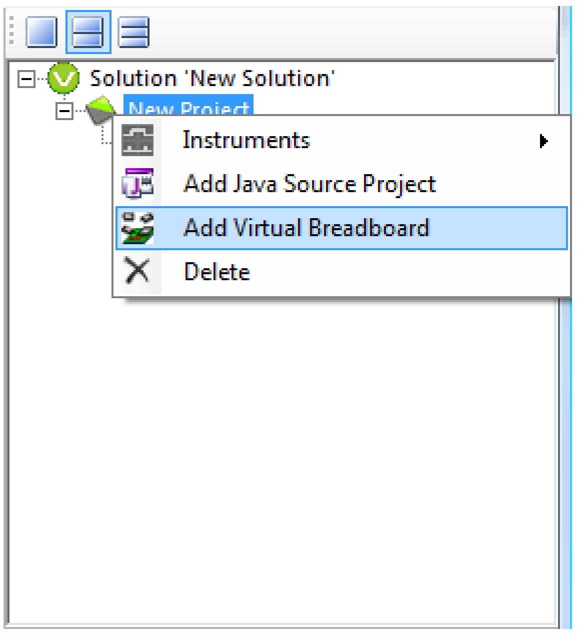
The Solution Explorer

The solution Explorer contains a tree representing the DesignSheets in the solution.

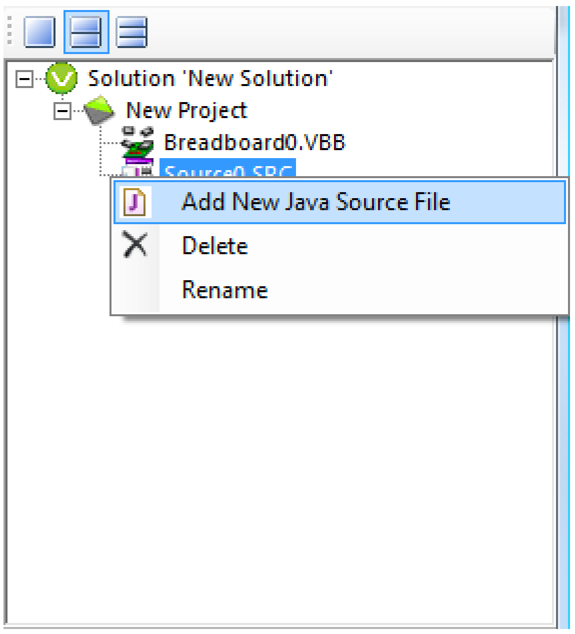


The Solution Explorer is context sensitive.

Right Click on a Project to add DesignSheet

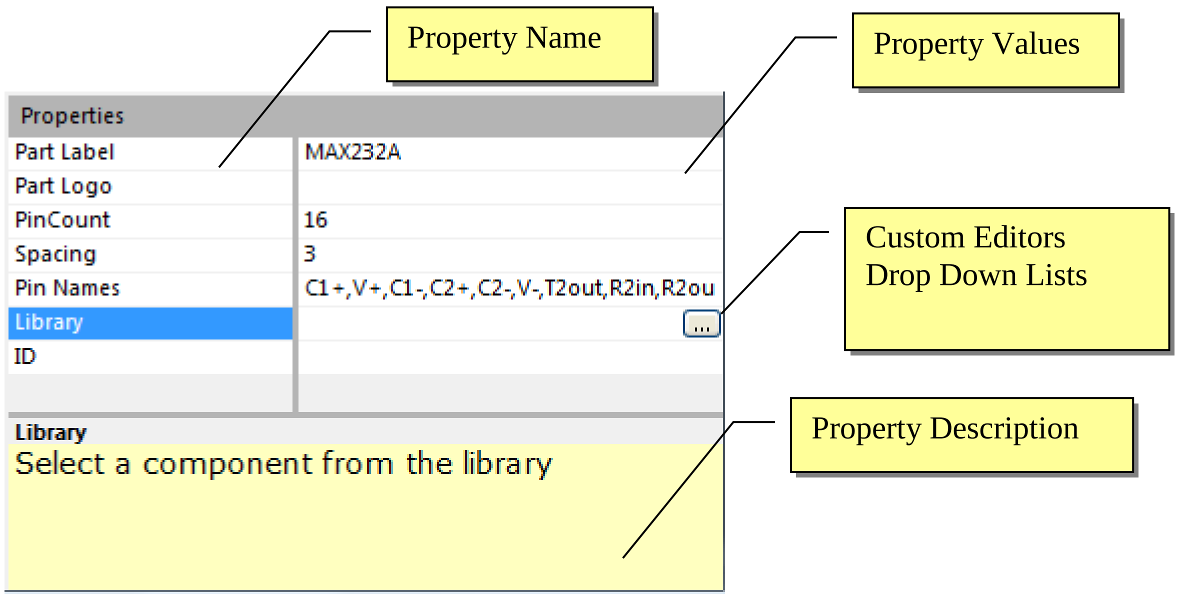


Right Click on a Source Project to add a source file to a Source Code Project



The properties panel

Many items, DesignSheets and Components have Properties
The properties editor is populated when components are selected with DesignSheets.
The properties are specific to individual components.



Properties	
Part Label	MAX232A
Part Logo	
PinCount	16
Spacing	3
Pin Names	C1+,V+,C1-,C2+,C2-,V-,T2out,R2in,R2ou
Library	
ID	

Library
Select a component from the library

When you select a component the properties box is populated with the component properties.

The property description panel

When a component is selected the description of the property is displayed in the property description panel

Empty panel

When a panel has no DesignSheet it appears blue. You can fill the panel with a DesignSheet by dragging and dropping a design into the panel

Status Toolbar

Shows status information including runtime timing and debug information

DesignSheet Toolbox

Toolbox of currently select DesignSheet The toolbox contains the collections of components specific to the current designer. Components are grouped into collections which can be drag and dropped onto the current DesignSheet. When the current designer changes the Toolbox is updated with the components specific to the newly selected DesignSheet.

New Project Dialog

The New Project form is responsible for locating and opening an existing project or project template or creating a new project. It is the first form that appears when you start RoboPAL. It also appears when you select New or Open from the Main Form.

There are 4 tabs

- New
- Existing
- Recent
- MarketPlace

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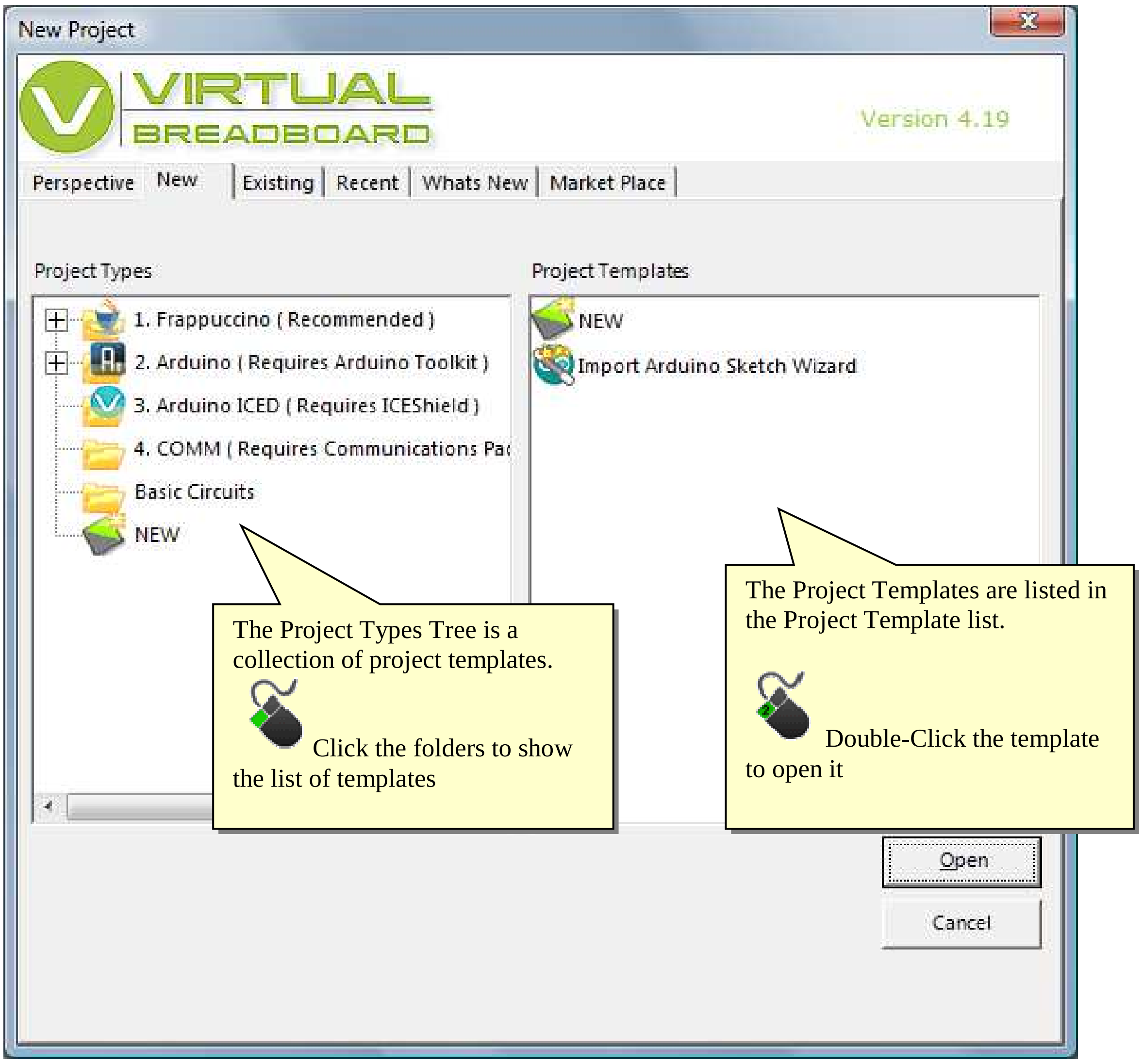
New Tab

The New Tab is used for creating New projects from project templates. A project template is a complete solution based on an example or project type which you can use to quickly get started. The templates are organized into a tree of project types to help you locate a template that best suits your embedded application challenge. The *Project Types* Tree on the left hand side selects the project type and the *Project* Templates lists the available templates for the selected type.

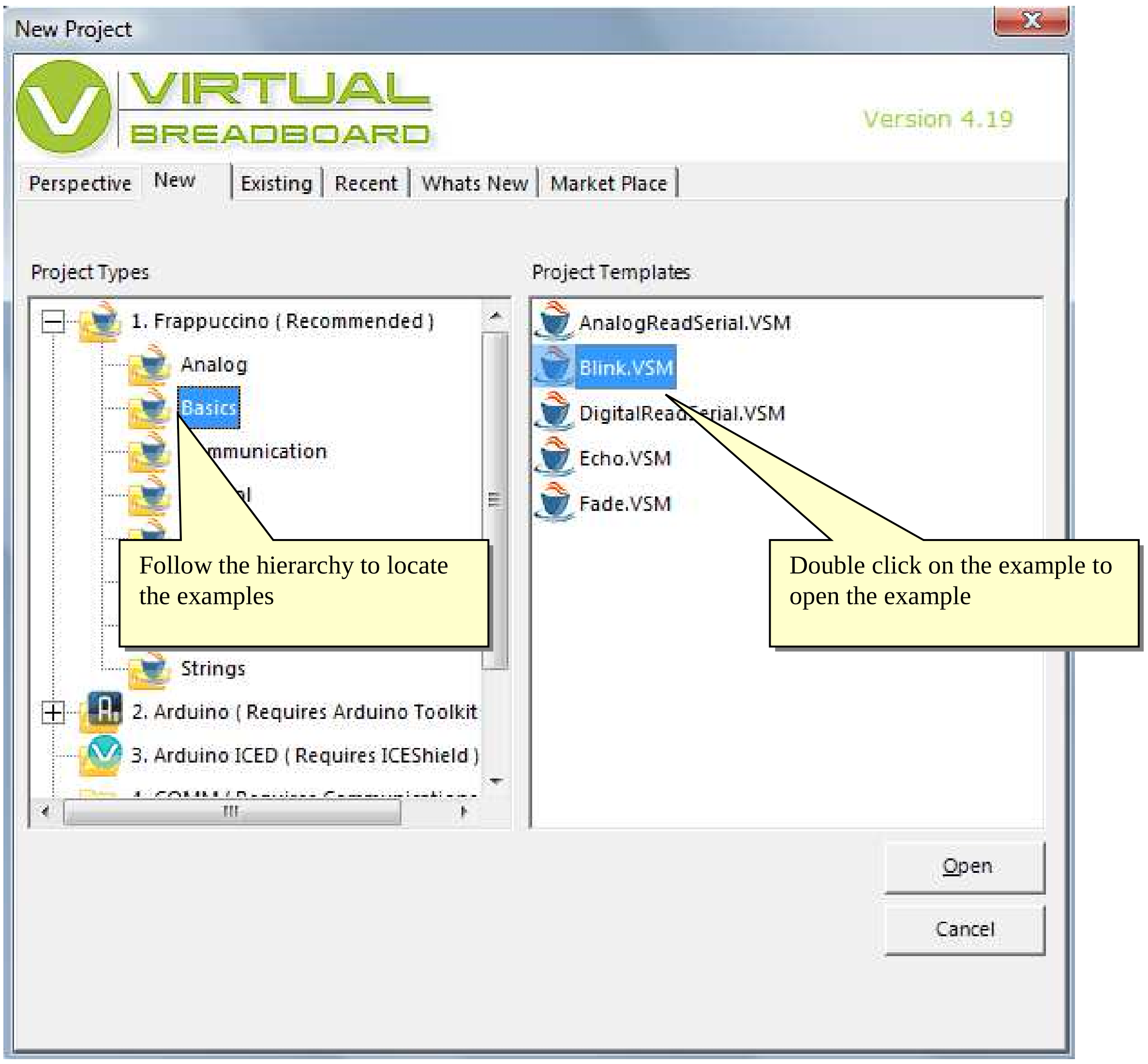

New Project
VIRTUAL BREADBOARD
Version 4.19
Perspective
New
Existing
Recent
Whats New
Market Place
Project Types
Project Templates
1. Frappuccino (Recommended)
2. Arduino (Requires Arduino Toolkit)
3. Arduino ICED (Requires ICEShield)
4. COMM (Requires Communications Pac
Basic Circuits
NEW
NEW
Import Arduino Sketch Wizard
Open
Cancel

The Project Types Tree is a collection of project templates.

Click the folders to show the list of templates

The Project Templates are listed in the Project Template list.

Double-Click the template to open it

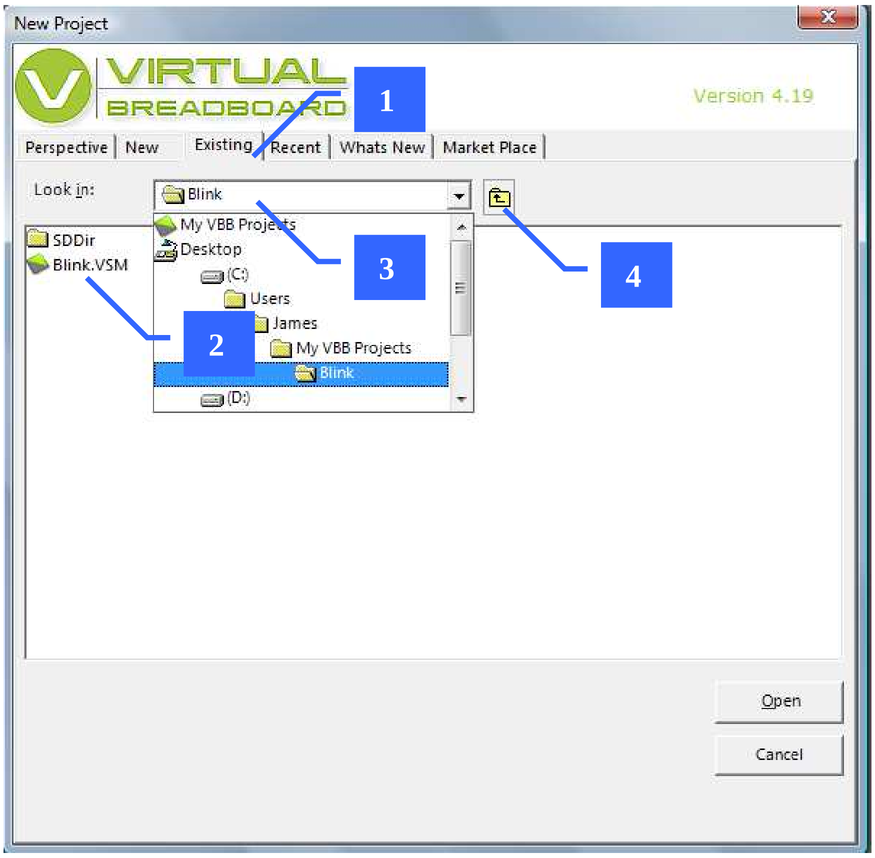


Follow the hierarchy to locate the examples

Double click on the example to open the example

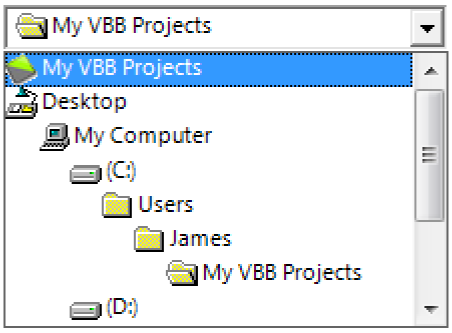
Existing Tab

The Existing Tab allow projects that already exist to be located and opened



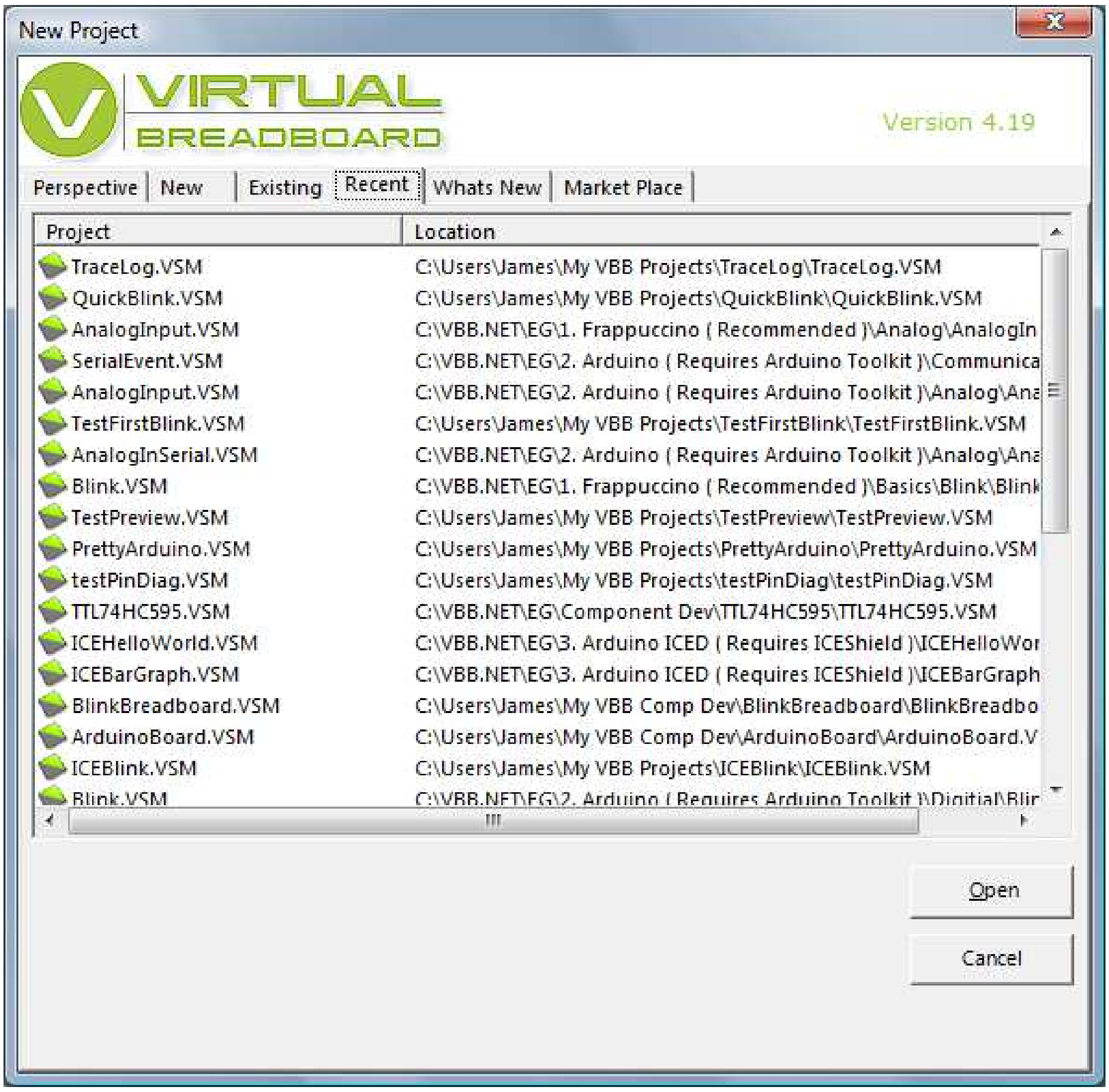
1. Existing Tab
2. List of VBB Solutions in the current directory
3. Drop down navigator
4. Move up to the previous directory

The navigation dropdown list allows you to search the computer for directories containing an existing VBB solution to open



Recent

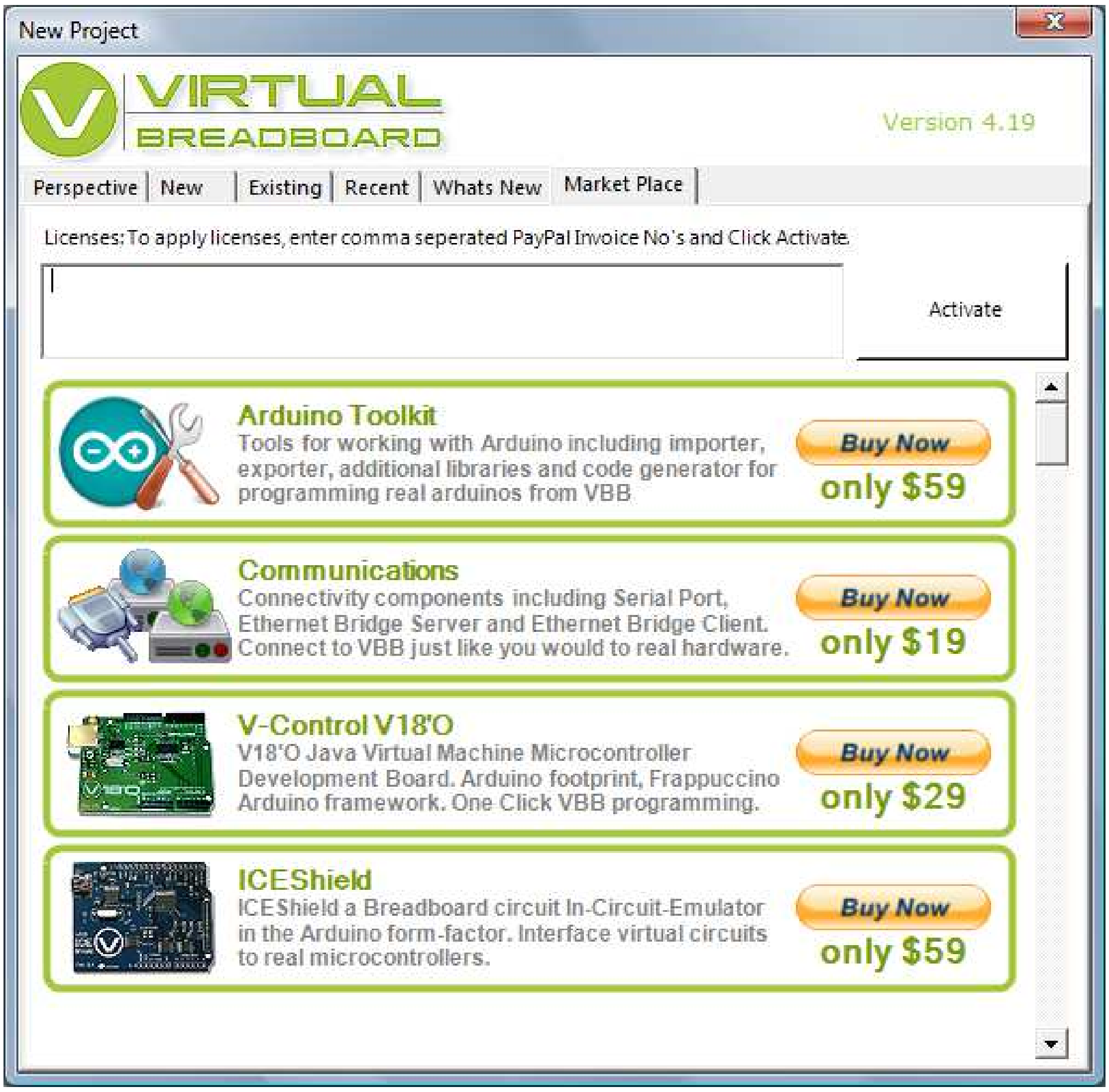
The recent tab hold the most recently used project list for quick access to recently used projects.



Project	Location
TraceLog.VSM	C:\Users\James\My VBB Projects\TraceLog\TraceLog.VSM
QuickBlink.VSM	C:\Users\James\My VBB Projects\QuickBlink\QuickBlink.VSM
AnalogInput.VSM	C:\VBB.NET\EG\1. Frappuccino (Recommended)\Analog\AnalogIn
SerialEvent.VSM	C:\VBB.NET\EG\2. Arduino (Requires Arduino Toolkit)\Communica
AnalogInput.VSM	C:\VBB.NET\EG\2. Arduino (Requires Arduino Toolkit)\Analog\Ana
TestFirstBlink.VSM	C:\Users\James\My VBB Projects\TestFirstBlink\TestFirstBlink.VSM
AnalogInSerial.VSM	C:\VBB.NET\EG\2. Arduino (Requires Arduino Toolkit)\Analog\Ana
Blink.VSM	C:\VBB.NET\EG\1. Frappuccino (Recommended)\Basics\Blink\Blink
TestPreview.VSM	C:\Users\James\My VBB Projects\TestPreview\TestPreview.VSM
PrettyArduino.VSM	C:\Users\James\My VBB Projects\PrettyArduino\PrettyArduino.VSM
testPinDiag.VSM	C:\Users\James\My VBB Projects\testPinDiag\testPinDiag.VSM
TTL74HC595.VSM	C:\VBB.NET\EG\Component Dev\TTL74HC595\TTL74HC595.VSM
ICEHelloWorld.VSM	C:\VBB.NET\EG\3. Arduino ICED (Requires ICEShield)\ICEHelloWor
ICEBarGraph.VSM	C:\VBB.NET\EG\3. Arduino ICED (Requires ICEShield)\ICEBarGraph
BlinkBreadboard.VSM	C:\Users\James\My VBB Comp Dev\BlinkBreadboard\BlinkBreadbo
ArduinoBoard.VSM	C:\Users\James\My VBB Comp Dev\ArduinoBoard\ArduinoBoard.V
ICEBlink.VSM	C:\Users\James\My VBB Projects\ICEBlink\ICEBlink.VSM
Blink.VSM	C:\VBB.NET\EG\2. Arduino (Requires Arduino Toolkit)\Digital\Blir

Market Place

The MarketPlace Tab shows a list of products and current activation status. You can purchase products directly from the MarketPLace by clicking the BUY NOW button of the feature your interested in. As more features are added they will appear in the marketplace



Licenses: To apply licenses, enter comma seperated PayPal Invoice No's and Click Activate.

Arduino Toolkit
Tools for working with Arduino including importer, exporter, additional libraries and code generator for programming real arduinos from VBB
only $59

Communications
Connectivity components including Serial Port, Ethernet Bridge Server and Ethernet Bridge Client. Connect to VBB just like you would to real hardware.
only $19

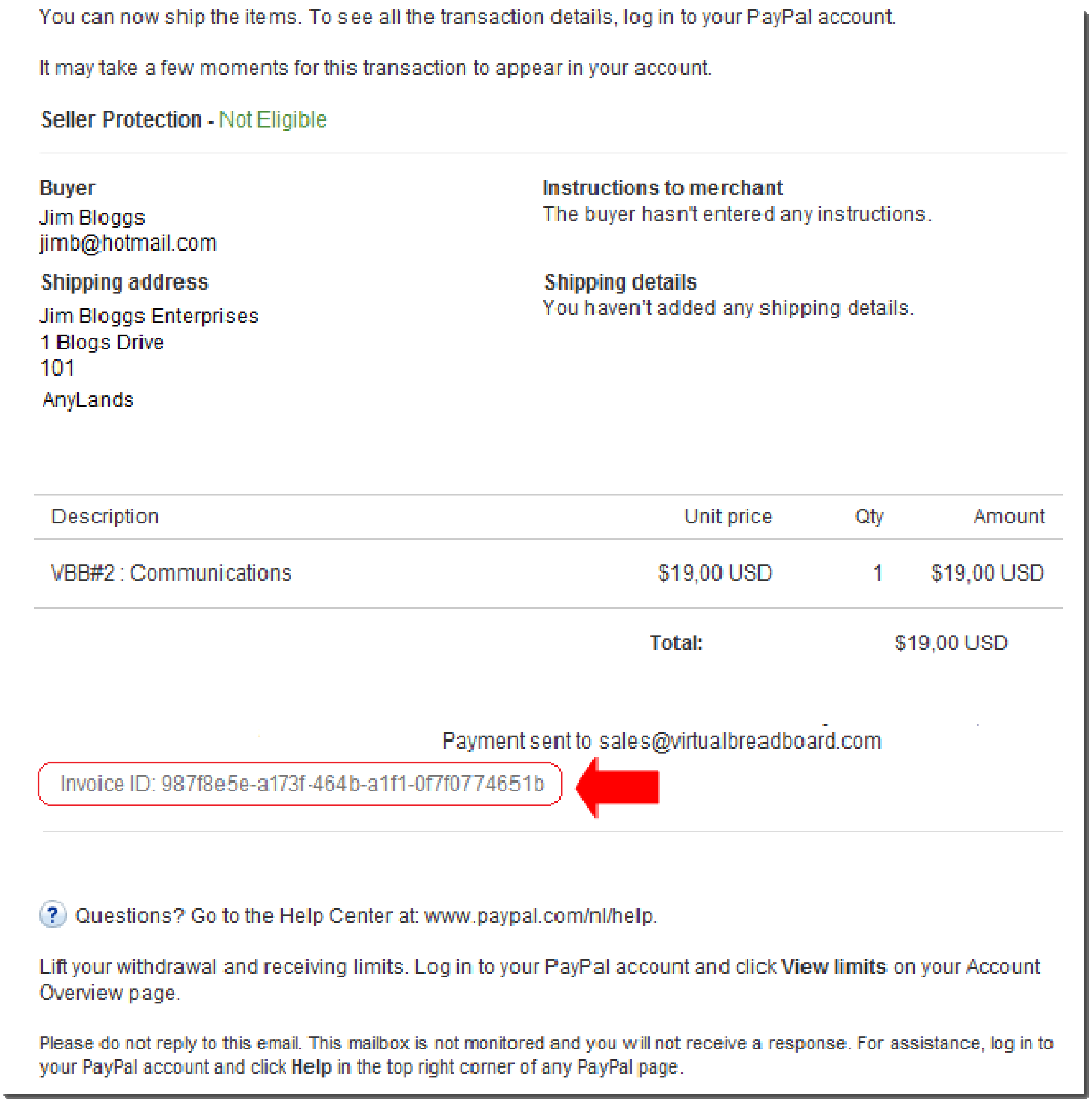
V-Control V18'O
V18'O Java Virtual Machine Microcontroller Development Board. Arduino footprint, Frappuccino Arduino framework. One Click VBB programming.
only $29

ICEShield
ICEShield a Breadboard circuit In-Circuit-Emulator in the Arduino form-factor. Interface virtual circuits to real microcontrollers.
only $59

Activating a VBB Feature

When you buy a VBB Feature using PayPAL the PayPAL receipt contains an invoice number. This invoice number is the *activation* code for the purchased feature.

Here is a sample receipt, the invoice number is highlighted in red.


You can now ship the items. To see all the transaction details, log in to your PayPal account.

It may take a few moments for this transaction to appear in your account.

Seller Protection - Not Eligible

Buyer
Jim Bloggs
jimb@hotmail.com

Shipping address
Jim Bloggs Enterprises
1 Blogs Drive
101
AnyLands

Instructions to merchant
The buyer hasn't entered any instructions.

Shipping details
You haven't added any shipping details.

Description	Unit price	Qty	Amount
VBB#2 : Communications	$19,00 USD	1	$19,00 USD
	Total:		$19,00 USD

Payment sent to sales@virtualbreadboard.com

Invoice ID: 987f8e5e-a173f-464b-a1f1-0f7f0774651b

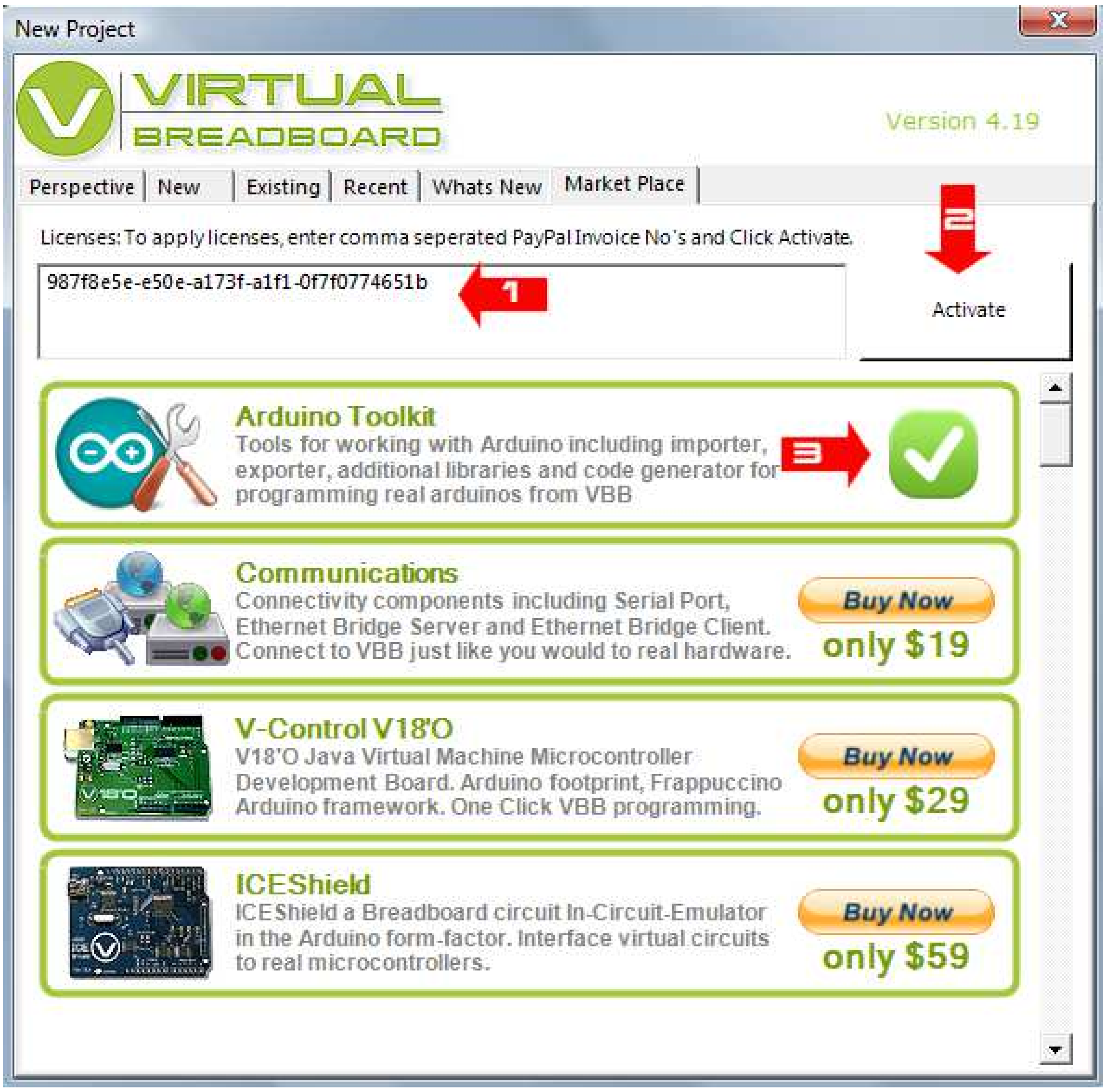
Questions? Go to the Help Center at: www.paypal.com/nl/help.

Lift your withdrawal and receiving limits. Log in to your PayPal account and click **View limits** on your Account Overview page.

Please do not reply to this email. This mailbox is not monitored and you will not receive a response. For assistance, log in to your PayPal account and click **Help** in the top right corner of any PayPal page.

Activating a feature

To activate a feature you have purchased in VBB you first start VBB and locate the MarketPlace tab. Then you copy the invoice number from the PayPal receipt into the Activation TextBox and click the Activate button. The activation code will be checked online and when valid the feature will become ticked with a green box to indicate its activated and ready to use.



Licenses: To apply licenses, enter comma seperated PayPal Invoice No's and Click Activate.

987f8e5e-e50e-a173f-a1f1-0f7f0774651b

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Connectivity components including Serial Port, Ethernet Bridge Server and Ethernet Bridge Client. Connect to VBB just like you would to real hardware.

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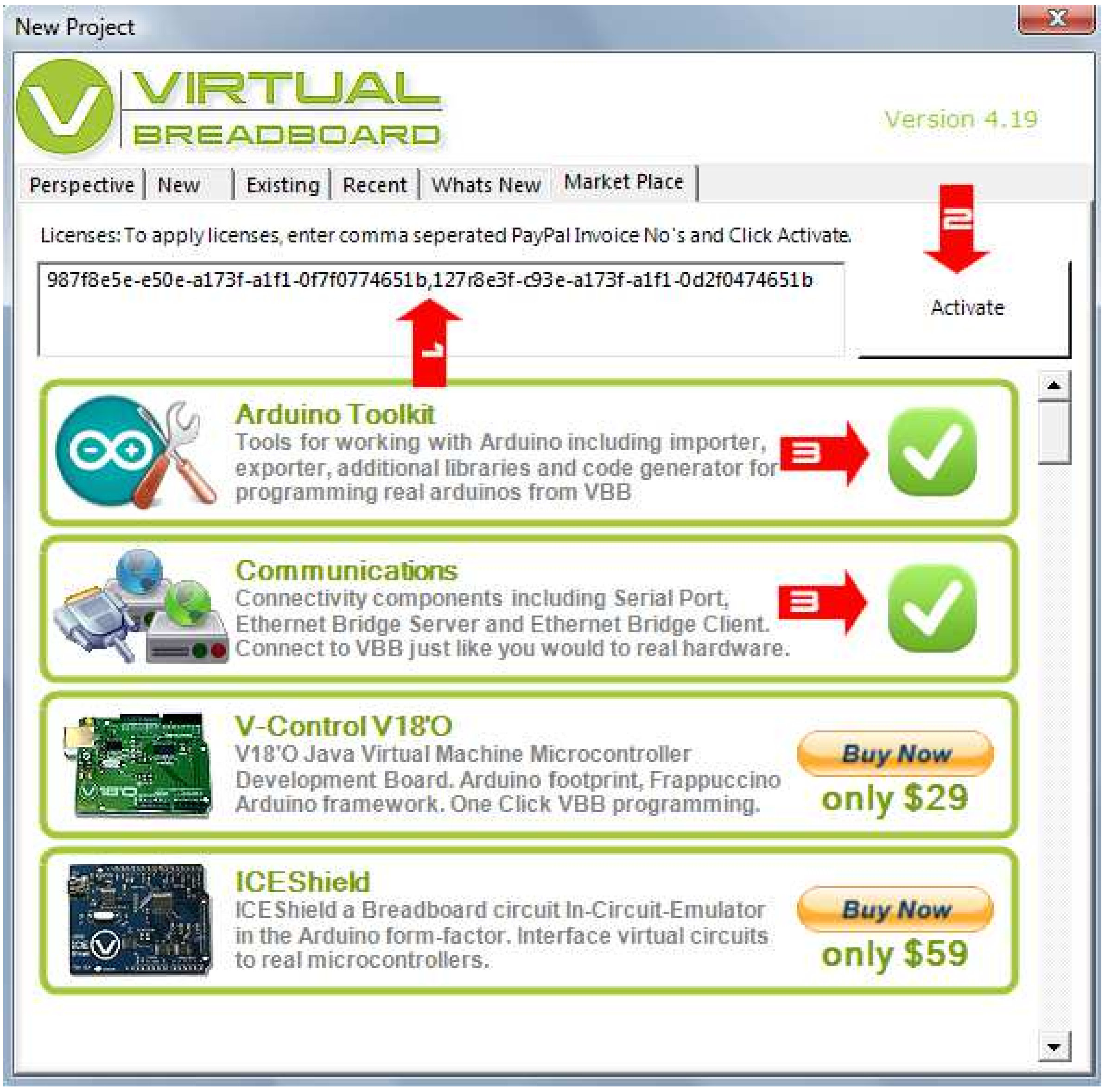
V18'O Java Virtual Machine Microcontroller Development Board. Arduino footprint, Frappuccino Arduino framework. One Click VBB programming.

