Device Design

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Preface

In this chapter we'll lay the groundwork for turning a collection of interconnected modules into a working Device.

Please go through the tutorial - there is a lot of practical information there.

At the end of the chapter some final directions are given needed to fully finish a device.

Sine Synth Device Tutorial

Here we will transform the Sine Synth module from the *Circuit Design* section into a finished **Device**.

First drag the Empty Synth (\\Scope\Data \DeviceDesign) into the Project window. Double click on the Empty Synth to go down one level. Now drag the Sine Synth module (from \\Scope\Data\Examples) into the Project window and make the appropriate audio and MIDI connections as shown below.

So that both output channels will be audible, connect the Sine Synth's **Out** pad to both the **inL** and **inR** pads of the **Synth Outpu**t module.

Some modules in the Sine Synth have surfaces where you can adjust some of the parameters. For the Sine Synth to become a device, we first need to make only the current MIDI channel available with the **MIDI Channel Linker** module.

Open the context sensitive menu for the **MIDI Channel Faders** as shown on the right. Select the entry **Store Value Pad.**

Now right click on the **CSyn** pad (below right) and select the entry **Connect to Val**. A connection symbol appears at the pad indicating that the MIDI Channel Linker is now connected to the adjusted MIDI channel.

As you know from the SCOPE synthesizer devices, you can assign a MIDI controller to a potentiometer or fader. In the **MIDI Controllers Settings** drawer in the **Control Ranger** you can select whether the control is to receive MIDI data from a MIDI channel or not. You must enable the **Link Channels** option for a control to read a MIDI channel.

MIDI Voice Controls Easy 16 Surface:

MIDI Channel Linker Module:

The next step describes how to quickly make a functioning control surface.

Double click on the minimized **Empty Synth** surface to open it to full size. In the upper right corner is a **close** button. At the top in the center is a graphical text **GO** that reads 'Device Surface'. In the bottom right corner is an LED to indicate MIDI activity. And at the bottom right is a button to open the Preset list.

So that you can set the MIDI channel, your surface needs a text control. It is simplest to use the existing functional control on the MIDI Voice Control module already assigned to the surface.

Using **<Ctrl><X>** you can, so to speak, cut the control from the MVC and assign it to the surface, but you first will need the help of the Project Explorer.

The device surface is in a special state called **Flip Out** mode. This mode is meant for using the surface, not designing it. For editing you must put it in **Flip In** mode. This will put the surface 'inside' the Project window. Select **Flip In** from the surface's popup menu.

Minimized View

Empty Synth Surface

Popup menu for a surface

Open the **Project Explorer**, which will aid you in the selection of modules.

Go to the Module Tree and select the **MiditextFader** in the branch under the **MVC Easy 16 Surface**. With this module selected, click use the **Copy With Connections** function - **<Ctrl><X>**.

Now select the **Empty Device Surface** in the **Project Window** and its entry in the module tree will become highlighted. Use **<Ctrl><V>** and the text control is made a child of the Empty Device Surface. If you move the surface, the control moves along with it.

Now you can position the text control somewhere on the surface.

In the same way you can bring other elements onto your surface - for example, the potentiometers and text displays of the **Filter+Amp** surface.

Using the controls of the existing modules like this is probably the fastest way to learn how to equip a surface with controls.

When you have finshed laying out the desired controls on your surface you can close all the various module surfaces and simply select the **Flip Out** option from

your surface's popup menu to enable it for use.

You can go on adding controls and making connections but one important consideration applies - make sure you connect the pads of the controllers directly to the pads of the modules, and not to their default surfaces. The reason for this:

When you optimize your synthesizer, all default surfaces and their connections are lost.

When you are 'finished' with your synthesizer, you should save a 'work version' of it. The next steps, **Optimization** and **Protection,** produce a device that can no longer be modified (described later in the manual, see pages 16-18).

Fundamentals

There are only a few basic things you should keep in mind when building devices. One thing - when you have a basic structure for a synth or an effect, you should fold the layout into a new module and give it a meaningful name (e.g. Synth Layout). Save this for security.

Empty Synth

Use this surface to quickly transform your layout into a synthesizer device. This bare-bones device provides MIDI controlability, a Preset list, and a surface with a minimized view.

