

THE ESSENTIAL GUIDE TO...



FM synthesis

Mac PC This month we delve deeper into the world of sound generation with Frequency Modulation synthesis

JARGON BUSTER

► **MODULATOR**
A signal used to rapidly change the frequency of a carrier

► **CARRIER**
The main source signal which is modified by the modulator

► **OPERATOR**
A configured oscillator and its associated envelopes

► **ALGORITHM**
A combination of modulators, carriers and operators

In last month's *Essential Guide*, we looked at how vocoders can be used to combine the characteristics of two input signals into one. This month, we're moving on to Frequency Modulation synthesis (or FM for short) which, as it turns out, has a lot

in common with last month's topic.

When it was introduced by Yamaha in the early 80s, FM synthesis gained a bit of a nerdy reputation and many of the earliest FM synths were simply used as 'preset boxes' as a result. However, this reputation came about largely as a

result of their limited hardware interfaces. Today we're spoiled by soft synths with highly graphical user interfaces, so although FM is more complex than subtractive synthesis, the biggest hurdle has already been overcome for you.

In addition, many popular subtractive soft synths contain elements of FM technology, making this an even more worthwhile subject to get to grips with. In other words, FM is not just for the hardcore synth programmer – read on as we unpack all that FM synthesis has to offer us. **cm**

WITH TODAY'S GRAPHICAL USER INTERFACES, THE BIGGEST HURDLE HAS ALREADY BEEN OVERCOME

FMHEAVEN: THE ANATOMY OF AN FM SYNTH

OSCILLATOR SECTION

This section provides direct access to the six oscillators that drive FMHeaven

MODULATION MATRIX

This parameter grid is used to define how the oscillators interact and modulate each other, or even themselves

VOLUME SECTION

These controls are used to adjust the levels and routing destination of the six oscillators

ENVELOPE SECTION

Standard four-stage envelopes can be used to control amplitude, frequency and filter cutoff

PROGRAMMING TABS

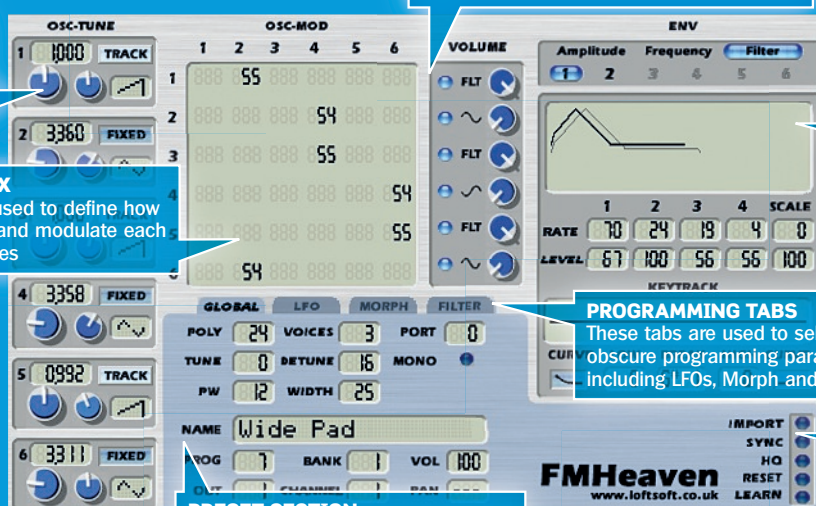
These tabs are used to select more obscure programming parameters including LFOs, Morph and filter controls

CONFIGURATION OPTIONS

These buttons are used to configure the overall behaviour of the FMHeaven synth

PRESET SECTION

FMHeaven comes with a wide range of presets to demonstrate the synth's versatility. Select them here



WHAT IS IT?

As we've already suggested, a parallel can be drawn between FM synthesis and vocoding; both use modulator and carrier signals as a starting point for generating sound. But that's pretty much where the similarity ends. Whereas a vocoder transfers the sonic character of the modulator over to the carrier, FM uses the frequency of the modulator to rapidly change (or modulate) the frequency of the carrier. The end result is a much more complex waveform with far more harmonics than either the modulator or carrier signals alone. This makes FM synthesis particularly useful for producing certain types of sounds (see *What's it used for?* for more on this).

If you've already got your head round subtractive synthesis, you'll probably already be familiar with envelopes and Low Frequency Oscillators (LFOs). The good news is that these concepts are also often used in FM synthesis. In fact, an oscillator can be combined together with an envelope to form an 'operator'. Most FM synths have multiple operators, as interesting sounds often require more than one to reproduce. So, generally speaking, more operators allow for increasingly complex sounds to be synthesized, although there isn't much point in using more than six at once.

WHAT'S IT USED FOR?

