Conduit plugin for Motion 5 and Final Cut Pro X

Creating custom effects for Final Cut Pro using the Conduit Effect System

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The **Conduit Effect System** is essentially an "effect construction kit". Using its visual user interface, you can start from simple building blocks and create almost any kind of image processing tool. The elementary blocks in Conduit are *nodes*. They are like signal processing boxes with input and output ports. By dragging with the mouse from these ports, you can easily wire nodes together to create effect setups.

Conduit works inside Apple Motion as a filter. It can be applied to any layer. Unlike a traditional filter that renders only one effect, the Conduit filter is infinitely customizable. Using the Conduit Editor window, the effect's nodes can be interactively edited even while you're watching the result playing in Motion's viewer.

(By the way, Conduit also works in many other apps. The filter plugin is available for After Effects, Photoshop, Aperture and Acorn. There's also a standalone app called PixelConduit that does even more. It's a free download at *http://pixelconduit.com*.)

With the new **Rig & Publish** functionality in Motion 5, Conduit also can be used to create custom effects for Final Cut Pro X. You can design an effect in Conduit, rig it up with appropriate slider controls, and publish it as an effect in FCP X. It becomes instantly available alongside FCP's built-in effects. What's more, you can go back and forth very easily. A single click in FCP takes you to Motion where you can edit the effect using Conduit, and have the modifications reflected in the effect published in FCP.

Published effect setups work seamlessly and render in realtime in Final Cut Pro X. Conduit works entirely on the GPU and has pervasive floating-point pixel support, so it's a great match for the powerful rendering engine in FCP X.

In fact, effects built in Conduit run faster than what you can get by simply combining the built-in tools of FCP X and Motion. This is because Conduit has a unique *node fusion* capability: all nodes that do pixel processing can be joined together to run in a single pass on the GPU, offering the best possible performance.
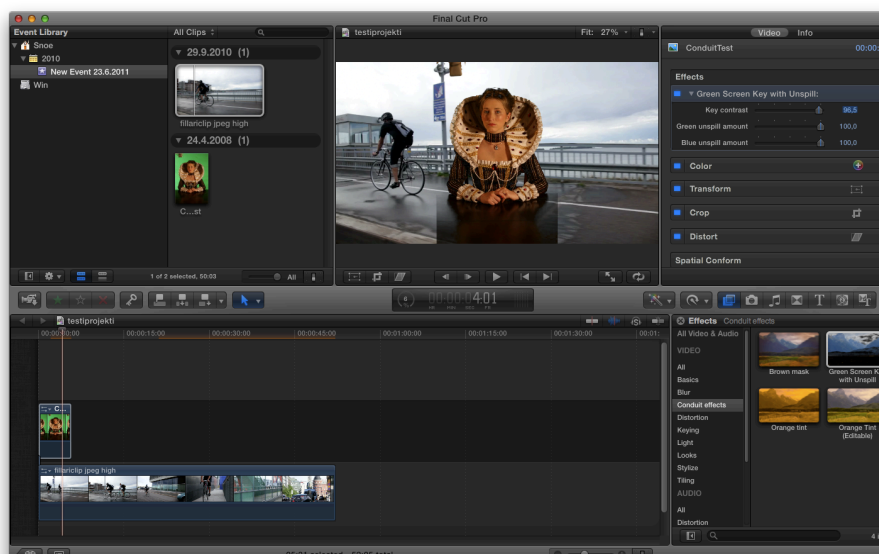
This document shows how to publish a Conduit effect from Motion 5 to make it available in Final Cut Pro X. The effect used in this tutorial is a powerful green screen keyer with an *unspill* feature for eliminating unwanted light reflections from the green background ("spill light"). The effect was built by combining Conduit's built-in nodes. In this tutorial, the effect is made accessible in FCP X with a simplified interface consisting of just a few sliders. This makes it really easy to key green screen elements directly on the project timeline as shown in the screenshot above.

Starting a new effect

When starting Motion 5, you are offered a choice of composition types. This choice is important because it affects how the composition can be used. Choose "Final Cut Effect":


Note that you must also select an appropriate resolution preset. Unless you know beforehand that you'll be working exclusively on SD material, it's a good idea to choose "Broadcast HD 1080". This ensures that the effect can render at full HD resolution.