ICEShield
ICEShield a Breadboard circuit In-Circuit-Emulator in the Arduino form-factor. Interface virtual circuits to real microcontrollers.

Activating multiple features

To activate more than one feature enter each activation code seperated by a comma ',' and press the Activate button.


New Project

VIRTUAL BREADBOARD

Version 4.19

Perspective | New | Existing | Recent | Whats New | Market Place

Licenses: To apply licenses, enter comma seperated PayPal Invoice No's and Click Activate.

987f8e5e-e50e-a173f-a1f1-0f7f0774651b,127r8e3f-c93e-a173f-a1f1-0d2f0474651b

Activate

Arduino Toolkit
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Communications
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Buy Now
only $59

Shipping

- The V18'O and ICEShield and other physical products are fullfilled from the Netherlands.
- Standard shipping is included in the price. There is no tracking number available.
    - Shipping time Europe : 2 to 5 days
    - Shipping time non-EU : 5 to 15 business days

Order Processing

- Sales made to european customers are processed by our Australian subsidery.
- Sales made to non-european customers are processed by our European subsidery.

Design Sheets

Context Sensitive Elements When a DesignSheet is activated the Toolbar and Toolbox change to the match selected DesignSheet

- Sheet Area
- Toolbar
- Toolbox

Standard Edition DesignSheets

DesignSheets are the main document managed by the VBB system. The standard design sheets are part of the standard version of VBB. Addition DesignSheets may be available with VBB Extended Features are enabled.

Java Source Code Projects (*.SRC)	The source code project is a special type of DesignSheet which contains a collection of java source code files for creating Java based applications.
Breadboard (*.VBB)	The Breadboard is a DesignSheet supporting the OpenVBB emulation framework. Components designed using OpenVBB can be dropped into a Breadboard DesignSheet, wired up and simulated
Logic Analyser (*.VLI)	Virtual MulitChannel Logic Analyser Instrument that is very useful for analyser logic signals for debugging and testing
Trace Log (*.VLG)	Virtual MulitChannel Logic Log logs signal changes and enables view filtering to interpret the log for debugging logic circuits.

Feature Extension DesignSheets

VBB is designed to be extended with additional pay-for-feature extensions. Some feature extensions will add new design sheets. For example the Arduino Toolkit adds the Arduino Code Generators. These extension design sheets will be documented in the user manual for the specific extension.

Arduino (*.ARD) (Arduino Toolkit)

Arduino code generator interfaces with the Arduino code chain and programs the device inline. Contains configuration information including the location of the Arduino toolchain, COM port to connect with target device.

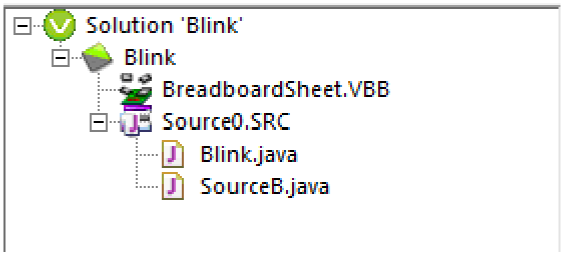
Java Source Code Project Design Sheet

The Java Source Code Project Design Sheet is a design sheet that contains a java project manager which manages a collection of java source code and java editor for editing the source code.

- Properties
- Sheet Area
- Toolbar
- Toolbox

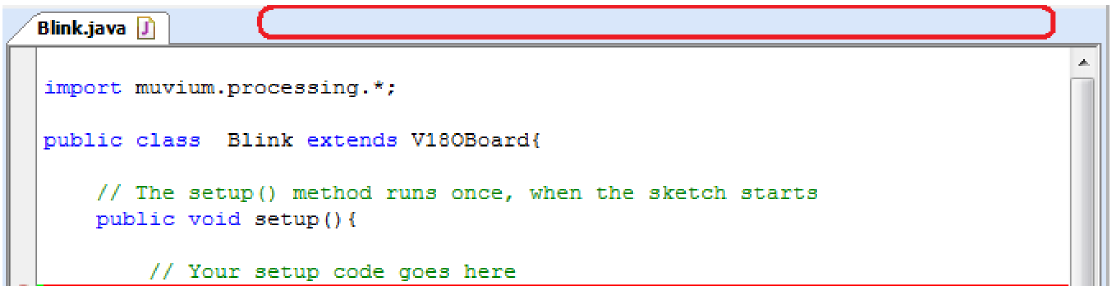
Solution Tree Manager

In the project manager view the Java Source Code Project appears with the list of the source files it contains as a sub-tree member



Activating Java Source Project

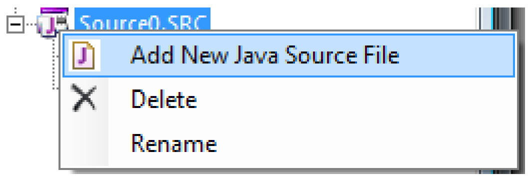
You can select the Java Source Project as the currently selected design sheet by clicking the title banner (the normal blue title bar is hidden) or **double clicking** the Java Source Project in the solution tree. Some functions such as copy/paste wont work as expected if the currently selected design sheet is not the Java Source Project containing the source editor you are working with.



```
import muvium.processing.*;

public class  Blink extends V18OBoard{

    // The setup() method runs once, when the sketch starts
    public void setup(){

        // Your setup code goes here
```

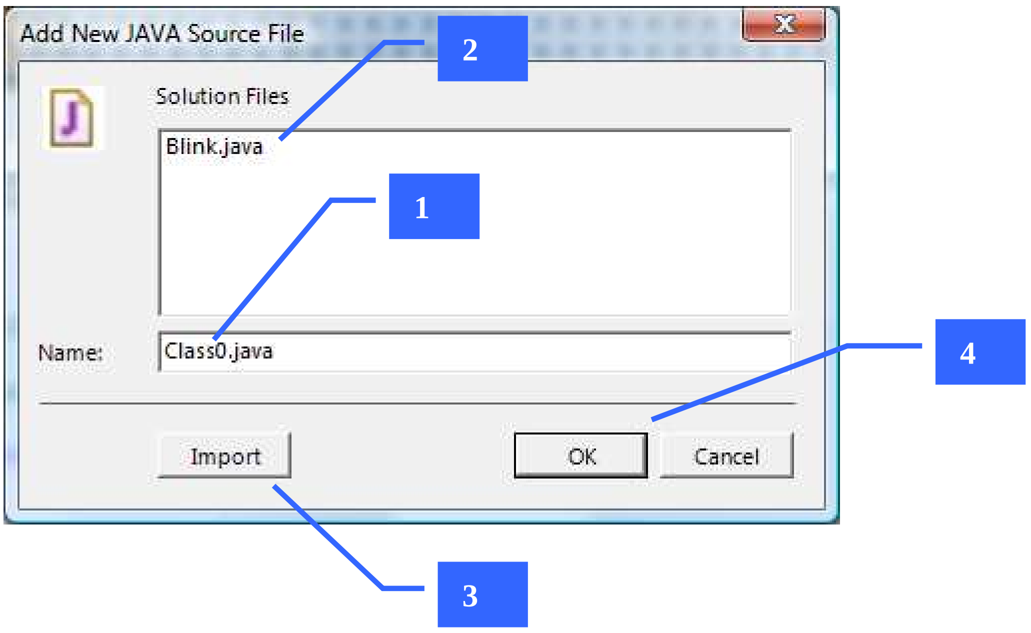
Context Sensitive Functions

By right clicking on a named Java Source Code Project in the Solution Tree the context sensitive functions are shown



Add New Java Source File

The Add New Java Source File menu allows you to add new source files to the project and pops up a dialog to allow you to name or select the java source file to add.



1 Suggested Source File name

When the Add New java Source File dialog appears it has a suggested Classname. To add you a new file you can accept this name or rename it to your preferred name. The name must be unique to the source code project which means there must not be another file of the same name in the solution directory

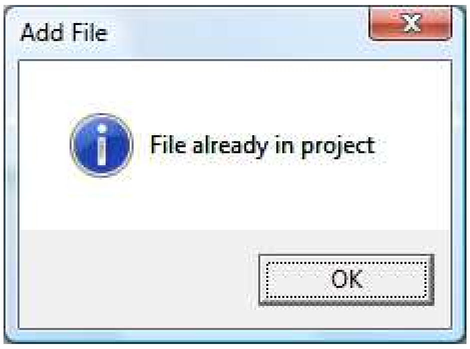
2. Solution Files

The java source files for the solution directory are shown in the Solution Files list. It can be that the source file is in the directory , for example if you have copied it directly into the directory, but not yet included in the project. In this case you can select the name from the solution files list and click OK to include it

3. Import

You might have source files you want to include in other directories. In this case you can click the import button to open a file dialog to allow you to select a file to import into the solution directory. Once imported the file will appear in the Solution Files list where you can select it to include it in the project as per (2)

4 Once you have named a new file or selected an existing one click the OK button to add it to the source project. If the file name you have selected is not unique you will receive the ‘File Already in Project’ message and the source file will not be added.


Add File

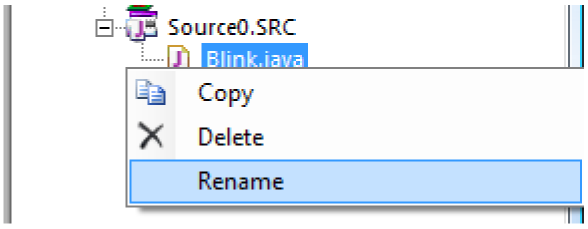
File already in project

Delete

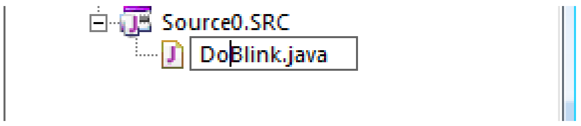
You can delete a java source file by right clicking on it in the Solution tree and clicking the delete menu option
The Java Source file will be removed from the Solution and also deleted from the solution directory

Rename

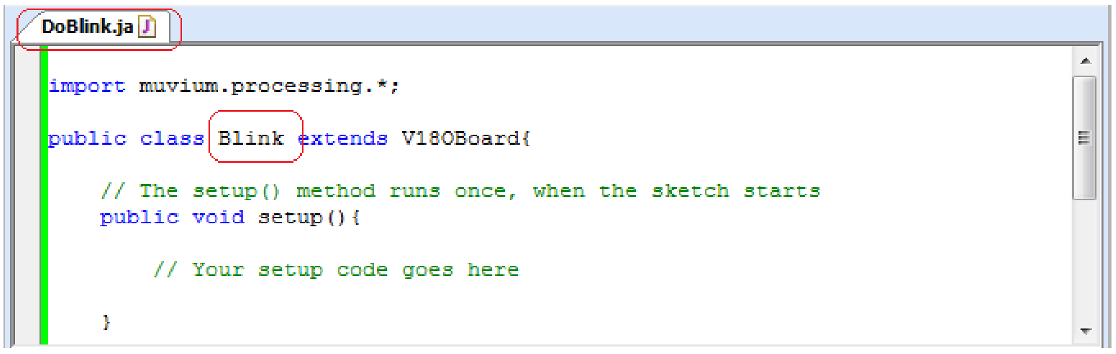
You can rename delete a java source file by right clicking on it in the Solution tree and clicking the rename menu option



The in-tree editor will then become enabled where you can edit the new name of the file



When you click enter the name of the Tab source class name is also renamed but the class Name in source is not renamed so you need to manual rename the source name. The name of the source name and the class name should match up



```
import muvium.processing.*;

public class Blink extends V180Board{

    // The setup() method runs once, when the sketch starts
    public void setup(){

        // Your setup code goes here

    }
```

Properties

Double click the Java Source Project in the Solution Tree to select the properties into the Properties Box.

Property	**Description**
Code Generator	The Code generator property is used to link the Java Source Code files to optional Code Generators such as the Arduino Code Generator when the Arduino Toolkit is activated. The default Code Generator is the Muvium Code Generator with Frappuccino framework
Development Mode	There are two development modes. Emulate Emulate+Debug In Emulate mode the code dynamically compiled using the Microsoft J# provider and executed as a Microsoft .DLL. This is faster execution speed but cannot be debugged In Emulate+Debug the code is compiled to java classfiles and executed on a custom JVM which models the muvium runtime. This is debuggable but executes slower.
ClassPath	The ClassPath allows additional external libraries to be included in the project. The classpath must point to source file directories and be absolute directory path values separate by semi colon.

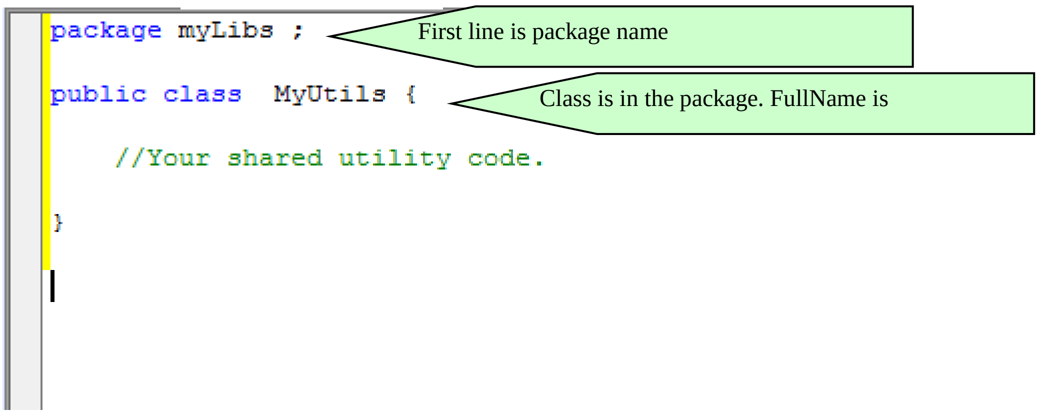
Working with ClassPath

The ClassPath to java is similar to the include path to C. VBB has only limited support for ClassPath and is restricted to Java Source Paths at the moment. This means for example Java Jar files cannot be used in the ClassPath yet. The reason is the j# code provider used in the emulate mode cannot process java class files. You use the ClassPath to include libraries you use regularly and want to share between projects. In order for a library to be able to be included in a VBB project it must use a package name and the directory path pointed to by the classpath must point at the top of the package tree.

Say for example you have a library file called MyUtils.java in order to be able to include this in your java App you must

1 Use a Package Name

The package name appears as the first line of any Java class. Give a package name, for example myLibs, your java code would like follows



```
package myLibs ;

public class  MyUtils {

    //Your shared utility code.

}
```

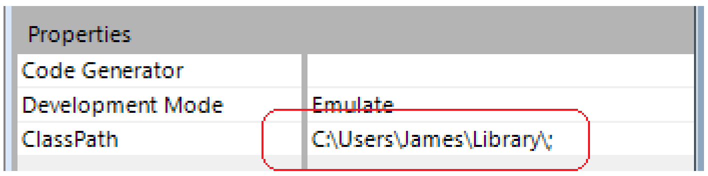
First line is package name
Class is in the package. FullName is

The full name of the class includes the package. Here its myLibs.MyUtils.

By java convention java packages start with lower case and java class files start with upper case characters

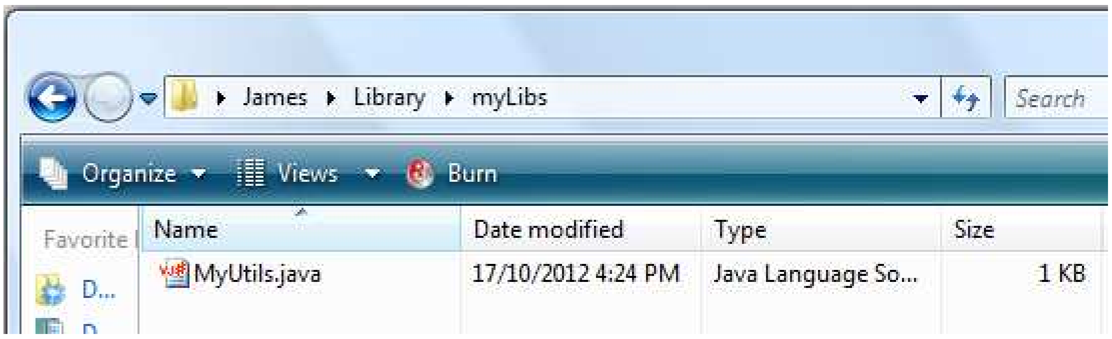
2 Save in the Package Name hierarchy with respect the ClassPath

So for say you Library directory you use in your ClassPath is “c:\Users\James\Library\;”



Properties	
Code Generator	
Development Mode	Emulate
ClassPath	C:\Users\James\Library\;

Then you need to save your MyUtils.java file in the MyLibs directory



Name	Date modified	Type	Size
MyUtils.java	17/10/2012 4:24 PM	Java Language So...	1 KB

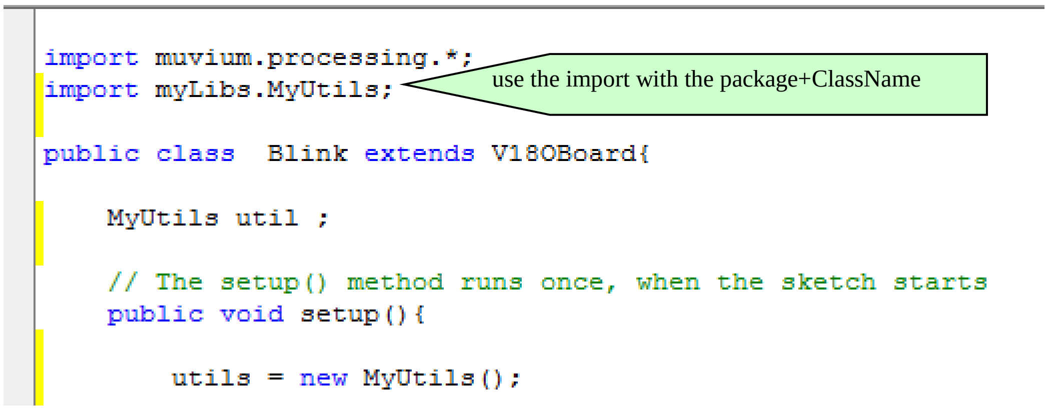
So the hierarchy looks like this
“c:\Users\James\Library\;” < ClassPath Directory
“c:\Users\James\Library\myLibs\ << Package Directory
“c:\Users\James\Library\myLibs\MyUtils << Library Source Code

You can also use ‘.’ Separated names for package names for example package myLibs.math ; In this case the directory structure extends with ‘.’ Becoming sub directories

“c:\Users\James\Library\;” < ClassPath Directory
“c:\Users\James\Library\myLibs\math << Package Directory
“c:\Users\James\Library\myLibs\math\MyUtils << Library Source Code

3. Use the Import with Package name in your Application

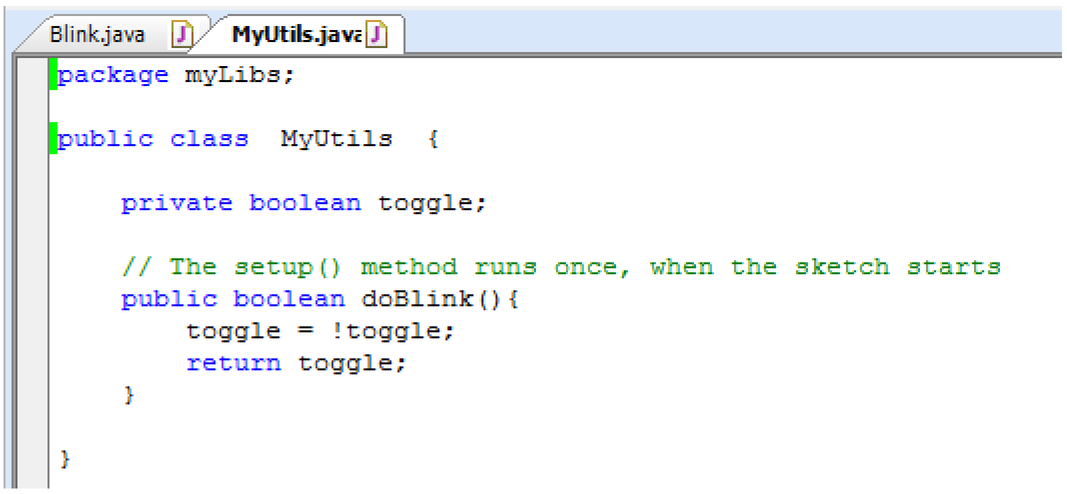
To actually enable the Java Source Code Project to find your library you need to include it using the import statement.



```
import muvium.processing.*;
import myLibs.MyUtils;

public class  Blink extends V18OBoard{

    MyUtils util ;

    // The setup() method runs once, when the sketch starts
    public void setup(){

        utils = new MyUtils();
```

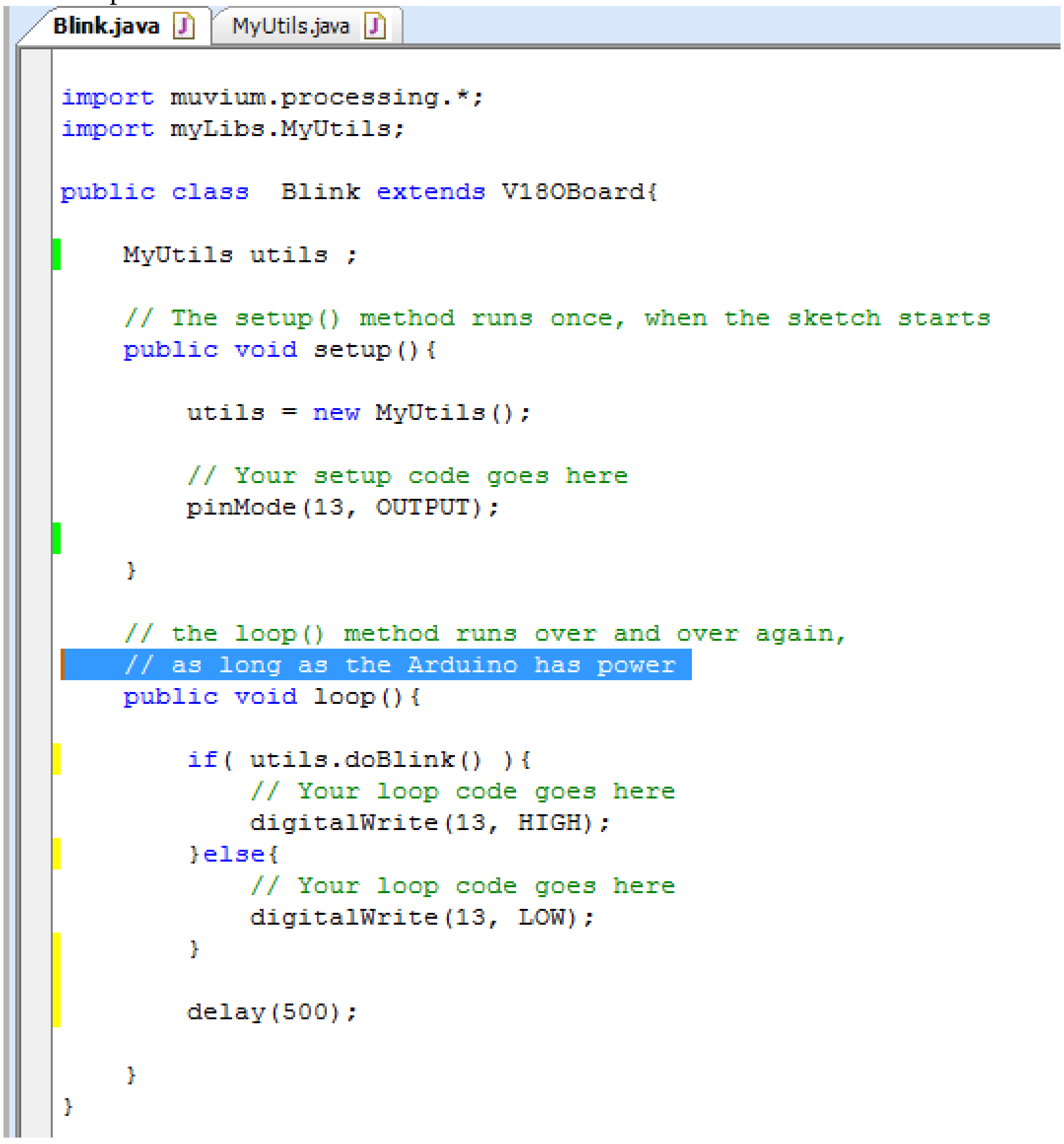
Working with Packages within the Java Source Project

Normally you create a sub directory heirachy to reflect the java package path. This is not presently supported in Source Projects. However you can work with the flat hierarchy. So for example to add a myLibs.MyUtils java class file you just add the package name to the java class file.



```
package myLibs;

public class  MyUtils  {

    private boolean toggle;

    // The setup() method runs once, when the sketch starts
    public boolean doBlink(){
        toggle = !toggle;
        return toggle;
    }

}
```

Then import and use it



```

import muvium.processing.*;
import myLibs.MyUtils;

public class  Blink extends V18OBoard{

    MyUtils utils ;

    // The setup() method runs once, when the sketch starts
    public void setup(){

        utils = new MyUtils();

        // Your setup code goes here
        pinMode(13, OUTPUT);

    }

    // the loop() method runs over and over again,
    // as long as the Arduino has power
    public void loop(){

        if( utils.doBlink() ){
            // Your loop code goes here
            digitalWrite(13, HIGH);
        }else{
            // Your loop code goes here
            digitalWrite(13, LOW);
        }

        delay(500);

    }
}
```

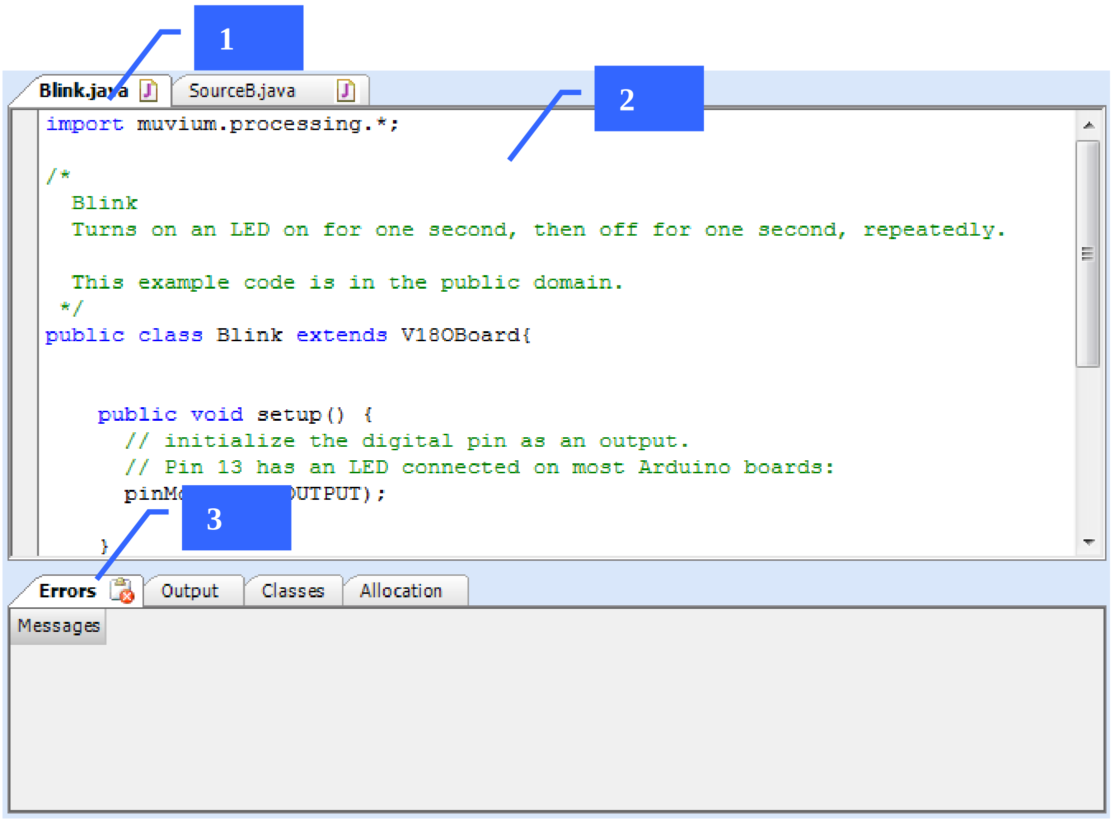
However, if you then want to share MyUtils as a library you must copy the file into the package name sub directory structure for it to be locateable

Sheet Area

The Sheet Area contains the editors and information tabs. There are two possible configurations

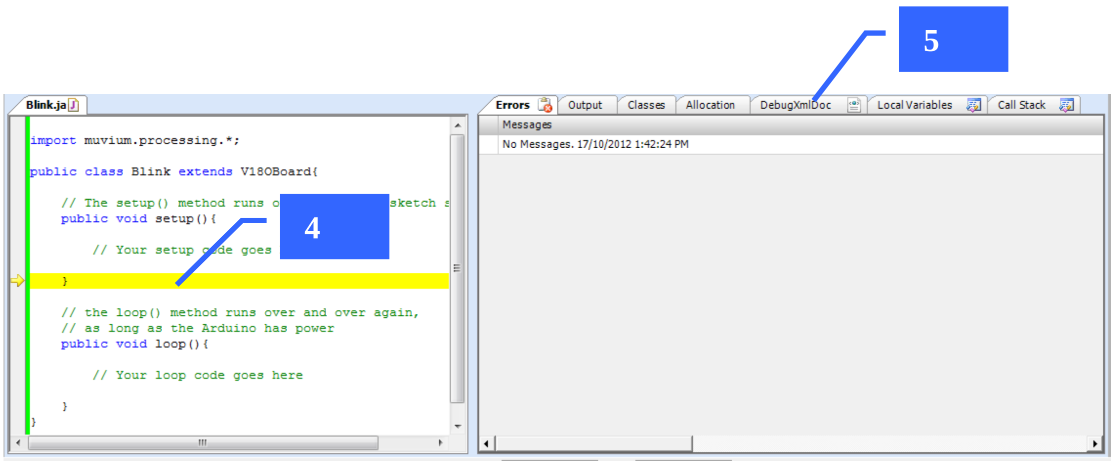
- Design Time Configuration
- Runtime Debug Configuration

Design Time Configuration



```
import muvium.processing.*;

/*
  Blink
  Turns on an LED on for one second, then off for one second, repeatedly.

  This example code is in the public domain.
 */
public class Blink extends V18OBoard{


    public void setup() {
      // initialize the digital pin as an output.
      // Pin 13 has an LED connected on most Arduino boards:
      pinM        UTPUT);
    }
```

Debug Runtime Configuration



```
import muvium.processing.*;

public class Blink extends V18OBoard{

    // The setup() method runs o          sketch s
    public void setup(){

        // Your setup code goes

    }

    // the loop() method runs over and over again,
    // as long as the Arduino has power
    public void loop(){

        // Your loop code goes here

    }
}
```

No Messages. 17/10/2012 1:42:24 PM

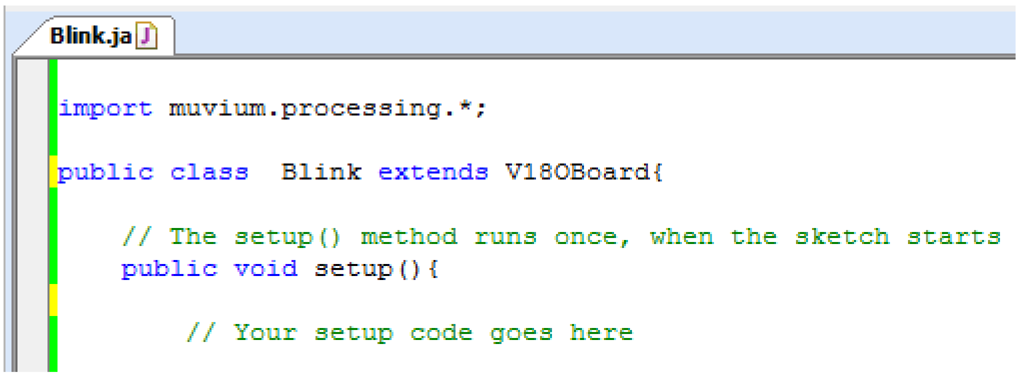
1. Source Code Tabs – Click the tab to select the source file as the current file
2. Design Time Source Editor – Editor the for the current source file with design time features tab completion etc
3. Design Information Tabs – Errors, Output, Classes Allocation
4. Runtime Editor with runtime features such as current line, call trace, breakpoint
5. Runtime debug Tabs = DebugXmlDoc, Local Variable, CallStack

Design Time Source Editor

The Editor at Design Time has useful features typical of modern source editor

Keyword Highlighting

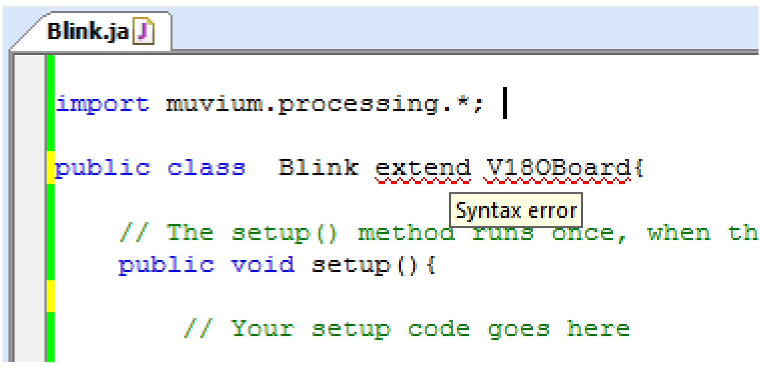
The editor understands the code is a java and highlights the java keywords such as import, public, class , extends etc. This make the code more readable



```
import muvium.processing.*;

public class  Blink extends V18OBoard{

    // The setup() method runs once, when the sketch starts
    public void setup(){

        // Your setup code goes here
```

Syntax Error Highlighting

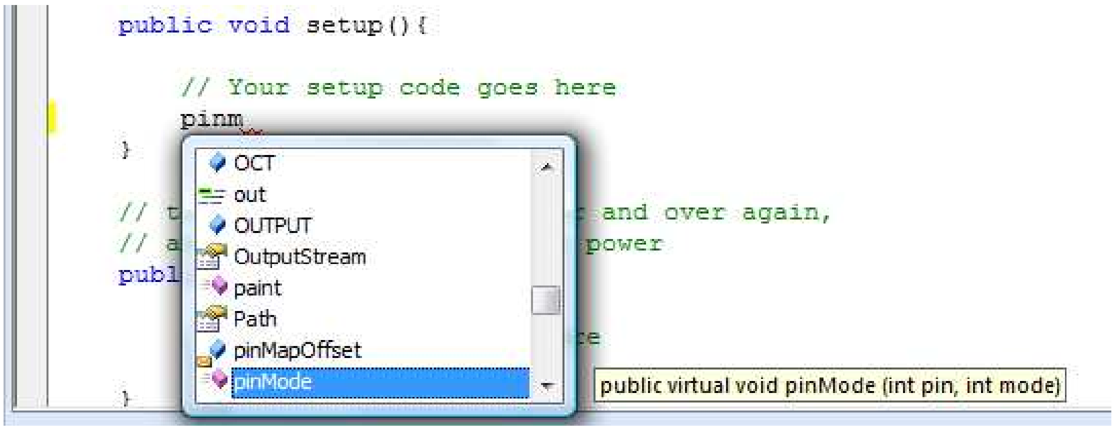
The editor can also detect when a syntax error has occurred with the java language structure and will highlight the syntax error with a red squiggle underscore to assist in locating and correcting the syntax error.



```
import muvium.processing.*;

public class  Blink extend V18OBoard{

    // The setup() method runs once, when th
    public void setup(){

        // Your setup code goes here
```

Tab Suggestions

As you type can get completion suggestions by typing {CTRL}+{TAB}
This will popup a context sensitive context box based on you're the text entered so far.



```
public void setup(){

    // Your setup code goes here
    pinm
}

// t                          and over again,
// a                          power
publ

                              te

}
```

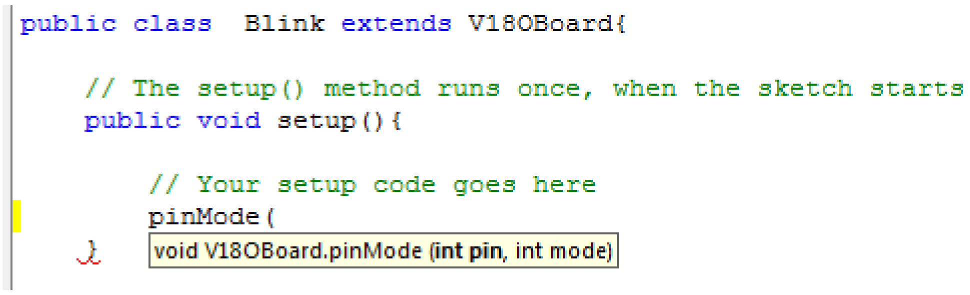
public virtual void pinMode (int pin, int mode)

You can navigate the suggestions box using the mouse or the {UP} and {DOWN} arrow keys

Pressing {TAB} or {ENTER} will choose the selected suggestion and enter the text. This is useful for getting the exact syntax of a function based on its partial name

Parameter Suggestions

When you have entered a recognised function name when you type the '(' you will receive parameter suggestions to help complete the function

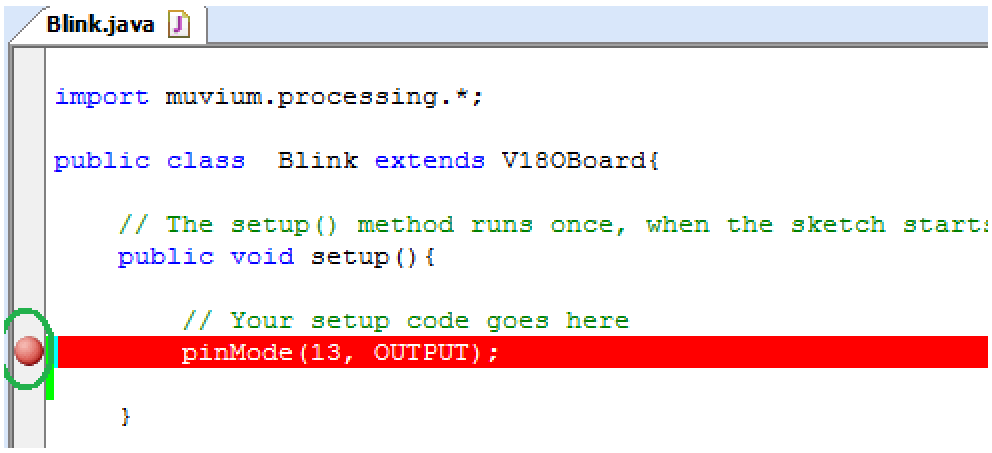


```
public class  Blink extends V18OBoard{

    // The setup() method runs once, when the sketch starts
    public void setup(){

        // Your setup code goes here
        pinMode(
    }
```

void V18OBoard.pinMode (**int pin**, int mode)

Toggle Breakpoints

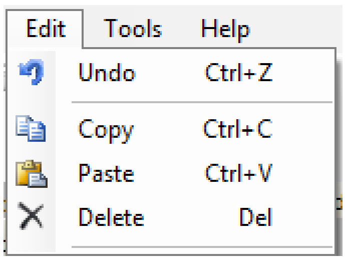
Clicking in the left hand margin toggles breakpoints on and off for a particular line of code. Breakpoints are used to stop execution when in Emulation+Debug mode


Blink.java

```
import muvium.processing.*;

public class  Blink extends V18OBoard{

    // The setup() method runs once, when the sketch start

    public void setup(){

        // Your setup code goes here
        pinMode(13, OUTPUT);

    }
```

Edit Menu, Cut, Copy and Paste Undo

You can cut, copy and paste code sections in the Source Editor.

