



The Wersi Sound Factory Master Classes

Master Class 12 : Spring 2016 : The Matrix - Part 6 : Source/Modifier Components - D (LFOs Cont'd)

[The Source/Modifier List for MC12](#)

LFO 1
LFO 2
LFO 3

There are grey boxes in this left margin throughout this Master Class suggesting you save each Matrix setting. This is so you can easily recall any sound arrangement without having to set it up again. By saving from the vacant end slots of your User Sounds Database you can easily find these sounds and delete them when no longer needed or save them as a usable sound elsewhere in the database list.

In this Master Class and the next (No 13) we are going to spend more time with understanding and using Low Frequency Oscillators, also known as LFOs. There is an immense amount of information in these Classes. Try not to rush through reading it all at once as there is a lot to take in and play with.

Also, before we get started, because of some of the programming used later on in this Class it is a good time to decide which of the instruments 'velocity response curves' is really the best one for you. You can find the choices available in each and every Total Preset that is in your instrument database. Go into **Selectors>Advanced** and pick your favourite response that you prefer to use when playing using Dynamics from any of the keyboards. Most people leave the setting on '4', the default value set by Wersi, but you can change this to suit yourself. If you change this setting after you start to explore some of these experiments you may find that they do not work as well with a new velocity curve selected, so be sure that you are happy with the setting before continuing.

So, just a quick recap from the last Master Class (No 11): the LFOs present in Sound Factory can be divided into two groups, with LFOs 1 and 2 in a separate group from LFO 3. LFO 3 settings can be found at the bottom of the **LFO/Matrix** page whereas LFOs 1 and 2 settings are found on a separate page called **General** and share this page with the **Pitch Bend - Voices** settings. There is a reason for this particular layout. LFO 1 and 2 are known as Global LFOs. LFO 3 is Local only. LFOs can be assigned only in the Matrix for each active Layer individually. They therefore need to be routed to the Destination and an initial modulation amount set before they appear to work.

Global LFOs are able to affect all the Layers contained within any sound simultaneously. If you use LFO 1, for example, its speed and waveform shape will be applied to any Layer that has LFO 1 selected in the Matrix. The Matrix still allows the user to control the Depth of modulation, the sign (negative or positive values are available) and to where the control signal is being sent (Destination).

LFO 3 is Local in its application. That means it can modulate only Destinations contained within the same Layer to which it is assigned. If you have two Layers, for example, and you assign LFO 3 in Layer one's Matrix, Layer two will remain unaltered by the LFO 3 modulation applied to Layer one. They are independent of each other.

LFO 3 has some abilities that LFOs 1 and 2 do not have. LFO 3 appears in the Matrix Destination list (*LFO3 Rate and LFO3 Depth - see Master Class 11 pages 3-5*) and can therefore be modulated in real time from another modulation source, including modulating itself if required.

This has all been said before but the better you are able to understand the LFO parameters the more useful they can become.

We are going to do some further experimentation with LFOs to make sure we all understand the difference between Global and Local LFO assignment.

Load into Upper Manual Selector one the following sound from the OAS database:

Pan Pipe 1 * (090-000-019)

More examples of using Global and Local LFOs

Once loaded, check your Modulation Wheel (MW) is assigned by moving it forward and playing the sound. The MW should increase the 'Tremolo' effect to the output making the existing modulation even heavier. If there is no change to the modulation depth, you will need to assign your MW in the **Selectors>Advanced** panel before going into Sound Factory.

Enter **Sound Factory>Expert Edit**.

There are three Layers which make up this sound. The first is the actual Sample Layer, the second and third Layers are Effects only. Mute Layers two and three for now.

Select the first Layer (the Sample, called Panflute) for editing and then go into the **LFO/Matrix** page.

Side-Chaining was covered in Master Class 11, page 2

We can now see three Rows of code, each with a dedicated specific task. Row 1 allows LFO 3 to add more modulation via the Modulation Wheel (MW). Row 2 allows Aftertouch to be used in the same way as Row 1 uses the MW. Row 3 sets the amplitude of LFO 3 via the Delay Ramp Modifier. All of these are examples of using Side-Chaining within the Matrix to produce the end result.

