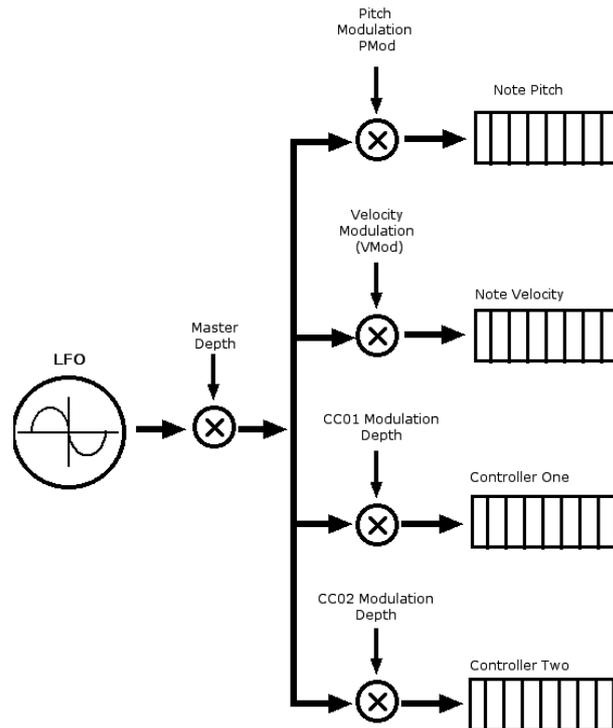


## Tutorial 2: Using the Low Frequency Oscillators

In this tutorial, we're going to look at using the Low Frequency Oscillators to introduce periodic changes to our sequences.

The *Low Frequency Oscillators (LFOs)* generate digital control signals that can be used to change Note Pitch, Note Velocity and Controller values to create seemingly complex variations in your music.



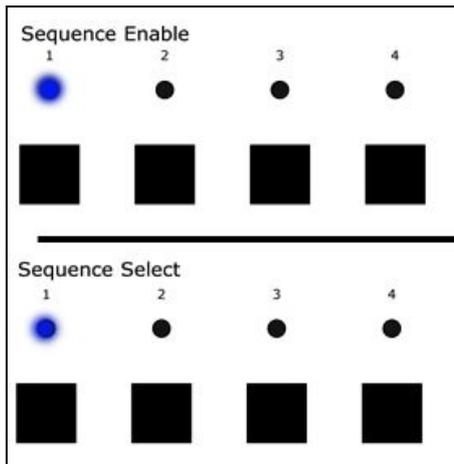
The above diagram might look pretty complex but it's quite simple really. Starting at the left-hand side, the *LFO* generates a control signal – one of the 6 waveforms available on the front panel – and the *Master Depth* control acts as a kind of *volume control*, limiting the amount of *LFO* signal that gets through.

The same signal is then sent internally to the *Note Pitch*, *Note Velocity* and *Controller Streams*, all of which have their own individual *depth* controls.

Now, select a sequence, something simple with all 16 steps active and normal, ie. not *skipped*, because we want to keep this exercise as simple as possible. Make sure that this is the only sequence enabled at the time and make sure that you select the same sequence in the *Sequence Select* strip.

## 3.8 THE TUTORIALS

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Let's begin by selecting an *LFO Waveform*. Choose the *SawUp* waveform to start off with. This will create slowly rising pitches and velocities that will drop down to their original values when the *LFO* resets back to the start. In this way the changes imparted by the *LFO* should be fairly easy to hear.

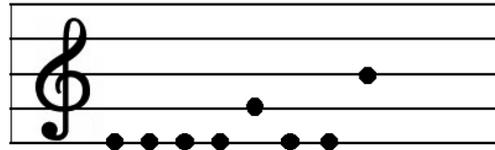
Now press the *Depth* push button in the *LFO Panel* and, using the *Data Wheel*, turn the *Master Depth* up to 75%. Next, press the *Sync* push button. The LED above the push button will switch on to indicate that the frequency of the *LFO* is now slaved to the length of the sequence.

Now we're ready to hear something. Press *Play* in the *Transport Strip* and listen to the playback. It should be exactly as it was before, because even though we've turned up the *Master Depth* control in the *LFO*, we're not yet sending any of the *LFO*'s signal to the individual streams.

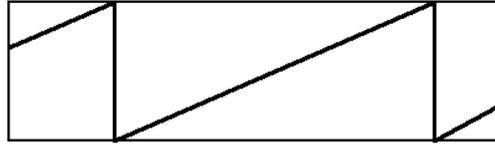
Go to the *Sequence Play Menu* and scroll through the pages until you come to the *Note Modulation* page.

```
39>Sequence 10   Seq 01
PMod 00   VMod 54
```

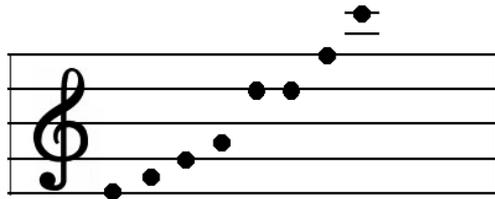
Using the *Data Wheel* slowly increase the *Pmod* parameter. You should begin to hear the pitch of the notes within the sequence change. Do the same with the *Vmod* parameter. If your synthesiser is playing a velocity-sensitive patch then you should start to hear the notes getting louder as the step counter moves towards the end of the sequence. When the *LFO* resets and the *sawtooth* waveform begins at 0 again, the note velocity will drop to its normal level.



