The Wersi Sound Factory
Master Classes

Master Class 13 : Summer 2016 : The Matrix - Part 7 : Source/Modifier Components - E (LFOs Cont'd)

The Source/Modifier List for MC13

LFO 1
LFO 2
LFO 3
Sine Amp
Sine Freq
Clip +/-
Rectify +/-
Row 1 - 6
Delay Ramp

In this Master Class we are going to have a look at some more LFOs in Sound Factory.

In Sound Factory, LFO 1, 2 and 3 are all obvious to find and edit. There are, however, two more LFOs that are contained within the Matrix itself. You can find them available only in the Modifier list named as **Sine Amp** and **Sine Freq**. Both of these options are 'Local' just like LFO 3 is and are limited to producing only Sine waveforms for their output shape. But they can still perform most of the duties that Sine waves could be used for as long as you don't need the sync and phase to be set for each of them.

They do also have a hidden ability; they can be modulated in real time by any of the available sources to control either the sine waveform amplitude or the sine waveform frequency, hence the naming.

Load the sound **MC13:MatrixPatt1** we kept in slot 127 from Master Class 12. If you did not save it then you will need to rebuild it as described in Master Class 12. The Matrix pattern is as below, for you to check. The only sample layer is **Accordion 2x8CH**.

MC13:Matrix Patt1

Row	Source	Modifier	Modify	Destination	Depth
1	LFO 3	Mod Wheel	+100.0 %	Off	+71.0 %
2	Aftertouch	LFO 1	+100.0 %	Off	+56.0 %
3	LFO 3	Delay Ramp	+706 ms	Off	+67.0 %
4					
5	LFO 3	Off	0.0 %	Off	-100.0 %
6	LFO 3	Off	0.0 %	Amp	+60.0 %

Sine Amp

Let's try the **Sine Amp** first with the following code placed into Row 6 of the above matrix.

Row	Source	Modifier	Modify	Destination	Depth
6	Off	Sine Amp	5.37 Hz	Amp	+70.0 %

Play a key and hold it down. With 'Off' as the Source which then supplies a value of zero into the sine amp there is no output modulation. So at the moment this is disabled from working. Change the Source parameter to read 'Constant', as below:

Row	Source	Modifier	Modify	Destination	Depth
6	Constant	Sine Amp	5.37 Hz	Amp	+70.0 %

Now the sine amp modulation can be observed as a tremolo effect on the accordion sound. Change the Source to 'Random', as below:

Row	Source	Modifier	Modify	Destination	Depth
6	Random	Sine Amp	5.37 Hz	Amp	+70.0 %

Every time you play a new key or chord, a new value is taken from the random generator (ref: MC12) and supplied into the 'Sine Amp' output volume, so every new note has a different random amount of tremolo applied to it.

Try Velocity as the Source now, as below:

Row	Source	Modifier	Modify	Destination	Depth
6	Velocity	Sine Amp	5.37 Hz	Amp	+70.0 %

Now each note can have the amount of tremolo modulation controlled from the keyboard by how hard you strike the key(s).

Another possibility available here is:-

Row	Source	Modifier	Modify	Destination	Depth
6	Mod Wheel	Sine Amp	5.37 Hz	Amp	+70.0 %

Here we can use the Mod Wheel to control and set the Depth required when playing.

Aftertouch is a useful Source to use

Try other Sources. They will all modulate the 'Sine Amp' in some way. You could even use one of the other LFOs to modulate this parameter if required. This is an example of an LFO modulating another LFO:

Row	Source	Modifier	Modify	Destination	Depth
6	LFO 3	Sine Amp	5.37 Hz	Amp	+70.0 %

Change LFO 3's parameter values to alter how the modulation controls the Sine Amp rate. This should be the set of values currently:

Wave	Sine	Phase	0°
Sync	Tempo + Beat	Rate Hz	4/4

Sine Freq

The **Sine Freq** works in the same fashion as the Sine Amp option. This time it is the frequency that will be affected by the Source modulation and not the amplitude. Let's try a couple of examples to get you working with this option.