Click Open to proceed.

You now have a Motion composition that contains a single element: a layer named *Effect Source*. This layer represents the content to which this effect is applied – in other words, the video track in FCP X that will eventually receive this effect. It's represented in Motion by a big downpointing arrow. This is just a placeholder for the eventual content (you'll never see the big arrow in FCP X).

Next, we'll apply the Conduit filter to this layer. Open the Library and navigate to the *Conduit* filter, in the *Conduit Effect System* category.
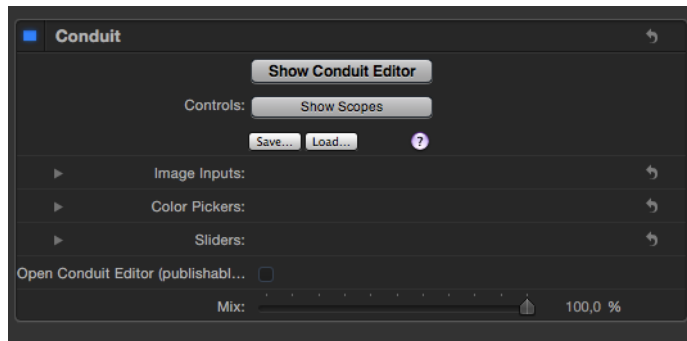
Click Apply (with the Effect Source layer selected). The Layers tab should now look like this:
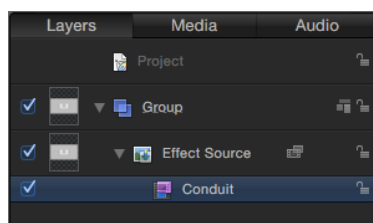
There's no change visible in the Viewer yet. This is because the Conduit effect is empty. Next, we'll load our effect there.
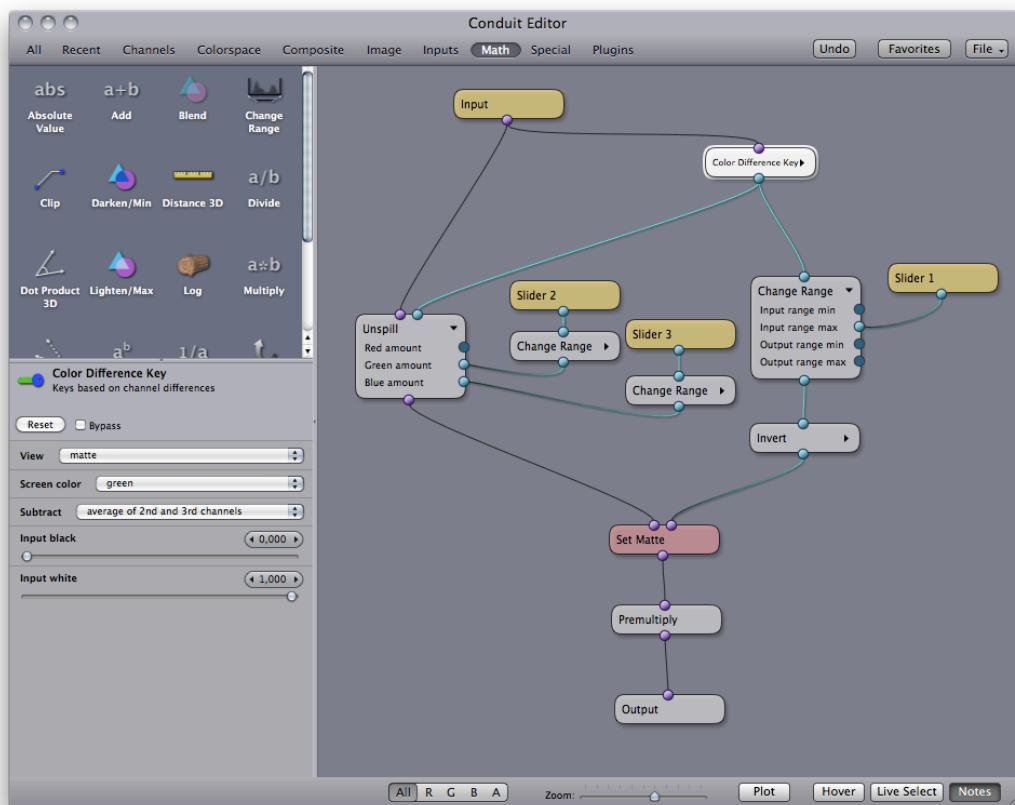
Setting up the green screen key in the Conduit Editor

