Dave Bellingham
Peter Gorges

Introduction to Additive Synthesis Advanced Sound Design Tips and Tricks

for all models KAWAI K5000

Library Hill



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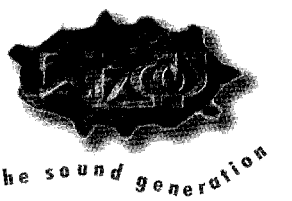
the sound generation

Introduction to Additive Synthesis, Advanced Sound Design, Tips and Tricks

Dave Bellingham
Peter Gorges

KAWAI
K5000

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Imprint

Authors:
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Peter Gorges

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Welcome ...

... to everybody. This WIZOO Guide to the Kawai K5000 series synthesizers was written primarily for those of you who are not new to synthesis in general but lost when it comes to additive synthesis, and also for anyone who would like to take *full* advantage of this extraordinarily powerful and flexible sound engine.

The guide features loads of practical examples, uses and explanations *in a ›real world‹ context* which will make the Advanced Additive synthesis engine both easier to understand and to use.

It is strongly recommended that you are in front of your K5000 with it turned on and hooked up to your PA as many of the explanations are best understood if you can see and hear what's going on.

You *won't* find info on how to use the arpeggiator or sequencer/APG sections in the specific models. This guide is dedicated to using the synth engine, and when we say using, we mean USING.

We're sure that you'll enjoy reading the book. We have put a lot of effort into it in order to make it a relaxed, conversational and humourous thing to read, and best of all, we have literally stuffed it with hardcore insights, tips and tricks you *will* not find anywhere else, no matter where you look ... after all, the last thing you wanted was *another* manual when you picked up your copy, right?

Have fun!

Dave Bellingham & Peter Gorges

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1 Introduction

This section will introduce you to the ›fundamentals‹ that you *need to know* on your way to becoming a programming wizard with your K5000. Some of the things you will learn here are pretty theoretical and you may wonder why we're actually getting you to read them ...

The answer's pretty simple really ... if you don't understand this stuff *now*, you'll be completely lost when we start doing some advanced programming with the K5000 as many of the terms used later are explained in this section.

There's a second reason too ... we have a sadistic streak!

Please load the ALL file included with the disk into your K5000 *now*. It contains all the example patches used in this book.

What is Sound?

You might think this is a pretty dumb question, but many people don't know what sound is ... ready to test *your* theories?

Simply put, sound is created by the movement of air.

All sounds that occur in nature (or elsewhere) are actually combinations of *sine* waves or, if you like, fundamental *tones* plus their related *harmonics*.

For any of you ›purists,‹ the closest ›natural‹—i.e. not synthetically generated—sound to a pure *sine* wave is a tuning fork ... although this also contains some overtones.

If you think of these fundamental *tones* as being like DNA—the building blocks of life ... you can consider them the ›building blocks‹ of sound.

These ›building blocks‹—fundamental *tones* plus their *harmonics*—change over time to create unique sounds ... let's say a dog barking.

›What's so unique about a dog's bark?‹ you're thinking to yourself ... well let's compare the ›woof‹ of a Great Dane to

the ›woof‹ (yap) of a Chihuahua. I'm pretty sure that most would agree that these barks sound different—the larger dog having a louder and deeper ›woof.‹

›So what have dog barks got to do with my K5000?‹ ... well lots, as it happens!

The Great Dane's bark is deeper and louder because of the physical characteristics of the animal. Compared to the Chihuahua, the Dane has much longer vocal cords, a bigger mouth, deeper chest cavity, bigger lungs and a dozen other physical attributes which can alter the depth and volume of its bark. And this is without going into things like being excited about going for ›walkies‹ or chasing a cat.

Fundamentally, however, the ›woof‹ we hear from either dog is made up from various combinations of *tones* or *frequencies* plus their *harmonics* ... it's those building blocks again.

1 To illustrate *frequencies,* play the middle ›C‹ on your K5000 keyboard.

2 Now play the C an octave above.

The pitch of the 2nd note is higher ... in fact it is playing at twice the speed or *frequency* of the first C.

Playing another C an octave above will be playing back at four times the speed or *frequency* of the middle C we started with.

Do you see a pattern forming here?

Going back to our barking dogs, the ›fundamental‹ or base *tone* of the Great Dane's bark is actually a slower *frequency* (and lower *pitch*) than that of the Chihuahua.

So, faster *frequencies* are heard as higher *pitches* and lower (or slower speed) *frequencies* are heard as lower *pitches*.

See ... this stuff isn't so hard ...

What is Synthesis?

In simple terms, synthesis (musically speaking) is the method of combining various elements together to create a sound ... to illustrate this, let's have a look at the word ›chicken.‹

If we were to break this down into its composite parts you would end up with something roughly like this ... CH–I–CK–EN ...

Working with small sections like the above means that you have full control over the individual bits because (as yet) no-one has come up with a method of synthesis which would allow you to create something as complex as speech in one hit.

Among the methods of synthesis which have been used over the years are analog, PCM (Pulse Code Modulation) and of course, additive as well as many others.

- A simple and often used analogy when comparing these methods of synthesis is related to art.

- Analog synthesis and PCM synthesis both use a subtractive method, much like a sculptor would start off with a large bit of rock and chip away (subtract) until the final shape was revealed.

- Additive synthesis is a lot like painting where you blend different colours together to create new hues and then you place them on a canvas using whatever's handy.

- Another term which is related to the PCM method of synthesis (and is also found in the K5000) is Sampling. The K5000 contains a number of samples which are useful for quick patch creation. Using the art analogy, sampling is most closely related to photography where a ›snapshot‹ of a sound at a particular moment in time is recorded and placed into memory.

Analog synthesis at its simplest incorporates three main sections, namely the VCO, VCF and VCA—abbreviations for Voltage Controlled Oscillator, Filter and Amplifier, respectively.

The VCO generates the sound (a simple but harmonically rich waveform such as a *sine* wave, *pulse* (sometimes called *square*) wave or *sawtooth* wave).

The VCF filters and contours the *colour* of the wave which has been sent to it from the VCO.

The VCA is the third component in the chain and controls the volume of the generated and filtered waveform over time.

PCM synthesis works in essentially the same way but substitutes the Voltage control for Digital control of the various sections ... the DCO, DCF and DCA.

The other difference is that instead of using a simple waveform as the starting point of a sound, samples (recordings of real instruments ... pianos, guitars, strings, drums etc.) are used instead.

This method of synthesis sounds *much* more realistic than analog synthesis when emulating acoustic instruments but is limited by the fact that sounds generated in this way sound ›static‹ and have very little movement, if any.

... this is where additive synthesis comes in.

So, what's this ›Additive‹ thing all about?

Additive synthesis is a method employed by the K5000 synthesizers which allows you to combine *tones* and their related *harmonics* together to create new sounds ... more on that in a moment ...

And what about the ›Advanced‹ Additive bit?

The ›Advanced‹ in Advanced Additive means that the K5000 synthesizers, in addition to conventional additive engines, also offer a separate envelope for *each* harmonic.

Colour—Harmonics

Remember our dogs from a page or two ago and the discussion about *tones* and *frequencies*? ... It's time for a new term—›*harmonics*.‹

- The fundamental (or ›base‹) *tone* is referred to as the first *harmonic.*
- A *tone* played at twice the speed (*frequency*) of the first harmonic is called the second *harmonic.*
- A *tone* played at four times the speed of the first harmonic is called the fourth *harmonic.*
- A *tone* played at 64 times the speed of the first harmonic is the 64th *harmonic.*

Once again we have another pattern forming here ... (bet you weren't expecting a maths lesson).

Each of these *harmonics* have a different tonal quality in relation to the *fundamental* (*base*) *tone* and as you build up a patch by adding harmonics, the colour of your sound starts to take shape.

In general, *harmonics* that have a mathematical relationship to each other, such as Octaves, Odd numbered or Even Numbered etc. sound ›musical.‹

A collection of *tones* with various related *harmonics* that change over time are what we perceive as a *sound,* musical or otherwise.

Contour—Harmonic Envelopes

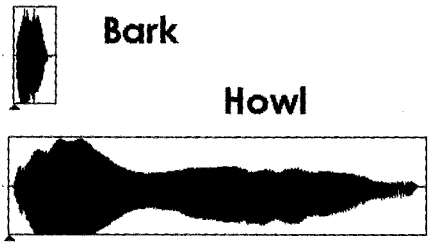
Back to our dogs ... the Great Dane and Chihuahua like to howl as well.

I'm pretty sure all of you will agree that a howl sounds different to a bark (or a yap).

The ›howl‹ is longer than the bark, and usually starts off gradually with a high pitch that slides down to a lower pitch, and then fades out to silence.

The ›bark‹ is short, starts quickly and doesn't vary much in pitch over time.

Check out the diagrams below to see the difference between these two.



The waveform diagrams above only show *volume* differences over time, as well as a comparative length difference. They do *not* show pitch differences.

The images above represent what is known technically as an *amplitude envelope*.

In non-technical terms and using the images as a reference, the ›Howl‹ gradually works up from the left to its loudest volume (*amplitude*) then slowly moves down the longer sustained portion on the right, before eventually fading out to silence. The ›Bark‹ very quickly reaches its loudest amplitude, doesn't sustain much at all and drops to silence almost immediately.

If we were to break down the sounds above into regions over time:

- The ›Bark‹ would have a quick *attack* time, a short *sustain* time and a short *release* time.
- The ›Howl‹ would have a longer *attack* time, a short *sustain* time, a short *decay* time, another *attack* time, a long *sustain* time and finally a long *release* time.
- The terms above ... *attack*, *decay*, *sustain* and *release* are found in the K5000's *envelope* generators.

The *amplitude envelope* allows you to sculpt volume levels of a sound over time.

In the case of the *amplitude envelope* (fancy name for volume control), you can change the various sections of the

sound to make them louder (or softer) and to take more (or less) time to change.

We're in the home stretch with this section ... PHEW!

So far we've covered that all *sounds* are made up of combinations of *tones* with various *harmonics* of different *frequencies* that change over time.

In a traditional synth (*subtractive*) you cannot control which *tones* and *harmonics* are contained in a *sound* as the waveform which is generated by the VCO is fixed. Any *envelope* changes made with this method of synthesis will affect the *whole sound.*

The K5000 allows you to have complete *envelope* control over *each harmonic* (up to 64 per source!!!) within the *sound* ...

In the Additive section of the K5000, the *amplitude envelope* is called the *harmonic envelope* and it is exactly the same thing, just a different name and there are 64 of 'em per source—WOW!

