Synthesizers & Recording

by Mark Styles

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The purpose of this article is to shed some insight for the budding synthesist as well as recordist. The true value of the synthesizer is becoming more obvious now that it's had time to develop and go through a few generations. Today there are available string machines, solo voiced synthesizers, percussion synthesizers, polyphonic synthesizers and even a few instruments that fit into all of these categories.

The synthesizer is a true chameleon of sound. Its versatility has made synthesizer practically a household word. One person with a modest amount of theory and keyboard technique can generate his own orchestra. The intrigue of a modular system lies in its capability to create a custom unique sound. Since the synthesizer can explore tonal areas still generally inaccessible to other instrumentalists, this article is addressed to helping people develop their own technique in exploring this area of sound.

Knowing Your Equipment

The first thing the recordist should be aware of is the machinery with which he is dealing. There are many different types of synthesizers, mixers, signal processors, and recorders. What equipment you have is not the issue, it is how you use it. A surprising number of sophisticated productions have been done on four track machines.

First of all, carefully read your owner's manual, learn about the optimum recording levels, and care and maintenance of your deck. The most brilliant of music won't make it on an out of alignment and dirty tape deck. Check output and input specifications of the different pieces of equipment you will be using (keyboards, mixers, decks, etc.). You will need a line transformer if you use effects designed for guitar use (such as echoplexes, phasers, or sustain pedals). Line transformers are devices which raise or lower the impedance of a signal to make it compatible with other signal processors. If you have a very weak or a very loud distorted signal, chances are that you will need a transformer. For instance, if you wanted to submix three tracks and phase one track in the process, you might need two transformers; one before and one after the phaser. Or you could get by with one, by going back into a mic level input of your mixer or deck. The keyword when working with synthesizers is experiment. For instance, try using the VCA out of the ARP 2600 into a line in of a tape deck, rather than the low level out and a mic input.

Tape

Use high output, low noise tape; master quality if you can afford it. If you plan to do much bouncing of tracks, it is worth the extra money not to be constantly subjected to tape hiss. Scotch 250, Ampex 456 or equivalent is the best to get. Chip in with someone and buy bulk or get just the hubs and roll your own.

Do not use cheap house brands or reject computer tape. Sure it works; but it's likely to flake and clog up your heads, or worse, wear them down. Save money by buying something less expensive, but still high quality for your dubs.

Use the high speed of your deck. 15ips is the optimum compromise between noise and tape cost. Each time you double the speed of a tape you raise the frequencies contained one octave. At 30 ips, you can shift most tape hiss beyond the range of hearing. A few decks sell accessory capstans that will shift the speed of your deck up one speed. Bear in mind this doubles the amount of tape you use, however.

DBX or Dolby are both great if you can afford them; but careful and conscious recording techniques will allow you to do a lot before you run into excessive noise.

Getting Ready To Record

Before you begin to record a piece, notate the instrumentation or sounds you plan to use. Plan out how many tracks you need and which should go down first (obviously you can't do a solo without a rhythm accompaniment to go by). A few minutes of planning here will save you hours of frustration later. After a few tries you should be able to develop a suitable method of notation. I use fairly conventional names for instrument sounds, but any name that symbolizes the sound for you will work. This notation can be as simple or complex as you need. It could be a whole score or just a simple time reference. (See fig. 1)

A great advantage of the synthesizer is the fact that you don't have to use microphones to record them. Thus it is possible to get a cleaner sound. The recording level for most signals should be about 0 db for the best signal to noise (s/n) ratio. Percussive sharp sounds however, should be recorded –3 db to –5 db. Generally meters are too slow to register transients. Distorted percussion can be very hard to detect; although the levels look fine, you might detect a faint roughness to its sound. Try recording the percussion again at a lower level.

Sometimes, a little bit of dirty signal might be just what your composition needs. Don't be afraid to experiment with echo pedals, sustains, phasers, etc. I find usually the best sound is a mix of the direct and the processed signal. This gives both the desired effect and clarity. Putting a synthesizer through a sustain box, then a guitar amp and miking it can make your guitar licks more realistic.

If you have a good amp and a spare room beside your studio, you can get some interesting sounds by experimenting with the following setup. Patch your synthesizer to the line in of your deck; also send the synthesizer output to a guitar amp in another room. Start by miking the amp as far away as possible. For each foot from the amp the mike is placed, you get approximately one millisecond of delay. Boost the treble on the amp to compensate for the distance. By playing with the mike distance and the balance of mike and direct signal you can get a lot of interesting sounds. This can be a good way to thicken the sound of some tracks. (See figure 2.)

