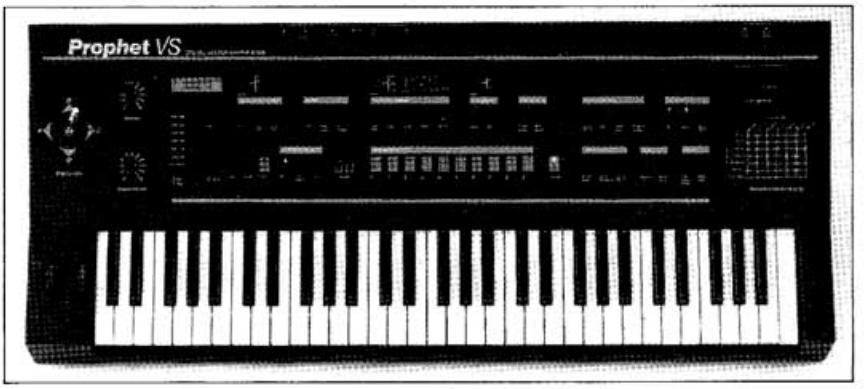
# Keyboard Report

Jim Aikin

## prophet vs analog/digital synthesizer




SURE, IT'S A RADICAL NEW APPROACH to synthesis. But does it sound good? Yes, it sounds good. It sounds very, very good. If Sequential's new Prophet VS sells as well as it sounds, it's going to be the success story of 1986.

"Radical" isn't a word that we would use lightly. Over the years it has become clear that new ideas in synthesis are few and far between. We've seen plenty of development in the area of performance controllers and convenience features—touch-sensitive keyboards, arpeggiators, expandable patch memory, MIDI, and so on. But most often, these seem to get pasted onto the outside of a synthesizer voice that looks suspiciously like a Minimoog: a couple of oscillators, a lowpass filter, a VCA, an LFO, and a couple of envelope generators.

PPG and Korg made a significant improvement by replacing the analog saw/triangle/pulse oscillators with digital oscillators with a choice of waveforms. The digital waveforms can have lots of interesting overtones, and dozens or hundreds of them may be available on a single instrument. But for dynamic waveshaping, PPG and Korg still rely on the analog lowpass filter (along with auxiliary techniques such as chorusing and LFO modulation). The oscillators themselves produce static sounds.

The breakthrough represented by the Prophet VS does not, we hasten to point out, involve dynamic waveshaping in the digital domain. The oscillators themselves are still putting out static waveforms. The difference is that the VS gives you four oscillators per voice, each with its own choice of wavetables, and lets you control the mix of the oscillators dynamically from a unique two-dimensional envelope. A simple enough concept, right? But it turns out to be unexpectedly powerful in creating warm, timbrally subtle and complex sounds. It's not overstating the case to say that the VS may be the first instrument to offer an effective and affordable alternative to the dynamic digital waveshaping of Yamaha's FM keyboards.

In addition to the new synthesis technique, which Sequential calls Vector Synthesis (hence the initials), the Prophet VS has a full array of performance features, including split and double modes and a multi-function arpeggiator, as well as a couple of design innovations that are both amazing and fun. Want to know more? That's what we're here for.

**Vector Synthesis.** The concept of vector synthesis is simple but powerful. Basically, the VS has four digital oscillators per voice. These are completely independent as to waveform; 127 waveforms reside in memory at a time. In addition to being mixed in any proportions, the oscillators can be individually detuned relative to one another, and can be individually modulated by LFOs and so on.

But that's just the beginning. The real power of the instrument is that oscillator mix can be dynamically controlled from a number of modulation sources. Primary among these is the mix envelope, which is separate from the filter envelope. The idea of adjusting the relative levels of four different audio sources from a single envelope shape is a bit difficult to grasp at first, but the system Sequential came up with is both elegant and easy to work with.

Here's how it works: The four oscillators, called A, B, C, and D, can be thought of as the four corners of a diagonal square. The mixer envelope has rate settings just like a normal envelope, but in place of level settings, it has a series of points which can fall anywhere within this square. Thus it is a two-dimensional envelope. The points of the envelope are defined by vectors with both X and Y coordinates (hence the name). The points are set by moving the joystick, and the current setting is displayed in the LCD window. The output levels of the four oscillators always add up to 100%; thus when the joystick is in the center of its range, the values are A25, B25, C25, D25. Jam the stick over to the right corner and the values change to A0, B0, C100, D0. Intermediate positions create some combination of values.

The only limitation of this system is that you can't mix two waveforms that are at opposite corners of the square without also including the remaining two waveforms. In order to do this, you have to switch the positions of two of the waves so that the two you want to mix are side by side. This takes less than ten seconds, so it's no big deal.