With this level of control, it would be possible to change the Great Dane's ›bark‹ into the Chihuaha's ›yap‹ and vice-versa (oh no ... it's the dogs again!) by altering the appropriate *harmonics* and their respective *harmonic envelope* levels within the *sound.*

Control—Velocity, Controllers

Having a collection of *tones* and their *harmonics* which have each been individually modified by the *harmonic envelope* is all well and good *but ... sounds* that occur in the real world are *not static*!

A number of factors can affect this such as wind, other noise, whether the sound happens indoors or outdoors, how loud the sound is and many thousands of other variables.

To simulate this ›real world‹ aspect of sound, the K5000 has a number of control functions which allow the *harmonic envelope* (and the *tones* and *harmonics* which it is shaping) to respond to input that *you* give it.

Keeping in line with the ›real world‹ theme ... and to illustrate this a little more clearly ... let's take a look at (listen to?) the sound of a Grand Piano.

When the piano's keyboard is struck softly, the amount of energy applied to the hammers which strike the strings is minimal and so the tonal quality of the sound is ›mellow, soft and rounded.‹

When struck hard, the tonal quality of the piano sound is ›bright, loud and sharp.‹

Using the K5000, you have the power to modify the *harmonic envelope* to respond to *velocity* (how hard you hit the keyboard) so that—*as one possible example*—the harder you hit the keyboard the more loudly the *even* harmonics are heard and if you play softly, the *odd* harmonics are more prominent.

Used in this way, the *sound* ›moves‹ and changes in response to your playing style.

Other possibilities and methods of using the control functions to modulate the *harmonic envelope* are through/via the pitch and modulation wheels, keyboard pressure (*aftertouch*) or using keyboard scaling so that the further up (or down) the keyboard you play, the more (or less) the *harmonic envelope* affects the sound.

Complex Changes—The Formant Filter

The Formant Filter is a real ›powerhouse‹ feature of the K5000 and can do some amazing things to your sounds. Technically the filter is not that remarkable *but* the amount of control you have over it, and therefore over your sound, is phenomenal.

In plain language, the Formant Filter is a 128-band equalizer, (see the *Glossary of Terms* on page 135) but there's a lot more to it—think of a 128-band-equalizer that you can run your thumbnail up and down like a haircomb, each tooth representing a frequency and you get closer to the concept of what the Formant Filter can do.

One of the many things that the Formant Filter can do is the emulation of physical characteristics of ›real‹ instruments, such as the length and body of a flute or radical sweeps across the frequency spectrum resulting in pseudo-melodies.

Here is a simple example of what the Formant Filter can do:

1 Load up ›StageMk1‹. StageMk1—A003

2 Press the EDIT button.

3 Press the 05 button in the Sound Select section of your K5000.

4 Press the L1 button.

In the resulting Window (the DFL Editor) you will see ›GEQ, Band, Level & Bias‹ listed on the right.

5 Press the R4 button.

6 Use the dial to change the Bias from 0 up to 63.

At (or near) 63, the sound should change to a very sweet ›bell-like‹ electric piano ...

This is only an introduction to, and a *very* simple example of, what the Formant Filter can do ... but we promise that it will get a lot more ›in-depth‹ in the next few chapters.

So ... there you have it!

From here on in, we'll concentrate less on the theoretical and more on the practical aspects of programming the K5000.

From time to time, there will be some technical/theoretical bits, and maybe the dogs will make a cameo appearance or two, just to help out ...

Once you've got the hang of it, you'll find the Advanced Additive synth engine both easy to use and unbelievably powerful ... and you will be creating new and unique sounds well into the next millenium.

OK—onto the next chapter ... is your propeller-hat on?

2 K5000 Programming Tutorial

This chapter is all about ›how to‹ program a patch using the K5000 in simple terms. In the next few chapters we'll take a more ›in-depth‹ look at the actual synthesis functions covering both their practical application—what they do to your sound—and also the technicalities if you're a propellerhead.

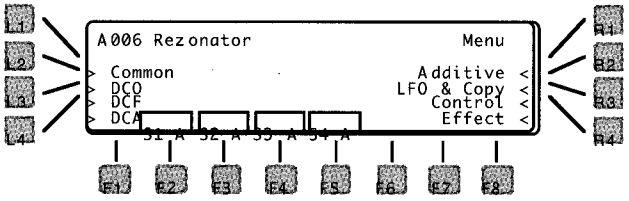
First step

There's no point in swimming the English Channel if you can't tread water, so if you haven't read the manual and don't know how to choose banks/patches, write patches and select parameters in the various edit windows, then go and read it *now*. When you're done, come back and we'll let you play.

'Ere, this all sounds a bit common ...

Select the ›@Vocoder‹ patch and press the EDIT button.

@Vocoder — A040



The K5000 Main Menu

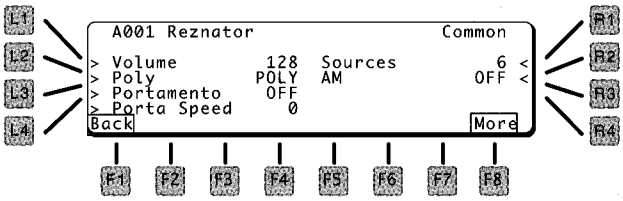
Note that this patch uses *two* sources which can be seen just above the F2 and F3 buttons.

Press the F3 button once so that the display changes from S2 P to S2--. You have just muted the second *source* in this patch so that we are now left with a single source which can be heard. To unmute this *source*, simply press the F3 button once—but leave it alone for now.

► The six *sources* can be muted/unmuted in this way.
P = a PCM source
A = an Additive source

Press the L1 (COMMON) button and press the F8 button on the ›name‹ page which will take you to the display shown below.

Adjusting the Volume using the dial will result in the patch being louder or softer. Try it.



Pressing L2 to select Poly allows you to use the dial and change the patch to play polyphonically or monophonically. Give it a try as well.

The next two functions are linked, so that Porta Speed will have *no* effect unless Portamento is ON.

Turn the Portamento ON, and change the Porta Speed to 115.

Now, select and change the Poly value between the 3 choices and play a couple of notes at least 2 octaves apart on the keyboard.

You'll hear how the note glides up or down and how the Poly value affects the way this sounds and responds ... this stuff is great for those phat & fonkee Chicago house bass sounds.

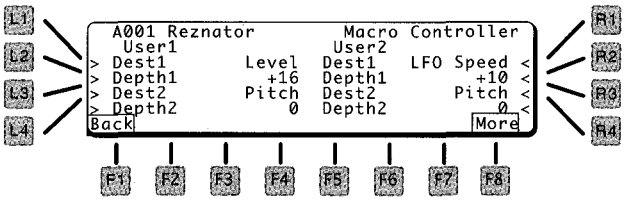
Also on this page is the Sources parameter, which allows you to define the number of sources available to the patch if you want to add other sources to the existing two. You can

also reduce the number of sources available to the patch to conserve polyphony.

The last parameter available is the AM (Amplitude Modulation) which we don't regard a very powerful tool—it's more like a concession to K4 and K1 owners.

► We think AM was important on the old K-synths as they had no other creative options to really change waveforms. On the K5000 there are so many better ways to shape your sound, so why bother about AM?

Pressing the MORE button will take you to the next page



This page and the pages that follow (keep pressing F8) is where you set up your patch Macro and footswitch controllers which are discussed at length in *Adding Realtime Control* from page 101 onwards. The Macro controllers are available on the K5000S or by using the MCB-1/10 with the K5000R/W.

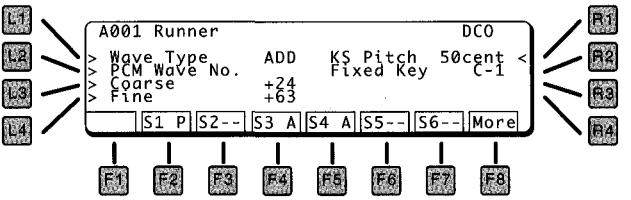
Using these four controllers, you can simultaneously adjust *two* discrete parameters with each knob.

The DCO—what's it all about?

Reselect the Vocodor Patch—don't save any changes when prompted.

The pic below shows the DCO page which you can get to by pressing EDIT/L2.

The DCO page



Press the F2 button once, so that the ADD source is muted, then press the F3 button twice—once to select the PCM source, and once to unmute it.

If you play a key or two, you should hear a kinda metallic raspy sort of sound.

Press the L2 button to select the PCM Wave No., and change it to 398. You can repeatedly play a note on the keyboard as you're doing this and hear the raw PCM waveforms that are in the K5000.

Now use the Coarse Tuning and change the value to –12.

You should be hearing a sawtooth sound—kinda like an old analog synth.

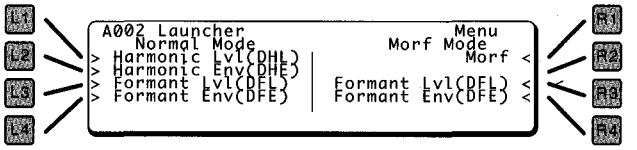
Congratulations—you've now mastered the selection and tuning of raw PCM waveforms in the K5000.

Setting relative levels between sources

As we're still playing around with our new sawtooth sound, unmute source 1 by pressing F2 and have a play with the keyboard.

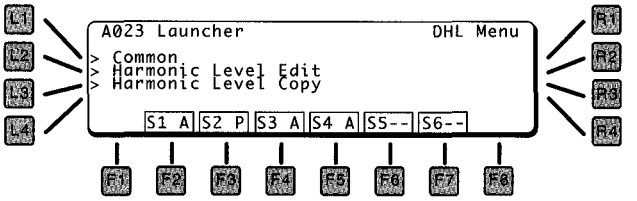
The ADD source is pretty loud in comparison with the sawtooth sound, huh?

To change this, return to the main menu by pressing the EXIT button, and press the R1 button—make *sure* that source 1 is selected before doing this.



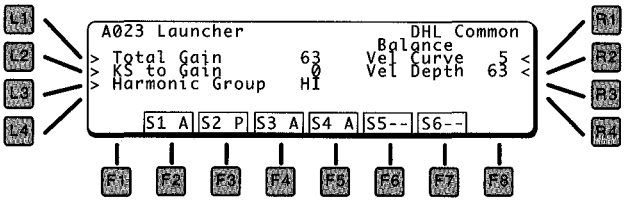
The Additive Synthesis Menu

Press L1 which will take you to this screen.



The Digital Harmonic Level Menu

... and then L1 again which will show you the screen below.

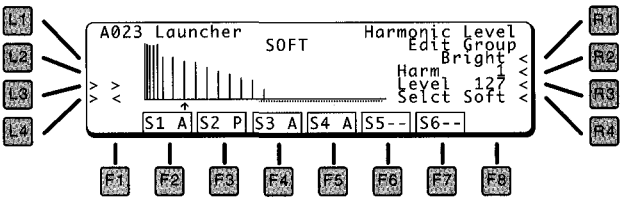


Select and change the total gain from 63 down to a level that you're happy with (we like 45 as the balance between them)

And we thought DHL was a courier company...