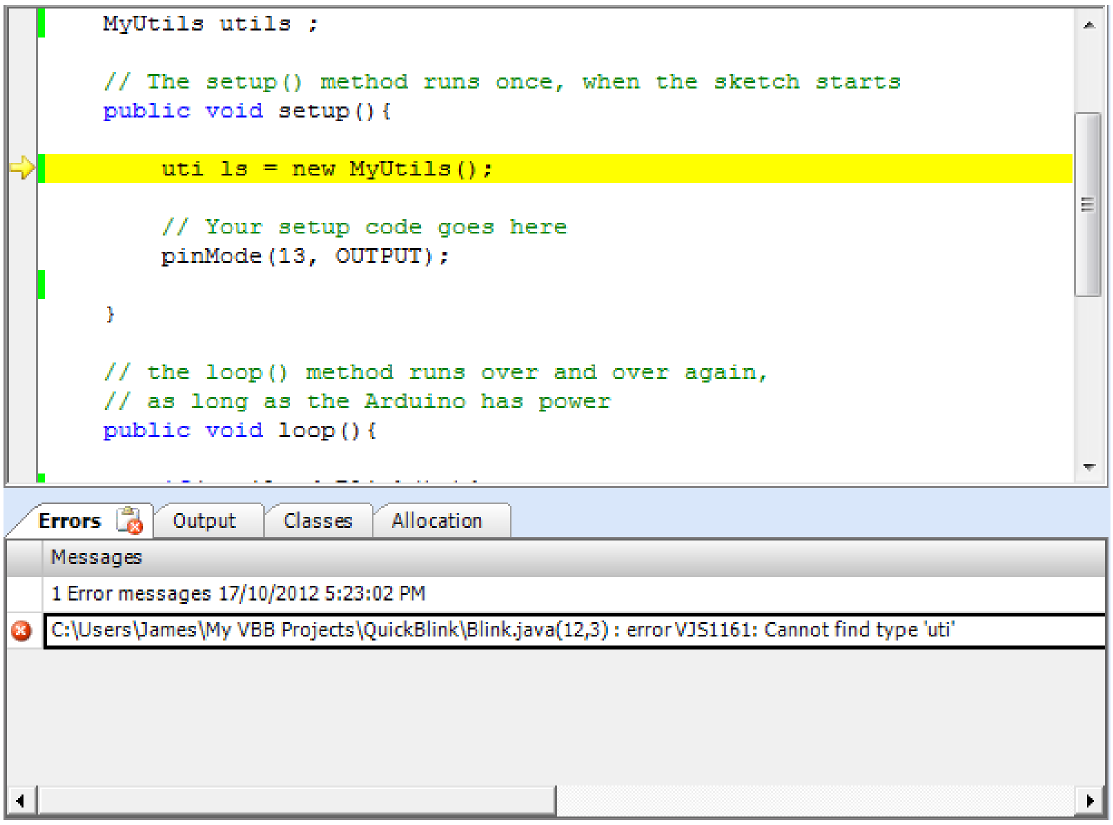


TIP: If the Java Source Editor Project is not the currently selected design sheet the Cut/Copy/Paste functions wont work with the Source Editor.

See Activate Java Source Project

Design Time Tabs

Errors Tab


```
    MyUtils utils ;

    // The setup() method runs once, when the sketch starts
    public void setup(){

        uti ls = new MyUtils();

        // Your setup code goes here
        pinMode(13, OUTPUT);

    }

    // the loop() method runs over and over again,
    // as long as the Arduino has power
    public void loop(){
```

```
1 Error messages 17/10/2012 5:23:02 PM
C:\Users\James\My VBB Projects\QuickBlink\Blink.java(12,3) : error VJS1161: Cannot find type 'uti'
```

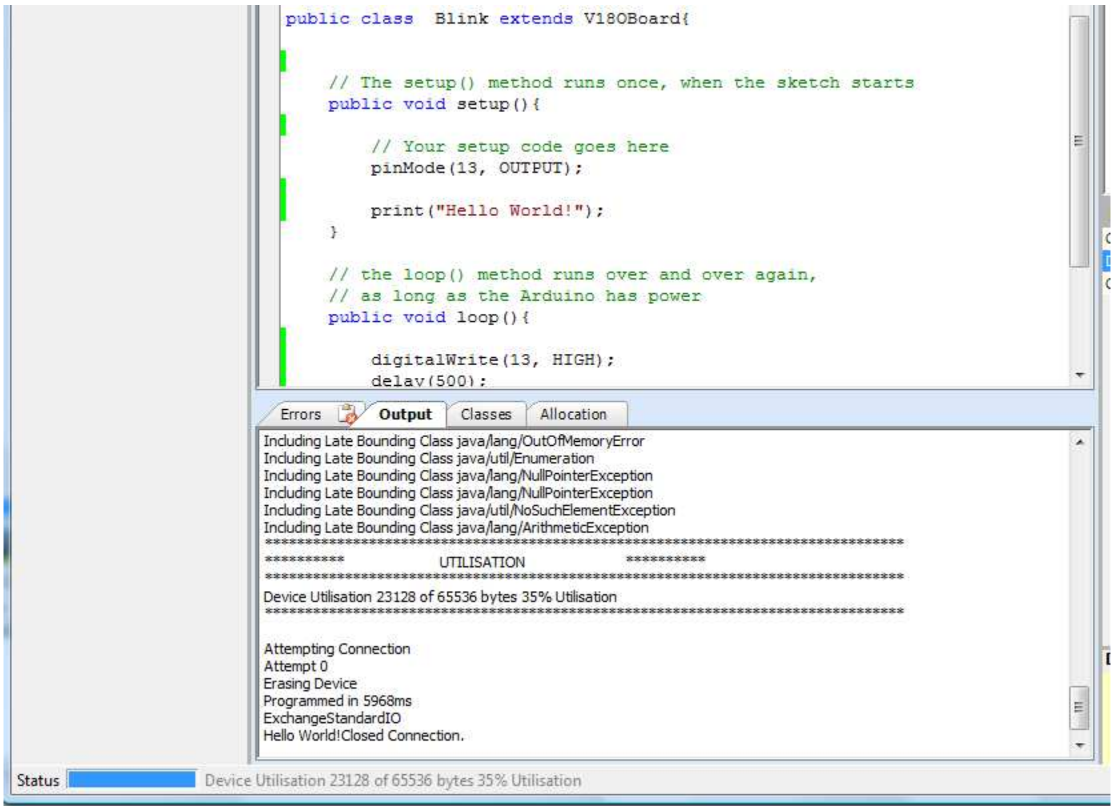
The errors tab contains a list of any syntax errors generated at build time. When you build the project the source code is compiled into java bytecode first by java J# code provider as a quick check and then secondly by the java jikes compiler. If errors for either of these two java compilers are generated then they are listed in the Errors tab.

For example if you mistyped util as uti ls then the compiler would locate the error.

If you Click on the error in the Errors tab then the error line will be located and highlighted in yellow

Output Tab

At design time the OutputTab reports design time information such as muvium compiler output



```
public class  Blink extends V180Board{

    // The setup() method runs once, when the sketch starts
    public void setup(){

        // Your setup code goes here
        pinMode(13, OUTPUT);

        print("Hello World!");
    }

    // the loop() method runs over and over again,
    // as long as the Arduino has power
    public void loop(){

        digitalWrite(13, HIGH);
        delay(500);
```

```
Including Late Bounding Class java/lang/OutOfMemoryError
Including Late Bounding Class java/util/Enumeration
Including Late Bounding Class java/lang/NullPointerException
Including Late Bounding Class java/lang/NullPointerException
Including Late Bounding Class java/util/NoSuchElementException
Including Late Bounding Class java/lang/ArithmeticException
************************************************************************************
**********              UTILISATION              **********
************************************************************************************
Device Utilisation 23128 of 65536 bytes 35% Utilisation
************************************************************************************

Attempting Connection
Attempt 0
Erasing Device
Programmed in 5968ms
ExchangeStandardIO
Hello World!Closed Connection.
```

Status Device Utilisation 23128 of 65536 bytes 35% Utilisation

Classes

Not yet implemented: The Classes Tab will show all the classes included in the current build. Useful for optimisation and dependency analysis

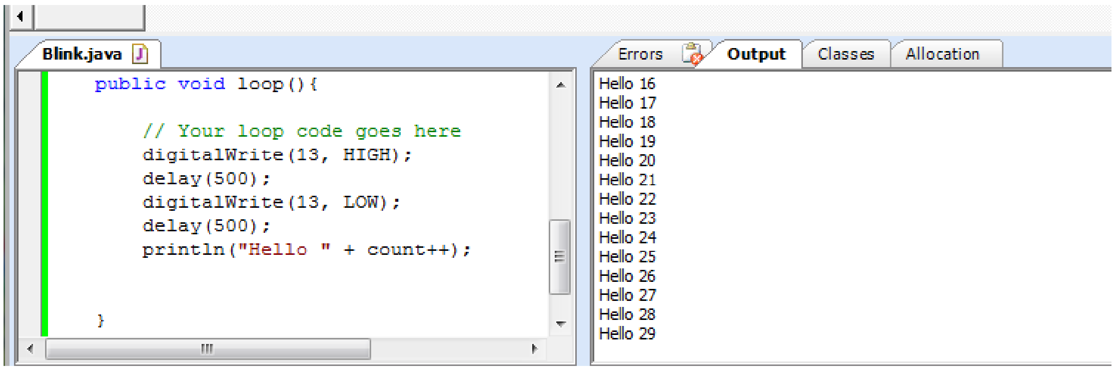
Allocation

Not yet implemented: The Allocation will show visually and in table form the allocation in bytes of the methods in the application. Useful for optimisation.

Runtime Tabs

Output

During runtime the Output tab shows the output of the standard output from the emulated code

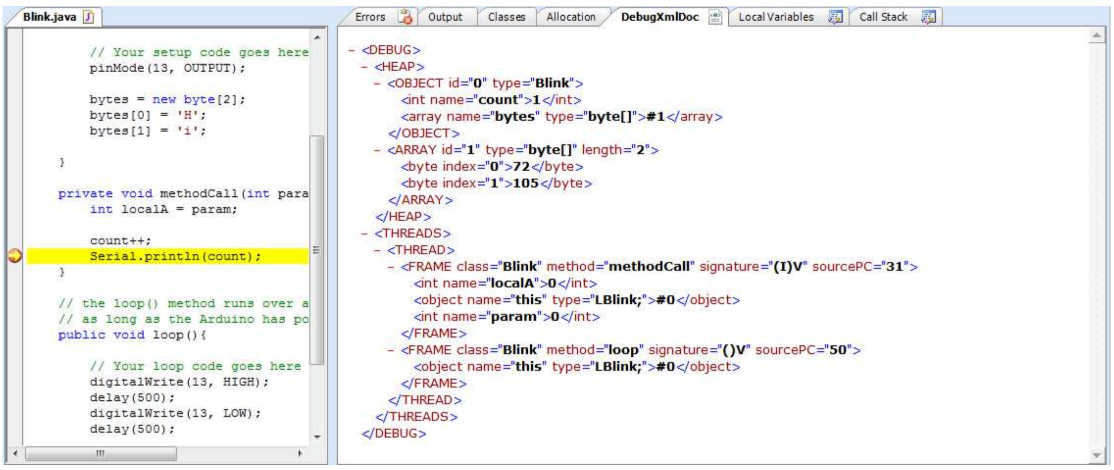


```
public void loop(){

    // Your loop code goes here
    digitalWrite(13, HIGH);
    delay(500);
    digitalWrite(13, LOW);
    delay(500);
    println("Hello " + count++);


}
```

```
Hello 16
Hello 17
Hello 18
Hello 19
Hello 20
Hello 21
Hello 22
Hello 23
Hello 24
Hello 25
Hello 26
Hello 27
Hello 28
Hello 29
```

.

DebugXmlDoc



```
        // Your setup code goes here
        pinMode(13, OUTPUT);

        bytes = new byte[2];
        bytes[0] = 'H';
        bytes[1] = 'i';

    }

    private void methodCall(int para
        int localA = param;

        count++;
        Serial.println(count);
    }

    // the loop() method runs over a
    // as long as the Arduino has po
    public void loop(){

        // Your loop code goes here
        digitalWrite(13, HIGH);
        delay(500);
        digitalWrite(13, LOW);
        delay(500);
```

```
- <DEBUG>
  - <HEAP>
    - <OBJECT id="0" type="Blink">
        <int name="count">1</int>
        <array name="bytes" type="byte[]">#1</array>
      </OBJECT>
    - <ARRAY id="1" type="byte[]" length="2">
        <byte index="0">72</byte>
        <byte index="1">105</byte>
      </ARRAY>
    </HEAP>
  - <THREADS>
    - <THREAD>
      - <FRAME class="Blink" method="methodCall" signature="(I)V" sourcePC="31">
          <int name="localA">0</int>
          <object name="this" type="LBlink;">#0</object>
          <int name="param">0</int>
        </FRAME>
      - <FRAME class="Blink" method="loop" signature="()V" sourcePC="50">
          <object name="this" type="LBlink;">#0</object>
        </FRAME>
      </THREAD>
    </THREADS>
  </DEBUG>
```

In Emulate+Debug mode when a breakpoint is hit or a single step executed a snapshot of the JVM memory is made and published as a Xml document.

To interpret the document you need to know a few things about a JVM

Heap

Heap = { References }

The Heap is a collection references where a reference is Object or an Array. Each object has an object Id which is used to reference other Objects. The Heap is Garbage Collectable so when an object is not longer referenced it becomes available for collection the next time the Garbage collector runs. The GC runs when there is not enough memory to create a new instance of an object or when a user invokes System.gc

Reference

Reference = Object | Array

Object

Object = { Fields}

An object is a collection of Fields.

Array

An array is a collection Reference of DataType
Array = { Reference | DataType }

DataType

DataType	ShortCut	Min Value	Max Value
boolean	True | False		
byte	Signed 8-bit byte		
char	Unsigned bit		
short	Signed 16-bit		
int	Signed 16-bit		
Long	Signed 32-bit		
Float	32-bit modified IEEE		
Double	32-bit modified IEEE		

Field

A Field is a store for data type or a reference

Field = Data Type | Reference

Thread

Thread = { FRAME }

A Thread is an independent execution context consisting of a collection of execution frames. Threads switch execution using the Thread.yield() or Thread.sleep() method.

Threads

Threads = { Thread }

Threads is a collection of Thread

FRAME

A frame is a execution context of a Method consisting of Local Variables and a Operand Stack.

Method

A method is a collection of java bytecode that is the output of the java compilation processes. A method executes the java bytecode using the frame location variables and operand stack to hold the partial results of the execution.

Local Variables

Local Variable = DataType | Reference

Are fast access registers in the frame execution context, including the method parameters, that contain either a datatype or a reference.

Frame Operand Stack

Frame Operand Stack = { DataType | Reference }

The frame operand stack is a stack of DataType or reference that hold the partial results of the stack based operations of the Java Virtual Machine.

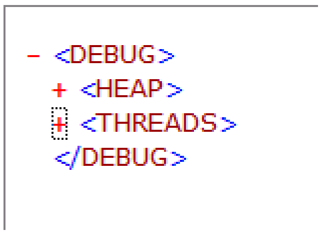
Interpreting the XML SnapShot View

When the JVM hits a breakpoint a snapshot of this memory model is made. This Xml view allows a complete snapshot of the memory model of the JVM. It is human readable view but it is a raw view which other views such as the local variable or call-stack view construct their views.

In the example shown

```
<DEBUG>
  <HEAP>
    <OBJECT id="0" type="Blink">
      <int name="count">4</int>
      <array name="bytes" type="byte[]">#1</array>
    </OBJECT>
    <ARRAY id="1" type="byte[]" length="2">
      <byte index="0">72</byte>
      <byte index="1">105</byte>
     </ARRAY>
  </HEAP>
  <THREADS>
    <THREAD>
      <FRAME class="Blink" method="methodCall" signature="(I)V" sourcePC="31">
        <int name="localA">3</int>
        <object name="this" type="LBlink;">#0</object>
        <int name="param">3</int>
      </FRAME>
      <FRAME class="Blink" method="loop" signature="()V" sourcePC="50">
        <object name="this" type="LBlink;">#0</object>
      </FRAME>
    </THREAD>
  </THREADS>
  </DEBUG>
<DEBUG>
```

`Lets Look at this snapshot one section at a time. XML is collapsible and`

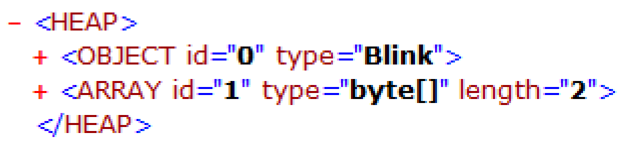


```
- <DEBUG>
  + <HEAP>
  + <THREADS>
  </DEBUG>
```

`DEBUG = { HEAP, THREADS }`

So DEBUG (Doc) contains 2 main block, the HEAP and the THREADS representing the memory model of the JVM

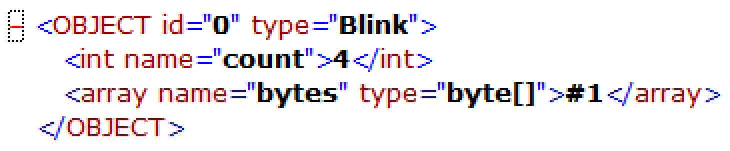
HEAP



```
- <HEAP>
  + <OBJECT id="0" type="Blink">
  + <ARRAY id="1" type="byte[]" length="2">
  </HEAP>
```

`HEAP = { Blink, byte[] }`

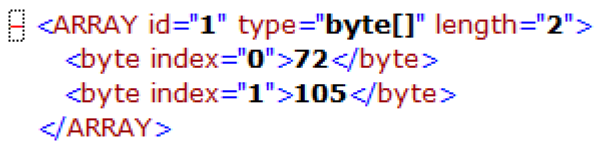
The HEAP is a collection of references, there are 2 references an instance of OBJECT Blink and Array of type byte with length of 2.



```
- <OBJECT id="0" type="Blink">
    <int name="count">4</int>
    <array name="bytes" type="byte[]">#1</array>
  </OBJECT>
```

```
Blink = { count, byte[] }
```

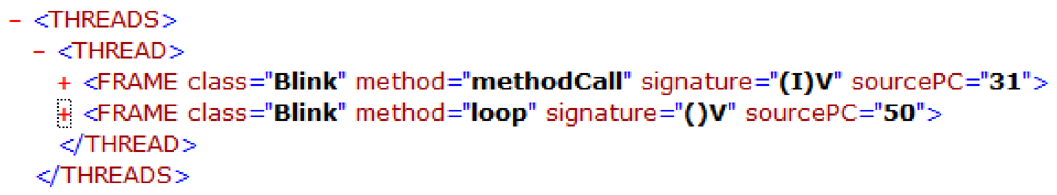
The first Reference in the HEAP is an Object with id=0. Is an instance of user defined type Blink and contains a collection of 2 fields, an integer named count with value of 4 and reference to the byte array stored on the heap with reference id 1.



```
- <ARRAY id="1" type="byte[]" length="2">
    <byte index="0">72</byte>
    <byte index="1">105</byte>
  </ARRAY>
```

The second Reference is an ARRAY with Reference id =1 so this is the reference that the Blink.bytes filed is referenceing. It is a byte array of length 2 with 2 values, { 72, 105 } = { 'H','i' } .

Threads

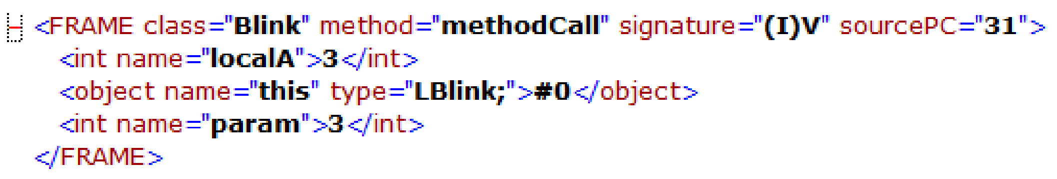


```
- <THREADS>
  - <THREAD>
    + <FRAME class="Blink" method="methodCall" signature="(I)V" sourcePC="31">
    + <FRAME class="Blink" method="loop" signature="()V" sourcePC="50">
    </THREAD>
  </THREADS>
```

Threads contains a single Thread so this application is single threaded.

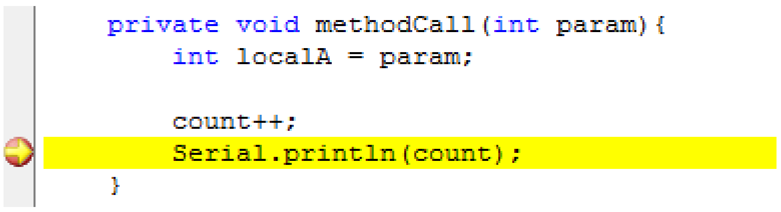
The single thread contains two frames which constitute a FRAMESTACK

The currently executing FRAME is for the method methodCall from the class Blink. It was called from previous call in the framestack which is from the method loop.



```
- <FRAME class="Blink" method="methodCall" signature="(I)V" sourcePC="31">
    <int name="localA">3</int>
    <object name="this" type="LBlink;">#0</object>
    <int name="param">3</int>
  </FRAME>
```

The methodCall frame has 3 local variables which correspond to the source code for the methodCall method.



```
    private void methodCall(int param){
        int localA = param;

        count++;
        Serial.println(count);
    }
```

However looking at the source code it seems to have only 1 local variable, localA.

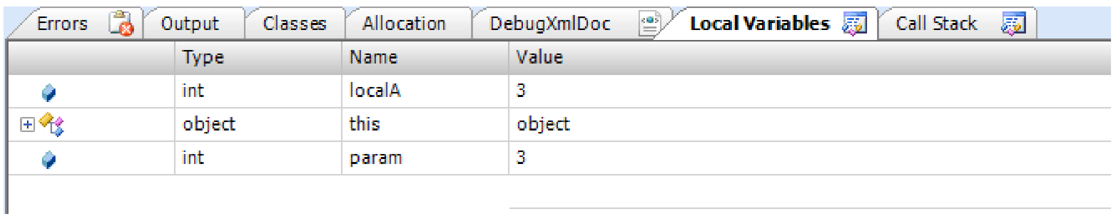
The java compiler though includes parameters as local variables so param becomes a local variable. In addition for methods that are not static, java creates an additional local variable to save the class instance that the method is called from. This is the 'this' variable and is accessed in code using the this keyword.

You can also see the current values of the local variables, localA and param have value 3 and 'this' is a reference which points to heap id='0' which we say earlier as the first object in the HEAP. When count++ is executed this operates on the instance of the class in 'this', so the field count will increment and now has the value 4 which means methodCall has been called 4 times up to this breakpoint.

Local Variable Tab

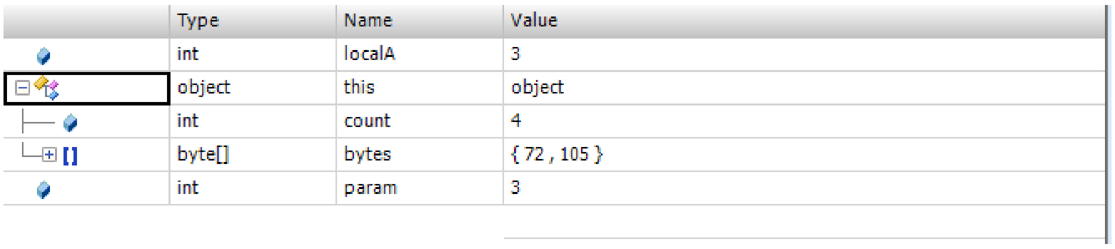
The local variable tab is a view of the current frame of the DebugDocXml. Using the same data from the previous example the Local Variable Tab will construct a navigateable tree view with some additional markup to help focus on the specific information you are interested in.

Here we can see the same 3 variables, localA, param and this along with their Type and values in a more direct view.



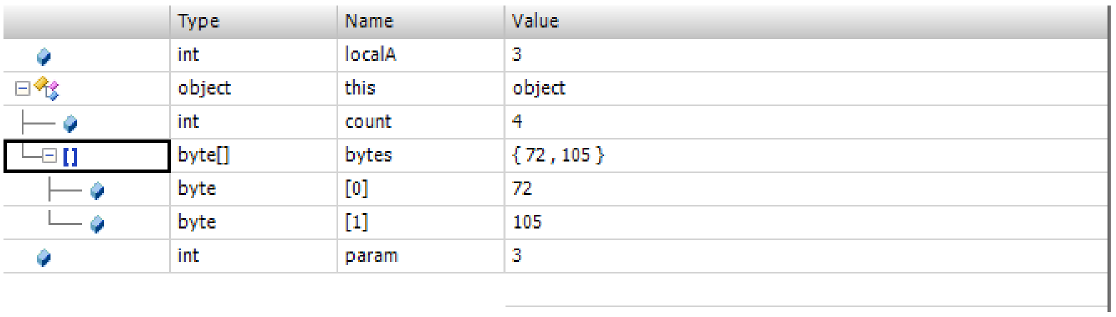
	Type	Name	Value
	int	localA	3
⊞	object	this	object
	int	param	3

The object 'this' is a collection of fields and we inspect the fields by clicking '+' to open the field collection in the view. Now we can see the instance 'this' contains the field count with value 4 and the references bytes. A summary of the contents of the byte array is shown in the Value field but you can inspect the specific members by clicking the '+'



	Type	Name	Value
	int	localA	3
⊟	object	this	object
├──	int	count	4
└⊞ []	byte[]	bytes	{ 72 , 105 }
	int	param	3

So in this way you can navigate the data model of the memory snapshot

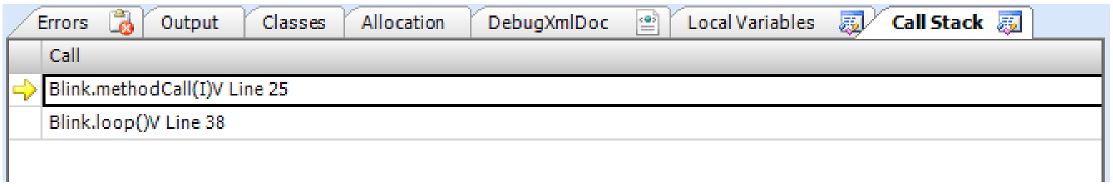


	Type	Name	Value
	int	localA	3
⊟	object	this	object
├──	int	count	4
└─⊟ []	byte[]	bytes	{ 72 , 105 }
├──	byte	[0]	72
└──	byte	[1]	105
	int	param	3

Call Stack

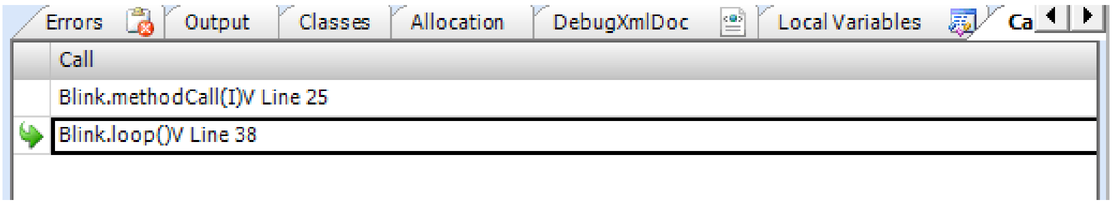
The Call Stack is also a view of a specific part of part of the DebugXmlDoc, specifically the FRAMESTACK of the currently executing Thread.

```
- <THREADS>
  - <THREAD>
    + <FRAME class="Blink" method="methodCall" signature="(I)V" sourcePC="31">
    + <FRAME class="Blink" method="loop" signature="()V" sourcePC="50">
    </THREAD>
  </THREADS>
```



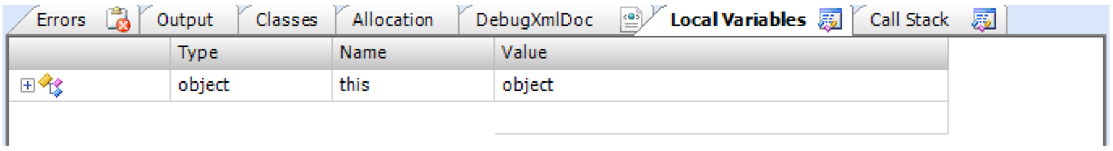
Call
Blink.methodCall(I)V Line 25
Blink.loop()V Line 38

The Call Stack has the additional feature of allowing you to select the current frame to view in the Local Variable View. So if you clock the Blink.loop() in the Call Stack the currently selected Call with be highlighted with a green arrow line. The source line for where the call was made will (todo) be highlighted as a green source line and the frame viewed by the Local Variable tab will change to that selected by the Call Stack



Call
Blink.methodCall(I)V Line 25
Blink.loop()V Line 38

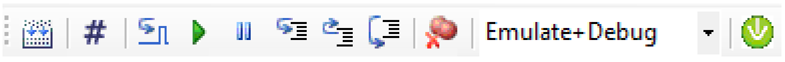
```
<FRAME class="Blink" method="loop" signature="()V" sourcePC="50">
  <object name="this" type="LBlink;">#0</object>
</FRAME>
```



	Type	Name	Value
⊞	object	this	object

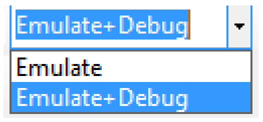
Clicking the topmost member of the call stack element highlights the line with a yellow arrow and line to indicate this is the currently executing line.

Toolbar : Java Source Code Project



The Source Code Project toolbar

Emulation Mode



There are two emulations modes supported.
Emulate
Emulate+Debug

Emulate mode

The java source code is compiled into a Microsoft .DLL by the J# Code Provider. The dynamic .DLL is loaded and the code is executed at full speed on the microsoft .net runtime. This is the full speed emulation mode but doesn't support debugging.

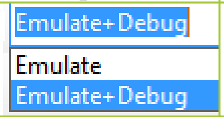
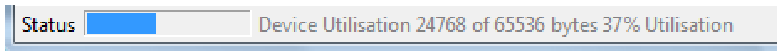
Emulate+Debug mode

The java source is compile into java byte code by the jikes compiler. The java byte code is loaded into custom JVM which executes the code and supports debugging. This mode is potentially slower execution but supports debugging.

In Emulate+Debug mode the debug toolbar becomes active when the virtualbreadbaord circuit is executed and the device is started in suspend mode. This allows you to set any breakpoints and gives you the option to either step or run the App.

However, this is a source of potential confusion when compared to Emulate only mode when you just want to run the emulation because you need to press run twice. First press run the circuit and second press run to start the emulated App.

Icon	ShortCut	Description
▦	Build	Builds the Java Source Code Project Application. The Java source code is pre-processed by the Microsoft J# Code Provider before being compiled by the jikes java compiler. Errors for either compilation are shown in the errors tab.
#	Reset	During executing in Emulation+Debug Mode resets the PC to 0 and halts the emulated micro returning it to the state it had when the circuit was first started.
⎍	Step Clock	Future
▶	Run Emulation	Runs the emulated Micro App. Will run until the code hits a

		breakpoint or the user clicks pause.
	Pause Emulation	Pause the Debug Micro emulation. Will enter step mode, the current line will be highlighted yellow and the debug views will be updated with the current snapshot of the memory model
	Step	Steps the current source line. The debug views will update and the current line will be highlighted
	Step Out	Future
	Step Over	Future
	Remove All Breakpoints	Removes all the Breakpoints
	 Emulate+Debug Emulate Emulate+Debug	Emulation Mode
	One-Click Program	Builds and programs a real-micro target. Will call build if the source code has changed and will call the Code Generator attached to the current java source code project. The default Code Generator is the Muvium Code Generator for Frappuccino. When programming the status is shown in the bottom left status bar  Status Device Utilisation 24768 of 65536 bytes 37% Utilisation

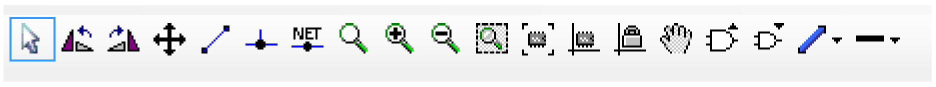
Breadboard DesignSheet

The Breadboard DesignSheet is a circuit emulation enabled drag and drop design sheet.

- DesignSheet – the DesignSheet a design graphic containing the component models
- Toolbar – the Breadboard toolbar is populated with graphical manipulation tools to zoom pan and manipulate the graphical design
- Toolbox – The Breadboard toolbox is populated with electronic component models which can be dragged and dropped on to Breadboard design

Toolbar : Breadboard

The graphics toolbar allows the manipulation of the Breadboard graphics, components and links.



Toolbar	Button	Description
Run Emulation	▶	Starts an Emulation of the virtual circuit - requires an ICEShield
Stop Emulation	■	Stop the Emulation and returns to Design mode.
Select Mode	↖	Enters Select Mode. The cursor becomes an arrow. In select mode click on components to select them. Selecting a component populates the property box with the component properties.
Rotate Left	↺	Rotate Left. Rotates a component 90 degrees left.
Rotate Right	↻	Rotate Right. Rotates a component 90 degrees right.
Move Mode	✥	Enters move Mode. The cursor becomes a NSEW pointer. In move mode you can drag and drop component to new location .
Link Mode	⁄	Enters link Mode. The cursor becomes a cross-hair and you can draw links between component pins.
Junction	┴	Merges two links by joining with a junction.
Net	NET	Merges links with the same net name
Zoom	🔍	Zoom Mode. Click the Zoom button to enter zoom mode. When over the Breadboard layout the cursor will change into a Zoom graphic. Click and hold the mouse down and then moving vertically up will zoom out and vertically down will zoom in. Stays in zoom mode until another graphic mode is selected
Zoom In	🔍+	Zoom in by factor 2

Zoom out	🔍	Zoom out by factor ½
Zoom region	🔍	Zoom to a region. *Not functional @v0.1*
Zoom Extents	⬚	Zoom to the extents. *Not functional @v0.1*
Restore Origin	⬚	Restore the origin to offset 0,0 and zoom =1
Lock origin	🔒	Lock the origin when zooming. When locked the offsets don’t change only the zoom factor. When not locked the offset changes to keep the center of the screen fixed
Pan	✋	Pan Mode. Click the Pan button to enter Pan mode. When over the Breadboard layout the cursor will change into a Hand Zoom graphic. Click and hold the mouse down and then drag the display to pan around. Stays in Pan mode until another graphic mode is selected
Grow	⬚	Grow the selected components by factor 2
Shrink	⬚	Shrink the selected components by factor ½
Link Color	✏	Set the link color. Sets the currently selected links to the selected color. Future links will be created with the new color.
Link Weight	▬	Set the link width. Sets the currently selected links to the selected weight. Future links will be created with the new weight.
Show Nets	⋈	Show the virtual nets between named nets in the circuit board.

Note on Zoom factor:

The snap to grid has a problem when the zoom factor is not a multiple of 2. You should not try to select links or draw links at arbitary zoom factors. The zoom, zoom extents, zoom region are best used to inspect the design and select components but you should restore the origin and use the zoom in, zoom out when drawing links to ensure the zoom is a multiple of 2.

DesignSheet : Breadboard

Placing a component from the Toolbox

Placing a component is an important skill – not quite drag and drop. You need to click on the Toolbox icon releasing the mouse button. This attaches the component to the mouse pointer when you move over the Breadboard design. You can then drag the component into position in the DesignSheet and click a second time to place the component.

Component Editing

There are several ways you can work with components.

- Placing a component
- Select a component
- Select a group of components
- Append a component to a selection
- Move a group of selected components
- Copy and paste selected components
- Delete selected components

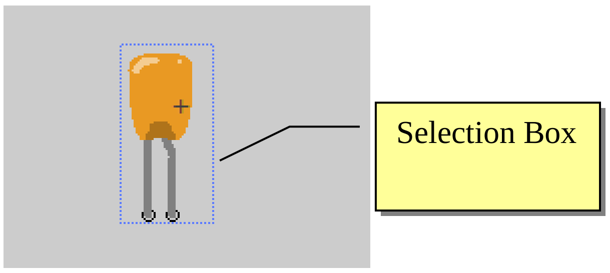
Placing a component from the Toolbox

Placing a component is an important skill – not quite drag and drop. You need to click on the Toolbox icon releasing the mouse button. This attaches the component to the mouse pointer when you move over the DesignSheet. You can then drag the component into position in the DesignSheet and click a second time to place the component.

Select a component

To select a component enter Select Mode and left click on the component

Selected components are bounded by a dashed blue line.

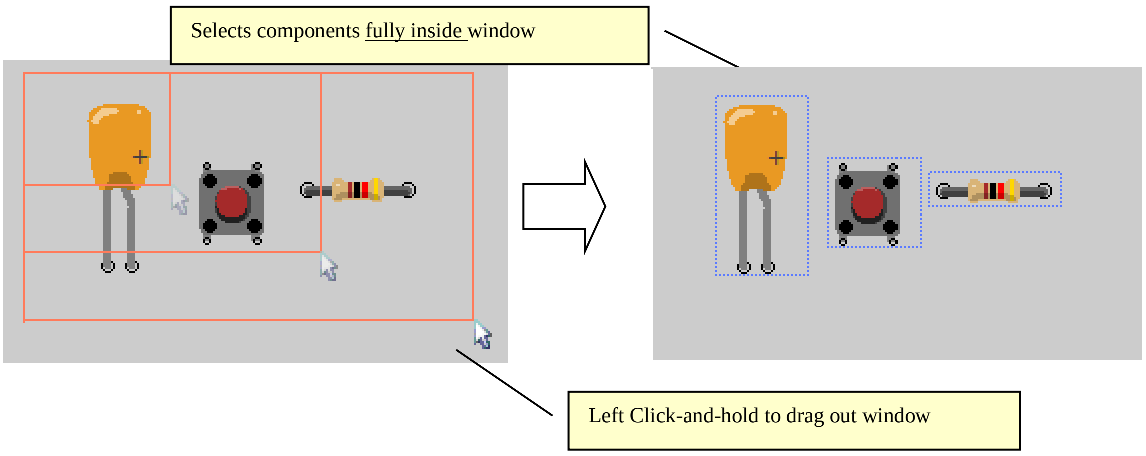


Select a group of components

Select a group by drawing a window around the components to select.

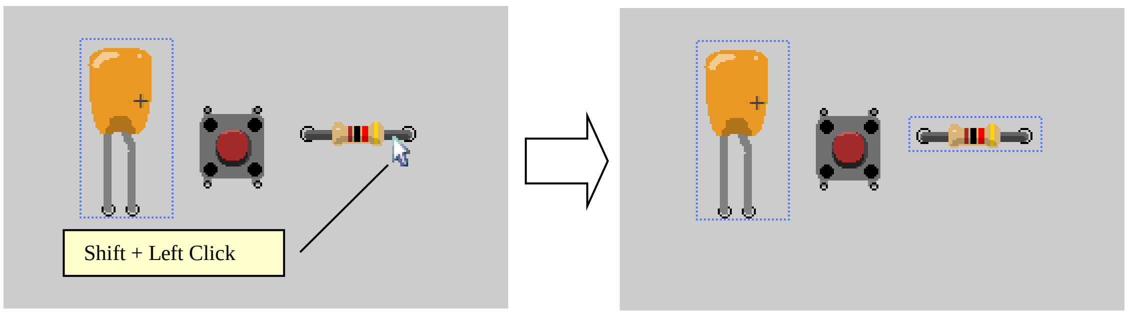
Draw a window with a Left Click to anchor the window, and holding down the mouse button drag out a window.

Release the mouse to select the components fully inside the window.


Selects components fully inside window
Left Click-and-hold to drag out window

Append a component to a selection

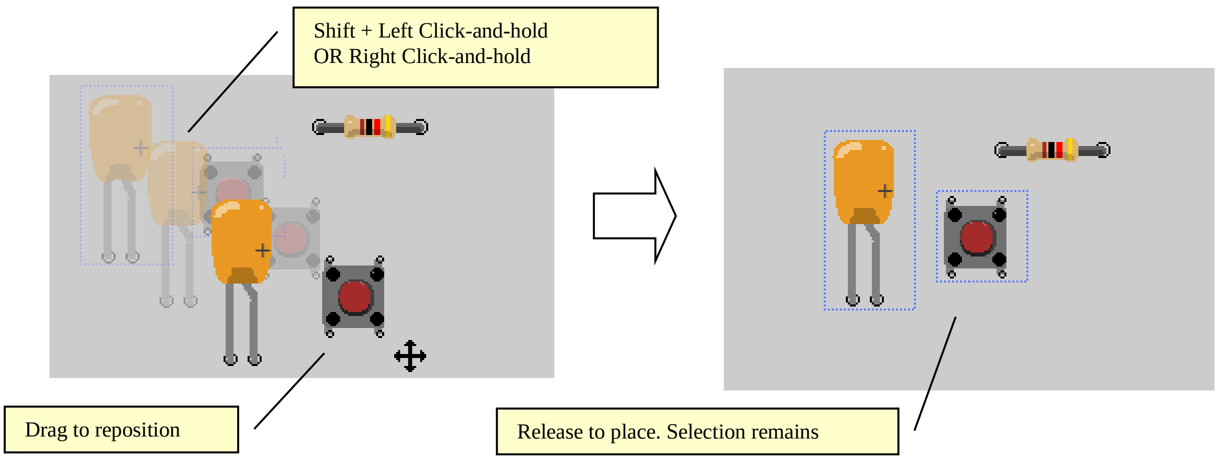
Append a component to a selection by holding shift and left clicking the component.



Move a group of selected components

To move a selected group of components
Select Move Mode by clicking the move state button

Shift + Left Button drag and drop or Right button drag and drop.