Original sequence



LFO Output



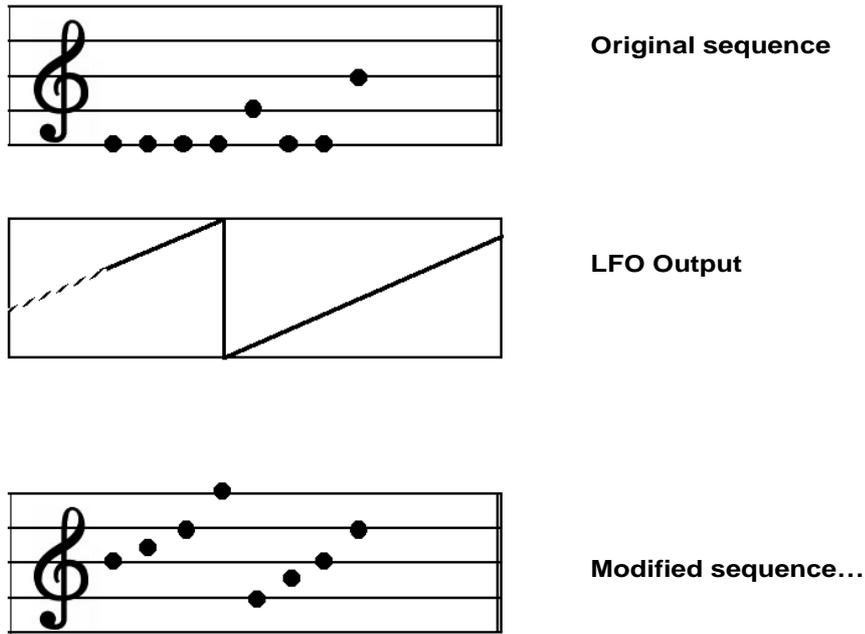
Modified sequence...

So, in a simple 8 note sequence, we should hear something similar to the above.

Next, we'll look at the *Time Offset* and *Depth Offset* parameters. The ***Time Offset (TOFF)*** field offsets the start of the oscillator cycle from 0 and is measured as a percentage of the *oscillator wavelength*. The ***Depth Offset (DOFF)*** field offsets the output level of the oscillator from the minimum possible value of 0.

That sounds a bit technical so let's actually hear what effect these two parameters have on our sequence.

When we vary the *Time Offset* parameter, we're simply varying the point at which the *LFO* starts. Press the *TOFF* push button and change the parameter so that it reads 50%. As the diagram shows, varying *TOFF* can have a dramatic effect on the sequence and this can be a very powerful tool if you're attempting to create new sequences.



**Original sequence**

**LFO Output**

**Modified sequence...**

Now, decrease the *Time Offset* parameter so that we're back to our original sequence then increase the *Depth Offset* parameter. We're now adding a fixed amount of modulation to each *note pitch* and *velocity* so we should hear the pitch of the notes rising and the notes themselves getting louder.

As we've been using the *Time* and *Depth Offset* parameters, you may have noticed that the resulting sequences have been less than musical. This is because *ZEIT* adds the modulation data and picks the note nearest to the result, which might not be a note in your chosen key. The remedy to this problem is to set *Force-to-Scale* to on. If you haven't already done so, press the *Force-to-Scale* push button in the *Pitch/MIDI* panel and then you should find that no matter what you do with *TOFF* and *DOFF*, the pitches will fall within the current key.

In this example, we chose an *LFO Waveform* so that the changes to the note pitches and note velocities were quite obvious. We also locked the frequency of the *LFO* to the length of the sequence so that we wouldn't have to get involved with complex frequency settings. Suppose, instead, that we wanted to do something more subtle.

Press the *Sync* button once so that the LED goes off and the *LFO* is no longer synchronised to the length of the sequence. In fact, the frequency of the *LFO* is now fixed and won't change when we vary the playback tempo. Next, select the *Tri waveform* (short for *Triangle*) and press *Play*. The abrupt change generated by the *SawUp* waveform is replaced by more gentle, sweeping changes.

```
50 LFO/Sweep 1   Seq 01
Rate>09.051 Hz  Dep 99
```

Press the *Rate* push button. The *Rate* parameter uses the *precision parameter editor* to change values, which some users find a little intimidating. To change the value, press the *Select* push button to move between the digits and the *Data Wheel* to increase and decrease the values. When you're finished, press the *Enter* push button to move to the next field.

When setting the *Rate* parameter, low frequencies mean long cycle times. A *Rate* of 0.100 Hz is equivalent to a cycle time of 10 seconds whilst 0.050 Hz is equivalent to a cycle time of 20 seconds. The minimum cycle time you can set is currently 0.010 Hz, which is equivalent to 100 seconds or nearly 2 minutes. Consequently, you can impart some very long, subtle changes to your sequences.

In the next tutorial, we'll look at combining what we've learned above with the *Controller Editors* to create more complex sequences.