If you haven't changed anything, press EXIT/L2.

The Harmonic Level Edit window



1 Press R4 and use the dial to change the value from SOFT to LOUD.

2 Press the R1 button and use the dial to scroll through the values available in this Edit Group parameter, and while you're doing this watch the display below the vertical lines in the onscreen ›ramp‹ where you will notice the ›dots‹ changing.

   These ›dots‹ indicate the individual harmonics in the various groups—select ›Oct‹ and you'll see that the 1st, 2nd, 4th, 8th, 16th, 32nd and 64th harmonics are selected. Select 5th and you'll see that the 3rd, 6th, 12th, 24th and 48th harmonics are selected.

   These harmonics are tuned to the selected interval above the *fundamental tone* that we talked about in the introduction chapter. Remember the mathematical relationships between harmonics stuff?—Octaves, 5ths, even, odd etc.—this is it in practice!

3 Select 5th and play a note on your keyboard and hold it down (use your sustain pedal if you have one).

4 While the note is sustaining, press R3, and dial like crazy to the left to change the level of the 5th group. You'll see it graphically changing on the display.

5 Now dial to the right and as the onscreen ›bars‹ get up towards the top of the ramp, if you keep on dialing they continue and you should slowly hear the 5th harmonics become audible.

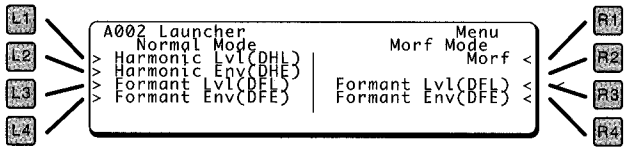
6 Select the Oct group and do the same thing.

Apart from giving your dialing finger a great workout, you have just covered almost all there is to know about the selection of harmonics and altering their volumes in relation to each other—well done!

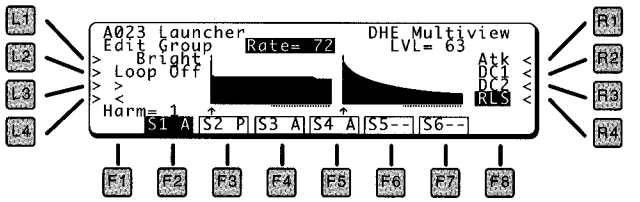
Creating harmonic contours—groupstyle

The grouping used in the DHL section has been carried over to the DHE (Digital Harmonic Envelope) to assist you in *quickly* putting a patch together.

Provided you haven't changed anything, press EXIT twice and you'll see the following screen.



Press L2, and on the next screen press L1—Harmonic Envelope Multiview, which looks something like this.



The Harmonic Envelope Multiview—allows you to see all harmonic envelopes

Notice the Edit Group parameter on the left hand side?

This works just like the one in the DHL, so you can scroll through and check them out using the dial.

1. Select Oct.
2. Press the R1 button and the Rate value is highlighted. Turn the dial to the left and you'll see that all of the Octave harmonics in the block change.

On the right-hand side, you will see Atk, DC1, DC2 and RLS. These are the various sections of the envelope that can be adjusted in the DHE Multiview and can be selected individually by pressing the R1—R4 buttons.

For now, however, we'll simply concentrate on the Atk (Attack) portion of the sound's Octave harmonics.

1 Change the rate to a value of 84 and press the R1 button. Notice that the LVL is now highlighted.

2 Change this to a value of 20 and play a key or two on the keyboard and hold it down. You should hear the Octave harmonics slowly fade in after a short period.

► The R1 button in this page accesses *three* discrete parameters. It will toggle between Rate and LVL if Atk is selected. If the Atk parameter is *not* selected, then you need to toggle the R1 button to either Rate or LVL (whichever you want to adjust) *before* you select DC1, DC2 or RLS.

We recommend using groups as often as possible. The alternative of building harmonic by harmonic, envelope by envelope is certainly possible, but is extremely painful, slow and it is *very easy* to forget exactly what it was you originally set out to create.

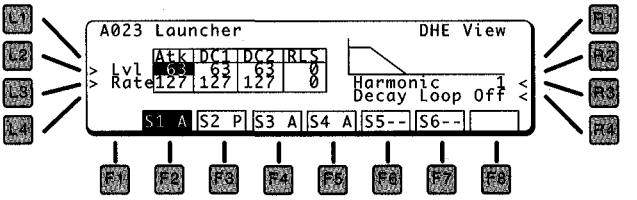
Using the DHE Multiview in this way allows you to quickly set up an ADD source with a group of harmonics that fade in or out etc. in the same way.

This is a great way to quickly put together a patch, but if you want to sculpt the sound further—the control freak in you takes over—it is possible in the next area we'll take a look at.

Harmonic Contours for surgeons

As we're still in the DHE Multiview window, press EXIT and then L2.

This is the DHE view window where you can individually adjust the envelope shape for each harmonic.



Press R3 and use the dial to scroll through the individual harmonics.

Note that for harmonics 1 and 2, the Atk LVL and Rate are 20 and 84, respectively. Harmonic 3 has Atk LVL and Rate of 63 and 127, harmonic 4 has 20 and 84 and so on.

The changes that we made in the DHE Multiview Window are reflected here and are related to the harmonic series we covered earlier for Octave harmonics. (1st, 2nd, 4th, 8th, 16th, 32nd and 64th ... remember?)

1 Select harmonic 1 and press the L2 button. Now use the dial and see what happens to the attack portion in the graphic in the top right of the screen.

2 Use the L2 and L3 buttons to step through the options in the chart and change the values so that they read as follows:

LVL	15	63	48	0
Rate	84	71	102	127

3 Now press the R4 button and change the value from OFF to LP1 and play a key on the keyboard.

You should hear the 1st harmonic start cycling after a short period creating a sort of pulsing sound which underpins the sustained stuff.

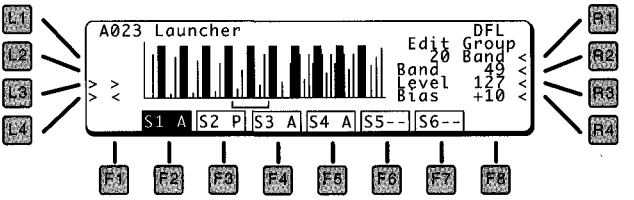
This cycling/pulsing thing is actually the 1st harmonic's envelope looping over the first down ramp you can see in the graphic. This is possible for every harmonic in your sound if you wish for those ›Aliens from Zarg‹ patches.

So there you have it!

Fun with Formant Filters

Now let's get into the real *fun* stuff... press EXIT twice to get back to the Additive Menu and select the DFL (Digital Formant Level) by pressing L3 and then L1.

The Formant Filter Level Edit page



1. Press the R1 button and change the value to GEQ, but first have a quick scroll through the options.
2. Press the R2 button and change the value to 91.
3. R3 ... and the winning value is 99.
4. Finally press R4, play and hold a note on the keyboard and go berserk with the Bias control.

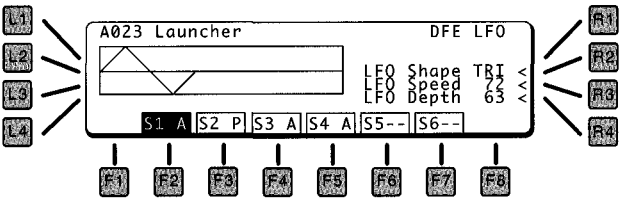
Note that while you're doing this, the PCM source is unaffected. The Formant Filter *only* works on ADD sources.

1. Change the value to 20 Band
2. Band to 38
3. Level to 127 and mess around with the Bias.
4. Play around with the values ... particularly the negative values, and if you hold down a chord and *slowly* dial through the values from around –4 to –30 you will hear a sort of melody start to happen.

Wouldn't it be *great* if you could automate that melody thing! As it happens—you can.

1. Set the BIAS to –28 and press EXIT twice.
2. In the ADD menu, select Formant Env—L4, and then R2.

The DFE LFO Edit page



In the DFE LFO page, change the LFO Shape to TRI, the LFO Speed to 17 and the LFO Depth to 34.
Now play a note and hold it down ... pretty wild, huh?

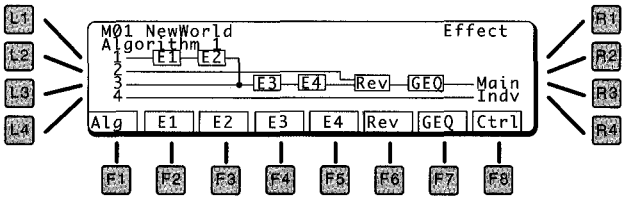
What is actually happening here is that the 20 Band Formant Filter that we set up a little earlier is now having it's Bias position (center frequency) swept up and down the harmonic group (WAVESET) by the LFO (Low Frequency Oscillator). As this Bias changes, the Formant Filter which can be customized to enhance particular frequencies, is moved as a whole.

The Formant Filter can be modulated in other ways or just left static, it's up to you, so experiment—you can't break anything.

Remember how this patch started out? (a vocal pad)—we think by now, you're starting to get an idea of how flexible the ADD engine is, and we haven't even got to the effects section yet.

Love and Fxion

Press EXIT three times to get back to the main menu and press R4.



The Effects Routing Page

Press F2 to select the effect.

1. Press L1 and change it to Phaser 2.
2. Press L2 and set your DRY/WET balance to 33/67
3. Speed to 33
4. Depth 75

5 Predelay to 100
6 Feedback to 67

Press F3 to select the second effect and change

the Type to TAP Delay 2
Delay level to 100
Delay Time 1 to 150mS
Tap Level to 80
DLY Time 2 to 250
Feedback to 76

This patch is also set up to be routed via the other FX busses as well, but we won't bother with them too much at this stage.

From here, you can adjust the F6 and F7 parameters to change the Reverb type and amount for the entire patch (this will affect *all* sources) and the 7-band GEQ which also affects the entire patch.

Play the keyboard—we'd only suggest a single note or two and listen to the big, constantly moving and dizzying mess that the patch has become.

If you like, you can run through the tutorial again, but this time don't use our settings—choose your own. Remember, you can't break anything, so experiment!

We did the overkill on the FX for two reasons. Firstly to show you how much power the FX processor has and how easy it is to *overdo* it. The second reason is to display the true nature of the K5000. This patch is only a *two* source patch and yet it fills most of the harmonic spectrum making it difficult to put in your drums, bass, pianos etc.

There are some things we *didn't* cover in this chapter, which we'll get to later on ... for now, it's coffee break time!