Initial Matrix Pattern 1 (Panflute sample layer)

Row	Source	Modifier	Modify	Destination	Depth
1	LFO 3	Mod Wheel	+100.0 %	Amp	+71.0 %
2	Aftertouch	LFO 1	+100.0 %	Amp	+56.0 %
3	LFO 3	Delay Ramp	+706 ms	Amp	+67.0 %

Change all the Destination parameters which read **Amp** to **Off** for each Row of code. This will disable Rows 1, 2 and 3 so the Sample is now without any modulation of any kind from the Matrix. Playing the keyboard now reveals that the Sample is unmodulated at present, with Rows 1 to 3 now having no effect on the sound.

MC12:Matrix Patt1-Stereo Sweep1

(Save this with the exact above name, including spacings to ensure it can all be easily read, in slot 00-079-000-127 of your User Sound Database) [Referred to as simply 'slot 127' from now on] NB: 'Patt' is short for 'Pattern'.

Add the code shown below to Row 6. We'll call this sound **MC12:Matrix Patt1-Stereo Sweep1**:

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					
6	LFO 1	Off	0.0%	Pan	+100.0%

Play and hold a key. The sound is now moving from side to side, speaker to speaker, at a moderate rate. Change pages by touching the **General** tab from the menu bar near the top of the screen. The LFO 1 and 2 parameters will now become available for editing. On the **General** page, LFO 1 and 2 tables of parameter values have the word **Global** in their title as a reminder to the user of how they each function.

There are four parameters for all three LFOs. These are:

Wave, Sync, Phase and Rate Hz.

The values of each parameter for each LFO are currently:

LFO parameters and their current settings

Global LFO 1 [Global page]	Wave	Sine	Phase	0°
	Sync	Off	Rate Hz	4.47 Hz

Global LFO 2 [Global page]	Wave	Sawtooth	Phase	0°
	Sync	Off	Rate Hz	30.00 Hz

Layer LFO 3 [LFO/Matrix page]	Wave	Triangle	Phase	Random
	Sync	Each Note	Rate Hz	4.47 Hz

We shall investigate all these parameters shortly.

Let's change the Rate (or speed) of the modulation. At present LFO 1 is set to a frequency of 4.47 Hz (Hertz). Slow down the Rate to a new value in this parameter field by turning the Tempo/Data wheel anti-clockwise to get the current Hertz display to change into seconds. Try 3.90 s (seconds), play and then hold a key. At this speed it's possible to hear the movement of the Sample Layer from left to right as LFO 1 modulates it. (Using headphones makes it easier to hear this movement.)

Copy this Panflute Sample Layer (Layer to Clipboard) and then paste it behind the first Layer so we have two sound producing Layers. Un-mute this new Layer and mute Layer four which has now moved down one position.

We now have two Layers (1 and 2) with identical programming in each. If you play a key, the sound of both Layers will move simultaneously in the same direction at the same time. That makes sense because we are using the same LFO (Global LFO 1) to modulate them both at the same time. The sound has also increased its output volume after being copied.

Now, in only one of these two Panflute Sample Layers go into its Matrix page and in Row 6 change the last value to read '-100%'. The whole Row should then look like this:

Row	Source	Modifier	Modify	Destination	Depth
6	LFO 1	Off	0.0%	Pan	-100%

This Layer is now 180 degrees out of phase with the other Layer with regard to LFO 1, because the Depth value is negative whereas in the other Layer it is positive. The only difference is the sign value in the Depth column of the Matrix. The effect of this can be a bit confusing to the ear as one Layer will appear in the left speaker whilst the other is in the right speaker; then they both appear together from the middle and then move back out to the edge of the stereo field, again and again. So it's hard to tell that they are actually swapping sides when a key is held down.

To aid in hearing this better, go into the **Sample** page of the Sound Layers and change the Octave up or down of only one of the Sample Layers. Play a key and hold it again. If you still are having trouble, try changing the Sample Sound that only that layer is playing back. The Accordion samples further down the list should help here. Remember that the effect will also be much more obvious if you use a pair of headphones to monitor the motion while trying this.