In Row 6 try this code:

Row	Source	Modifier	Modify	Destination	Depth
6	Key	Sine Freq	5.37 Hz	Pitch	+50.0 %

With this code, the Sine Freq (frequency/rate/speed) will change its output value according to where a note is played on the keyboard. Low Notes have a lower output value than high notes so the tremolo frequency will increase as you work your way across the keyboard from left to right.

Then try this code:

Row	Source	Modifier	Modify	Destination	Depth
6	Mod Wheel	Sine Freq	5.37 Hz	Pitch	+50.0 %

This uses the 'Mod Wheel' to set the rate of modulation applied. Try some of the other Sources available again to get to grips with some of the possibilities that are here waiting to be programmed.

Advanced Applications

Advanced Applications

So far we have done only some basic programming using the available LFOs. Now we are going to jump into some more advanced programming which will require the use of some unfamiliar parameter components we have not yet dealt with. Follow the instructions carefully and you should obtain the finished product described here.

This first example has the basic idea of having two string section layers. The first is the standard one found in the OAS database. The other is to have some programming applied to it from Sound Factory using an LFO plus some control code.

Strings Wash Sound

Into Selector one on the Upper Manual, load **JazzFlute 1 * (090-000-018).** Make sure that Selector One has 'Dynamic' switched 'On'. You can check this by striking the keyboard harder when the sound should produce an 'overblown' attack when 'Dynamic' is activated. If 'Dynamic' is 'Off' the sound will remain the same regardless of how hard the keyboard is played. Make sure 'Dynamic' is switched 'On'.

Go into **Sound Factory>Expert Edit>Sample** page.

Select Layer two ('Flute Hard') and delete it as it will not be used. This just leaves Layer one active at the moment. From the drop-down lists choose:

Sample Bank: Wersi 1.
Samples: Strings Warm.

Set the following parameters to these values:

Sample Page

Volume		Pitch		Sample Edit		Sample Delay	
Volume dB	-3.0 dB	Octave	+0	Wave Start	0 %	Mode	Off
Panorama	<C>	Semi	+0	Velocity	0 %	Delay ms	0 ms
Pan Key	-90 %	Cent	0.0	Random	0 %		
		Key	+100.00				

Filter-Map Page

Filter		Key Switch		Velocity Switch	
CutOff	70 %	High Key	G8	High Vel	127
Resonance	3 %	Low Key	C-2	Low Vel	0
Velocity	+ 30 %	X-Fade	0	X-Fade	0
Key	+100 %				

Envelope Page

Envelope		Velocity to:	
Attack ms	160 ms	Attack	0 %
Decay	0 ms	Volume	0 %
Sustain	100 %		
Fade	0 %		
Release ms	336 ms		

LFO/Matrix

Set all the destinations in the first three rows to 'Off' so that they cannot be activated by accident later. There is no modulation used in this layer. Rows 4 to 6 contain no code. The result should look like this:

MC13:Matrix Patt2

Row	*Source*	*Modifier*	*Modify*	*Destination*	*Depth*
1	**Aftertouch**	**LFO 3**	**+100.0 %**	**Off**	**+15.0 %**
2	**Mod Wheel**	**LFO 3**	**+100.0 %**	**Off**	**+15.0 %**
3	**LFO 3**	**Delay Ramp**	**+528 ms**	**Off**	**+10.0 %**
4	**Off**	**Off**	**-0.0 %**	**Off**	**-0.0 %**
5	**Off**	**Off**	**-0.0 %**	**Off**	**-0.0 %**
6	**Off**	**Off**	**-0.0 %**	**Off**	**-0.0 %**

Save this as **MC13:Matrix Patt2** in slot 126.

This completes the first Layer's programming, so onto the next one. Copy (Layer to Clipboard) this Layer and paste behind the first. Then select Layer two to edit if it hasn't already been selected.