Aside from an extricable link to the sound of the 80s, FM synths are well known for their ability to produce bright, metallic 'twang' or 'bong' type percussive sounds. They're good at this due to the fact that they produce a lot of extra harmonics. Taking this idea to the extreme, FM synths can be used to create noise-like sounds – a good starting point for making synthesized hi-hats for example. But with some careful programming, most FM synths can also be coaxed into producing a range of lush, reedy sounds as well – although this takes a little more skill and patience!

Like other synth technologies, FM's become an established part of some music genres; for example, FM basses are popular in dance music.

Believe it or not, you may already be well acquainted with the overall sound of FM; several early generations of Sound Blaster sound cards used a basic on-board FM synth for all non-sample based sound generation. Although the OPL-3 synth was never cutting edge technology, it did prove how versatile FM synthesis was as a sound generation technique.



◀ Awesome: early Sound Blaster cards made use of FM synthesis

HOW DO I USE IT?

There are basically two different ways to use FM synthesis; either as a sound generation technique in its own right, or in conjunction with other synthesizer technologies (such as subtractive synthesis, for example). Pure FM synths generally offer a greater degree of flexibility, but a subtractive synth with some Frequency Modulation capability can provide a more familiar environment for you to get started with.

Broadly speaking, there are three main steps involved in creating a new patch with FM synthesis. The first requires you to set up the oscillators; choosing waveforms, selecting an octave and setting fine tuning. Next, the envelopes for each oscillator need to be defined: these control how the oscillator parameters change over time (typically, amplitude and possibly frequency as well). In the final step, a modulation matrix is normally used to determine how the different oscillators interact and modulate each other. Sometimes it's possible to configure the modulation matrix to make an oscillator modulate itself, often with very interesting results. As ever, experimentation is the key here.

As a final note, it's worth mentioning that some FM synthesizers also offer additional functions – including things like LFOs, filters and effects – which can be used to add variety, interest and impact to a patch.

FIVE TO TRY...

FM7
www.native-instruments.com



Sytrus
www.sytrus.com



DX-10
www.mda-vst.com



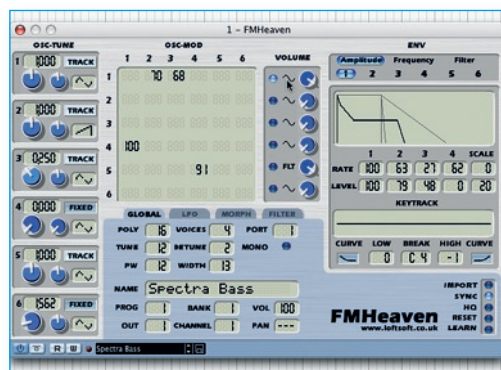
VX7
www.maz-sound.de



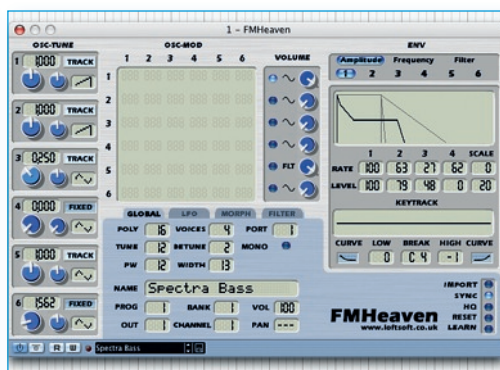
Atlantic
www.rocktave.com



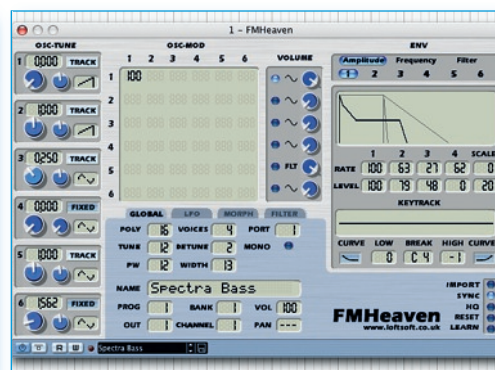
STEP BY STEP FM synthesis in practice with FMHeaven



1 Load the FMHeaven plug-in into your host (www.loftsoft.co.uk). Make sure the **Spectra Bass** preset is selected and deactivate all oscillators except the first by clicking the blue indicators in the Volume section. Click on the FLT button to bypass the synth's filters. »



2 Locate oscillator 1 and click in the waveform box repeatedly until a sawtooth wave is selected. Now play some notes; you should hear a bright sawtooth sound. Next, reset the modulation matrix by clicking on each number and dragging downwards to set the positions to zero. »



3 Set position 1,1 to 100%. We're now using oscillator 1 both as a carrier and modulator; it's modulating itself. Play a few notes – you should be able to hear white noise on top of the saw tooth. Reduce the pitch of oscillator 1 to 0, and you're left with a thick FM hi-hat.