Click Tracks

When recording a piece, the first step is to lay down a time reference. This reference, known as a click track, usually is a low frequency sawtooth, pulse, or a gated sine wave. Depending on your system, there are several ways to generate and use clicks. Their primary function would be to advance sequencers, fire envelopes or pulse switches. One method is to record a pulse or sawtooth at a moderately soft amplitude, –3 db to –7 db. This reduces the chance of crosstalk or bleedthrough to another track. Record more than enough click to last the length of the tune.

Most pre-amp sections of current synthesizers consist of a pre-amp and envelope follower. The envelope follower puts out a voltage proportional to the amplitude of the signal being fed to it. Since the sequencer needs only a rising edge to operate, you should have no problem. In fact, on some systems, patching the taped click directly into the sequencer clock or step input will work fine.

Most envelopes require two inputs, however, to accomplish this, take the click back off the tape and patch into the pre-amp, then patch the pre-amp output to the gate and trigger of the ADSR (see figures 3 & 4). You could also try patching the pre-amp out into the trigger and the envelope follower into the gate input. Aries and Moog both make pre-amp-follower modules which put out the necessary voltages to control the ADSR. The Aries module has a gate and trigger output, and the Moog an S-trigger output. Some experimenting with the Aries system reveals that you have noticeably more control over the ADSR parameters by using the gate and trigger outputs rather than the pre-amp and envelope follower. To get stable gates and triggers requires careful adjustment of the pre-amp, envelope follower and threshold levels.

By using the pulse as a click and varying the pre-amp gain and envelope follower threshold you can get the envelopes to double trigger, that is fire on both the rise and fall of the pulse. Patch the click into the pre-amp, then patch the full wave rectifier signal into the threshold. What happens is that the full wave rectifier inverts the negative slope into a positive (see figure 5). By adjusting the gain you can bring the amplitude up enough to fire the ADSRs twice per pulse. You'll shortly discover that only certain envelope settings will work. If the attack rise time of the ADSR is slower than the train of incoming pulses, or the sustain and release time is too short, you will then get either none or intermittent envelopes.

When you have a workable click on tape, play it back a few times to double check that it fires everything correctly. Too high a recording level or drop out on the tape will result in the sequencer jumping around or dropping steps, making it impossible to sync up to previously recorded tracks.

Submixing and Bouncing

Submixing, or bouncing is the process of mixing a number of tracks down to one track. This is done to make room for additional overdubs or to simplify a complex mix. (You only have two hands and up to twenty-four or more faders on big boards.) Bear in mind especially on home decks, each generation brings a certain amount of signal degeneration.

Generally submixing is done in the sync mode; that is the tracks are moved to another location on tape exactly parallel to their original position.

Figure One: **Score and Timing Reference.**

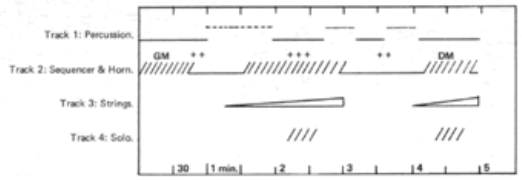


Figure Two: **Acoustic Delay.**

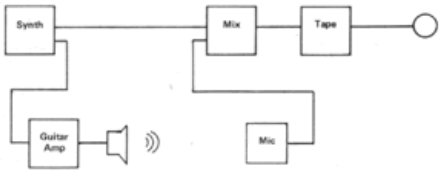
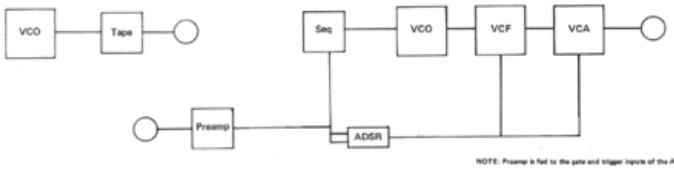


Figure Three: **Click Tracks.**



NOTE: Preamp is fed to the gate and trigger inputs of the ADSR.