Go to Layer two's Sample page and put these values into the appropriate parameters:

Sample Bank: String Sections.
Samples: Tremolo Strings.

Sample Page

Volume		Pitch		Sample Edit		Sample Delay	
Volume dB	-1.8 dB	Octave	+2	Wave Start	0 %	Mode	Off
Panorama	L64	Semi	+0	Velocity	+0 %	Delay ms	0 ms
Pan Key	-90 %	Cent	-0.1	Random	0 %		
		Key	+100.00				

Filter-Map Page

Filter		Key Switch		Velocity Switch	
CutOff	45 %	High Key	G3	High Vel	127
Resonance	0 %	Low Key	C-2	Low Vel	80
Velocity	0 %	X-Fade	0	X-Fade	0
Key	+48 %				

Envelope Page (no changes)

LFO/Matrix

Row	*Source*	*Modifier*	*Modify*	*Destination*	*Depth*
1	**LFO 3**	**Off**	**0.0 %**	**Amp**	**+100.0 %**
2	**LFO 3**	**Off**	**0.0 %**	**LFO 3 Depth**	**-50.0 %**
3	**LFO 3**	**Off**	**0.0 %**	**Pan**	**+67.0 %**
4	**LFO 3**	**Off**	**0.0 %**	**Cutoff**	**+20.0 %**
5	**Off**	**Off**	**-0.0 %**	**Off**	**-0.0 %**
6	**Off**	**Off**	**-0.0 %**	**Off**	**-0.0 %**

LFO 3 parameter settings

Wave	Sine or Triangle	Phase	244°
Sync	Tempo + Beat	Rate Hz	8/4

I'll just work through the four active rows of code in the above Matrix so that you know what should now happen and how it interacts with the rest of the programming on the other pages.

Row 1: ***LFO 3 to Amp***. This routes the LFO 3 output into the Amplitude control for this Layer. It therefore controls the volume of this Layer. It is a slow 'tremolo' which, at this speed, sounds more like a slow envelope working and not an LFO.

Row 2: *LFO 3 to LFO 3 Depth.* This is an example of self-modulation from LFO 3. It helps with the overall range of the first Row of code that is controlling the amplitude of this Layer. If you are not sure, disable the Destination to 'Off' and listen with only the second Layer activated (mute the first Layer to do this). It is subtle to hear but it does change the overall shape of the fade in and out.

Row 3: *LFO 3 to Pan*. This modulates the Layer's position within the stereo field. On the Sample page the parameter 'Panorama' is set to 'L64'. That is as far to the left that any sound could be panned. The LFO modulation actually moves the layer across towards the middle and back again as it cycles.

Row 4: *LFO 3 to Cutoff*. Here we are just adding some filter modulation. As the sound becomes louder the filter opens up and then closes as the sound becomes quieter. This is what happens when we play any acoustic instrument and so this imitates this type of behaviour to help with the illusion. The Filter values on the Filter-Map page and the Matrix modulation help achieve this.

The other important part is played by the LFO 3. The choice of waveform is left to your preference. Both waveforms suggested work well for this example. The ability to be tempo synchronised is helpful here too. I use this program in a few arrangements now. All of them are at different tempos so everything stays locked together because of the Sync option used. The Phase parameter is very useful in altering where the fade in/out will happen in the bar. In this case it is set to be 'peaking' in volume at around the start of bar two in a rhythm pattern.

Because of the programming on the Filter-Map page, this layer will work only within a certain key/velocity range. Notes above G3 are ignored. This can be changed but I selected this value because, with the octave shift of +2 on the sample page, notes above this are very shrill to my ear and possibly out of the acoustic instrument range, which I didn't want. The Low Velocity parameter (80) restricts the velocity range. The Layer will work only if your key velocity produces a value greater than this. Change this value to suit before you save this.