With the Conduit filter still selected in the Layers tab, open the Inspector tab:

This is the interface to the Conduit filter. The big button labelled "Show Conduit Editor" will open Conduit's editing window where you can design effects. The rest of the filter interface is three sets of parameters: Image Inputs, Color Pickers and Sliders. These provide values that you can use to control your Conduit effects. Later in this tutorial, we'll be rigging up the sliders so that we can control the Conduit effect directly from FCP X.

But first, let's open the Conduit Editor…

This screenshot shows the Conduit Editor with the green screen keyer effect already loaded.

To access this effect, click the *Favorites* button in the Conduit Editor, and choose the item labelled: "Green Screen with Unspill (3 sliders)".

The nodes that do the important work here are *Color Difference Key* and *Unspill*. Explaining their precise operation is a bit beyond the scope of this tutorial, but note how Unspill has two inputs: it takes both the original image and the key mask generated by the Color Difference Key. This is how the Unspill's "magic"

works – it knows the key that has been generated and removes the spill accordingly. (By the way, the purple color on the node connectors indicates a color image, while the light cyan indicates a "scalar", i.e. a grayscale image such as a mask.)

The three *Slider* nodes are interesting because they are this effect's connection to the outside world. These are the sliders that we'll publish to Final Cut Pro X. You can see here how the sliders are hooked into specific parameters on nodes. Next when we rig these sliders up in Motion, we'll give them more useful names that reflect their purpose.

Slider 1 connected to the "Input range max" parameter will be named **Key contrast**, because that's what it effectively controls here. (The *Change Range* node performs a simple math operation for scaling an input value to a new range. In this case, we're using it to effectively set the white point for the mask image. The same operation could also be done with the *Levels* node, which has additional settings like gamma that are useful for image processing.)

Sliders 2 and 3 drive the "Green amount" and "Blue amount" parameters of the Unspill node. These together control the color balance of the unspill processing. When rigging the sliders, we'll name these simply **Green unspill amount** and **Blue unspill amount**. (If you want more control, you could also add a slider to control the "Red amount" parameter. It's omitted here to make the keyer effect as simple as possible – decreasing both green and blue effectively increases red, so it's not absolutely necessary to have a third slider for it.)

## Rigging sliders from Conduit to Motion

A "rig" in Motion can be used to group multiple sliders under the control of a single slider. This is a powerful new feature: for example, you could create a rig that drives several filter parameters with a single control. (In Conduit, you can achieve the same thing by connecting a single Slider node to multiple nodes' parameters. The rigging feature enables the same kind of functionality: a single slider in a Motion rig can control any parameters within the Motion composition.)

The rig for this tutorial is quite simple. Each slider in this rig just drives a single parameter in the Conduit filter. The purpose of the rig is to make the Conduit effect's sliders useful in FCP X: the rig allows us to give proper effect-specific names to the sliders. The sliders' ranges can also be changed. In this tutorial we'll set the ranges to 0-100 so they are easy to control in FCP.

We'll return to Motion's Inspector to rig the sliders. (You can close the Conduit Editor window, it won't be needed for the rest of this tutorial.) Select the Conduit filter again to show its parameters in the Inspector (if it's not visible already). In the filter's list of parameters, click on "Sliders" to show the list of the Slider parameters for the filter.

These eight sliders are the "other side" of Conduit's interface. Within the Conduit Editor, these slider values are available as the Slider nodes. Within Motion, the slider values are provided here. What we need to do next is to add the sliders that are used by our Conduit keyer effect to a rig, so that they can be published to FCP.