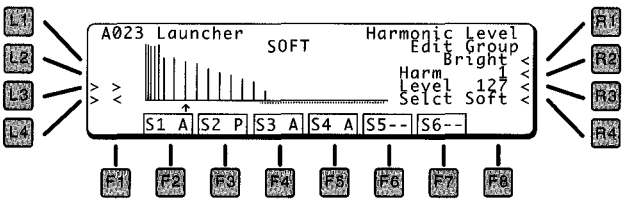
See you in the kitchen. If not, see you next chapter!

3 ADD Synthesis Blocks

This chapter is a relatively hardcore one where we'll take a good look at the synthesis functions of the K5000 without repeating the manual, except where we felt it needed a little clarification. Some things here are conceptual and are designed to make you think about new ways of using your K5000. We'll assume that you know how to get around after reading the tutorial and your manual, so there's no ›press this, dial this‹ stuff here.

How to make use of the DHL Groups

This section looks at the various harmonic groupings and explains what type of things they do to your sounds. You'll find them in the DHL page—Harmonic Level Edit Groups.



The DHL Edit Window

Try them out using the ›WizooIni‹ patch.

WizooIni —A001

1 Select an Edit Group

2 Change the LEVEL with the VALUE dial.

BRIGHT

This group of harmonics is the upper 32 in your waveset and is the ›top end‹ of your sound. Increasing the LEVEL with this setting will make the upper harmonics louder in a proportional scale, with the 64th harmonic gradually changing

BRIGHT—A014

more quickly to become the loudest and the 33rd harmonic being the softest. If you continue to increase the level, this scaling becomes less pronounced until all upper harmonics are of equal value.

You can reduce aliasing by setting the 64th harmonic to a value of Zero. A smoother way of accomplishing this is by using a positive value for KS to Gain in the DHL Common Page.

► You can use BRIGHT to soften or brighten the sound. Be especially careful with the latter—always check by playing on the upper half of the keyboard. With all high harmonics fully turned up, aliasing is very likely to occur.

DARK

DARK—A015

The lower 32 harmonics of the waveset and is the ›bottom end‹ of your sound. Adjusting this will make the lower harmonics louder in a proportional scale, with the 1st harmonic being the loudest and the 32nd harmonic being the softest, as with the BRIGHT group. If you continue to increase the level, this scaling becomes less pronounced until all lower harmonics are of equal value.

ODD

ODD—A016

These are the ODD numbered (1, 3, 5, 7 etc.) harmonics in the waveset.

You can adjust the EVEN/ODD balance for all ADD sources by using the EVEN/ODD knob on the front panel.

Increasing the level of the ODD harmonics makes the sound more ›hollow.‹ This is ideal for creating a ›woody‹ sound and you should use lots of odd harmonics when creating clarinets and oboe-ish sounds. All harmonics are changed by the same amount and this is true for all of the following groups as well.

EVEN

EVEN—A017

The EVEN numbered harmonics in the waveset (2, 4, 6, 8 etc.). Adjusting the EVEN harmonic level will make the sound more nasal or brassy. Ideal for strings and brass.

OCT

This group adjusts the OCTAVE harmonics above the fundamental (2, 4, 8, 16, 32, 64). This is great for adding overtones to your sound and adds an organ like quality. Also useful for bell sounds.

OCTAVES—A018

5TH

Like the octave group, the 5th harmonics are those above the fundamental tone and are again great for organ and bell tones.

5THS—A019

► By starting from Zero, then consecutively selecting OCT and 5TH and setting all harmonics of these groups to FULL level, you have the makings of great Organ sounds—at the very least, you won't have to ever search for ›footages‹ (pipe lengths) ever again!

ALL

Adjusts ALL harmonics simultaneously by the same value.

► You can easily add more bottom end to a spectrum by lowering the overall level with ALL, then select EACH and increase the 1st, 2nd and 3rd harmonic levels to higher values. This obviously works in reverse for thinning out a spectrum as well.

EACH

Allows you to control the individual level of each harmonic in the waveset. This is extremely powerful, but we recommend that you initially set up a basic spectrum using the other groups, by copying DHL sources from other patches or by using a SoundDiver template. Following this, use EACH for fine tuning the spectrum.

Be careful when changing harmonic levels, especially in the lower area (up to 7th harmonic) as a slight change can alter the tonal character of the spectrum completely.

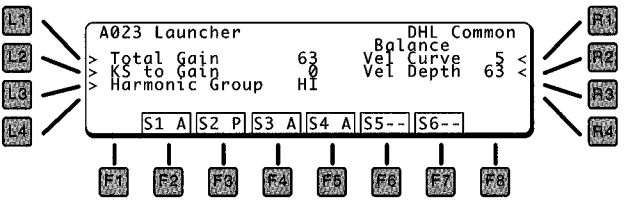
Use 'em

Using the groups and adjusting them as groups is the most efficient way to generate new sounds from scratch. Once you're getting close to an approximation of what you want to end up with, you can adjust harmonic levels individually if you wish.

Controlling the entire DHL made easy

The DHL Common section allows you to adjust the entire volume level of the waveset, retaining all proportionate relationships between harmonics.

The DHL Common Window



Additionally, in this section, you can control how the DHL responds to the keyboard scaling, or in other words, you can set up the DHL to get gradually louder as you play towards the treble end of the keyboard and softer towards the bass end of the keyboard, as one example.

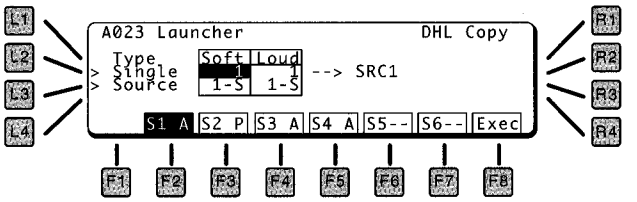
VELCURVE—A020

There are a number of velocity curves available which are graphically displayed in the K5000 manual and SoundDiver. These affect not only the DHL, but also the DHE and DFL areas as well.

The Velo Depth parameter in the DHL common page gradually sets the velocity controlled blend from Soft to Loud.

Velocity curves are a great ›trick‹ for changing the way a patch responds, and therefore, the way it sounds, very quickly and easily.

Controlling time using Harmonic Envelopes



The DHE Multiview window—allows for ›group‹ editing of harmonic envelopes.

The Digital Harmonic Envelopes (DHE) are edited in much the same fashion as the DHL and feature the same ›groups‹ which allow you to adjust mutiple harmonics simultaneously.

Be careful with the DHE LEVELS as their direct relationship to the DHL LEVELS can alter the tonal characteristics of your source. Use the DHL levels for building spectrums as they are more precise.

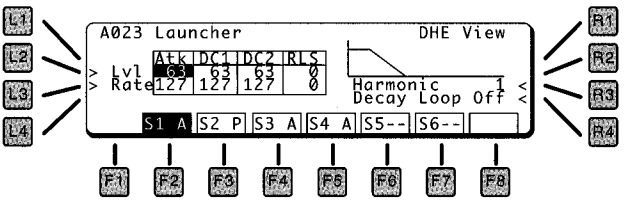
► It makes sense to have a group of harmonics, such as 5ths or octaves responding in the same way as these grouped harmonics share the same tonal character. If these harmonics have the same envelope shape, then their impact as a group will be much more pronounced than if an individual harmonic fades in or out at a particular point in time.

DHE WAVE—A021

Be aware of the fact that the envelope LEVELS directly correspond to the Harmonic Levels—each envelope level adjusts the corresponding harmonic level. For example you could set all harmonics to full level and then create a blend between sawtooth and square by setting these ›waveforms‹ in the DHE levels.

Adjustments to individual harmonic envelopes will make subtle differences to the sound and this precision and finesse is the beauty of the Advanced Additive synth engine.

The DHE View allows you to adjust harmonic envelopes individually.



No other synthesis model gives you such precise control over sound in time. The drawback, however, is that harmonic envelopes require a *lot* more effort to program, so we recommend taking the following approach:

- If you want to create a fast and simple ›color‹ envelope over time, use the DCF and it's envelope.
  If you need detailed control over groups of harmonics, use the DHE instead of or in combination with the DCF.
  Work in small increments and constantly check as you're doing this.

The DHE, like the DHL, also features the ability to copy an entire DHE from one source/patch to another which is obviously a great shortcut (Additive: DHL Copy).

Featured in SoundDiver (which will be covered in more depth later on) is the ability to use envelope templates, much like using the DHE copy function. This allows the general envelope shape of a piano sound—short attack, long sustain, medium release—to be quickly applied to a vocal sound or another sound you may create. Likewise you could use a string envelope—long attack, long sustain, short release—on an electric piano sound allowing you to ›bow‹ your synthesized Rhodes.

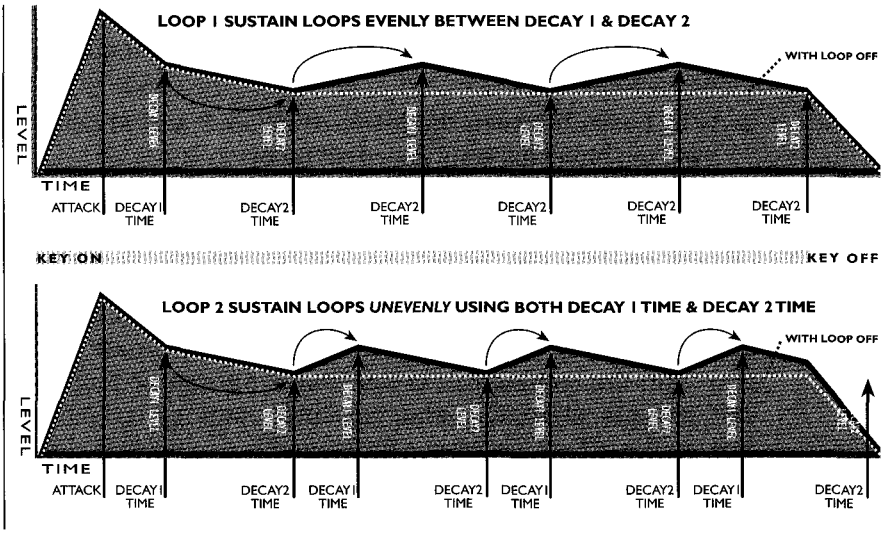
As you can see, the DHL/DHE combination both work in a very similar fashion with common methods to both. As a pairing they allow complete control over the overall level and levels over time of *each* of the 64 harmonics available in a source.

DHE Loops—Perpetual motion

One of the problems with any method of synthesis is that sound is not constant and if it is, it becomes real annoying real fast—despite the modulation in pitch, our personal tolerance for car alarms is about 10 seconds—how's yours?