Save this as 'MC13:Matrix Patt3' in slot 125

So once you have named and saved this sound it is time to learn how to apply it when performing. It is set up in the programming with the ability to choose at which point the second layer will become active. I don't use it all the time because it can become boring when overused and it is nicer when it appears occasionally. However, I will play either a single key or a combination of keys harder than the others and that will be the trigger for the second String Layer to come in on cue. With practice you can produce some very interesting 'String Washes' in the accompaniment background of your arrangements. Pick your moment to use this.

Creating a Trill Sound

Here is another example to play with. This one uses the 'Constant' to help understand its function within the three main LFOs.

The idea with this is to program a sound of your choice, but to give it the ability to 'trill' quickly between two notes. A 'Trill' is the rapid alternation of two musical notes that are either a semitone or a tone apart. Any interval larger than a tone apart is normally considered to be called a 'Tremolo'. Tremolo in this case is not the modulation of the 'Amp' parameter in the Matrix. Here it refers to the rapid oscillation of normally two or more notes; an octave for example.

Using the LFOs it is possible to trill or tremolo depending on the settings used. The programming is very similar for both these options and requires only a parameter value modification to change one into the other.

In order for this to work correctly, certain values and Modifiers must be placed in the Matrix at key points, so please follow this example carefully.

In 'Upper Selector One' load **Jazzflute 1* (090-000-018)**. Key Velocity will be used to turn the trill 'on' and 'off' so make sure that Dynamic is activated for Upper Selector 1 in 'Selectors' before entering Sound Factory otherwise you will not be able to set the switch value properly. Also load this sound into the 'Lower Selector One' slot as well: the reason for this will become clear soon.

With Selector One active on the upper manual, enter **Sound Factory>Expert Edit**.

On the Sample page we find that there are two Sample Layers which contribute to the overall sound programming. Select the second Layer (Flute Hard) and delete it, leaving the first Layer (Flute Medium) active only.

Go to the Filter-Map page and change the Velocity Switch 'High Vel' value to 127. This will allow this Layer to 'sound' at any velocity produced by the player.

On the LFO-Matrix page disable all the modulations that are active by selecting 'Off' as the Destination choice. You could, instead, remove all of the information in the first three rows if you want to be sure that nothing is happening from this existing code.

In Row 4, place this code:

Row	Source	Modifier	Modify	Destination	Depth
4	LFO 3	Off	0.0 %	Pitch	+100.0%

Then in LFO 3's parameter settings change the waveform shape to 'Square'. The Square waveform is chosen because it outputs only one of two values at any time. Either a maximum '+1' value and then a '-1' value or vice versa depending on the phase settings mentioned earlier in this text. This would make it an ideal choice for alternating between two notes once it has all been set up correctly.

However, because the LFOs are bipolar with their output values, when playing a note the pitch not only goes above the note played but also below. Play 'Middle C' and listen. Slow down the rate value (1.50 s should do the trick) so you can hear the sound jumping from an octave above the played note to an octave below and then back again. Although the LFO is basically performing correctly we will need to modify the LFOs bipolar output behaviour to have a unipolar output. A limited range of values, '0' to '+1' only is required. This will then remove the drop below the principal note so that it uses only this note and values above this note from the LFO.

Changing Bipolar Modulations to Unipolar Modulations

Changing Bipolar Modulations to Unipolar Modulations

This is relatively easy to perform once you understand the 'Modifier' processes available and how to use and combine them. Basically what is needed here is to remove all the negative values or all the positive values from a bipolar source. The choice of which to use depends on the user's requirements. A 'Modifier' will be added into the code Row to accomplish this task, in effect side-chaining the output. The Square waveform will then supply the required range of modulation.

Clip +/- Rectify +/-

For this task, there are a couple of options available in the Matrix modifier list. **Clip +/-** and **Rectify +/-** options are all able to remove parts/values of a bipolar signal. To help with making this easy to understand, the **Clip -** option has been selected as it removes only values. Change the Row 4 code to this.