Select Slider 1 and click on the arrow on its right-hand side to open a menu:
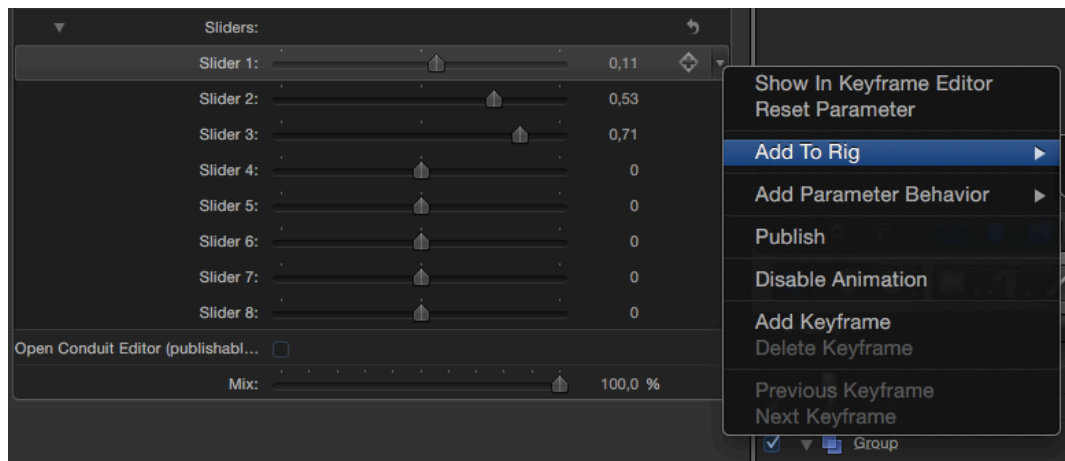
In this menu, choose *Add to Rig > Create New Rig > Add to New Slider*.

A new rig has now been created. You can see it in the Layers tab. It contains a slider that's simply titled Slider. We should first rename the rig and the slider to keep track of their purpose. Just click on the item's title in the Layers tab:
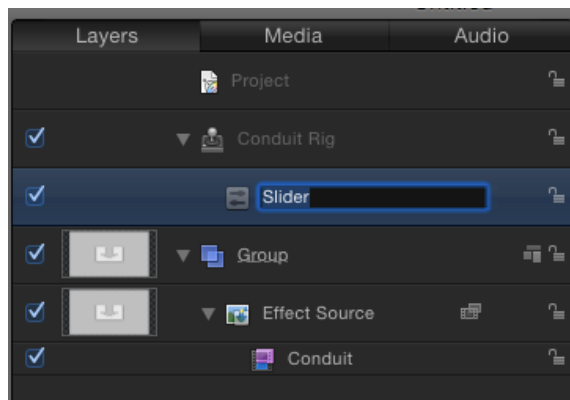
Rename the rig to **Conduit Rig**, and the slider to **Key contrast**.

Next we need to decide how this new slider corresponds to the one we have in the Conduit filter. Motion doesn't do this automatically. Open the Inspector tab:
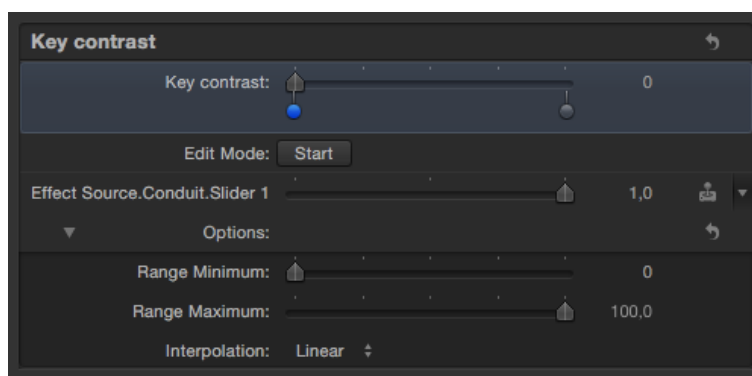

In this view, the slider labelled "Key contrast" is what we're exporting to FCP X. The slider labelled "Effect Source.Conduit.Slider 1" is what we're controlling with this new slider.