A major complaint that people have about samplers is that they sound ›static‹ and your ear/brain combo will eventually start perceiving loops in the sample. At this point you recognize the sound as being synthetic or just plain boring and many of us tend to ›shut off‹ or go do something more interesting. Having said this, we're gonna talk about loops in the K5000.

Where this differs from a sampler is that sample loops cycle over a portion/portions of the *entire* sound. The K5000 DHE loops cycle over a portion of one or more harmonics contained in the sound, with the length and shape of the loop being different for each harmonic if you wish.



DHE Loops can be used over different portions of each harmonic envelope.

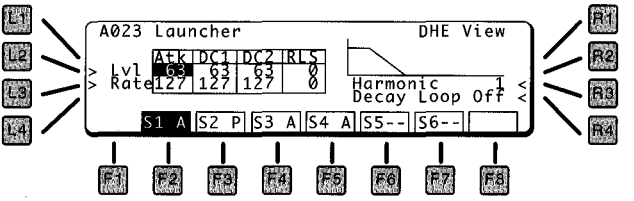
DHE LOOP—A022

Remember that there are 64 harmonics, each capable of having it's own envelope, so having two or three or 30 harmonics all with their own loops will create a sound that seems to be endlessly moving.

This will eventually cycle and the ear will eventually pick this up, but it will take a lot longer than recognising the same thing in a sampled loop. Many will *never* hear it.

This totally discounts other modulation possibilities from the LFO or Formant Filter sections which we'll get to shortly.

The DHE looping parameters can be found in the DHE view.



There are basically three settings—OFF, LP1 and LP2.

- OFF– If this needs explanation you really shouldn't be anywhere near a piece of sophisticated electronic equipment like a K5000.
- LP1– Loops between the levels of DECAY 1 and DECAY 2. It uses the envelope time specified by DECAY 2
- LP2– Loops between the levels of DECAY 1 and DECAY 2. It uses the envelope time specified by DECAY 1 *and* DECAY 2, first using one, then the other.

Judicious use of the DHE looping parameters can really add a lot of life to any sustained pads that you may create. Going nuts with the looping can create some ›out there‹ sounds or can emulate chorusing and ensemble settings, which can free up the effects processor for something more useful, particularly when using the K5000 multitimbrally.

Formant Filter—the blade of the sound butcher

In the words of the K5000 manual; ›*The K5000's Formant Filter is a 128-band graphic equalizer, which can be used to create additional additive effects.*‹

This is not the whole truth—in fact, it's not even close. The Formant Filter (FF) is a set of 128 bands in intervals of one semitone.

When set neutral, which means the BIAS value is set to Zero and there's no influence of any envelope or control, the 64th band exactly matches the first harmonic of the note C3 (60). Accordingly the 76th band matches the second harmonic, the 88th band the 4th a. s. o.

► Check out ›@Clustaz,‹ a patch which demonstrates this.

@Clustaz—A005

The Formant Filter works in a fashion similar to a graphic EQ which has 128 bands. But the special capabilities of the FF come into play when you move the filter laterally (sideways) by changing the BIAS value by hand, wheel or envelope.

This is what distinguishes the FF from an EQ and makes it the most sophisticated synthesizer filter available (in our humble opinion). You can literally draw a lowpass with three peaks, a flanger or the Manhattan Skyline.

Like the DHL and DHE there is a copy parameter which allows the copying of one Formant Filter from any patch to another patch.

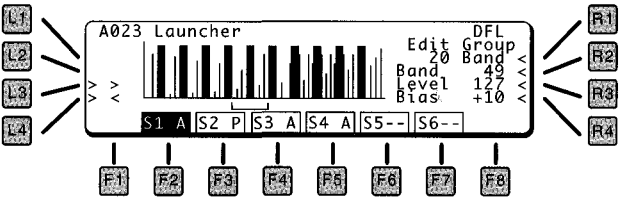
Peter has programmed a whole bunch of templates which you will find in SoundDiver for the Formant Filter which do some crazy things to the original sound, without touching any other parameters—but more on this later.

Formant Filter Nuts and Bolts

The Formant Filter shares some programming traits of the DHL and DHE in the form of groups of *frequencies*, not harmonics, as in the other sections.

The frequency distance between two harmonics in a DHL spectrum depends on their position. The distance between two FF bands is always one semitone.

We won't go through FF bands individually as they are covered by the manual and the concept of selecting a specific frequency or group of frequencies for global adjustment is exactly the same in practise as with harmonics in the DHL and DHE.



The GEQ band setting has a special feature which allows it to gradually change the band levels. You can use this to create smooth holes or peaks in the filter shape.

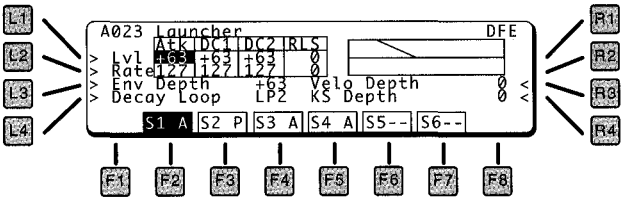
- The BAND control is just like a rubber band and the Formant Filter is like a comb. To lasso more ›teeth‹ on the comb, you simply stretch the band—to select less, you stretch it less. The BAND control effectively defines the range of frequencies spanned (number of ›teeth‹) which can then be adjusted using the LEVEL control.
- The LEVEL control adjusts the amount of formant filtering—how much the Formant Filter affects the sound—within the range defined by the BAND control.
- The BIAS control adjusts the entire Formant Filter by shifting the center frequency up and down the entire range of frequencies.

Keeping the Formant Filter under control

As there is one Formant Filter available to each ADD source in your patch, you may want to keep these bad boys in check. This is where the DFE—Digital Formant Envelope—comes to the rescue. Think of it as your very own zookeeper who keeps your animal filters in their cages and stops them from being unleashed onto an unsuspecting pair of ears or worse yet, your $ 5000 speakers.

The standard complement of envelope controls is here allowing you to shape the movement of the bias parameter

over time. There is also an envelope depth function which determines how much the envelope actually affects the bias.



The DFE Envelope Edit allows precise control over the FF.

Additionally there are controls for looping, which are just like the loops available for the individual harmonics in the DHE section we covered above.

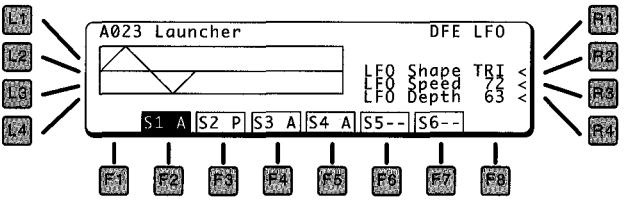
With these, you can control the FF to cycle over a particular section of the envelope that say ... pumped a range of frequencies for a second and then almost completely shut down for those ›door's open, door's closed, door's open/closed and there's a really loud party on the other side‹ sounds.

Actually the LFO mode is nothing more than a simplified, looped envelope preset.

Velocity Depth allows you to control how much the filter envelope will affect the bias based on how hard you play the keyboard. This parameter is affected by the Envelope Depth parameter—i. e. if the envelope depth is set to Zero—no effect—then it won't matter how hard or soft you play. Similarly, the KS Depth parameter will have no effect if the Envelope Depth parameter is set to Zero.

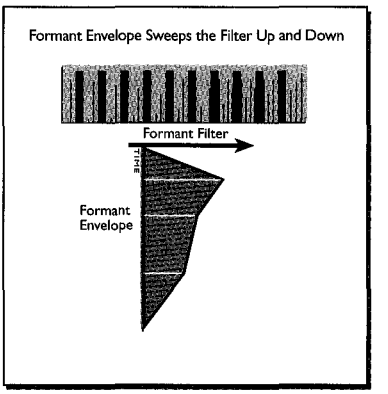
The KS Depth parameter allows you to control how much the filter envelope will affect the sound based on the pitch of note played. This is directly related to the DHL Vel Curve and KS to Gain parameters.

Last, but not least, and a personal fave is the ability to set the FF envelope to LFO mode.



MelMaker—A010

Using this allows the entire FF to be modulated in amazing ways—a great patch to check out is ›MelMaker‹ which shows this in all it's glory, and if you followed the tutorial, you would have seen this in action already.



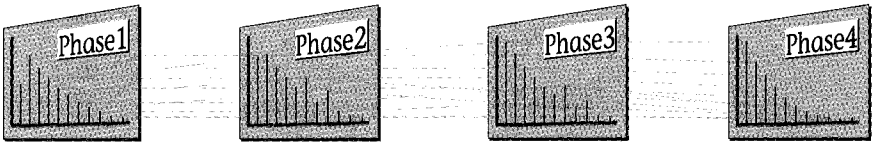
The MelMaker patch is a classic example of the FF being swept up and down by the Formant Envelope.

Morf's Up—the quick and easy approach

You've probably seen Terminator 2 with big Arnie and that liquid terminator—remember the guy who was a floor, then a knife, then frozen etc.? If you've seen it, you'll remember how he seemed to just melt into whatever he chose to.

This was quite a blast at the time and used a technique called ›video morphing‹ which is pretty lame in these days of living, breathing dinosaurs, but it's still a cool flick and we still dig the SFX.

Kawai had a great idea—with focus on the impatient and the newbies—to include exactly the same idea into the K5000—only using sound, not video images, to ›morph‹ into each other.



Using Morf mode, there are six potential sources in *each* patch in your K5000—not including Loud and Soft variations. Given the fact that you can combine everything with everything there's literally millions of combinations already available in the patch memory of your machine.

Read the manual regarding Morf mode and have a good play with this. we think the manual explains the functions reasonably well, but doesn't explain why you would want to, and the number of possibilities afforded by morfing sounds.

For you serious programmers, invest your time in other areas of the synth. Morf mode is fun but the results are generally unspectacular.

If you want to create ›Pro‹ patches, then Morf Mode is *not* for you, but if you just want to have a bit of fun, or are looking for a really quick solution, then give it a whirl.

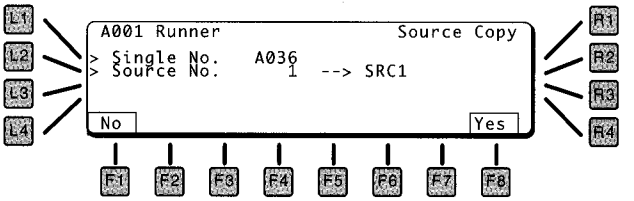
Using the Copy functions

You may think that a copy function isn't that exciting, and you'd probably be right. Having just read the ›potential of Morf mode‹ stuff, however, the copy functions may now be a lot more interesting because, like morf mode, you can copy any source from any patch to any other patch. This opens up millions of instant possibilities, however—as it always is in life—only a handful of them may yield exciting results—it's a matter of taste.