At this point we now have two Sample Layers, each being modulated in opposite directions by a single LFO (Global LFO 1). The beauty of using this is that if you should want to change the speed of this modulation for both Layers, you need only go back to the General page and adjust the Rate parameter for Global LFO 1 and all the Layers having LFO 1 in their Matrix will change simultaneously. Try adjusting the Rate parameter for LFO 1 while playing and then return to the setting of 3.90 s before continuing with this Master Class.

If you want the Layers to be independent of each other you will need to use LFO 3, because it is Local and modulates only within its own Layer. That then allows you to set the Waveform, Rate, Phase and Sync as required for each Layer individually. That's the difference between the two types, either all layers (Global) or an individual layer or selected multiple layers (Local). You can also use a mixture of both if the programming requires it. The only limit is on how many free Matrix Rows are available to assign your required code routings.

Save this as:
'MC12:Matrix
Patt2-Stereo
Sweep2' in slot
126.

NB: The
'Mutes' do not
save.

Save this as:
'MC12:Matrix
Patt3-Stereo
Sweep3' in slot
125.

While playing with this sound you may have noticed that the sounds are constantly moving regardless of what timing you play your keys in. The sounds are always changing their position because the LFO 1 is cycling on its own without respect for when a key is pressed. Try repeating the same key to help show you this if you hadn't noticed this effect. This brings us onto two of the other available LFO parameters; **Sync and Phase**.

Sync & Phase Options.

Sync

Sync is short for **Synchronisation**. When the Sync parameter states that it is **Off** the LFO(s) in question will start to cycle at their specific rates as soon as the sound is loaded. With **Off** selected, the LFO is completely isolated from any kind of keydown trigger or reset. This is why when we play any keys with this **Off** setting selected, the sound, as in the above case, continues moving between the speakers even if we don't have a key held down. When we play a new key, the sound is placed in the sound field at the appropriate place according to the LFO value at the time.

Sync:
Off

To demonstrate this, let's try a quick experiment. Change the Release parameter on the Envelope page of one of the Layers to a value of 4.01 s. When you play a key, because this Layer has a longer release time than the other layer it will continue sounding in a decaying manner when you release the key. Therefore you will hear the sound of only this Layer continue to move across the stereo image after all the keys have been released from the keyboard. After you've had a play with this, reset the release time to the original setting (48 ms) and continue on.

Sync:
First
Note

Next, let's turn **Sync** in LFO 1 to its next available option: **First Note**. Play and repeat a single key. Now the LFO starts each time from the same place in the stereo field. If you play and hold that key the LFO will continue to cycle on from that point. You can play other keys while the first key is held down and you will not interfere with the cycle that the LFO is currently in. If you then release all the keys and then play another note, the LFO will start back again from the original position. We can specify the start position by using the **Phase** parameter values.

Phase

The **Phase** parameter allows the user to change where in the selected LFO waveform the sound should start from when it receives a keydown/trigger pulse (eg when a key is pressed). Phase is measured using degrees (a small circle °) to the right of its value. Degrees are a measure of angle and there are 360° (360 degrees) in a complete cycle of a waveform. In Sound Factory we can select, only from various offered angles between 0° and 360°, the point from which we wish the waveform to start. Currently 0° is the Phase value, which means the waveform starts from the beginning of its cycle.

Remember that the name of a Sample Layer stays as the original name when replaced by a new sound sample until the new overall sound is saved

At the moment we have the original Pan Pipe 1 * sound on both Layers. Change the second Layer to **Accordion 2x8CH** which is further down the sample list found on the Sample page and, on the Sample page, ensure its Octave is set to zero. The moment you play any key, the Pan Pipe seems to move out from the centre towards the right speaker and the Accordion goes from the centre towards the left speaker. Try changing the Phase values to get an idea of some of the possible places these two sounds could start from within the stereo field.

Save this Accordion-only example as: 'MC12:Matrix Patt4-Accordion1' in slot 124.

If you go to the very end of the available angle values for Phase you find the last one is called Random. This will place the two sound Layers anywhere within the stereo field. Once the key is down the Random value is taken and applied to the Destination selected. The LFO will then continue on from that position with its chosen wave shape as it did with the other examples.

After trying these examples, delete the first Pan Pipe Layer leaving the remaining sample Layer as **Accordion 2x8CH** (though still called 'Panpipe' until you save the sound).

Sync: Each Note

The next option available in the Sync parameter list is: **Each Note**.