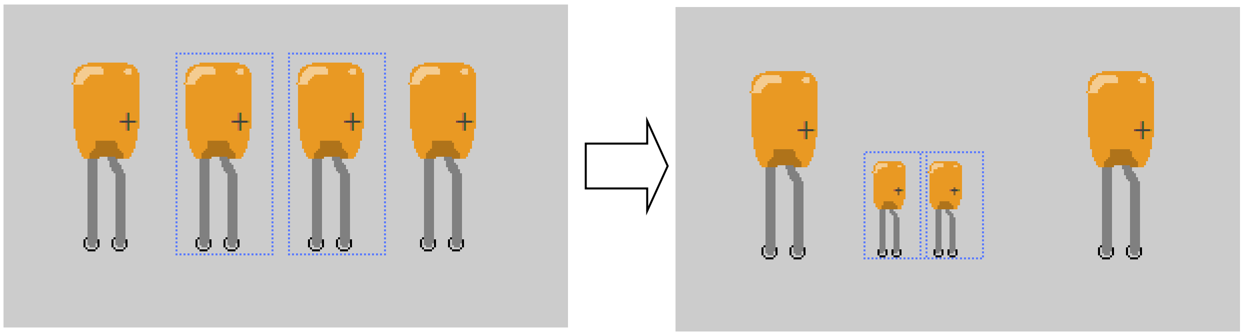

Shift + Left Click-and-hold
OR Right Click-and-hold
Drag to reposition
Release to place. Selection remains

Shrink and grow a selection

To increase density of certain parts of a graphical design it can be useful to scale down a component or group of components. Equally it is useful to be able to restore the size of the components and scale components back up.

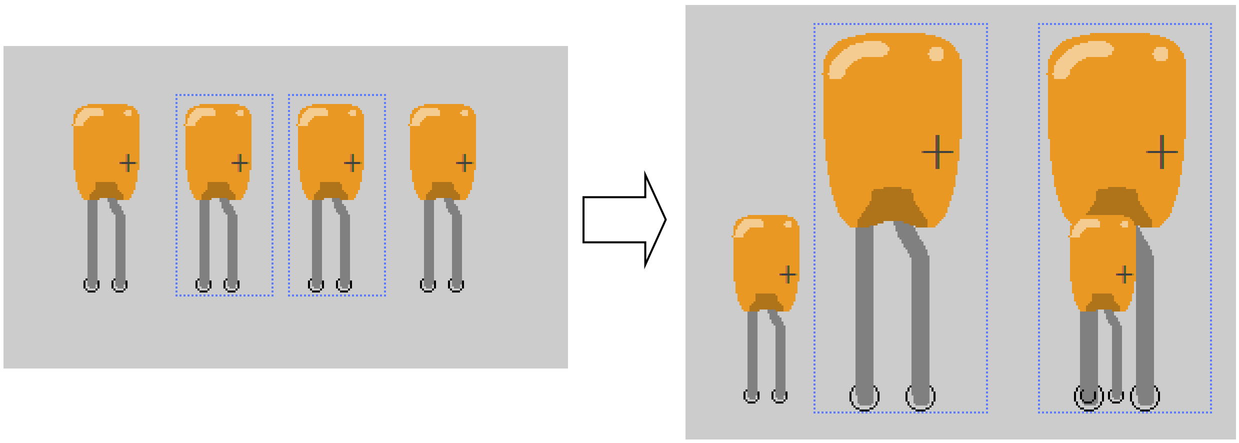
To scale down a component selection

- Click the scale down component toolbar button



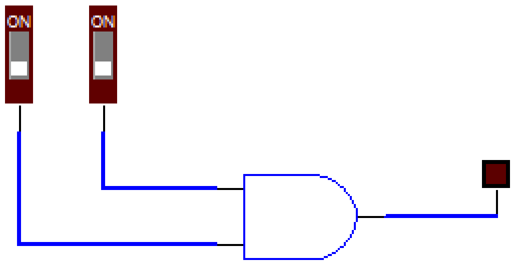
To scale up a component selection

- Click the scale up component toolbar button



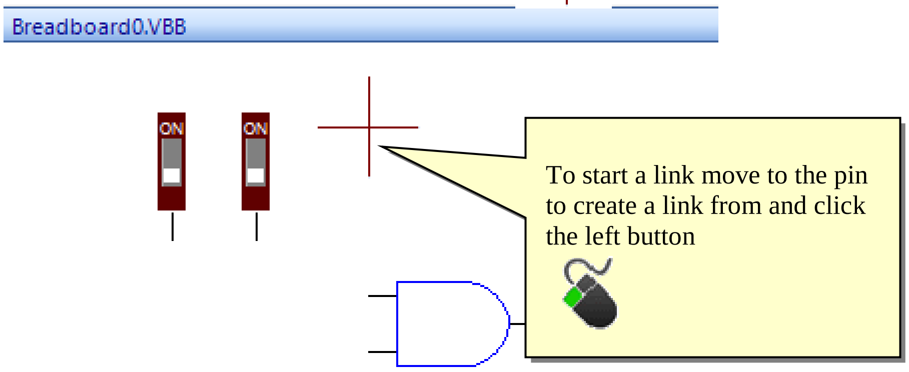
Wiring Essentials

Wires are links from component pin to component pin.

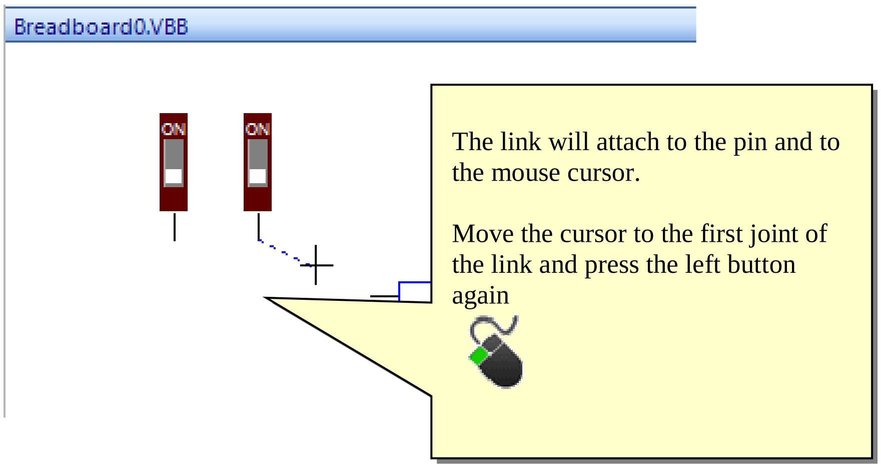


To begin wiring click the wiring button

The cursor will become a crosshair

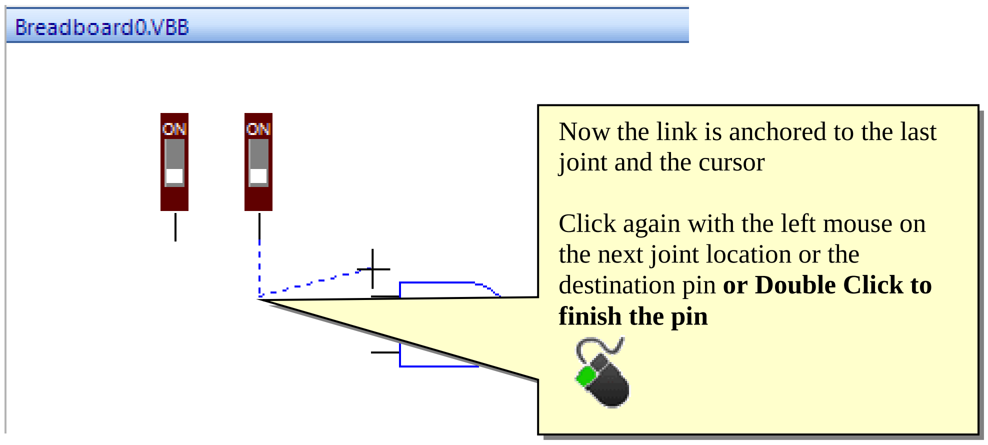


To start a link move to the pin to create a link from and click the left button



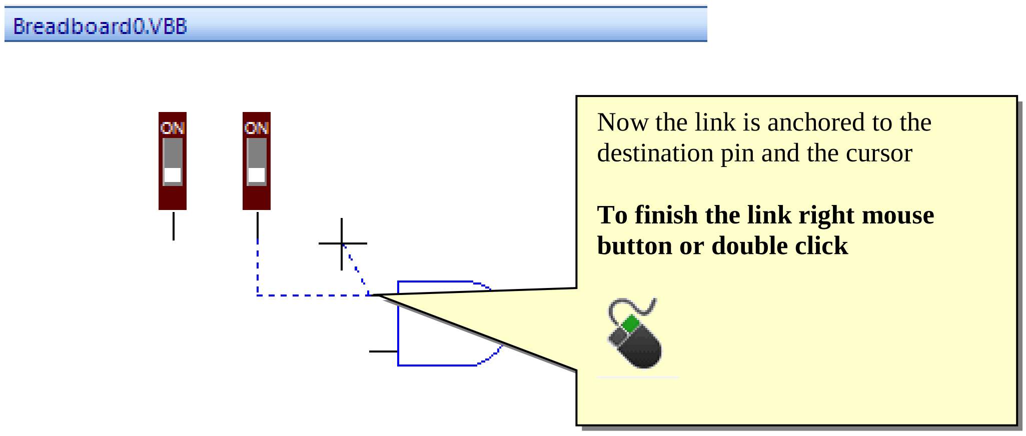
The link will attach to the pin and to the mouse cursor.

Move the cursor to the first joint of the link and press the left button again



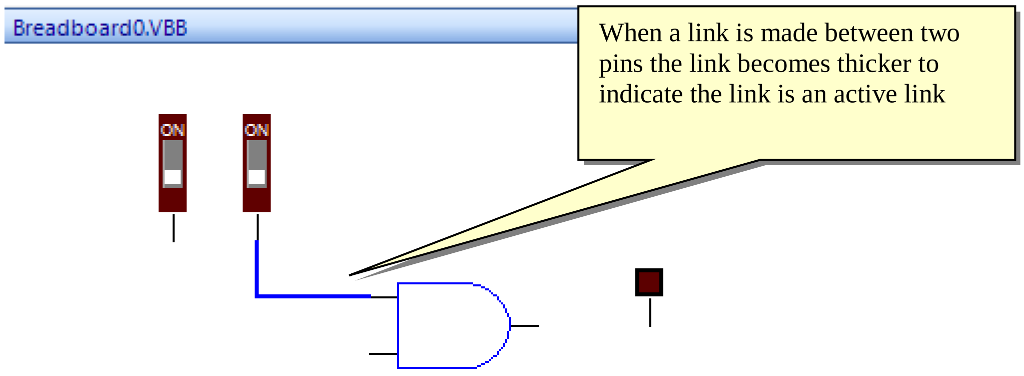
Now the link is anchored to the last joint and the cursor

Click again with the left mouse on the next joint location or the destination pin **or Double Click to finish the pin**



Now the link is anchored to the destination pin and the cursor

To finish the link right mouse button or double click



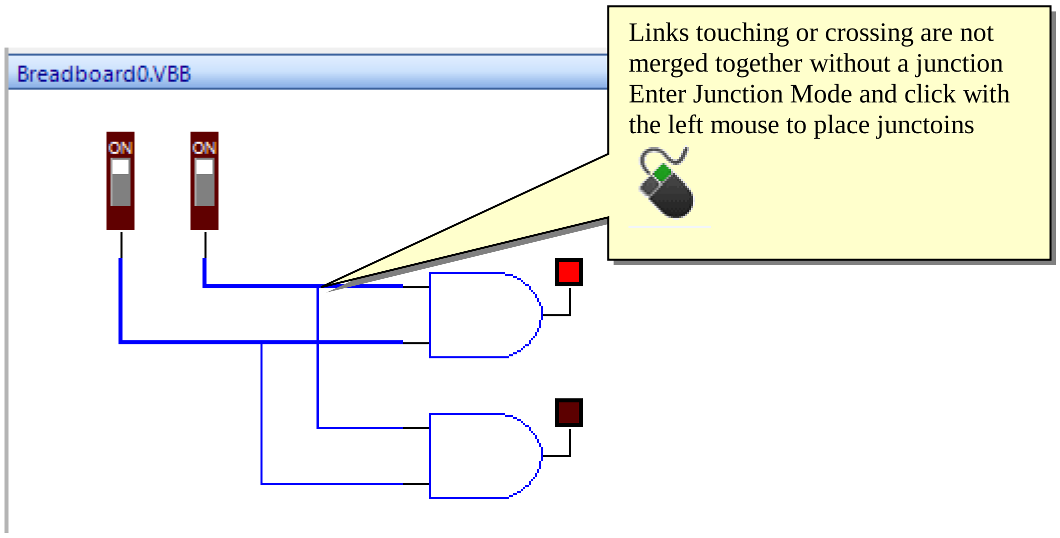
When a link is made between two pins the link becomes thicker to indicate the link is an active link

Working with Junctions

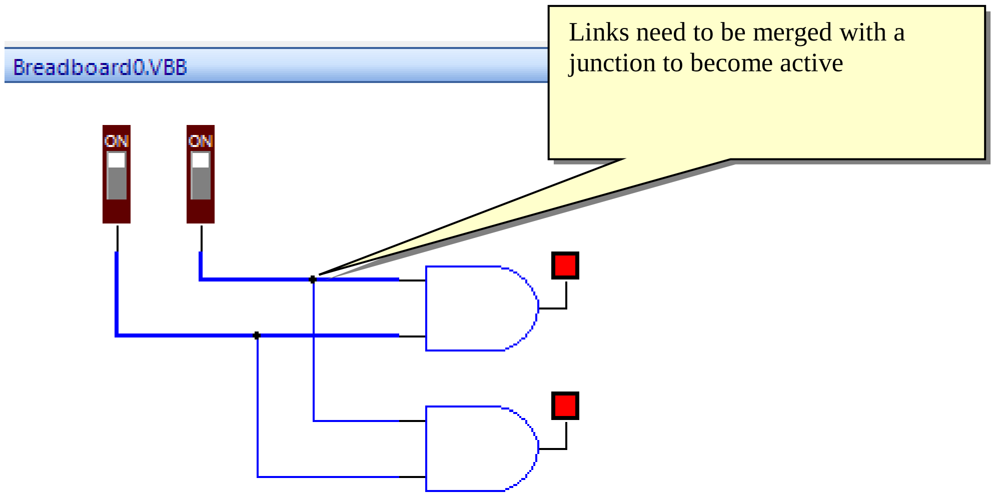
Junctions are used to merge links together.

Note: Links overlayed over each other are not considered a single link

To create a junction click the junction mode ⊹ and then



Links touching or crossing are not merged together without a junction
Enter Junction Mode and click with the left mouse to place junctoins

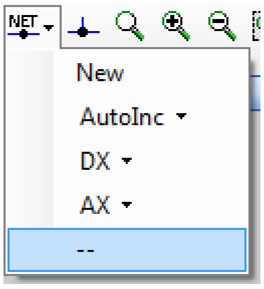


Links need to be merged with a junction to become active

Working with Net Labels

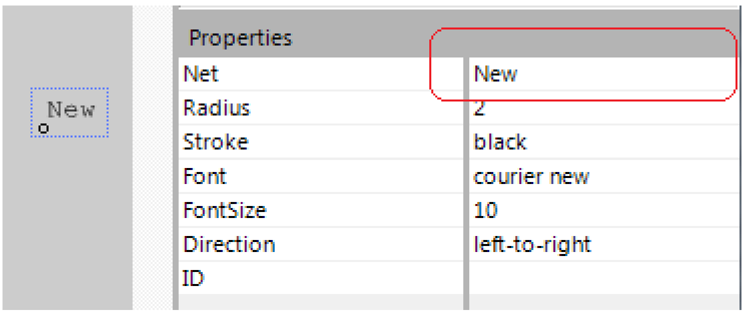
Net Labels allow connections to be made between pins by using a name instead of a wire. This can be used to better organise the connection layout.

The Net Toolbar option is used to place nets and features some helper options to add nets



New

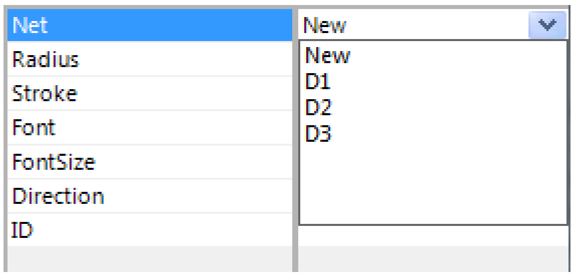
New is the standard option to add a new net. When you add a new net it is placed with the Name new. You can edit the name by clicking the net name and editing the name in the property box



Properties	
Net	New
Radius	2
Stroke	black
Font	courier new
FontSize	10
Direction	left-to-right
ID	

Drop Down List of Named nets

You can also select a net from the drop-down list in the property box. The dropdown list contains the names of all the nets currently on the Breadboard.

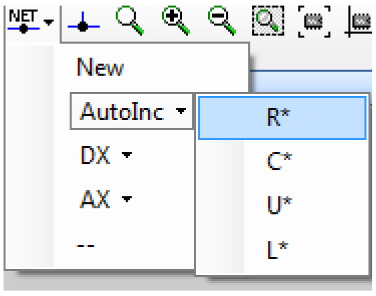


Net	New
Radius	
Stroke	
Font	
FontSize	
Direction	
ID	

AutoInc

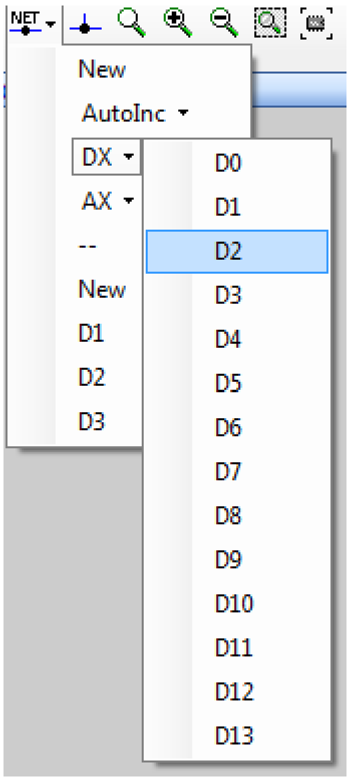
The AutoInc dropdown option has a further sub dropdown menu which allows you to select a net using the common prefixes (R = Resistor, C = Capacitor, L = Inductor , U = Integrated Circuit)

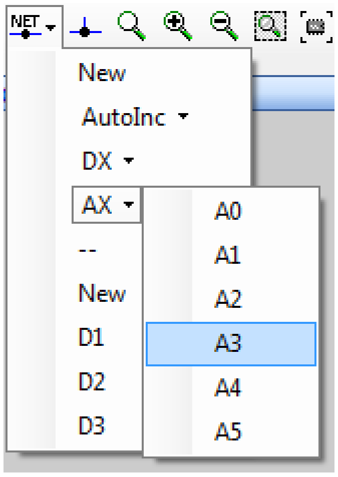
When you select form the submenu the net will be named +1 to the current highest net name. So for example if you have R1,R2,R2 on your breadboard already and you select R* then the net will be named R3.



DX / AX

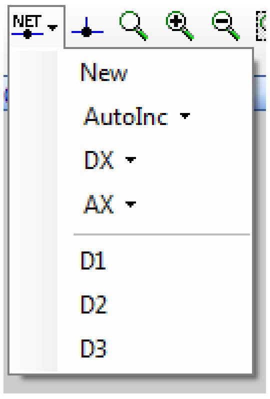
The V18'O, Arduino and others have a naming convention for digitial pins of D0, D1, D2 .. and Analog Pin A0,A1,.. These nets are also automatically added when using the V18'O, Arduino components so these are very commonly used net names. The AX and DX submenus gives you a shortcut for selecting these names.





All Nets (--)

All the current nets on the Breadboard are listed below the – toolbar separator giving a shortcut to select a matching net for a net to be placed.

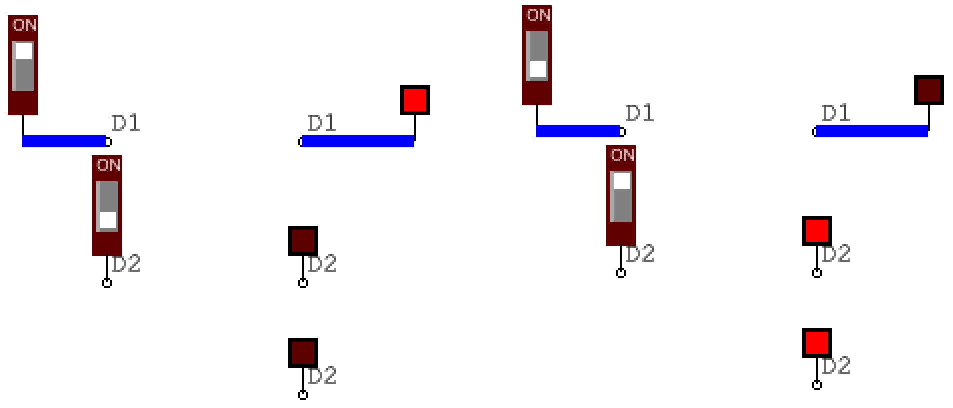


Virtual Links

Nets can be thought of as acting a virtual link between the pins that are connected by the Net

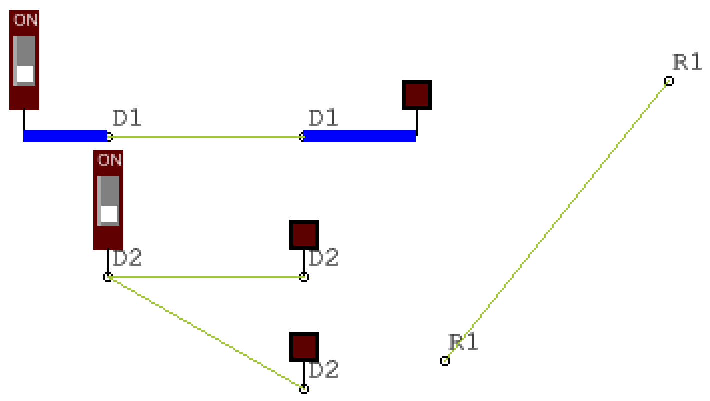
Nets can be

- Connected to the end of links or midway along links like junctions
- Placed over pins directly



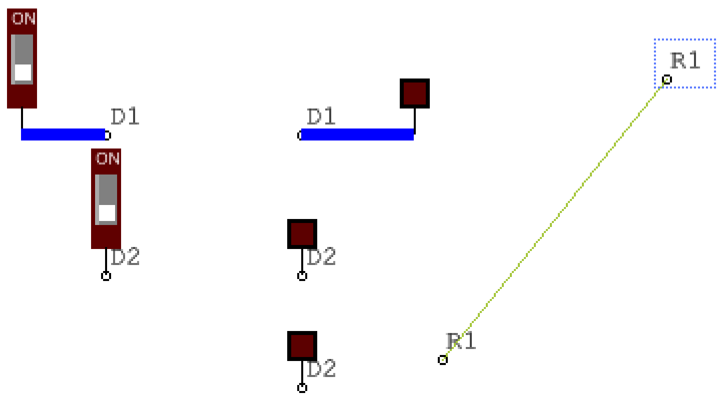
Show Links

You can view the links between the nets using the ShowLinks button. When you click the button it will show the links. It is a state button and when you unselect the button it will hide the links again.



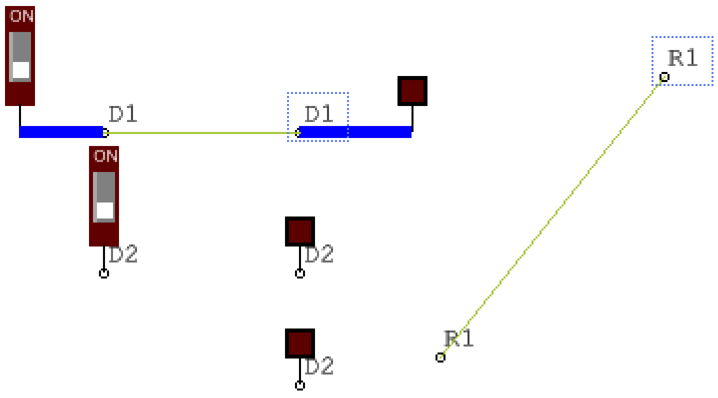
Showing specific Net Links

To show a specific net link you can select a member of the net and click to ShowLinks button



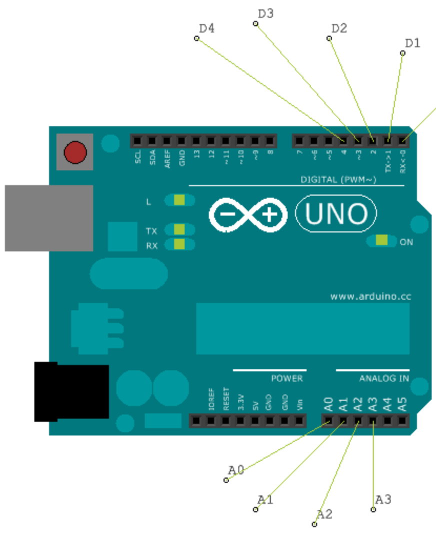
Show subgroups of links

If you select members of more than one net then the links belonging to all the selected nets will be shown.

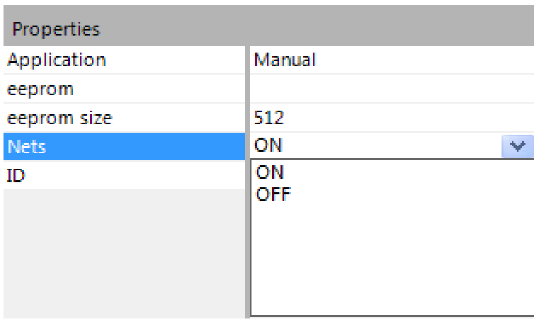


Predefined Nets

Arduino footprint boards have predefined nets associated with the pins



By default the nets for these on but you can switch off the default nets using the components Nets property

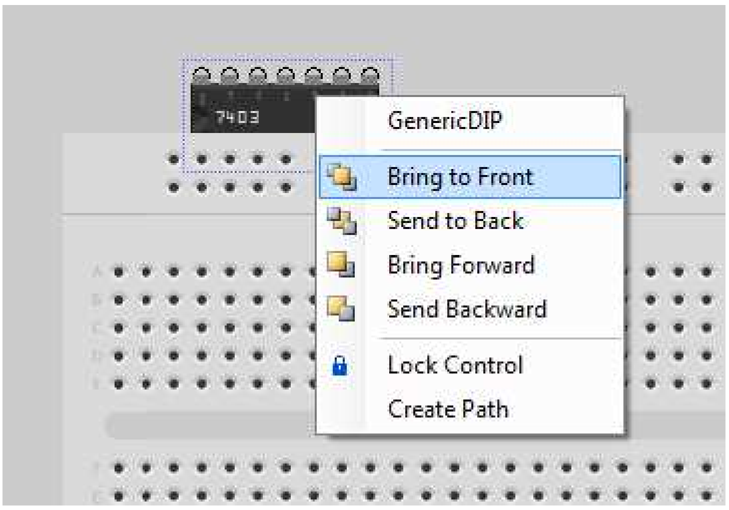


Properties	
Application	Manual
eeprom	
eeprom size	512
Nets	ON
ID	ON OFF

Component Layering

Components are layered , you move components up and down the layering using the context menu.

Select the component and press right click to start the context menu.

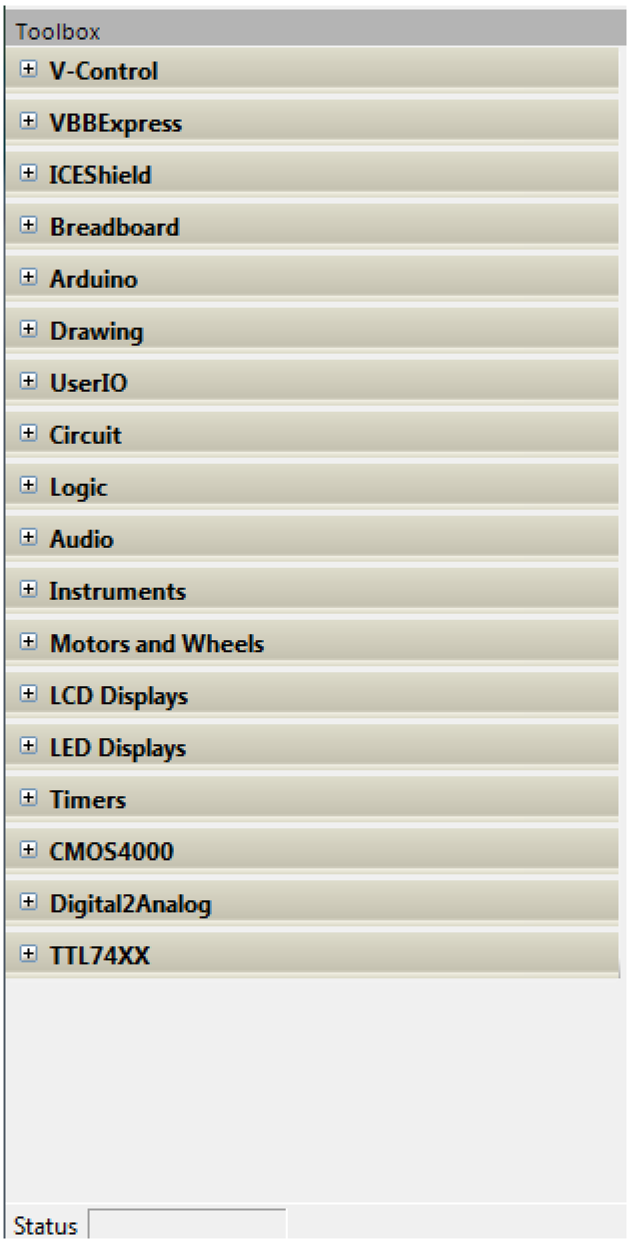


Locking a Component

The context menu contains an option for locking components. Select the component, right click to bring up the context menu and click Lock Control to lock the component. A locked component cannot be accidentally moved.

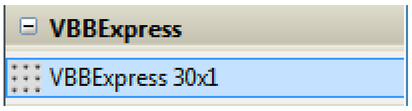
Toolbox : Breadboard

The Breadboard Toolbox is the most important Toolbox to VBB as it contains the component models that constitute the circuits



- VBBExpress
- ICEShield
- Breadboard
- Arduino
- Drawing
- UserIO
- Circuit
- Logic
- Audio
- Instruments
- Motors and Wheels
- LCD Displays
- LED Displays
- Timers
- CMOS4000
- Digitial2Analog
- TTL74XX

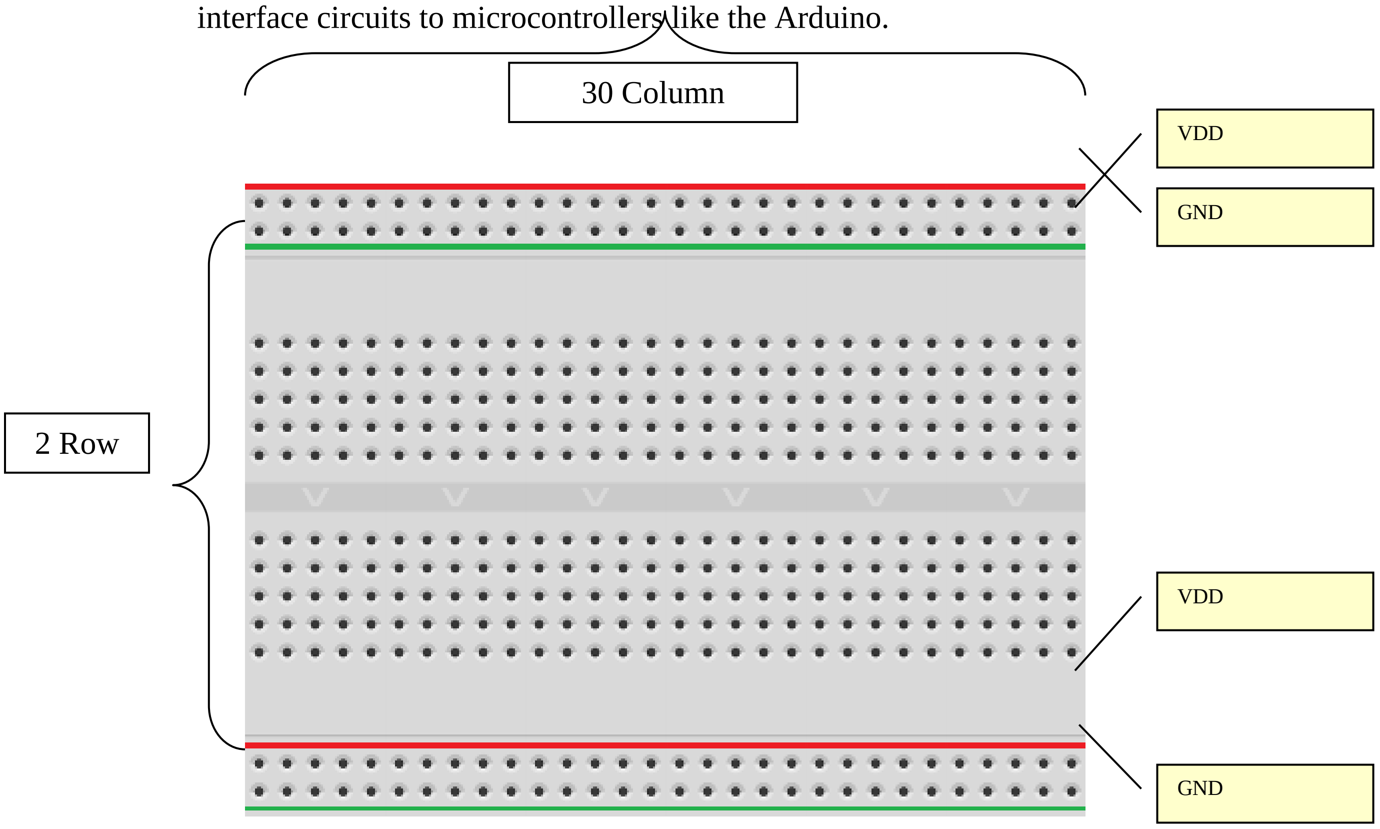
VBBExpress



The VBBExpress group are make-able Breadboards which when used in your designs can be converted into Printed Circuit boards by our low cost PCBExpress service. The Breadboards available in VBBExpress group while being representative of typical solderless Breadboards they are unique designs that can be converted into a real PCB using the VirtualBreadboard PCB service. In particular you should notice the power rail configuration. In a regular solderless Breadboard there is no required orientation of VDD/GND but with the Makeable VBB Breadboards the RED edge should be used for VDD and green edge as GND.

VBB 30 x 1

The 30 x 1 is a 30 Column x 1 Row VirtualBreadboard ideal for small circuits and interface circuits to microcontrollers like the Arduino.



Properties

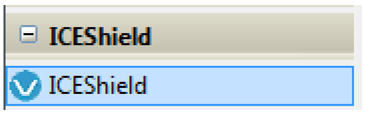
Property	Description
ID	Identifier used in BOM
PCB Overlay	The Overlay to use when fabricating a VirtualBreadboard. Breadboard | Bitmap | { Color }

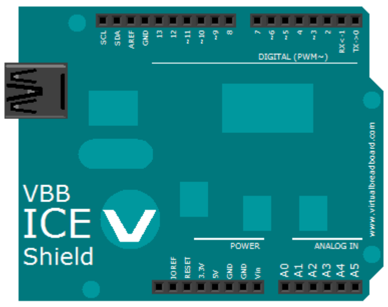
	Breadboard – Shows the same Breadboard pattern as used in design time Bitmap – Use the Bitmap in the Overlay Bitmap as the Bitmap Color – Use the selected color as the color for the whole background
Overlay Bitmap	The Bitmap to use for the Overlay when the PCB Overlay property is set to Bitmap. The bitmap is selected using the popup file dialog The bitmap is stretched to fill the PCB. The suggested size is (420 x 320) PNG bitmap
Show PCB Links	When true the wire links are shown in the overlay. When false the wire links are hidden in the overlay

See Menus => File => PCB Preview

ICEShield

ICEShield





The ICEShield is an Arduino form factor “Shield”. When you attach an ICEShield to an Arduino or other Arduino form-factor microcontroller such as a V18’O or Netduino, Uno32, Amicus or so on, the ICEShield does one of two things depending which way you look at it.

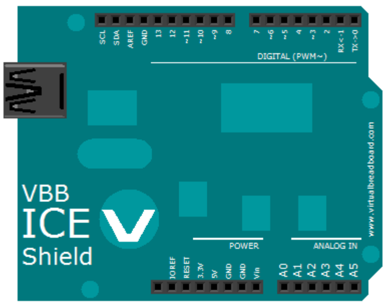
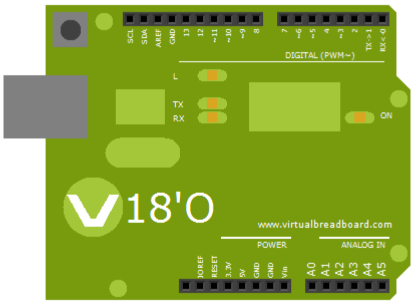
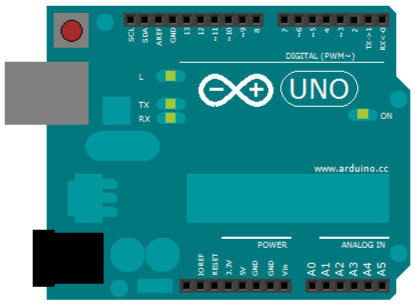
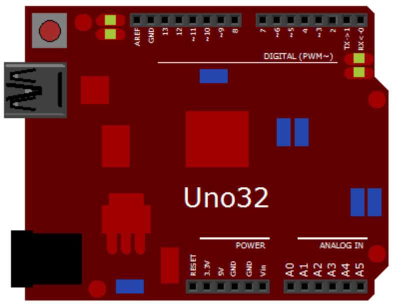
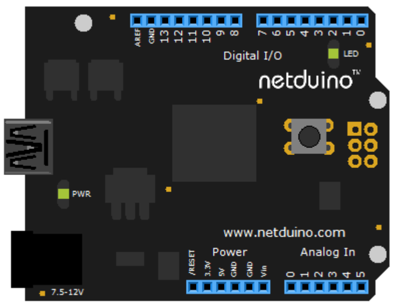
From the Microcontrollers perspective, the ICEShield looks like the Breadboard electronic circuit designed in VBBExpress. A ‘Virtual Circuit.

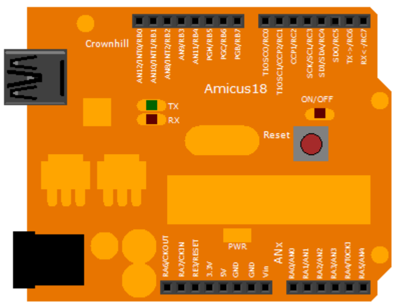
From the Virtual Circuits perspective, the ICEShield looks like the Microcontroller attached to it. A Virtual ‘Arduino’, ‘V18’O’, ‘Netduino’ etc.

Property	Description
ID	Identifier used in BOM
Virtualised	The Avatar of the ICEShield graphic ICEShield | ArduinoUNO | V18’O | Netduino | Amicus | Uno32
Wait Pin	The pin to assign the Wait pulse. The Wait Pin can be used by the Microcontroller to ensure its output pins have been read. *
Synch Request Pin	The request pin can be set high by the microcontroller to request a signal synchronisation.*
Synch Ready Pin	The ICEShield sets the Synch Ready Pin high when a synchronisation with the virtual circuit is complete. *

* See the ICEShield User Manual for more information

Avatars

ICEShield		This is the default Avatar and is a visual representation of the ICEShield itself
V18'O		V18'O is VirtualBreadboards own Java based Microcontroller www.virtualbreadboard.com www.muvium.com
Uno		Uno is the popular Arduino Uno footprint www.arduino.cc
Uno32		Uno32 is the Microchip PIC32 ChipKit board http://www.chipkit.org
Netduino		Netduino is the popular Microsoft .NET board www.netduino.com

Amicus	 Crownhill Amicus18 TX RX ON/OFF Reset PWR ANx	Amicus is a pBasic powered microchip board http://www.myamicus.co.uk/

ICEShield Aware Drivers

When a real microcontroller connects to a virtual component model through the ICEShield there is a delay introduced by the ICEShield. Microcontroller libraries that drive both real and virtual components like the LiquidCrystal display must be made 'ICEShield aware' and introduce the appropriate 'Wait States' in their implementation. This is best done as a conditional compile statements in the timing sensitive parts of the routines. This is typically only a few additional lines of code which are compiled out when working with a real version of the hardware.

As an example the LiquidCrystal component model has a timing sensitive section when sending the pulse enable. Conditional compile commands VBBWait() are added to edges of the pulse to ensure the edges are captured.

```
void VBBLiquidCrystal::pulseEnable(void) {
  // delayMicroseconds(2000);
  VBBWait();
  digitalWrite(_enable_pin, LOW);
  delayMicroseconds(1);
  VBBWait();
  digitalWrite(_enable_pin, HIGH);
  delayMicroseconds(1);    // enable pulse must be >450ns
  VBBWait();
  digitalWrite(_enable_pin, LOW);
  delayMicroseconds(100);   // commands need > 37us to settle
  VBBWait();
}
```

You should refer to the ICEShield user manual for more information on the ways to work with the Wait and Synch pins to created ICEShield aware drivers.