If you try dragging the first slider, you'll note that the second slider doesn't move. We must fix this, or the slider won't have any effect.

Click on the first circle below the "Key contrast" slider. It turns blue to indicate that it's active. Then drag the "Conduit.Slider 1" to the right, so that the value shown in the field is 1.0.

Next click on the second circle of "Key contrast" (at the right-hand end below the slider). Enter the value 0.01 into the "Conduit.Slider 1" field, as shown below:
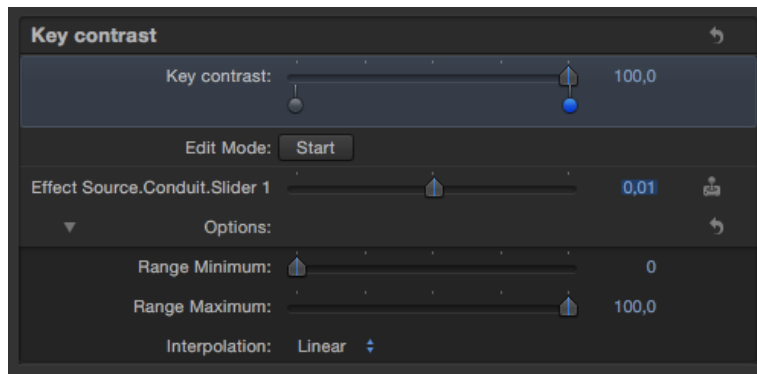

Now try dragging the Key contrast slider. The second slider will move accordingly, but in a different range.

What happened here is simply that we've rigged up the slider so that the value visible in FCP X is in a different range than the value that's eventually delivered to the Conduit filter. Our rigged slider is in the range 0-100, which is convenient for FCP X editing because all other effect controls in FCP use the same range. We've set up this rigged slider so that a value of 0 corresponds to 1.0 for the Conduit slider, and a value of 100 corresponds to 0.01.

(Actually, this transformation of slider ranges is the exact same kind of operation that's done with the Change Range node in Conduit. Motion offers a different interface, but the practical use is very similar.)

Next we'll rig the two other sliders. These follow the same pattern.

Go back to the Conduit filter's Inspector, and open the menu for Slider 2. Select *Add to Rig*, but this time, instead of *Create New Rig*, choose *Conduit Rig > Add New Slider*:
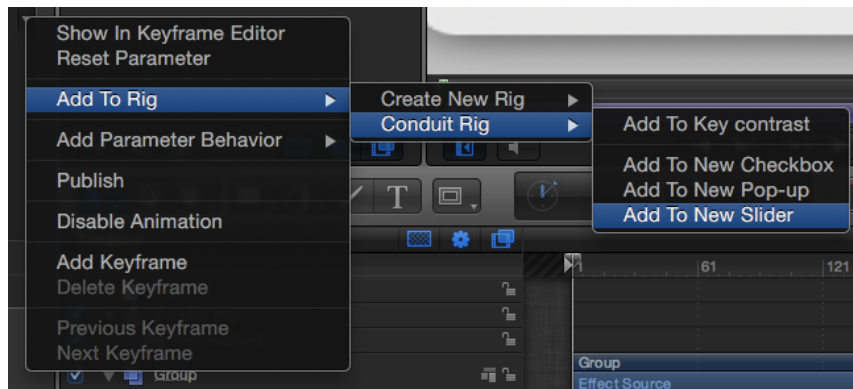
Rename the new slider to **Green unspill amount** in the Layers tab.