Figure Four: **A typical patch using the click track from tape.**

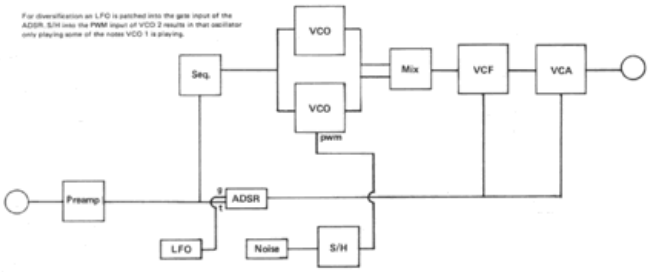


Figure Five: **Waveforms.**

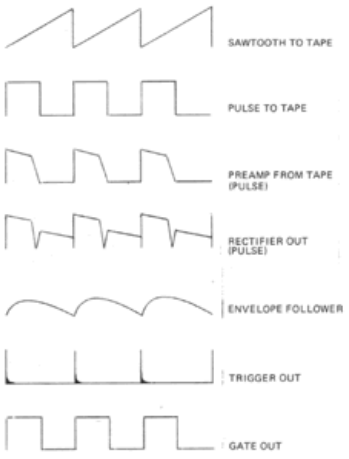


Figure Six: **Submixing.**

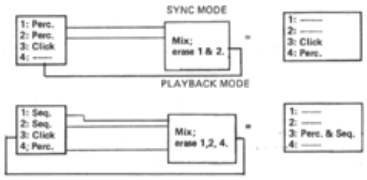


Figure Seven: **Submixing to an adjacent track.**

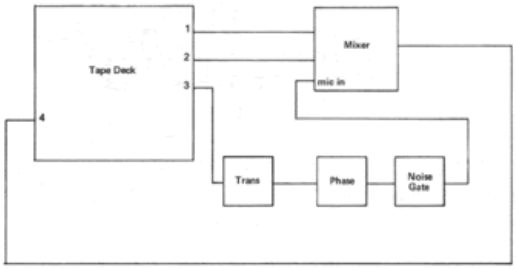


Figure Eight:

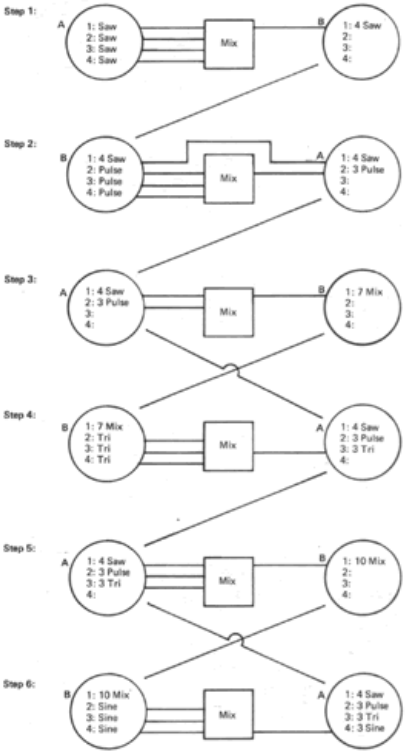


Figure Nine: **Typical patch showing use of sequencer and S/H.**

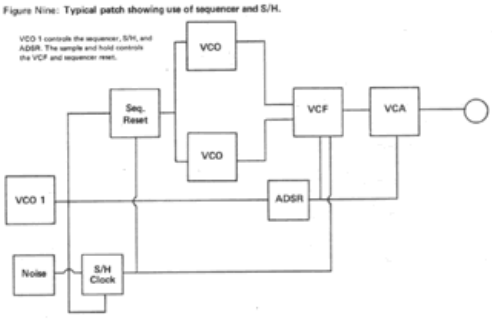
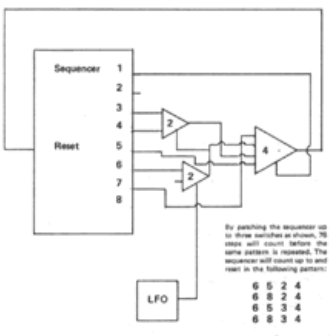
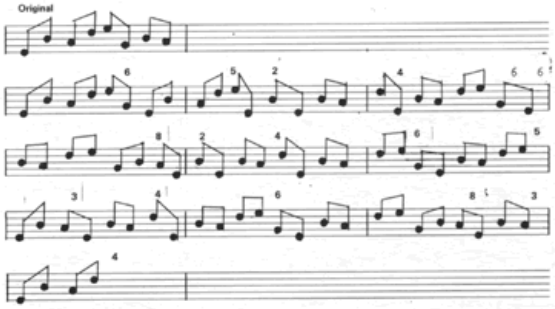