Row	Source	Modifier	Modify	Destination	Depth
4	LFO 3	Clip -	-100.0 %	Pitch	+100.0%

With the values in the Matrix set this way there is no change to the output of the LFO at the moment. A quick check will confirm this to you. But by increasing the Modify value from '-100.0%' to '0.0%', we can remove the negative values that would normally appear in our chosen LFO. If you increase the values into the positive range all the way to its maximum (+100%) you will have removed all the modulation range of the LFO output so you would be back to a sound with no modulation affecting your sample. Set the code to read:-

Row	Source	Modifier	Modify	Destination	Depth
4	LFO 3	Clip -	0.0 %	Pitch	+100.0 %

At first glance it appears that the **Clip -** function is not active, but you should now know that it is removing the negative values from the LFO without affecting the positive output value range. Playing a key now will reveal that the note will jump up only an octave and then return to its original principal note again. If you increase the rate of the LFO (5.86 Hz for example) you can hear this 'tremolo' effect working.

So step one is basically complete. The LFO is at present set to modulate between the principal note and the next octave above (Pitch: +100% in the code Row). This setting produces a musical tremolo at the octave.

How do we determine what value should be used in the Matrix to produce a trill between two notes a semitone apart?

This will require a value smaller than +100% placed in the Depth value for Row 4. So start to dial down towards zero to try to find the exact figure that should be entered into the Matrix to represent a semitone, while listening to the results of the modulation.

This turns out to be a small problem. Because the LFO is cycling between its possible outputs it is difficult to confirm the actual interval that the value should be set to for the correct interval to be produced. Fortunately there is a solution to finding the correct value needed in the Matrix.

In the Wave selector for LFO 3 in the **Layer LFO3** table at the bottom of the screen choose **Constant** as its output shape. With Constant selected the maximum range of any LFO is now available to help assess just how much modulation is required in the matrix depth parameter. Select the Depth parameter value in Row 4 and set its initial value to zero, then leave it highlighted ready for adjusting.

Row	*Source*	*Modifier*	*Modify*	*Destination*	*Depth*
4	**LFO 3**	**Clip -**	**0.0 %**	**Pitch**	**0.0 %**

How to tune a trill or oscillation between any two notes

Play and hold 'Middle C' on the upper manual (this requires you to hold the 'C' with the left hand using either the second, third, fourth or fifth fingers) and on the lower manual with the same hand reach down with your left thumb, play and hold the 'C#' above 'Middle C'. This creates a dissonance between the two sounding notes at first but, by using your right hand on the Tempo/Data Wheel, start increasing the Depth value in the display. Do this slowly so you can hear the two notes gradually become 'tuned' to each other until you are satisfied that they are forming a 'unison' (Unison: two or more notes playing exactly the same pitch). Technically the upper manual modulation is being tuned to the lower manual pitch in this case. Here the Constant was used to find the exact value required. If you don't trust your hearing that much try this setting in Row 4.

Row	*Source*	*Modifier*	*Modify*	*Destination*	*Depth*
4	**LFO 3**	**Clip -**	**0.0 %**	**Pitch**	**+29.0 %**

Save this as 'MC13:Matrix Patt4' in slot 124

This Depth value (29%) seems to represent the semitone interval accurately. Swap the LFO 3 waveform back from the constant to the square wave and now, when playing, you will hear a trill on each note played. The square wave now modulates the pitch to the depth of a semitone producing the trill effect.

All the musical intervals are available. Just follow the above procedure and substitute the lower manual note for the interval you want. For example, a fifth would require the upper manual to have 'Middle C' selected with the 'G' above 'Middle C' selected on the lower manual. Then turn the Tempo/Data Wheel and tune until the unison becomes apparent and that will be the required value. Then select 'Square' as your waveform to hear it modulate at the correct depth to produce an alternating perfect fifth. Intervals larger than an octave are also available. All you need to do is add the same code twice in the Matrix, for example:-

Row	*Source*	*Modifier*	*Modify*	*Destination*	*Depth*
4	**LFO 3**	**Clip -**	**0.0 %**	**Pitch**	**+100.0 %**
5	**LFO 3**	**Clip -**	**0.0 %**	**Pitch**	**+100.0 %**

This will alternate between the principal note and the note two octaves above it.