The method for creating a working synth using this device is described in the tutorial section.

The Empty Synth module belongs to the script class **NewDevice** - thus it is a Device module. It's in the \\Scope\Data\Circuit Design\Basics folder and in the device Design file (\\Scope\Data\DeviceDesign). It is 'camouflaged' as a module, however simply by renaming the file with the .mdl extension.

By renaming it as a module it is ensured that it won't be detected as a device when it loads, and therefore is not loaded as a *reference*. This way you are prevented inadvertantly storing your Empty Synth project without modifications. (When an object is saved as a 'reference' only information about its name and location is saved with the project. The modified object is not included in the project's data).

The Empty Synth already contains some modules as described below.

Num Voices Of Parent

With the **Num Voices Of Parent** module you can determine the polyphony of your synthesizer. This value is set at the **Voic** pad. As the Empty Synth conatins this module, the Empty Synth is the module's parent. As the Num Voices Of Parent module value increases, so too does the number of voices for the Empty Synth.
The polyphonic modules which are contained in the device will inherit this value. Polyphony, therefore, is a property inherited by all its children.

For synthesizers the number of voices is limited to 16.
This restriction comes from the Voice Controls

themselves, as they cannot administer more than 16 voices.

MIDI Channel Linker:
Allows MIDI channels to be used for controllers.

MIDI Controller Linker:
This module ensures that MIDI controllers can be assigned. It makes MIDI input available to a controller. If a controller is assigned, moving it onscreen also provides MIDI output.

Preset List Loader:
Provides for the loading of parameters via Presets. This module must be a child of the Device module. You must connect the **Voice** pad of this module to the pad of the same name on the Num Voices Of Parent module in order Presets to adjust this porperty. If the value at the **Show** pad is 1, then this pad will be visible on the surface.

MIDI LED Timer:
Used to indicate when a MIDI signal is present. The module has an output for a controller. In the Empty Synth, this output of the MIDI LED Timer is connected to the red LED on the Device Surface.

Synth Output:
Routes the output of the synth layout to the the surface of the device. This is a placeholder used for pads you rename and export in your layout.

Empty Effect

The Empty Effect device is of the Script class EffectInsert. These devices can be used with the Big Mixer's mono and stereo inserts. For it to work correctly there is a consideration with regard to pad names. The system uses a naming convention to identify the inputs and outputs of an effect, so these names must not be changed.

If the effect is to be used as an aux effect only, then you don't have to worry about the pad names.

There is an option, **Use mono Input (Left)** that, when enabled, routes the signal arriving at the left input to both the left and right outputs.

The **Presets** button is enabled and connected ready to load a preset list for your effect.

The **Bypass** button is enabled and connected. When pressed, it routes the input directly to the output.

Disabled

Preset Button

Bypass Button

In the **Connection** drawer there are four text fields used to display the name of the connected module. For this to function, they must know the name of the effect. If you have finished your design, and have renamed your effect to, say, ‘4-D Audio’, put this name in the field to the right of the ‘Parent’ pad in the text field pad list.

Since the pads of the four text fields are connected, you only need to enter the name in one of the pad lists.

You can also connect these fields. Simply click on the fields, and then, for example, click on the AUX input on the Big Mixer.

You can remove the Connections drawer entirely if you don’t need routing text in your design.

Structure your design between the **Effect Input** and **Effect Output** modules, and connect your I/O pads to them. See the *Chorus Effect* example in \\Scope\Data\Examples.

‘RoutingText’ Text Fields

Pad list for RoutingText fields

Assigning Surfaces

The surface of the **Empty Synth** has an associated minimized view. By doubleclicking on it, it expands to the full view.

Minimized View of the Empty Effect

The **Empty Effect** surface does not yet have an associated minimized representation. You can, however, drag the 'Empty Effect Surface M' (\\Scope\Data\Device\Design) surface to the first level under Empty Effect and delete the older surface.

The new surface does have a minized view attached. You must now restore the connections to the switches. Use the modules' popup menus (Store Pad, Connect to...). Connect **Use Mono Input (Left)** to the **Swit** pad on the module in the upper left part of the layout, the **Presets** button to the **Show** pad, finally the **Bypass** button to the the **Swit** pad in the right side of the layout.