Figure Ten: **Sequencer and Switches.**



By patching the sequencer up to three switches as shown, 16 steps will count before the same pattern is repeated. The sequencer will count up to and reset in the following pattern:

6 5 2 4
6 8 2 4
6 5 3 4
6 8 3 4



This is so that the submixed section will be in time with the unmixed tracks on the tape. To do this the record head temporarily acts as a playback head. You cannot bounce to an adjacent track (one exception, see Mixing in Sync Mode), otherwise you will get electronic feedback. This is apparent by pinned meters, and a very high frequency oscillation.

Since most of you are using four track machines, a way to get more mileage from your deck is to record three tracks, and then mix on to the fourth track using playback mode (not sync). You could also be adding a fourth part as you mix down. The playback head has a better frequency response and will not feedback when mixing on to an adjacent track. When you are satisfied with your submix, go back and erase the first three tracks for more overdubs. Again, refer to your owners manual. Generally the procedure is the same, but a few decks have peculiarities to them. Some decks (Tascam four tracks) have only two heads, erase and record/playback. If this is the case you can only submix in the sync mode.

Tracks which are full and cover a broad frequency range bounce well, because they tend to mask noise. Record your first tracks (ones that will be bounced once or more) brighter than usual. When you mix them down, reduce the high end by the same amount that you brightened it. This will bring the sound back to its proper perspective while also getting rid of some tape hiss.

When submixing, also keep faders down when no signal is present. If you invest in noise gates (or use VCAs with envelope followers), you'll discover they're great for tracks with intermittent signals. Record delicate and soft sounds last; they don't hold up as well as wide range sounds when bounced.

Submixing in the Sync Mode

If you need to submix and still retain your click for future reference (which is absolutely necessary in many cases), you must mix down using the sync mode. Begin by putting your click on track three, then fill tracks one and two. Now mix one and two to track four in the sync mode. This method after one submix, however, effectively gives you the capabilities of a two track. What you can do is lay down some percussion, submix, add sequences, then dump the click. Once you are through with the click you can submix in the playback mode (See figure 6).

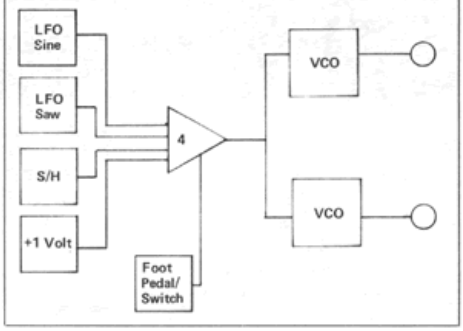
Occasionally you can submix to an adjacent track if you have a situation similiar to the following example:

Track 1: Kick/Snare
Track 2: Bass
Track 3: Occasional Perc./Hi Hat
Track 4: Track To Mix On To

What you want to do is mix tracks one, two and three down to track four. Obviously tracks one and two will have no problem. Track three could be bounced if it is kept at a low enough volume or a noise gate is used. Electronic feedback is similiar to acoustic feedback in some respects. There is a certain amount of leeway before a threshold is reached and the speakers begin to howl. Likewise with electronic feedback; although you don't hear any "build up", you will be able to transfer a certain amount of signal to an adjacent track before feedback occurs. Do this with caution or you could damage your meters, electronics or ears. Some experimenting here will reveal to you what you can and can't get away with (see figure 7).

If you're going for big productions; the syncing of two decks up to each other can work if you exercise a lot of patience.

Figure Eleven: **Using the electronic switch as a voltage control preset.**



Use two decks, each with its own reel of tape. Fill reel A with four tracks, and mix down to track 1 of reel B. Fill the remaining three tracks on B and then mix down on to track 2 of reel A; at the same time, copy track 1 (which has 4 tracks) on to track 1 of reel A. Tape reel A will become your work master. Mix tape A, which now contains seven tracks, on to track one of tape B, which acts as a reference mix. Fill tape B with three more tracks and mix those back on to track three of tape A. Again mix tape A's ten tracks on to one track of tape B. Add three more tracks and mix this back on to tape A. You now have thirteen tracks on one reel of tape, with only four being more than two generations old.