ICEShield Aware SDK's

ICEShield aware SDKS are collections of Drivers that are ICEShield aware.

Frappuccino

Frappuccino is the Java Arduino compatible port sponsored by VirtualBreadboard and Muvium.

www.muvium.com

The Frappuccino SDK is the ‘native’ VirtualBreadboard SDK which is the reference implementation. All VBB/VBBExpress Component Models will always ship with a Frappuccino SDK driver.

ArduinoSDK

ICEShield ‘aware’ libraries for the Arduino

Uno32 SDK

ICEShield ‘aware’ libraries for the ChipKit Uno32

Hybrid Emulation Circuits

Another possibility with ICEShield when the optional ‘Stack-able’ headers are installed is to create Hybrid circuits. A Hybrid circuit is where you use real components alongside virtual components.

Updating the ICEShield Firmware

See Menus => Help => Update ICEShield Firmware

Breadboard Components

There are two types of Components in Breadboard

- Generic Layout (No Emulation)
- Component Models (Emulation)

These can used used in combination on circuit but only the sections of the circuit that contain Component Models will emulate.

Layout Components

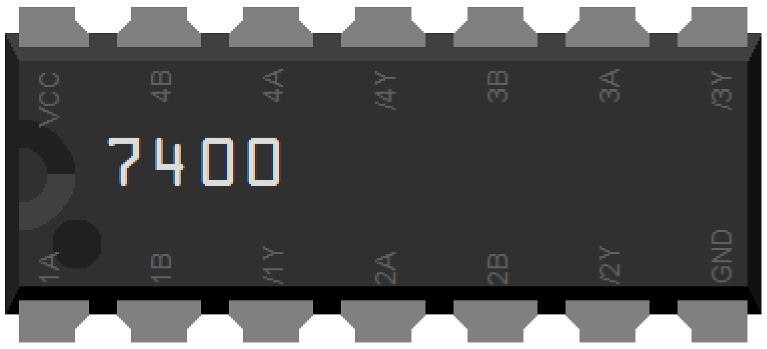
Layout Components are generic graphics only components and will not emulate. These components are parametric models of the common hole-through components. Layout components help you create a circuit board which can be fabricated by our PCB service or as a guide when assembling a real circuit board even where specific components models are not available.

Generic Layout Only

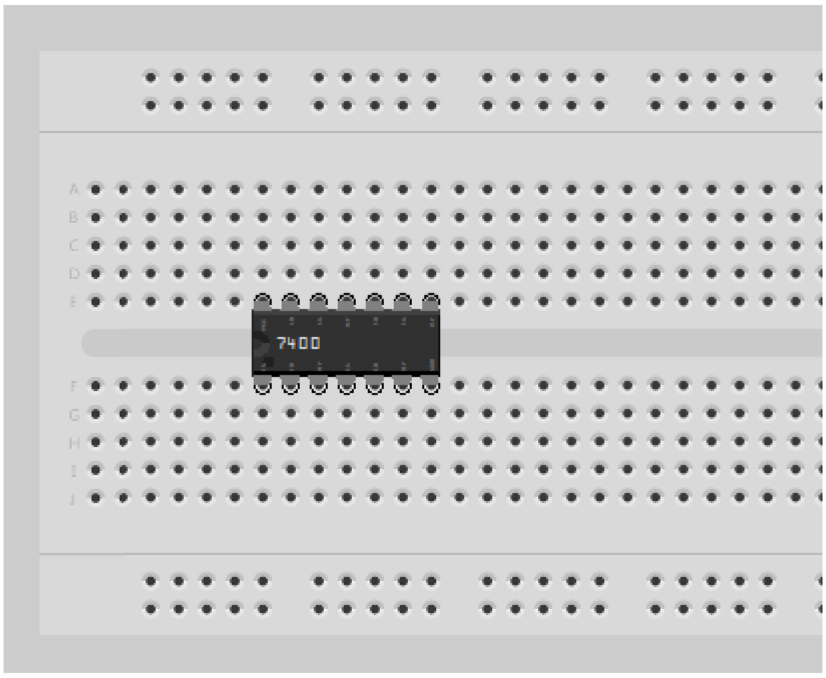
- Generic DIP
- Axial
- Radial

Generic DIP

Breadboards are useful because they have pin sockets that match the spacing of the standard DIP packaging of electronic circuits. The Generic DIP component allows you to easily create a DIP component package.

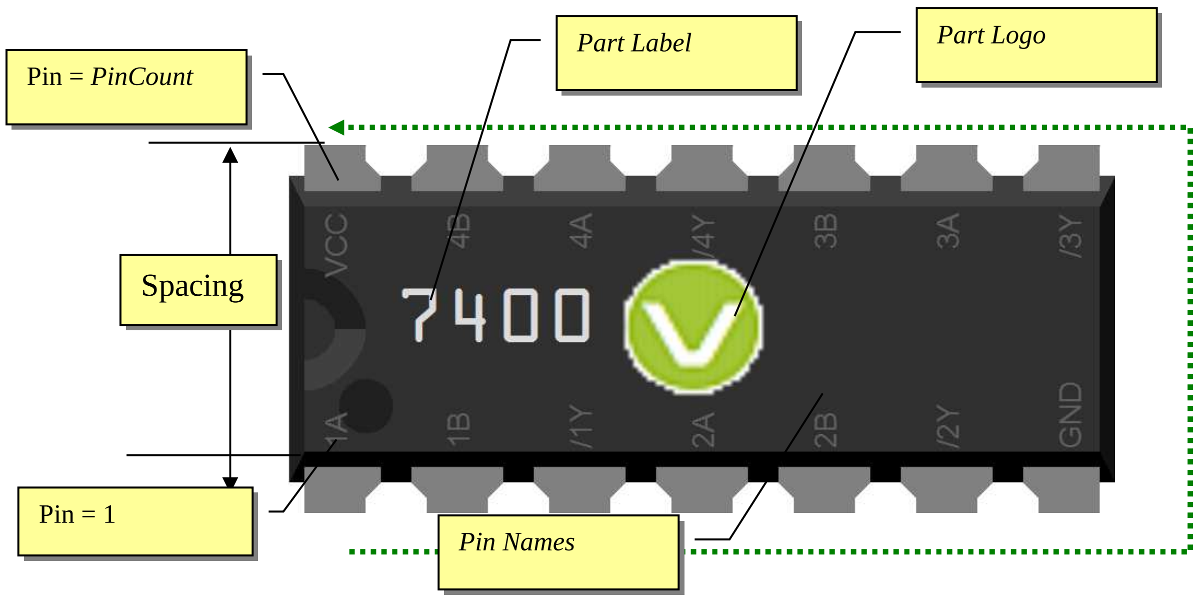


DIPs components are typically placed across the center section.


A
B
C
D
E
7400
F
G
H
I
J

Parametric

The DIP component is parametric so you can create any DIP by setting the component properties accordingly.

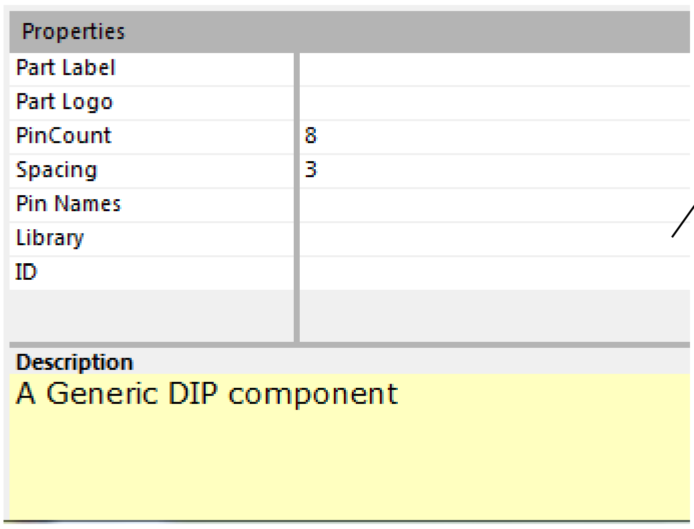


Library

Property	Description
ID	Identifier used in BOM
Part Label	The part name shown on the packaging
Part Logo	An optional logo that is shown center of the package. Uses magenta for transparent color
PinCount	The number of pins (multiple of 2)
Spacing	The size of the spacing between pins – in hundreds of mil – typically 3 or 5
Pin Names	A CSV(comma separated array) of names starting from pin 1 to pin pin pinCount of the pins labels. This is shown as an overlay as a form of schematic for the part
Library	The Library is a special property which actives as Custom Dialog to select a component from a library which then sets the properties

Using the Library Component

When you first place a Generic DIP the properties are blank. You can enter your own values or select from the library. To use the library



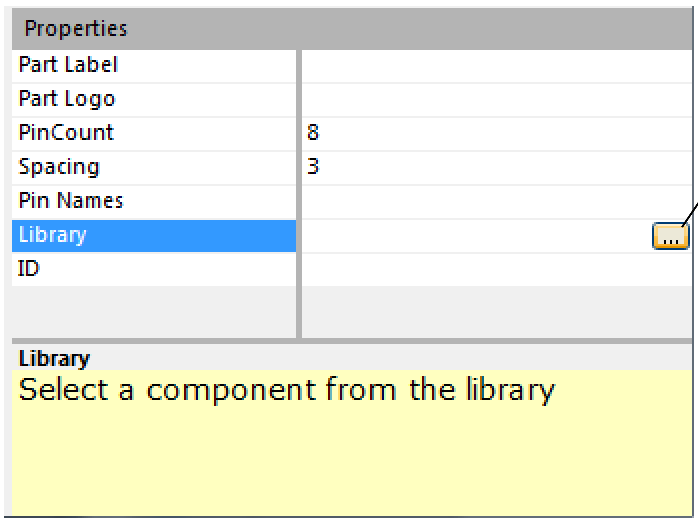
Properties

Part Label	
Part Logo	
PinCount	8
Spacing	3
Pin Names	
Library	
ID	

Description

A Generic DIP component

1. Click on the Library property to show the custom editor button



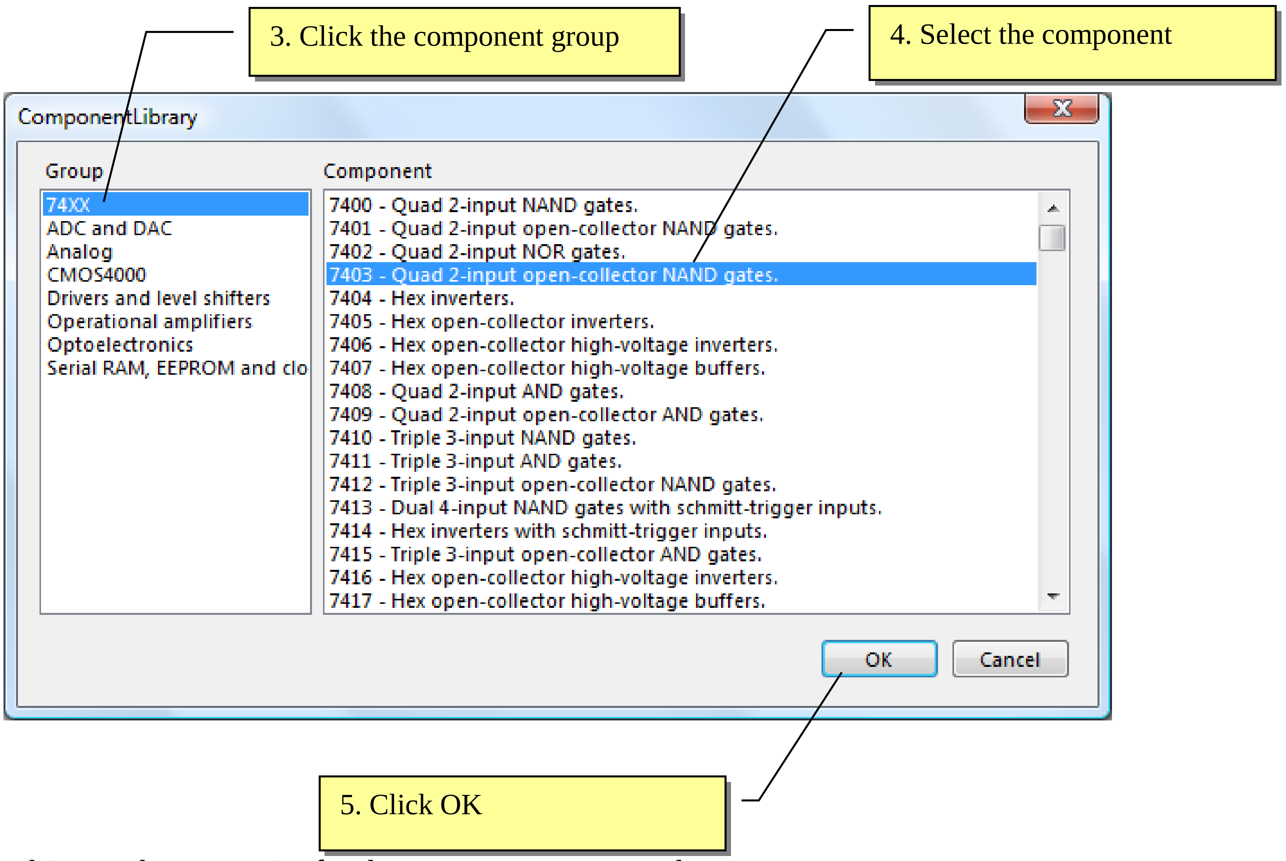
Properties

Part Label	
Part Logo	
PinCount	8
Spacing	3
Pin Names	
Library	
ID	

Library

Select a component from the library

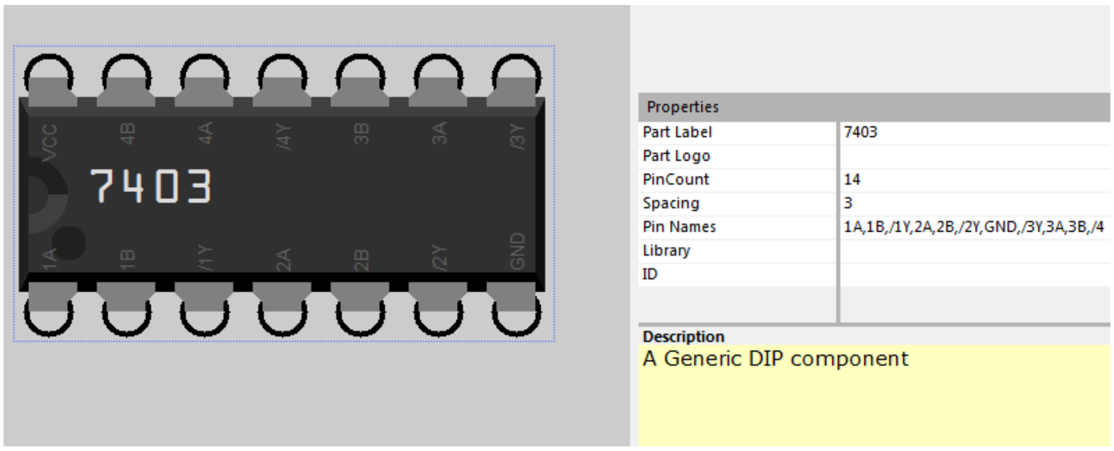
2. Click the custom editor button to show the Component Library Dialog



Group:
- 74XX
- ADC and DAC
- Analog
- CMOS4000
- Drivers and level shifters
- Operational amplifiers
- Optoelectronics
- Serial RAM, EEPROM and clo

Component:
- 7400 - Quad 2-input NAND gates.
- 7401 - Quad 2-input open-collector NAND gates.
- 7402 - Quad 2-input NOR gates.
- 7403 - Quad 2-input open-collector NAND gates.
- 7404 - Hex inverters.
- 7405 - Hex open-collector inverters.
- 7406 - Hex open-collector high-voltage inverters.
- 7407 - Hex open-collector high-voltage buffers.
- 7408 - Quad 2-input AND gates.
- 7409 - Quad 2-input open-collector AND gates.
- 7410 - Triple 3-input NAND gates.
- 7411 - Triple 3-input AND gates.
- 7412 - Triple 3-input open-collector NAND gates.
- 7413 - Dual 4-input NAND gates with schmitt-trigger inputs.
- 7414 - Hex inverters with schmitt-trigger inputs.
- 7415 - Triple 3-input open-collector AND gates.
- 7416 - Hex open-collector high-voltage inverters.
- 7417 - Hex open-collector high-voltage buffers.

This sets the properties for the component creating the component.

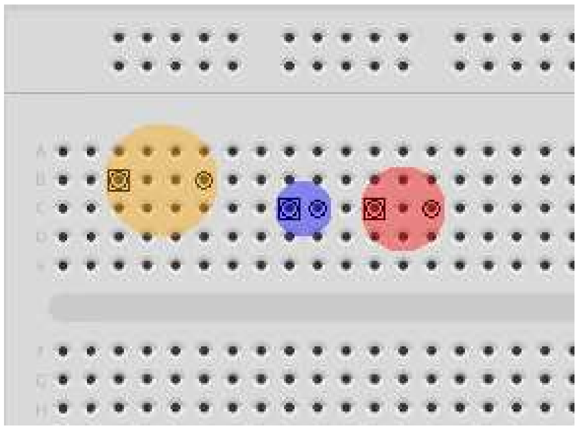


Properties	
Part Label	7403
Part Logo	
PinCount	14
Spacing	3
Pin Names	1A,1B,/1Y,2A,2B,/2Y,GND,/3Y,3A,3B,/4
Library	
ID	

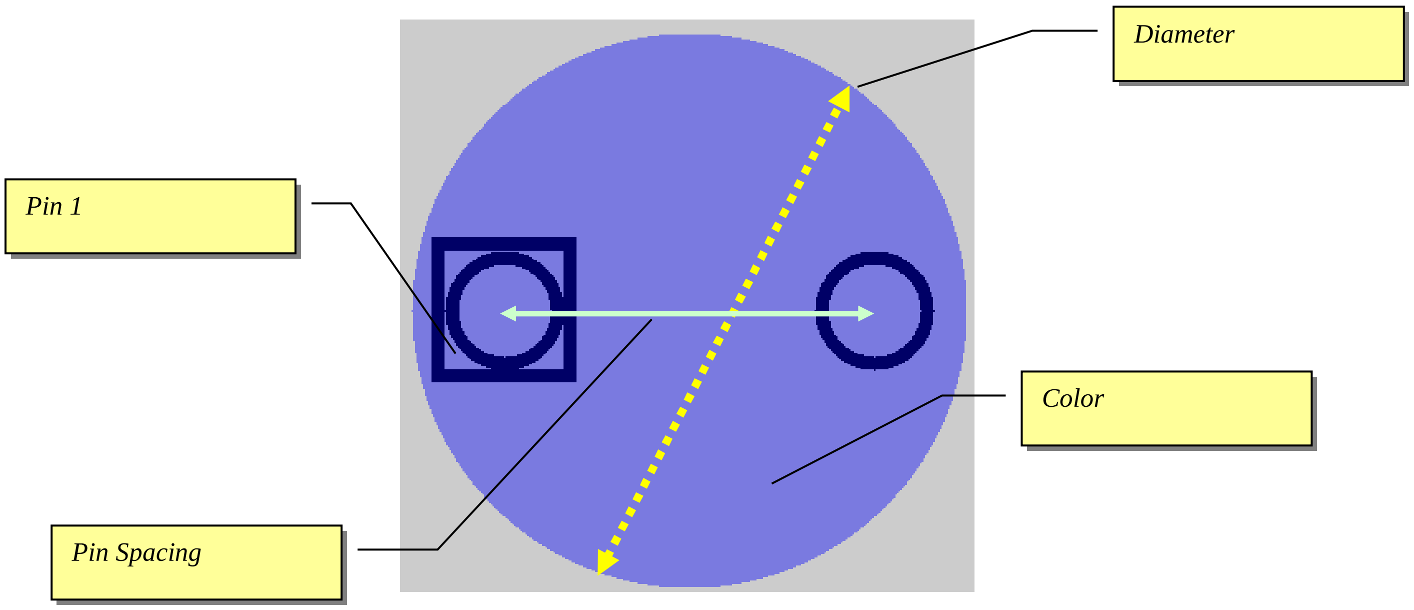
Description
A Generic DIP component

Radial Component

Generic Radial component can be used to model components with a 2 pin Radial configuration for which there is no matching visual component.



Parametric Model

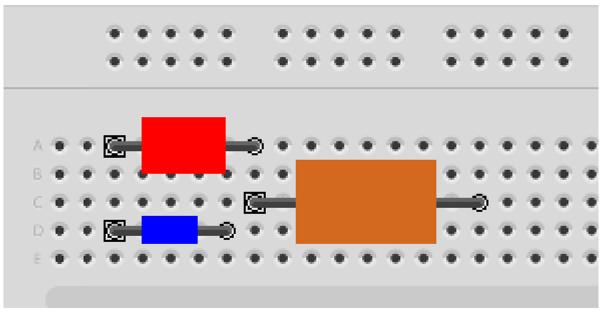


Properties

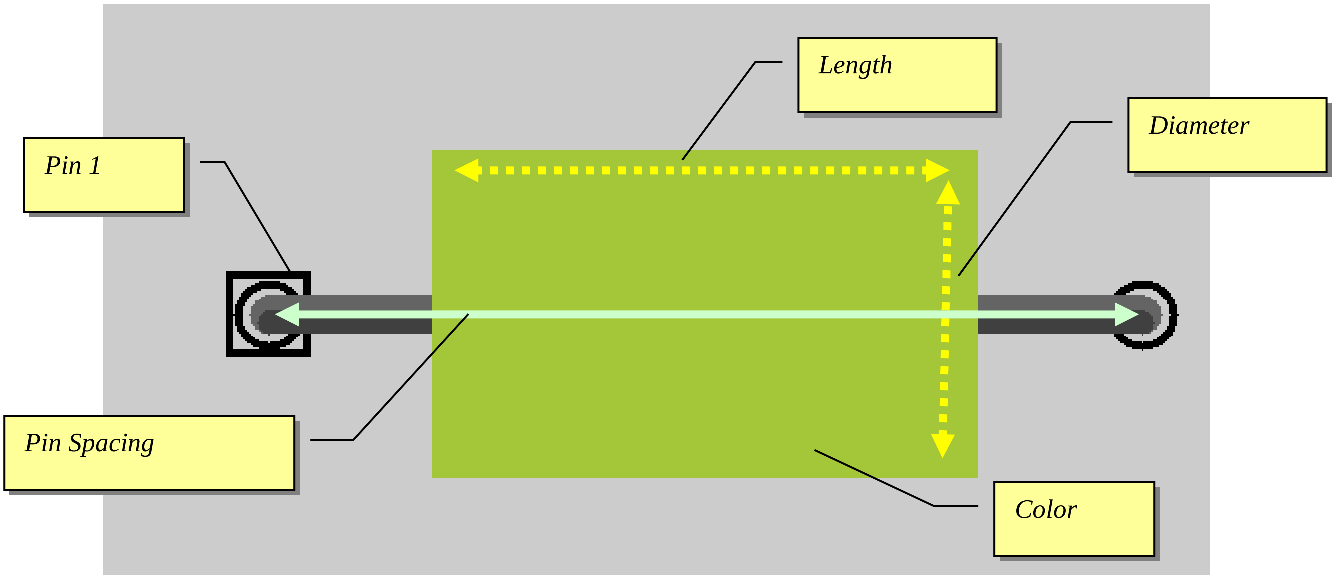
Property	Description
ID	Identifier used in BOM
Spacing	The number of grid spacings between pins
Diameter	The diameter of the radial component in grid spacings (0.1”)
Color	The color of the Radial packaging
Value	The value of the part to appear in the BOM. Eg Capacitance or special part no.

Axial Component

Generic Axial component can be used to model components with a 2 pin Axial configuration for which there is no matching visual component.



Parametric Model



Properties

Property	Description
ID	Identifier used in BOM
Spacing	The number of grid spacings between pins
Diameter	The diameter of the axial component in grid spacings (0.1")
Length	The length of the axial component in grid spacings (0.1")
Color	The color of the Radial packaging
Value	The value of the part to appear in the BOM. Eg Capacitance or special part no.

Component Models

The second type of VBBExpress components are Component Models. Component Models are realistic representations of common components used in Breadboards. Components models will also emulate for many circuit configurations so can be used to validate a circuit before committing to fabrication by our PCB service and also for experimenting with different designs.

Circuit Emulation

Its quite Natural to expect that VBB can work exactly like the real world. Unfortunately, as with all software VBB is just an approximation of the real world. You will also be disappointed if you expect VBB to work like SPICE and compute Voltage/Current transient behaviour of discrete components. In fact VBB doesnt calculate current at all. Nevertheless you can still approximate many of the most common circuit configurations using VBB.

Discrete Emulation

Despite their limitations discretes can be used to model a wide variety of common circuit. When the circuit function is supported you can use the discrete component for both the circuit documentation and layout and the emulation.

Resistors are modelled either as a straight-through wire or a pull-up or pull-down.
Capacitors are modelled as an open-circuit.
Diodes are modelled as switched pull-up or switched pull-down resistor.
NPN Transistors are modelled as a switch which turns on when the base voltage is HIGH
PNP Transistors are modelled as a switch which turns on when the base voltage is LOW

Component Models

	Breadboard	
	ICEShield	
	LiquidCrystal	
	Resistor	
	Diode	

	LED	
	Momentary	
	Ceramic Capacitor	
	Tantalum Capacitor	
	Electrolytic Capacitor	
	Toggle	Toggle switch
	NPN	Models of TO-92 NPN Transistor
	PNP	Models of TO-92 PNP Transistor
	VREG	Model of TO-220 Voltage regulator
	Trimmer	Model of Trimmer Potentiometer
	Relay	Model of a common relay
	Solonoid	Model of a Solonoid component
	PNP	Models of TO-92 PNP Transistor
	7 Seg Array Module	LED Matrix Module
	LED Matrix Module	LED Matrix Module

Liquid Crystal

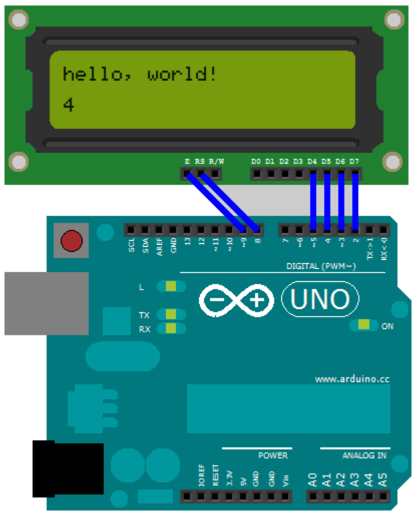
Properties

Property	Description
ID	Identifier used in BOM
Display Cols	The number of columns of text the display will show can be used to model different displays 8 | 10 | 16 | 20 | 32 | 40

Pins

Property	Description
E	Enable
RS	Register Select Pin
R/W	Read/Write Pin – Not functional
D0-7	Data Pins. Only 4 bit mode using D4-D7 is used

Emulation



Supports HD44780 emulation in 4-bit mode..

Fonts: If available the `HD44780` font is used else the default is used.

Limitations

- 4 Bit mode only supported
- Custom Bitmaps not supported
- R/W read not support

Drivers

The HD44780 clocks in data using a pulse to the Enable pin. Microcontroller software should ensure the Enable pulse is captured by co-ordinating with the ICEShield Wait() pin.

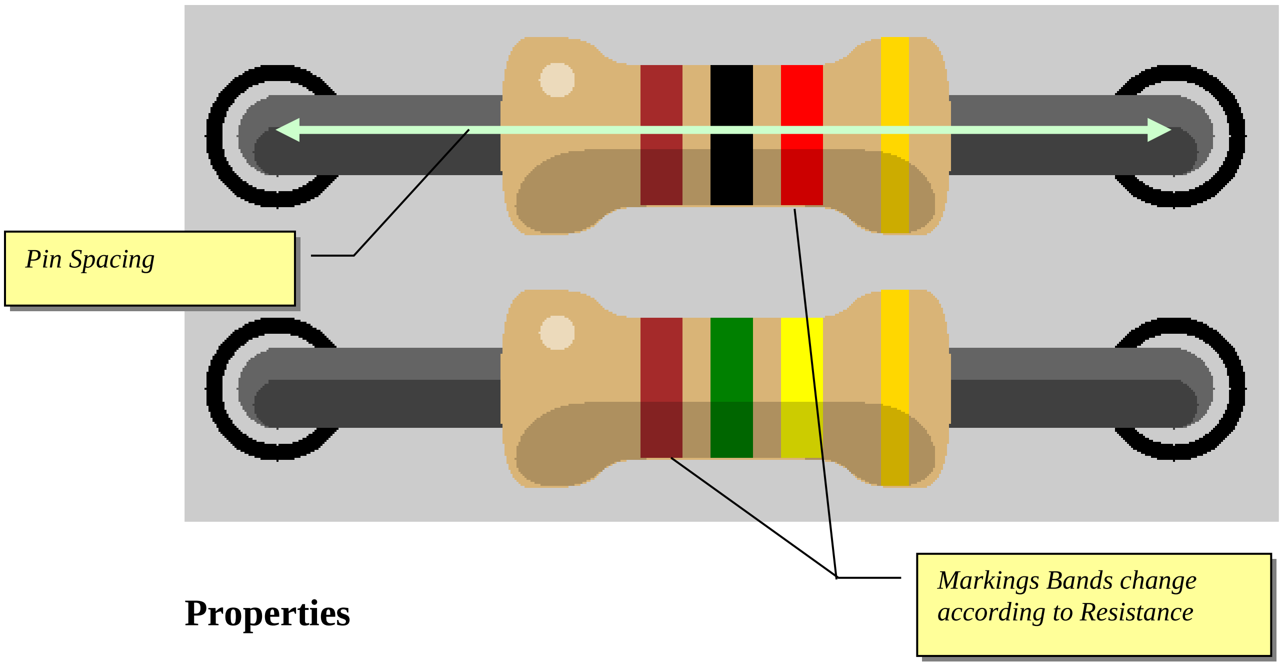
The following conditional compile LiquidCrystal libraries have been made 'ICEShield' aware for use with the Virtual LiquidCrystal. Refer to the SDK for examples using the library.

SDK	Library
Frappuccino	muvium.processing.arduino.LiquidCrystal
ArduinoSDK	VBBLiquidCrystal
Uno32SDK	VBBLiquidCrystal

Resistor

Generic resistor component models the standard axial resistor with parametric spacing and resistance color bands.

Parametric Model



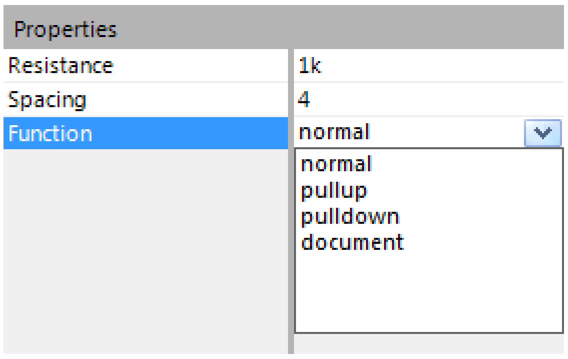
Properties

Property	Description
ID	Identifier used in BOM
Resistance	The resistance of resistor – the color markings update according to resistance
Spacing	The number of grid spacings between pins
Function	*Emulation Mode Normal | Pullup | PullDown | document*

Resistors

Resistors have three modes which can be selected from the Function property of the resistor.

- Pullup
- Pulldown
- Normal (default)
- document



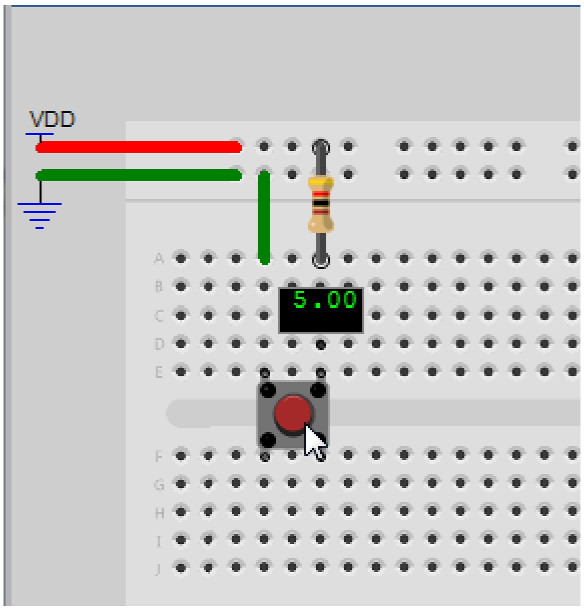
Properties	
Resistance	1k
Spacing	4
Function	normal

Pullup Mode

A Pullup resistor pulls a voltage HIGH if its not driven LOW.

One end of the pull-up resistor is assumed to be connected to Vdd even if its not actually wired that way.

A common example shown here is to attach a pullup to a momentary switch so that the output is normally HIGH and switched LOW when the button is pressed.

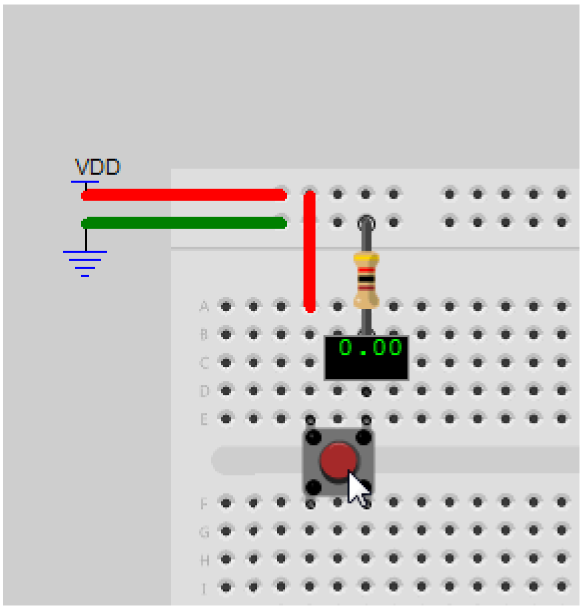


Pulldown Mode

A Pullup resistor pulls a voltage LOW if its not driven HIGH.

One end of the pull-down resistor is assumed to be connected to Gnd even if its not actually wired that way

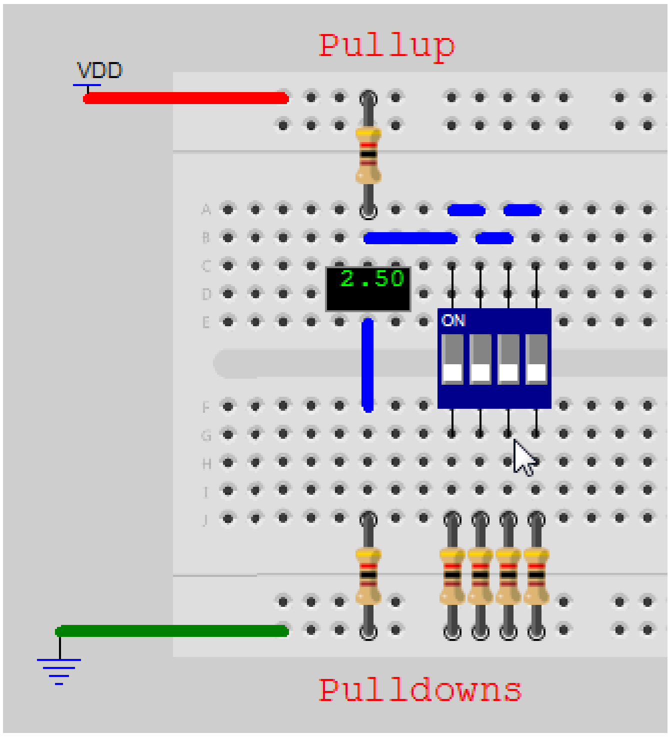
A common example shown here is to attach a pulldown to a momentary switch so that the output is normally LOW and switched HIGH when the button is pressed.



Voltage Divider

Pullup and Pulldown resistors can also be used in some Voltage Divider configurations.

Voltage dividers are used for creating reference voltages, or even digital to analog converters. In this example a 4-bit analog to digital converter is created by ladder. The resistors are switched together using a DIP switch array to create a network of resistor values. This circuit will emulate because the pullups are connected to VDD and the pulldowns are connected to GND. There are other Voltage divider networks which dynamically drive the resistors, these cannot be emulated directly.



Normal Mode

In normal mode a resistor function the same as a regular wire

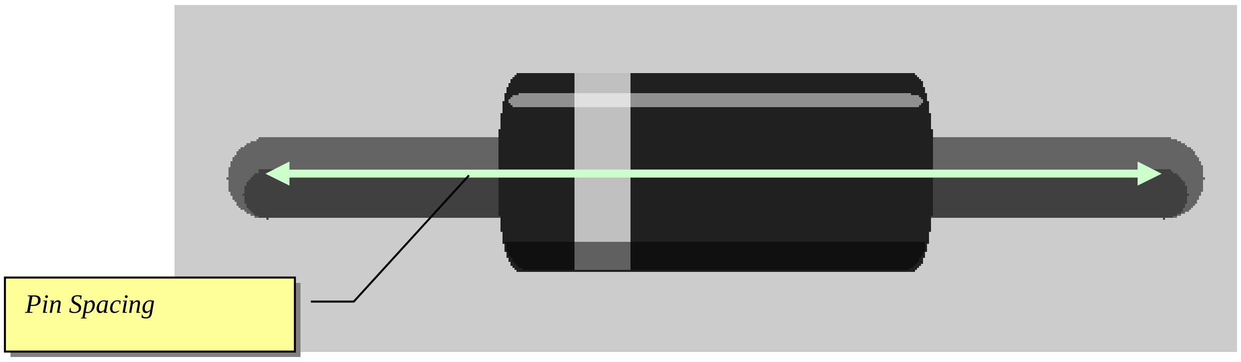
Document Mode

In document mode a resistor does not participate in the circuit

Diode

Generic diode component models the standard axial diode with parametric spacing.

Parametric Model



Properties

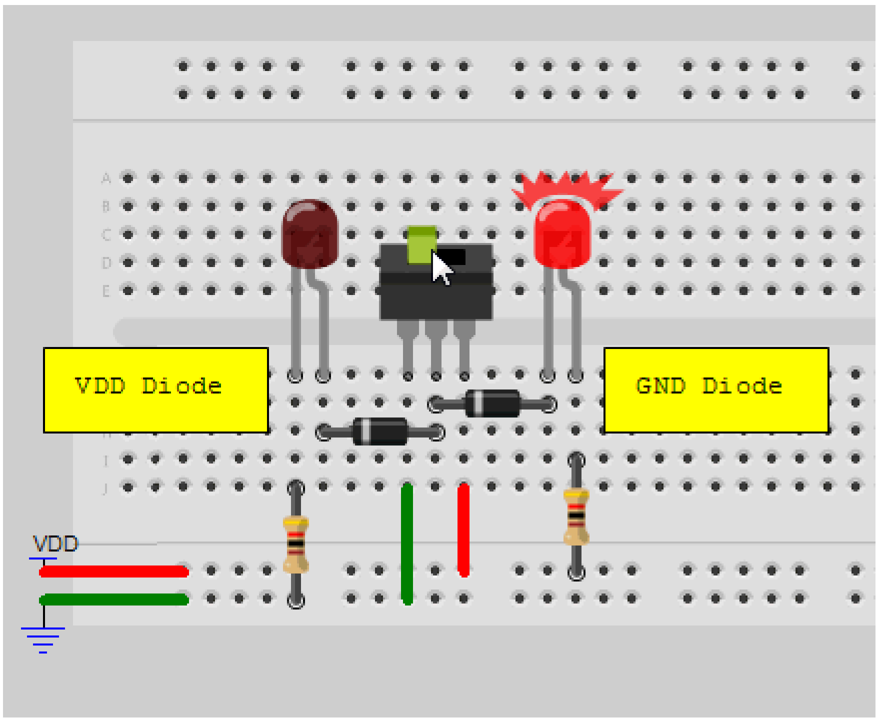
Property	Description
ID	Identifier used in BOM
Spacing	The number of grid spacings between pins
Function	*Emulation Behaviour* *Document* | *VDD* | *GND*

Diodes

Diodes are modelled as switched pull-up or switched pull-down resistor.