The process of defining a timbre envelope may sound a bit arcane, and indeed it could take a while to learn exactly what this machine is capable of, but the results are instantly audible and thoroughly satisfying right from the start. You can pick any four waveforms and set up any slow, smooth mix envelope, and it will sound great. The timbral activity is rich and pleasing, because the harmonic spectrum is constantly changing, in subtle or obvious ways, entirely independent of the shaping provided by the lowpass filter.

**Waveforms.** The Prophet VS stores 127 different waveforms in memory at a time. Of these, 95 are permanent (ROM), while the remaining 32 are user-programmable (RAM). There are two ways of creating new waveforms: by combining existing waveforms and by loading data from a sampler via MIDI. You could probably play and program the instrument happily for years without ever worrying about waveform creation, as the existing waveforms offer lots of variety. It's wonderful to see this level of creative flexibility being put into the hands of the musician, however.

The factory waveforms include some old favorites, such as sawtooth, square, thin pulse, and sine. Some others we recognized as derived from pipe organ concepts, with specific sine overtones mixed in an additive manner. But the only theoretical limits for the user waveforms are the limits of wavetable resolution itself. We did notice that the "sine" wave had some audible high harmonics in it, presumably due to the limitations of wavetable size, but this isn't necessarily bad. In fact, it's good. Why? Normally, a digital oscillator has a lowpass filter at its output to smooth the steps of the quantized wave. Since the VS has a lowpass filter associated

### Prophet VS

**Keyboard:** 5 octaves, C to C, unweighted. Velocity and monophonic pressure.
**Voices:** 8-voice polyphony. Four digital oscillators, three five-stage envelope generators, analog lowpass filter, and two LFOs per voice.
**Memory:** 100 user patches. 127 waveforms (32 user-programmable). Cartridge port for 100 additional patches. Arpeggiator holds 61 or 122 notes (depending on mode), including velocity values.
**Interfacing:** MIDI in, out, and switchable out/thru. Stereo audio outs double as mono out and headphone out. Footswitch ins for release pedal and arpeggiator pedal.
**Features:** Envelope-controlled and joystick-controlled waveform mixing, eight-character patch names, keyboard split and double modes, built-in stereo chorus, stereo panning and individual voice positioning. Multi-function arpeggiator can be synced to MIDI clock. Wavetable loading from external data source.
**Dimensions:** 38" x 15½" x 4½". 36 lbs.
**List Price:** $2,599.00.
**Contact:** Sequential, 3051 N. First St., San Jose, CA 95134. (408) 946-5240.

with the voice, no filter was put on the oscillators themselves, thus giving you the maximum number of clean high harmonics. If you want a sine wave with no harmonics, just use the lowpass filter on the voice.

For you techies, each wave is stored as a set of 128 12-bit words. If you're used to building megabyte sonorities on a mainframe computer this may not seem like much, but for practical musical purposes at an affordable price, it's a fantastic amount of timbre storage.

In creating a waveform of your own, you can combine any four of the existing waveforms, tuning each of them anywhere among the first 32 harmonics and mixing them in any proportions you like. If you like adding sine waves, you could create a wave by adding four sine waves at different harmonics, store this wave, and then recall it as a unit to mix with three more sine waves, and so on. You do reach a point of diminishing returns with this process. Adding non-sine waveforms and tuning them to non-octave overtones seems to produce foldover; that is, because of the mathematics involved, you don't get a higher and higher sound. You just get a sound that has different partials in it. Still, you can build lots of different waveforms with this system, and it's very easy to use.

If you'd rather, you can load waveforms from an external sampling machine, using the proposed MIDI sample dump protocol. To do this, you must truncate the sample to exactly 128 12-bit words. If you've got your sampler hooked to a computer with good sound editing software, this should pose no problems. Those of you who are not familiar with this type of technology should understand that the 128-word limit is too short to allow you to play anything resembling an actual sampled sound from the VS. All you can do is pull out, for example, a single cycle of a bassoon waveform and transfer that to the synthesizer. The synthesizer will still have to provide the attack transients, dynamic shaping, and so on. This might turn out to be a potent source of new waveforms, but it's certainly not necessary to use this capability to enjoy playing the VS.

**Synthesizer Voice.** While the voice on the VS doesn't have quite the conceptual complexity of the Oberheim Xpander, it has a few new wrinkles that give it plenty of musical power. There are four digital oscillators per voice, as already mentioned, and these can be detuned from one another and modulated independently from various sources, including key pressure and the filter envelope. Each voice has three envelope generators, one each for oscillator mix, filter cutoff, and overall amplitude. These are not simple ADSR envelopes, either; more on that below. Each voice has two LFOs, and these can modulate one another's rate and depth if desired. The filter is of the standard analog lowpass resonant type.

The modulation matrix has seven possible sources and 15 possible destinations. Sources include key pressure (monophonic), key velocity, key position, filter envelope, modulation wheel, and the two LFOs. Destinations include the frequencies of the four oscillators, filter cutoff, oscillator mix along two separate axes (A-C mix and B-D mix), rate and amount for both LFOs, amplitude envelope, voice panning, and chorus rate and depth.