With this selected each new key will restart the LFO at the chosen start point in the Phase parameter field (currently Random). Play and hold a single key, then without letting that first key go, add another key to it and then another key and so on. Every time a new key is selected, you will hear the LFO restart from the beginning again. Try changing the Phase parameter again. You will hear the LFO restart from the position specified by the phase parameter that you have just selected.

The three options listed above (**Off**, **First Note** and **Each Note**) are all dependent on using a **Rate** value either based on time measured in seconds or a frequency value measured in Hertz (Hz).

Sync: Tempo

The next two options use the rhythm unit Tempo as the basic computation factor for the LFO Rate/speed. The LFO Rate values change from being either in Hertz or seconds to musical note values for the cycle period (also sometimes called time divisions).

The range of options available is as follows for the **Sync: Tempo** mode:

8/4, 7/4, 6/4, 5/4, 4/4, 3/4, 4/4T, 2/4, 1/4D, 1/2T, 1/4, 1/8D, 1/4T, 1/8, 1/16D, 1/8T, 1/16, 1/32D, 1/16T, 1/32 and 1/64.

Now some of these might appear a little confusing and look like time signatures that can be found in all sorts of written music. But they actually represent time values for the LFO to complete a cycle of its chosen waveform. The capital letters after some of the 'fractions' refer either to dotted (D) time values or to triplet (T) time values, eg 1/8D is a dotted eighth note, 1/16T is a triplet sixteenth note etc.

By having these values available, we can program any of the LFOs to be 'in time' with the rhythm unit. This type of programming has the advantage if you produce a sound that ends up being used in several arrangements. If the tempo is different for each arrangement, the LFOs will still keep in time regardless of the tempo selected; very handy.

Before going any further, please be aware that owing to some system bugs present in this version of Sound Factory, LFOs 1, 2 and 3 behave slightly differently from each other when engaging any of these Tempo based options.

Tempo Modes

Tempo LFO Modes

Tempo + Note

Tempo + Note

This option changes the Rate display into the various musical note time values listed above. With the rhythm unit off, play keys with the **MC12:Matrix Patt4-Accordion1** sound selected, but with the Sync of LFO 1 set to 'Tempo + Note'. Then turn on the rhythm unit and you can still hear the LFO re-triggering the repeat on every key you play, in time.

Tempo + Beat

Tempo + Beat

This is the final **Sync** option. Once again the LFO is in sync with the rhythm unit but there is no re-triggering. LFO 3 ignores this command and behaves as if 'Tempo + Note' has been selected for its sync option. This appears to be a bug, unfortunately.

Let's just try a quick experiment.

Ensure you still have the **MC12:Matrix Patt4-Accordion1** sound loaded and go into the Matrix for the **Accordion 2x8CH** Layer. Change the code in Row 6 to this:

Row	Source	Modifier	Modify	Destination	Depth
6	LFO 3	Off	0.0%	Amp	+100%

So we can appreciate the differences, set LFO 1, 2 and 3's parameters to the following:

Save this example as: 'MC12:Matrix Patt5-Accordion2' in slot 123.

Wave	Sawtooth	Phase	0°
Sync	Tempo + Note	Rate Hz	1/16

We shall use the Matrix to select the different LFOs in turn to compare their effect with each other.

Accordion
note
repeat

Play a key and hold it down. We have created a repeated Accordion note. If you load this sound (**MC12:Matrix Patt5-Accordion2**) into a Total Preset you can change the speed of the repeat by changing the Tempo control of the rhythm unit.

Of course, we could use any looped sample (sustained sound) that is in the Sound Factory database with the above LFO/Matrix formula and the results would be the same, except for the choice of Sample used. If you try this with a Sample that is not looped (a percussive sound), the repeat will still work but only for the duration of the Sample. It will disappear once the Sample has got to its end.

After playing with LFO 3 as a source, try LFO 1 in the Matrix instead. Row 6 code should be changed to this:

Row	Source	Modifier	Modify	Destination	Depth
6	LFO 1	Off	0.0%	Amp	+100%

Save this
example as:
'MC12:Matrix
Patt6-
AccordionRepeat'
in slot 122.