In the slider's inspector, set up the slider's range by clicking on the two circles as described above. For the first circle, set the "Conduit.Slider 2" value to zero. For the second circle, set the value to 1.0 as shown below:
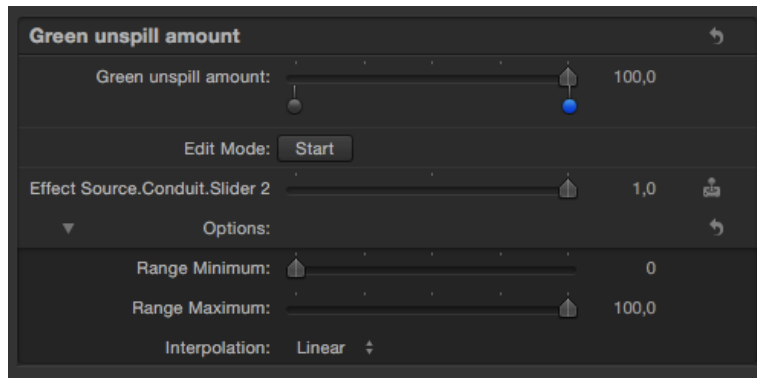
Do the same process for the third slider:

- Go to the Conduit filter's Inspector, choose Slider 3, open its menu and choose *Add to Rig > Conduit Rig > Add New Slider.*
- In the Layers tab, rename the new slider to **Blue unspill amount**.
- In the new slider's inspector, click on the first circle below the slider's start, and drag the "Effect Source.Conduit.Slider 3" to a value of zero.
- Click on the second circle, and drag the "Conduit.Slider 3" to a value of 1.0.

Publishing the effect to Final Cut

That's it – we're done rigging sliders. Only one step remains. The sliders won't become visible in FCP X until they are published.

Select the rig we created, "Conduit Rig", and open its Inspector. Click on the arrow on the right-hand side of the "Key contrat" slider's name and choose Publish from the menu:
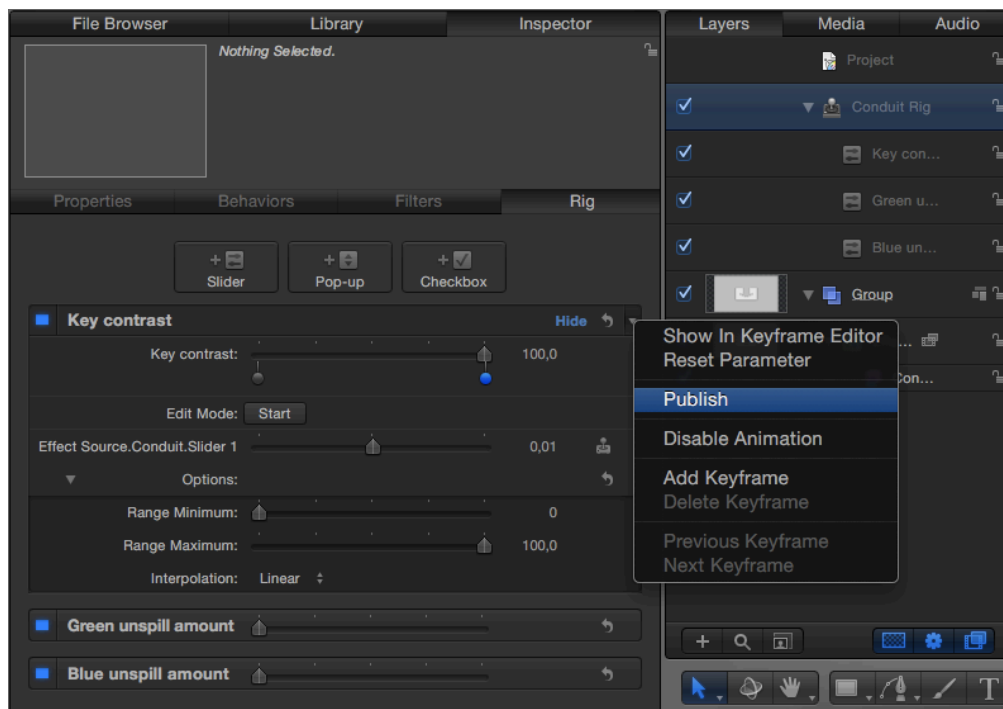
Do the same for the two other sliders. The sliders are now published to FCP X.