In the tutorial chapter, you learned how to mute/unmute sources so that you could listen to them in isolation. When

isolated, you can hear the portion of the entire sound that you like from your favourite six patches and combine them into one superpatch.

The Source Copy Window



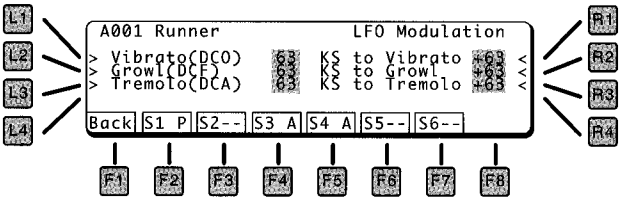
Utilising the copy functions in all areas of the K5000 is a great idea. If a professional programmer or yourself has programmed an envelope template or waveset, a Formant Filter setting, a modulation routing or an effects combination that is just *great*, then there is no reason not to make use of it as a basis for your own experiments.

If you consider that every waveset, envelope etc. that you or someone else has set up is a template which can be used in another patch, then you already have thousands of templates for all sorts of jobs in the factory patches.

As pointed out earlier, if you have a ›template‹ which is not perfect, but pretty close to what you want, then copy it and carry out some small adjustments.

The LFO—your third hand

The LFO Modulation page



The LFO in the K5000 can be used to modulate pretty much everything in a number of different ways, so the description

in the manual which says that it can be used to ›give vibrato and tremolo effects‹ doesn't really do it justice.

The ability to set a delay time on the LFO is great if you're standing on stage playing a screaming solo and using the pitch bend wheel, but you need modulation to ›kick in‹ at a particular time in the sound.

LFO FADE—A023

Other great features are the ability to set the LFO up to respond to how hard or soft you're playing or to where on the keyboard you're playing—bass or treble end.

► For more info on the LFO refer to *LFOs—simple, but there's a catch ...* on page 57.

4 Programming with PCM Sources

As you've no doubt discovered, the K5000 features a whole bunch of PCM samples which add ›spice‹ to ADD sources and can be used as the basis of a patch in their own right.

The downside to using PCM sources is that many of the wonderful features, such as control over individual harmonics and Formant Filtering which are available to additive sources are simply not available to the PCM synth engine.

The K5000, on this level, is much like many other subtractive synthesizers on the market. The bonus of the effects processor and additive sources, however, end any comparison.

Subtractive Synthesis

As briefly touched on in the introduction chapter, subtractive synthesis is a lot like sculpture. Harmonically rich waveforms such as SAWTOOTH and SQUARE waves are gradually cut away to reveal the ›Venus de Milo‹—your sound.

In the K5000's case, these ›harmonically rich waveforms‹ are actually 123 PCM samples. (recordings of acoustic instruments and other sounds stored in computer memory)

Any of these samples can be used alone or combined with one or more of the *six* sources available in a K5000 patch. Each PCM source can then be individually ›sculpted‹ to form part of, or an entire, sound.

A rose by any other name ...

Analog synthesizers feature analog components throughout, and these days many of the ›analog‹ synths you see in music technology magazines are partially under digital control or are completely digital but sound and, in some cases look like, analog synthesizers of the 60's and 70's.

The fundamental theory and methods of subtractive synthesis are still the same some 35 years down the road, so even though some of the names have changed—like VCO has become DCO—... a rose is still a rose.

Let's take a look at the individual sections of a subtractive synthesizer following the signal flow and the choices available in the K5000.

► We won't spend too much space and time on this issue. Analog or subtractive sound programming is pretty simple and obvious. You'll find it on billions (well a lot anyway) of conventional synthesizers and there's heaps of books (take a look at the WIZOO Library Hill). As the subtractive portion of the K5000 is not the exception from the rule, we decided to keep this chapter short and give more focus to the hardcore ADD stuff.

What is the DCO?

The Digitally Controlled Oscillator is the ›voice box‹ of any synthesizer and actually generates the sound. In analog synthesizers its pitch was voltage controlled (VCO) and its waveforms were generated by analog circuits.

The subtractive synthesizer on the K5000 uses the PCM synthesis method—you will find some ›analog‹ waveforms in the PCM Wave-ROM as well—and the subtractive portion of it is available to ADD sources too.

What is the DCF?

The Digitally Controlled Filter is used for colouring and contouring the sound generated by the DCO. The filters literally ›filter‹ out frequency ranges so that you are left with the portion of the sound that you want to hear. The interesting thing about these filters is that a control source—like an envelope, velocity or an LFO—can make the filter cutoff frequency move, thus creating changes of the sound color over time.

Traditional analog synthesizer filters come in two flavours—LOW PASS and HIGH PASS—which as you might expect, allow the LOW and/or HIGH frequency ranges to ›pass.‹

DCF LOPA—A024/
DCF HIPA—A025

► You can even bypass the whole DCF by setting its mode to—Bypass (bet that was a surprise!)—but we won't recommend doing so even with ADD sources. It's always good to have the DCF ›smooth out‹ the very high frequency range a bit.

DCF filtering can be quite brutal to your sound as it can clear large chunks in one hit—no comparison to the fine, detailed changes available with additive harmonic levels.

As always in life there are two sides to the coin: Techno ADDicts use the filter distortion for basslines and distorted drum sounds. This is the reason why the Kawai engineers didn't implement an autobalance for resonance and DCF level.

You can make the DCF effect even more pronounced by using resonance. Be careful when turning up the resonance value because it adds to the overall source level, high resonance values (above 4) are very likely to cause distortion

You can balance the reso effect by lowering the DCF level value. Our rule of thumb: for every two steps you increase the resonance decrease the DCF level by one.

Both the subtractive *and* additive synthesizer engines of the K5000 can use the DCF section, the ADD section can get by without it, but the PCM section really *needs* it.

DCF RESO—A026

DCF Tips

- On instrument sounds—whether natural or electronic—always let the DCF cutoff be controlled by velocity and key tracking. Velocity gives you a better overall feel and key

tracking provides a balanced sound character throughout the entire keyboard range.

- You will need to experiment with the Velo to Cut and the Velo to Env parameter to find the right balance. Always give a bit to the Velo to Cut parameter (+10 at least) and add the envelope to it. As a good guide: The lower the sustain level (Dcy2 L) of the DCF envelope, the higher the direct envelope depth, otherwise the velocity would not affect sustained notes.

FF—A027/FILTER—A028

- Make heavy use of the DCF only on PCM sources. Its your only sound shaping tool—apart from effects, that is. When creating ADD sources, your preference should be the use of harmonic envelopes and the Formant Filter. In fact the Formant Filter can easily and completely simulate the DCF, plus a whole lot more.

How about the DCA?

DCA stands for Digitally Controlled Amplifier and is the part of the synthesizer that controls the volume of the sound or *sections* of the sound over time.

In the K5000, both subtractive and additive sources can use the DCA.

The subtractive engine relies entirely on the DCA for it's overall envelope shape whereas the additive engine is *far* more accurately shaped by the DHL and DHE.

We suggest the use of the DHL and DHE to set the volume *differences* between harmonics and the use of the DCA to shape the overall volume envelope for the *entire* source.

In most cases this is the best solution in addition to being the easiest and fastest way.

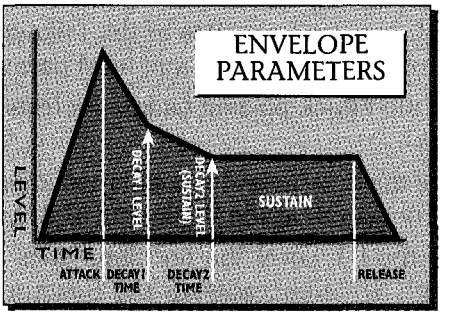
► The DCA envelope offers a few functions not available to the DHE. You can—among others—control Attack, Decay and Release times by key tracking, controllers and velocity. We recommend you make use of these features in addition to the ADD envelope parameters as

this gives you even more realtime control and expression to the overall sound.

Envelopes—a simple guide

Each of the sections in a subtractive synthesizer features envelopes which control different aspects of the sound over time.

To offer detailed control over the shape of the envelope, it is broken down into segments, each consisting of a TIME and a LEVEL parameter. Most envelopes are more or less broken down into these four segments:



- ATTACK—This is the beginning of a sound. The attack parameter can shape the start of a sound to respond in different ways so that—as examples—string sounds slowly fade in and piano sounds are heard as soon as you strike a key. Adjusting the attack to a longer time could be used to make the piano slowly fade in.
- DECAY—After the attack portion of a sound has been completed, most naturally occuring sounds dip slightly in level which is what the decay parameter deals with.
- SUSTAIN—This is the body of the sound and is usually the longest part. In the case of a piano sound, after the initial keystrike and the brighter and louder decay portion, the

resounding string tone takes over—this is the sustain of a piano.

- RELEASE—This is the portion of the sound that fades away to silence. This fade can be quick or slow.
- Collectively the envelope is often called the ADSR—each letter signifying the first letter of each sound section—Attack, Decay, Sustain, Release.
- In the most popular analog ADSR envelopes, the four parameters were even more restricted to Attack Time, Decay Time, Sustain Level and Release Time. No Attack Level, no Decay Level. As this envelope concept is easy to program yet not very flexible, many digital synthesizers—including the K5000 series—offer some extensions. In the K5000 each envelope consists of the following segments, each offering a separate time and level parameter:

  A This is the attack portion as known from the ADSR envelope.

  D1 This is the first decay. You will most often use this for little clicks or plucks at the beginning of the sound.

  D2 From the D1 Level the envelope goes on to the D2 Level, which is comparable to the Sustain Level of the ADSR-Envelope
- Look at the table below—it allows you to compare the different K5000 envelopes with each other and with the ›analog‹ ADSR.

	Attack		Decay		Sustain		Release	
	Level	Time	Level	Time	Level	Time	Level	Time
conventional ADSR	0	yes	–	yes	yes	–	0	yes
Pitch Env	yes	yes	0	yes	0	–	–	–
DCF Env	0	yes	yes	yes	yes	yes	0	yes
DCA Env	0	yes	yes	yes	yes	yes	0	yes
DHE	yes	yes	yes	yes	yes	yes	yes	yes

	Attack		Decay		Sustain		Release	
	Level	Time	Level	Time	Level	Time	Level	Time
DFE	yes	yes	yes	yes	yes	yes	yes	yes
Parameter Name in K5000	AL	AT	D1L	D1T	D2L	D2T	RL	RT

When designing envelopes for a synth the developers always have to find a compromise between flexibility and ease-of-use. Well—at least one thing is for sure: Note volumes have to start and end at Zero level, so this is fixed. But sound colour and separate harmonics can start and end wherever you want. Be aware that the K5000 envelopes offer you unrivalled flexibility in controlling sound over time and velocity. The best thing: You *may* use it, but you don't have to.