Sounds impossible? It's not; the trick to doing the above is to put a series of reference points at the beginning of the tune. Mark the beginning of the two tapes with a grease pencil and then record a metronome with a voice countdown of ten seconds. Cue the two decks up and start them simultaneously. Synchronize them by applying a light amount of pressure on the faster of the two decks. It's best to use this procedure on tracks that are not super tight time wise; legato strings, voices, spaced solos, etc. Obviously the decks have to be fairly stable. Generally you can run decks two or three minutes without getting too far apart.

This is where the term "flanging" originates. You take two reels of tape with the same program material, play them simultaneously while recording on to a third deck. By rubbing the flange of one deck, numerous phase cancellations occur as the two tapes go in and out of sync. This is really a fun experiment to try. It is a more subtle and less artificial sound than the phasers and flanging devices currently available, but it does require three decks, and a good amount of patience and time.

Obviously this is not a high technology solution, and it is a lot of work, but it does allow you to get much more out of your system. After working on a few pieces you'll begin to get the feel of submixing and bouncing tracks. An ideal tool to have is a ten band graphic equalizer. It can help you to preserve the tonal spectrum of each track as you mix down. Be careful not to get too extreme with it. Overprocessed tracks might sound novel the first few listenings, but not so good the next day when it might be too late to remix.

Sequencers

Sequencers are perhaps the most fascinating of the synthesizer modules. Their capability for creating textures has enticed an untold number of musicians. Sequencers basically can be divided into two categories: analog and digital. Each manufacturer's parameters differ, but a typical analog sequencer might be 3x8; the first parameter being rows and the second being steps. Each row simultaneously produces output at its respective jack. By connecting a sequencer to an electronic switch you can achieve one 24 note sequence or one 8 and one 16 note sequence. Pots or sliders are used to set the voltages.

Digital sequencers also vary widely with manufacturer. They generally produce one output even though there may be several layers. A keyboard and/or calculator type entry pad is used to load voltages. Digital sequencers are faster to load and easier to tune than their analog counterparts. The chief disadvantage of digital sequencers is their volatile memory. (The stored voltages are lost when the power is removed.)

A number of sequencers have been developed which incorporate the features of both analog and digital. The ARP sequencer for instance has sliders but also a "quantizer" function which will effectively round the slider voltage to a discrete 1/12 chromatic scale voltage. Sequential Circuits advertises a sequencer which is digital with parameters of 16 by 16. You can only playback one layer at a time, but it contains a battery back up which allows you to unplug the unit and still retain the memory.

There are a number of ways to use sequencers besides controlling VCOs. Syncopated rhythms can be generated by patching the voltage output back into the clock. By controlling the filters and VCAs certain notes can be emphasized. The use of a S/H with a sequencer can give a lot of variety also. Use the same clock and try patching the S/H in different places (see figure 9).

The use of a set of electronic switches can increase the versatility of a sequencer greatly. The switches can increase the apparent length of a sequencer or add variation in the rhythmic or melodic content by resetting and stepping the clock. The switches can also let you make simple preset patches, such as changing the modulation source for VCOs (see figures 10 & 11).

An interesting technique is to record a sequence, rewind, and on another track record the same sequence with a different voice. Tune the VCOs down an octave or fifth, or fourth, change the filter and envelope settings. This will give a bigness to a sequence, by stressing it more. Even try it a third time, octaves above. You can gate or fade the signal before it reaches the tape, giving added emphasis. The main thing to remember when working with sequencers and synthesizers in general is to keep the harmonic quality moving.

When recording, I find it useful to lay down a melodic sequence first then go back and add percussion somewhat after the fact. It's a good procedure to lay in sections of percussion rather than a blanket all the way through a piece. The same for the melodic sequences too, they can become monotonous. Change filter settings, envelopes, octaves and even tempo as you lay down a track.

Sequencers can also be used without referencing to a click. If a faster and higher pitched sequence is layered in over a rhythmic bed, the mind tries to correlate it into a meaningful experience. Many a visual and audio track have been joined together and worked even though they were created by unrelated people for different projects.

One of the challenges of synthesizers is not just creating sounds, but groups of sounds and blending them into a meaningful and cohesive whole. The art of synthesizing, especially with modular systems, requires the composer to develop skills in a number of areas; music, electronics, logic, technique and patience. This knowledge and skill can benefit many other areas of your life besides synthesizing.