- document *No connection in circuit*
- VDD *Switched Pullup*
- GND *Switched Pulldown*

VDD and GND Mode



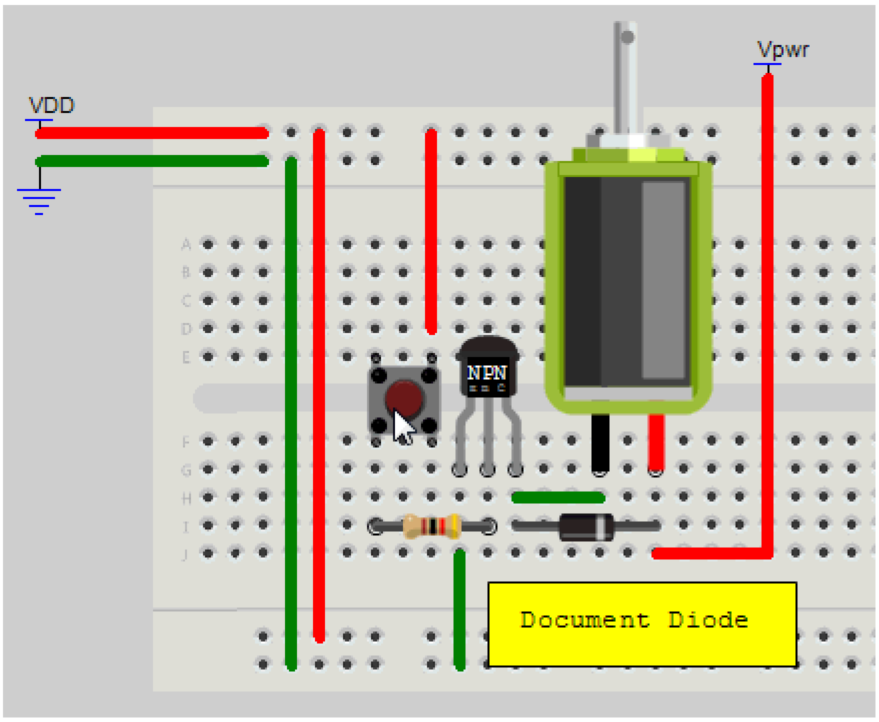
There are two common modes supported

In GND mode the diode acts as a pulldown resistor when connected to ground.

In VDD mode the diode acts as a pullup resistor when connected to VDD.

Document mode

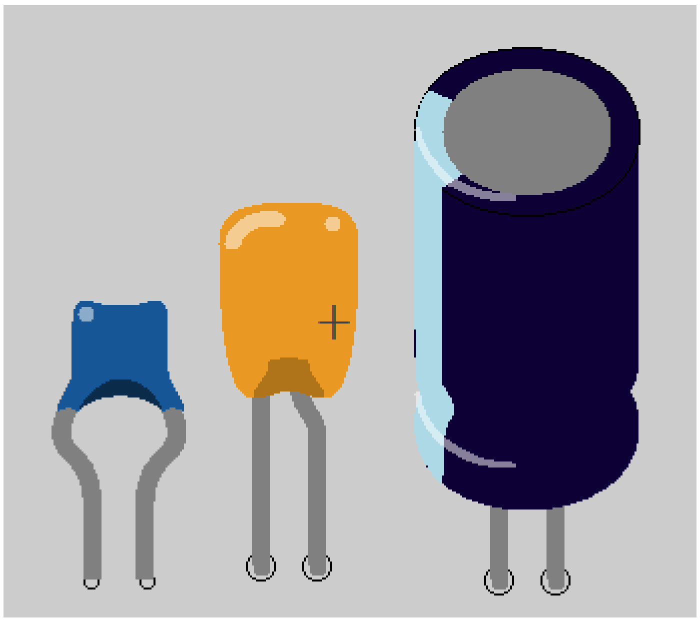
Diodes can also be used in document mode. A common example is a protection diode you often see in circuits accross solonoid and motors. The protection diodes can be placed using document mode so they appear in the circuit but dont participate in the emulation.



There are lots of other circuit tricks that use diode non-linearity and other diode characteristics.
These wont work in VBB and require the use of document mode

Ceramic Capacitor
Tantalum Capacitor
Electrolytic Capacitor

Generic capacitor components



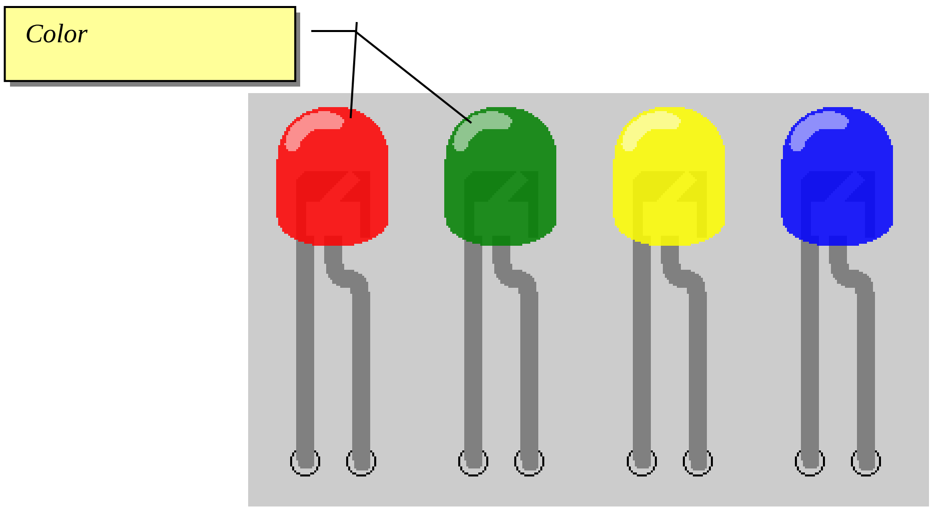
Properties

Property	Description
ID	Identifier used in BOM
Capacitance	The capacitance value of the capacitor to appear in BOM

LED

Standard LED component with parametric color

Parametric Model



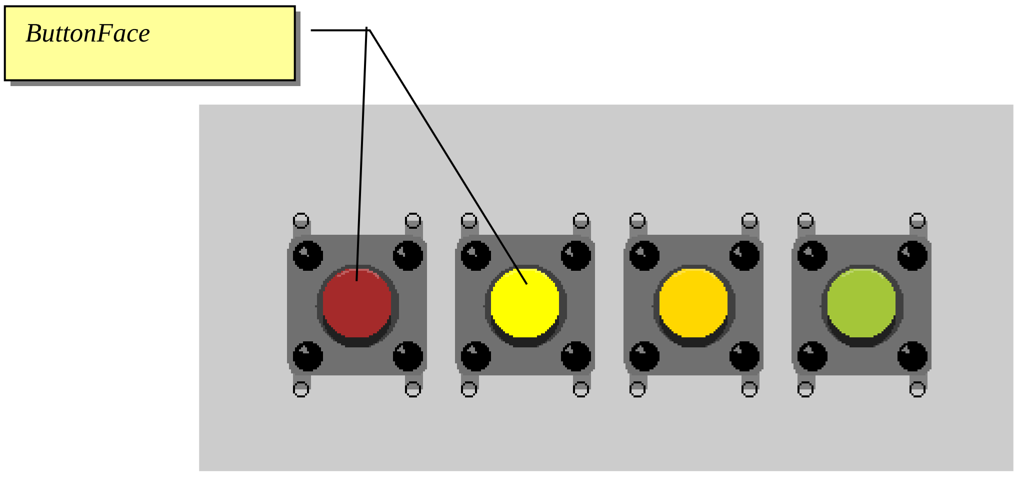
Properties

Property	Description
ID	Identifier used in BOM
LED	Color of the LED

PushButton

Momentary PushButton with button color

Parametric Model



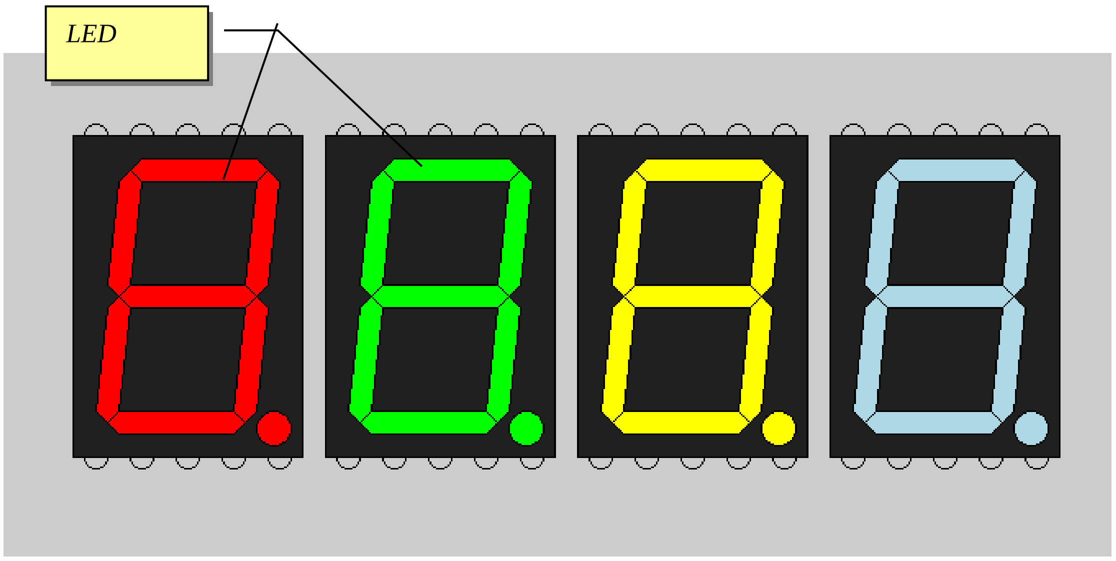
Properties

Property	Description
ID	Identifier used in BOM
ButtonFace	Color of the button

Seven Segment Display

Seven Segment display with parametric color

Parametric Model



Properties

Property	Description
ID	Identifier used in BOM
LED	Color of the LED segments

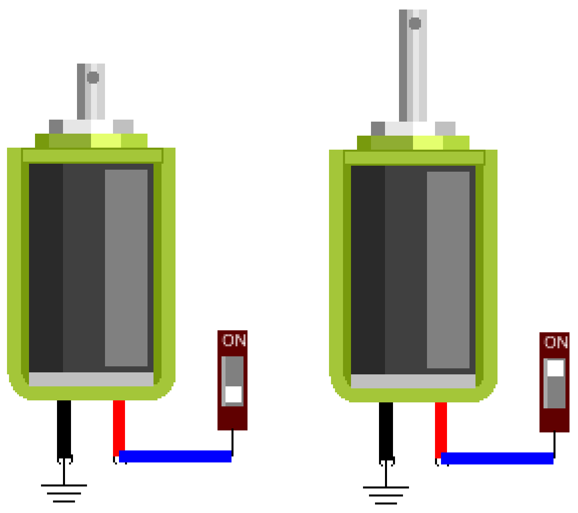
Other Components

Non parametric components

	Toggle	Toggle switch
	NPN	Models of TO-92 NPN Transistor
	PNP	Models of TO-92 PNP Transistor
	VREG	Model of TO-220 Voltage regulator
	Trimmer	Model of Trimmer Potentiometer
	Relay	Model of a common relay
	Solonoid	Model of a Solonoid component

Property	**Description**
ID	Identifier used in BOM
Value	Value shown in BOM *(not implemented v0.1)*

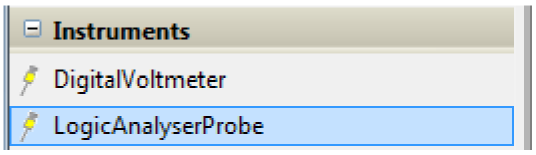
Solonoid



Logic Analyser

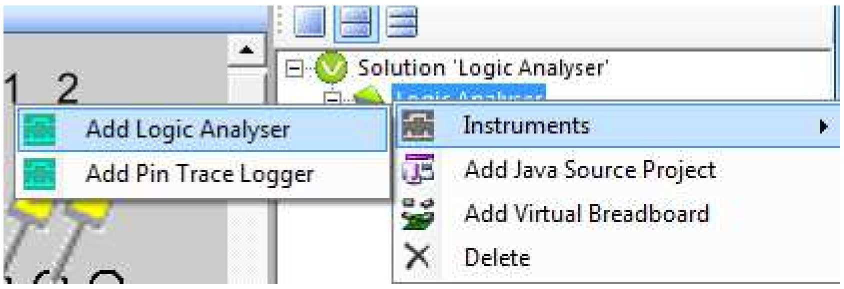
*Trace Log (*.VLG)*

The Logic Analyser traces signal events for logic analysis of circuits useful for debugging. The Logic Analyser works with Logic Probes that are placed onto Breadboard sheets and linked to the Logic Analyser Instrument from the Instrument property of the LogicProbe.



Design Sheet – The design sheet is a form which graphs signal events
Toolbar – None
Toolbox – None

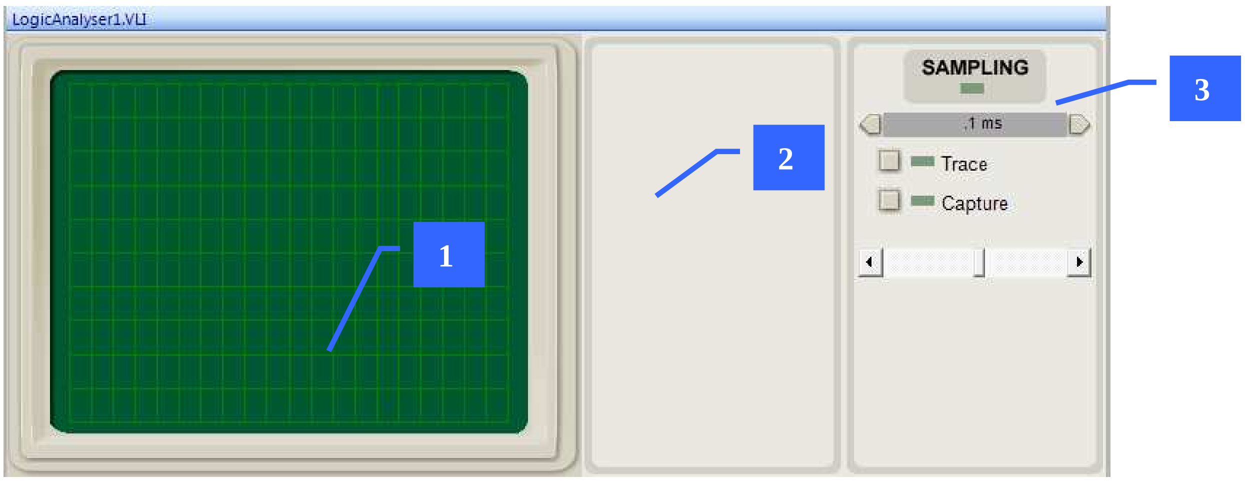
Adding a Logic Analyser



The trace log is found in the instruments project context sub menu. Right click on the project and select the Add Logic Analyser from the drop down context menu

Drag the Design Sheet into a View

The Logic Analyser doesn’t have a default view location so wont appear until you drag it from the Project tree into a view pane

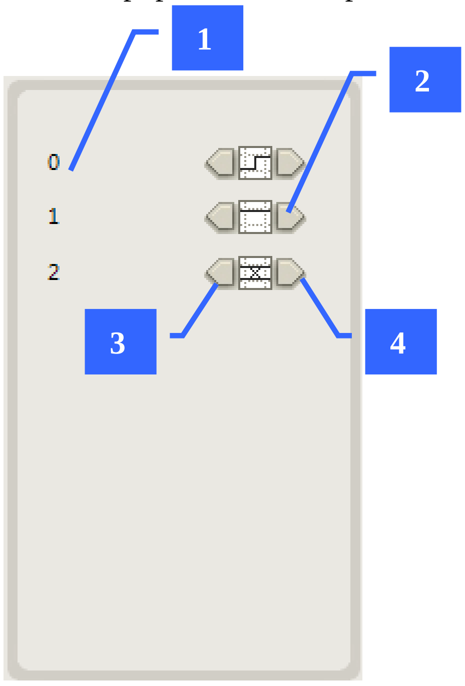


1. View Window

The trace grid is where the signal chart will be drawn. The probes sample the signal from the Breadboard sheet and are drawn into the TraceGrid. Up to 10 probes can be sampled

2. Probe List

The Probe list is initially empty when the circuit emulation is first run the probe list becomes populated with a probe list and trigger elements for each probe.



1 Probe name

The name of the probe is taken from the name property of the probe on the Breadboard sheet

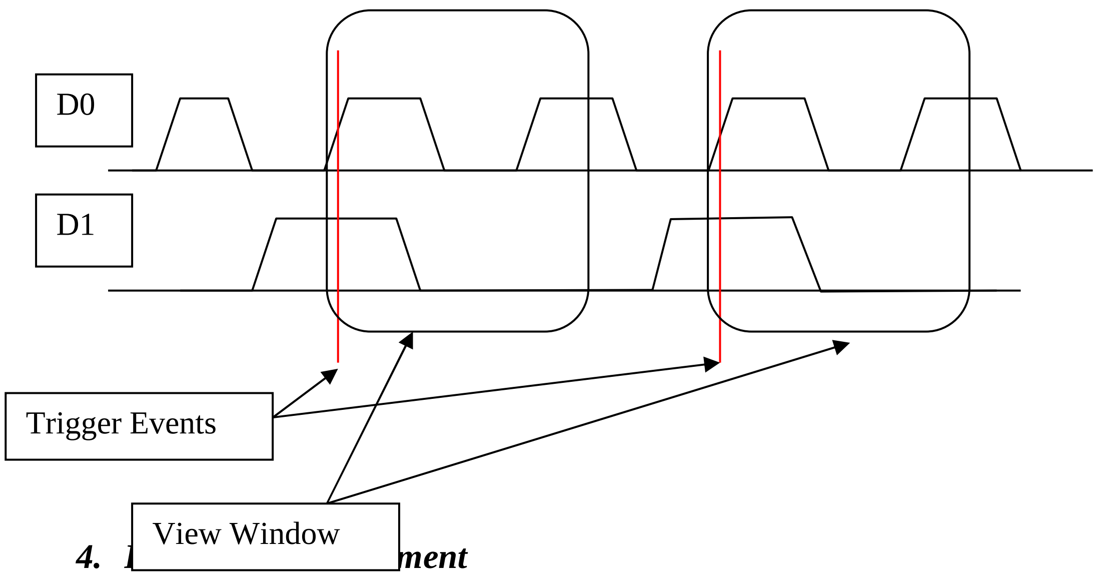
2. Trigger Element

The trigger element for each probe is combined to make a trigger event which is detected by the logic analyser to begin recording. This makes it possible to capture specific parts of a signal

There are 5 possible trigger options

Icon	**Trigger**	**Description**
⊠	Don’t-Care	Not used in the trigger detection
↑	Rising Edge	Trigger occurs when signal moves from low to high
↓	Falling Edge	Trigger occurs when signal moves from high to low
▔	HIGH	Trigger occurs when signal is HIGH.
▁	LOW	Trigger occurs when signal is LOW

A trigger is formed by AND the trigger elements together. For example the above trigger is ISRISING(0) AND ISHIGH(0). The left hand edge of the view window is marked by the trigger



4. I [illegible] *ment*

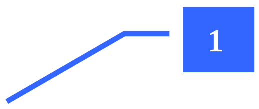
Click to switch to the previous filter element

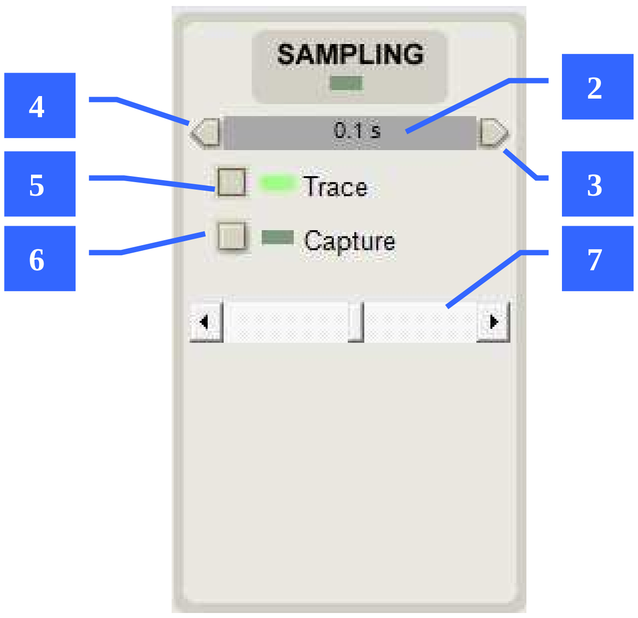
5. Next Filter Element

Click to switch to the next filter element

3. Sampling Control Panel

The sampling control panels determines how signals are captured and viewed in the View Window



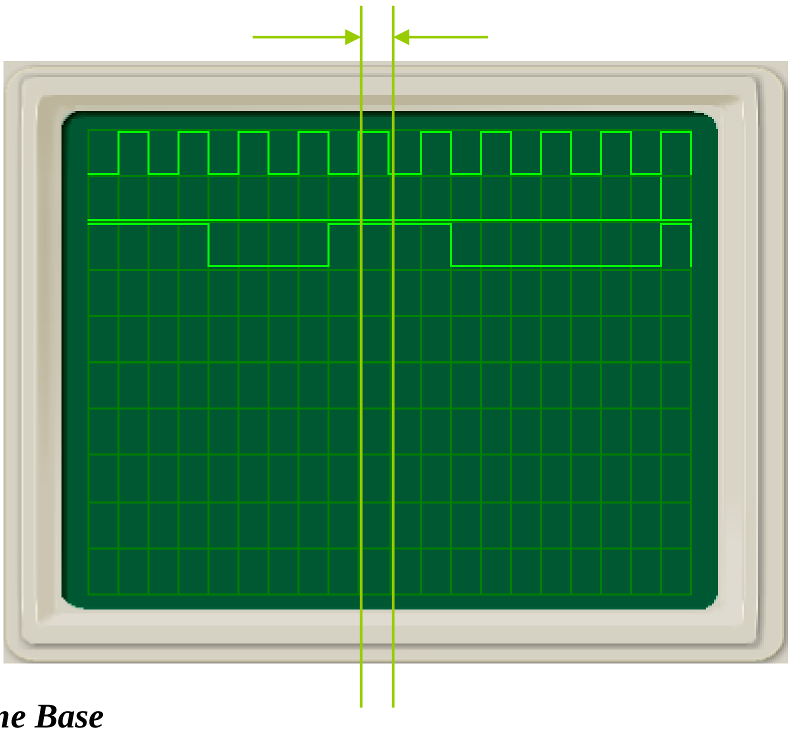


1. Sampling LED

The sampling LED flashes when a trigger event occurs and a sample is made

2. TimeBase

The Timebase is the displayed time per view per horizontal grid in the View Window from 0.1 microsecond through to 1 second.



3. Next Time Base

Decreases the timebase

4. Previous Time Base

Increases the timebase

5. Trace Mode Toggle Button

Click to enable trace mode. In trace mode the signal is sampled continuously and refreshes each time a trigger event occurs

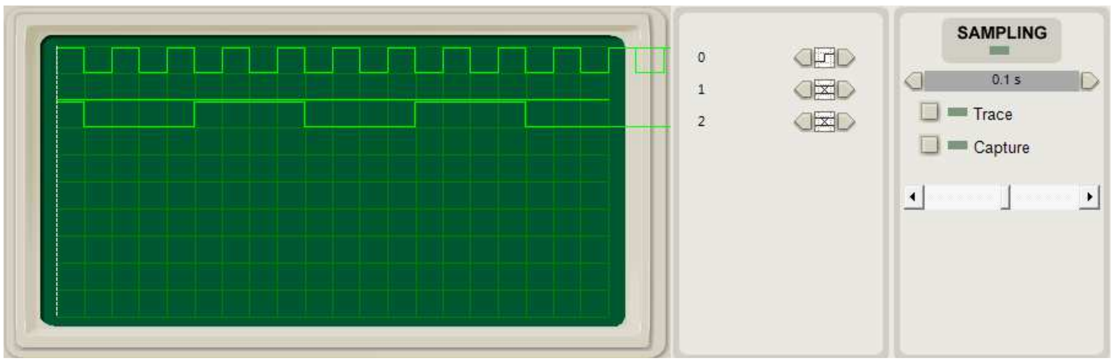
6. Capture Mode Toggle Button

Click to arm capture. In capture mode the first trigger event is captured and viewed. The capture mode button becomes disabled. You can then analyse the resulting signal trace without it changing. To sample another signal you need to arm the capture mode again.

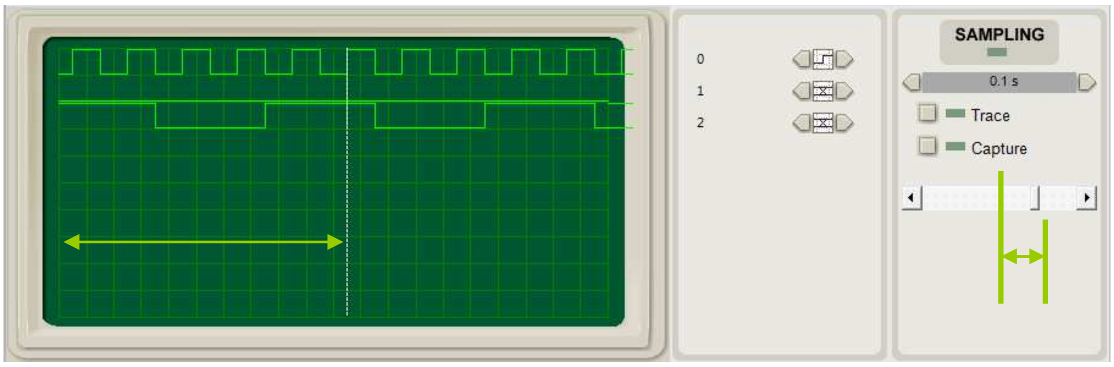
7. View Window Offset

Adds an offset to the view window left or right from the trigger event so you can view different parts of the signal in and around the trigger event

Offset = 0



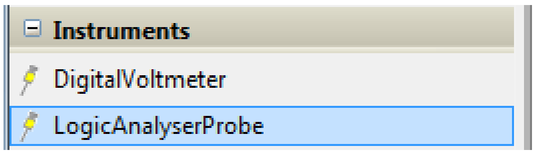
Offset = ~+50% Shifts the left offset along to view the signal before the trigger



Trace Log Design Sheet

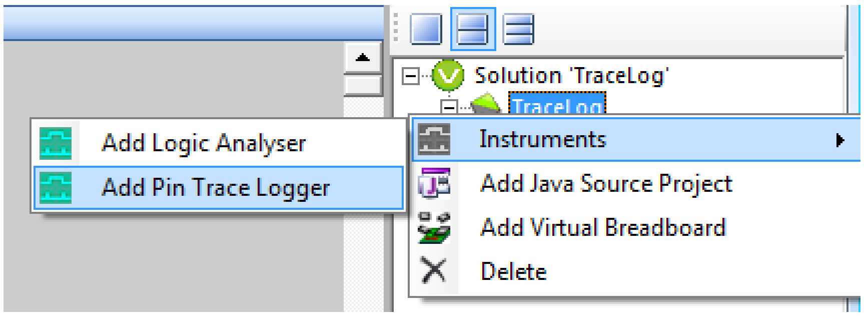
Trace Log (*.VLG)

The tracelog logs signal events for logic analysis of circuits useful for debugging. Trace Log works with Logic Probes that are placed onto Breadboard sheets and linked to the Trace Log instrument from the Instrument property of the LogicProbe.



Design Sheet – The design sheet is a form which logs signal events
Toolbar – None
Toolbox – None

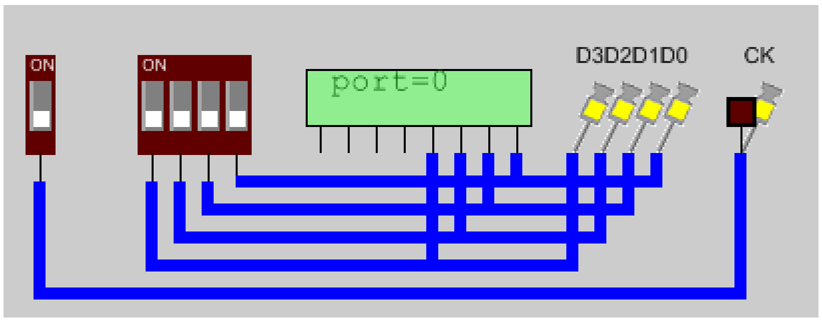
Adding a Trace Log

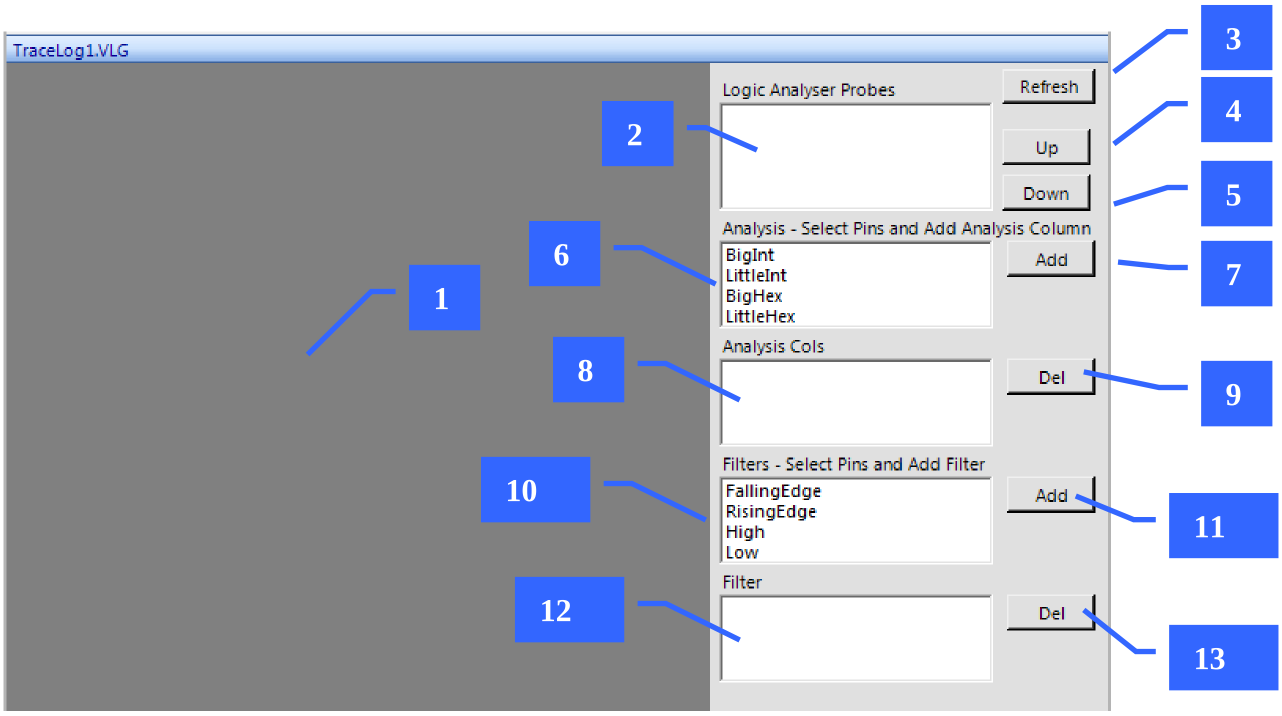


The trace log is found in the instruments project context sub menu. Right click on the project and select the Add Pin Trace Logger from the drop down context menu

Drag the Design Sheet into a View

The Trace Log doesn't have a default view location so wont appear until you drag it from the Project tree into a view pane

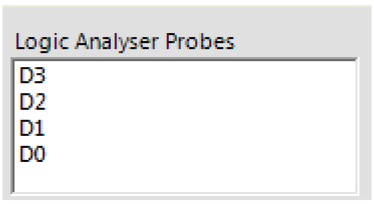




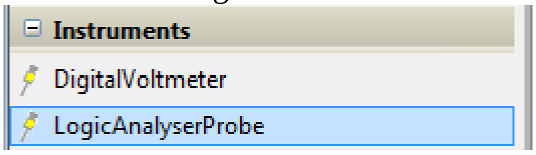
1. Trace Log Pane

The logged events will appear

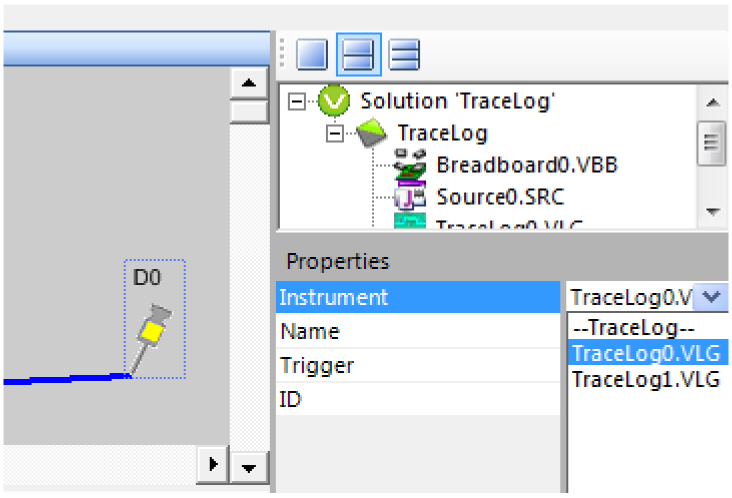
2. Logic Probe List



The list of linked Logic Analyser Probes. When adding a logic probe to a Breadboard design sheet



To link it you select the Instrument as the TraceLog to link to from the Instrument list in the properties box

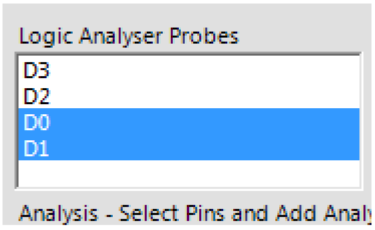


3. Refresh

Refreshes the Logic Probe list. If new logic probes are added to a Breadboard design sheet you need to click refresh to repopulate the list

4. Up Button
5. Down Button

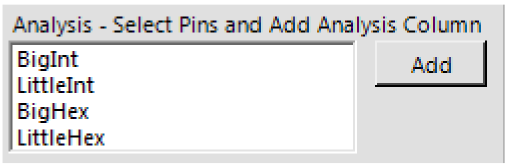
The Logic Probe List is ordered. You can move a logic probe name up the list by selecting in the list and pressing the Up/Down Button.



The order influences the column the probe data will appear in the log pane

6. Analysis Function List

List of analysis functions available. Analysis functions create a new column and apply the analysis function to a collection of probe data. Analysis functions are often used to display bus value during triggered events



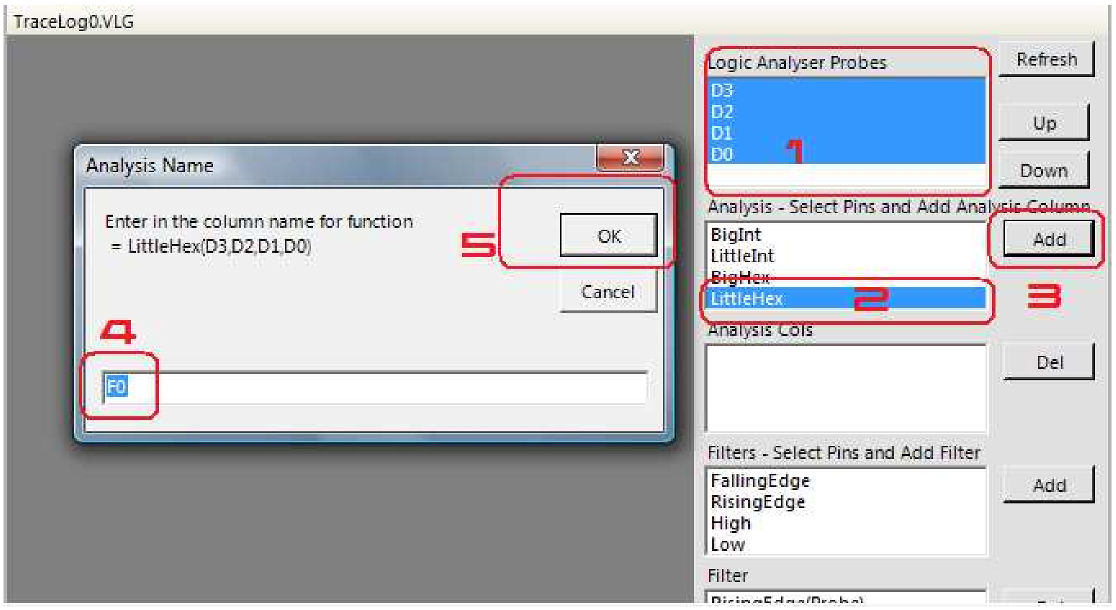
BigInt – Computes an integer with big endian and displays as Base 10

LittlInt – Computes an integer with little endian and displays as Base 10
BigHex – Computes an integer with little endian and displays as Base 16
LittleHex – Computes an integer with little endian and displays as Base 16

7 Add Analysis function Button

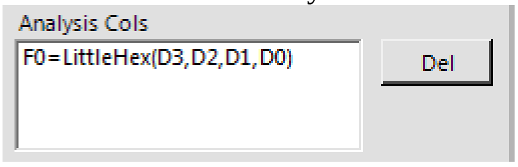
To add an analysis function

6. Select the logic probes to analyse
7. Select the analysis function
8. Click Analysis Add Button
9. Name the Analysis function column
10. Click OK to Add



8 Analysis functions list

Contains the list of analysis functions that have been added

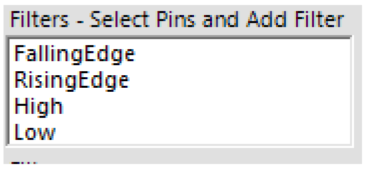


9. Delete Analysis function

To delete analysis function(s) select the functions from the list and press delete

10 Filters list

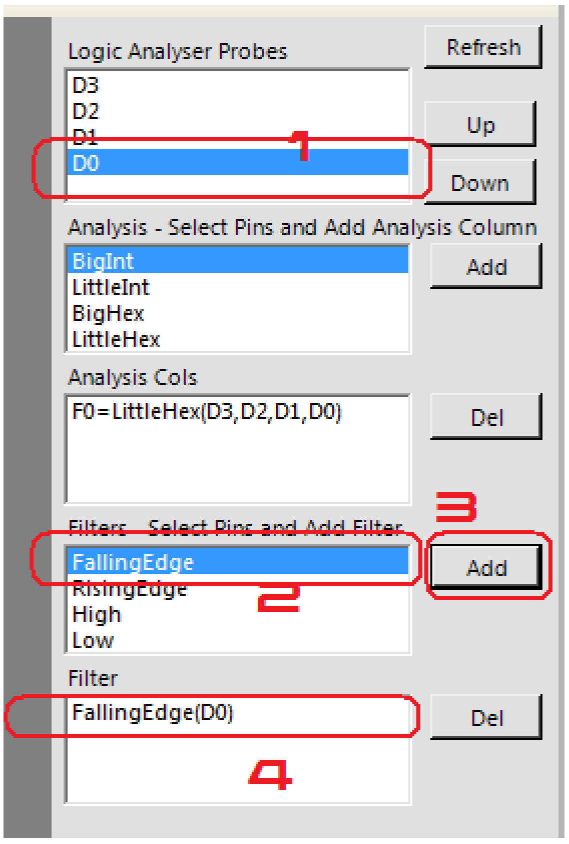
Contains a list of available filters that can be added. More than 1 filter can be added and the resulting filter is the AND of each filter. The filter represents an event for which data will be logged and analysis functions applied



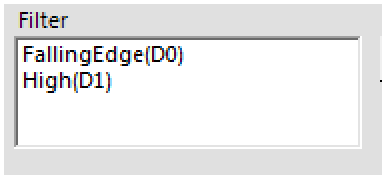
FallingEdge – A logic probe changes from HIGH to LOW
RisingEdge – A logic probe changes from LOW to HIGH
High – A logic probe is HIGH
Low – A logic probe is LOW

11. Add Filter Button

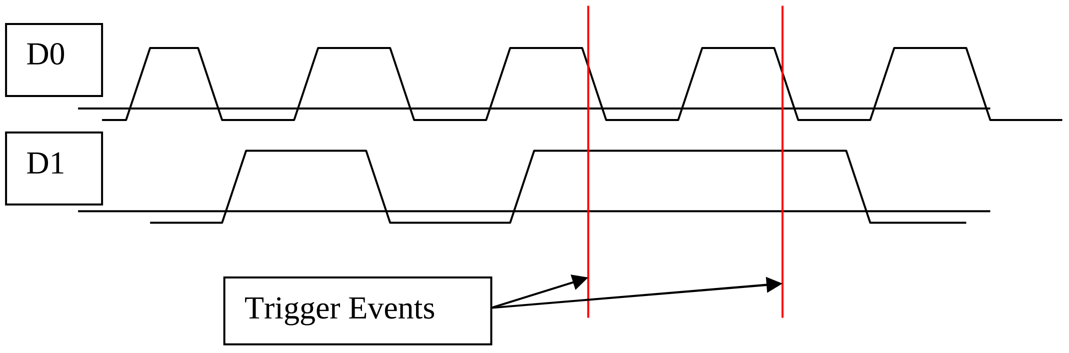
To add a filter,
1) Select the Logic Probe in the logic probe list
2) Select the Filter in the filter list
3) Click the Add Filter button
4) The Filter will be added to the Filter list



12 Filter List



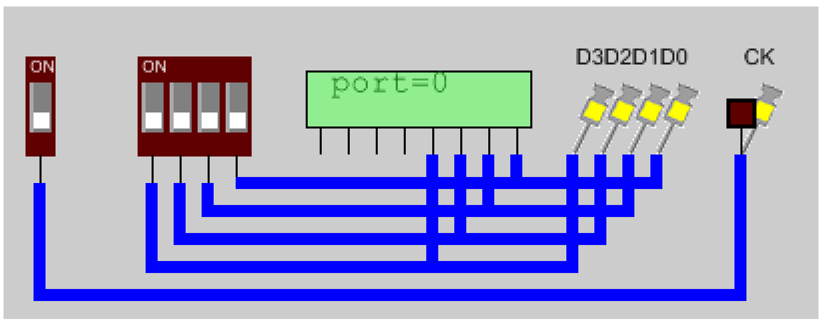
The Filter List is the list of current filters which represent the filter. For example the filter shown is
Log a record When FallingEdge(D0) and High(D1)



13 Delete Trigger

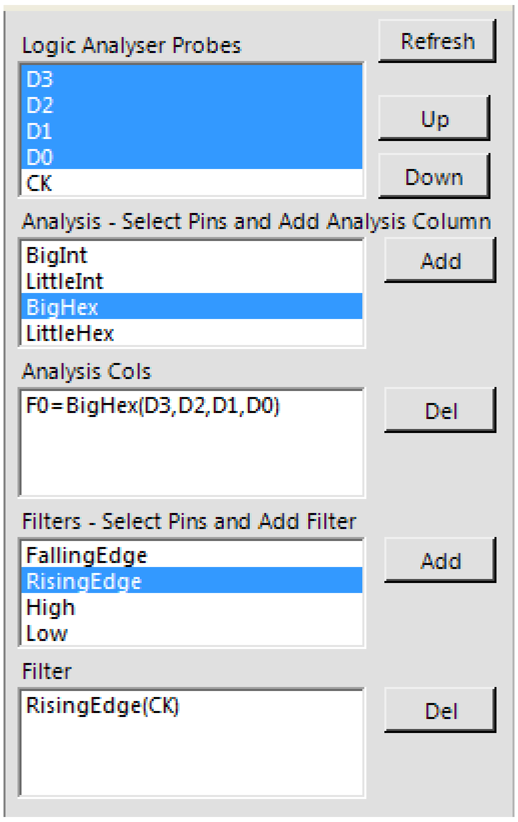
To delete a trigger select the trigger element and press the delete trigger button

Worked example with the Trace Log



In this example I have a 4-bit bus with logic probes D0 – D4. The Bus LCD is used to show the current value. I also have a CLK pin.

