Philosophy of RIDES IN THE STORM

BERLIN, 08.05.2023

Opening words

In our time with many new modules, new electronic musical instruments and new companies entering the market every day,sometimes it's difficult to find an instrument that has the right balance of rich functionality and that beautiful tone combined in the same piece of work.
But as we see it, it is precisely this narrow cross-section that makes a product unique and special. And while that balance is entirely subjective,we believe that our opinion on this is shared by many passionate, creative people around the world. From a technical point of view, this is not a trivial task and to achieve this, a very specific approach should be considered and we are ready to share it with you.

1. Discrete&Integrated

Our designs are very often, although not exclusively, discrete. This means we use the simplest available components in the signal path, such as discrete semiconductors, resistors, capacitors, etc. rather than using macros - called ICs or "chips" - to implement a function. While one or the other isn't definitely better or worse, we think discrete makes particularly good sense in our case.

1.1. Signal path and its influence on sound parameters and qualities

Arbitrarily, the circuitry of any electronic musical instrument (or any studio or audio device for that matter) can be divided into two distinct parts - the signal path and the control circuit. And while the controls can have a significant impact on the desired sound quality at the output, this is difficult to achieve without a properly designed signal path. In the signal path of our products mostly discrete circuits are used, but this is not the case in the control part.

1.2. Degree of integration and discretisation in the signal path
There are some musical instruments that are conventionally thought of as discrete, simply because they don't use dedicated VCO or VCF chips in their signal path. But they still use another IC, such as comparators, operational amplifiers, OTAs and VCAs that have similar limitations as the fully integrated VCO or VCF ICs. By customizing our schematics, we are able to design circuits that completely avoid these limitations.

1.3. Heat dissipation and schematic flexibility
Some of these are the lower possible heat dissipation and the lower schematic flexibility possible with ICs. To get the best performance, some stages of the circuit should be biased to a specific current consumption that is either not possible, or they get too hot. Oftentimes, dedicated ICs are optimized for a smaller footprint, lower power consumption, lower price, and convenient functionality, rather than just sound quality or a specific feature that we want to implement, but was not intended by the IC developer. But though individual, unlike any other sound signature can be more easily achieved with discrete circuits, there are some synthesizer chips that are beautifully designed and we will probably use them in the future.

1.4. When to use integrated and when discrete (the disadvantages of being puristic and going fully discrete path)?
Basically we use discrete in the signal path and a mix of integrated and discrete is used in the control circuitry.
Of course, this is not set in stone. We just use what gives us the best results. Being purist in electronic design can be advantageous only if it is not restrictive.

1.5. Impact of the discrete approach on price, chip availability and compactness

One aspect of using generic simple building blocks that is usually overlooked is price - you can build very powerful instruments that are also inexpensive due to the low price of the individual parts. Same with chip with discretisation the obsolescence and limited availability have much less influence, unlike with the dedicated ICs, since all generic componets are easily available ot interchangeable. Repairability is also better, though at the expense of the more complex troubleshooting process.In the past it was thought that the use of discrete elements would result in less compact circuits, but this is no longer the case with the small footprint SMD parts available today.

2. Circuit diagrams (how we create our schematics, from scratch, influences and copying)

Copying the circuit, apart from the moral aspect, inevitably copies, at least in part, the characteristic sound of an instrument. That's why we create our designs from scratch and consider this a big part of creating an unique musical instrument. The schematics, while not a clone of specific instruments from the past, are surely influenced by them, but the main influences for our designs are those of industrial electronics, measurement and laboratory equipment, studio and recording equipment, as well power amplifiers.

2.1. Distortion and noise, single ended and differential, push-pull, class A bias and headroom

Tailoring the nature of the overtones produced by various mechanisms, their order, relative and absolute amounts has a lot to do with each instrument's subjectively perceived sound signature and when designing a discrete circuit, we can certainly influence how the instrument will sound. One can do this by implementing gain stages and buffers as single-ended or differential push-pull, biasing them in Class A or changing the amount of the even low-order harmonics or the odd high-order harmonics by manipulating the headroom of various stages in the signal path. The possibilities are nearly unlimited. As for noise, we try to minimize it whenever possible (except of course in the noise generator).

2.2. Either Short feedback or no feedback in the discrete part. Speed and bandwidth, low order harmonics and less complex Miler compensation

Using short local negative feedback paths can, when properly designed, produce less higher order harmonic distortion, percieved by human ear as fatiguing and harsh. Such approach is also esential in achieving DC stability and in eliminating some parasitic high frequency oscillations in less complex way. Care is taken also that there occurs no slew limiting, in any stage, except VCF and portamento parts, so the full possible bandwidth is achieved. This results in clean and defined high and low end, qualities often overlooked in synthesizer world.

