

# Designing a macro in Digital Works

## About macros

In digital works, macros can be used to easily reuse and implement a circuit in another circuit. This functionality makes it a lot easier to design larger circuits, without getting lost in a big collection of gates.

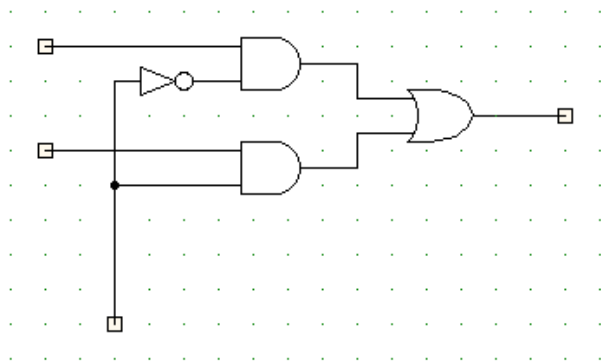
Macros have an unlimited amount of inputs and outputs, which can be connected in a logical diagram.

## Creating a macro: Step 1. Drawing the Logical Diagram

As an example, we will create a simple 2 line, 1 bit MUX. To do this, we need 3 inputs (input bits I0, I1 and a selection bit S) and 1 output (output bit O). Inputs and outputs in Digital Works can be implemented using the Tag Device, which appears as a small box:



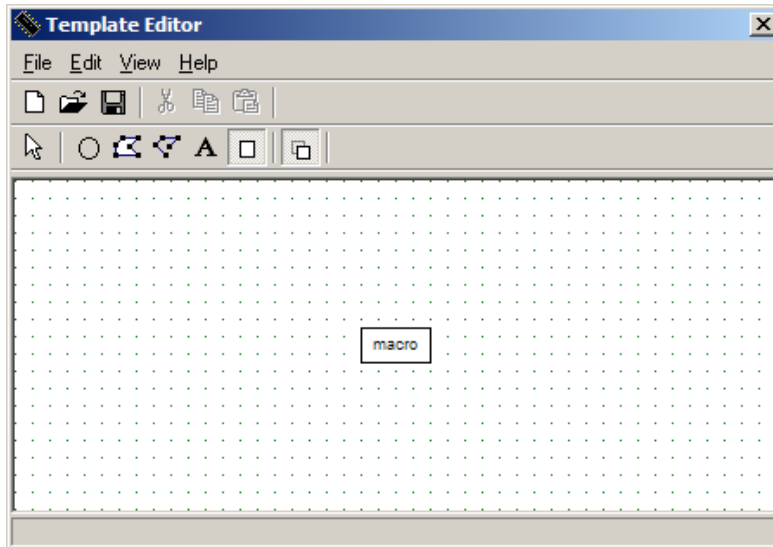
We will use the following logical diagram:



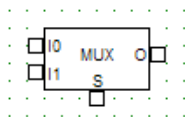
## Step 2. Designing the Template

Every macro has its own appearance, which is entirely customizable in the template editor. Digital Works does not provide a quick way to create a default template for your circuit, so we will go through the steps of making one.

Let's start by opening the template editor. It can be found in the menubar under Tools → Template Editor. This will bring up a window looking like this:

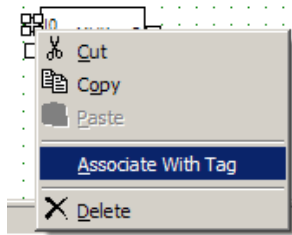


Now it is time to change the look of the macro to fit a MUX. It is possible to change and add shapes, text and pins. Pins are used to connect wires to the input and output of the macro. You can move text with move precision by using Ctrl + ArrowKey. Here is what you might end up with:

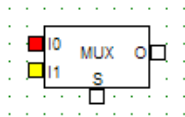


Notice how text is placed near the pins to show what the pin is to be used for. It is common in Digital Works to place the pins right outside the macro's box.

Now we need to associate the pins with the tag devices in the logical diagram. To do this, first close the template editor. Then right-click on the tag device you want to associate (shown here is input I0) and select Template Editor. Digital Works will open the template editor again. Now right-click on the pin you want to use and choose Associate With Tag:



The pin will turn yellow. The pin associated with the selected tag device will always be yellow, while pins associated with other tags are made red. Non associated pins are simply white. After opening the template editor with tag I1 selected and associating it, you should see something like this:

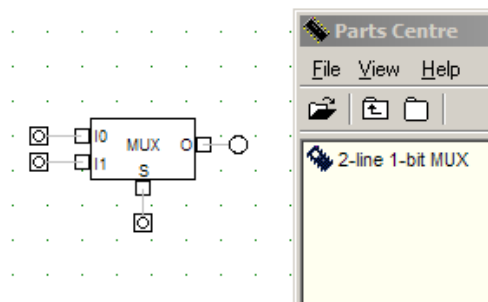


### Step 3. Saving and testing

We have a template and logical diagram finished, so we can save our macro like any other circuit. It is probably a good idea to place it in a folder along with other macros and to give it a proper name. Something like "2-line 1-bit MUX" should be fine.

To insert the macro into a new circuit, simply open the Parts Centre, find your macro and drag it onto the circuit. Then you can connect it like you would any other device. This is also the point where you can finally test your macro.

A testing setup:



It is very important to check your macro for any incorrect behaviour before actually using it. This is mainly because Digital Works simply copies the inside of your macro to the new circuit, instead of using a reference to the macro file. This means that when you change your macro file, you will need to reinsert it everywhere you have used it (and redraw all the wires). When working on a larger project with multiple layers of macros, having a smaller macro that is not functioning properly takes a lot of time to fix.