What I want to do is to log the values of the bus in Hex format on the rising clock edge of the clock. To do this I setup a trace log configuration as follows.


Logic Analyser Probes

D3
D2
D1
D0
CK

Analysis - Select Pins and Add Analysis Column

BigInt
LittleInt
BigHex
LittleHex

Analysis Cols

F0=BigHex(D3,D2,D1,D0)

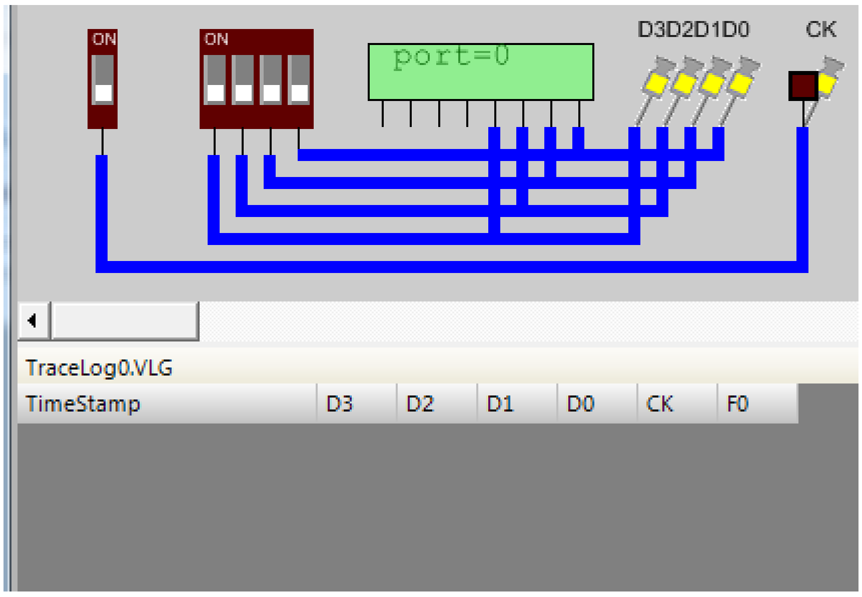
Filters - Select Pins and Add Filter

FallingEdge
RisingEdge
High
Low

Filter

RisingEdge(CK)

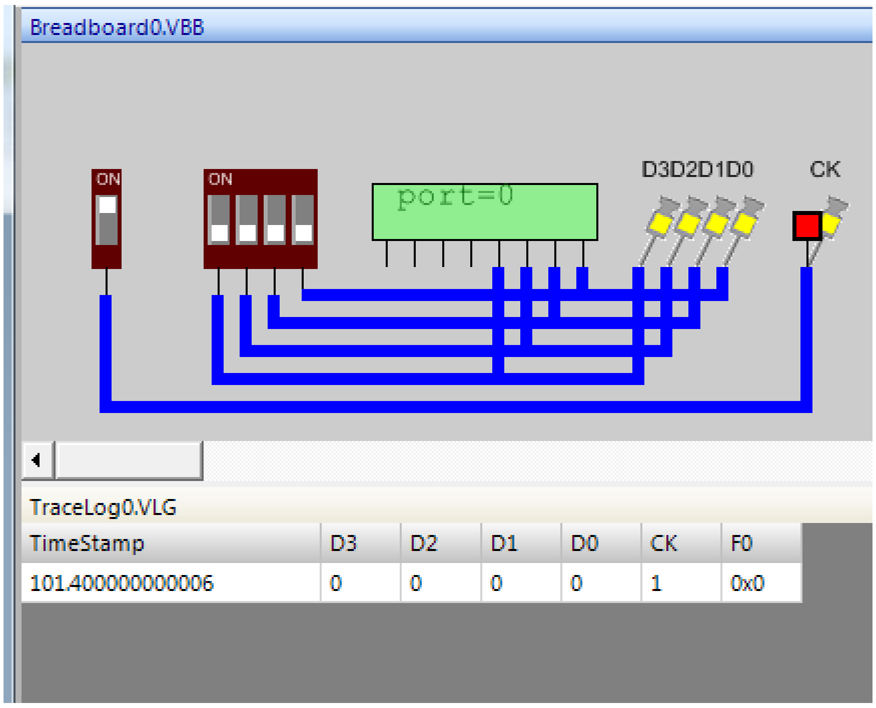
Now when the emulation is run



TraceLog0.VLG

TimeStamp	D3	D2	D1	D0	CK	F0

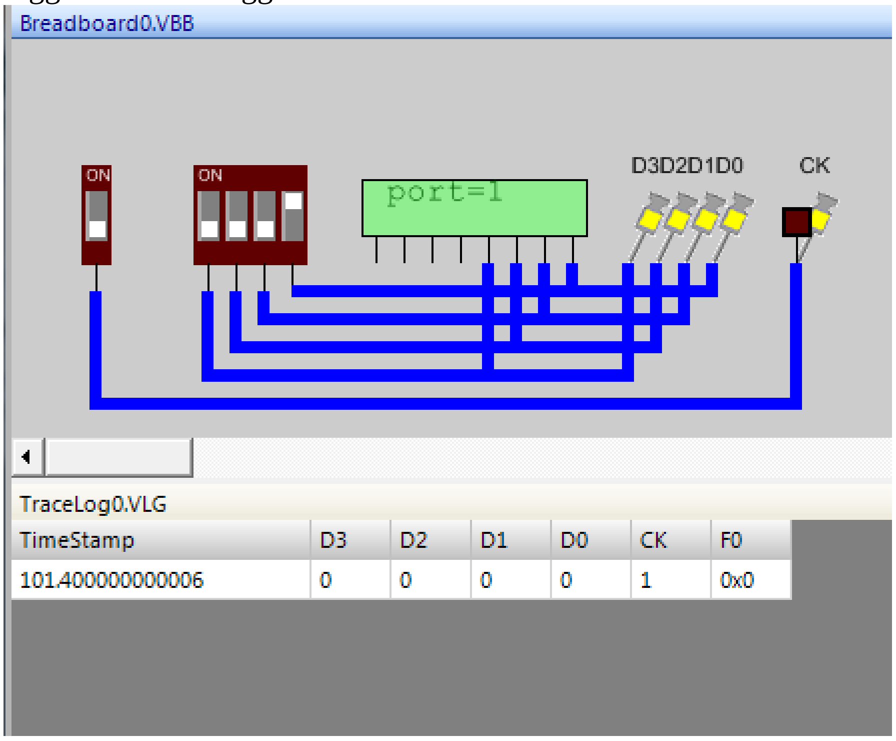
The value of the logic probes D0,D1,D2,D3 and CK are recorded when the on the rising edge of the CK pin. In addition the analysis column F0 has been added with the hex value of the port



TraceLog0.VLG

TimeStamp	D3	D2	D1	D0	CK	F0
101.400000000006	0	0	0	0	1	0x0

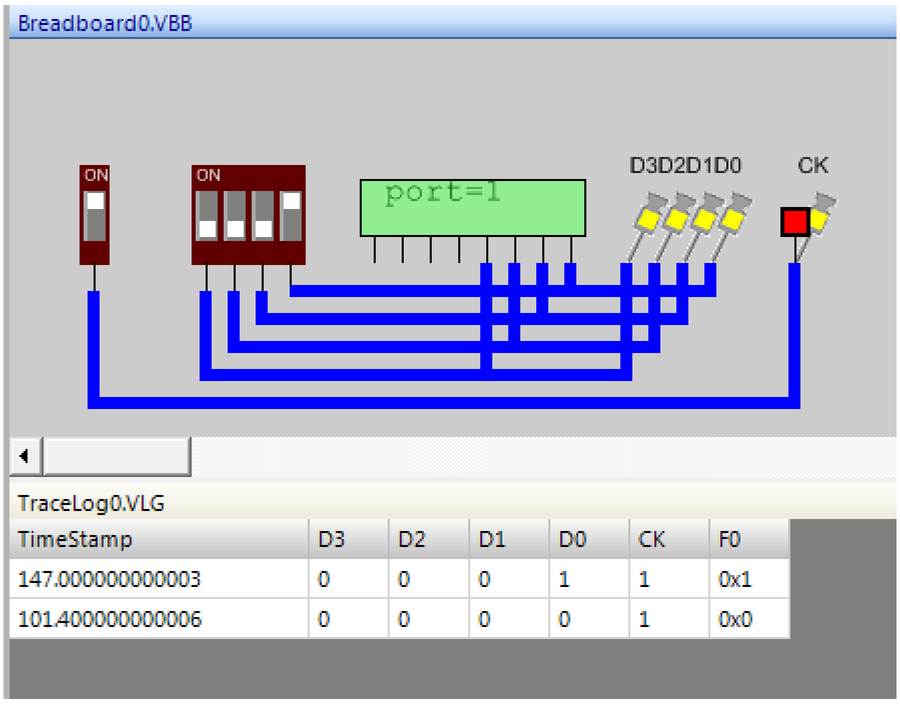
You can see that even though the port values have changed to 1 the data is not logged until the trigger occurs ie where the clk rises



TraceLog0.VLG

TimeStamp	D3	D2	D1	D0	CK	F0
101.400000000006	0	0	0	0	1	0x0

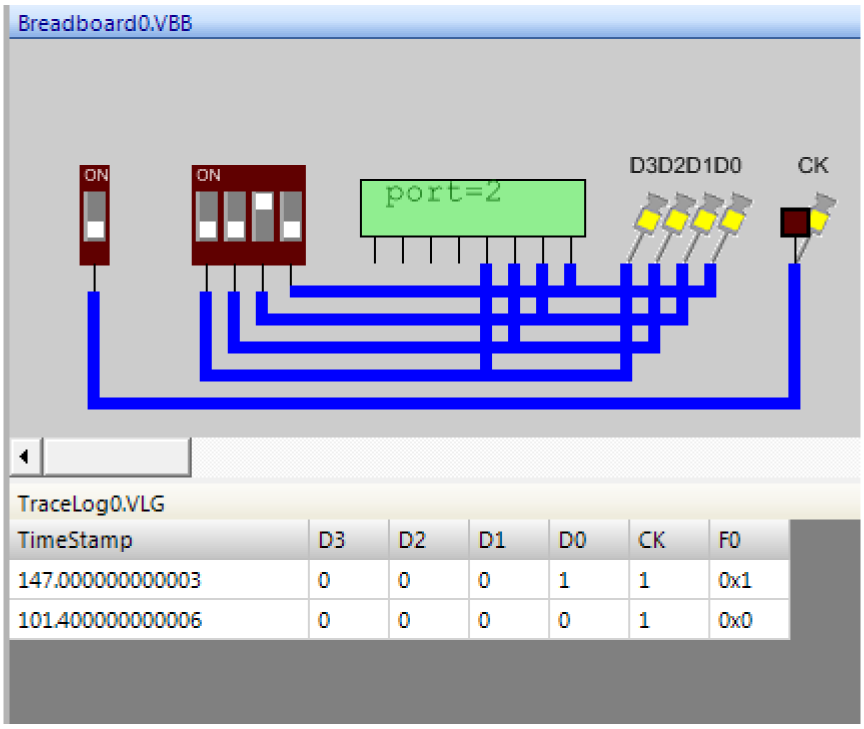
So now as the CLK has the rising edge the data is logged



TraceLog0.VLG

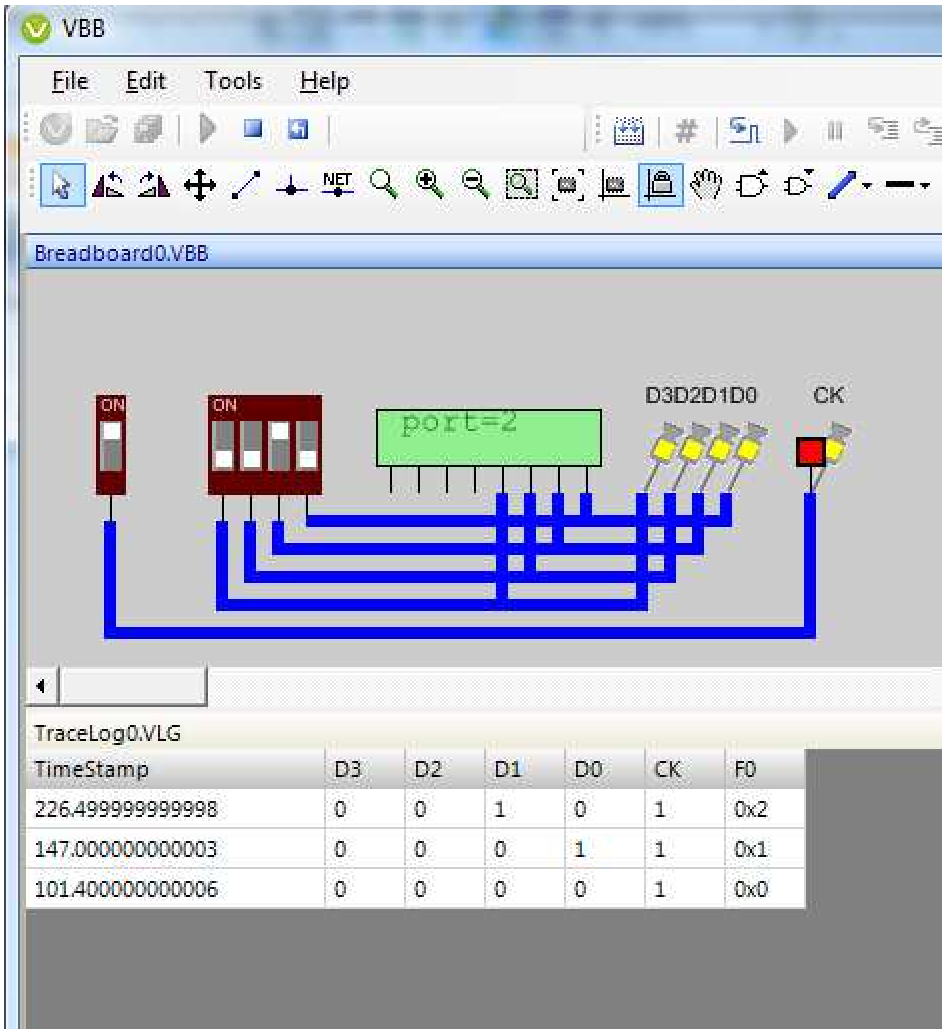
TimeStamp	D3	D2	D1	D0	CK	F0
147.000000000003	0	0	0	1	1	0x1
101.400000000006	0	0	0	0	1	0x0

This is repeated with all the values of the 4-bit port showing the trace log values

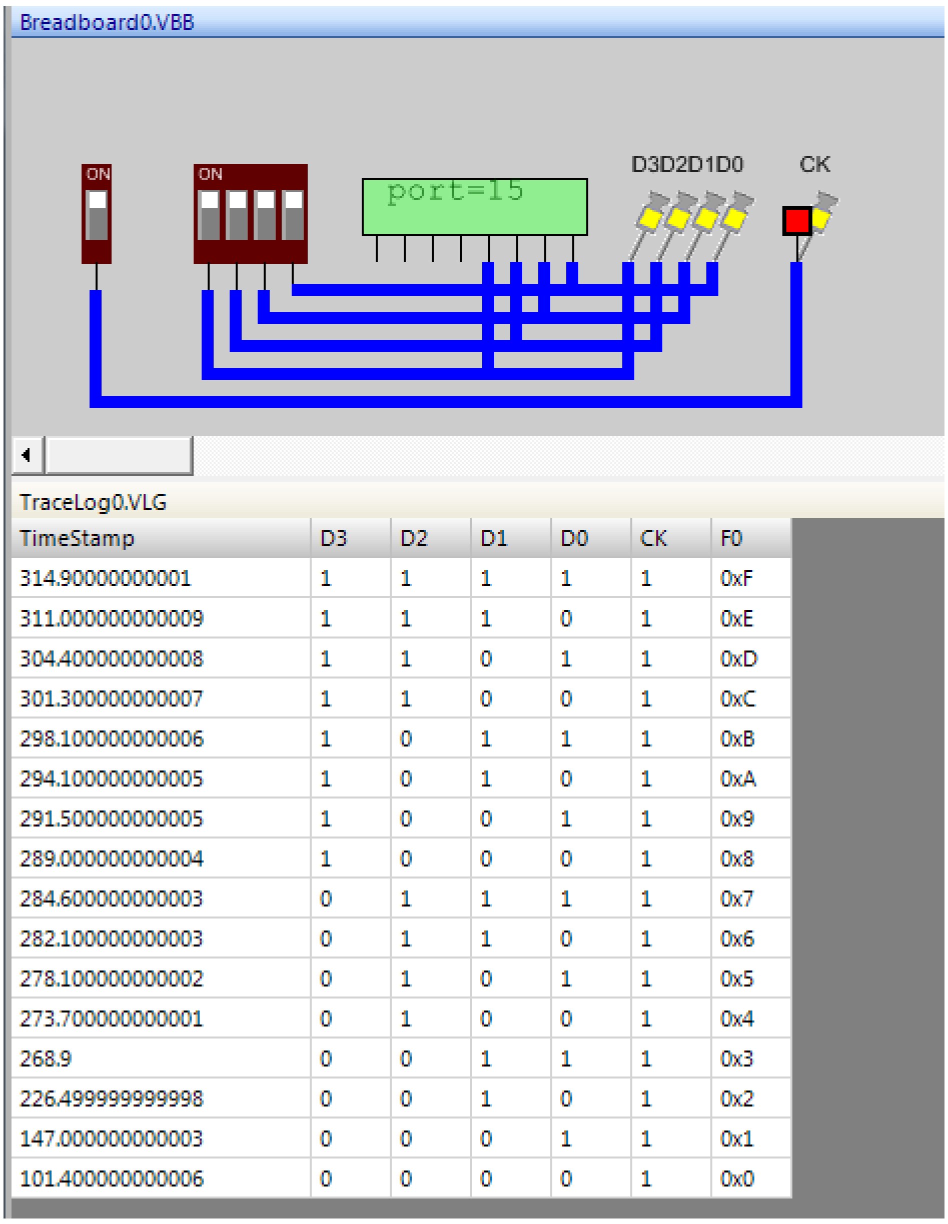


TraceLog0.VLG

TimeStamp	D3	D2	D1	D0	CK	F0
147.000000000003	0	0	0	1	1	0x1
101.400000000006	0	0	0	0	1	0x0



TimeStamp	D3	D2	D1	D0	CK	F0
226.499999999998	0	0	1	0	1	0x2
147.000000000003	0	0	0	1	1	0x1
101.400000000006	0	0	0	0	1	0x0

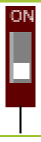


TraceLog0.VLG

TimeStamp	D3	D2	D1	D0	CK	F0
314.90000000001	1	1	1	1	1	0xF
311.000000000009	1	1	1	0	1	0xE
304.400000000008	1	1	0	1	1	0xD
301.300000000007	1	1	0	0	1	0xC
298.100000000006	1	0	1	1	1	0xB
294.100000000005	1	0	1	0	1	0xA
291.500000000005	1	0	0	1	1	0x9
289.000000000004	1	0	0	0	1	0x8
284.600000000003	0	1	1	1	1	0x7
282.100000000003	0	1	1	0	1	0x6
278.100000000002	0	1	0	1	1	0x5
273.700000000001	0	1	0	0	1	0x4
268.9	0	0	1	1	1	0x3
226.499999999998	0	0	1	0	1	0x2
147.000000000003	0	0	0	1	1	0x1
101.400000000006	0	0	0	0	1	0x0

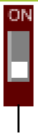
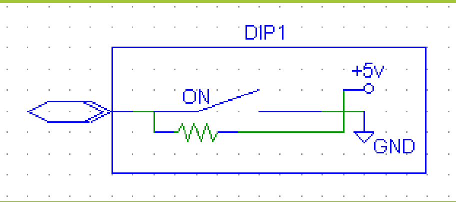
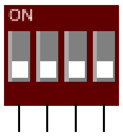
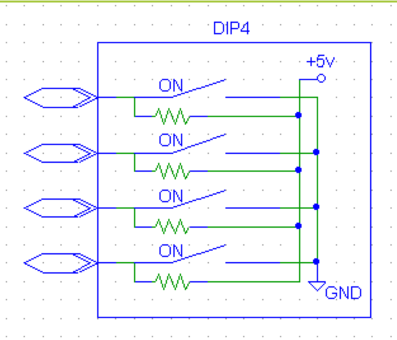
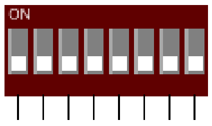
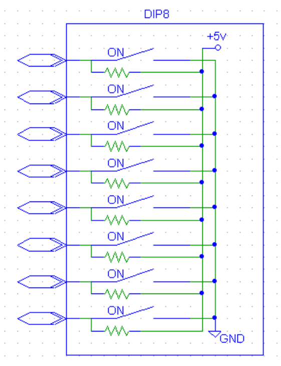
UserIO

UserIO components don’t match directly to physical devices but they provide common functions useful for quickly modelling and testing a circuit.

Name	VBB Icon	Description
DIP1,DIP4,DIP8		
LED1,LED4,LED8		

DIP1, DIP4, DIP8

The DIP component is an N (N=1|4|8) array of DIP switches which are connected to 5V when Switch = ON and 0V (GND) when Switch = OFF. DIPS are an interactive component. Clicking on the DIP switch, the white square region, toggles the value of the switch. The SETTINGS property is an N Binary string representing the values of each of the DIP switches. Clicking the respective DIP switch will change the value of SETTINGS, alternatively the value can be directly edited in the SETTINGS property textbox.

Name	VBB Graphic	Equivalent Circuit
DIP1		
DIP4		
DIP8		 DIP8 +5v ON ON ON ON ON ON ON ON GND

Pinout

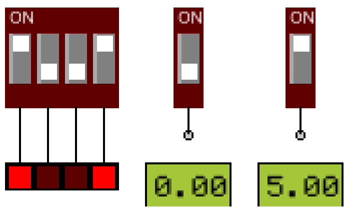
Pin	Name	Description
N	*OUTPUT[N]*	DIP Output. Nth Pin is 5V if the Nth switch is ON. Nth Pin is 0V – GND if the Nth switch is OFF

Properties

Name	Default	Options	Description

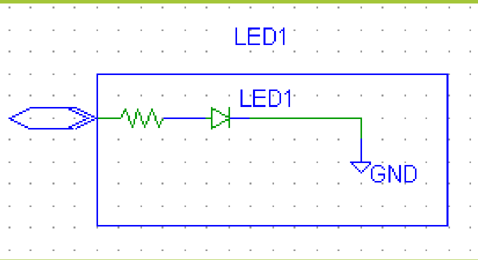
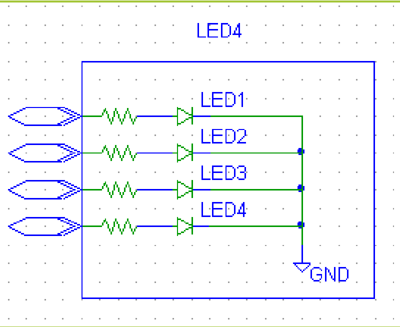
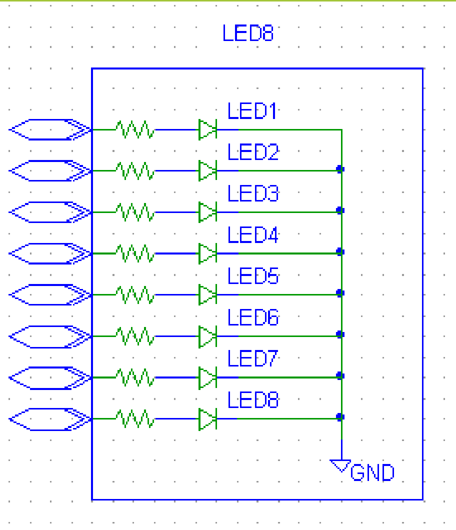
OnState	HIGH	HIGH | LOW	The value of the DIP output when in the ON state. Either driven HIGH or driven LOW when the DIP is on ON
DIP	0	<User Entry>	The decimal value of the DIP. DIP1 0 or 1, DIP4 0 to 15, DIP4 0 to 255. You can type the value into the setting box or click the dip switches at designtime or runtime to change the value
Pins	Bottom	Top | Bottom	The pins are rendered either on the Top or Bottom of the DIP body as per this setting

Usage



LED1, LED4, LED8

The LED component is an N (N=1|4|8) array of Light Emitting Diode (LED) indicators. The Nth LED is ON when the Nth input pin is driven by greater than 2.5V otherwise the LED is OFF. The color of the LED is determined by the *COLOR* property. When the LED is ON the LED color is lighter than when OFF giving a visual clue to voltage level at the LED input pin. LEDs are a fundamental indicator of circuit status.

Name	VBB Graphic	Equivalent Circuit
LED1		
LED4		
LED8		 LED8 LED1 LED2 LED3 LED4 LED5 LED6 LED7 LED8 GND

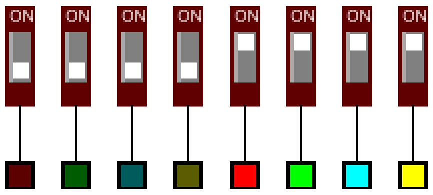
Pinout

Pin	Name	Description
N	*INPUT[2N]*	LED Input pins. Nth LED is ON when the Nth *INPUT* pin is > 2.5V else is OFF

Properties

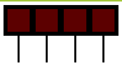
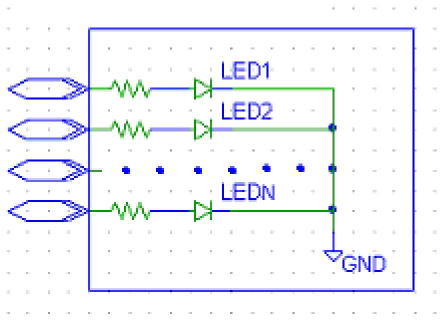
Name	Default	Options	Description
COLOR	RED	RED | GREEN | BLUE | YELLOW	Color of LED. LED is lighter when ON than OFF giving a visual clue to the status of the LED.

Usage



LedArray

The LED component is an N array of Light Emitting Diode (LED) indicators. The Nth LED is ON when the Nth input pin is driven by greater than 2.5V otherwise the LED is OFF. The color of each individual LED is determined by the *COLOR* property. When the LED is ON the LED color is lighter than when OFF giving a visual clue to voltage level at the LED input pin. LEDs are a fundamental indicator of circuit status.

Name	VBB Graphic	Equivalent Circuit
LedArray		

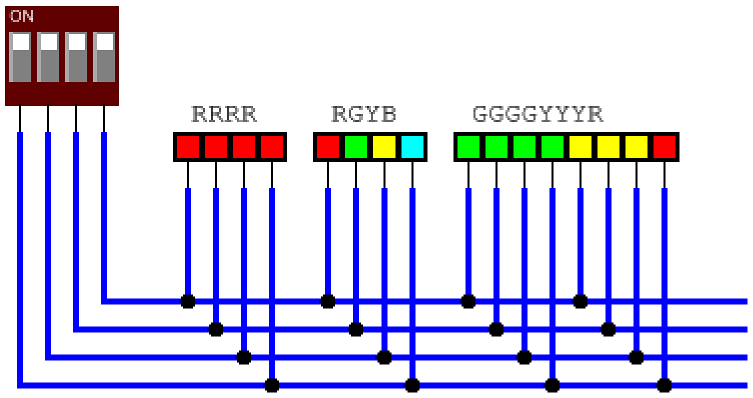
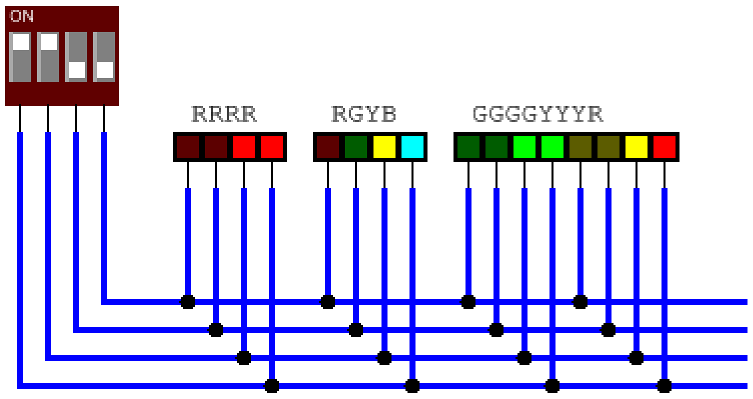
Pinout

Pin	Name	Description
N	*INPUT[N]*	LED Input pins. Nth LED is ON when the Nth *INPUT* pin is > 2.5V else is OFF

Properties

Name	Default	Options	Description
Colors	RRRR		Colors and Length of the Led Array. A String of length N with letters ‘R’ (Red), ‘G’ (Green) , ‘Y’ (Yellow) or ‘B’ (Blue).

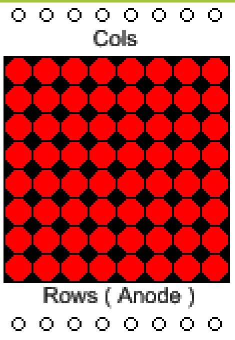
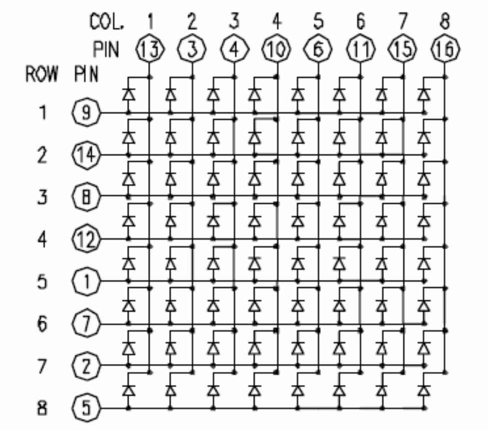
Usage


ON
RRRR
RGYB
GGGGYYYR

ON
RRRR
RGYB
GGGGYYYR

DotMatrixLED8x8

The DotMatrixLED8x8 component is a Dot Matrix LED array. The array consists of 8 Rows and 8 Columsn. Each Row Anode pin drives 8 LEDS each attached to one of the cathode column pins.

http://sigma.octopart.com/140413/datasheet/Lumex-LDM-24488NI.pdf

Name	VBB Graphic	Equivalent Circuit
DotMatrixLED8x8		 COL. 1 2 3 4 5 6 7 8 PIN 13 3 4 10 6 11 15 16 ROW PIN 1 9 2 14 3 8 4 12 5 1 6 7 7 2 8 5

By switching quickly between each row and using the persistence of vision effect a each dot in the matrix can be individually addressed. To emulate the persistence of vision effect VBB only changes the state of the LED when COL is LOW. In this way the COL pin becomes like a latch operation which latches the value of LED.

COL	ROW	Description
LOW	*HIGH*	LED ON.
LOW	*LOW*	LED OFF
HIGH	*Don't Care*	No Change.

Pinout

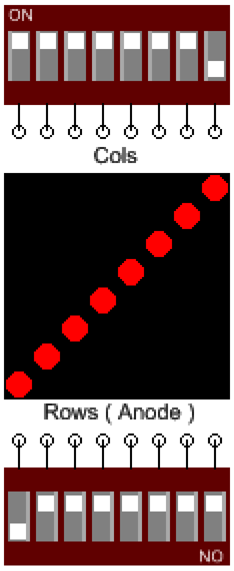
Pin	Name	Description
Cols	*Col 0..7*	Column Cathode pins of the Dot Matrix array.
Rows	*Row 0..7*	Row Anode pins of the Dot Matrix array

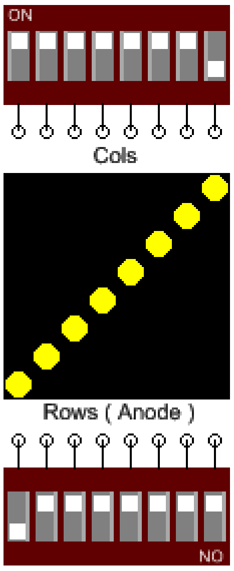
Properties

Name	Default	Options	Description

COLOR	RED	RED | GREEN | BLUE | YELLOW	Color of LED in the array. The default color is red. The options are red,green,blue and yellow but you can also type in any named color

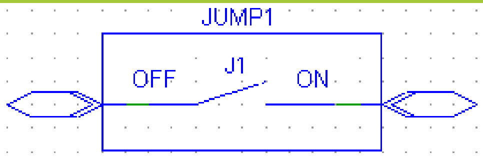
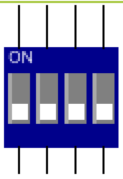
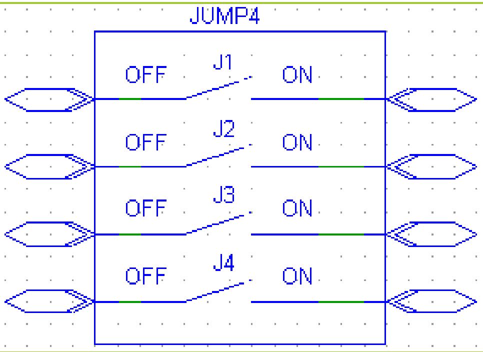
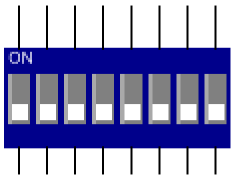
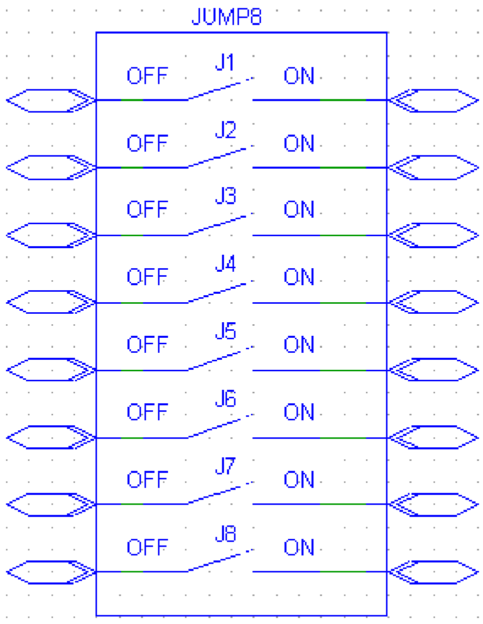
Usage





JUMP1, JUMP4, JUMP8

The JUMPER component is an N (N=1|4|8) array of switches which form a short circuit between the Nth input/output pin pair when the Nth Switch = ON and open-circuit O/C when Nth Switch = OFF. JUMPERS are an interactive component. Clicking on the JUMPER switch, the white square region, toggles the value of the JUMPER switch. The SETTINGS property is an N Binary string representing the values of each of the JUMPER switches. Clicking the respective JUMPER switch will change the value of SETTINGS. Alternatively the value can be directly edited in the SETTINGS property textbox.

Name	VBB Graphic	Equivalent Circuit
JUMP1		
JUMP4		 JUMP4 OFF J1 ON OFF J2 ON OFF J3 ON OFF J4 ON
JUMP8		 JUMP8 OFF J1 ON OFF J2 ON OFF J3 ON OFF J4 ON OFF J5 ON OFF J6 ON OFF J7 ON OFF J8 ON

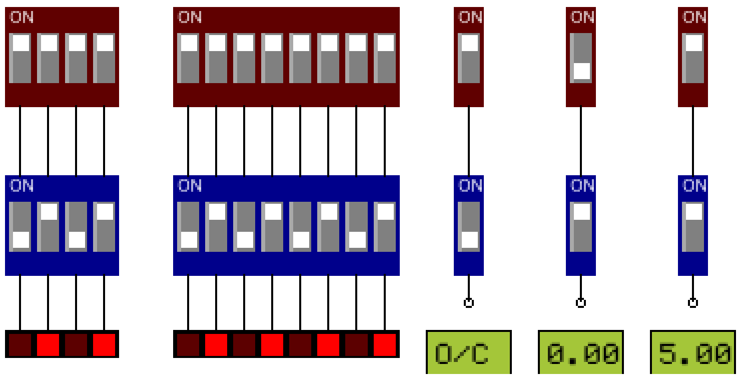
Pinout

Pin	Name	Description
N	*IO[2N]*	JUMPER IO Switch pain. Nth IO pair is short-circuit where Nth switch is ON, and open-circuit (O/C) when the Nth switch is OFF

Properties

Name	Default	Options	Description
SETTINGS	[JUMP1] 1 [JUMP4] 1111 [JUMP8] 11111111	<User Entry>	N Bit binary string holding JUMPER switches status. Is modified by clicking the component in-place or direct editing in the SETTINGS property textbox.

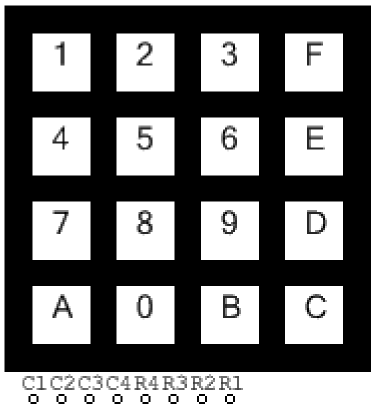
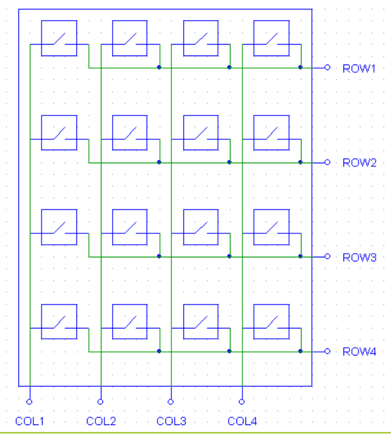
Usage



NumericKeyPad

The KEYPAD4x4 component consists of a Col x Row array of touch switches. The KEYPAD has column connect pins (C1,C2,..Cols-1) and row pins (R1,R2,..Rows-1). Each switch is connected to one column and one row connection pin such that each (row, column) combination is unique for each switch. The appearance of the KEYPAD component is determined by the *KEYMASK* property which contains a string of the key characters used on the key faces. The currently activated switch is determined by the *KEYON* property where **KEYON** = 0 when no switch is connected and **KEYON** = 1 to (Cols*Rows) when a valid switch is activated. KEYPAD is a user interactive component. Clicking on individual keys will activate the switch for that key. When active the background of the key becomes light green in color giving a visual clue to the state of the key. Only one switch can be active at any one time. Clicking on the currently active switch will toggle the switch to off resulting in no key being selected and **KEYON** = 0. When a key is on its switch becomes active creating a short-circuit across the unique row, column connection pin combination for that key.