Play and hold a key. Notice that the rate of the LFO cycle has changed: it's become quicker. Try LFO 2 as the source in Row 6 of the Matrix instead and it behaves like LFO 1. In fact it is LFO 3 which is modulating at the correct rate for the parameter value that has been set (1/16). It produces four semiquavers to a crotchet beat. LFO 1 and 2 however produce six semiquavers (sextuplet) in a crotchet beat. There is a bug here as well causing this behaviour. LFO 1 and 2 are reading the wrong value from the value apparently being displayed. Listen carefully to decide which value is best for you when synchronising to Rhythm Tempo.

Jeff's
Balalaika
Demo

Jeff has provided a **Balalaika** demonstration based on this repeating Accordion example. It imitates the way a player produces a continually repeating effect by constantly striking the strings. This is a very useful feature to apply to a number of sounds in the database that would naturally be played this way. Here's how it's done.

Creation of
the Balalaika
Sound

- 1) Load the **Pan Pipe 1 * sound (090-060-019)** into Sound Factory. There are three Layers listed, namely **Panflute**, **Fact – Chorus** and **Fact – Early Reflections**.
- 2) Select the **Panflute** Layer, then go to the **Sample Bank** list and select **Wersi 2** and then from the **Samples** list select **CD-Violin**. This will provide the foundation for our Balalaika sound.
- 3) With the **Panflute** layer (though it is now the CD-Violin Sample) still selected, enter the Matrix page.

Set the Destination of each of the first three Rows to **Off** (as in **Initial Matrix Pattern 1** on page 2) so that they have no effect on the sound. Then in Row 6 in the Matrix enter the following code:

Row	Source	Modifier	Modify	Destination	Depth
6	LFO 3	Off	0.0%	Amp	+100%

This uses LFO3 to vary the amplitude of the sound.

- 4) Enter the following parameters for LFO 3 in the **Layer LFO3** table at the bottom of the Matrix page.

Wave	Sawtooth	Phase	0°
Sync	Tempo + Beat	Rate Hz	1/16

The Rate parameter is set to 1/16 to produce a sufficiently fast repetition.

The Wave parameter is set to a Sawtooth wave to achieve the abrupt reduction in volume necessary to produce a break in the sound between repeats. (See page 9)

Save this
Balalaika sound
as a new User
Sound in your
User Sound
database.

On the WersiClub International website there is an audio demonstration of this sound featuring the song 'Laura's Theme' from the movie Dr. Zhivago. I wonder if trembling hands from the cold weather in Russia helps with this style of playing!

LFO 3 modulating itself

I also mentioned earlier that it is possible for LFO 3 to modulate itself. To demonstrate this, reload **MC12:Matrix Patt5-Accordion2** and add the following new code to Row 5 so Rows 5 and 6 look like this:

Row	Source	Modifier	Modify	Destination	Depth
5	LFO 3	Off	0.0%	LFO 3 Depth	-100%
6	LFO 3	Off	0.0%	Amp	+100%

Save this example as: 'MC12:Matrix Patt7-LFO3 SelfMod' in slot 121.

Play and hold another key and in the Depth column of Row 5, which is set to '-100%', highlight this value (the back ground turns red) and then increase the value gradually until you get to the maximum possible value of '+100%'. Listen carefully to the 'shape' of the repeat change while doing this. At '-100%' the repeat is more 'staccato' like, and at '+100%' it becomes more 'legato' between triggers. This is LFO 3 self-modulating its own amplitude and changing its output shape depending on the settings used in Row 5.

Now remove the above Row 5 code (set Destination to Off).

Accordion Swell, in tempo

Here's another setup for the Accordion that I like to use when it is only accompanying other instruments. This one is based on the idea of imitating the action of the bellows going back and forth when being played as accompaniment without needing to keep making adjustments to the swell pedal to change the volume all the time. Most Accordion players tend to create this effect in time so this is a good candidate for this type of LFO modulation.

Save this example as: 'MC12:Matrix Patt8-AccordionSwell' in slot 120. When you come to delete these temporary MC12 sounds, do not delete this one until you have saved it in slot 127 as 'MC13:Matrix Patt1'

Change the Matrix code of Row 6 into this:

Row	Source	Modifier	Modify	Destination	Depth
6	LFO 3	Off	0.0%	Amp	+60%

Then set LFO 3 parameters to these settings:

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

Now, with the rhythm of your choice activated, play some of your favourite chords. Make sure that the duration of the chords is equal to either two or four beats to hear the effect working. The Accordion will be gently increasing and decreasing its volume in time using the LFO 3, helping to add a little bit more authenticity to the chords when played.