What about having the modulation go in the opposite direction, ie down instead of up?

This is easy to do as well: just change the Depth sign from positive to negative. Try this with a single code Row as below:

Row	*Source*	*Modifier*	*Modify*	*Destination*	*Depth*
4	**LFO 3**	**Clip -**	**0.0 %**	**Pitch**	**-100.0 %**

Now the modulation goes down an octave instead of up.

We now have a Flute that trills all the time. The next thing to do is to get it to respond to velocity note values so that we can control when it will be used and when not by playing the keys with a different amount of attack.

There is a small amount of LFO programming also to be added before we carry on: the setting of Sync and Phase values in the Layer LFO3 table.

Set Sync to 'First Note' and adjust phase to '0°'. See the above text if you need to remind yourself about these parameter functions again. You can always change these parameter values to suit your own requirements.

Place this code back into Row 4 if you changed it earlier:

Row	*Source*	*Modifier*	*Modify*	*Destination*	*Depth*
4	**LFO 3**	**Clip -**	**0.0 %**	**Pitch**	**+29.0 %**

In Row 5 add this line of code:

Row	*Source*	*Modifier*	*Modify*	*Destination*	*Depth*
5	**Velocity**	**Switch**	**+95.0 %**	**Off**	**0.0 %**

This Row of code looks like it is doing nothing as it is not routed to any of the available destinations, but it is acting as a place holder for values. First of all, the Velocity value is taken and then passed onto the Switch. The Switch makes a comparison with its Modify value (+95% here) and the value coming from the keyboard Velocity. If that keyboard Velocity is equal to or greater than the Switch Modify value it will then trigger a full output value. If the Velocity value is less than the Switch value, there will be no output from this code line. In a sense, this has turned Velocity into an on or off Switch. Now we need to send this to the appropriate Destination. In Row 6 put this line of code:

Row	*Source*	*Modifier*	*Modify*	*Destination*	*Depth*
6	**Row 5**	**X-Fade**	**+80.0 %**	**LFO 3 Depth**	**+100.0 %**

Save this as 'MC13:Matrix Patt5' in slot 123

This last Row completes the programming required.

Here's what is happening. Row 6 is monitoring the output of Row 5. Remember Row 5 is now outputting only two possible values, an on or an off. When Row 6 detects an output value from Row 5 it then activates the LFO 3 Depth parameter with the appropriate output value.

The important parameter is actually the 'Modify' value (+80%) in Row 6. You will need to set this value to suit your own playing ability. What should happen once this is all set correctly is as follows. You should be able to play with a normal Velocity and not have any 'trilling' appearing within the sound. When you do want it to trill, play the key in question a bit harder than the rest. If you have set the value correctly, the note should engage the trill. Play a new key at the lower Velocity value and the trill will not sound. Values at and around '+100%' will cause the trill to be on all the time. Values around '+0%' will disengage the trill from working altogether. I've used '+80%' to get you started, but try adjusting this value until you feel comfortable with being able to control the trill easily. It might take several attempts to find your ideal setting. If it appears to be impossible to get the right value, change the Switch Modify value in Row 5 to +90% or +85%, then retry setting Row 6 to +80% adjusting from this value again. When you change the Switch value you are redefining the point at which the Velocity value will be compared, so this in turn changes the response of the Switch activation/deactivation point.

Jeff's Trumpet Trill Demo

Jeff has provided this demonstration of a Trumpet trill based on the Flute example featured earlier. The trill will alternate between a given note and a note a semitone or tone higher, and is activated by striking the key harder using the Dynamic function. Here's how it's done.

Creation of the Trumpet Trill Sound

1) Load the **Trumpet *** sound (**090-000-012**) into **Sound Factory>Expert Edit**. There is just one Layer listed, namely **Trumpet Mezzoforte**.