Name	VBB Graphic	Equivalent Circuit

NumericKeyPad
Rows=4
Cols = 4
	 1
	2
	3
	F
	4
	5
	6
	E
	7
	8
	9
	D
	A
	0
	B
	C
	C1 C2 C3 C4 R4 R3 R2 R1
		 ROW1
		ROW2
		ROW3
		ROW4
		COL1
		COL2
		COL3
		COL4

Pinout

Pin	Name	Description
	C1, C2,..CN	Column Connections
	R1,R2..RN	Row Connections

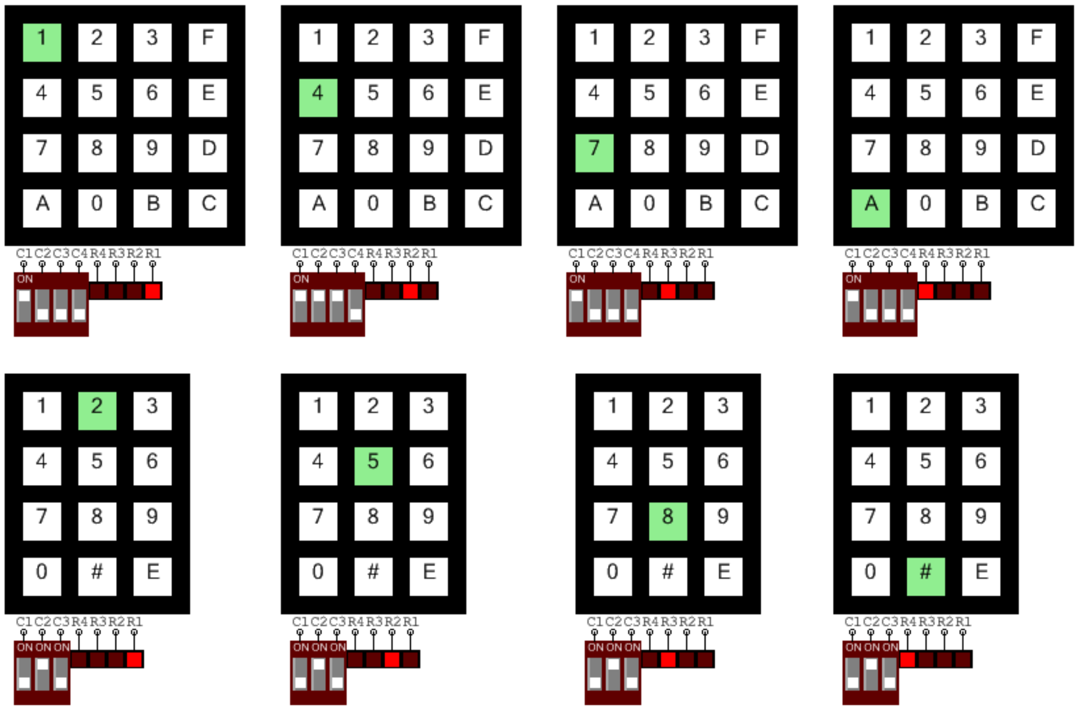
Properties

Name	Default	Options	Description
Rows	4	<User Entry>	The number of Rows of the KeyPad
Cols	4	<User Entry>	The number of columns of the KeyPad
KeyMask	123F456E789	<User Entry>	Col * Row character string

	DA0BC		containing the key-face character for each KEY

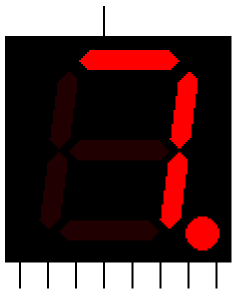
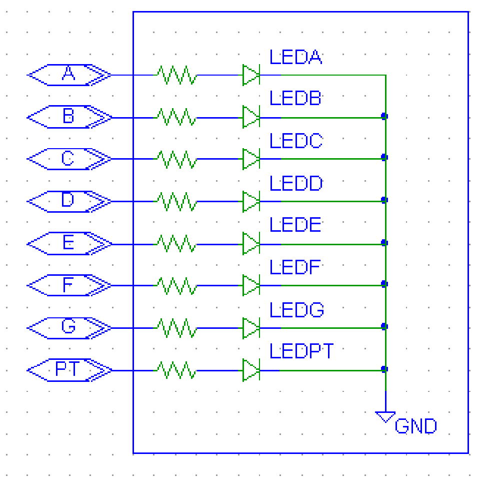
Usage

The switch is connected by pressing a key joining a column and a row. Typically the user scans all columns and row combinations to detect the keypress



Seg7

The SEG7 component is a 7-Segment Display module, which consists of a versatile array of LEDS which can be sequenced to form numbers and a limited form of alphanumeric character. 8 LEDS A, B, C, D, E, F, G, PT are physically arranged on the 7-Segment device. A LED Segment is ON when 5V HIGH is applies its corresponding input pin an is OFF when 0V LOW is applied. When the appropriate patterns are applied to the inputs, 7-Segment display modules are able to display numbers and ASCII characters.

Name	VBB Graphic	Equivalent Circuit
		 A B C D E F G PT LEDA LEDB LEDC LEDD LEDE LEDF LEDG LEDPT GND

Pinout

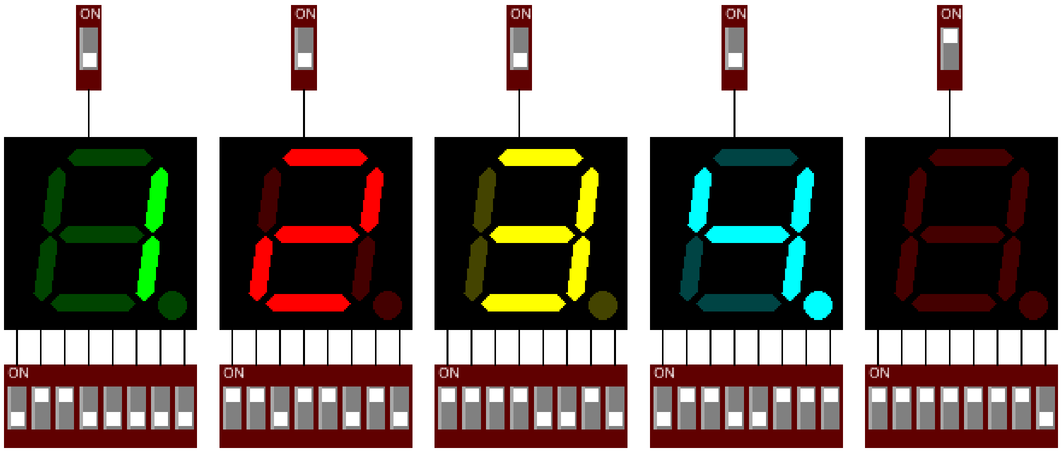
Pin	Name	Description
1	A	A LED Segment Input. HIGH = ON, LOW = OFF
2	B	B LED Segment Input. HIGH = ON, LOW = OFF
3	C	C LED Segment Input. HIGH = ON, LOW = OFF
4	D	D LED Segment Input. HIGH = ON, LOW = OFF
5	E	E LED Segment Input. HIGH = ON, LOW = OFF
6	F	F LED Segment Input. HIGH = ON, LOW = OFF
7	G	G LED Segment Input. HIGH = ON, LOW = OFF
8	PT	PT LED Segment Input. HIGH = ON, LOW = OFF
9	AN	Common Cathode. LOW = ON, HIGH = All Off

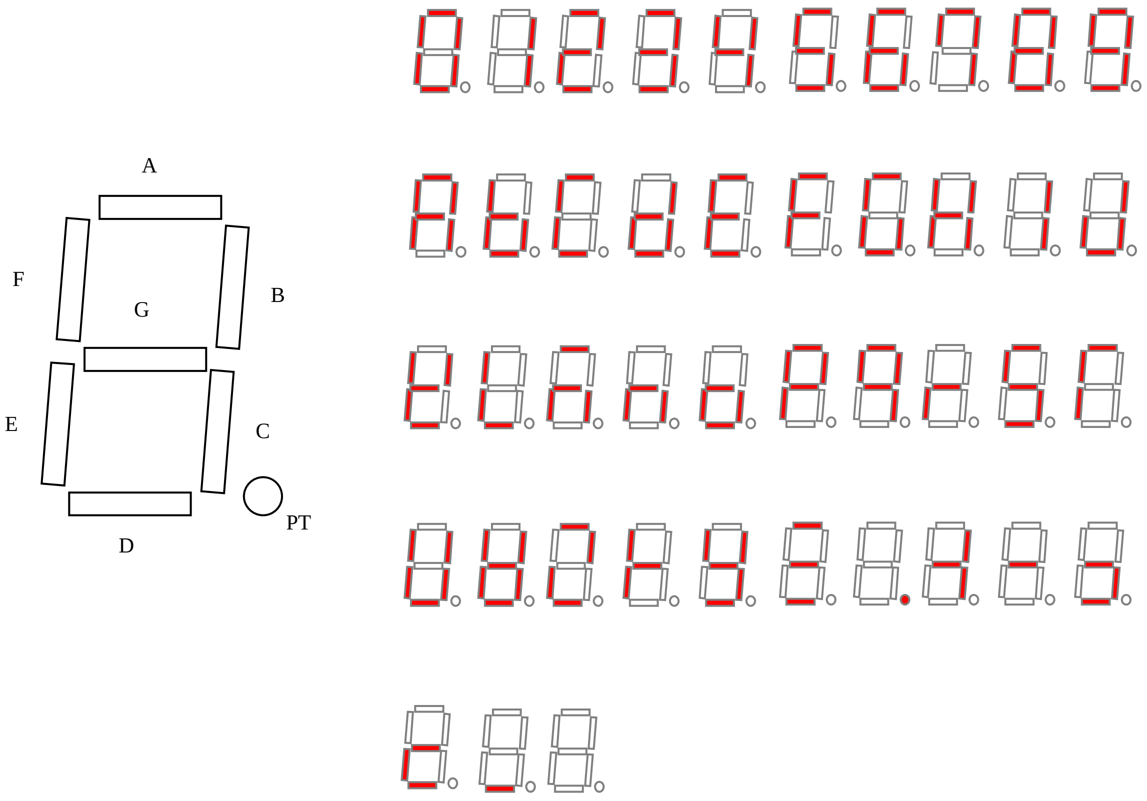
Properties

Name	Default	Options	Description

Color	red	red|green|blue|yellow	Sets the color of the LED elements

Usage

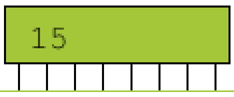




Char	A	B	C	D	E	F	G	PT	HEX
0	1	1	1	1	1	1	0	0	FC
1	0	1	1	0	0	0	0	0	60
2	1	1	0	1	1	0	1	0	DA
3	1	1	1	1	0	0	1	0	F2
4	0	1	1	0	0	1	1	0	66
5	1	0	1	1	0	1	1	0	B6
6	1	0	1	1	1	1	1	0	BE
7	1	1	1	0	0	1	0	0	E4
8	1	1	1	1	1	1	1	0	FE
9	1	1	1	1	0	1	1	0	F6
A	1	1	1	0	1	1	1	0	EE
B	0	0	1	1	1	1	1	0	3E
C	1	0	0	1	1	1	0	0	9C
D	0	1	1	1	1	0	1	0	7A
E	1	0	0	1	1	1	1	0	9E
F	1	0	0	0	1	1	1	0	8E
G	1	0	1	1	1	1	0	0	BC
H	0	1	1	0	1	1	1	0	6E
I	0	1	1	0	0	0	0	0	60
J	0	1	1	1	1	0	0	0	78
K	0	1	0	1	1	1	1	0	5E
L	0	0	0	0	1	1	0	0	06
M	1	0	1	0	1	0	1	0	M
N	0	0	1	0	1	0	1	0	N
O	0	0	1	1	1	0	1	0	O
P	1	1	0	0	1	1	1	0	P
Q	1	1	1	0	0	1	1	0	Q
R	0	0	0	0	1	0	1	0	R
S	1	0	1	1	0	1	1	0	S
T	1	0	0	0	1	1	0	0	8C
U	0	1	1	1	1	1	0	0	7C
V	0	1	1	1	1	1	1	0	7E
W	1	1	0	1	1	0	0	0	D8
X	0	0	0	0	1	1	1	0	07
Y	0	1	1	1	0	1	1	0	76
Z	1	0	0	1	0	0	1	0	92
.	0	0	0	0	0	0	0	1	01
+	0	1	1	0	0	0	1	0	62
-	0	0	0	0	0	0	1	0	02
(	0	0	0	1	1	0	1	0	1A
)	0	0	1	1	0	0	1	0	32
_	0	0	0	1	0	0	0	0	10
SPACE	0	0	0	0	0	0	0	0	00

DigitalPort

The DigitalPort Component is an instrument which displays the decimal value of the binary value represented by its input pins

Name	VBB Graphic	Equivalent Circuit
DigitalPort		

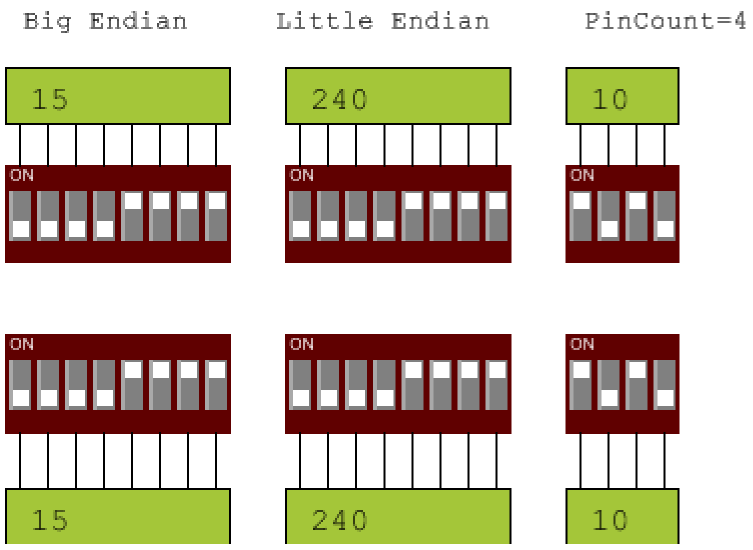
Pinout

Pin	Name	Description
1.. PinCount	*INPUT[PinCount]*	Port input pins

Properties

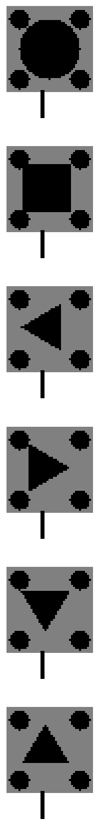
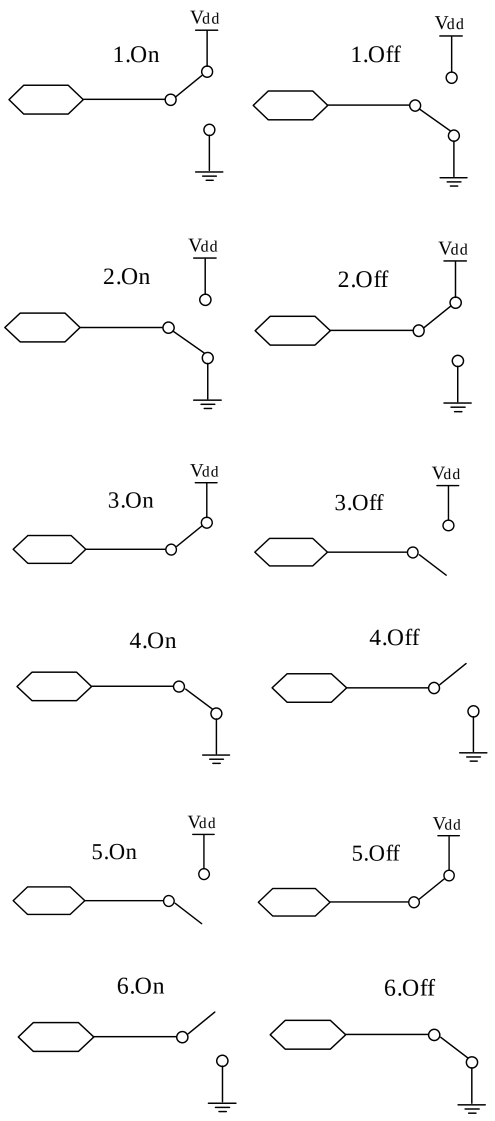
Name	Default	Options	Description
Endian	Big	Big|Little	Endian determines the direction of calculation of the value of port
PinCount	8	4|8|16	The number of bits of the port.
Pins	Bottom	Bottom|top	Determines if the pins are rendered on the top or the bottom

Usage



PushButton

The Button component is an interactive switch. Clicking the color panel of the button toggles the value of the POSITION property. The contact type determines the circuit made when the POSITION is ON or OFF. The color of the button is determined by the COLOR property. When POSITION = ON the color is set by ColorOn property and when POSITION =OFF the color is set byt the ColorOff property. When these colors are not the same the color can be used as a visual clue to the state of the button.

Name	VBB Graphic	Equivalent Circuit
Button		 1.On Vdd 1.Off Vdd 2.On Vdd 2.Off Vdd 3.On Vdd 3.Off Vdd 4.On 4.Off 5.On Vdd 5.Off Vdd 6.On 6.Off

Pinout

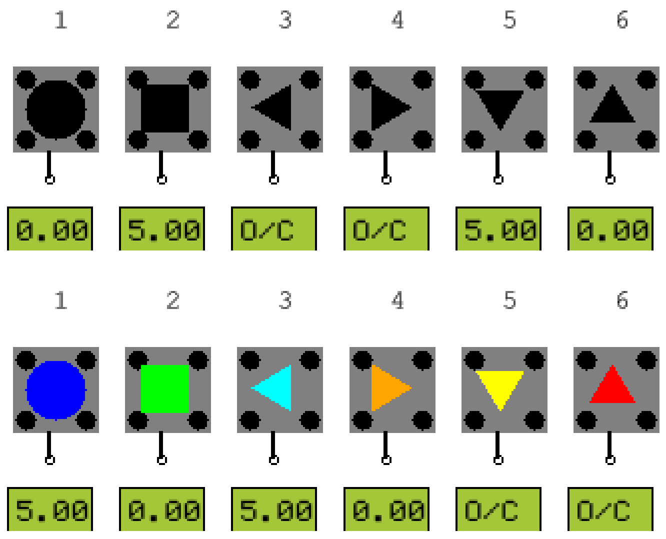
Pin	Name	Description
1.	*B1*	The contact pin for the button

Properties

Name	Default	Options	Description
Contact Type	1. On=VDD, Off=GND	1. On=VDD, Off=GND 2. On=GND, Off=VDD 3. Make VDD 4. Make GND 5. Break VDD 6. Break GND	The contact Type
Button	1. circle	1. circle 2. square 3. left arrow 4. right arrow 5. down arrow 6. up arrow	The graphic of the button.
ColorOn	blue	Red|green|blue|yellow|NamedColor	Sets the graphic color of the On button. Can be a named color in addition to the option colors
ColorOff	black	Red|green|blue|yellow|NamedColor	Sets the graphic color of the On button. Can be a named color in addition to the option colors

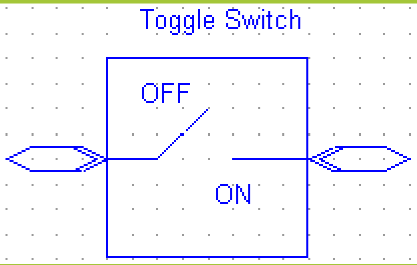
Usage

Not you can change the size of the buttons using the Scale Up



Switch

The Switch component is an interactive switch. Clicking the switch image toggles the value of the POSITION property. When POSITION = ON a short circuit is present across the IO pins. When POSITION = OFF there is an open-circuit across the IO pins. To give a visual clue to the state of the switch, when POSITION = ON the switch lever in the ON Position or the Bitmap On is shown and when POSITION = OFF the switch lever in the OFF position or Bitmap Off is shown.

Name	VBB Graphic	Equivalent Circuit
ToggleSwitch		

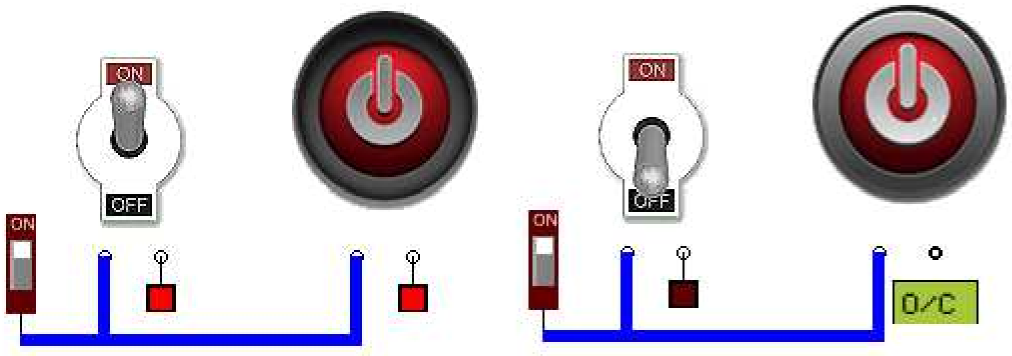
Pinout

Pin	Name	Description
1	*IO*	Switch input/output pin
2	*IO*	Switch input/output pin

Properties

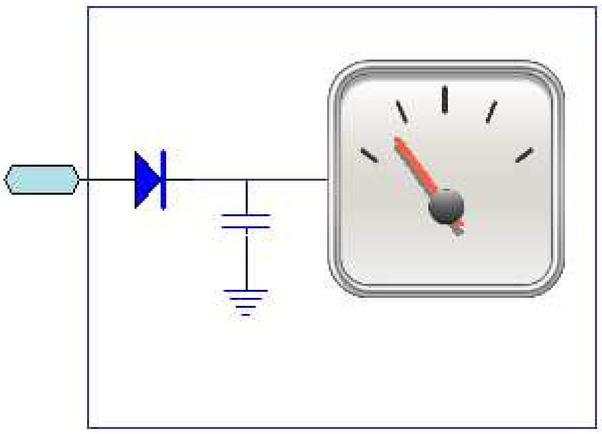
Name	Default	Options	Description
Switch	1. Off	1. Off | 2. On	The state of the ToggleSwitch
Bitmap On		FileDialog for Bitmap .png | .bmp	If set use this Bitmap in the On position
Bitmap Off		FileDialog for Bitmap .png | .bmp	If set use this Bitmap in the Off position

Usage



PanelMeter

The PanelMeter is a Voltage Meter Instrument with a dial representation of the voltage on its input pin between Vss(left) and Vdd(right) The Panel Meter has the equivalent of a LOW PASS filter on the input pin so can display voltage levels for both absolute voltage levels and PWM equivalent analog voltages

VBB Graphic	Equivalent Circuit
	

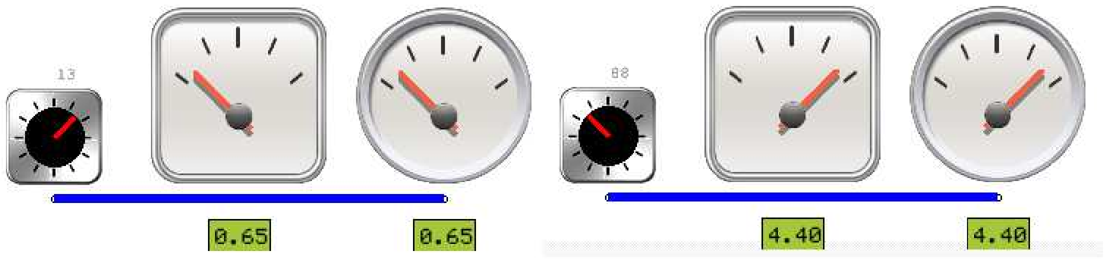
Pinout

Pin	Name	Description
1		The voltage sense input pin

Properties

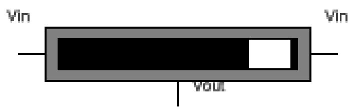
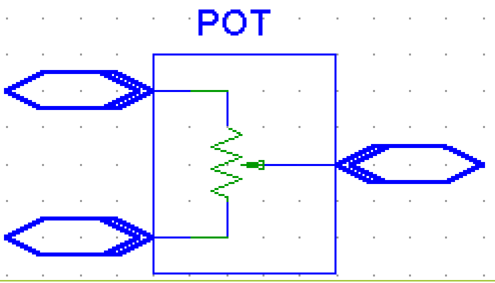
Name	Default	Options	Description
Shape	Square	Square | Round	The shape of the Panel Meter

Usage



SlidePot

The SlidePOT (potentiometer) is a variable voltage divider and consists of two inputs and a single output. The *OUTPUT* voltage is determined by the input voltages and the value of the *POSITION* property where OUTPUT = (**POSITION** x V_{INA}) + ((1 – **POSITION**) x V_{INB}). Where Property *POSITION* has a valid range from range from [0..1]. POT is an interactive component. Clicking on POT will set the *POSITION* property. Clicking on the far left of the POT component corresponds to position 0. Clicking on the far right of the POT component corresponds to position 1. Clicking in-between the left and right will set the POT to a position linearly between 0,1. The *POSITION* property can also be set using the property editor. You can also drag the POT Knob with the mouse to continuously change the value.

VBB Graphic	Equivalent Circuit
	

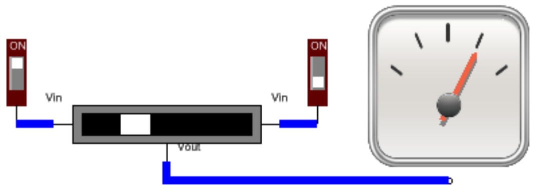
Pinout

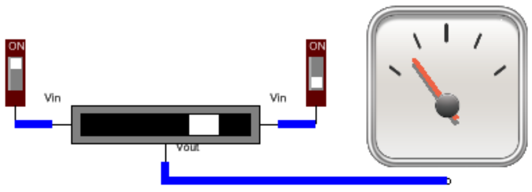
Pin	Name	Description
1	*INA*	Input voltage reference
2	*INB*	Input voltage reference
3	*OUTPUT*	Variable output voltage

Properties

Name	Default	Options	Description
pot	0	0 | 25 | 50 | 75 | 100 | <User Entry>	Potentiometer setting between 0,1 which determines the ratio of *INA:INB* using in *OUTPUT* voltage where *OUTPUT* = (**POSITION** x V_{INA}) + ((1 – **POSITION**) x V_{INB}).

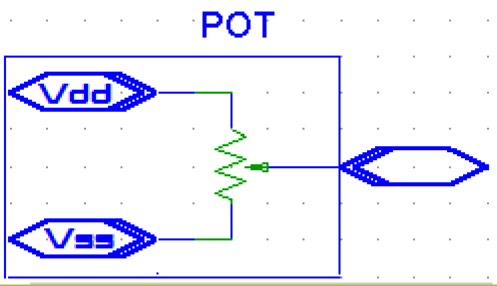
Usage





RotaryPot

The RotaryPOT (potentiometer) is a variable voltage divider connected between Vdd and Vss with a single output. The *OUTPUT* voltage is determined by the rotation position where OUTPUT = Vdd x (**POSITION** / Positions). To rotate the POT you use the mouse to drag the rotation dial.

VBB Graphic	Equivalent Circuit
	

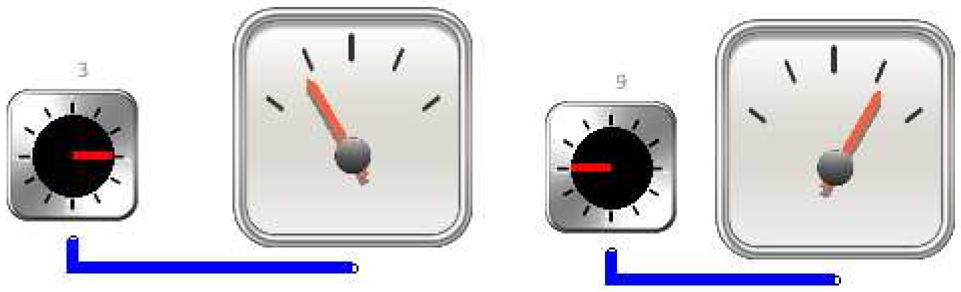
Pinout

Pin	Name	Description
1	*OUTPUT*	Variable output voltage

Properties

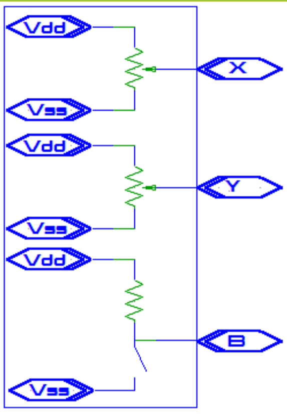
Name	Default	Options	Description
Positions	12	10 | 12 | 24 | 100 | <User Entry>	The number of positions or steps of the Potentiometer
Position			Potentiometer setting between 0,Positions-1 which determines the OUTPUT = Vdd x (**POSITION** / Positions

Usage



JoyStick

The JoyStick component is a model of a regular PC JoyStick with 2 potentiometers on the X and Y axis and button with a pullup resistor. Move the mouse over the keypad to move the JoyStick in X, Y and click the mouse to press the button pulling the button output to ground.

VBB Graphic	Equivalent Circuit
	

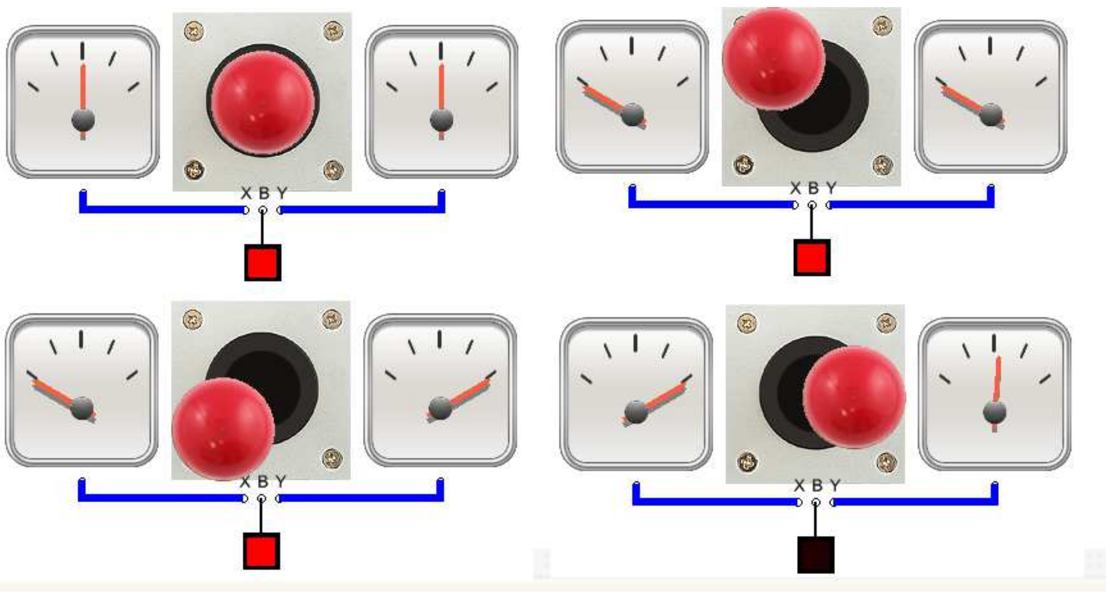
Pinout

Pin	Name	Description
1	*X*	X-Axis output Vcc (left) through Vdd (right)
2	*B*	Pulled up button. House mouse down to pull down
3	*Y*	Y-Axis output Vcc (top) through Vdd (bottom)

Properties

None

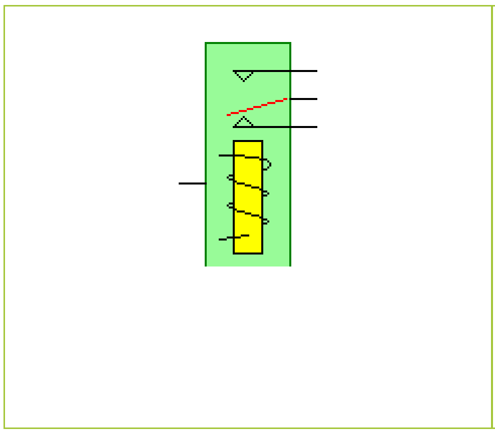
Usage

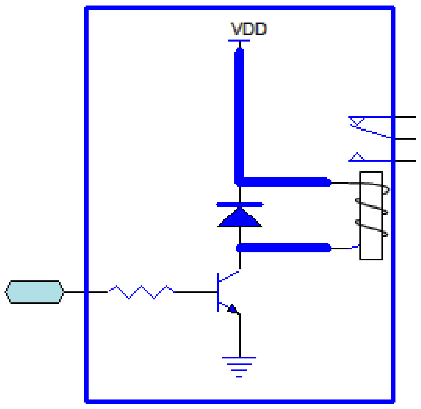


Relay

The relay component is a model of a SPDT – single pole double throw relay. The drive circuit is included in this ideal model

VBB Graphic	Equivalent Circuit





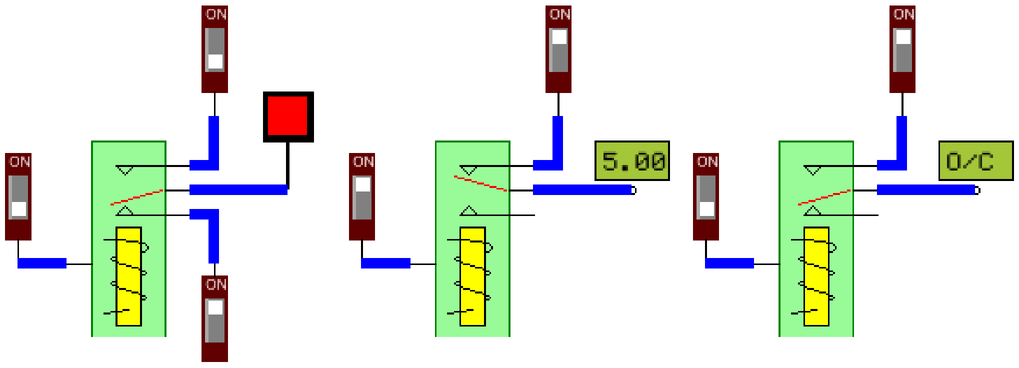
Pinout

Pin	Name	Description
1	*ON*	Relay Solonoid driver circuit
2	*A*	Top contact is connected to C when ON = HIGH
3	*C*	Shared contact point
4	*B*	Bottom contact is connected to C when ON = LOW

Properties

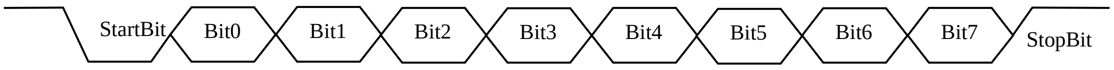
None

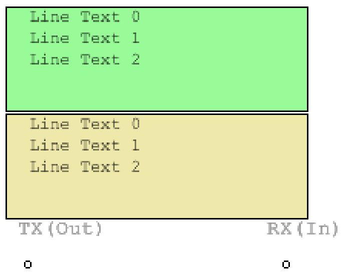
Usage



MiniTerminal

The mini terminal is a RS232 terminal which can send a receive asynchronous UART communications at TTL levels ie Vdd to Vcc at BAUD. Click on the Green screen segment and type to send messages. When pressing ENTER the characters set in the Enter property are sent. Communications is standard 8,N,1



VBB Graphic	Equivalent Circuit
	

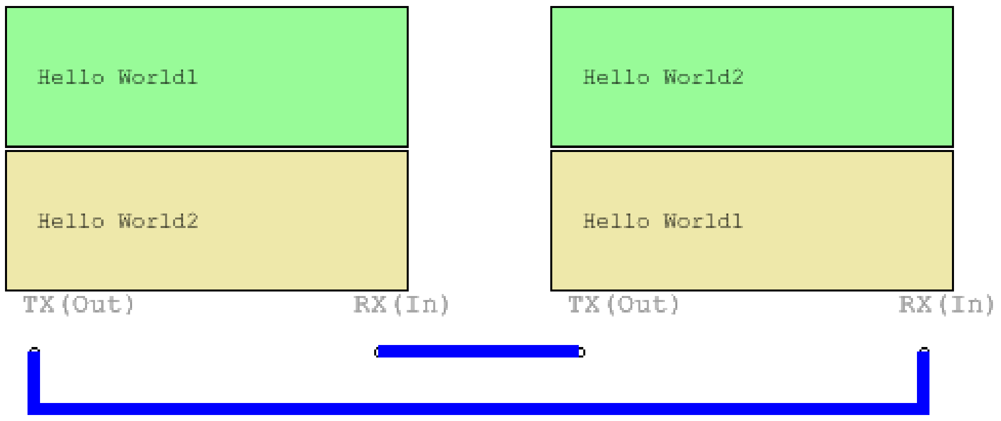
Pinout

Pin	Name	Description
1	*RX(In)*	The input into which the communications is received
2	*TX(Out)*	The output from which communications is sent

Properties

Name	Default	Options	Description
BAUD	9600	2400 | 9600 | 19200 | 57600 | 115200	The baud rate of the communications
Enter	LF(13)	CR(10)|LF(13)|CR(10)+ LF(13)	The characters sent when pressing the enter key

Usage



CMOS 4000

	Description
4000	Dual 3-input NOR gates and inverter.
4001	Quad 2-input NOR gates.
4002	Dual 4-input NOR gates.
4006	Dual 4-bit and dual 5-bit serial-in serial-out shift registers with

	Description
4007	Dual complementary 'pair and unbuffered inverter
40097	3-state hex non-inverting buffer
40098	3-state hex inverting buffer
4011	Quad 2-input NAND gates.
4012	Dual 4-input NAND gates.
4013	Dual 4-input NAND gates.
4014	8-bit parallel-in serial-out shift register with three parallel outputs.
4015	Dual 4-bit serial-in parallel-out shift register with asynchronous reset.
4016	Quad analog switches
4017	4-bit asynchronous decade counter with fully decoded outputs, reset and both
40174	6-bit D flip-flop with reset.
40175	Quad D-Type Flip-Flop
4018	5-stage (divide by 2,4,6,8 or 10) Johnson counter with preset inputs
4019	8-to-4 line noninverting data selector/multiplexer with OR function
40194	4-bit bidirectional universal shift register with asynchronous reset
40195	4-bit universal shift register.
4020	14-bit asynchronous binary counter with reset.
4021	8-bit parallel-in serial-out shift register with asynchronous load input.
4022	3-bit asynchronous binary counter with fully decoded outputs, reset and both.
4023	Triple 3-input NAND gates.
4024	7-bit asynchronous binary counter with reset.
40240	Octal inverting buffers with 3-state outputs.
40244	Octal buffers with 3-state outputs.
4025	Triple 3-input NOR gates.
4027	Dual J-K flip-flops with set and reset.
4028	1-of-10 noninverting decoder/demultiplexer.
4029	4-bit synchronous binary/decade up/down counter with preset and ripple carry.
4030	Quad 2-input XOR gates.
4031	64-bit serial-in serial-out shift register with multiplexed inputs.
4035	4-bit inverting/noninverting universal shift register with J-/K inputs.
40374	Octal D-type flip-flop with 3-state outputs.

	Description
4040	12-bit asynchronous binary counter with reset.
4041	Quad buffers with complementary outputs.
4049	Hex inverters with high-to-low level shifter inputs.
4050	Hex buffers with high-to-low level shifter inputs.
4051	8-to-1 line analog multiplexer/demultiplexer with dual power supply.
4052	8-to-2 line analog multiplexer/demultiplexer with dual power supply.
4053	Triple 2-to-1 line analog multiplexer/demultiplexer with dual power supply.
4066	Quad analog switches.
4067	16-to-1 line analog multiplexer/demultiplexer.
4068	8-input AND/NAND gate with complementary outputs.
4069	Hex inverters.
4070	Quad 2-input XOR gates.
4071	Quad 2-input OR gates.
4072	Dual 4-input OR gates.
4073	Triple 3-input AND gates.
4075	Triple 3-input OR gates.
4076	4-bit 3-state D flip-flop with reset, dual clock enables and dual.
4077	Quad 2-input XNOR gates.
4078	8-input OR/NOR gate with complementary outputs
4081	Quad 2-input AND gates
4082	Dual 4-input AND gates
4085	Dual 3-wide 2/1-input AND-NOR gates
4086	6-wide 2/1-input AND-NOR gate.
4094	8-bit 3-state serial-in parallel-out shift register with output latches.
4502	8-bit 3-state serial-in parallel-out shift register with output latches.
4510	BCD up/down counter.
4511	BCD to 7-segment latch/decoder/driver.
4512	8-input multiplexer with 3-state output.
4514	1-of-16 decoder/demultiplexer with input latches.
4515	1-of-16 decoder/demultiplexer with input latches.
4519	Quadruple 2-input multiplexer.
4539	Dual 4-input multiplexer.

	Description
4543	BCD to 7-segment latch/decoder/driver.
4555	Dual 1-of-4 decoder/demultiplexer.
4556	Dual 1-of-4 decoder/demultiplexer.
4731	Quadruple 64-bit static shift register.