2.3. The difference between short signal path and uncompromised one

We avoid building signal paths, compromised with unwanted noise and distortions. Sometimes is better to do the extra work and have some more complexity, but to preserve the basic tone purity. Short and simple signal path is good, but not at the expence of sound quality.

2.4. Gain stages and loads

Output gain stages, including Op Amp otput stages, are known to produce more distortions when driving heavy loads. While this can be used to produce some interesting timbres, it is better to design the circuitry in such a way, as to minimize this effect in the stages not specificaly dedicated to achieving audio signal coloration and distortion.

2.5. Layout and signal path integrity

We dont shy away from multilayer PCBs, sometimes we use up to eight layers. Benefits from having our pcb traces nice and tidy, with low impedance ground and power planes between them greatly outweights the increased design process complexity. This approach creates products with significantly less crosstalk between different parts of the circuitry, better power supply rejection, less electromagnetic interference and noise.

2.6. Bringing some studio quality sound in Euro Rack world
We already wrote above, that we have strong influence from studio&recording equipment. This claim has couple of sides - from the high quality passive elements we use and the way we design the circuitry in our instruments, to that we have quite some utility modules with technology close to what you can find in studio environment. In the future some modules with System500 functionality and with comparable haracteristics are already planed to be released for Eurorack format.

3. Component choice
One part of how an instrument will sound is the element choice. While we think that schematic design choices have the most influence, the componets still have significant impact.

3.1. SMD versus trough hole, miniaturisation and form factor
We use SMD whenever possible. The dispute about SMD versus trough hole is a very old one and while 10-15 years ago there was still some superiority in the quality of the TT components, now that is not the case, exept for some very specific passive elements, which are anyway not very relevant in synthesizer building. Actually designing with SMD is better in minimizing parasitic inductances and capacitances, because of the intrinsically less parasitics in the end termination of SMD parts and optimised PCB layout. While this is not always hearable, it is definetely measurable effect. Other important thing is the influence of the element form factor on the distortion and noise profile. Voltage and current coefficient of resistance and capacitance, which are

directrly corelated with element size, are significant contributor, among the component material and production technology, for excessive noise, component nominal value drift and distortions, which usually are not benign sounding. A lot of the bad reputation of the SMD parts is probably due to suboptimal component choices, like using in the signal path the cheapest, lowest quality elements with inadequate form factor, which results in higher noise, current and voltage coefficients. Susceptibility of the circuitry to this effects is, of course, different in the different parts of it, but where needed we use at least 0603 and in some case even 1206 resistors and capacitors with maximal voltage ratings at least 50% higher than the required, in order to minimize these unwanted effects.

3.2. Either quality caps or no caps
Let us define what we mean under quality, in regard to capacitors - that is foremost the type of dielectric material used in the production, but also the production technology itself. Some capacitors are superior, according to our listening and measurement tests and we use them troughout our products exclusively, but we are trying to design our circuits so, that we use lesunlike any others capacitors in the signal path alltogether.

3.3. Resistors and trimmers
We mentioned the significance of the form factor in resistor choice, but another factor to consider is again the material and the production technology. Thin metal film, low thermal drift, 1% accuracy or less is what we solder in our products. Trimmers are equaly, and sometimes even more important than the other components for the overall performance of an instrument, so a low thermal drift cermet multiturn types are used everywhere.

3.4. Regulators and references
There are cases where moving one module or device to another rack or room can result in VCOs and VCFs detune

and some other functions to perform in unusual way. To avoid this we use where needed stable low noise internal voltage references. In signal generating and processing modules, as well as the ones which proper functioning relies on stable PSU, both positive and negative rails are regulated with low drop, low noise voltage regulators. That also assures that no audible crosstalk between the modules and ripple from PSU is presented at the device outputs.

3.5. Discrete semiconductors, matched pairs, transistor arrays, op-amps

All single transistors are high bandwidth, high gain, low noise types. We use also well matched pairs for all our differential circuitry and super matched transistor arrays, where that can bring particular advantages. Depending on where we use them, the Op Amps are either high quality audio types, similar to what you can find in expensive mixing consoles, for example, or precision, low power Op Amps for the control circuitry.

4. How we want our instruments to sound? Closing words

We always strived for pure, majestic sound with almost acoustic quality and resolution to it. And while that can be viewed as some higher standard of perfection still to be achieved, the discrete approach we use, together with our modern design influences position us sonically closer to the big modulars of 70-ties, combined with definition and sound clarity, rather than the later decades of synthesizer development. Nevertheless, because of the extended functionality, interface ergonomics, small form factor and the flexible control possibilities of our instruments, we definetely would like to imagine them much more like something from the future, than from the past. Anyway, quite interesting combination, isn't it?