Now we need only to save the effect. Choose *Save As* from the File menu:
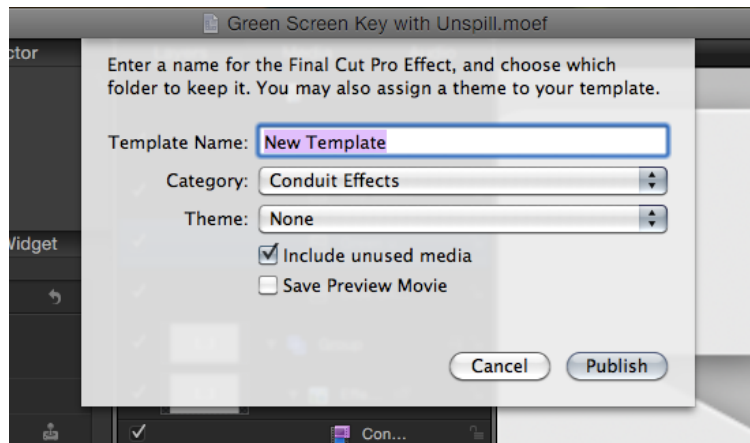
For *Template Name*, you can enter something like "Green Screen with Unspill". This will be the name of the effect in FCP X's Effects Browser.

Click Publish to save the effect.

 (If you want to change the name later, you can do it by renaming the file in Finder. Effects are saved in *Movies / Motion Templates / Effects* under your home folder.)

Using the published effect in Final Cut

The published effect should be instantly available in Final Cut Pro X. You can find it using the Effects Browser, at the bottom-right-hand corner of the user interface:
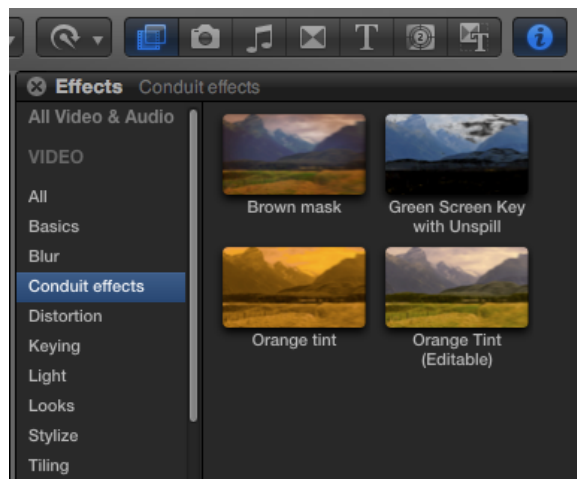
FCP X automatically generates preview images for published effects – a nice touch. Even better, you can see the effect applied live by simply scrubbing over the preview image when a clip is activated in the Viewer.

This screenshot shows the keyer applied to a video track:

You can see the original elements on the left-hand side. The even green background has allowed a very nice key, with unspill taking care of the reflection on the table. (There's no deeper point to this combination of images, it's just for the demo. Well, who knows, I guess there might be some kind of avantgardist production that would call for this Elizabethan court lady to be composited over a cyclist…)

The parameters we published from Motion are visible in the Video Inspector on the right-hand side.

If you need to go back to Motion to tweak the effect template, just Ctrl+click on the effect preview image in the Effects Browser and choose *Edit in Motion*.

Adding a new slider to the existing effect

If you feel like doing some more rigging, try adding a fourth slider to the effect. This new slider will be "Red unspill amount". Here are the rough steps (look back in this tutorial for more specifics):

- Return to Motion, select the Conduit filter and open the Conduit Editor window
- Create a Slider node, and check that it's set to "Slider 4" by selecting it
  To create a new node, either drag from the node box at the top-left-hand corner of the Conduit Editor, or right-click on the node view background
- Copy one of the Change Range nodes that are connected to the green/blue parameters on Unspill; then connect the nodes as follows: *Slider 4 > Change Range > Red amount (*parameter input on Unspill)
  To copy a node, hold the Alt key and drag the node with the mouse
- Back in Motion's Inspector, with the Conduit filter selected, add the Slider 4 parameter to the existing rig as a new slider
- In the rig, select the newly created slider and rename it to "Red unspill amount"
- Publish the new slider

Once you save the updated effect template in Motion, it should be available in FCP X instantly. You don't need to close either application.