There are two limitations built into this matrix. First, not all sources can be routed to all destinations. Key pressure can be routed anywhere, but the modulation wheel can only control the amount of the two LFOs and the chorus depth. And second, each source can have only one amount. That is, for a given patch, the pressure amount might be +68, and this same pressure response will be routed to all the destinations for which pressure is switched on. (A single destination can be switched on for some sources and off for others.)

We might agree or disagree with Sequential's choices for certain specific features of this matrix. It's great to see both positive and negative modulation amounts for many of the parameters, but on the other hand, it would have been nice to see a MIDI controller input added. And the mod wheel certainly ought to be able to control LFO rate as well as LFO amount. In general, though, the system seems both flexible and eminently useful for generating expressive effects.

The envelope generators on the VS are an adaptation of a concept that we first encountered on the Buchla 400 (see Keyboard Report, July '83). We're surprised that nobody else has yet picked up on the idea, as it seems a natural. In a word, the envelopes loop. Instead of being stuck with a static sustain level, you can set up a sustain loop in which the envelope will cycle between points 2 and 3, points 1 and 3, or points 0 and 3. It will loop either forward-only or forward-and-backward, and the loop can be set to repeat from one to seven times, or continuously until the key is lifted. We would have liked to see envelopes with a specific number of repetitions continue to cycle after key-up rather than jumping to the release segment, as it is a bit disconcerting to hear a timbre loop stop when you lift the key. But you can't have everything. The loops in their current version are very useful.

Even without the loops, the envelopes are a bit more complex than those on a DX7. They have five points, numbered 0 through 4. With the amplitude envelope, point 4 must have a level of 0. In the absence of a loop, point 3 is the sustain point. There is no rate 0, obviously, as the envelope starts instantly at point 0. In addition, one excellent feature of the Prophet-T8 has been retained: Each envelope has two rate 4 settings, one for when the sustain pedal is down and the other for when it is up. Normally, this "alternate release" rate will be longer than the regular release, mimicking a piano's sustain pedal response, but with layered voices it might be useful to program one voice to have a long release when the pedal is down and the other when the pedal is up.

The two LFOs have a choice of triangle, square, up sawtooth, down sawtooth, and random waveshapes. Frequency can be varied from about .15Hz to about 25Hz. As already mentioned, each LFO can modulate the other's rate and depth. We found that the maximum effect that this modulation could have was somewhat less than we might have liked, but unless you're a dedicated avant-gardist, you'll probably appreciate having nice subtle control over small changes in vibrato, which is the basic application of this type of modulation.

An instrument with this much in the way of timbral resources probably doesn't need a built-in chorus, but it's got two. Chorusing can be switched on separately for the left and right output channels, and the rate and depth are separately programmable for each patch. Stereo panning is also included, and stereo location can be controlled from such sources as the LFOs (great for swirling effects) and the keyboard. Each voice is panned separately, and each can have its own starting location in the stereo field, so all kinds of stereo effects are possible.

As it happened, the unit we received for review had what we suspect was a bad voice controller card. Whatever the cause may have been, the result was that now and again a note would fail to turn off, just as if a MIDI message had been interrupted. We assume that this was no more than an isolated problem with a bad component.

**Performance Features.** Some of the performance-oriented features on the VS are pretty standard, but a couple of them definitely go that extra mile. The five-octave keyboard, with velocity and monophonic pressure sensing, is real standard, as are the pitch-bend and mod wheels. Pitch-bend amount is programmable, but globally, not separately for individual patches. Maximum bend range is a fifth in each direction.

The keyboard split and layer functions are basically familiar as well. One new feature is a delay setting, in which the second voice in a layer can follow the first by up to half a second. The second voice can be detuned as well. By nudging these two parameters around, you should be able to get some wonderful fat sounds. Each voice has the number of a second "link voice" stored with it, along with whether the link is a split or a layer, the location of the split point, and the delay and detune settings. All this data is remembered even when split and layer are turned off.

The arpeggiator on the VS has more features, and is more fun to play with, than any other arpeggiator we've ever seen. For some types of electronic trance music, it could easily be used interactively in a concert situation. It can operate in a number of modes, can sync to MIDI clock at lots of different rates, can run two separate arpeggios with different numbers of notes simultaneously (!), can play arpeggios with rests, and can be latched and used as an accompaniment while playing a live solo. In this last mode, the pitch-bend wheel affects only the live solo voices, not the arpeggiation.

Arpeggio scanning can occur in up, down, up/down, assignable, reverse assign, or random order. When using assign mode, the memory can store more than a hundred notes. Transposition of latched arpeggios is also implemented, with or without a foot-pedal. The last arpeggio you played is remembered when the arpeggiator is switched off, and can be restarted by pushing a single button. You can choose whether or not key velocity will be stored and played back as part of an arpeggio.

*Continued*