Alter the Depth parameter value (currently +60%) to change the overall effect Depth but try not to overdo it as it can become overpowering when too much modulation is applied in the Matrix, unless that is what you are after. We shall be starting Master Class 13 with this example, hence the renaming recommended in the margin box.

Jeff's Concertina Demo

Jeff has provided a Concertina demonstration based on this Accordion Swell effect. It imitates the way a player can add dynamics to the sound by using the instrument's bellows to vary the volume. This helps to produce a more authentic playing experience. Here's how it's done.

Creation of the Concertina Sound

1) Load the **Diatonisch 1 * sound (090-000-021)** into Sound Factory. There are three Layers listed, namely **Diatonisch**, **Fact – Shelf EQ** and **Fact – Detune**.

2) Select the **Diatonisch** Layer and then enter the Matrix page for this sample.

In Row 6 in this Matrix enter the following code:

Row	Source	Modifier	Modify	Destination	Depth
6	LFO 3	Off	0.0%	Amp	+65%

This uses LFO3 to vary the amplitude of the sound.

Leave all the other Rows in the Matrix as they are, but since one of these employs Aftertouch, make sure that this is not selected (in Selectors) when playing the sound. Otherwise, set its Destination to Off.

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

Wave	Sine	Phase	0°
Sync	Tempo + Beat	Rate Hz	3/4

The Rate parameter is set to 3/4 because the audio demo provided is in waltz time. You will need to set this parameter to match the time signature of the music you are playing.

The Wave parameter is set to a Sine wave to achieve a smooth variation in volume. (See page 8)

On the WersiClub International website there is an audio demonstration of this sound featuring the song 'True Love' from the movie 'High Society'. As you may recall, Bing Crosby and Grace Kelly sang this song out on the open sea, so you might want to steady the boat before reaching for the Concertina!

LFO Waveforms

Wave shape or Waveform selection in an LFO can be very important, as in the above examples. When we set up the Accordion note repeat on page 5 (**MC12:Matrix Patt5-Accordion2**), we used a Sawtooth waveform. If we had used a Sine or Triangle waveform instead we would have ended up with the equivalent of some sort of tremolo effect. Reload **MC12:Matrix Patt5-Accordion2** into Sound Factory and have a play with that repeated note example and also the automatic swell example (**MC12:Matrix Patt8-AccordionSwell**) by changing the Waveform shape to hear what effect each has.

The Waveform list available for LFOs 1, 2 and 3 is as follows:

Off, Constant, Sine, Triangle, Sawtooth, Square, S+H Random, S+H Alternate, Random Drift and Slow Drift.

Let's work through each of these to see what each Waveform offers us.

1. Off

Now this might seem unhelpful as we will only hear the effect of an LFO once it has been routed to a Destination in the Matrix, and we can disable routings easily from there. However, it's also handy to be able to turn off any LFOs at their source, especially if you have several LFO Destinations active within the Matrix at any one time. Also, if you are using more than one LFO you can easily check which LFO is modulating whatever parameter by changing it to **Off** instead of muting other modulations in the Matrix.

2. Constant

This also seems to be an unhelpful option to have here, but it is useful in helping set up modulation ranges. There is an example using **Constant** in Master Class 13 next time, after we have covered the rest of the Waveforms here.

3. Sine

This is the first Waveform that actually outputs variable repeatable values for use in the Matrix. This Waveform can be used for vibrato effects when sent into the Pitch Destination, tremolo effects when sent into the Amp Destination, stereo panning when routed into Pan and filter rotor wah effects when sent to Cutoff. Beware sending this to Reso though that can be used if applied carefully. In general, this Waveform and the next in the list are usually the first choice for any of the above types of modulation unless you are looking for something a bit different.

Save this as a new User Sound in your User Sound database.

Waveforms available to the LFOs

The waveforms Sine, Triangle, Sawtooth and Square are explained in the Appendix to Master Class 11

4. Triangle

This is very similar to the Sine waveform. However, because it does have a point and not a curve at its extremes, it has a more defined change of direction when used. Here is an example.