Empty Effect Layout

Gate & Sync

If you want to use the **Single Load** option for an LFO (which is more efficient in a polyphonic environment, and recommended) you will need to include another module for correct MIDI Note triggering of the LFO.

The **Gate To Gate** module receives and transmits a gate signal to a single-loaded LFO so that it will only retrigger the LFO after all keys have been released. This is the case when the value at the **Mode** pad is 1. If this value is 0, then the LFO triggers each time a key is pressed.

With FM Operators a synchronous trigger is required to guarantee phase-accurate triggering.

The **Gate to Sync** module converts an asynchronous **Gate** signal to a synchronous **Sync** signal. Using this, all FM operators will start at the same sample tick.

Module Group

Use the **Module Group Window** when you want to make several copies of a module, such as a mixer 'rail' while maintaining the connections between the surface and the layout. First fold the modules in the layout together, and then the group the graphic components together as desired.

Click on **Add to Group** in the layout module's and graphic group's popup menus and open the **Module Group** window.

In the window you will see the names of the two module groups you added. Right click on one of the two modules and choose the entry **Duplicate Group with routings**.

You have now created an exact copies, with routings, of both modules. They are located directly over the originals and all you have to do is move them to the desired locations. Repeat for as many times as required.

This technique is similar to simply copying a group, but it copies many groups, on different levels, with their routings intact.

Module Properties

In the first field, the **Script Class** of a module is displayed.

The **Voices** scroll field value indicates the number of voices set for the module. If it is left blank, it inherits the value from its parent. It will also pass it down to its children.

The **Board** field lets you choose which hardware platform (Scope, Pulsar, Pulsar SRB) this module is to be loaded to. If nothing is explicitly indicated, it will load automatically to an appropriate board. Please use this only in exceptional cases.

Often it makes sense to enable **Single Load**. Normally in a polyphonic circuit, when you load an LFO, 16 LFOs are actually loaded (if you are using 16 voices). You don't see this, but that's how it works. With an LFO you don't need to load, LFOs don't produce or pass voices - they control modulators.

Enabling this option reduces the implied performance penalty.

ModuleProperties Dialog

Optimization

When you have finished a design you should follow the optimization procedures below. This ‘finishes’ your synthesizer and frees a great deal of your PCs working memory.

Make sure you store a work version of your device somewhere seperatly, as an optimized version is no longer capable of being edited.

Optimizing Layout Modules:

1. Select the layout module in the Module Tree.

2. Delete all surfaces:
This option deletes all layout module surfaces, and child-module surfaces. These surfaces are not required after the design is complete.

Make sure no connections to module surface controls exist on the device surface.

3. Delete all circuit bitmaps for the Device:
Deletes all bitmaps of the module’s child modules. You will now only be able to access the modules in the Module Tree.

Popup menu for Modules in the Module Tree

4. Delete all Unused Bitmaps
This deletes all hidden pad bitmaps and their routings.

After these three optimizations, only the surface module for the Device itself remains.

Before continuing on to optimize the surface, we recommend you save the device again.

Optimizing the Surface:

4. Automatic Clip Children
This optimization speeds drawing of GOs of the types: ‘Back’, ‘Background’, ‘Integration’, ‘BKGround’, ‘Back1’ and ‘View’.

In certain cases Clip Children can lead to problems. If this happens, disable the Clip Children option.

5. Flat Surface
Combines all the graphic elements, including shadows and dynamic bitmaps into a static bitmap.

The surface cannot be changed in size, or shadowed any differently - it is as if it were a ‘screenshot’.

Independent modules, such as Controllers, are not affected by this optimization.

If a surface includes drawers, they are optimized the same way.

Last Step - Protecting Your Device

You've got an optimized, working device, and it's time to perform the final step - protecting the device. Now your synth will becomes a fully functioning, independent SCOPE device.

Important: After performing this step, access to the internals of this device is absolutely impossible. It can never be opened again. Make sure you have made a safety copy of your device layout before protecting it.

To protect your synth, simply bring up the popup menu for your Device module and select **Protect**. That's it! You've just given birth to a new SCOPE synth, and it didn't hurt at all!