The most flexible envelopes are located in the ADD section—Harmonic Envelopes and Formant Filter Envelope, the least flexible envelope is the Pitch Envelope.

As each part of a subtractive synthesizer—DCO, DCF, DCA—does a different job, many synthesizers have a separate envelope for each of these sections to achieve more control over the sound. This is how they affect the K5000 sources:

- The envelope in the DCO controls *pitch* changes over time.
- The envelope in the DCF controls *tonal* changes over time.
- The envelope in the DCA controls *volume* changes over time.
- The envelope in the DHE section controls volume changes for *each harmonic* over time (ADD sources only)
- The envelope in the DFE section controls the FF BIAS value over time—again: ADD sources only.

LFOs—simple, but there's a catch...

The LFO section of the K5000 is pretty easy to understand, yet offers some features you won't find in any other synth's LFO.

Do we have to mention that the Waveform parameter controls the shape of the modulation, that sine creates vibrato or square plays a ›trill‹ when applied to DCO pitch?

You know this already?

OK, let's take you a step further and have a look at a really fun feature: The Delay and Fade In.

Let's say you want the LFO to create kind of a rotating effect—like a Leslie speaker cabinet, for example. Simply put, you *can* achieve this by applying the LFO to Pitch (just a bit), DCF Cutoff (a bit more) and DCA Volume (quite a bit).

Lets say you're the demanding type of person. You want the rotation to smoothly blend in when the note is held, and you want it to accelerate over time.

The rotor in a Leslie cabinet is a horn that rotates—for those of you not familiar. This means that sometimes the outlet of the horn points towards you, sometimes away from you, and most of the time it's in-between. The horn position affects the pitch (something like the sound of an ambulance-coming towards you-and-going past-effect), the sound color and the volume.

We admit this sounds difficult to replicate,but look at the following to see how easy this is to achieve with the K5000's LFO:

SmthWssn — A011

Select the ›SmthWssn‹ patch.

Waveform	Tri	smooth rotation shape
Speed	95	end speed of the fast rotation
Delay Onset	0	delays the LFO, not needed here
Fade In Time	46	Time from almost no rotation to full speed and rotor
Fade In to Speed	63	amount of change to the Rotor speed over the Fade In Time
Vibrato	6	a little pitch change
Growl	17	some more color change
Tremolo	23	plus volume change

Try this with two sources slightly detuned and LFOs out of phase (use Delay Onset to offset them against each other)—and there you go with a nice Leslie simulation.

Programming can always be that easy with a little imagination and a creative approach instead of boiling your brain-cells with technical BS.

We can only encourage you to think creatively: K5000 synthesis requires an open mind.

A Subtractive Session

OK—let's put some of that subtractive synthesis power to work. We strongly advise that you follow the steps. This way, everything should be pretty clear as you work your way through.

This is a totally subtractive patch with the added bonus of effects. Dave was messing around with a sort of J. M. Jarre ›Magnetic Fields‹ track and came up with this patch as a result in a couple of minutes.

Magnetic—A006

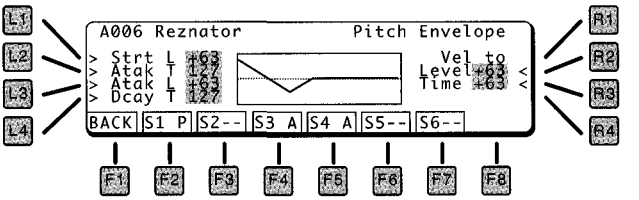
The patch is extremely responsive to touch with the filters opening and closing in response to velocity. The harder you hit, the faster the filter envelopes attack. It is also useful as a fat bottom-end pad and can be used as a ›house‹ lead sound.

Now let's mess around with it a bit.

DCO Functions

The tutorial section covers the selection and tuning of PCM waveforms, so we won't double-up here. Take another look at this chapter later if you like.

1. Press EDIT / L2 and then F8 (MORE).
2. Make sure that S1 is selected and is showing S1 P.
3. In the Pitch Envelope window change the STRT L to +63 and Atak T to 67.



The DCO Pitch Envelope adjusts the pitch of a PCM source over time.

Play the keyboard and listen to what's happened.

Congratulations—you have just adjusted the Pitch Envelope. Let's take it a step further.

1 Change Atak L to –28.

2 Ensure that Dcay T is set to 64.

Play the keyboard again. That's attack and decay mastered!

If you like, you can play with these settings a little further on your own to get a better ›feel‹ for what's going on.

Also in this edit window is the Vel to Level and Time parameters. Change the Time value to +57 and you'll get a really clear picture of what this does as you play a note on the keyboard at different velocities. Do the same with the level parameter.

PITCHENV—A029

Remember that *each* source can have different tunings and pitch envelopes. You can also set up each source to respond to velocity in different ways.

DCF Functions

Get out of EDIT mode by pressing EXIT a couple of times and press F8 when prompted to save or quit.

Magnetic—A006

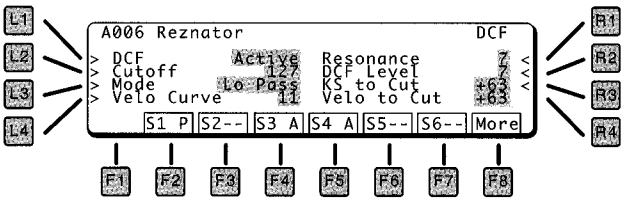
Ensure that ›Magnetic‹ is loaded.

1 Press EDIT / L3

2 In the DCF window, mute source 2 by pressing F3.

3 Press L1 and turn the dial to Bypass

4 Play a couple of notes on the keyboard and then turn the dial back to Active and play a few more notes.



The DCF Window

There's quite a bit of difference between the bypassed and filtered signals ... but not enough!

1. Press L2 and use the dial to adjust the Cutoff from 0 to 127—while you're doing this, repeatedly play a note on the keyboard.
2. Reset it to 31 when you're done.

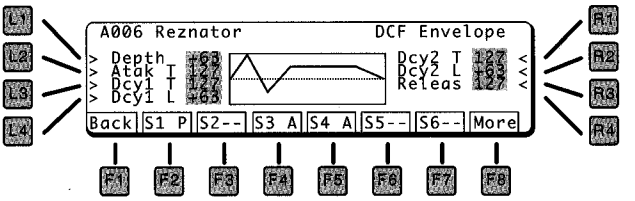
This function ›cuts off‹ the frequency range at a particular point allowing you to shape a more muffled or brighter sound.

1. Now press L3 and use the dial to change the filter from Low to Hi pass and play a few notes.
2. Reset it to Lowpass when you're done.
3. Select the Velo Curve and change the value, trying a few out by playing the keyboard across the *entire* range. This parameter adjusts how the filter responds to *where* you play on the keyboard—i. e. are you playing bass or treble notes.

Time to introduce the nasty little monster of the K5000—filter resonance. This control, when coupled with the Cutoff function does savage things to your sound, your hearing, your speakers and causes the dog to run away—pausing on it's way out to bite you for being such a bastard!

We cannot emphasize this enough—use caution with this parameter—it's *great* if you're into this sort of thing but the K5000 filter is *very* capable of damaging your hearing and your speakers—*no joking*!

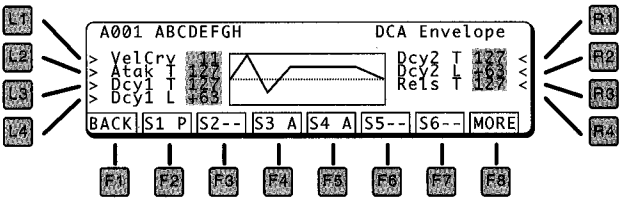
The DCF Envelope View



The DCF Envelope is marginally more sophisticated than the DCO envelope, but the concepts of the ADSR are the same. The only difference here is that your are controlling the *colour* of the sound over time—or more correctly, the filter—not pitch as you were with the DCO envelope.

DCA Parameters

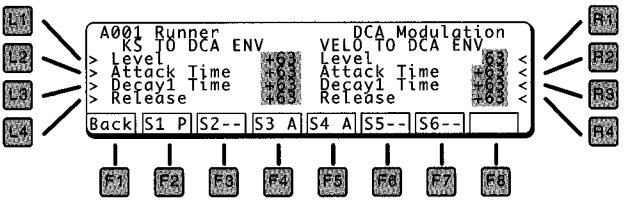
The DCA controls the volume of your entire source over time.



This is the master VOLUME envelope for the entire sound. You can, as with the DCO and DCF, control individual sources with their own ADSR.

The combined output of the original signal generated by the DCO and filtered by the DCF is sent to the DCA. If part of your sound is too loud or soft or takes too long to ›get going,‹ then the first port of call should be the DCA.

The DCA can be modulated by velocity and keyboard scaling.



Leslie

Does this sound need a Leslie? If so, try the option explained above.

Other cool subtractive options

The K5000 has a number of great effects and modulation features which are discussed in the Effects and Modulation chapter—surprise, surprise.

These can be used with any source be they additive or subtractive.

The other great bonus is, of course, additive synthesis.

So if you've got an ›analog‹ headspace—you have this to add ›spice‹ to your subtractive sounds.

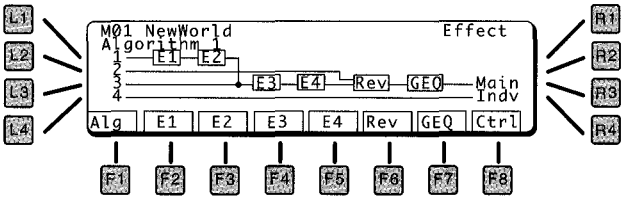
5 Effects and Modulation

The K5000 features an extremely powerful effects processor which sounds great and is a vital component of the Advanced Additive synth engine.

The manual offers a reasonable description of the parameters available for each of the algorithms, so we won't replicate this information, nor will we cover different settings for ›Coliseum‹ or ›Whitehouse‹ reverb or ›Spawn of Satan‹ distortion patches—there are many other books dedicated to this sort of thing—take a look into WIZOO's Library Hill program. Rather, we'll concentrate on some of the routing practicalities, shortcomings and creative control options available.

In addition, there are a number of flexible source routings for modulation of ADD and PCM sources, filtering and effects. We'll cast an eye over these as well.

Effects Processor rules of thumb



The Effects Page

When used on a single patch, each *source* can be routed to a different FX bus.

Utilize the difference in effect routings for creating completely new patches. Combine a phasing string pad with a ensembled choir patch or try the originally clean guitar signal with a wall of overdrive.

When used multitimbrally, each *sound*—an entire patch—can be routed to a different FX bus. This may, and in all likelihood will, radically affect the sound of the patches used. This is a double-edged sword as sometimes it sounds great and sometimes ... well it doesn't!