Reload '**MC12:Matrix Patt4-Accordion1**' and change Row 6 into this:

Row	Source	Modifier	Modify	Destination	Depth
6	LFO 3	Off	0.0%	Pan	+100%

This is very similar to our very first experiment used in this Master Class (page 2, **MC12:Matrix Patt1-Stereo Sweep1**), with only the LFO number changed from LFO 1 to LFO 3 to make it easier to edit the values in both the Matrix and the Layer LFO3 panel as they are both found on the same page.

Set LFO 3 values as follows:

Wave	Sine	Phase	0°
Sync	Off	Rate Hz	1.50 Hz

Play and hold a single key only and listen very carefully to what happens when the waveform gets to the edge (extreme left or extreme right) of the stereo field. To my ear it sounds almost blurred and not clearly defined.

Now change the waveform of the LFO 3 to a **Triangle**. Play the same key and listen carefully once again. This time the edge of the stereo field appears to have a clearer defined limit when it changes direction. Go back and forth between these two Waveforms and really listen to what is happening at the edges: smoothed edge with the Sine, pointy edge with the Triangle. (Try using headphones.)

Once you think you have identified the difference, use the next Waveform available.

5. Sawtooth

Play another single key and hold it down. The sound moves across the sound field and then jumps back to the original starting point and moves across again, and again. Change the Row 6 code to this:

Row	Source	Modifier	Modify	Destination	Depth
6	LFO 3	Off	0.0%	Pan	-100%

The direction of the Sawtooth LFO modulation has reversed.

6. Square

Change the waveform into **Square**, play another key and the sound will jump from side to side only. Square waves produce only two values, '+1' and '-1' with nothing in-between.

7. S+H Random

S+H is an abbreviated term from the days of analogue synthesisers. It stands for **Sample and Hold** and has been very popular with musicians and keyboard players in particular who are interested in electronic music. Jean Michel Jarre, Tangerine Dream, Tomita, and many, many others have all used this process in their recordings. Basically it is a way of being able to generate random values in a time frame of choice or a triggering of choice. Unlike the waveforms discussed already, this will generate an entirely non-repeating pattern.

How this is done in Sound Factory is difficult to determine, but in the old days it would require a varying input which would be sampled at either a specific regular time interval or irregular time interval (a keydown, for example) or possibly both. The value at the sample point would then be stored or held (which is where we get 'hold' from) and then passed on to the Destination as its new modulation value. The whole thing would then repeat each step at a regular rate or be triggered specifically by the player/programmer with a new value sampled and then passed on again.

Save this example as: 'MC12:Matrix Patt9-AccordionStSw' in slot 119.

8. S+H Alternate

This is based on the above idea of producing random values. The difference with this waveform is that it is only every other value that is random. Using the following example, this is a bit like saying every even number will be a random even number whilst leaving the odd number 'one' alone, resulting in something like: 1, 58, 1, 16, 1, 12, 1, 22, 1, 2, 1, 98 and so on.

9. Random Drift

Once again this is based on producing a non-repeating pattern. This time, the values are interpolated. This means that there are no abrupt modulation value changes; they all run smoothly from one to the other or glide into each other. You can hear this if you slow down the rate from 1.50 Hz to 4.78 s.

10. Slow Drift

This is a variation of Random Drift. The random numbers generated with this option appear to use a smaller maximum value range than Random Drift. You could say that Random Drift has a value range of -1 to +1. By comparison, Slow Drift appears to use -0.5 to +0.5. Therefore the change in output value is not as drastic as with Random Drift.

The important thing here is when you decide you need to use one of these options for programming, try them all to see which LFO type and waveform best suits what you are after musically. There are no rules to follow, just what sounds good to your ears and gives the results you require.

In the next Master Class 13 (Summer 2016) we shall continue to explore Low Frequency Oscillators still further. We shall be starting from the **MC13:Matrix Patt1** sound. You were advised in a grey box on page 7, once you are ready to delete all the temporary sounds from this Master Class 12, to rename **MC12:Matrix Patt8-AccordionSwell** as **MC13:Matrix Patt1** and to save it into slot 127 so you can load it instantly next time.

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