2) Select this Layer and then enter the Matrix page.

There are three Rows at the top of the Matrix. Set the Destination of each of these to **Off** so that they have no effect on the sound. Then on Rows 4, 5 and 6 enter the following code:

Row	*Source*	*Modifier*	*Modify*	*Destination*	*Depth*
4	**LFO 3**	**Clip -**	**0.0 %**	**Pitch**	**+29.0 %**
5	**Velocity**	**Switch**	**+95.0 %**	**Off**	**0.0 %**
6	**Row 5**	**X-Fade**	**+80.0 %**	**LFO 3 Depth**	**+100.0 %**

Row 4 uses LFO3 to vary the pitch of the sound and a Modifier of +29% to set a semitone for the pitch change of the trill.

3) Enter the following parameters for Layer LFO3 at the bottom of the Matrix page.

Wave	Square	**Phase**	180°
Sync	Each Note	**Rate Hz**	4.17 Hz

The Phase parameter is set to 180° so that the trill begins on the note of the key being played rather than the note above.

When playing this sound remember to set the Dynamic control to **On** to activate the effect.

Refinements to the Trumpet Trill

There are two refinements we can make to the basic coding of this Trumpet Trill. The first is related to how an actual trumpeter might play the trill and the second is a facility for selecting the pitch range of the trill, either a semitone or a whole tone. This latter function is very useful as a particular piece of music might require one or the other or both.

Making the Trumpet Trill More Natural

When musicians are playing trills, the speed of these often varies within the trill so here is a refinement to the code that makes the effect more realistic.

Change Rows 1 and 2 in the Matrix to the following code :-

Row	*Source*	*Modifier*	*Modify*	*Destination*	*Depth*
1	**Constant**	**Delay Ramp**	**314 ms**	**LFO3 Rate**	**+ 6.0%**
2	**LFO 1**	**Off**	**0.0 %**	**LFO3 Rate**	**+ 24.0 %**

The first Row defines an increase in the trill speed after a delay of 314 ms
The second line adds a degree of randomness to this speed variation.

In order for this effect to work we need to set up the parameters for LFO 1. Select the General page and enter the following for LFO 1.

Wave	Random Drift	**Phase**	Random
Sync	Off	**Rate Hz**	1.50 Hz

Now when you activate the trill you should hear a more natural sounding effect.

Semitone or Whole Tone Trill Mode

We shall use the Modulation Wheel to switch between a semitone trill and a whole tone trill. So in the backwards position (Mod Wheel Down) we define a semitone trill and in the forwards position (Mod Wheel Up) a whole tone trill. In this way we can select the required mode at the beginning of a piece or change the mode if required during the piece.

To implement this additional feature we will need two samples, one to define a semitone pitch change and the other to define a whole tone pitch change.

1) On the Sample page copy the **Trumpet Mezzoforte** sample (Layer to Clipboard) and paste this behind the existing sample.
2) Select the first sample and in its Play-Mode box at the bottom of the page set the Trigger Condition to **Mode Wheel Down**.
3) Now select the second sample and in its Play-Mode box at the bottom of the page set the Trigger Condition to **Mode Wheel Up**.
4) Finally with the second sample still selected go to its Matrix page and change line 4 from:

LFO 3	**Clip -**	**0.0%**	**Pitch**	**+ 29.0%**

to:

LFO 3	**Clip -**	**0.0%**	**Pitch**	**+ 50.0%**

The +50% Depth parameter changes the pitch range from a semitone to a whole tone.

When playing this sound, simply position the Modulation Wheel up or down to select the type of trill you require.

Many thanks to Ian Terry for providing the coding for these refinements.

There is an audio demonstration of all the coding for the Trumpet Trill featuring the tune 'Trumpet Voluntary', generally attributed to Henry Purcell just before he went off to invent washing powder.

In the next Sound Factory Master Class 14 (expected October 2016) we shall be looking into Envelopes contained within the Matrix and their possible applications.

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