► Like all the best things in life, effects are best used in moderation although it's fun to indulge occasionally. Add effects after setting up the rest of your patch. The best way to do this is by using an ›initialized‹ neutral patch with all FX disabled. This will assist you in creating a patch which sounds strong without FX—if and when you decide to add them—look out!

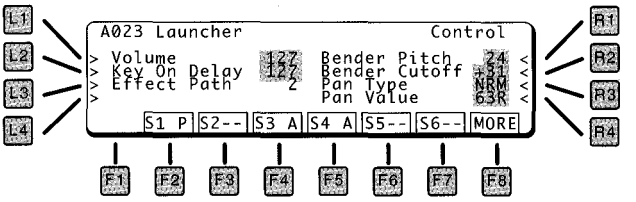
The effects processor can seriously ›blow out‹ the harmonic levels of your patch resulting in aliasing or other unwanted artifacts.

The other advantage is that when used multitimbrally, patches with minimal effects sound pretty much as they should in the overall mix.

Add effects *after* you have set up your DHL, DHE, DFL etc and DCO, DCF, DCA in your additive and subtractive sources.

When programming your patches, use the Effect Path parameter in the Control pages to choose the effects bus INPUT for each source.

The Effect Path parameter routes the currently selected source to any of the four inputs (buses) in the effects section.



Effect Routing—potential pitfalls

The flexibility of the onboard FX processor allows you to route the four ›effects units‹ into others in series or parallel. While there are no absolute rules about what effects you should or shouldn't route into other effects, there are some factors which you should be mindful of:

- Some effects, like phasing or distortion, can add a *lot* of gain and emphasis to particular harmonics resulting in your original sound being unrecognizable.
- This extra gain can blast your eardrums and the speaker membranes into the rear wall of your studio.
- Again with the gain. If the level coming *out* of one of your ›effects units‹ is too hot going *into* the next processor, you can easily introduce distortion or aliasing even if you're using ›nice‹ effects like reverbs and delays.
- Routing chorus into delay is *not* the same as routing delay into chorus. The results are *completely* different.
- Logically *plan* your effects routings, pausing for a moment to consider what each effect will do to the sound although if you're only going to swap the chorus and delay around, you shouldn't spend too much time concerning yourself with this. Remember that once a sound has passed through one processor, the output from that processor is *summed*—is a combination of the sound *and* the effect—and is then passed onto the next processor in the chain. This summed effect will, in general, be, louder and will enhance certain frequencies in the original source.
- The global REVERB which follows the four ›effects units‹ can be used to enhance the overall ambience of the sound. It can also destroy any of the subtle delay and chorus effects you may have set up in the DHE or the four preceding effects. Add it *after* you have set up the other FX and only if your patch ›needs‹ it. The 7-Band graphic EQ which is the last ›effect‹ in the sound signal flowpath also has the ability to destroy any subtlety you may have programmed into your patch. It's useful, however, for ›less than perfect‹ listening environments and for circumventing some technical issues with the K5000's output stage—see the Tips and Tricks chapter.

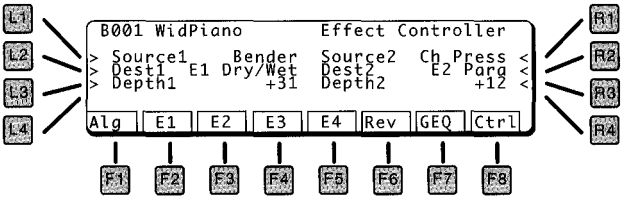
Realtime Effects Control

The effects processor, like other sections of the K5000 synth engine, can be manipulated in realtime using a variety of controllers such as the mod wheel, aftertouch and many others.

CONTROL—A030

You can access these via the effects control page.

The Effects Control Page



While it's possible to do, we don't recommend putting all of your eggs in one basket. Assigning your various destinations to different controllers is a better bet.

As other parts of your sound can also be controlled using the same modulation sources, such as your mod wheel, aftertouch etc., it is possible to assign *both* effects and synthesis parameters to a single control source.

As an example, you could assign the effect depth, the balance between two sources and the speed of the Formant Filter LFO to *one* controller such as the mod wheel. One roll of your thumb and your patch would go nuts!

GospelOrg—A031

Take a listen to the ›GospelOrg‹ patch and use the mod wheel to change the Rotary effect speed. This is a great example of how to use the effects control parameters—sensibly.

When and where to use FX

Sometimes it's smarter and easier to use the FX processor than to do a whole lot of programming to achieve the same or similar results. It's also smarter at times to use one type of effect over another to achieve a particular ›sound‹ which is appropriate to the type of music/playing style of your tracks.

First off, we'll take a look at where the K5000 FX processor has a bit of a weakness. The global reverb which runs across

the entire mix is not a particularly great reverb and doesn't offer enough control to really tailor the sound given it's location in the signal path. You may get better results with external processing—more precise control, more headroom and ›shimmer‹—if you have a superior external effects unit.

Another shortcoming is in the absence of compression and gating types of algorithms although similar effects can be obtained by clever use of the filters (including bandpass effect) and envelopes.

- Delay FX—The K5000 delay algorithms are quite good and there's a good range of them for different jobs. Let's take a look at where you may be able to use specific algorithms more effectively than others.
- TAP DELAYS have two discrete delay times which can be set. The advantage of using this delay type is that really irregular beating patterns can be created by changing these times. If you control these in realtime, you can create those ›trippy‹ effects used on the dancefloor to simulate pushing ahead/pulling behind the beat with a sequenced or arpeggiated riff.
- SINGLE DELAY offers really precise control over the timing of your delays and is ideal for effecting sequenced or arpeggiated material that requires perfect synchronicity between the original and effected signal
- DUAL DELAY pans incoming signals hard left and right, regardless of incoming signal and uses two discrete delays so you can get effects which bounce from speaker to speaker.
- STEREO DELAY retains the pan position of the incoming signal and sounds full and rich—the Rolls Royce delay.
- CROSS DELAY bounces each repeat of the delayed signal from speaker to speaker. The effect is quite different to the Dual Delay.

- AUTO PAN constantly moves the signal from one side to the other of the stereo field. Useful on sustained pads and on some more staccato sounds like electric pianos for creating ›movement‹ in the sound.
- Chorus FX—Chorus effects are slightly detuned signals which are summed with the original signal and are useful for ›thickening‹ and ›warming up‹ the sound. They are great on strings and pads, electric pianos—in fact anything that sustains. Used in conjunction with a simple DCF setting, you can save hours of programming time by taking the ›edge‹ off of hard digital sounds like raw DX-ish electric piano sounds.

Use of the chorus can save programming time on single or dual source patches. You can even save sources and voices by simulating the effect of two detuned sources by using one source and the chorus.

Engage—A004

1. Load ›Engage‹ and open the Effects Edit page—EDIT/R4.
2. In here, select E1 and change the Dry/Wet balance to 100/0.
3. After playing it for a short time, change the effect to Chorus 1 with the following settings:

   Dry/Wet= 0/100
   Speed= 3
   Depth= 100
   Predelay= 0ms
   Wave= TRI

This adds a subtle but noticeable difference to the ›fullness‹ and motion of the sound. Experiment with the following effects using this patch if you wish. Remember to set the Dry/Wet balance to 0/100 and Depth parameter to 100 if applicable to the effect.

- FLANGING is a different type of chorus effect which slowly or quickly moves the detuned signal out of phase with the original signal resulting in a sound which has a ›cyclic,‹ ›whooshing‹ quality to it, formerly called ›jet effect.‹ The

main difference between Chorus and Flanger is that the Flanger feeds the effect signal back to the Flanger Input (Feedback). The higher the Feedback amount, the more cutting the Flanger sound appears. Hard to describe but it sounds great on electric pianos, clavinets and on synthetic string pad sounds. The more percussive the sound you use the Flanger on, the less delay time you should use unless you want to create doubling echos. Don't use it on any ›real‹ string emulations as it will instantly make them sound synthetic.

- ENSEMBLE effects are great for ›real‹ string and pad sounds or sounds with a slow attack and long sustain. The ensemble effect is actually three out of phase chorus effects which create a really rich sound. The reason why ensemble works so well on string sounds is because the phase correlation between the choruses changes but the detuning doesn't, unlike flanging type effects. Avoid using ensemble on sounds with a quick attack such as electric pianos. Ensemble is Peter's favourite effect on additive sounds as it gives even single metallic sources a ›richness‹ that he regards one of the strongest points of the K5000.
- CELESTE, which is also a three phase chorus is great on electric pianos because the phase correlation remains constant but detune rate and time can be changed.
- Phase FX—Phasing effects don't add a detuned signal to the original source, but generate a signal which is out of phase (out of time) with the original. The effect can be both more subtle and much more pronounced than chorus FX and creates motion in a range of different sound types. Useful on electric pianos, strings, basses ... you name it.
- ROTARY effects are essential on any Hammond B3/C3 sounds. Don't bother trying to program this into your sounds, just use the effect. While it ain't the ›real thing‹ (Leslie speaker cabinets) it's pretty good.

- Filter FX—The most obvious type of filter effect is Wah Wah which adds ... well a ›wah‹ kind of sound, so that your instrument seems to ›talk‹—check out any Jimi Hendrix album and you'll know what a Wah Wah sounds like.

When using the Wah Wah effect, be cautious, particularly with the resonance setting as it can be *very* hot on the output, resulting in distortion, aliasing and your eyes, ears and nose exploding in a torrent of blood. By the way wah effects are great on guitars, clavs etc.

- BANDPASS—Is useful for quickly modifying certain types of patches on which a simple DCF is already applied and for those nasal ›Video Killed the Radio Star‹ covers. Can be particularly useful on bass sounds for adding ›punch.‹
- EXCITER/ENHANCER—These are great for ›lifting‹ a particular sound out of the mix, either in multitimbral mode or in single mode when you want to add that extra bit of ›sizzle‹ to a particular source in your patch. Be aware that these effects both enhance the high frequency content of the original signal, so they can introduce aliasing and can alter the tonal quality (colour) of your ADD wavesets.

Engage—A004

- DISTORTION/OVERDRIVE—Again, caution is advised as these effects can add a lot of gain to your signal. Great for guitars, clavs, Nine Inch Nails covers etc. Use of the Low Filter gain can add a lot of ›balls‹ to your sound (sorry if that offended the more politically correct among you). Adjusting the Hi Filter gain adds ›crunch‹ to your sounds. If you listen to Engage with the default Overdrive effect, you'll have an instant Adrian Belew simulation.

Feeding Bandpass or Exciter *into* the Distortion FX with the Hi and Lo Filters adjusted can create a range of speaker simulations—experiment!